2.13 ARROYO TOAD

Species:	Arroyo Toad (*Bufo microscaphus*)
Federal Status:	Endangered
State Status:	CSC
CNDDB Rank:	G2G3S2S3
Science Advisors Group:	3
Covered Species:	Yes
Focal Monitoring Species:	Yes
Planning Species:	Yes

CONSERVATION GOALS

1. Maintain conditions in the planning area that will allow for normal evolutionary processes and genetic integrity and exchange through conservation and management of riparian and upland habitats and a functional Habitat Reserve, including habitat linkages and dispersal corridors.
2. Manage habitat and populations of the arroyo toad to maximize the likelihood that populations are sustained in the planning area, and in doing so "provide for recovery" on a subregional basis and "contribute to recovery" on a rangewide basis.

CONSERVATION STRATEGY

1. Create a permanent subregional Habitat Reserve that provides sufficient riparian/wetland breeding habitat and adjacent upland foraging and estivation habitat to support the identified *major* and *important populations* in *key locations* in San Juan Creek, Bell Canyon, lower Cristianitos Creek, lower Gabino Creek, and Talega Canyon to maximize the likelihood of the species' persistence within the planning area.
2. Formulate a HRMP to provide for long-term protection and management of the arroyo toad and its habitat and provide for restoration of riparian habitat to enhance the amount and quality of existing breeding habitat.

HABITAT AND SPECIES CONSERVATION AND IMPACTS ANALYSIS

The conservation analysis for the arroyo toad is based both on site-specific information (*i.e.*, identified *major/important populations/key locations*) and a consideration of impacts to suitable upland foraging and estivation habitat in the context of site-specific habitat use based on radio telemetry data collected for the San Juan Creek population on RMV by Ramirez (2003). As

noted above, toads can move up to 1.2 miles in adjacent upland habitat foraging and estivation habitat, but that for the purposes of critical habitat modeling the USFWS (2001a) set the 80-foot contour above the streamcourse as the area "most likely to contain primary constituent upland habitat elements that are essential to arroyo toads." (66 Federal Register, 9420, 2/7/01).[1] An approximately 80-foot contour was used to define suitable upland habitat adjacent to San Juan, Talega, lower Gabino and lower Cristianitos creeks by the following method.[2] The centerlines of these creeks on RMV property were buffered on both sides by the approximate 80-ft contour line (see *Figure 200-M*) and then intersected with the digital SCS soils map for Orange County, the NCCP vegetation database, and the proposed development footprints for PAs 2, 3 and 4 for San Juan Creek and the PA 8 development envelope for Talega, Cristianitos and Gabino creeks. An analysis of PA 1 along San Juan Creek was omitted because toads have not been observed this far downstream and thus it was assumed that toads would not be using this area. Furthermore, the development footprints for PAs 3 and 4 do not exclude the setbacks along the San Juan Creek corridor separating the PAs that would ultimately provide a 1,320-foot (400 m) wide protected corridor (thus, the analysis assumes the maximum impact area) and the PA 8 footprint includes the entire 1,349-acre planning area within which a maximum of 500 acres will developed. Thus, the analysis provides an "overstated" estimate for impacts to upland habitat adjacent to the creeks. These intersections were then sorted by Habitat Reserve, proposed development in PAs, permanent and temporary infrastructure impacts, soil type and vegetation type. Soils considered to be suitable for upland foraging and estivation include all non-clayey sands and loams and include the following: Botella loam, Cieneba sandy loam, Myford sandy loam, Capistrano sandy loam, Riverwash, Corralitos loamy sand, Modjeska gravelly loam, San Andreas sandy loam, Soboba cobbly loamy sand, Soboba gravelly loamy sand, Yorba gravelly sandy loam, Soper loam, Soper gravelly loam, and Sorrento loam. Soils that were considered to be unsuitable for the toad include clays and rock outcrops, as follows: Alo clay, Bosanko clay, Bosanko-Balcom complex, Botella clay loam, Calleguas clay loam, Chino silty clay loam, Cropley clay, outcrop-Cieneba complex, Soper rock outcrop complex, and Sorrento clay loam. Vegetation communities considered to be suitable for the arroyo toad include chaparral, forest, grassland, riparian, coastal sage scrub and woodland. Vegetation and cover types considered unsuitable include open water, freshwater marsh, agriculture (the vast majority is nursery adjacent to San Juan Creek), developed, and disturbed.

Based on the intersection of elevation, soil, and vegetation parameters, an estimated total of 1,074 acres of suitable habitat is present on RMV within the 80-foot contour adjacent to the San Juan Creek *major population*, 195 acres adjacent to the Talega Canyon *major population*, and

[1] The longer movements exhibited by toads may not be essential to the short-term life history requirements of a local population but probably serve to link separate local populations and provide for exchange of individuals and genetic material important for long-term viability of the metapopulation.

[2] The 80-foot contour criterion used in the 2001 critical habitat designation was subsequently revised to 82 feet in the 2005 final critical habitat designation (70 Federal Register, 19576, 4/13/05). Because the 80-foot criterion was an approximation based on USGS topography, the 2-foot difference in the two criteria is not significant.

495 acres adjacent to the Lower Cristianitos Creek/Lower Gabino Canyon *important population* (*Table 2-26*).

TABLE 2-26
CONSERVATION ANALYSIS FOR ARROYO TOAD HABITAT

Population	Total Habitat Area on RMV	Habitat Reserve Acres	Total Impact Acres	PA Impact Acres	Infrastructure Impact Acres	Temporary Impacts
San Juan Creek Major Population						
Habitat Acres	1,074	672	402	345	57	29
Percent		63%	37%	32%	5%	
Talega Canyon Major Population						
Habitat Acres	195	169	26	0	0	0
Percent		87%	13%	0%	0%	
Lower Cristianitos Creek/Lower Gabino Canyon Important Population						
Habitat Acres	495	481	14	2	12	7
Percent		97%	3%	<1%	2%	

Subarea 1 Impacts

The proposed Covered Activities would not directly impact any arroyo toad breeding locations in San Juan, Talega, Cristianitos or Gabino creeks *major/important populations* (*Figure 173-M*), with the exception of some small impacts related to placement of piers to support bridge crossings of San Juan Creek and lower Cristianitos Creek, as described below.

Development adjacent to San Juan Creek in PAs 3 and 4 and associated infrastructure, would result in permanent direct impacts to 402 acres (37 percent) of suitable foraging and estivation habitat, as defined above, including 345 acres in the PAs and 57 acres from infrastructure construction, operation and maintenance/repair (*Table 2-26*). It should be noted, however, that existing Ortega Highway already substantially impacts uplands adjacent to PA 4 and thus these areas have reduced value for toad under existing conditions.

Permanent impacts to suitable breeding habitat in San Juan Creek for placement of bridge piers in the creek bottom would total about 0.06 acre. Impacts for bridge abutments, which would be constructed outside the active creek channel on adjacent historic terrace, are included in the road impact analysis, which totals about 23 acres. Based on conceptual designs, significant long-term shading impacts to San Juan Creek would not occur because both proposed bridges across

San Juan Creek are at least 50 feet high. Sufficient light would reach below the bridge structures to promote growth of typical riparian species such as mule fat and willows.

The PA 8 development overlaps with 26 acres (13 percent) of the potential foraging and estivation habitat adjacent to the Talega Canyon *major population.* This estimate likely overstates the impact because it does not reflect siting of development in PA 8 that will in part focus on avoiding impacts to the toad. As discussed in more detail below, a five-year radiotelemetry study of arroyo toad habitat use in the area will be conducted pursuant to SAMP USACE Permit Special Condition I.D.8 to help inform the appropriate siting of development in PA 8 and to minimize impacts to toads. No permanent or temporary infrastructure impacts to the Talega *major population* will occur.

