7.0 IMPACTS OF *ARUNDO*: Federally Endangered and Threatened Species

7.1 Examination and Characterization of *Arundo* Impacts on Flora and Fauna

Arundo's impacts on federally listed species will be evaluated and described. These species have been intensively studied with: documentation of distribution, assessment of stresses on their habitat, and identification of ecological constraints to their ability to persist in the habitats that they occupy. This allows a thorough exploration of impacts caused by *Arundo,* as well as the subjective ranking of the impact level. The determination of critical habitat areas and extensive survey data collected for the species also allows for a spatial assessment of their interaction with *Arundo* distribution at the watershed level (using the *Arundo* spatial data collected for this study). A total of 22 federally listed species will be examined representing five taxonomic groups: amphibians (4), birds (8), fish (4), mammals (1), and plants (5).

To determine the impacts of *Arundo* on federally listed species, we reviewed documents prepared by the U.S. Fish and Wildlife Service during their evaluations for listing and recovery. We restricted the focal species to federally listed species in order to 'standardize' the individual species descriptions and treatment (biology, reproduction, distribution, review of impacts and stresses). The documents used include: Critical Habitat Designations, Recovery Plans, Incremental Reviews (5 year, 10 year, etc.), and Biological Opinions (Section 7 and 10) issued for projects that may adversely impact listed species. A significant amount of the data presented in this chapter is taken directly from numerous Biological Opinions issued by the USFWS. Many of these Biological Opinions are for *Arundo* control programs on the watersheds within the study area, including: Salinas, Ventura, Santa Clara, Santa Ana, San Juan, Santa Margarita, San Luis Rey, Carlsbad CHU, and San Diego River. Additional Biological Opinions and documents prepared by NOAA/NMFS for programs carrying out activities (channel maintenance, sand extraction, etc.) in the project watersheds were also reviewed. These documents are a significant resource as they specifically examine: population status (distribution and abundance, sometimes trends), general biology (reproduction, foraging, movement/migration, predation, habitat needs), and stressors for the species (abiotic, biotic, and anthropogenic). Impacts caused by *Arundo* invasion are evaluated for each of these areas.

7.1.1 Determine Arundo Impact Score

Information from USFWS documents, this report, and other data, literature, and expert opinions was used to determine an 'Impact Score' for each species on a 10-point scale (Table 7-1). Impacts of *Arundo* on each sensitive species are described in Section 7.2, with evaluation of general ecological and habitat needs, reproduction, movement, range and other impacts/threats. Higher scores reflect significant *Arundo* impacts to both abiotic and biotic modification of riparian systems. A general discussion of *Arundo* impacts (both biotic and abiotic) is presented in section 2.7.

Table 7-1. *Arundo* Impact Score for each sensitive species.

Score	Impact Level	Impacts
10	Very severe	Very significant alteration of abiotic structure and biological function, and direct take of individuals
9	Severe	Significant alteration of abiotic structure and biological function and direct take of individuals
8	Very high	Alteration of abiotic structure and biological function, direct take possible
7	High	Alteration of abiotic structure and biological function: impacts on mobility
6	Moderate/High	Moderate alteration of abiotic structure and/or biological function
5	Moderate	Minor alteration of abiotic structure and/or biological function
4	Low/Moderate	Low abiotic or biotic impacts
3	Low	Slight changes in food resources, harboring pathogen/predator OR Minor changes to estuary systems
2	Very low	Minor interaction: mobility
1	Very low/Improbable	Difficult to describe any interaction with *Arundo*
0	None	No interaction

7.1.2 Determine Arundo and Federally Listed Species 'Overlap Score'

To characterize the level of interaction between each sensitive species and *Arundo*, a watershed specific 'Overlap Score' was created (Table 7-2). This metric measures the abundance and distribution of *Arundo* and the sensitive species, with a specific focus on overlap in spatial distribution. The score for the metric captures the level of interaction between *Arundo* and the listed species. The *Arundo* spatial data set was examined with GIS data for each listed species (Maps 1-30, Appendix B).

A listed species with large populations high on the watershed where *Arundo* does not occur would be ranked with a low score, even if the watershed has high *Arundo* abundance overall. A high metric score (10) requires frequent occurrence of the sensitive species within portions of the watershed that have high *Arundo* abundance. Low scores are given for species that have low occurrences within areas of low *Arundo* cover. Intermediate scores are given for co-occurrence, where there are moderate levels of abundance for *Arundo* and/or sensitive species. Species that occur at or near the end of the watershed may not have significant co-occurrence with *Arundo* stands, but they may have significant *Arundo* upstream of them that is modifying abiotic processes or generating *Arundo* biomass into the sensitive species habitat (*Arundo* debris, or modified hydrology). These interactions, which are often for estuarine or river mouth species, have a full range of overlap/interaction scores from low to high.

Table 7-2. Definition of overlap scores that are assigned to federally listed species.

Overlap Score	***Arundo* abundance** (nearby or upstream of sensitive species)	**Listed species *relative* abundance & distribution**	**Interaction Level**
10	Very High	Very high (core area)	High interaction
9	High	High	
8	High	Moderate	
7	Moderate	High	
6	Moderate	Moderate	Moderate interaction
5	Low	High	
4	High/Moderate	Low	
3	Low	Moderate	
2	Low	Low	Low interaction
1	Any	Historic range* or a few records of more 'abundant species	Possible or potential interaction
0	Any	Not recorded	No interaction

* Sensitive species not currently known to occur in the area, but has confirmed historic distribution.

7.1.3 Calculate 'Cumulative Arundo Impact Scores'

The 'Impact Score' for each species is then multiplied by the 'Overlap Score' on each watershed to generate a 'Cumulative *Arundo* Impact Score' for each sensitive species. This data can be examined for each species, taxonomic group, and watershed. Scores highlight species and those watersheds that are most impacted by *Arundo*.

7.2 Species Descriptions and *Arundo* Impacts Elucidated

Each federally listed species is evaluated below for potential impacts caused by *Arundo*. These impacts may be either indirect (modification of habitat) or direct (loss of life- such as fire or emergency response to fire or flood). All types of impacts are explored and relative importance/magnitude of the impact is described for each species. A general discussion of *Arundo* impacts (both biotic and abiotic) is presented in section 2.7.

Interaction of *Arundo* distribution and species occurrences is presented by watershed in Table 7-3 and Appendix B. Information on the biology and distribution of each species is taken from USFWS documents and other reports, which are listed at the end of each species' summary. Citations to particular studies within these documents are not listed here.

7.2.1 California Tiger Salamander (*Ambystoma californiense*)

Federal status: Endangered for the Santa Barbara Distinct Population Segment (September 2000). Critical habitat was designated in August 2005, but may change as it is under review.
State status: Threatened (May 2010).
Arundo impact score: 1

General Ecological Needs/Habitat Affinities:
The California tiger salamander is a stocky, terrestrial amphibian. Adult males are about 20 cm (8 in) long, and females a little less than 18 cm (7 in). It is restricted to grasslands and low foothill regions (typically below 2000 feet/610 meters) where lowland aquatic sites are available for breeding. They prefer natural ephemeral pools, or ponds that mimic them (e.g. stock ponds that are allowed to go dry). While on land they are generally underground in burrows. They are poor burrowers, therefore require refuges provided by ground squirrels and other burrowing mammals in which to enter a dormant state called *estivation* during the dry months.

Arundo impacts: *Arundo is not typically abundant on the low order streams and steeper hilly terrain that are favored by the tiger salamander. No significant alteration of abiotic process would occur.*

Breeding/Life History:
California tiger salamanders require lowland aquatic sites for breeding. They prefer natural ephemeral pools, or ponds that mimic them. Around November, salamanders come out of their burrows, usually on a wet, stormy night. They may travel as much as a mile to a pond to breed. They prefer natural ephemeral pools, or ponds that mimic them. Females lay eggs singly or in small groups. They may lay as many as 1,300 eggs. These are usually attached to vegetation. Eggs hatch in about 10 to 14 days. Larvae require significantly more time to transform into juvenile adults than other amphibians such as the western spadefoot toad and Pacific tree frog. Around late spring, salamanders leave the ponds to find burrows. Adults reach sexual maturity in 4 or 5 years. Although they may live as long as 10 years, they may reproduce only once, or not at all. Some salamanders die before they reach sexual maturity, and others may not find a suitable pond for mating in very dry years. The main predators of the California tiger salamander are birds such as egrets and herons, fish, and bullfrogs.

Arundo impacts: *Little impact as Arundo not abundant enough to impact hydrology of pools.*

Diet:
Adults mostly eat insects. Larvae eat algae, mosquito larvae, tadpoles and insects.

Arundo impacts: *Little impact as Arundo not abundant enough to impact food resources or habitat that food resources depend on.*

Movement:
A California tiger salamander spends most of its life on land underground. It uses burrows made by squirrels and other animals. Around November, usually on a wet night, salamanders come out of their burrows and may go as much as a mile to a pond to breed. In late spring, salamanders leave the ponds to find burrows.

Arundo impacts: *Little impact as Arundo not abundant enough to impact movement of salamanders or change distribution of mammals that create micro habitat needed by the species.*

Status/Distribution or Historic and Current Range:
This species is restricted to California and does not overlap with any other species of tiger salamander. They are found in grassland and oak savannah plant communities with vernal pools and/or seasonal ponds (including constructed stock ponds). They predominantly occur from sea level to 2,000 feet in central California. In the Coastal region, populations are scattered from Sonoma County in the northern San Francisco Bay Area to Santa Barbara County (up to elevations of 3,500 ft/1,067 m), and in the Central Valley and Sierra Nevada foothills from Yolo to Kern counties (up to 2,000 ft/610 m).

Arundo impacts: *There is very low interaction between Arundo distribution and salamanders. Critical areas have almost no overlap and occurrence data has a few points of interaction (Appendix B). Pajaro River in San Benito would be the greatest interaction and Salinas is very low (based on current Salinas survey data). If salamanders were found to occur in the Salinas River itself significant revision of impact scores would be needed.*

Decline and Threats:
The primary cause of the decline of California tiger salamander populations is the loss and fragmentation of habitat from human activities and the encroachment of non-native predators. All of the estimated seven genetic populations of this species have been significantly reduced because of urban and agricultural development, land conversion, and other human-caused factors. A typical salamander breeding population in a pond can drop to less than twenty breeding adults and/or recruiting juveniles in some years, making these local populations prone to extinction. California tiger salamanders therefore require large contiguous areas of vernal pools (vernal pool complexes or comparable aquatic breeding habitat) containing multiple breeding ponds to ensure re-colonization of individual ponds.

Arundo impacts*: No additional Arundo interaction with decline and threats.*

Overall impact metric for *Arundo* on CA tiger salamander: Very low/improbable impact, score of 1

Interaction of *Arundo* distribution and CA tiger salamander occurrence is presented by watershed in Table 7-3 and Appendix B.

Sources:
Species Account, California Tiger Salamander (*Ambystoma californiense)*, U.S. Fish & Wildlife Service Sacramento Fish & Wildlife Office.

7.2.2 Arroyo Toad (*Bufo californicus*)

Federal status:	Endangered, December 16, 1994. Critical habitat designated April 13, 2005. Recovery plan completed in 1999.
State status:	Not listed?
Arundo impact score:	10

General Ecological Needs/Habitat Affinities:
Arroyo toads breed and deposit egg masses in shallow sandy pools, which are usually bordered by sand-gravel flood-terraces. Optimal breeding habitat consists of low-gradient sections of slow-moving streams with shallow pools, nearby sandbars, and adjacent stream terraces. Stream order, elevation, and floodplain width appear to be important factors in determining habitat capacity. High stream order (i.e., 3rd to 6th order), low elevation (particularly below 3,000 ft/914 m) and wide floodplains seem to be positively correlated with arroyo toad population size. However, small populations are also found in 1st and 2nd order streams up to 4,600 ft (1,402 m). Outside the breeding season, arroyo toads are

essentially terrestrial and use a variety of upland habitats including (but not limited to): sycamore-cottonwood woodlands, oak woodlands, coastal sage scrub, chaparral, and grasslands.

Arundo impacts: *Changing geomorphic processes- rivers and streams move away from complex multi-channel structure with elevational complexity to a single narrow channel. The single channel is also deeper, typically transporting sediment out of the system under low flow events. Larger events also may not be generating as much sediment deposition in open areas. Because there are fewer open areas sediment is being trapped within Arundo stands which themselves have low arroyo toad use (Camp Pendleton management reports). Arundo has a very strong affinity for the same areas favored by arroyo toads: low elevation, broad floodplains and especially high stream order systems. Direct take of the species can occur during Arundo fire events and fire suppression efforts.*

Breeding/Life History:
Breeding is typically from February to July on streams with persistent water. Eggs are deposited and develop in shallow pools with minimal current and little to no emergent vegetation. Substrate is generally sand or fine gravel overlain with silt. Eggs hatch in 4-5 days, and hatchlings are immobile for 5-6 days. They then disperse from the pool margin into surrounding shallow water and develop for 10 weeks. After metamorphosis (typically June/July) the juvenile toads remain on the bordering gravel bars until the pool dries out (8-12 weeks, depending on site and rainfall/conditions).

Arundo impacts: *Arundo does not typically occur within pools/stream channel, but it may overhang pools/stream channel. Arundo does use large amounts of water, which could alter hydrology of the stream, potentially accelerating the dropping of the water table and the drying of pools. Arundo biomass in pools would likely be a negative impact. The greatest impact is that the system has fewer areas for pools to form. The areas that would be open/bar habitat are filled in with Arundo (Sections 5.1 & 2). This restricts pools to the narrow channel zone where pools are less likely to form. Pools that do form are also at greater risk of late season flow events that purge pools of egg masses and possibly even breeding adults.*

Diet:
Arroyo toad tadpoles feed on loose organic material such as algae, bacteria, and diatoms. They do not forage on macroscopic vegetation. Juvenile toads feed almost exclusively on ants. By the time they are 0.7 to 0.9 inch length they forage on beetles and ants. Adults consume a wide range of insects and arthropods.

Arundo impacts: *Arundo litter provides limited food for aquatic insects (Going & Dudley 2008) in comparison to native litter. This would reduce forage for aquatic insects which could be a food source for tadpoles. Decaying Arundo litter would be little nutritional value for insects. Arundo does support ants (particularly non-native argentine ants), but diversity and abundance is low for other arthropods (Herrera & Dudley 2003, Lovich et al. 2009). Arundo stands also are a barrier to toad movement and studies looking at toad use of Arundo showed little use, presumably indicating a low function for foraging.*

Movement: Arroyo toads have been observed moving one mile within the stream reach and 0.6 miles away from the stream into upland native habitat and agricultural areas. Movement may be regulated by topography and channel morphology. Toads are critically dependent on upland terraces and the marginal zone between stream channels and upland terraces during the non-breeding season, especially during periods of inactivity (generally late fall and winter). Toads generally burrow within sandy or loamy substrate with no associated canopy cover, within mulefat scrub, or within arroyo willow patches. The majority of individuals tracked in one study were located immediately adjacent to the active channel or within the bench habitats within the flood prone areas.

Arundo impacts: *Movement of toads both within and through the system is significantly restricted in highly invaded systems. Arundo can also be abundant in the area between the channel and terraces, filling open spaces in the habitat. This area is specifically noted as being a critical portion of the habitat for the first year toads. Chapter 5 demonstrates that this is where Arundo is most abundant and dense.*

Status/Distribution or Historic and Current Range:
Current estimated distribution is shown in Appendix B. Critical habitat areas have been designated. Survey data is of high quality in San Diego and Orange Counties and lower quality as one moves north. Santa Clara and Salinas in particular have not had substantial uniform survey work, but these areas do not have large populations (according to Biological Opinions). Distribution and abundance levels have been assessed from FWS data, CNDDB data, critical habitat areas, and verbal descriptions in USFWS Biological Opinions (all watersheds). Arroyo toads have disappeared from 75% of occupied habitat in California. Arroyo toads once occurred on 22 river basins from Monterey County (upper Salinas) to San Diego County southward to San Quintin, Baja CA, Mexico. In Orange and San Diego Counties the species occurred from estuaries to the headwaters of many drainages. Populations now are restricted to headwaters and small isolated populations along streams/rivers. The arroyo toad is principally along coastal drainages, although it has also been found on the desert facing slopes of San Gabriel and San Bernardino Mountains. Core populations occur on: Santa Margarita, San Luis Rey and San Juan Watersheds. Secondary watersheds are San Dieguito and Sweetwater. Additional smaller populations occur on San Diego, Los Angeles, Santa Clara and Salinas Watersheds.

Arundo impacts: *Arundo is abundant within core population areas as well as satellite populations. Arundo is less abundant in some of the more mountainous areas where toad populations occur. Significant overlap in Arundo and toad distribution exists (Table 7-3).*

Decline and Threats: Dam building and operation (modification of hydrologic regime and flushing events). Urban and agriculture development, sand and gravel mining. Impacts from vehicle and recreation activities. Non-native predators (bull frogs, fish, crayfish, etc.). Non-native plants (*Arundo* and tamarisk). Loss of habitat, modification of hydrology, and non-native predation have caused arroyo toads to disappear from a large portion of previously occupied habitat. Currently the greatest threats to arroyo toads are continued stream modification, development, and pressure from non-native organisms. Most systems have already had significant hydromodification.

Arundo impacts: *Arundo does interact with human hydromodification and flood management. Clearing of areas for reduced flood risk increases dispersal and spread of the plant. Reduced flow capacity and higher flood risk, exacerbated by Arundo stands, can lead to engineered solutions that contain and restrict flows.*

Overall impact metric for *Arundo* on Arroyo toad: Very severe impacts (10)

Interaction of *Arundo* distribution and occurrence of arroyo toads is presented by watershed in Table 7-3 and Appendix B.