The PA 8 development envelope also overlaps with two acres of suitable foraging and estivation habitat in the Lower Cristianitos Creek/Lower Gabino Canyon *important population*. Permanent infrastructure impacts on this population would be 12 acres, resulting in a total of 14 acres (3 percent) of impact to suitable foraging and estivation habitat. In addition, about 0.02 acre of impact to potential breeding habitat in Cristianitos Creek would occur for the placement of bridge piers.

A total of 29 acres would be subject to temporary impacts resulting from infrastructure.

Potential indirect impacts to the arroyo toad include hydrologic conditions of concern such as changes in rates of erosion or sedimentation and the generation of pollutants of concern such as metals. These potential indirect effects are addressed in the Management section below.

Subarea 1 Conservation

The proposed Covered Activities would conserve all arroyo toad breeding locations in the Habitat Reserve (*Figure 173-M*), including the San Juan Creek *major population* and Bell Canyon *important population/key location* in the San Juan Creek Watershed and the Talega Canyon *major population/key location* and the Lower Cristianitos Creek/Lower Gabino Canyon *important population/key location* in the San Mateo Creek Watershed. In the San Juan Creek Watershed, all upland foraging and estivation habitat within Caspers Wilderness Park adjacent to the *major population/key location* in San Juan Creek and the *important population/key location* in Bell Canyon would be conserved. As shown in *Table 2-26*, 672 acres (63 percent) of the suitable foraging and estivation habitat adjacent to the San Juan Creek *major population/key location* would be conserved on RMV and 100 percent would be conserved in San Juan Creek and Bell Canyon within Caspers Wilderness Park. In the San Mateo Creek Watershed, 169 acres (87 percent) of the potential foraging and estivation habitat adjacent to the Talega Canyon *major population/key location* would be conserved, and 481 acres (97 percent) of the habitat adjacent to

the Lower Cristianitos Creek/Lower Gabino Canyon *important population/key location* would be conserved.

Although the above habitat-based analysis estimates that 402 acres (37 percent) of suitable habitat within the 80-foot contour adjacent to San Juan Creek on RMV, which extends well beyond the 100-year floodplain, would be impacted, it is reasonable to assume that the impact on actual arroyo toad use areas would be substantially less because the majority of toad activity is confined to flood prone areas of the creek. Ramirez (2003) conducted a radiotelemetry study in the RMV portion of San Juan Creek in 2001 to determine the activity patterns and spatial distribution of toads. Ramirez found that toads use all habitats within the flood prone area of San Juan Creek and that core activity areas also were concentrated in this area (see *Figure 201-M*). Ramirez states that

> *The majority of individuals tracked during the study were located immediately adjacent to the active channel or within the bench habitats located within the San Juan Creek flood prone area. A single arroyo toad was documented within the upland terrace north of San Juan Creek burrowed in loam substrate within annual grassland.* (p. 2)

In addition, existing Ortega Highway is a movement barrier to uplands in PA 4 likely limiting the extent to which toads currently use suitable habitat the PA.

It should also be noted that any long-distance instream toad movements north and south in the San Mateo Creek Watershed would most likely occur along Chiquita, Gobernadora and Trampas creeks. These drainages are all within the Habitat Reserve and there would be no constraints on toad movements. The Trampas drainage also provides a relatively unconstrained dispersal route between populations in the San Juan and San Mateo watersheds that are separated by about three miles.

The conservation estimates for the Talega and Lower Cristianitos/Lower Gabino populations are conservative because they are based on the "over-stated" impacts in PA 8. Pursuant to SAMP USACE Permit Special Condition I.D.8, a five-year radiotelemetry study of the arroyo toad populations near PA 8 will be undertaken and the results will be submitted to the USACE prior to submittal of an application to USACE. The results will be used to design appropriate measures to minimize impacts to arroyo toads in PA 8.

Habitat connectivity within the riparian systems is critical for maintaining habitat connectivity to support dispersal and migration movements within the watersheds. Within the San Juan Creek Watershed, the *major population* in San Juan Creek and the *important population* in Bell Canyon are directly connected. As discussed below, invasive species controls in San Juan Creek will be implemented to improve habitat connectivity among the populations in the creek. Within the

San Mateo Creek Watershed, the *major population* in Talega Canyon and the *important populations* in lower Cristianitos and lower Gabino creeks also are directly connected, allowing for movement by toads between the systems.

The Habitat Reserve would also conserve upland habitat between the San Juan and San Mateo watersheds that would allow for the likely rare dispersal events between the San Juan and San Mateo populations. The minimum distance between the San Juan Creek and lower Cristianitos Creek populations is about 3-3.5 miles. The Habitat Reserve would facilitate long distance overland movements by toads. A minimum 6,000-foot wide swath of natural vegetation between PAs 4 and 5 would be conserved, providing a robust connection between the San Juan and Cristianitos creek populations. The only potential obstacle to dispersing toads would be 50 acres of new orchard sited somewhere within PAs 6 and/or 7, which is highly unlikely to inhibit toad movement. Based on topography and vegetation characteristics, dispersal along the "path of least resistance" likely would generally be along the current alignment of Cristianitos Road that takes advantage of the most gentle terrain separating the two watersheds. A potential north-south dispersal route following Cristianitos Road gradually climbs from about 300 feet at San Juan Creek to about 500 feet maximum elevation before dropping down into Cristianitos Canyon where, at about 300 feet, the Cristianitos population is located. A tributary to Cristianitos Creek adjacent to the road that picks up about 1.1 miles south of San Juan Creek would seem the most likely dispersal corridor through Cristianitos Canyon. A second potential dispersal route is a tributary to San Juan Creek east of Cristianitos Road that would require toads to disperse through dense and rugged chaparral at elevations of at least 600 feet. Both potential dispersal routes would be conserved in the Habitat Reserve. Habitat connectivity and provisions for toad movements, both for instream and overland, are consistent with the USACE Permit Special Condition I.D.2 regarding San Juan, Cristianitos, Talega, and Gabino creeks.

ADAPTIVE MANAGEMENT PROGRAM

Stressors

Management of the arroyo toad will consider a variety of environmental stressors that have been generally identified for the species:

- Altered fire regime/related erosion
- Too frequent flood regime
- Too infrequent flood regime
- Precipitation
- Upstream diversion
- Groundwater extraction
- Water quality

- Urbanization adjacent to Reserve
- Exotic plant invasion
- Exotic predators
- Cattle-related impacts
- Roads and trails
- Recreation and Collection
- Recreation

The arroyo toad has been extirpated from 75 percent of its former range (USFWS 1994c). However, since the listing of the arroyo toad, numerous new locations have been located through site-specific surveys. The decline of the arroyo toad has been attributed to the cumulative effects of a number of factors, including diversions and dams of streamcourses for flood control and reservoirs, conversion of riparian/wetland habitats for agricultural and urban uses, road construction, off-road vehicles, cattle grazing, campground development, and mining.

Any human activities (*e.g.*, dams, diversions, mining) or natural events (*e.g.*, wildfires) that affect sedimentation sources can negatively impact arroyo toad habitat, which require periodic flooding to modify stream channels, limit the proliferation of vegetation within the main channel and adjacent terraces and redistribute coarse sediments. Off-road vehicle and heavy cattle use of streambeds and along banks cause significant impacts to arroyo toads, either through direct disruption of breeding pools and egg masses and crushing of metamorphs and adults and indirectly through chronic degradation of riparian/wetland and upland habitats. Stream diversions and groundwater extraction can leads to early drying of breeding pools, restriction of the foraging period essential for rapid growth, and loss of damp subsurface soil, which may result in high adult mortality (Sweet 1992). Introduced plants and predators can cause substantial reductions in the size of extant populations, and may have contributed to regional extinctions of arroyo toads (Hayes and Jennings 1986). In San Juan Creek, for example, extensive stands of giant reed have displaced native vegetation and compete for water essential for maintaining breeding pools and damp soil conditions, effectively precluding toads from these reaches of the creek. Introduced predators such as bullfrogs and crayfish that prey on adult arroyo toads are encouraged by artificially maintained perennial streams, ponds and lakes. Common corvids (crows and ravens) and mesopredators (raccoons and skunks), and possibly pets, may be predators of arroyo toads (E. Simandle, pers. comm. to D. Murphy, 2005). Pollutants, including herbicides, pesticides (including insect growth regulators), and fertilizers are a threat to toads (E. Simandle, pers. comm. to D. Murphy, 2005; USFWS 1999c). Roads and trails act as sinks for arroyo toads as a result of roadkill, especially where they are located adjacent to breeding areas and where toads may congregate to forage (USFWS 1999c). Recreation activities can result in several types of impacts, including collecting of toads by children, noise at night at campgrounds and streamside developments, and mountain biking, hiking and horseback riding in streamcourses and riparian areas.

The reader is directed to the Recovery Plan for the arroyo toad (USFWS 1999c) for more information on environmental stressors and threats to the species.

Goals

Goals for protecting and managing the arroyo toad and its habitat include the following:

1. Maximize the likelihood of the persistence of the physiographic diversity of riparian/wetland habitats and adjacent upland habitats in the Habitat Reserve.
2. Restore riparian/wetland habitats and enhance the quality of degraded riparian/wetland habitats in the Habitat Reserve such that the net habitat value of the existing riparian/wetland habitat system is preserved.
3. Manage fire regimes to sustain and enhance riparian/wetland quality in the Habitat Reserve.
4. Manage cattle-related impacts during the breeding season per the Grazing Management Plan (*Appendix G*).
5. Manage exotic invasions of riparian/wetland habitats such as giant reed, pampas grass, tamarisk, and castor bean.
6. Protect and manage the arroyo toad breeding and upland foraging and estivation areas in the Habitat Reserve.

Management and Monitoring Objectives (number of goal met by objective in parentheses)

Objective 1: Implement Conservation Strategy to protect and manage approximately 1,322 acres of suitable breeding and upland foraging and estivation habitat within the 80-foot contour of the identified *major/important populations* in the RMV portion of the Habitat Reserve (actual acreage will vary in relation to natural and anthropogenic environmental effects such as floods, wildfires and drought) (Goals 1 & 2).

Objective 2: Remap vegetation communities in Habitat Reserve within two (2) years of executing IA to establish a baseline for long-term tracking of the Reserve (Goals 1, 2 & 5).

Objective 3: Update vegetation community map at 5-year intervals (Goals 1, 2 & 5).

Objective 4: Collect regional climate, weather and air quality information to examine potential correlations between vegetation and population changes and environmental variables (Goals 1, 2 & 6)

Objective 5: Provide for no net loss of acreage and function of the waters of the U.S./State (Goals 1 & 2).

- Implement riparian/wetland restoration component of Habitat Restoration Plan.

Objective 6: Maintain/restore riparian/wetland ecosystem integrity and maintain and/or restore floodplain connection (Goals 1 & 2).

- Address historic meander conditions and excessive sediment input from upstream land uses in Gobernadora Creek, including construction of a detention/water quality basin below Coto de Caza.
- Address headcutting, entrenchment and channel degradation and erosion in upper Gabino Creek to control fine sediment yields.
- Address erosion from the clay pits and implement creek stabilization actions in upper Cristianitos Creek to control fine sediment yields.
- Conduct riparian/wetland restoration on a case-by-case basis over the long-term management and monitoring of the Habitat Reserve.

Objective 7: Conduct annual botanical and wildlife field studies within predesignated sample plots to monitor fine-grained changes in riparian/wetland nesting habitat for the arroyo toad species (Goals 1, 2, 5 & 6).

Objective 8: Implement Wildland Fire Management Plan such that sub-basin watersheds, riparian/wetlands, and arroyo toad breeding areas are protected to the extent possible (Goals 1, 2, 3 & 6).

Objective 9: Implement Grazing Management Plan to manage riparian/wetland habitats such that existing habitat values are maintained and enhanced (Goals 1, 2, 4 & 6).

- Exclude cattle from riparian areas during the arroyo toad breeding season (March-August).

Objective 10: Implement Invasive Species Control Plan to manage invasive exotic species in riparian/wetland habitats (Goals 1, 2, 5 & 6).

- Control major infestations of giant reed in San Juan Creek and smaller infestations in GERA and Cristianitos Creek.
- Control major infestations of tamarisk in Cristianitos Creek and isolated clusters in Gabino and San Juan creeks.
- Control pampas grass infestation in San Juan Creek and Cristianitos Creek.

- Control substantial castor bean infestation Cristianitos Creek and scattered occurrences in San Juan Creek.
- Control Spanish sunflower occurrences Gobernadora Creek (GERA) and monitor/conduct early eradication in Chiquita Creek, San Juan Creek and Cristianitos Creek as needed.
- Control bullfrogs and crayfish in areas that pose a risk to the arroyo toad.
- Assess and control Argentine ants where determined to pose a risk to arroyo toad.