Sources:
Arroyo toad (*Bufo californicus*) Five Year Review: Summary and Evaluation, U.S. Fish and Wildlife Service, Ventura, CA. August 2009. http://ecos.fws.gov/docs/five_year_review/doc2592.pdf

Stillwater Sciences. 2007. Focal Species Analysis and Habitat Characterization for the Lower Santa Clara River and Major Tributaries, Ventura County, California. Santa Clara River Parkway Floodplain Restoration Feasibility Study.
Formal Section 7 Consultation for Invasive Plant Removal in the San Juan Hydrologic Unit, Orange County, CA, U.S. F&WS, Carlsbad Fish and Wildlife Office, Carlsbad, CA.

7.2.3 California Red-Legged Frog *(Rana aurora draytonii)*

Federal status: Threatened, May 23 1996. Critical habitat was first designated in 2001, but has been changed several times, with the most recent designation occurring in 2010.
State status: None
Arundo impact score: 3

General Ecological Needs/Habitat Affinities:

California red-legged frogs live from sea level to about 5,000 ft/1,524 m in California and Baja California, Mexico, and may be found in a variety of habitats. The frogs breed in aquatic habitats such as streams, ponds, marshes and stock ponds. Larvae, juveniles and adults have been collected from streams, marshes, plunge pools and backwaters of streams, dune ponds, lagoons, and estuaries. They frequently breed in artificial impoundments such as stock ponds, if conditions are appropriate. If riparian vegetation is present, red-legged frogs spend considerable time resting and feeding in it. The moisture and camouflage provided by the riparian plant community apparently provides good foraging habitat and may facilitate dispersal in addition to providing pools and backwater aquatic areas for breeding. Frogs may move through upland habitats, primarily in wet weather. For the California red-legged frog, suitable habitat is potentially all aquatic and riparian areas within the range of the species and includes any landscape features that provide cover and moisture.

The riparian and upland habitats adjacent to aquatic areas used by the California red-legged frog are essential in maintaining frog populations, and for protecting the appropriate hydrological, physical, and water quality conditions of the aquatic areas. The frog uses both riparian and upland habitats for foraging, shelter, cover, and non-dispersal movement. One researcher who studied California red-legged frog's terrestrial activity in coastal forest and grassland habitats recommends at least a 328 ft (100m) buffer zone for protection of adjacent aquatic and upland habitat, as well as seasonal restrictions for activities within this zone. In a recent study also specific to the California red-legged frog, the recommendation was for establishing zones around breeding habitat, non-breeding habitat, and migration corridors that are sufficient to protect function of the amphibian habitat. However, the study authors discourage setting specific distances for these zones due to differences in biological or site-specific requirements; they further state that any distances set for avoidance of upland habitat should be made on a case-by-case basis, taking into account the need to protect breeding and non-breeding habitat as well as any migration corridors. Without protecting and maintaining the upland areas surrounding breeding and non-breeding habitats the quality of the water feature may deteriorate to such an extent as to not support the California red-legged frog.

Arundo impacts: *Red legged frogs have very wide distribution among habitat types but tend to occur in steeper terrain than Arundo. Arundo is typically not abundant enough to alter abiotic factors that would severely degrade frog habitat.*

Breeding/Life History:
Red-legged frogs breed from November through March, though earlier breeding has been recorded in southern localities. Males appear at breeding sites 2-4 weeks prior to females. Females deposit egg

masses on emergent vegetation so that the masses float on the surface of the water. Eggs hatch in 6 to 14 days, and larvae undergo metamorphosis 3.5 to 7 months after hatching. Sexual maturity is attained at 2 years by males and 3 years by females. Adults may live 8 to 10 years, although the average life span is considered much lower.

Arundo impacts : *Impacts would be minor as breeding pools are not usually in close proximity to Arundo stands. Arundo is not abundant enough to alter hydrology and pool duration.*

Diet:
The diet of the red-legged frog is highly variable. Tadpoles probably eat algae, and invertebrates seem to be the most common food of adults. Larger frogs can eat vertebrates such as Pacific chorus frogs and California mice. Feeding activity probably occurs along the shoreline and on the surface of the water. Juveniles have been found to be active diurnally and nocturnally, but adults are largely nocturnal.

Arundo impacts: *Minor impacts, if any, as Arundo is not abundant enough to typically affect abundance of food resources.*

Movement:
Juvenile and adult California red-legged frogs may disperse long distances from breeding sites throughout the year. They can be encountered living within streams at distances exceeding 1.8 miles from the breeding site, and have been found up to 400 feet from water in adjacent dense riparian vegetation. During period of wet weather, some individuals may make overland excursions through upland habitats, mostly at night. In Santa Cruz County, red-legged frogs made overland movements of up to 2 miles over the course of a wet season. Most of these long-distance movements were over variable upland terrain. Adult California red-legged frogs may disperse from breeding sites at any time of year depending on habitat availability and the environmental conditions of the aquatic habitat. In addition, a few frogs may disperse long distances in search of additional breeding or non-breeding habitat.

Arundo impacts: *Low likely hood of impact except on Ventura River watershed where dense Arundo stands could impede movement (as seen with arroyo toads).*

Status/Distribution or Historic and Current Range:
The current distribution of the red-legged frog is primarily in the coastal drainages of central California. Today, only 28 counties have known populations. Monterey, San Luis Obispo and Santa Barbara counties have the greatest amount of currently occupied habitat. Only four areas within the entire historic range of this species may currently harbor more than 350 adults.

Arundo impacts: *Arundo does have some overlap in distribution (Appendix B). Arundo is not usually abundant in these areas- particularly on smaller size watersheds, but localized high Arundo cover can exist and could lead to impacts (fire, limited movement, impacts to breeding pools). A significant noted exception occurs on Ventura River watershed where dense Arundo overlaps with core population areas.*

Decline and Threats:
The frog and its habitat are threatened by a multitude of factors including but not limited to:
1) Degradation and loss of habitat through urbanization, mining, improper management of grazing, recreation, invasion of nonnative plants, impoundments, water diversions and degraded water quality, 2) Introduced predators, such as bullfrogs, and 3) Previous overexploitation.

Historically, the California red-legged frog was found in 46 counties. The range was thought to extend coastally from Sonoma County (but recently has been confirmed further north in Mendocino County)

and inland from the vicinity of Redding, Shasta County, south to northwestern Baja California, Mexico. The frog has sustained a 70 percent reduction in its geographic range in California as a result of habitat loss and alteration, overexploitation, and introduction of exotic predators.

Arundo impacts: *Little interaction between Arundo and these factors.*

Overall impact metric for *Arundo* on California red-legged frog: Low impact, score of 3.

Interaction of *Arundo* distribution and CA red-legged frog occurrence is presented by watershed in Table 7-3 and Appendix B.

Sources:

Biological and Conference Opinions for Annual Removal of Giant Reed and Tamarisk in Upper Santa Clara River Watershed, Los Angeles county, CA (File No. 2004-01540-AOA)(1-8-06-F-5).

Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the California Red-Legged Frog: Final Rule. 50 CFR Part 17 [FWS-R8-ES-2009-0089], U.S. Fish and Wildlife Service.

7.2.4 Mountain Yellow-Legged Frog (*Rana muscosa*)

Federal status:	Endangered (Southern California DPS July 2 2002), Endangered Candidate List (frogs occurring north of the Tehachapi Mountains). Critical habitat for the southern California DPS designated on September 14 2006.
State status:	Candidate species
Arundo impact score:	4

General Ecological Needs/Habitat Affinities:

Mountain yellow-legged frogs live in glaciated alpine lakes, ponds, tarns, springs, and streams. Lakes used usually have grassy or muddy margins, and adults are typically found sitting on wet rocks along the shoreline, usually where there is little or no vegetation. Field research conducted by USGS and the San Diego Zoo within the current and historic range of the mountain yellow-legged frog in the San Jacinto, San Bernardino, and San Gabriel mountains has been carried out to improve understanding of habitat preferences of this species. Results indicate that adult frogs prefer deep, long, pools with little understory and ample leaf litter. Tadpoles also were more likely to be found in pools with less understory and more leaf litter, but showed no preference for pool depth or length. They did, however, demonstrate a preference for pools with rock substrate. Mountain yellow-legged frogs have been observed in the field basking in direct sunlight, sometimes in aggregations of more than 20. It is hypothesized that frogs aggregate to reduce the surface area exposed to the air and thus reduce water loss. Suitable habitat for mountain yellow-legged frogs presumably must include appropriate basking structures

Arundo impacts: *Low level of Arundo impacts due to little overlap in range. Frogs are restricted to higher elevations in general. But overlap in occurrence in two areas create the potential for interaction (Los Angeles River, in the San Gabriel Mountains and Santa Ana River in San Bernardino Mountains). Frogs appear to prefer little vegetative cover- Arundo would therefore be negatively associated with prime habitat.*

Breeding/Life History:

Breeding sites are generally located in, or connected to, lakes and ponds that do not dry up in the summer, and that are sufficiently deep not to freeze through in winter. The frogs breed in June or July.

Eggs hatch within several weeks and larvae usually transform during July or August. Larvae at high elevations, or subject to severe winters, may not metamorphose until the end of their fourth summer. Adults hibernate in water during the coldest months, under ice or near shore under ledges and in underwater crevasses.

Arundo impacts: *Arundo may add to water stress in foothill washes shortening pool duration.*

Diet:
Adults feed on terrestrial insects and adult aquatic insects: beetles, flies, wasps, bees, ants, true bugs, and spiders. They also consume large quantities of Yosemite toad and Pacific treefrog tadpoles and can be cannibalistic. Tadpoles graze on algae and diatoms along rocky bottoms of streams, lakes, and ponds.

Arundo impacts: *Limited impacts to food resources.*

Movement:
This species has no distinct breeding migration, as adults are almost always found within two to three feet of water. In some areas, there is a seasonal movement of frogs from deeper lakes to nearby breeding areas after overwintering. Frogs typically move less than a few hundred meters.

Arundo impacts: *Limited impacts to movement- very localized at stream/pool edges.*

Status/Distribution or Historic and Current Range:
Once common throughout much of southern California, the mountain yellow-legged frog has been decreasing in numbers since the 1970s. The frog lives in the Sierra Nevada Mountains of California and Nevada from southern Plumas County to southern Tulare County, at elevations mostly above 6,000 feet. A genetic study published in 2007 revealed that there are two distinct mountain yellow-legged frog species that do not overlap in range or interbreed: a northern and central Sierra Nevada species and a southern Sierra Nevada and southern California species. In southern California, only a small wild population of less than 200 individuals can be found in the San Gabriel, San Bernardino, and San Jacinto Mountains. For the first time in April 2010, scientists reintroduced its eggs to its former habitat at University of California Riverside's James San Jacinto Mountains Reserve.

Arundo impacts: *The frogs have isolated small populations (Appendix B). The fact that several of the San Gabriel Mountain populations co-occur with Arundo is of concern. Impacts related to water use, shading, and the frogs' preference for less vegetated pools indicates that Arundo is likely a minor to moderate stressor on habitat fitness. Arundo could become a more pronounced impact if it continued to increase in abundance at sites where overlap in ranges occurs.*

Decline and Threats:
These frogs are threatened by predation by introduced trout, pesticides, environmental changes from drought and global warming, disease, and habitat degradation due to livestock grazing. More than 93 percent of northern and central Sierra Nevada populations, and more than 95 percent of southern Sierra Nevada and southern California populations, are already extinct.

Arundo impacts: *Little interaction with other stressors- but the species very tenuous persistence makes low to moderate levels of impacts already outlined potentially significant for the species especially for isolated southern CA populations.*

Overall impact metric for *Arundo* on mountain yellow-legged frog: Low/Moderate impact (4)

Interaction of *Arundo* distribution and mountain yellow-legged frog occurrence is presented by watershed in Table 7-3 and Appendix B.

Sources:
USGS, Mountain yellow-legged frogs reintroduced to wild 4/16/2010.
Mountain Yellow-legged Frog Update, Mountain Yellow-legged Frog Captive Breeding 2009 Annual Report, San Diego Zoo.
Species Profile for the Mountain Yellow-Legged Frog, U.S. Fish & Wildlife Service.

7.2.5 Western Snowy Plover (*Charadrius alexandrinus nivosus*)

Federal status: Threatened, March 1993. Critical habitat designated September 2005. Recovery Plan published in 2007.
State status: Species of special concern
Arundo impact score: 5

General Ecological Needs/Habitat Affinities:
The Pacific coast population of the western snowy plover breeds primarily above the high tide line on coastal beaches, sand spits, dune-backed beaches, sparsely-vegetated dunes, beaches at creek and river mouths, and salt pans at lagoons and estuaries. This habitat is unstable because of unconsolidated soils, high winds, storms, wave action, and colonization by plants. Less common nesting habitats include bluff-backed beaches, dredged material disposal sites, salt pond levees, dry salt ponds, and river bars. In winter, western snowy plovers are found on many of the beaches used for nesting as well as on beaches where they do not nest, in man-made salt ponds, and on estuarine sand and mud flats.

Arundo impacts: *Arundo is typically not abundant in beach and estuary habitats (although it can develop into large stands if left to persist there). The major impacts from Arundo are related to biomass accumulating in these areas. Additionally there may be impacts to sediment transport (Chapter 5) which could be effecting beach and estuaries. These impacts are speculative but possible given Arundo strong effect of fluvial and processes. Plovers have strong preference for river mouths and estuaries in comparison to beach areas along bluffs (Appendix B).*

Breeding/Life History:
The Pacific coast population of the western snowy plover breeds primarily on coastal beaches from southern Washington to southern Baja California, Mexico. Nesting western snowy plovers at coastal locations consist of both year-round residents and migrants. Migrants begin arriving at breeding areas in central California as early as January, although the main arrival is from early March to late April. Since some individuals nest at multiple locations during the same year, birds may continue arriving through June. In California, pre-nesting bonds and courtship activities are observed as early as mid-February. Eggs are laid in scrapes (depression in the sand or other substrate created by the male). The earliest nests on the California coast occur during the first week of March in some years and by the third week of March in most years. Peak initiation of nesting is from mid-April to mid-June. Nests typically occur in flat, open areas with sandy or saline substrates; vegetation and driftwood are usually sparse or absent. In southern California, western snowy plovers nest in areas with 6 to 18 percent vegetative cover and 1 - 14 % inorganic cover; vegetation height is usually less than six centimeters (2.3 inches).
Nests consist of a shallow scrape or depression, sometimes lined with beach debris (*e.g.*, small pebbles, shell fragments, plant debris, and mud chips); nest lining increases as incubation progresses. Driftwood, kelp, and dune plants provide cover for chicks that crouch near objects to hide from predators. Although driftwood is an important component of western snowy plover habitat, too much driftwood on a beach, which may occur after frequent and prolonged storm events, can be detrimental if there is not sufficient open habitat to induce the birds to nest. In southern California nests are usually located within 328 ft

(100 m) of water, which could be either ocean, lagoon, or river mouth. Invertebrates are often found near debris, so driftwood and kelp are also important for harboring western snowy plover food sources. Hatching lasts from early April through mid-August, with chicks reaching fledging age approximately one month after hatching. Fledging of late-season broods may extend into the third week of September throughout the breeding range.

Arundo impacts: *Arundo biomass significantly degrades nesting habitat by covering open sandy substrate. Additional impacts are outlined in FWS BO's: In some areas of California, such as the Santa Margarita River in San Diego County, and the Santa Clara and Ventura Rivers in Ventura County, giant reed has become a problem along riparian zones. During winter storms, giant reed is washed downstream and deposited at the river mouths where western snowy plovers nest. Large piles of dead and sprouting giant reed eliminate nesting sites and increase the presence of predators, which use it as perches and prey on rodents in the piles of vegetation.*

Diet:
Western snowy plovers are primarily visual foragers, using the run-stop-peck method of feeding. They forage on invertebrates in the wet sand and amongst surf-cast kelp within the intertidal zone, in dry sand areas above the high tide, on salt pans, on spoil sites, and along the edges of salt marshes, salt ponds, and lagoons. They sometimes probe for prey in the sand and pick insects from low-growing plants. Western snowy plover food consists of immature and adult forms of aquatic and terrestrial invertebrates.

Arundo impacts: *Arundo debris and stands reduce habitat quality for food (invertebrates); impacts feeding as well as foraging for prey.*

Movement:
While some western snowy plovers remain in their coastal breeding areas year-round, others migrate south or north for winter. In Monterey Bay, California, 41 % of nesting males and 24 % of the females were consistent year-round residents. At Marine Corps Base Camp Pendleton in San Diego County, California, about 30 % of nesting birds stayed during winter. The migrants vacate California coastal nesting areas primarily from late June to late October.

Arundo impacts: *Arundo debris piles limit movement of young.*

Status/Distribution or Historic and Current Range:
The Pacific coast population is defined as those individuals that nest within 50 miles of the Pacific Ocean on the mainland coast, peninsulas, offshore islands, bays, estuaries, or rivers of the United States and Baja California, Mexico. By the late 1970s, nesting western snowy plovers were absent from 33 of 53 locations with breeding records prior to 1970. By 2000 populations had declined further to 71 % of the 1977-1980 levels along the California coast and 27 % of the 1977-1980 levels in San Francisco Bay. However, since then populations have grown substantially, roughly doubling along the coast while fluctuating irregularly in San Francisco Bay. Recent population increases along the coast have been associated with implementation of management actions for the benefit of western snowy plovers and California least terns, including predator management and protection and restoration of habitat.