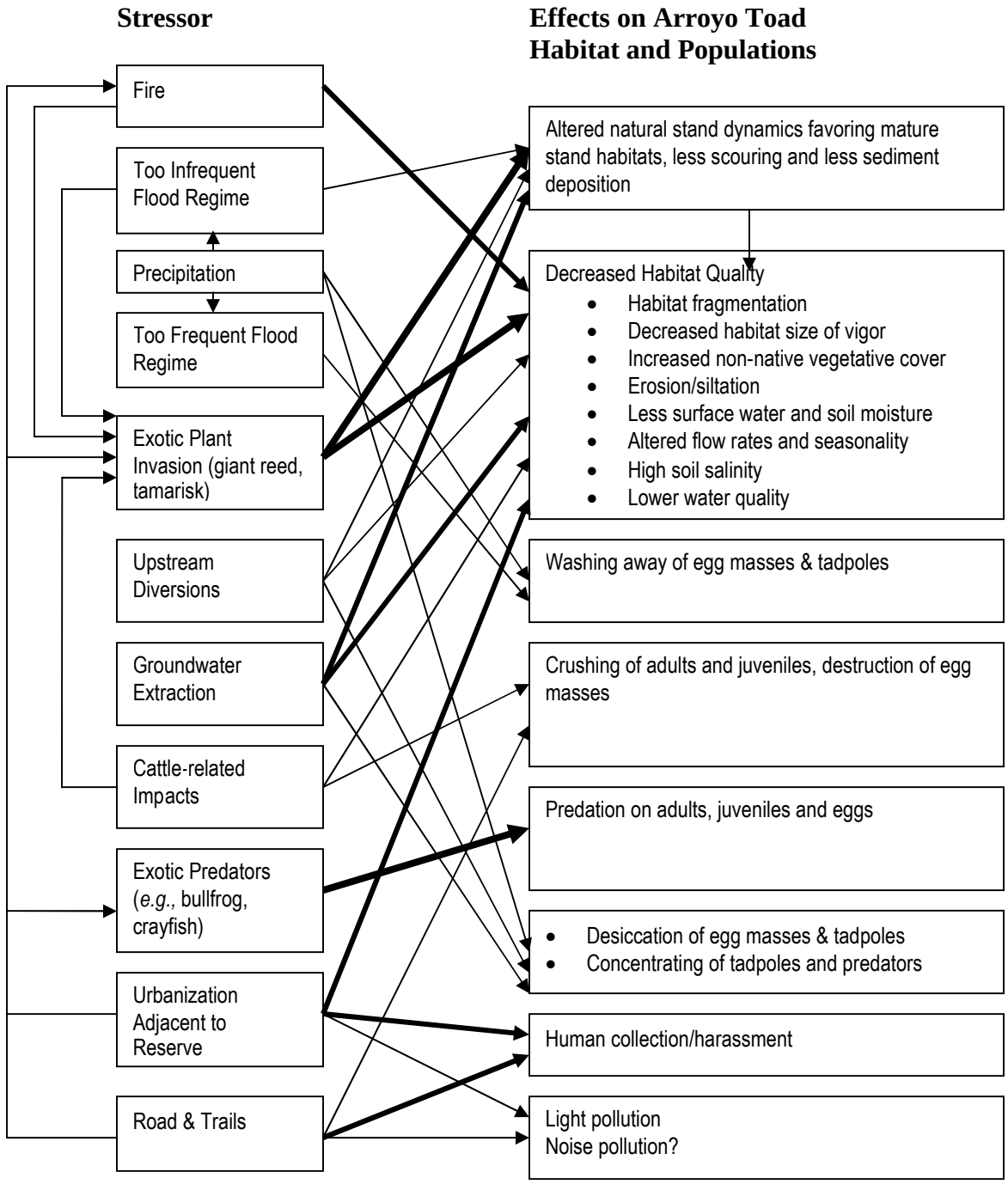
Conceptual Model

Yes – See figure below.

Regional and Subregional Management Information Needs

- The rangewide status and overall population trends of the species.
- The decline of arroyo toads in the context of general global amphibian declines that are occurring from a likely multitude of causes such as disease, pollutants and contaminants, pesticides, habitat loss and degradation, and introduced predators (USFWS 1999c).
- Whether life history traits (*e.g.*, longevity, behavioral patterns) vary in different parts of the arroyo toad's range that are relevant to management of the species; *e.g.*, toads in the central portion of their range in Riverside, Orange and San Diego counties may be active all year (USFWS 1999c).
- Overwintering habitats and threats to adult toads during the non-breeding season.
- The appropriate riparian stand age to maintain high quality breeding habitat.
- The effectiveness of habitat restoration, including revegetation and enhancement in supporting breeding populations of arroyo toads.
- The nature of upland habitat use by arroyo toads for foraging, estivation and dispersal.
- Disease as a significant risk factor for the arroyo toad.
- Water quality/contaminants (*e.g.*, herbicides such as atrazine that may affect development via endocrine disruption; *e.g.*, Hayes *et al.* 2003) as a significant risk factor for the arroyo toad.
- Aerial contaminants as a significant risk factor for the arroyo toad.

Arroyo Toad Conceptual Stressor Model



- The long-term effectiveness of the variety of protection and management measures implemented to conserve the arroyo toad (see Recovery Plan; USFWS 1999c).
- Interspecific competition/interference; *e.g.,* between California toads and arroyo toads with regard to calling activities and prey (USFWS 1999c).
- The extent to which invasive species controls will expand and enhance arroyo toad breeding habitat.
- The most effective methods for controlling bullfrogs and crayfish in the Habitat Reserve.
- What risk Argentine ants pose directly to arroyo toads in the Habitat Reserve and indirectly through impacts on the native insect prey population, particularly impacts on native ants (*e.g., Liometopum occidentale*) that are important prey for juvenile toads in the first 4-5 weeks post-metamorphosis (USFWS 1999c).

Level of Management and Monitoring Priority - High

As a listed species with a limited distribution subregion-wide and clearly identified immediate threats to long-term persistence in the San Juan Creek Watershed (*i.e.,* giant reed infestation), the arroyo toad has a high priority for management and monitoring in Phase 1 of the HRMP. Substantial management and monitoring actions will be implemented in the early years of the HRMP to address this species.

Level of Monitoring (*e.g.*, Species-specific, habitat, landscape, combination)

Monitoring will be conducted both at a species-specific and habitat landscape level.

Monitoring Variables

Listed below are suggested species- and habitat-based monitoring variables. The detailed monitoring program for the arroyo toad will be developed by the Reserve Manager and Science Panel (see *Appendix O* for an example monitoring approach for the arroyo toad).

Species-specific Monitoring Variables

1. Distribution and spatiotemporal trends of arroyo toad population
2. Proportion of stream segments occupied (PAO; see *Appendix O*)
3. Status of introduced predators such as bullfrog and crayfish.
4. Status of Argentine ants in breeding habitat and direct and indirect (*e.g.,* on primary prey) impacts on toads.

Habitat-based Monitoring Variables

1. Vegetation communities long-term status
2. Relative cover of different native plant species
3. Proportion of exotic plant species/native plant species
4. Results of habitat restoration activities, including invasive species controls, riparian/wetland restoration, and creek and soils stabilization programs

Abiotic Monitoring Variables

1. Climate
2. Weather
3. Air quality
4. Water quality and runoff

Management Actions

The following management actions implemented as part of the HRMP will directly benefit the arroyo toad and its habitat:

- Implement riparian/wetland restoration plan
- Implement Wildland Fire Management Plan
- Implement Invasive Species Control Plan

Habitat restoration and enhancement activities and invasive species controls to benefit the toad provide an integrated and comprehensive approach to habitat management. Within the San Juan Creek Watershed, this approach includes implementation of giant reed control programs within San Juan Creek in Caspers Wilderness Park by the County and on RMV property. Control of giant reed in San Juan Creek will result in more arroyo toad breeding habitat both by providing for more native riparian vegetation and increasing water supplies necessary to sustain breeding pools throughout the winter/spring breeding season. Movement along San Juan Creek will be enhanced through the USACE Permit Special Condition I.D.3 regarding retrofitting or relocation of the existing Cow Camp culvert to allow fish passage. Finally, construction of the new Cow Camp Road likely will reduce traffic on existing Ortega Highway, thereby reducing impacts to toad upland movements.

As part of the HRMP, bullfrog and crayfish control programs to help protect arroyo toads would be implemented, with a special focus on permanent water bodies that provide source concentrations of bullfrogs and crayfish (also see SAMP USACE Permit Special Condition I.D.5 regarding eradication of bullfrogs in water quality treatment basins within 1,640 feet [0.5 km] of streams known to support arroyo toads).

Within the San Mateo Creek Watershed, several restoration actions that would benefit the toad have been identified, including: **(1)** subject to the discretion of the Reserve Manager and Science Panel, CSS/VGL restoration and soils stabilization programs to control erosion and generation of fine sediments in Cristianitos and upper Gabino canyons potentially resulting in long-term, chronic degradation of downstream toad breeding habitat; and **(2)** controls of exotic species, such as pampas grass, giant reed and tamarisk in lower Cristianitos Creek, and bullfrogs and crayfish in water bodies in the watershed. Currently an annual monitoring of populations and some plant exotics controls (pampas grass, tamarisk, giant reed, sweet fennel, and artichoke thistle) to benefit the arroyo toad is conducted by Northrop Grumman in lower Cristianitos Creek from the Camp Pendleton boundary to the Cristianitos Bridge (per Special Conditions 1 & 2 of USACE Permit #199915591-RLK).

"Coordinated Management Plans" that are not formal elements of the HRMP but will also benefit the arroyo toad are:

- Water Quality Management Plan
- Grazing Management Plan

The WQMP is an important component of the management approach for the arroyo toad. As noted in the impacts discussion above, potential indirect impacts to the arroyo toad include hydrologic conditions of concern such as changes in rates of erosion or sedimentation and the generation of pollutants of concern such as metals. In the San Juan Creek Watershed, Verdugo Canyon hydrology would be maintained to protect sources of coarse sediment that are important for arroyo toad breeding habitat in downstream areas of San Juan Creek. Breeding sites in the San Juan Creek Watershed would be conserved by maintaining hydrology, water quality and sediment delivery to San Juan Creek, including flow characteristics of episodic events, and minimizing additional loadings of nutrients or pollutants (*e.g.*, metals) through implementation of the WQMP. In particular, stormwater flow characteristics comparable to existing conditions from Trampas Canyon into San Juan Creek would be maintained to preserve the natural succession of riparian habitat and the overall hydrologic/geomorphic conditions, identified in the *Geomorphic and Hydrologic Needs of Aquatic and Riparian Endangered Species* report (PCR and Dudek 2002), and protect and enhance breeding habitat for the arroyo toad population in this reach of the creek. Similarly, natural hydrological conditions would be maintained in the San Mateo Watershed to protect the Talega and Lower Cristianitos/Lower Gabino populations.

The coordinated GMP will help protect arroyo toad habitat during the breeding season once such areas are dedicated.

Potential Target Studies

Several regional and subregional information management needs relevant to management of the arroyo toad were listed above, some of which could be addressed at the subregional scale and would help inform management of the Habitat Reserve. Other regional and subregional information management needs, particularly those related to rangewide persistence of the species (*e.g.*, landscape habitat fragmentation) are best studied at a rangewide scale. The following are potential target studies that could be implemented at the subregional scale:

- Evaluation of impacts of exotic predators on arroyo toads
- Assessment of impacts of Argentine ants and evaluation of the effects of ant controls
- Evaluation of restoration effects on breeding populations, including invasive species controls, active revegetation and upstream restoration in Gobernadora to reestablish natural creek meander and control fine sediments
- Evaluation of adverse edge effects on occupation and/or breeding success
- Evaluation of the exclusion of cattle during the breeding season.

SPECIES ACCOUNT

Rangewide and Regional Status

The arroyo toad originally ranged from the upper Salinas River system in Monterey County, south through the Santa Ynez, Santa Clara and Los Angeles river basins and the coastal drainages of Orange, Riverside and San Diego counties in the U.S. and south to the Arroyo San Simeon system about 16 km (10 mi) southeast of San Quintin, Baja California, Mexico (USFWS 1999c). Although the arroyo toad primarily occurs in coastal drainages, it also is known from desert slopes of the Transverse and Peninsular ranges south of the Santa Clara River in Los Angeles County (USFWS 1999c). Population areas along the desert slope include the Mojave River in San Bernardino County and Little Rock Creek, Whitewater River, San Felipe Creek, Vallecito Creek, and Pinto Canyon in Riverside County (Jennings and Hayes 1994; Patten and Myers 1992; Stebbins 1985). As of 1994, only 22 discrete populations were thought to exist in California over an area representing about 25 percent of the historic range of the species. The final recovery plan for the arroyo toad divided the existing range into three units: the northern, southern and desert units (USFWS 1999c). The drainages within these units generally describe the existing distribution of the toad and are listed below.

Northern Unit

San Antonio River, Monterey County
Sisquoc River and tributaries, Santa Barbara County
Upper Santa Ynez River Basin (Indian, Mono, Agua Caliente), Santa Barbara County
Sespe Creek, Ventura County
Piru Creek (Upper and Lower), Ventura and Los Angeles counties
Upper Santa Clara River Basin, Los Angeles County
Upper Los Angeles Basin (Big Tujunga, tributaries, Arroyo Seco), Los Angeles County

Southern Unit

Santiago Creek, Orange County
San Jacinto River and Bautista Creek, Riverside County
San Juan basin and Trabuco Creeks, Orange and Riverside counties
San Mateo and San Onofre Creek basins, San Diego and Orange counties
Lower Santa Margarita basin (De Luz, Roblar, and Sandia creeks), San Diego County
Upper Santa Margarita basin (Temecula Creek, Arroyo Seco), Riverside and San Diego counties
Lower and Middle San Luis Rey basin (below Lake Henshaw), San Diego County
Upper San Luis Rey basin (above Lake Henshaw), San Diego County
Santa Ysabel Creek, San Diego County
San Diego Basin (including San Vicente Creek), San Diego County
Sweetwater River basin (including Viejas, Petersen creeks), San Diego County
Cottonwood Creek basin, San Diego County

Desert Unit

Little Rock Creek, Los Angeles County
Upper Mojave River basin (Mojave, Deep, Horsethief, Little Horsethief), San Bernardino County
Whitewater River basin, Riverside County

The arroyo toad is federally-listed endangered and is a CDFG CSC with a CNDDB rank of G2G3S2S3. Per the CNDDB ranking, it is considered restricted in range/rare to endangered within its range (the toad is endemic to California, therefore the global and state ranks are identical). As of 1994, only 22 discrete populations were thought to exist in California over an area representing about 25 percent of the historic range of the species. The decline of the arroyo toad has been attributed to the cumulative effects of a number of factors, including diversions and dams of streamcourses for flood control and reservoirs, conversion of riparian/wetland habitats for agricultural and urban uses, road construction, off-road vehicles, cattle grazing, campground development, and mining.

Subregional Status

Within the Southern Subregion planning area the arroyo toad is associated with riparian, streamcourses with sandy benches along streams in both the San Juan Creek and San Mateo Creek watersheds (see PCR and Dudek 2002 and *Figure 173-M*). In addition, the USFWS (2001a) cited a personal communication from D. Holland that a population of the arroyo toad also occurs in upper Arroyo Trabuco, but the population size and specific location has not been confirmed (*e.g.,* it does not appear in the 2002 CNDDB). Surveys consistently have found toads in the San Juan Creek Watershed from about the mouth of Chiquita Canyon upstream to about Hot Springs Creek and in lower Bell Canyon in Caspers Wilderness Park. In the portion of the San Mateo Watershed within the planning area, the toad occurs in Talega, lower Gabino and lower Cristianitos creeks. In 1998 Bloom conducted a study area-wide survey to assess the status of the toad, although his survey in Arroyo Trabuco only extended as far north as Oso Parkway. Since 1998, additional studies have been conducted on the arroyo toad in relation to the SOCTIIP project (Bloom 2001; Bloom and Niemela 2001) and an independent radio-telemetry study by Griffin *et al.* 1999). Annual monitoring of populations and some plant exotics controls (pampas grass, tamarisk, giant reed, sweet fennel, and artichoke thistle) to benefit the arroyo toad is conducted by Northrop Grumman in lower Cristianitos Creek from the Camp Pendleton boundary to the Cristianitos Bridge (per Special Conditions 1 & 2 of USACE Permit #199915591-RLK).

Because these studies were conducted in different years under different environmental conditions, the absolute numbers of toads detected within the same reaches of drainages are variable, but relatively consistent among different drainages; *i.e.,* areas with a small number of detections had consistently fewer detections across survey years than areas where larger numbers of toads were detected.

Based on the comprehensive survey data for the arroyo toad, two *major populations* and two *important populations* were identified for the planning area. As described in more detail below, the two *major populations* are located in **(1)** San Juan Creek from near the confluence with Chiquita Canyon north to beyond the confluence with Hot Spring Creek and **(2)** in Talega Creek from the confluence with Cristianitos Creek to at least the eastern boundary of the planning area. The two *important populations* are located in **(1)** Bell Canyon from the confluence with San Juan Creek north to about 2.2 miles north of the confluence and **(2)** lower Cristianitos/lower Gabino Canyon extending from the confluence of Cristianitos and Talega creeks to about 3,000 feet upstream of the confluence of Gabino and La Paz creeks (*i.e.,* into middle Gabino) and in Cristianitos Creek extending about 2,500 feet upstream of Gabino Creek.