Arundo impacts: *Arundo is abundant on several key watersheds that support plover populations (Appendix B).*

Decline and Threats:
Habitat degradation caused by human disturbance, urban development, introduced beachgrass (*Ammophila* spp.), and expanding predator populations have resulted in a decline in active nesting areas and in the size of the breeding and wintering populations.

Arundo impacts: *As indicated Arundo stands are correlated with predation as predators use stands for perching in nesting areas.*

Overall impact metric for *Arundo* on the Western snowy plover: Moderate, score of 5.

Interaction of *Arundo* distribution and the Western snowy plover's occurrence is presented by watershed in Table 7-3.

Sources:

Recovery Plan for Pacific Coast Population of the Western Snowy Plover, USFWS, 2001 http://www.fws.gov/arcata/es/birds/WSP/documents/RecoveryPlanWebRelease_09242007/WSP%20Final%20RP%2010-1-07.pdf

Powell, A.N., J.M. Terp, C.L. Collier, and B.L. Peterson. 1997. The status of western snowy plovers (*Charadrius alexandrinus nivosus*) in San Diego County, 1997. Report to the California Department of Fish and Game, Sacramento, CA, and U.S. Fish and Wildlife Service, Carlsbad CA, & Portland OR.

7.2.6 Western Yellow-Billed Cuckoo (*Coccyzus americanus*)

Federal status: Species of Concern
State status: Endangered
Arundo impact score: 7

General Ecological Needs/Habitat Affinities:
Western yellow-billed cuckoos typically inhabit densely foliated, stands of deciduous trees and shrubs, particularly willows, with a dense understory formed by blackberry, nettles, and/or wild grapes, adjacent to slow-moving watercourses, backwaters, or seeps. River bottoms and other mesic habitats, including valley-foothill and desert riparian habitats, are necessary for breeding. Dense low-level or understory foliage with high humidity is preferred. Field studies and habitat suitability modeling have concluded that vegetation type (*e.g.*, willow scrub and cottonwood-willow forest), patch size, patch width, and distance to water are important factors determining the suitability of habitat for yellow-billed cuckoo breeding. Patch size is an important variable determining presence of cuckoos in California, with a trend toward increasing occupancy with increased patch size. Few cuckoos have been found in forested habitat of less than 25 acres. Willow-cottonwood habitat patches greater than 1,970 ft (600 m) in width were found to be optimal, and typically anything less than 328 ft (100 m) is unsuitable.

Arundo impacts: *Arundo and cuckoos both prefer broad river bottoms creating a significant interaction between the species. Cuckoos prefer well-developed riparian habitat that is dense with large gallery trees. Arundo displaces native vegetation and fires generate create younger serial stages that cuckoos do not prefer or utilize as habitat.*

Breeding/Life History:
Western cuckoos breed in large blocks of riparian habitats, particularly woodlands with cottonwoods (*Populus fremontii*) and willows (*Salix* spp.). Dense understory foliage appears to be an important factor in nest site selection, while cottonwood trees are an important foraging habitat in areas where the species has been studied in California. Clutch size is usually two or three eggs, and development of the young is very rapid, with a breeding cycle of 17 days from egg-laying to fledging of young. Although yellow-billed cuckoos usually raise their own young, they are facultative brood parasites, occasionally laying eggs in the nests of other yellow-billed cuckoos or of other bird species. Males and females reach

sexual maturity the first year after hatching. Chicks are able to fly between 17 and 21 days after hatching and within a few weeks will migrate to South America.

Arundo impacts: *Arundo significantly degrades habitat by impacting lager mature trees (fire) and displacing the dense native understory vegetation. Arundo fragments and degrades riparian habitat through fire and swaths of low value habitat isolating higher quality patches.*

Diet:
More than 75 % of the yellow-billed cuckoo's diet is comprised of grasshoppers and caterpillars, though the species has been known to eat other insects such as beetles, cicadas, wasps, flies, katydids, dragonflies, and praying mantids.

Arundo impacts: *Arundo provides none of the preferred food sources and displaces native vegetation- particularly native willows and cottonwoods that are habitat for mourning cloak butterfly and caterpillars.*

Movement:
Cuckoos leave North America in August and head to their wintering grounds in northwestern Costa Rica, Panama, and west of the Andes in Columbia, Ecuador, and Peru. It is believed that western cuckoos migrate primarily to southern Central America, remaining along the Pacific, and down into northwestern South America, remaining west of the Andes.

Arundo impacts: *No impact to migration. Movement within habitat is impacted.*

Status/Distribution or Historic and Current Range:
Yellow-billed cuckoos occur in the western United States as a distinct population segment (DPS). The area for this DPS is west of the crest of the Rocky Mountains. In California prior to the 1930s, the species was widely distributed in suitable river bottom habitats, and was locally common. It is estimated that in California the species' range is now about 30 % of its historical extent. Studies since the 1970s indicate that there are fewer than 50 breeding pairs in all of California. Given that only Santa Ana and Santa Clara have had reported sightings since 1989, it is possible that the species may become or is already functionally extirpated from Southern California. Sightings may be individuals migrating to the South Fork of the Kern River or the Sacramento River.

Arundo impacts: *Arundo* is abundant on the two watersheds with cuckoo occurrence data collected since 1989; all other occurrence data is from the 1970s or late 1800s/early 1900s (Los Angeles region- Appendix B).

Decline and Threats:
Adequate patch size and loss of habitat are the primary threats to western yellow-billed cuckoo populations. Principal causes of riparian habitat losses are conversion to agricultural and other uses, dams and river flow management, stream channelization and stabilization, and livestock grazing. Available breeding habitats for cuckoos have also been substantially reduced in area and quality by groundwater pumping and the replacement of native riparian habitats by invasive non-native plants, particularly tamarisk and *Arundo*. Fragmentation effects include the loss of patches large enough to sustain local populations, leading to local extinctions, and the potential loss of migratory corridors, affecting the ability to recolonize habitat patches. Much of the catastrophic decline of the cuckoo in California has been directly attributed to breeding habitat loss from clearing and removal of huge areas of riparian forest for agriculture, urban development and flood control (see chapter 5.3- historic trends of geomorphology, particularly the loss of terraces, where mature gallery forest would occur). Another likely factor in the loss and modification of the yellow-billed cuckoo is the invasion by exotic tamarisk

(*Tamarisk* spp.) and *Arundo*. The spread and persistence of tamarisk and *Arundo* has resulted in significant changes in riparian plant communities. In monotypic tamarisk and *Arundo* stands, the most striking change is the loss of community structure. The multi-layered community of herbaceous understory, small shrubs, middle-layer willows, and over-story deciduous trees is often replaced by one monotonous layer. Plant species diversity has declined in many areas and relative species abundance has shifted in others. Other effects include changes in percent cover, total biomass, fire cycles, thermal regimes, and perhaps insect fauna. Conversion to tamarisk or *Arundo* typically coincides with reduction or complete loss of bird species strongly associated with cottonwood-willow habitat including the yellow-billed cuckoo

Overall impact metric for *Arundo* on the Western yellow-billed cuckoo: High impact, score of 7.

Interaction of *Arundo* distribution and the Western yellow-billed cuckoo's occurrence is presented by watershed in Table 7-3 and Appendix B. Note that although there is high impact to habitat function for the species- the species is only present as 'historic occurrences' on most watersheds. Santa Ana and Santa Clara still have periodic sightings. These watersheds score high in relative abundance: there are not many sightings but these are a large proportion of sightings for the species. It is not locally abundant anywhere.

Sources:

U.S. Fish and Wildlife Service Species Assessment and Listing Priority Assignment Form for: *Coccyzus americanus* (Yellow-billed Cuckoo), Western United States Distinct Population Segment. http://ecos.fws.gov/docs/candforms_pdf/r8/B06R_V01.pdf

Stillwater Sciences. 2007. Focal Species Analysis and Habitat Characterization for the Lower Santa Clara River and Major Tributaries, Ventura County, California. Santa Clara River Parkway Floodplain Restoration Feasibility Study.

7.2.7 Southwestern Willow Flycatcher (*Empidonax trailii extimus*)

Federally status: Endangered, February 1995. Critical habitat designated October 2005. Final recovery plan completed August 2002.
State status: Endangered, January 1991.
Arundo impact score: 8

General Ecological Needs/Habitat Affinities:
The southwestern willow flycatcher occurs in riparian woodlands along streams and rivers with mature, dense stands of willows (*Salix* spp.), cottonwoods (*Populus* spp.), or smaller spring fed areas with willows or alders (*Alnus* spp.). Riparian habitat is used for both foraging and breeding.

Suitable habitat typically consists of the following habitat features: 1) Nesting habitat with trees and shrubs that include, but are not limited to, willow (*Salix* spp.) species and boxelder (*Acer negundo*), 2) Nesting habitat with a dense (*i.e.*, 50- 100 %) tree and/or shrub canopy, 3) Dense riparian vegetation with thickets of trees and shrubs, 4) Dense patches of riparian forest interspersed with small areas of open water or marsh, creating a mosaic; patch size may be as small as 0.25 ac or as large as 175 ac.

Arundo impacts: *Arundo displaces native vegetation forming monotypic stands or co-occurring with native woody vegetation. Both of these situations degrade habitat value. Abiotic system changes caused by Arundo related to fire and more frequent flooding degrade habitat value by creating more areas with early serial stages.*

Breeding/Life History:
Nests are typically placed in even-aged, structurally homogeneous and dense plant communities. They usually nest in the upright fork of a shrub, but occasionally nest on horizontal limbs within trees and shrubs. Historically the flycatcher nested primarily in willows and mulefat (*Baccharis salicifolia*) with a scattered overstory of cottonwood. With changes to riparian plant communities, they still nest in willows where available, but are also known to nest in thickets dominated by the non-native shrub tamarisk (*Tamarix* species) and Russian olive (*Elaeagnus angustifolia*). Males typically arrive in California at the end of April and females arrive approximately one week later. They have a home range that is larger than the defended territory. Territorial defense usually begins in late May. Territory size varies from 0.25 to 5.7 acres, with most in the range between 0.5 and 1.2 aces. They typically raise one brood per year, with a clutch size usually 3-4. The fledglings leave the nest at age 12-15 days in early July, and usually disperse from the natal territory at age 26-30 days. In southern California flycatchers usually leave the breeding grounds by the end of August, and it is exceeding scarce in the United States after mid-October.

Arundo impacts: *Arundo degrades habitat quality as it displaces vegetation with suitable nesting structure.*

Diet:
The southwestern willow flycatcher is an insectivore that forages within and above dense riparian vegetation, taking insects on the wing or gleaning them from foliage. They may also forage in areas adjacent to nest sites which may be more open. They are active diurnally.

Arundo impacts: *Arundo appears to have little foraging value for the southwestern willow flycatcher as it supports a reduced diversity and abundance of aerial insects compared to native vegetation (Herrera & Dudley 2003). Arundo displaces vegetation that supports food species.*

Movement:
Males usually arrive in California at the end of April, and females about a week later. They generally leave in August. The migration routes and destination of the willow flycatcher are not well known. The flycatcher most likely winters in Mexico, Central America and perhaps northern South America, however, the habitat is uses as wintering grounds are unknown.

Arundo impacts: *No impact to migration- but Arundo interferes with movement within the territory- obstructing access to lower canopy and impeding foraging.*

Status/Distribution or Historic and Current Range:
Current estimated distribution of the southwestern willow flycatcher in California is shown in Figure 7-16/19. The current breeding range includes southern California, southern Nevada, Arizona, New Mexico and western Texas. The historic range in California apparently included all lowland riparian areas of the southern third of the state. In the 1930 it was considered a common breeder in coastal southern California, but it declined precipitously over the last 50 years or so.

Arundo impacts: *Arundo is abundant on two specific watersheds with large numbers of flycatchers (Table 7-3, Appendix B). One watershed has moderate interaction/overlap in distribution and eight watersheds have slight interaction. The species has a wide distribution but low populations on most watersheds.*

Decline and Threats:
The major threats to the flycatcher are the destruction, modification, or curtailments of habitat, and nest parasitism by cowbirds. Loss and modification of riparian habitat has occurred due to urban and agricultural development, water diversion and impoundments, channelization, livestock grazing, off-road vehicle and other recreational uses, and hydrological changes resulting from these and other land uses.

Overall impact metric for *Arundo* on southwestern willow flycatcher: Very high impact, score of 8.

Interaction of *Arundo* distribution and southwestern willow flycatcher occurrence is presented by watershed in Table 7-3 and illustrated in Appendix B.

Sources:
U.S. Fish and Wildlife Service. 2002. Southwestern Willow Flycatcher Recovery Plan. Albuquerque, New Mexico. http://ecos.fws.gov/docs/recovery_plans/2002/020830c.pdf
Stillwater Sciences. 2007. Focal Species Analysis and Habitat Characterization for the Lower Santa Clara River and Major Tributaries, Ventura County, California. Santa Clara River Parkway Floodplain Restoration Feasibility Study.

7.2.8 Belding's Savannah Sparrow (*Passerculus sandwichensis beldingi*)

Federal status: Species of Concern
State status: Endangered, 1974.
Arundo impact score: 2

General Ecological Needs/Habitat Affinities:
Belding's are ecologically associated with dense pickleweed, particularly *Sarcocornia pacifica (formerly Salicornia virginica)*, within which most nests are found.

Arundo impacts: *Arundo is not typically abundant in estuaries although it can occur there. Of more concern is biomass from upstream sources that accumulates in estuaries. Most of the estuaries where the sparrows occur are connected to smaller stream order riverine systems. Less Arundo is found on these size systems. Arundo impacts to system hydrology and geomorphic processes could be of concern in certain situations- sediment loads, biomass blocking flows. But these impacts are probably less on the size river systems that support sparrow habitat in estuaries.*

Breeding/Life History:
Breeding territories can be very small and they nest semi-colonially or locally concentrated within a larger block of habitat, all of which may appear generally suitable.

Arundo impacts: *Minimal impact.*

Diet:
Feeds mostly on the ground (seeds), generally alone or, during the non-breeding season, in small flocks.

Arundo impacts: *Minimal impact.*

Movement:
They remain within the salt marsh year round.

Arundo impacts*: Minimal impact.*

Status/Distribution or Historic and Current Range:
Based upon the 2010 surveys, Belding's sparrows are doing well within their range in California but particularly at Point Mugu, Seal Beach National Wildlife Refuge (NWR), Bolsa Chica, Upper Newport Bay, Sweetwater Marsh NWR, and Tijuana Slough NWR. This is associated in part with the levels and quality of hands-on efforts at these wetlands. For example, Point Mugu has one of the most active and successful Natural Resources Management programs of any of the coastal wetlands in the southern California Bight. At San Elijo and Los Peñasquitos Lagoons the ocean inlets are being monitored and kept open as much as possible. This often minimizes flooding and hyper-saline conditions that greatly reduce Belding's sparrows nesting success.

Arundo impacts: *There is interaction between sparrow and Arundo distributions. Arundo occurs within occupied habitat in a few areas, but as noted it is not abundant in estuaries. Arundo debris is not mapped, but is predicted based on abundance of Arundo upstream of occupied sites. Many of the occupied estuaries are on smaller lower energy systems so significant Arundo biomass inputs are not likely. Calleguas Watershed is a noted potential exception but much of the estuary complex is not well connected to the river mouth. This partly protects it from Arundo debris being pulled back into the estuary complex after it has been dispersed into the ocean or from deposition as debris racks during flow events.*

Decline and Threats:
Over 75% of the coastal wetland habitats within this range have been lost or highly degraded and the remainder suffer from the effects of increasing human populations.

Overall impact metric for *Arundo* on the Belding's savannah sparrow: Very low impact, score of 2.

Interaction of *Arundo* distribution and the Belding's savannah sparrow's occurrence is presented by watershed in Table 7-3 and Appendix B.

Sources:
A Survey of the Belding's Savannah Sparrow in California 2010, State of California, The Resources Agency, Department of Fish and Game Wildlife Branch. Prepared by Richard Zembal and Susan M. Hoffman, Clapper Rail Recovery Fund, Huntington Beach Wetlands Conservancy, September 2010.

7.2.9 Coastal California Gnatcatcher (*Polioptila californica californica*)

Federal status: Threatened, March 1993. Critical habitat (Revised) designated December 2007.
State status: None?
Arundo impact score: 2

General Ecological Needs/Habitat Affinities:
The range and distribution of the gnatcatcher is closely aligned with coastal scrub vegetation. This vegetation is typified by low (<1m), shrub and sub-shrub species that are often drought deciduous. The coastal scrub plant communities that overlap the range of the gnatcatcher include Venturan, Diegan, and Riversidean coastal sage scrub (CSS) communities, and Martirian and Vizcainan coastal succulent scrub communities. Gnatcatchers may also occur in other nearby plant communities, especially during the non-breeding season, but gnatcatchers are closely tied to coastal scrub for reproduction.

Arundo impacts: *Arundo is not typically found in coastal sage scrub, but CSS habitat and riparian zones are closely aligned in most areas along the coast. Impacts related to fire, both fires starting in*

Arundo and Arundo contributions to wildland fires, can have impacts to adjacent habitat. Fire impacts to CSS can result in both direct take of the species as well as degradation of habitat (short term functional loss, and potentially long term degradation- dependent on fire history and recovery of site). Gnatcatchers are also year round residents and riparian vegetation offers refuge and food resources in late summer/fall/winter when coastal sage scrub is less productive.