- The *major population* in San Juan Creek (No. 1 on *Figure 173-M*) extends from near the confluence with Chiquita Canyon north to about 0.8 km (0.5 mi) south of Hot Springs

Creek in the Cleveland National Forest. (Note: Bloom [1998] mapped potential habitat to an area about 915 m (3,000 ft) downstream of Antonio Parkway bridge). While this population can be considered continuous because toads have been observed throughout the area, the reach of San Juan Creek extending north from near the confluence with Bell Canyon supports the large majority of the toad population in San Juan Creek and provides the highest quality habitat for the species in the creek. This reach supported about 435 counted adult toads in 1998 (Bloom 1998) and is the second largest population area in the subregion. Habitat for the toad approximately 800 feet below the confluence with Bell Canyon becomes degraded by a proliferation of giant reed and the open stream channel becomes obscured by riparian vegetation by about 1,600 feet below Bell Canyon. This demarcation is consistent with Bloom's observation of 29 toads in this reach in 1998, compared to fewer toads downstream. Because it supports a large population and high quality habitat, the portion of the *major population* in "upper" San Juan Creek from about 1,600 feet south of Bell Canyon can be considered a *key location.*

Surveys in San Juan Creek downstream of Bell Canyon on RMV property have yielded persistent, but relatively small, population counts. In the segment from near the mouth of Gobernadora Creek to about 2,000 feet south of Bell Canyon, counts were 24 individuals before 1997, 22 individuals in 1998 by Bloom and 14 individuals in 2001 by Bloom and Niemela. In the more downstream portion of this segment between Gobernadora and Chiquita, pre-1997 counts were 14 individuals, 6 by Bloom in 1998 and 8 by Bloom and Niemela in 2001. The consistent small numbers of individuals in this reach of San Juan Creek distinguish it from the *key location* of this *major population* upstream from the point about 1,600 feet south of Bell Canyon. Recent breeding in this lower reach has been limited to the area just downstream of Trampas Canyon and is maintained by artificial runoff from Trampas. The reason for fewer toad detections and apparent decline in breeding south of the confluence with Bell Canyon in recent years is not completely known, but likely is the result of a combination of natural and anthropogenic factors, including an inferred natural groundwater barrier between Chiquita and Gobernadora canyons and San Juan Creek that limits inter-aquifer exchange, groundwater withdrawals, truck traffic, other human activity, and bullfrogs in the abandoned mining pit. In contrast, upper San Juan Creek probably is naturally wetter, allowing for longer persistence of breeding pools, and is subject to fewer human uses. In addition, giant reed is proliferating in the reach below Bell Canyon, resulting in degradation of toad habitat. For recovery purposes, active management to maintain breeding pools and control giant reed in the stream likely will be needed to sustain this segment of the population on a long-term basis.

- The *important population* in Bell Canyon (No. 2 on *Figure 173-M*) extends from the confluence with San Juan Creek north about 2.2 miles up Bell Creek into Caspers

Wilderness Park. In 1998 Bloom counted 29 calling males in this area. This *important population* is considered a *key location* because it is situated in a relatively undisturbed area and is directly connected to the San Juan Creek *major population*.

- The *major population* in Talega Canyon (No. 3 on *Figure 173-M*) was categorized as "abundant" by Bloom in 1998 based on presence of metamorphs. In the same 1998 study year Griffin *et al.* (1999) counted 41 calling toads in the same reach. Bloom (pers. comm. 2004) considers the Talega population be one of the most significant in Orange County, although not as large or important as the San Juan Creek population in Caspers Wilderness Park. In addition, this population is connected to the downstream arroyo toad populations in lower Cristianitos and San Mateo creeks on Camp Pendleton, as well as the upstream populations in Cristianitos and lower Gabino creeks. In addition to suitable geomorphic conditions for the toad discussed above, the combination of higher precipitation in the upper watershed and presence of year-round springs provides a more reliable water source to support breeding pools.

- The *important population* in lower Cristianitos Creek and lower Gabino Creek (No. 4 on *Figure 173-M*) extends from the confluence of Cristianitos and Talega creeks upstream into Gabino Creek to about 3,000 feet north of the confluence with La Paz Creek and in Cristianitos Creek about 2,500 feet upstream of Gabino Creek.

  Over several surveys in the segment of Cristianitos Creek between its confluence with Gabino Creek in the north and Talega Creek in the south, calling males have numbered 37 before 1997, 11 by Bloom in 1998, 7 by Griffin *et al.* in 1998 and 26 by Bloom in 2001. The segment of lower Gabino from the confluence with Cristianitos to La Paz Creek numbered 30 before 1997, 21 by Bloom in 1998, 21 by Griffin *et al.* [1999] in 1998, and 8 by Bloom in 2001 (as well as 200 metamorphs observed during this survey). Bloom also observed a total of 38 adults in this reach during six survey nights in 2003, with the eight adults as maximum number of individuals observed on any single night (Bloom 2003). In 2004 the total was 26 adults (cited in Bloom 2005). In 2005, a year of near record rainfall, Bloom observed a total of 276 adults (159 males and 117 females) and 89 metamorphs in this area, the largest number (Bloom 2005). The portion of the *important population* within lower Gabino and lower Cristianitos creeks is considered a *key location* because it is linked along the streamcourse to the *major population* in Talega Canyon.

  The segment of Cristianitos Creek upstream of the confluence with Gabino Creek is included as part of the *important population* because it is directly connected to the populations in lower Gabino Creek and Cristianitos Creek downstream of Gabino. However, this portion of the *important population* is not considered a *key location*. This

reach is considered marginal breeding habitat for arroyo toads because of the clayey sediments that are characteristic of this portion of the creek. Out of three survey years, only in 2001 were toads (5 adults) recorded along this stream segment and they were observed only adjacent to the creek. There was no evidence that toads were breeding in the creek.

The San Juan Creek and Bell Canyon populations probably comprise distinct, but linked populations. The San Juan Creek and Bell Canyon populations are linked because the streamcourses are directly connected by suitable habitat, allowing toads to move freely between the two areas. However, the two sub-basins are physically distinct; the Bell Canyon sub-basin is a much smaller sub-watershed and characterized by a narrower canyon. It is likely that peak flows and timing for the two sub-basins are different, thus affecting the character of toad breeding habitat.

Likewise, the Talega, Cristianitos and Gabino canyons populations probably are distinct, but linked local populations. Like Bell Canyon and San Juan Creek, they are all connected by suitable habitat within the drainages. However, these sub-basins are characterized by different geological structures and processes that likely affect the quality of toad breeding habitat. For example, as summarized in the *Baseline Conditions and Hydrologic Conditions* report (PCR *et al.* 2002), Talega Canyon has the highest proportion of poorer infiltrating soils of any of the other sub-basins in the San Mateo Watershed, while Gabino Canyon has a higher infiltration capacity than other sub-basins in the watershed. Although Talega has a high runoff volume, it also has a relatively low magnitude of peak flows because of the elongated shape of the sub-basin and long routing distance of the streamcourse. In contrast, Gabino has the highest peak flows and runoff volume because of its high drainage density, position high in the watershed and steep terrain. Sediment from Gabino also contains a high proportion of cobbles and other larger particles that are less suitable for toad breeding habitat. Cristianitos is a relatively small sub-basin and has the lowest absolute runoff volume and peak flows of the sub-basins studied in the watershed. The clays in the sub-basin contribute to fine sediments discharged to the creek, which generally are an unsuitable substrate for toad breeding habitat.

An additional reason that the populations in these sub-basins should be considered linked, but distinct is that fires within the sub-basins would be expected to have different effects on the populations; *e.g.*, a fire in the Talega sub-basin may result in temporary disruption or loss of the Talega population. In such a case the Cristianitos and Gabino populations would be important source populations for recolonization of the Talega sub-basin.

Whether the San Juan Creek and San Mateo Creek populations are linked is unknown. The minimum distance between occupied toad habitat in the San Juan and San Mateo watersheds populations is about 3.7 km (2.3 mi). Based on the observation of toads moving as far as 1.9 km

(1.2 mi) from streams, it is conceivable that toads occasionally could move between the two watersheds.

Biological Considerations

Arroyo toads are found in foothill canyons and inter-mountain valleys where rivers are bordered by low hills and the stream gradients are low (Miller and Miller 1936; Sweet 1992). The arroyo toad uses riparian environments for breeding and adjacent uplands for foraging and estivation. Arroyo toads are known to either breed, forage, and/or aestivate in aquatic habitats, riparian, coastal sage scrub, oak, and chaparral habitats. The species is restricted to medium- to large-sized, slow-moving streams. The majority of arroyo toad population studies occur within third and fourth order drainages that are characterized by decomposed granite bedrock. However, toad populations have been found in a wide range of stream orders, including lower, second order, and higher, fifth and sixth order coastal streams characterized by sedimentary rock (PCR *et al.* 2002). According to USFWS, streams supporting arroyo toads range from first to sixth order in the central part of the species' range (Orange, Riverside and San Diego counties) (USFWS 1999c).

Natural geomorphological processes are important for maintaining suitable breeding habitat for the arroyo toad. Periodic flooding is required to modify the stream channel, limit the proliferation of vegetation within the channel and the adjacent upland terrace, redistribute coarse sediments within the streamcourse, and redistribute breeding pools (USFWS 2001a). The flooding regime is directly responsible for the development of the appropriate number and size of breeding pools, friable soils for juvenile and adult toads to create burrows, and unvegetated lower stream terraces (Jennings and Hayes 1994; USFWS 1999c).

Breeding pools must be open and shallow with minimal current, and a sand or pea gravel substrate overlain with sand or flocculent silt (Sweet 1989). Breeding sites generally have flow rates less than 5 cm per second (cm/sec) (USFWS 1999c). Currents greater than 5 cm/sec are sufficient to displace eggs and embryos up to 82 hours post hatching (Sweet 1992). Stream bottoms composed of sand or well-sorted gravel are favored by adults for breeding (USFWS 2001a). Larval growth appears to be more rapid in pools with low silt loads (Jennings and Hayes 1994). Griffin *et al.* (1999) found that fine-, medium-, and coarse-grained sands are the preferred adult burrow substrate and that cobble is the least preferred, although burrow sites can be interspersed with heavier gravel and cobble.

Water persistence in natal pools is key to successful breeding by arroyo toads. Streams must have persistent water from March to mid-June in shallow, gravely pools less than 7.1 cm (18 in) deep and adjacent sandy terraces. The larval period of arroyo toads lasts about 65-85 days, so

the persistence of water is crucial for successful breeding and high mortality of tadpoles can occur if breeding pools dry up too quickly.

Adjacent banks must provide open, sandy or gravely terraces with very little herbaceous cover for adult and juvenile foraging areas, within a moderate riparian canopy of cottonwood, willow, or oak. Heavily shaded pools are unsuitable for larvae and juvenile toads due to lower water and soil temperatures and poor algal mat development (Sweet 1992). Juveniles favor areas that remain damp, have midday surface temperatures of 34 to 37 degrees Celsius (C) (93.2-98.6 degrees Fahrenheit [F]) and contain less than 10 percent cover, because these sites possess the thermal and refuge characteristics required for juvenile survival and rapid growth (Sweet 1992).

Several studies have examined the instream activity of arroyo toads during the breeding season. Studies summarized by the USFWS (2001a) indicate that subadults and male adults can move anywhere from 0.8 km (0.5 mi) to more than 1 km (0.6 mi) along streamcourses during a single breeding season. In upper Piru Creek it was inferred that toads had moved as far as 8 km (5 mi) along a streambed, based on the consistent absence of toads from this area in previous surveys.

There also is some information of lateral movements from streams into uplands during the breeding season. The USFWS states that "Although the upland habitat use patterns of this species are poorly understood, activity probably is concentrated in the alluvial flats (areas created when sediments from the stream are deposited) and sandy terraces found in valley bottoms of currently active drainages." (66 Federal Register, 9415, 2/07/01). Upland habitat use appears to be related to rainfall amounts, availability of surface water, width of streamside terraces and floodplains, vegetative cover and topography (USFWS 2001a). For example, Griffin *et al.* (1999) found that lateral movements were related to topography adjacent to the stream. In coastal streams with broad floodplains, 33 males moved an average maximum of 92 m (302 ft) from the stream, while in a narrower canyon 13 males moved only 23 m (75 ft) from the streambed. Ramirez (2000) observed a similar pattern where 12 toads in a very narrow floodplain on a desert slope moved a maximum distance of 37 m (121 ft) and an undisclosed number of toads moved a maximum of 200 m (656 ft) in a broader floodplain. Griffin *et al.* (1999) noted that tall cliff faces may hinder toad movements into upland habitats, with a female struggling on a 60 degree sandstone slope along a cliff edge.

While there seems to be a general relationship between lateral movement and topography, the USFWS (2001a) concluded that there are not enough data "to characterize fully overwintering activities and habitat use in all of the systems that arroyo toads inhabit." However, they did conclude that, "Individual toads have been observed as far as 2 km (1.2 mi) from streams where they breed, but are found most commonly within 0.5 km (0.3 mi) of those streams (USFWS 1999c; Griffin *et al.* 1999; Dan C. Holland, Camp Pendleton Amphibian and Reptile Survey,

Fallbrook, California, unpublished data; Holland and Sisk 2000)." (66 Federal Register, 9415-9416, 2/7/01). A recent radio telemetry study of habitat use and toad movements by Ramirez on RMV property in San Juan Creek found that arroyo toads primarily utilized the broad floodplain of the creek during breeding season movements, with the most distance lateral movement about 274 m (810 ft) (Ramirez 2003). Four separate radio telemetry studies on inland populations in more mountainous areas by Ramirez showed that toads used narrower areas of 50 to 200 m (10 to 650 ft) from the stream compared to areas with broader floodplains (69 Federal Register, 23255, 4/28/04).

With regard to burrow use, the four Ramirez studies on inland populations in mountainous areas showed that arroyo toads utilized burrows up to 324 m (1,062 ft) from the edge of a stream, with an average of 16 m (52 ft) (69 Federal Register, 23255, 4/28/04). Based on a sample of 109 location, Ramirez (2003) found that burrow locations on RMV in San Juan Creek ranged from locations within the active stream channel to distances up to 274 m (810 ft) from the stream, with a mean distance of 23.9 m (78 ft); the distribution of burrow locations is heavily skewed toward locations within 50 m (164 ft) of the stream. This study supports the general finding that toad activity and estivation sites tend to be concentrated near the active stream channel.

Protection Recommendations

- Maintain and manage riparian and aquatic habitats along San Juan Creek for breeding populations of the arroyo toad.
- Provide upland foraging and estivation habitat within the upland terraces in the floodplain of San Juan Creek, with a particular focus on the south side of the creek, to maintain existing population levels of the arroyo toad.
- Maintain Verdugo Canyon hydrology to maintain sources of coarse sediment that are important for arroyo toad breeding habitat in downstream areas.
- Protect breeding and foraging habitat and movement opportunities within the lower Gabino Canyon, lower Cristianitos and Talega Canyon streamcourses and adjacent alluvial terraces for the arroyo toad. Address potential upland estivation habitat needs in the context of best scientific information regarding the influence of topography, soils and other factors that appear to influence arroyo toad lateral movement and frequency of use in upland areas away from streamcourse habitat areas.
- Protect the integrity of arroyo toad populations in Talega Canyon by maintaining current stormwater runoff patterns and hydrologic conditions.
- Protect the arroyo toad population within middle Gabino Creek upstream from the confluence with La Paz Creek by avoiding impacts to breeding, foraging and estivation habitat and protect canyons to avoid downstream impacts to the toad.