Breeding/Life History:
The gnatcatcher is non-migratory and defends breeding territories ranging in size from 1 - 6 hectares (2 - 14 acres). The home range size of the gnatcatcher varies seasonally and geographically, with winter season home ranges being larger than breeding season ranges and inland populations having larger home ranges than coastal. The breeding season of the gnatcatcher generally extends from late February through July (sometimes later), with the peak of nest initiations occurring from mid-March through mid-May. Nests are composed of grasses, bark strips, small leaves, spider webs, down, and other materials and are often located in California sagebrush (*Artemisia californica*) plants about 1 m above the ground. The incubation and nestling periods encompass about 14 and 16 days, respectively.

Arundo impacts: *No impact except those related to fire.*

Diet:
California gnatcatchers are ground and shrub-foraging insectivores. They feed on arthropods, beetles, spiders, leafhoppers, and other small insects. Most of their water intake is obtained through their diet.

Arundo impacts: *Little impact-although riparian areas can be used for foraging during times of low productivity in CSS, and high Arundo cover degrades this function.*

Movement:
The gnatcatcher is non-migratory. Dispersal of juveniles generally requires a corridor of native vegetation that provides certain foraging and sheltering requisites and that connects to larger patches of appropriate sage scrub vegetation. These dispersal corridors facilitate the exchange of genetic material and provide a path for re-colonization of extirpated areas. The gnatcatcher generally disperses short distances through contiguous, undisturbed habitat, but juvenile gnatcatchers are capable of dispersing long distances (up to 22km/14 mi) across fragmented and highly disturbed sage scrub habitat, such as that found along highway and utility corridors or remnant mosaics of habitat adjacent to developed lands.

Arundo impacts: *No impact.*

Status/Distribution or Historic and Current Range:
The range of the gnatcatcher is coastal southern California and northwestern Baja California, Mexico, from southern Ventura and San Bernardino Counties, California, south to approximately El Rosario, Mexico, at about 30 degrees north latitude.

Arundo impacts: *See Appendix B.*

Decline and Threats:
The main threat to the coastal California gnatcatcher is habitat loss, fragmentation, and degradation. Urban and agricultural development, livestock grazing, invasion of exotic grasses, off-road vehicles, pesticides, and military training activities all contribute to the destruction of gnatcatcher habitat.

Overall impact metric for *Arundo* on the coastal California gnatcatcher: Very low impact, score of 2. If wildland fires were documented to have greater extent due to presence of *Arundo* stands in core gnatcatcher upland areas this score should be elevated. Significant take and/or long term degradation would occur to upland habitat.

Interaction of *Arundo* distribution and the coastal California gnatcatcher's occurrence is presented by watershed in Table 7-3 and Appendix B.

Sources:

Coastal California Gnatcatcher Five Year Review, U.S. Fish and Wildlife Service, Carlsbad, CA. September 2010. http://ecos.fws.gov/docs/five_year_review/doc3571.pdf

7.2.10 Light Footed Clapper Rail (*Rallus longirostris levipes*)

Federal status: Endangered, October 1970. No critical habitat designated.
State status: Endangered, June 1971
Arundo impact score: 3

General Ecological Needs/Habitat Affinities:
The light-footed clapper rail uses coastal salt marshes, lagoons, and their maritime environs. Nesting habitat includes tall, dense cordgrass (*Spartina foliosa*) and occasionally pickleweed (*Sarcocornia pacifica* – formerly *Salicornia virginica*) in the low littoral zone, wrack deposits in the low marsh zone, and hummocks of high marsh within the low marsh zone. Fringing areas of high marsh serve as refugia during high tides. Although less common, light-footed clapper rails have also been observed to reside and nest in freshwater marshes.

Activities of the light-footed clapper rail are tide-dependent. They require shallow water and mudflats for foraging, with adjacent higher vegetation for cover during high water. They forage in all parts of the salt marsh, concentrating their efforts in the lower marsh when the tide is out, and moving into the higher marsh as the tide advances.

Arundo impacts: *Arundo does not occur in the lower estuary habitat that rails use. However, biomass of Arundo from upstream stands can be deposited in estuaries (relevance is tied to abundance of Arundo on a given system). Also, larger order systems that are significantly invaded may have significant modification of flow dynamics, sediment transport, and hydrology which may affect quality of estuary habitat at the river mouth (if estuaries are still connected to the river system).*

Breeding/Life History:
Nesting usually begins in March and late nests hatch by August. Nests are placed to avoid flooding by tides, yet in dense enough cover to be hidden from predators and to support the relatively large nest. Potential predators on eggs, nestlings, or adults include California ground squirrels, old world rats, striped skunk, feral house cats, dogs, gray fox, red fox, Virginia opossum, and raptors.

Arundo impacts: *Arundo harbors a range of mammals and predators that use the physical structure.*

Diet:
Light-footed clapper rails are omnivorous and opportunistic foragers, which rely mostly on salt marsh invertebrates such as beetles, garden snails, California horn snails, salt marsh snails, fiddler and hermit crabs, crayfish, isopods, and decapods.

***Arundo impacts**: No impact.*

Movement:
The light-footed clapper rail is resident in its home marsh except under unusual circumstances. Within-marsh movements are also generally confined and usually of no greater spread than 1,312 feet (400m). However, a banded captive-bred female rail which was released at Point Mugu in August of 2004 was found in December of 2004 at Upper Newport Bay, a distance of 145 km (90 mi) along the coast. Minimum home range sizes for nine clapper rails that were radio-harnessed for telemetry at Upper Newport Bay varied from approximately 0.8 - 4.1 acres. The larger areas and daily movements were by first year birds attempting to claim their first breeding territories.

***Arundo impacts:** No impact.*

Status/Distribution or Historic and Current Range:
The historical range of the light-footed clapper rail was originally described as extending from Santa Barbara County, California to San Quintin Bay, Baja California, Mexico. In the early 1900s, ornithologists noted a decrease in the abundance of rails and observed that they were no longer found in areas, which were formerly occupied. Since 1900, 75 %of the coastal estuaries and wetlands in southern California have been destroyed or adversely modified. Light-footed clapper rails have not been detected in Santa Barbara County since 2004 or in Los Angeles County since 1983. The range in California now extends from Ventura County in the north to the Mexican border in the south.

***Arundo impacts:** Rails occur in estuaries of both large and small watershed systems- particularly in San Diego County (Appendix B). Rails can extend fairly far into the watershed (where pickleweed occurs), but some of these are historic records. Arundo is abundant on some of these watersheds.*

Decline and Threats:
Continued loss and degradation of salt marsh habitat.

Overall impact metric for *Arundo* on the light-footed clapper rail: Low impact, score of 3.

Interaction of *Arundo* distribution and the light footed clapper rail's occurrence is presented by watershed in Table 7-3 and Appendix B.

Sources:
Light-footed Clapper Rail Five Year Review, U.S. Fish and Wildlife Service, Carlsbad, CA. August 2009. http://ecos.fws.gov/docs/five_year_review/doc2573.pdf

7.2.11 California Least Tern (*Sterna antillarum browni*)

Federal status: Endangered June 2, 1970. Final Recovery Plan 1980, revised 1985.
State status: Endangered, June 27, 1971.
Arundo impact score: 4

General Ecological Needs/Habitat Affinities:
California least terns nest on beaches, usually choosing locations in an open expanse of light-colored sand, dirt or dried mud close to a lagoon or estuary with a dependable food supply. Formerly, sandy open beaches were used, but human activity on beaches has forced terns to nest on mud and sand flats back from the ocean, and on man-made habitats. In addition to nesting areas, California least terns also require secure roosting and foraging areas. Roosting areas are of two kinds: pre-season nocturnal roosts and post-season dispersal sites where adults and fledglings congregate. Terns forage primarily in nearshore ocean waters and in shallow estuaries and lagoons.

Arundo impacts: *Arundo is not abundant in the beach and estuary habitat- but there can be locally occurring stands and occurrences of the plant. Arundo debris and to a lesser degree hydrologic and geomorphic alteration of river systems can have impacts on terns.*

Breeding/Life History:
Most least terns begin breeding in their third year. Mating begins in April or May. The nest is a simple scrape in the sand and may be lined with shell fragments, pebbles, twigs. Typically there are 2 eggs. Both parents incubate and care for the young. They can re-nest up to two times if eggs or chicks are lost early in the breeding season. Nesting season extends from approximately May 15 into early August, with the majority of nests completed by mid June. A second wave of nesting occurs from mid-June to early August. These are mainly re-nests after initial failures, and second year birds nesting for the first time. Predators of the California least tern are larger birds, mammals such as raccoons and foxes, and domestic dogs and cats.

Arundo impacts: *Most tern breeding areas are nearly devoid of vegetation and plant debris (observation of nesting sites in San Diego and Ventura Counties). Arundo debris and live plant structure is a degradation of habitat. Debris reduces useable area. Any structure fosters predation from birds and any concealment encourages predatory mammals.*

Diet:
California least terns eat small fish.

Arundo impacts: *No impact.*

Movement:
The California least tern is migratory, usually arriving in its breeding area by mid April and departing again in August. However, terns have been recorded in the breeding range as early as March 13 and as late as October 31. Adult terns move south along the California coast with their fledglings in the autumn, stopping to rest and feed along the migration route.

Arundo impacts: *No impact.*

Status/Distribution or Historic and Current Range:
Historically California least terns nesting in large colonies spread along undisturbed beaches. However with development of the California coast and fragmentation of large beach areas, birds now nest in the small fragments of habitat remaining in the same general areas. The nesting range in California is discontinuous, with large colonies spread out along beaches at estuaries. The northern limit for nesting is San Francisco Bay, and the southern limit is in Baja California, Mexico. Today the tern is concentrated in three southern California counties: Los Angeles, Orange and San Diego.

Arundo impacts: *Arundo is abundant on several watersheds in Orange and San Diego Counties (Appendix B).*

Decline and Threats:
California least terns were apparently once abundance and well distributed on barrier beaches and beach strand along the southern California coast. The reduction in tern numbers was apparently gradual and associated with human population increases in the area. The species was noted as seriously declining within its range before the 1930s. Today the tern is concentrated in three southern California counties: Los Angeles, Orange and San Diego. Since 1973 there has been on overall increase in least tern in California due to recovery efforts such as site management and protection of known nesting sites (fencing, predator control, monitoring, research). Decline of the California least tern is due to loss and degradation of beach habitat, impacts and disturbance from human and domestic animal use of beaches, and loss and fragmentation of wintering habitat.

Overall impact metric for *Arundo* on the coastal California least tern: Low/Moderate, score of 4.

Interaction of *Arundo* distribution and the coastal California least tern's occurrence is presented by watershed in Table 7-3 and Appendix B.

Sources:
California Least Tern Five Year Review Summary and Evaluation, U.S. Fish and Wildlife Service, Carlsbad, CA. September 2006. http://ecos.fws.gov/docs/five_year_review/doc775.pdf
Revised California Least Tern Recovery Plan, U.S. Fish and Wildlife Service, Portland, Oregon. April 1980. http://ecos.fws.gov/docs/recovery_plan/850927_w%20signature.pdf

7.2.12 Least Bell's Vireo (*Vireo bellii pusillus*)

Federal status: Endangered, May 1986. Critical habitat designated February 1994. Draft recovery plan completed in 1998.
State status: Endangered, October 1980.
Arundo impact score: 9

General Ecological Needs/Habitat Affinities:
Least Bell's vireo is a small, olive-grey migratory songbird that nests and forages almost exclusively in riparian woodland habitats. Primary constituents of critical habitat for the vireo include riverine and floodplain habitat, and adjacent coastal sage scrub, chaparral, or other upland communities. Nesting habitat typically consists of well-developed overstories and understories, and low densities of aquatic and herbaceous cover. The understory frequently contains dense subshrub or shrub thickets. These thickets are often dominated by sandbar willow (*Salix hindsiana*), mulefat (*Baccharis salicifolia*), young individuals of other willow species, such as arroyo willow (*Salix lasiolepis*) or black willow (*Salix gooddingii*), and one or more herbaceous species. Important overstory specie include mature arroyo willow and black willows; occasional cottonwoods (*Populus* spp.) and western sycamores (*Platanus racemosa*) occur in some habitats. Additionally, coast live oak (*Quercus agrifolia*) can be a locally important overstory component, as can mesquite (*Prosopis* spp.).

Arundo impacts: *Arundo and vireos prefer the same broad coastal riparian habitat types. Significant impacts from abiotic modification of the riverine system impact ecosystem to the detriment of the vireo. There changes include fire, geomorphic impacts that interfere with vegetation succession, and outright displacement of vegetation that vireos are dependent on. Direct take and long term degradation of habitat occurs after fires initiating in Arundo stands as well as wildland fires that are larger are more intense when Arundo is present.*

Breeding/Life History:
Following pair formation, it takes approximately 5 - 7 days for them to finish nest construction and egg laying. Young typically fledge within 20 - 24 days after eggs are laid. The egg laying and incubation periods are critical to the nesting success, as disturbance at this point may result in abandonment of the nest.

Arundo impacts: *Arundo displaces native vegetation reducing available habitat for nesting. Arundo does not have suitable structure for vireo nests.*

Diet:
They are almost exclusively insectivorous, and forage in riparian woodland and suitable adjacent upland habitat.

Arundo impacts: *Arundo support a low abundance and diversity of insects, particularly in comparison to native vegetation (Herrera & Dudley 2003, Going & Dudley 2008). Vireos are rarely seen feeding on Arundo as the plants has few insects that directly feed on it. Birds are rarely seen feeding in Arundo.*

Movement:
Least Bell's vireos generally begin to arrive from their wintering range in southern Baja California and establish breeding territories by mid- to late March. Most breeding vireos depart by the third week of September and only a very few individuals are found wintering in California. Most vireos occupy home ranges that are typically from 0.5 - 4.5 acres, but a few may be as large as 7.5 acres. Once the young are fledged they wander widely throughout the parents' territory.

Arundo impacts: *Arundo stands inhibit movement of avian species as the feed, spatially segregating the habitat. Territories frequently include Arundo stands but there is always a native component of the territory. Territories are roughly drawn- it would be interesting to see if territory size is larger when Arundo is present.*

Status/Distribution or Historic and Current Range:
Historically the vireo was described as common to abundant in the appropriate riparian habitat from as far north as Tehama County, CA to northern Baja, Mexico. Habitat loss has fragmented most remaining populations into small, disjunct, widely dispersed subpopulations. Currently the largest population of vireos is on Marine Corps Base Camp Pendleton in San Diego County. This population combined the population in the Prado Basin represent approximately 60 % of all known territories in California.

Arundo impacts: *Arundo is abundant on the three largest population centers for the vireo: Santa Margarita, Santa Ana, and San Luis Rey. Vireos are in greater abundance on larger systems, but they do occur on smaller watersheds if riparian vegetation is well developed (Appendix B). Vireos also occur in greater abundance in urban riparian areas then other federally listed species.*

Decline and Threats:
Decline of vireos is primarily the result of habitat loss and degradation, and cowbird nest-parasitism. The historic loss of wetlands (including riparian woodlands) has been estimated at 91 %. Much of the potential remaining habitat is infested with non-native plants and cowbirds. Ongoing causes of destruction or degradation of habitat include: removal of riparian vegetation; invasion of non-native species (e.g. *Arundo*, cowbird); thinning of riparian growth, especially near ground level; removal or destruction of adjacent upland habitats used for foraging; increases in human-associated or human induced disturbances; and flood control activities, including dams, channelization, water impoundment or extraction, and water diversion. Vireos are also sensitive to many forms of human disturbance, including noise, night lighting, and consistent human presence in an area.

Overall impact metric for *Arundo* on least Bell's vireo: Severe impact, score of 9.

Interaction of *Arundo* distribution and least Bell's vireo occurrence is presented by watershed in Table 7-3 and Appendix B.

Sources:

Stillwater Sciences. 2007. Focal Species Analysis and Habitat Characterization for the Lower Santa Clara River and Major Tributaries, Ventura County, California. Santa Clara River Parkway Floodplain Restoration Feasibility Study.

Programmatic Biological Opinion for the Salinas River Watershed Permit Coordination Program, Monterey County, CA (1-8-02-F-19), US Fish and Wildlife Service, Ventura, CA. 2002.

7.2.13 Tidewater Goby (*Eucyclogobius newberryi*)

Federal status: Endangered, March 7 1994. Critical habitat designated November 20 2000.
State status: none
Arundo impact score: 7

General Ecological Needs/Habitat Affinities:
The tidewater goby, a species endemic to California, is found primarily in waters of coastal lagoons, estuaries, and marshes. The species is benthic in nature, and its habitat is characterized by brackish, shallow lagoons and lower stream reaches where the water is fairly still but not stagnant. Tidewater gobies prefer a sandy substrate for breeding, but they can be found on rocky, mud, and silt substrates as well. The species is typically found in water less than 1 m deep. Tidewater gobies have been documented in waters with salinity levels from 0 - 42 parts per thousand (ppt), temperature levels from 8 - 25 ° C (46 - 77° F), and water depths from 25 200 cm (10 to 79 in). Critical habitat includes the stream channels and their associated wetlands, flood plains, and estuaries.

Arundo impacts : *Alteration of geomorphology and accumulation of excessive dead biomass in habitat areas are the primary impacts. It is possible that abundant Arundo is extremely detrimental to the species as they have not been observed on the Salinas River, Santa Clara, and Santa Margarita, and San Luis Rey Rivers in recent time frames. River channels could be becoming too deep for the species on some systems (such as San Luis Rey) resulting from excessive vegetation on floodplains (see chapter 5). The species now seems to occur on smaller river/creek systems, many of which have no or little Arundo on them (areas of Camp Pendleton and Estero Bay).*

Breeding/Life History:
The tidewater goby is typically an annual species, although some variation has been observed. Reproduction occurs year-round although distinct peaks in spawning, often in early spring and late summer, do occur. Male tidewater gobies begin digging breeding burrows in relatively unconsolidated, clean, coarse sand (averaging 0.5 mm diameter), in April or May after lagoons close to the ocean. Female tidewater gobies can lay 300 - 500 eggs per clutch, and can lay 6 - 12 clutches per year. Male tidewater gobies remain in the burrow to guard the eggs that are attached to sand grains in the burrow ceiling and walls. The male tidewater goby cares for the embryos for approximately 9 - 11 days until they hatch. Tidewater goby larvae are planktonic for 1 - 3 days and then become benthic from that point on. Tidewater goby are preyed upon by native and non-native fish, and by fish eating birds.

Arundo impacts: *Accumulated biomass within the channel near the river mouth would cover substrate needed for reproduction.*

Diet:
Tidewater gobies feed mainly on small animals, usually mysid shrimp, amphipods, ostracods, and aquatic insects. Juvenile tidewater gobies are generally day feeders, although adults mainly feed at night.

Arundo impacts: *Unknown if biomass would impacts aquatic food resources. Excessive channel depth would negatively affect feeding (individuals prefer a water depth of up to 1 m).*

Movement:
The tidewater goby appears to spend all life stages in lagoons, estuaries, and river mouths. Tidewater gobies may enter marine environments only when flushed out of lagoons, estuaries, and river mouths by normal breaching of the sandbars following storm events. Tidewater gobies generally select habitat in the upper estuary, usually within the fresh-saltwater interface. Tidewater gobies range upstream a short distance (up to 1.5 miles/2.41 km) into fresh water, and downstream into water of up to about 75 % sea water (28 ppt).

Arundo impacts this by: *The preferred habitat zone frequently has significant Arundo on the banks (in highly invaded systems) It is possible that Arundo debris in these systems interferes with movement during and after flood events- particularly if there are large rafts vegetation (Arundo canes and native vegetation).*

Status/Distribution or Historic and Current Range:
Tidewater gobies are endemic to California and historically ranged from Tillas Slough near the Oregon border to Agua Hedionda Lagoon in northern San Diego County, and are found today entirely within the original known range of the species. The known localities are discrete lagoons, estuaries, or stream mouths separated by mostly marine conditions. Tidewater gobies are absent from areas where the coastline is steep and streams do not form lagoons or estuaries. Tidewater gobies have recolonized areas where they have been extirpated.

Arundo impacts: *Arundo and goby distributions are shown Appendix B. As noted, the species has not been found in several large and heavily invaded watersheds since 2001. But there are smaller watersheds with populations nearby. Goby populations and distribution may naturally fluctuate in response to large flooding events. It will be informative to see if they return to systems that have had Arundo neatly eradicated (Santa Margarita and San Luis Rey).*

Decline and Threats:
The tidewater goby is threatened by modification and loss of habitat as a result of coastal development, channelization of habitat, diversions of water flows, groundwater overdrafting, and alteration of water flows. Potential threats to the tidewater goby include discharge of agricultural and sewage effluents, increased sedimentation due to cattle grazing and feral pig activity, summer breaching of lagoons, upstream alteration of sediment flows into the lagoon areas, introduction of exotic gobies and rainwater killifish, habitat damage, and watercourse contamination resulting from vehicular activity in the vicinity of lagoons.

Arundo impacts: *Arundo effects several of these parameters (water availability, sediment transport), but it is unclear exactly how these factors interact with goby habitat.*

Overall impact metric for *Arundo* on the tidewater goby: High impact, score of 7.

Interaction of *Arundo* distribution and tidewater goby occurrence is presented by watershed in Table 7-3 and Appendix B. It is important to note that there are many smaller watersheds that have no or very low *Arundo* presence and therefore impacts are non-existent. Goby have occurred on large systems- and they are in significant decline or do not occur on these systems over the time period when *Arundo* has become a significant impact. Other hydrologic factors have also changed significantly over that time frame (water flows, sediment transport, etc.) so several factors may be at play.

Sources:

Programmatic Biological Opinion for the Salinas River Watershed Permit Coordination Program, Monterey County, CA (1-8-02-F-19), US Fish and Wildlife Service, Ventura, CA. 2002.

U.S. Fish and Wildlife Service. 2005. Recovery Plan for the Tidewater Goby (*Eucyclogobius newberryi*). U.S. Fish and Wildlife Service, Portland, Oregon.

7.2.14 Unarmored Three Spine Stickleback (*Gasterosteus aculeatus williamsoni*)

Federal status: Endangered, October 13 1970. Designation of critical habitat remains pending. Recovery Plan completed in 1985.
State status: Endangered, June 27 1971.
Arundo impact score: 8

General Ecological Needs/Habitat Affinities:

The unarmored three-spine stickleback inhabits slow moving reaches or quiet water microhabitats of streams and rivers. Favorable habitats usually are shaded by dense and abundant vegetation, but in more open reaches algal mats or barriers may provide refuge. The best habitat seems to be a small clean pond in the stream with a constant flow of water through it. Adults are found in all areas of the stream and tend to gather in areas of slower moving or standing water. In areas where water is moving rapidly, adults tend to be found behind obstructions, or at the edge of the stream, particularly under the edge of algal mats. No adults have been found to be living permanently in ponds isolated from the main stream.

Arundo impacts: *Arundo occurs within the core stickleback population area of the upper Santa Clara Watershed. There is Arundo present within much of the stickleback's range and significant Arundo in the fish's lower range on the main stem of the river. For more invaded portions of the river changes to sediment transport and high water use of Arundo could be impacting pool persistence and quality. Arundo fires in more invaded habitat would also cause impacts.*

Breeding/Life History:

There is some reproduction during almost every month. A large increase in reproductive activity occurs in the spring in about March, and continues at lower levels throughout summer and fall. Males build nests of aquatic vegetation on the bottom within his territory. Nests are located where there is ample vegetation and a gentle flow of water. After the female lays the eggs, the male fertilizes them, guards them, and fans them. Young sticklebacks hatch in a nest from eggs which have been brooded for several days by the adult male. The exact amount of time the young stay in the nest is unknown. Larger juveniles and sub-adults tend to be found in the protection of vegetation, in slow moving or standing water. Fish apparently only live for one year.

Arundo impacts: *Pool/channel water quality and duration may be impacted.*

Diet:

The stickleback feeds mostly on benthic insects, small crustaceans, and snails, and to a lesser degree flat worms and nematodes. Males may also eat stickleback eggs.

Arundo impacts: *Pool/channel water quality and duration may be impacted- which could effect abundance and diversity of food resources.*

Movement:
The unarmored three-spine stickleback remains within stream channels and ponds within the stream area. No adults have been found to be living permanently in ponds isolated from the main stream.

Arundo impacts: *Minimal impacts.*

Status/Distribution or Historic and Current Range:
Historically they were distributed throughout southern California, but are now restricted to the upper Santa Clara River and its tributaries in northern Los Angeles and Ventura Counties, San Antonio and Canada Honda creeks on Vandenberg Air Force Base in Santa Barbara County, and San Felipe Creek in San Diego County. The Canada Honda and San Felipe Creek populations were transplanted.

Arundo impacts: *Arundo and stickleback overlap in distribution (Appendix B).*

Decline and Threats:
Habitat degradation from flood control and channelization are the primary threats to the unarmored three-spine stickleback. Habitat degradation also occurs from trampling of stream banks by humans and livestock, causing increased soil erosion and sedimentation which reduces availability of plants and insects for habitat and food. Damage to emergent vegetation along stream banks degrades the nursery areas. Stream channelization allows increased water velocity in pools, eliminates shallow backwaters and reduces aquatic vegetation. Channelization also increases peak flows during floods, and large flood events scour the channel and wash stickleback individuals downstream. Urbanization has caused a degradation of water quality due to increased run-off, siltation, nutrients, pesticides and other pollutants. These pollutants affect the health of the sticklebacks and can cause deformities. Introduced predators and competitors negatively affect the stickleback by directly removing individuals or restricting them to habitats that predators cannot enter. Other threats to the stickleback include genetic introgression, agricultural impacts, oxygen reduction, groundwater removal, possibly water loss due to transpiration from increase plant growth, and off-road vehicle use.

Arundo impacts: *Arundo stands on floodplains can create many of the same hydrologic and flow conditions as man-made channelization such as faster flows, high erosion within channels, etc. These factors may contribute to the sticklebacks decline by decreasing the elevation and channel complexity that stickleback may prefer over a simple deeper channel form. These factors are more relevant in the lower portions of the sticklebacks' range on the Santa Clara.*

Overall impact metric for *Arundo* on unarmored three-spine stickleback: Very high, score of 8.

Interaction of *Arundo* distribution and unarmored three-spine stickleback occurrence is presented by watershed in Table 7-3 and Appendix B.

Sources:
Unarmored Threespine Stickleback Recovery Plan (Revised), U.S. Fish and Wildlife Service, Portland, Oregon, 1985.
Biological and Conference Opinions for Annual Removal of Giant Reed and Tamarisk in Upper Santa Clara River Watershed, Los Angeles county, CA (File No. 2004-01540-AOA)(1-8-06-F-5).

7.2.15 Southern Steelhead (*Oncorhynchus mykiss*)

Southern California Distinct Population Segment (DPS)
Federal status: Endangered August 18 1997. Critical habitat was designated on September 2 2005.
South-Central California Coast DPS
Threatened Jan 5 2006, Critical habitat designated September 9 2005.
Arundo impact score: 7

General Ecological Needs/Habitat Affinities:
Southern steelhead can survive a wide range of temperature conditions, but require streams with adequate dissolved oxygen. Adult steelhead migrate from the ocean to freshwater spawning grounds. Spawning habitat consists of gravel substrates free of excessive silt. Adults do not feed during their upstream journey, rather use their energy reserves. Once they are large enough, smolts migrate downstream to the ocean, and to successfully complete this journey they require refuge areas with good cover and water quality.
Riparian vegetation provides cover and protection from predators and areas of refuge from high velocities. Riparian vegetation is also important in maintaining low stream temperature, stabilizing banks, and providing food sources for migrating steelhead. To provide these benefits, riparian vegetation needs high vigor, density, and species diversity, including a mixture of canopy trees, brush and grasses. Areas of lowered velocity or reverse flow areas within the channel allow steelhead to use energy reserves efficiently during migration in order to save energy for spawning. Sediment removal of sandbars reduces flow-field complexity, particularly of edgewater eddies and low velocity zones. This likely results in adult steelhead migrating through higher velocities and consuming higher levels of reserved energy. If too much reserved energy is consumed, and sufficient resting pools are not available, adults could be unable to reach spawning grounds, or have less energy for reproductive development. Furthermore, modification of sandbars and velocities could also simply increase the amount of time it takes for steelhead to reach spawning grounds. Removing and/or altering sandbars also reduces the convergence of flows through pools, thus reducing the processes that maintain pools. Pools provide cover and refuge. During the upstream migration steelhead rest in pools and during downstream migration smolts take refuge in pools during the day. Adults and smolts both require adequate flows for migration; they need enough water flow to travel up and down the river/stream, and to keep the river mouth open to the ocean.
Steelhead metabolism can be impacted by high water temperatures and the associated reduction in dissolved oxygen. Temperatures above 20° C have been known to stop fish migration, and temperatures above 25° C can be lethal to salmon and trout. High levels of suspended sediment (e.g. 3,000-4,000 mg/L), generally the result of large storm events or channel grading activities, can significantly impact fish migration and survival. Fish can suffer from gill abrasion and reduced visibility, and suffer mortality after exposure of two or more days. Fish at the mouth of a river would be delayed 1-2 days until the initial flush of sediment passes after a storm.

Arundo impacts: *Arundo has a significant number of impacts on river systems- some of which are negative and others that may be positive. Arundo typically occurs in areas that steelhead pass through so impacts to migration are important to explore. Arundo is not good at stabilizing eroding banks stands and clumps break off and are undercut by flows. This may increase erosion rates locally. Arundo does form dense stands of vegetation on floodplains. These dense stands create conditions that deepen low flow channels and push systems to single thread form in comparison to more complex braided systems or broader shallow systems. This single deep channel may aid migration of steelhead. However, single thread narrow channels have higher velocity and fewer areas to rest; this could be a detriment. Single thread channels also tend to transport (carry) greater suspended loads under a larger*

range of flow events. This could also be a detriment to steelhead, particularly if there a large number of sediment inputs (such as agricultural inputs or other disturbed sites). Highly invaded systems may have Arundo water use that reduces duration of surface flows- this would be a severe impact to steelhead. Water use may be lower at the time of year when fish migration occurs, partially offsetting transpiration rates. Arundo biomass could be a significant stressor as both a physical hindrance to passage and as a contamination in the water column. Water temperature impacts for portions of the habitat where fish passage is occurring are extremely difficult to quantify. It is not clear that large systems would have significant shading of the channel from mature gallery trees. Arundo shades a narrow band of the bank if the low flow channel is directly adjacent to the bank. More complex, but probably more relevant is water depth which may be strongly affected by Arundo stands (by effecting channel depth- chapter 5). Shading would be more relevant in upper portions of the watersheds where fish develop; these areas do not typically have Arundo in them.

Breeding/Life History:
Adult steelhead migrate from the ocean into freshwater streams to spawn between December and April. Female steelhead dig a nest in a stream area with suitable gravel composition, water depth, and velocity. Females may deposit eggs in four to five nests. Steelhead eggs hatch three to four weeks after being deposited. Juvenile steelhead typically spend one to two years rearing in freshwater before migrating to estuarine areas as smolts and then into the ocean to feed and mature. The majority of smolts enter the ocean at age two in March and April. They migrate at night and seek refuge and feed during the day. Steelhead can then remain at sea for up to three years before returning to fresh water to spawn.

Arundo impacts: *Arundo impacts on migration have been reviewed. Arundo debris in estuaries and Arundo effects on sediment movement could degrade estuarine habitat where smolts reside prior to entering the ocean.*

Diet:
Young steelhead fry feed mostly on zooplankton. Adult steelhead eat aquatic and terrestrial insects, mollusks, crustaceans, fish eggs, minnows, and other small fishes.

Arundo impacts: *Little impact as Arundo is not typically present or abundant in the upper portions of watersheds where juveniles develop. There could be greater impacts on Ventura River, Estero Bay and Santa Ynez, but spawning grounds are not clearly indicated on data sets.*

Status/Distribution or Historic and Current Range:
Steelhead within the Southern California DPS includes all naturally spawned anadromous steelhead populations below natural and manmade impassable barriers in streams from the Santa Maria River, San Luis Obispo County, California, to the U.S.-Mexico Border. South-Central California Coast DPS includes all naturally spawned anadromous steelhead from the Pajaro River (inclusive) to, but not including, the Santa Maria River, California. An estimated 30,000 - 50,000 steelhead once spawned in southern California rivers, but the recent runs in four major river systems were made by fewer than 500 adults total. Steelhead could once be found in 46 watersheds in the region, but only remained in 17 - 20 drainages by 2002. Many of these creeks and rivers now sustain only the resident form of steelhead, rainbow trout. Anadromous steelhead currently occur in only four large river systems in southern California: the Santa Maria, Santa Ynez, Ventura, and Santa Clara rivers. But periodic sightings have occurred on San Mateo (San Juan HU) and the San Luis Rey River.

Arundo impacts: *Arundo occurs in abundance on several critical watersheds and may occur on portions of spawning areas on a subset (Appendix B).*

Decline and Threats:
Decline is due to long-standing human induced factors such as lack of flows due to groundwater pumping, dams and water diversions, blocked access to historic spawning and rearing areas upstream of dams, and channel modification.

Arundo impacts: *Arundo has significant impacts on water use, channel form, and sediment transport. These are complex hydro geomorphic processes explored in chapter 5. Most impacts would appear to be strongly negative, others could facilitate migration.*

Overall impact metric for *Arundo* on the southern steelhead: High impact, score of 7.

Interaction of *Arundo* distribution and southern steelhead occurrence is presented by watershed in Table 7-3 and Appendix B.

Sources:
Programmatic Biological Opinion for the United States Army, San Francisco District Corps of Engineers' permit pursuant to 404 of the Clean Water Act for Monterey County Water Resources Agency regional General Permit for the Salinas River Channel Maintenance Program; National Marine Fisheries Service, Southwest Region, Long Beach CA. July 2003.

7.2.16 Santa Ana Sucker (*Catostomus santaanae*)

Federal status: Endangered, April 12 2000. Critical habitat has not been designated.
State status: Species of special concern.
Arundo impact score: 6

General Ecological Needs/Habitat Affinities:
The sucker is fairly general in its habitat requirements, occupying both low-gradient, lowland reaches, and high-gradient, mountain streams. The sucker seems to do best in small to medium streams with higher gradients, clear water, and coarse substrates, such as the east fork of the San Gabriel River. Flowing water is essential, but can vary from slight to swift. It is typically associated with gravel, cobble, and boulder substrates, although it is also found over sand and mud substrates.

Arundo impacts: *Arundo abiotic impacts are of particular concern for the sucker, particularly high water use and modification of geomorphology and sediment transport on the Santa Ana. Arundo is not abundant in the low channel areas where fish occur. The Los Angeles River is steeper in gradient and Arundo, though present, is not abundant enough to significantly impact water availability and fluvial processes.*

Breeding/Life History:
They live three to four years, but reach sexual maturity in one year and have high fecundity. Spawning generally occurs from late March to early July, with the peak in May and June.

Arundo impacts: *Probably low impact- but water use and drying of pools/stream sections could be a factor in some portions of the Santa Ana.*

Diet:
The sucker feeds mostly on algae, diatoms, and detritus scraped form rocks and other hard substrate. Aquatic insects comprise only a small part of their diet.

Arundo impacts: *Probably low impact- but water use and drying of pools/stream sections could be a factor in some portions of the Santa Ana.*

Movement:
Little is known about sucker movements, however other species in the same family are known to be high vagile and undertake spawning migrations.

Arundo impacts: *Probably low impact- but water use and drying of pools/stream sections could be a factor in some portions of the Santa Ana. Modification of sediment transport and fluvial processes would also affect channel forms and movement.*

Status/Distribution or Historic and Current Range:
Historically the sucker occupied the Los Angeles, San Gabriel, and Santa Ana Rivers from near the Pacific Ocean to their uplands. It was described as common in the 1970s, but has since experienced declines throughout most of its range, and now persists in isolated, remnant populations. Approximately 70-80% of its historic range in the Los Angeles, San Gabriel and Santa Ana Rivers has been destroyed. Currently the sucker is found 1) in portions of Big Tujunga Creek between the Big Tujunga and Hansen dams along the Los Angeles River, 2) in the west, east and north forks of the San Gabriel River above Morris Dam, and 3) reaches of the Santa Ana River between the city of San Bernardino and the vicinity of Anaheim. There is also a population of suckers in the Santa Clara River that is thought to be introduced and that has hybridized with the Owen's sucker, so it is not included within the range of the native sucker.

Arundo impacts: *Arundo significantly overlaps with the Santa Ana population and to a lesser degree the Los Angeles River population (Appendix B). There is also a hybridized population on the Santa Clara that may be introduced. There is significant Arundo within this populations range. The Santa Clara watershed is given a distribution score (Appendix B) but it is lowered to reflect the questionable genetic integrity of the resident population. If revisions to the Santa Clara's population value are made a higher impact interaction score should be given.*

Decline and Threats:
Threats that have contributed to the decrease in the sucker include 1) destruction and degradation of habitat through urbanization, channelization, flood control structures, water diversion, water withdrawal, and water quality reduction, 2) direct loss of suckers due to water diversion, 3) competition and predation from non-native species, and 4) loss of connectivity.

Overall impact metric for *Arundo* on the Santa Ana sucker: Moderate/High, score of 6.

Interaction of *Arundo* distribution and Santa Ana sucker occurrence is presented by watershed in Table 7-3 and Appendix B.

Sources:
Biological Opinion on the Prado Mainstem and Santa Ana River Reach 9 Flood Control Projects and Norco Bluffs Stabilization Project, Orange, Riverside, and San Bernardino Counties, California; U.S> Fish and Wildlife Service, Carlsbad, CA, December 2005.

7.2.17 San Joaquin Kit Fox (*Vulpes macrotis mutica*)

Federal status: Endangered, March 11, 1967. No critical habitat has been designated.
State status: Threatened, June 27, 1971.
Arundo impact score: 1

General Ecological Needs/Habitat Affinities:
This species historically inhabited grassland, scrubland, and wetland communities in the San Joaquin Valley and adjacent habitat. Today kit foxes are found in grassland and scrubland communities, most of which have been extensively modified by humans.

Kit foxes use dens for temperature regulation, shelter from adverse weather and protection from predators. They either dig their own dens, use those constructed by other animals, or use human-made structures (culverts, abandoned pipelines, or banks in sumps or roadbeds). Kit foxes often change dens and many dens may be used throughout the year. The majority of their dens lie in relatively flat terrain or gently sloping hills, in washes, drainages, and roadside berms.

Arundo impacts: *Arundo is not abundant within the habitat occupied by foxes. However, it does degrade the habitat as foxes prefer very open habitat with little or no vegetation structure to avoid predation. Arundo creates structure and may interact with dens that occur on washes.*

Breeding/Life History:
Kit foxes can breed when one year old. Adult pairs stay together all year. During September and October, females begin to clean and enlarge their pupping dens. Mating occurs between December and March. Litters of two to six pups are born in February or March. Pups emerge from the den after about a month.

Arundo impacts: *Very minor impacts related to potentially higher predation and lower denning quality.*

Diet:
Kit fox eat small mammals such as mice, kangaroo rats, squirrels and rabbits. They also eat ground-nesting birds and insects. They are primarily nocturnal hunters.

Arundo impacts: *No impact likely.*

Movement:
The kit fox is mostly nocturnal, but can be active in the daytime during cool weather. Home ranges of approximately one to twelve square miles have been reported. Development has significantly degraded movement and dispersal corridors for young kit foxes. Juvenile survival and successful dispersal has been declining in recent years. Three occurrences of kit fox movement have been documented between the Salinas-Pajaro region and the Carrizo Plain Natural Area. Although the total movement of kit foxes between these areas is unknown, land development along the natural movement corridors between Carrizo Plain and the Salinas Valley, as well as development within Salinas Valley has probably reduced immigration of kit foxes into the Salinas Valley, possibly contributing to their decline.

Arundo impacts: *Dense Arundo stands may inhibit movement to new areas as kit foxes prefer open areas. Riparian corridors are extremely important for movement of wildlife. Foxes may use roads as alternate corridors if riparian zones are overly vegetated (Arundo), leading to increased mortality from vehicles. Arundo is not abundant enough on the upper Salinas to significantly discourage use of riparian habitat as a corridor- but migration and use of riparian habitat downstream (north) in Salinas valley could be reduced by Arundo, particularly below King City where Arundo cover is very high.*

Status/Distribution or Historic and Current Range:
In the San Joaquin Valley before 1930, the range of the San Joaquin kit fox is believed to have extended from southern Kern County north to Contra Costa County on the west side and near La Grange, Stanislaus County, on the east side. Until the 1990s, Tracy was the farthest northwest record, but now there are records from the Antioch area of Contra Costa County. By 1930, the kit fox range had been reduced by more than half, with the largest portion remaining in the southern and western parts of the Valley. By 1958, an estimated 50% of the Valley's original natural communities had been lost, due to extensive land conversions, intensive land uses, and the use of pesticides. In 1979, only about 6.7% of the San Joaquin Valley's original wildlands south of Stanislaus County remained untilled and undeveloped. Today many of these communities are represented only by small, degraded remnants. Kit foxes are, however, found in grassland and scrubland communities, which have been extensively modified by humans with oil exploration, wind turbines, agricultural practices and/or grazing. The kit fox population is fragmented, particularly in the northern part of the range.

Arundo impacts: *Arundo and foxes co-occur in the Salinas watershed (Appendix B).*

Decline and Threats:
Kit foxes are subject to competitive exclusion or predation by other species, such as the nonnative red fox, coyote, domestic dog, bobcat, and large raptors. Loss and degradation of habitat by agricultural, industrial, and urban developments and associated practices continue, decreasing the carrying capacity of remaining habitat and threatening kit fox survival. Such losses contribute to kit fox declines through displacement, direct and indirect mortalities, barriers to movement, and reduction of prey populations.

Overall impact metric for *Arundo* on the San Joaquin kit fox:
Extremely low/improbable, score of 1. If high quality habitat was identified north of Salinas range where Salinas River could serve as a corridor, then Impact score should be increased.

Interaction of *Arundo* distribution and the San Joaquin kit fox occurrence is presented by watershed in Table 7-3 and Appendix B.

Sources:
Programmatic Biological Opinion for the United States Army, San Francisco District Corps of Engineers' permit pursuant to 404 of the Clean Water Act for Monterey County Water Resources Agency regional General Permit for the Salinas River Channel Maintenance Program; National Marine Fisheries Service, Southwest Region, Long Beach CA. July 2003.
Species Account SAN JOAQUIN KIT FOX (*Vulpes macrotis mutica)*, U.S. Fish & Wildlife Service, Sacramento Fish & Wildlife Office.

7.2.18 San Diego Ambrosia (*Ambrosia pumila*)

Federal status: Endangered, July 2 2002. Final critical habitat designated November 30 2010.
State status: None?
Arundo impact score: 7

General Ecological Needs/Habitat Affinities:
Ambrosia pumila is a perennial herb in the sunflower family (Asteraceae). It occurs primarily on upper terraces of rivers and drainages. Within these areas, the species is found in open grassland of native and nonnative plant species, and openings in coastal sage scrub, and primarily on sandy loam or clay soils. The species may also be found in ruderal habitat types (disturbed communities containing a mixture of

native and non-native grasses and forbs) such as fire fuel breaks and edges of dirt roadways. Non-native grassland and ruderal habitat types provide adequate habitat for *A. pumila*; however, non-native plants can out-compete *A. pumila* plants for resources in some situations. *Ambrosia pumila* consistently occurs in areas near waterways such as upper terraces of rivers or other water bodies. These areas do not necessarily provide high levels of soil moisture, and *A. pumila* is adapted to dry conditions. *A. pumila* may require periodic flooding for some segment of its life cycle. Additionally, areas subject to periodic flooding may be less amenable to competing non-native and native plants. *A. pumila* is a clonal herbaceous perennial plant that spreads vegetatively by means of slender, branched, underground root like rhizomes from which new aboveground stems (aerial stems or ramets) arise each year. Aerial stems of *Ambrosia pumila* sprout from their underground rhizomes in early spring after winter rains, and flower between May and October. However, aerial stems have been observed sprouting under dry conditions in late fall. The aerial stems senesce after the growing season, leaving the rhizome system in place from which new aerial stems may sprout when environmental conditions are appropriate. Little is known about its reproductive system, but it is presumed to be wind-pollinated. It is thought to have limited sexual reproductive output due to low production of viable seed. The dispersal strategy of *A. pumila* is unknown and the seeds lack structures that facilitate dispersal by wind or passing animals. It may depend on periodic flooding of nearby waterways for dispersal of seeds and rhizomes that can produce new aerial stems. The longevity of individual plants and of seeds, and the potential for buried seed banks to develop in the soil are unknown.

Arundo impacts: *Arundo and A. pumila overlap in range and in habitat. This creates the potential for direct competition and for impacts related to water use, fire and modification of geomorphic processes. These are slightly mitigated by the fact that ambrosia is present in the higher elevation portions of the riparian zone- higher terraces and transition/eco-tones with scrub and grass lands. Arundo debris may cover plants habitat. Arundo fires may result in take and or type conversion. Modified flood and sediment transport may decrease habitat fitness and interfere with seed dispersal of ambrosia.*

Status/Distribution or Historic and Current Range:
Ambrosia pumila is distributed in southern California from northwestern Riverside County, south through western San Diego County, to northwestern Estado de Baja California, Mexico. It is generally found at or below elevations of 487 m (1,600 ft) in Riverside County, and 183 m (600 ft) in San Diego County. At the time of listing, 15 native occurrences of *A. pumila* were considered extant in the United States: 3 in Riverside County and 12 in San Diego County (native is used here to differentiate these from occurrences derived from plants translocated to another site).

Arundo impacts: *Ambrosia is present on highly invaded watersheds, specifically San Diego and San Luis Rey (Appendix B). The strong overlap in range makes larger scale impacts to ambrosia relevant. On Santa Ana one population near Lake Elsinore appears to above the river and little Arundo is present up stream or nearby. The other Santa Ana population is historic (1940), but is near large Arundo infestations on the main river. If new populations were found there could be greater potential for impacts on Santa Ana.*

Decline and Threats:
Loss and degradation of *Ambrosia pumila* habitat is the result of development, non-native plants, fuel modification, altered hydrology and fragmentation. Development results in direct loss of habitat. Competition from non-native plants, primarily non-native grasses and forbs, pose a significant threat to the species throughout its range. No research has been done to clarify the specific effects of non-native plants on *Ambrosia pumila*, but a recent study by the Center for Natural Lands Management in San Diego County demonstrated that reduction of non-natives increased percent cover of *Ambrosia pumila.* Fuel modification activities that can negatively affect *Ambrosia pumila* include weed abatement, fire

suppression, and landscaping practices (including mowing, discing, and plowing). Altered hydrology has the potential to impact *Ambrosia pumila.* It almost always occurs on the upper terraces of rivers/streams or near the margins of vernal pools, where under natural conditions the plants would likely be subjected to inundation during large-scale flooding events. If *Ambrosia pumila* is dependent on these periodic flooding events for some aspect of its life history (e.g., seed germination, dispersal) or control of competing plants, altering the flooding regimes of associated waterways or vernal pools could have a significant impact on the species. However, it is unknown if and to what degree *Ambrosia pumila* is dependent upon periodic flooding or other aspects of its proximity to waterways.

Overall impact metric for *Arundo* on the San Diego ambrosia: High impact, score of 7.

Interaction of *Arundo* distribution and San Diego ambrosia occurrence is presented by watershed in Table 7-3 and Appendix B.

Sources:
Ambrosia pumila (San Diego ambrosia) 5 Year Review and Summary, US Fish and Wildlife Service, Carlsbad Office, CA, July 15 2010. http://ecos.fws.gov/docs/five_year_review/doc3557.pdf

7.2.19 Marsh Sandwort (*Arenaria paludicola*)

Federal status: Endangered, August 3, 1993. Critical habitat has not been designated.
State status: Endangered, February 1990.
Arundo impact score: 4

General Ecological Needs/Habitat Affinities:
Marsh sandwort is an herbaceous green perennial in the Caryophyllaceae family that is often supported by surrounding vegetation. The trailing stems often root at the nodes and can be up to 1 m long. The opposite leaves are lanceolate and narrowly sharp pointed with a solitary mid-vein. It blooms from May to August. Flowers are small, white and borne singly on long stalks. Marsh sandwort is found in freshwater marshes from elevations to about 1,476 ft (450 m) with saturated soils and acidic bog soils, predominantly sandy with high organic content. Vegetation around the Black Lake Canyon population includes emergent freshwater marsh species and some riparian woodland or wetland tree species, mainly willow and wax myrtle. The two existing populations of marsh sandwort in San Luis Obispo County are found in freshwater marshes located within a system of active to partly-stabilized sand dunes.

Arundo impacts: *Minor impacts on the upper Santa Ana to a very old historic sighting (1899).*

Status/Distribution or Historic and Current Range:
Historically it has been collected by botanists from scattered locations near the Pacific coast in southern and central California and Washington. Only two of California's seven historical populations are known to exist today, near the southern San Luis Obispo County coast at Black Lake Canyon on Nipomo Mesa and at Oso Flaco Lake further south.

Arundo impacts: *Only one historic signing on Santa Ana River (Appendix B).*

Decline and Threats:
Immediate threats to the survival of marsh sandwort include habitat destruction, habitat degradation, and competition with non-native species for light, nutrients and space.

Arundo impacts: *Arundo would be a stressor and competitor if it were re-discovered on the Santa Ana River.*

Overall impact metric for *Arundo* on the marsh sandwort: Low/moderate impact, score of 4.

Interaction of *Arundo* distribution and marsh sandwort occurrence is presented by watershed in Table 7-3 and Appendix B.

Sources:

Recovery Plant for marsh sandwort (*Arenaria paludicola*) and Gambel's watercress (*Rorippa gambelii*). U.S. Fish and Wildlife Service, Portland, Oregon, 1998.

7.2.20 San Jacinto Valley Crownscale (*Atriplex coronata* var. *notatior*)

Federal status: Endangered, October 1998. Critical habitat has not been designated.
State status: none
Arundo impact score: 7

General Ecological Needs/Habitat Affinities:

San Jacinto Valley crownscale is an annual plant in the goosefoot family (Chenopodiaceae). It grows 4 to 12 inches (30.5 cm) tall with grayish colored leaves. The plant generally flowers in April and May. This bushy plant can have one or several gray-green stems, which turn deep yellow as it grows older and dies. San Jacinto Valley crownscale is restricted to highly alkaline and silty-clay soils. These soils are found in certain alkali sink scrub, alkali playa, vernal pool, and annual alkali grassland habitats. Habitat for San Jacinto Valley crownscale is typically flooded during winter rains and the plant emerges as waters recede in the spring.

Arundo impacts: *Crownscale does occur in wash areas/floodplain on Alberhill Creek north of Lake Elsinore, where significant Arundo stands also occur. Therefore the two species interact and compete with each other for resources and space.*

Status/Distribution or Historic and Current Range:

San Jacinto Valley crownscale has a narrow range of distribution and is only known to occur in western Riverside County. Within western Riverside County, there are four general population centers of the plant – in the floodplain of the San Jacinto River at the San Jacinto Wildlife Area/Mystic Lake; in the San Jacinto River floodplain between the Ramona Expressway and Railroad Canyon Reservoir; in the Upper Salt Creek Vernal Pool Complex in the west Hemet area; and in the floodplain of Alberhill Creek north of Lake Elsinore. The San Jacinto Valley crownscale experienced a severe decline between 1992 and 1999, when it lost 70 % of its population; it continues to decline today. Because floodwaters carry crownscale seeds over long distances, population ranges may shift from year to year.

Arundo impacts: *As shown in Appendix B Arundo and San Jacinto Valley crownscale overlap in range. Closer examination of polygon data shows clear co-occurrence within the riparian areas.*

Decline and Threats:

The San Jacinto Valley crownscale is in particular danger from increased urbanization because its habitat is nearly flat and therefore easy to develop. It is also threatened by habitat fragmentation, agricultural weed-control measures where its habitat is repeatedly disked, off-road vehicle use, alteration of hydrology, deliberate manure and sludge dumping, trampling by livestock, and competition from nonnative species.

Arundo impacts: *The sites have all of these impacts: agricultural use, urban use, water management facilities. Arundo adds to the population's stress by directly competing against it. Arundo is also dense enough to add biomass debris over crownscale habitat following flood events. Fire could also impact habitat and sedimentation. Of added concern is response to fire and flood events that are of greater magnitude due to high Arundo cover. The area has heavy infrastructure (roads, water transfer, levees, agriculture use, etc.) that would likely lead to damaging emergency actions in response to events.*

Overall impact metric for *Arundo* on the San Jacinto Valley crownscale: High Impact, score of 7.

Interaction of *Arundo* distribution and San Jacinto Valley crownscale occurrence is presented by watershed in Table 7-3 and Appendix B.

Sources:

Species Profile for San Jacinto Valley crownscale (*Atriplex coronata notatior*), U.S. Fish and Wildlife Service, http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=Q2ZR

7.2.21 Nevin's Barberry (*Berberis nevinii)*

Federal status: Endangered, October 13, 1998. Critical habitat designated on February 13 2008.
State status: Endangered, January 1987.
Arundo impact score: 4

General Ecological Needs/Habitat Affinities:

Nevin's barberry is a large rounded shrubby member of the barberry family (Berberidaceae) that grows up to 13 ft (4 m) tall, with blue-green, spiny pinnate leaves. It is widely cultivated and popular in xeric gardens, in part for its bright red edible berries and bright yellow flowers that bloom March through April. Nevin's barberry generally grows within sandy, gravelly soil, on north facing slopes or low gradient washes. On north-facing slopes, it is associated with coastal scrub and chaparral habitat, while in low gradient washes it is found in alluvial and riparian scrub. In general, the plant occurs from 800-5200 ft (1,585 m) above sea level, with local distribution potentially related to the presence of groundwater. Associated plant communities are alluvial scrub, riparian scrub or woodland, coastal sage scrub, chaparral, and/or oak woodland.

Arundo impacts: *Arundo occurs within population ranges of barberry when plants are located within low gradient washes. These are not usually areas where Arundo becomes overly abundant, but it be locally abundant. Direct competition between plants as sites could occur. Abiotic impacts are unlikely due to limited extent of Arundo upstream of washes where barberry occurs.*

Status/Distribution or Historic and Current Range:

The distribution of Nevin's barberry is scattered, with populations located throughout southern California in Los Angeles, Riverside, and San Bernardino counties. There have been a total of 34 occurrences of *Berberis nevinii* reported in southern California, five of which have been or are presumed extirpated and 7 considered to have been introduced. Total number of individuals is estimated at 500, with approximately half of those as naturally occurring individuals. In addition, the majority of occurrences are comprised of only one to few individuals, with little to no reproduction observed.

Arundo impacts: *Arundo and barberry co-occur in Santa Clara (Arundo is scattered to dense), and several area on the Los Angeles and San Gabriel Rivers (Arundo is scattered, Appendix B).*

Decline and Threats:
Population decline is likely related to low fecundity and habitat loss. Populations that occur in alluvial washes are threatened by urban and agricultural development, competition by non-native plant species, off-road vehicle activity, road maintenance, and vegetation clearing and channelization for flood control. While population sizes vary considerably among extant groups, the majority of occurrences are comprised of only one to a few individuals, with little to no reproduction observed. Most of the historic habitat of Nevin's barberry has been eliminated by agriculture, urban development, and flood control and stream channelization.

Overall impact metric for *Arundo* on the Nevin's barberry: Low/moderate impact, score of 4.

Interaction of *Arundo* distribution and Nevin's barberry occurrence is presented by watershed in Table 7-3 and distribution is shown in Appendix B.

Sources:
Stillwater Sciences. 2007. Focal Species Analysis and Habitat Characterization for the Lower Santa Clara River and Major Tributaries, Ventura County, California. Santa Clara River Parkway Floodplain Restoration Feasibility Study.
Center for Plant Conservation, National Collection Plant Profile for Nevin's Barberry, http://www.centerforplantconservation.org/collection/cpc_viewprofile.asp?CPCNum=2777

7.2.22 Spreading Navarretia (*Navarretia fossalis*)

Federal status:	Threatened, October 13 1998. Critical habitat: October 18 2005. A proposal for revised critical habitat was initiated on June 10 2009.
State status:	None
Arundo impact score:	6

General Ecological Needs/Habitat Affinities:
Spreading navarretia is an annual plant in the Polemoniaceae (phlox family). It is a low, mostly spreading or ascending plant 4 - 6 inches (10 - 15 cm) tall. The leaves are long and finely divided into slender spine-tipped lobes and the lavender-white flowers are arranged in flat-topped, compact, leafy heads. Each seed is covered by a layer that becomes sticky and viscous when the capsule is moistened. Spreading navarretia is typically found in vernal pool (seasonal depression wetlands) habitat, particularly in Los Angeles and San Diego Counties. In western Riverside County, however, *Navarettia fossalis* is associated with seasonally flooded alkali vernal plain habitat that includes alkali playa (highly alkaline, poorly drained), alkali scrub, alkali vernal pool, and alkali annual grassland components. *Navarretia fossalis* depends on the inundation and drying cycles of its habitat for survival. It germinates from seeds left in the seed bank. Most *Navarretia* species have indehiscent fruit, or fruit with fibers that absorb water and expand to break open the fruit after a substantial rain. The timing of germination is important so that the plant germinates under favorable conditions in the spring rather than the summer, autumn, or winter. *Navarretia fossalis* abundance also varies from year to year depending on precipitation and the inundation/drying time of the vernal pool. The occurrences of plants can also vary spatially in alkali playa habitat where pools are not in the same place from year to year. After germination, the plant usually flowers in May and June as the vernal pool is devoid of water. The plant then produces fruit, dries out, and senesces in the hot, dry summer months.

Arundo impacts: *Although navarretia habitat sounds restrictive Arundo co-occurs with the Riverside San Jacinto Valley navarretia population (Appendix B). This area is a broad floodplain and is the same area where San Jacinto crownscale is found. This area has a narrow river thread heavily invaded with*

Arundo bordered by flat floodplains. Impacts described in the crownscale section ally to this species as well (risk of fire, Arundo debris, flood damage and 'emergency actions' to repair and protect infrastructure.

Status/Distribution or Historic and Current Range:
Spreading navarretia extends from northwestern Los Angeles County to western Riverside County, and coastal San Diego County in California, to San Quintin in northwestern Baja California, Mexico.

Arundo impacts this by: *As noted these species co-occur in San Jacinto Valley (Appendix B).Populations of navarretia that occur in San Diego County watersheds typically occur in vernal pools where Arundo is not present. The Santa Clara navarretia population also occurs in a vernal pool.*

Decline and Threats:
Threats include agriculture, fragmentation, grazing and urbanization.

Overall impact metric for *Arundo* on spreading navarretia: Moderate/high Impact, score of 6.

Interaction of *Arundo* distribution and spreading navarretia occurrence is presented by watershed in Table 7-3.

Sources:
Center for Plant Conservation, National Collection Plant Profile for spreading navarretia, http://www.centerforplantconservation.org/collection/CPC_ViewProfile.asp?CPCNum=2930
5-Year Review for spreading navarretia (*Navarretia fossalis*) U.S. Fish and Wildlife Service, http://ecos.fws.gov/docs/five_year_review/doc2574.pdf

Table 7-3. Examination of *Arundo* impacts on federally listed species by watershed.
'*Arundo* impact rank' and 'overlap rank' (potential for interaction between *Arundo* and listed species distribution and abundance) for each species. The cumulative impact score is in Table 7-4.

Category	Federal Listing[1]	Scientific name	Common name	*Arundo* Impact	Tijuana Estuary	Otay	Sweet-water	S.Diego/ Penasquitos	San Dieguito	Carlsbad	San Luis Rey	Santa Margarita	San Juan	San Francisquito Crk/ Newport	Santa Ana	L.A./ San Gabriel/ Santa Monica	Calleguas	Santa Clara	Ventura	S.Barbara, SouthCoast &S.Ynez	Estero Bay	Salinas	S.Cruz/ Benito	Count
Amphibian	En	*Ambystoma californiense*	California tiger salamander[2]	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	2
Amphibian	En	*Bufo californicus*	Arroyo toad	10	-	-	5	3	7	-	10	10	7	7	-	3	-	4	-	-	-	2	-	10
Amphibian	Th	*Rana aurora draytonii*	California red-legged frog	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	2	5	2	3	5
Amphibian	En	*Rana muscosa*	Mountain yellow-legged frog	4	-	-	-	-	-	-	-	-	-	-	4	6	-	-	-	-	-	-	-	2
Bird	Th	*Charadrius alexandrinus nivosus*	Western snowy plover	5	1	1	1	6	-	8	-	9	-	-	0	4	0	1	-	1	-	-	-	9
Bird	Sp of Concern	*Coccyzus americanus occidentalis*	Western yellow-billed cuckoo	7	-	-	1	-	-	-	-	1	0	-	7	-	-	4	-	-	1	-	-	5
Bird	En	*Empidonax traillii extimus*	Southwestern willow flycatcher	8	-	-	2	2	3	2	10	10	3	-	6	1	-	2	-	2	-	-	-	11
Bird	Sp of Concern	*Passerculus sandwichensis beldingi*	Belding's savannah sparrow	2	3	3	3	3	3	3	-	-	-	2	2	2	6	-	-	2	-	-	-	11
Bird	Th	*Polioptila californica californica*	Coastal California gnatcatcher	2	3	3	3	3	3	3	4	4	3	4	4	2	2	1	-	-	-	-	-	14
Bird	En	*Rallus longirostris levipes*	Light-footed clapper rail	3	2	2	3	2	2	4	2	3	-	2	-	-	1	-	-	1	-	-	-	11
Bird	En	*Sterna antillarum browni*	California least tern	4	-	1	-	3	2	4	-	7	-	1	-	1	-	1	-	-	-	-	-	8
Bird	En	*Vireo bellii pusillus*	Least Bell's vireo	9	4	4	4	4	4	3	9	10	6	6	10	4	3	3	3	1	-	-	-	14
Fish	En	*Eucyclogobius newberryi*	Tidewater goby	7	-	-	-	-	-	4	8[a]	8[a]	-	-	-	-	3	6[a]	8	5	3	4	1	7
Fish	En	*Gasterosteus aculeatus williamsoni*	Unarmored three spine stickleback	8	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	1
Fish	En&Th[3]	*Oncorhynchus mykiss*	Steelhead	7	-	-	-	-	-	-	1	-	1	-	-	4	-	8	8	7	5	8	5	9
Fish	Th	*Catostomus santaanae*	Santa Ana sucker	6	-	-	-	-	-	-	-	-	-	-	9	7	-	4	-	-	-	-	-	3
Mammal	En	*Vulpes macrotis mutica*	San Joaquin kit fox	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1
Plant	En	*Ambrosia pumila*	San Diego ambrosia	7	-	2	-	-	7	-	7	-	-	-	2	-	-	-	-	-	-	-	-	4
Plant	En	*Arenaria paludicola*	Marsh sandwort	4	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
Plant	En	*Atriplex coronata var. notatior*	San Jacinto Valley crownscale	7	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	0
Plant	En	*Berberis nevinii*	Nevin's Barberry	4	-	-	-	-	-	-	-	-	-	-	-	5	-	3	-	-	-	-	-	2
Plant	Th	*Navarretia fossalis*	Spreading navarretia	6	-	-	-	-	-	-	-	-	-	-	10	-	-	1	-	-	-	-	-	1

[1] En = Endangered, Th = Threatened, Sp of Concern = Species of Concern
[2] Santa Barbara Distinct Population Segment (DPS)
[3] Southern California (DPS) is endangered, South-Central California Coast DPS is threatened.
[a] Recent historic 1990s/2000

Table 7-4. Cumulative impact scores for *Arundo* impacts on threatened and endangered species by watershed.
The cumulative impact score is calculated by multiplying the *Arundo* impact rank by overlap rank. Impact scores are for each watershed and species, and are totaled for each watershed and species.

Category	Federal Listing[1]	Scientific name	Common name	Tijuana Estuary	Otay	Sweet-water	S.Diego/ Penasquitos	San Dieguito	Carlsbad	San Luis Rey	Santa Margarita	San Juan	San Francisquito Crk/ Newport	Santa Ana	L.A./ San Gabriel/ Santa Monica	Calleguas	Santa Clara	Ventura	S.Barbara, SouthCoast &S.Ynez	Estero Bay	Salinas	S.Cruz/ Benito	Total
Amphibian	En	*Ambystoma californiense*	California tiger salamander[2]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	**6**
Amphibian	En	*Bufo californicus*	Arroyo toad	-	-	50	30	70	-	100	100	70	70	-	30	-	40	-	-	-	20	-	**580**
Amphibian	Th	*Rana aurora draytonii*	California red-legged frog	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24	6	15	6	9	**60**
Amphibian	En	*Rana muscosa*	Mountain yellow-legged frog	-	-	-	-	-	-	-	-	-	-	16	24	-	-	-	-	-	-	-	**40**
Bird	Th	*Charadrius alexandrinus nivosus*	Western snowy plover	5	5	5	30	-	40	-	45	-	-	-	20	-	5	-	5	-	-	-	**160**
Bird	Sp of Concern	*Coccyzus americanus occidentalis*	Western yellow-billed cuckoo	-	-	7	-	-	-	-	7	-	-	49	-	-	28	-	-	7	-	-	**98**
Bird	En	*Empidonax traillii extimus*	Southwestern willow flycatcher	-	-	16	16	24	16	80	80	24	-	48	8	-	16	-	16	-	-	-	**344**
Bird	Sp of Concern	*Passerculus sandwichensis beldingi*	Belding's savannah sparrow	6	6	6	6	6	6	-	-	-	4	4	4	12	-	-	4	-	-	-	**64**
Bird	Th	*Polioptila californica californica*	Coastal California gnatcatcher	6	6	6	6	6	6	8	8	6	8	8	4	4	2	-	-	-	-	-	**84**
Bird	En	*Rallus longirostris levipes*	Light-footed clapper rail	6	6	9	6	6	12	6	9	-	6	-	-	3	-	-	3	-	-	-	**72**
Bird	En	*Sterna antillarum browni*	California least tern	-	4	-	4	8	16	-	28	-	4	-	4	-	4	-	-	-	-	-	**72**
Bird	En	*Vireo bellii pusillus*	Least Bell's vireo	36	36	36	36	36	27	81	90	54	54	90	36	27	27	27	9	-	-	-	**702**
Fish	En	*Eucyclogobius newberryi*	Tidewater goby	-	-	-	-	-	-	56	56	-	-	-	-	21	42	-	35	21	28	7	**266**
Fish	En	*Gasterosteus aculeatus williamsoni*	Unarmored three spine stickleback	-	-	-	-	-	-	-	-	-	-	-	-	-	64	-	-	-	-	-	**64**
Fish	En&Th[3]	*Oncorhynchus mykiss*	Steelhead	-	-	-	-	-	-	7	-	7	-	-	28	-	56	56	49	35	56	35	**329**
Fish	Th	*Catostomus santaanae*	Santa Ana sucker	-	-	-	-	-	-	-	-	-	-	54	42	-	24	-	-	-	-	-	**120**
Mammal	En	*Vulpes macrotis mutica*	San Joaquin kit fox	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	**2**
Plant	En	*Ambrosia pumila*	San Diego ambrosia	0	14	-	-	49	-	49	-	-	-	14	-	-	-	-	-	-	-	-	**126**
Plant	En	*Arenaria paludicola*	Marsh sandwort	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	**4**
Plant	En	*Atriplex coronata var. notatior*	San Jacinto Valley crownscale	-	-	-	-	-	-	-	-	-	-	70	-	-	-	-	-	-	-	-	**70**
Plant	En	*Berberis nevinii*	Nevin's Barberry	-	-	-	-	-	-	-	-	-	-	-	20	-	12	-	-	-	-	-	**32**
Plant	Th	*Navarretia fossalis*	Spreading navarretia	-	-	-	-	-	-	-	-	-	-	60	-	-	6	-	-	-	-	-	**66**
			Total:	**59**	**77**	**135**	**134**	**205**	**123**	**387**	**423**	**161**	**146**	**417**	**220**	**67**	**326**	**107**	**127**	**78**	**115**	**54**	**3,361**

[1] En = Endangered, Th = Threatened, Sp of Concern = Species of Concern
[2] Santa Barbara Distinct Population Segment
[3] Southern California Distinct Population Segment (DPS) is endangered, South-Central California coast DPS is threatened.

Table 7-5. Cumulative *Arundo* impact score for each species for all watersheds combined, and sum and average for each taxa group.

Category	Federal Listing[1]	Scientific name	Common name	Cumulative Impact Score for all watersheds	Summary for Taxa Group
Amphibian	En	*Ambystoma californiense*	California tiger salamander[2]	6	Sum – 686 Ave – 171.5
Amphibian	En	*Bufo californicus*	Arroyo toad	580	
Amphibian	Th	*Rana aurora draytonii*	California red-legged frog	60	
Amphibian	En	*Rana muscosa*	Mountain yellow-legged frog	40	
Bird	Th	*Charadrius alexandrinus nivosus*	Western snowy plover	160	Sum – 1,596 Ave – 199.5
Bird	Sp of Concern	*Coccyzus americanus occidentalis*	Western yellow-billed cuckoo	98	
Bird	En	*Empidonax traillii extimus*	Southwestern willow flycatcher	344	
Bird	Sp of Concern	*Passerculus sandwichensis beldingi*	Belding's savannah sparrow	64	
Bird	Th	*Polioptila californica californica*	Coastal California gnatcatcher	84	
Bird	En	*Rallus longirostris levipes*	Light-footed clapper rail	72	
Bird	En	*Sterna antillarum browni*	California least tern	72	
Bird	En	*Vireo bellii pusillus*	Least Bell's vireo	702	
Fish	En	*Eucyclogobius newberryi*	Tidewater goby	266	Sum – 779 Ave – 194.8
Fish	En	*Gasterosteus aculeatus williamsoni*	Unarmored three spine stickleback	64	
Fish	En&Th[3]	*Oncorhynchus mykiss*	Steelhead	329	
Fish	Th	*Catostomus santaanae*	Santa Ana sucker	120	
Mammal	En	*Vulpes macrotis mutica*	San Joaquin kit fox	2	2
Plant	En	*Ambrosia pumila*	San Diego ambrosia	126	Sum – 298 Ave – 59.6
Plant	En	*Arenaria paludicola*	Marsh sandwort	4	
Plant	En	*Atriplex coronata var. notatior*	San Jacinto Valley crownscale	70	
Plant	En	*Berberis nevinii*	Nevin's Barberry	32	
Plant	Th	*Navarretia fossalis*	Spreading navarretia	66	
			Total:	**3,361**	

7.3 Results

7.3.1 Summary by Species and Group

7.3.1.1 Impact Scores

Within the study area, 22 federally protected species were found to be impacted at some level by the presence of *Arundo*. The magnitude of the impact score ranged from 10 (very severe) to 1 (very low/improbable) (Table 7-3). Five taxonomic groups are represented: amphibian, avian, fish, mammal, and plant. All groups have a minimum of four species with the exception of mammal, which had one.

Amphibians had the widest range of *Arundo* impact scores among the groups. Arroyo toads had severe impacts from *Arundo*, both abiotic and biotic. The other amphibian species (California tiger salamander, California red-legged frog, and mountain yellow-legged frog) were less impacted due to greater habitat use in foothills and mountains where *Arundo* is less abundant. In these areas, *Arundo* is less likely to directly impact the species or to generate enough biomass to degrade habitat significantly.

Avian species fell into two general classes based on the habitat they use. Species that use riparian habitat had impact scores that ranged from high (7) to severe (9), reflecting both abiotic and biotic impacts. This included the least Bell's vireo, southwestern willow flycatcher and yellow-billed cuckoo. Species that use estuary and beach areas were also impacted by *Arundo*, usually as a function of biomass accumulating in habitat areas (discharged from upstream riparian areas), but also to a lesser degree from *Arundo* growing in estuaries and on beaches. Avian species that use beach and estuary habitat had impact scores ranging from moderate (5) to very low (2), reflecting *Arundo* impacts on breeding and predation. In addition to these two classes, the gnatcatcher had a low impact score (2), because it does not breed or feed exclusively in riparian habitat. Avian species were also, as a group, susceptible to physical changes in habitat structure, encouraging predators that use *Arundo* as perches and/or dense cover for denning.

Fish species had fairly uniform impacts from *Arundo* related to modification of abiotic processes that control geomorphology and hydrology. Modification of channel form and depth is a significant change to habitat structure. *Arundo* biomass and shading also have possible effects on habitat quality. Fish habitat varies depending on the species. It may occur only near the river mouth (tidewater goby), reside along river/stream corridors (Santa Ana sucker, stickleback), or pass through the main river corridor to headwaters that are relatively uninvaded by *Arundo* (southern steelhead). Southern steelhead also reside for part of their life-cycle in estuaries. *Arundo* impact scores ranged from very high (8) to moderate/high (6).

The only federally listed mammal species examined was the San Joaquin kit fox, which resides in the northern part of the study area. It has a very low/improbable (1) impact score from *Arundo*. The kit fox does not utilize riparian habitat frequently, and is not dependent on it. It may use riparian areas as corridors for movement.

Water use, fire, biomass and modification of geomorphology are the primary *Arundo* impacts on the five plant species examined. Four of the plant species occur on upper portions of the riparian zone (San Diego ambrosia and Nevin's barberry) or broad areas within the floodplain (San Jacinto crownscale and spreading navarretia). These four species have *Arundo* impact scores ranging from high (7) to low/moderate (4). San Jacinto crownscale and spreading navarretia occur at a single location within the San Jacinto/Santa Ana watershed, so it is possible to look at very specific interactions for these two species. The fifth plant species, marsh sandwort, occurs in inland freshwater marsh. It is a historic occurrence, so *Arundo* impacts were projected to the species' habitat preferences. Although it is

unlikely that marsh sandwort still occurs at this location, *Arundo* is having abiotic and biotic impacts that degrade habitat characteristics favored by the plant.

7.3.1.2 Overlap or Spatial Interaction Scores

Overlap rank scores are given in Table 7-3. These were generated by interpreting distribution maps of *Arundo* and each listed species. Species occurring in downstream portions of the watersheds (river mouth, estuaries, beaches) can receive high scores if significant *Arundo* infestations occur upstream. Scores ranged from 1 (no interaction) to 10 (very high interaction).

Overlap scores captured the interaction between *Arundo* and each species' distribution and abundance. Avian species were the widest ranging, with high numbers of watersheds recording occurrences, particularly in the southern and middle of the study area. Fish species also had large numbers of watersheds with occurrences, but more in the middle and northern portions of the study area. Plants were the most restricted, each species typically occurring on only one or two watersheds.

7.3.1.3 Cumulative Impact Scores

The *Arundo* impact score is multiplied by the overlap score to generate a cumulative impact score for each species in each watershed. This metric highlights watersheds, species and taxa groups that are under the most significant pressure from *Arundo*. The avian group is the most impacted by *Arundo*, with a score of 1,596 (199.5 average). This is followed closely by amphibians at 686 (171.5 average). The plant group has the lowest score at 298 (59.6 average), largely due to very limited population ranges for the listed species. Mammals also rank very low, being represented by a single species with low abundance and low impacts from *Arundo*.

Several species stand out as having severe cumulative *Arundo* impact scores across the study area (Figure 7-1). The highest scoring species in the 'severe' category are the least Bell's vireo (702) and the arroyo toad (580). The southwestern willow flycatcher has a 'very high' cumulative impact score of 344. The three species are frequently cited as being under significant pressure from *Arundo* within their ranges. These data strongly supports these accounts.

The cumulative impact scores for the fish are 'very high' for two species (steelhead and tidewater goby), 'high' for the third (Santa Ana sucker) and 'moderate' for the fourth species (unarmored three spine stickleback). *Arundo* impacts on fish have not been recognized in the literature or explored in detailed studies. *Arundo*'s influence on abiotic processes indicates that significant impacts and degradation are likely occurring on heavily *Arundo* invaded watersheds.

The 'high' score for the western snowy plover (160) and the tidewater goby (266), and to a lesser degree the California least tern (72), demonstrate that estuaries, beaches and river mouth areas that support these listed species are impacted by *Arundo* on a number of watersheds within the study area. This has been alluded to in numerous studies and it appears to be a valid area of concern. *Arundo* not only degrades riparian habitat, but it also impacts estuaries and beaches, both of which are wetlands of high value and diversity.

Watershed totals for cumulative *Arundo* impact scores clearly demonstrate that those highly-invaded larger watersheds have the most severe impacts to federally listed species (Santa Margarita = 423, Santa Ana = 417, San Luis Rey = 387 and Santa Clara = 326) (Figure 7-2). The Salinas River is the exception, likely due to its more northern position and its lower diversity and abundance of federally listed species. The next tier of highly-impacted watersheds is well separated from the higher tier with scores of 220 for Los Angeles./San Gabriel/Santa Monica and 205 for San Dieguito. The moderate impact tier includes

eight watersheds whose cumulative *Arundo* impact scores range from 161 to 107 (Figure7-2). These include San Juan, San Francisquito/Newport, Sweetwater, San Diego, Ventura, Carlsbad, Santa Barbara, and Salinas. The low cumulative *Arundo* impact tier includes five watersheds whose values range from 78 to 54 (Figure 7-2).:Estero Bay, Otay, Calleguas, Tijuana, and Santa Cruz/Benito. The cumulative *Arundo* impact scores highlight watersheds with *Arundo* impacts to a number of federally listed species. Low ranking watersheds may still have a high cumulative impact for a single species, such as steelhead on the Ventura watershed.

7.3.2 Discussion

Arundo impact scores are very severe (10) to moderate/high (6) for 11 out of the 22 evaluated federally listed species. This indicates that *Arundo*'s modification of abiotic and biotic ecosystem processes is having significant impacts on a wide range of species:

Listed fish as a taxonomic group has high impact scores from *Arundo*. This has not been widely recognized in conservation biology. Listed avian species that fairly exclusively use riparian habitat (least Bell's vireo, southwestern willow flycatcher, yellow-billed cuckoo) had high impact scores and are recognized as being impacted by fires and habitat degradation. Arroyo toads appear to be severely impacted by *Arundo* invasion as they are dependent on geomorphic forms and hydrology that are severely degraded by *Arundo*. Listed plants also had significant impacts tied to specific sites where populations occur.

The cumulative impact scores, which account for the interaction in actual distributions of *Arundo* and the individual listed species, highlight particular species that are under significant pressure within the study area. Five species stand out: least Bell's vireo, arroyo toad, southwestern willow flycatcher, steelhead and tidewater goby. Arroyo toad, steelhead and tidewater goby have not been previously highlighted as species under significant pressure due to habitat and ecosystem modification by *Arundo*.

The impacts described to estuarine and beach avian species are an important extension of impacts to additional habitat types. These impacts typically rank as moderate to low, but they are well documented as pressures on breeding areas, as well as predation.

Prioritization of watersheds by impacts caused by *Arundo* to federally listed species is complicated. The larger watersheds clearly have the greatest impacts on federally listed species (Figure 7-2). These systems are heavily invaded and are having the most severe modification of abiotic and biotic processes, which is reflected in impact scores. It is interesting to note that three of the four systems also have the most active and comprehensive *Arundo* eradication programs. These systems have already been prioritized in terms of on the ground activity.

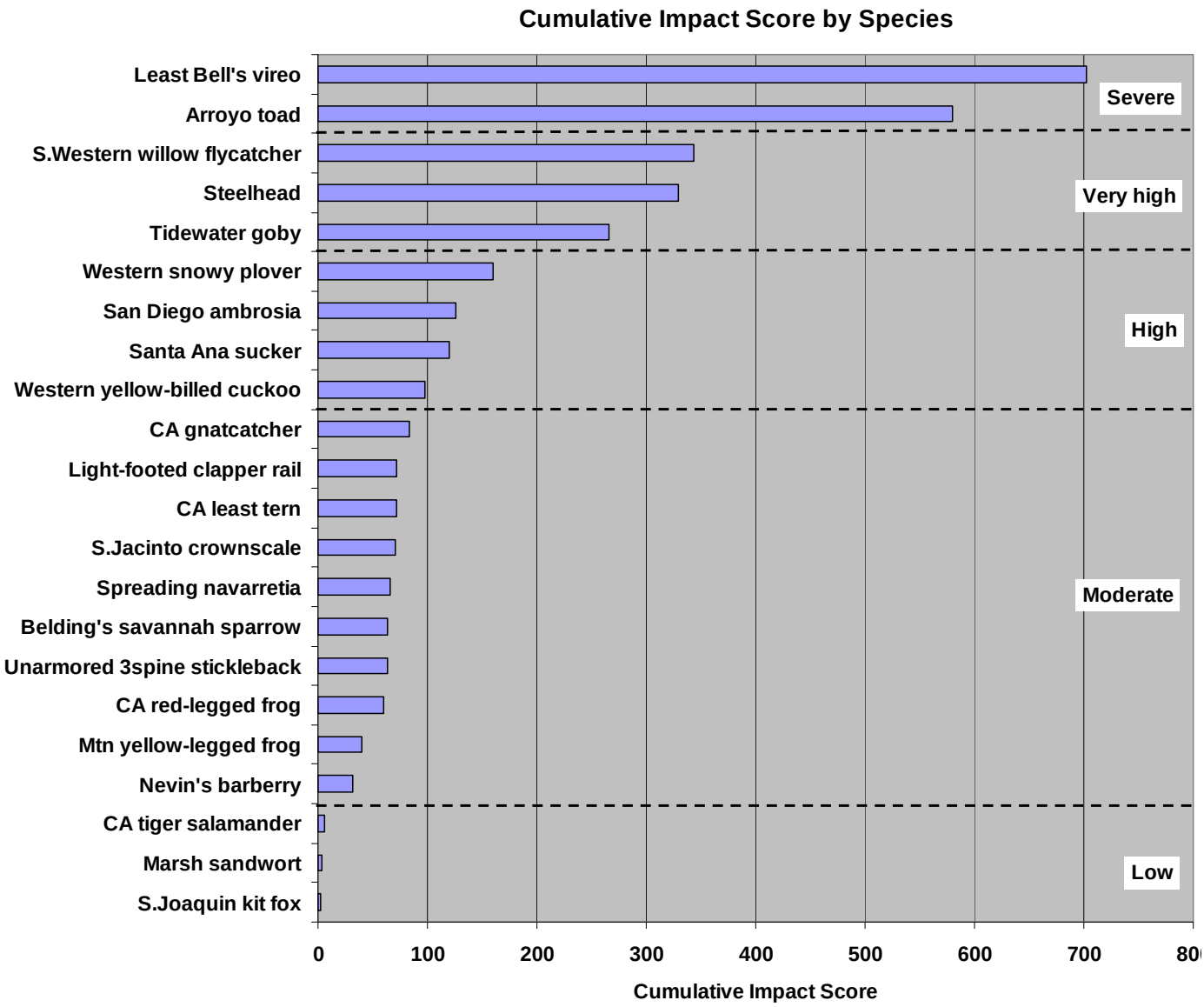

Figure 7-1. Cumulative *Arundo* impact score by species for all watersheds.

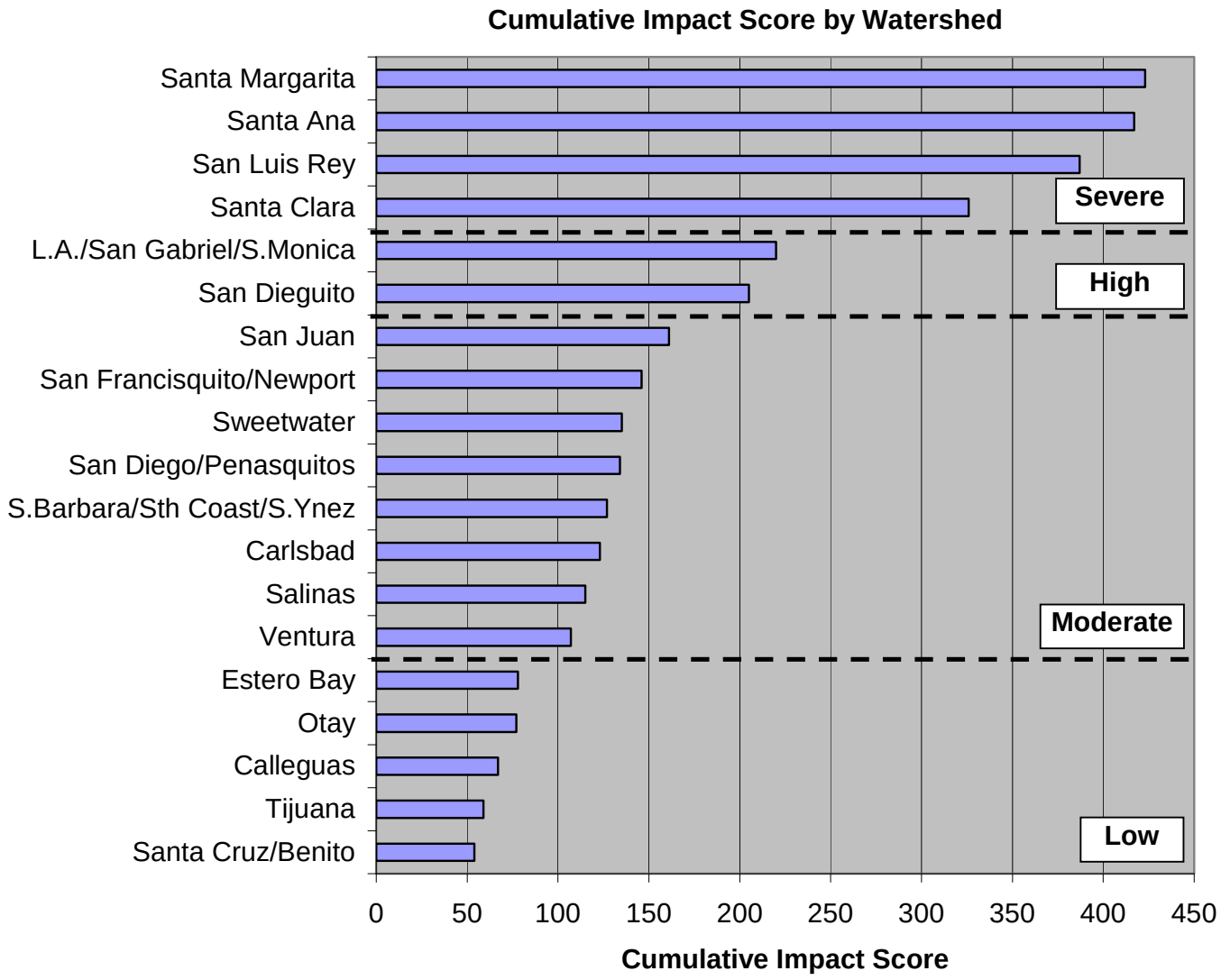

Figure 7-2. Cumulative *Arundo* impact scores by watershed for all federally listed species combined.