- Protect the integrity of arroyo toad populations in lower Gabino Creek, as well as downstream populations in Cristianitos and San Mateo creeks, by protecting the generation and transport of coarse sediments in La Paz Creek to downstream areas.
- Protect the *key location* of the arroyo toad upstream from the confluence of Cristianitos and Talega creeks by avoiding direct impacts to breeding, foraging and estivating habitat and avoiding indirect impacts to the Cristianitos and lower Gabino sub-basins.

Management Recommendations

- Within the Gobernadora, Verdugo, Cristianitos, Gabino, and La Paz sub-basins, protect the integrity of downstream habitat for the arroyo toad by maintaining hydrology, water quality and sediment delivery to San Juan and San Mateo creeks, including flow characteristics of episodic events, and minimizing additional loadings of nutrients or toxics.
- Maintain stormwater flow characteristics comparable to existing conditions from Trampas Canyon into San Juan Creek to preserve breeding habitat for the arroyo toad population in San Juan Creek.
- Attempt to identify groundwater sources that are important to breeding pools and address potential management measures.
- Implement a bullfrog eradication program within San Juan Creek to help protect arroyo toads, with a special focus on Cal-Mat Lake and other water bodies that provide source concentrations of bullfrogs.

Restoration Recommendations

- In coordination with upstream eradication efforts, implement a giant reed removal program for San Juan Creek within RMV boundaries to protect arroyo toad habitat.
- Implement an invasive plant species eradication effort in Cristianitos Creek between the confluences with Gabino and Talega creeks.

2.14 WESTERN SPADEFOOT TOAD

Species:	Western Spadefoot Toad (*Spea [=Scaphiopus] hammondii*)
Federal Status:	FSC
State Status:	CSC
CNDDB Rank:	G3S3
Science Advisors Group:	3
Covered Species:	Yes
Focal Monitoring Species:	No
Planning Species:	Yes

CONSERVATION GOALS

1. Manage habitat and populations of the western spadefoot toad to maximize the likelihood that existing populations are sustained in the planning area, and in doing so "provide for recovery" on a subregional basis and "contribute to recovery" on a rangewide basis.
2. Provide for unconstrained long distance movements between breeding locations.

CONSERVATION STRATEGY

1. Create a permanent subregional Habitat Reserve that provides sufficient breeding habitat and adjacent upland foraging and estivation habitat to support the five *important populations* in Subarea 1: **(1)** vernal pools on Chiquita Ridge in Ladera Open Space; **(2)** vernal pools on Radio Tower Road; **(3)** San Juan Creek from the RMV Headquarters to the confluence with Verdugo Creek; **(4)** the stock pond in upper Cristianitos Canyon; and **(5)** lower Gabino Canyon.
2. Formulate a HRMP to provide for long-term protection and management of the western spadefoot toad and its habitat and provide for enhancement of breeding habitat.

HABITAT AND SPECIES CONSERVATION AND IMPACTS ANALYSIS

The conservation analysis for the western spadefoot toad is based on documented breeding locations and surrounding habitat because of its dependence on aquatic habitat for reproduction. Western spadefoot toads apparently do not move far from their breeding pool during the year, with movements within a few hundred meters of breeding pools (Zeiner *et al.* 1990), and it is likely that their entire post-metamorphic home range is situated around a few pools. Because conservation of the spadefoot toad depends on site-specific protection, a landscape-level habitat

analysis was not conducted for this species, except for the purpose of assessing overland dispersal and migration opportunities.

Subarea 1 Impacts

The proposed Covered Activities would result in impacts to four (17 percent) of the 24 breeding locations (*Figure 176-M*). These impacts assume that through project site design the three vernal pools supporting spadefoot toads and their hydrological sources in PA 5 would be protected (*e.g.*, by limiting the grading to below the grade of the pools) (see the Ranch Plan GPA/ZC EIR MM 4.9-35). Two of the impacted locations would be associated with proposed RMV development within PA 1 and two would occur in association with the Prima Deshecha Landfill Expansion GDP. Both impacted locations in PA 1 are within the San Juan Creek *important population*. One of the two impacted locations on the Prima Deshecha Landfill would be directly impacted by proposed expansion activities in Zone 4 of the Landfill and the other, although located in SOS, is only 150 feet from the edge of the Zone 4 impact area, likely resulting in inadequate upland habitat adjacent to the breeding site to support the life history requirements of the species. One temporary impact resulting from trail construction also was identified.

Subarea 1 Conservation

A total of 19 locations (79 percent) would be conserved in the Habitat Reserve and one location (4 percent) in Subarea 1 SOS, including the Chiquita Ridge *important population*; three of the five locations in the San Juan Creek *important population*; all five locations in the Radio Tower Road *important population* (per MM 4.9-35); the Upper Cristianitos *important population*; the Lower Gabino Creek *important population*; a location in upper Chiquita, two locations along Chiquita Ridge (north and south of the Chiquita Ridge *important population*); a location at the confluence of Bell and San Juan creeks; and a location in SOS in NAS Starr Ranch (*Figure 176-M*). All conserved breeding locations except one location in San Juan Creek would have at least a 650-foot upland habitat buffer zone (about a 30-acre area) from proposed development that would be adequate to support all life stages of the spadefoot toad. The location next to PA 4 would be subject to at least temporary impacts, but because the PA 4 area adjacent to San Juan Creek will have long-term impacts limited to trails and infrastructure, and because the creek itself will be undisturbed, this site is considered conserved.

There is relatively little information bearing on the question of spadefoot toad movement between separate breeding locations or their capability of moving long distances (in contrast to the arroyo toad, for example) (see Morey 1998). They appear to carry out all their life-history requirements within a few hundred feet of breeding pools. The Habitat Reserve would, however, link all the *important populations* by natural vegetation communities and, thus would facilitate

potential dispersal between populations. Direct linkages between the *important populations* include the following:

- A continuous linkage along Chiquita Ridge of approximately 6,860 feet from the Chiquita Ridge/Ladera Open Space population to the San Juan Creek population that includes grassland, coastal sage scrub, barley fields and riparian along Chiquita Creek;
- A linkage between the San Juan Creek and Radio Tower Road populations over a distance of approximately 4,750 feet composed mostly of grassland. Ortega Highway is an existing obstacle to movement between the two populations and could function as a sink. However, there are drainage culverts under Ortega Highway that could be used by toads. For example, there is an existing corrugated steel pipe culvert measuring 13 feet x 54 feet that crosses under Ortega Highway at Radio Tower Road that could be used by dispersing toads (Dudek 1995).
- A linkage of approximately 8,975 feet between the Upper Cristianitos and Lower Gabino populations along Cristianitos Creek and the canyon composed primarily of grassland and riparian habitats east of and within the creek and chaparral and coastal sage scrub west of the creek in the Donna O'Neill Land Conservancy.

The potential habitat linkages between the San Juan Creek and Radio Tower Road populations to the Upper Cristianitos populations though are more circuitous. Movement between the San Juan Creek and Upper Cristianitos populations, for example, could occur in a manner similar to that described for the arroyo toad and southwestern pond turtle. That is, based on topography and vegetation characteristics, dispersal along the "path of least resistance" between these two populations likely would generally be along the current alignment of Cristianitos Road that takes advantage of the most gentle terrain separating the two watersheds. A potential north-south dispersal route following Cristianitos Road gradually climbs from about 300 feet at San Juan Creek to about 500 feet maximum elevation before dropping down into Cristianitos Canyon where, at about 300 feet, the Cristianitos population is located. A tributary to Cristianitos Creek adjacent to the road that picks up about 1.1 miles south of San Juan Creek would seem the most likely dispersal corridor to the Cristianitos population. A second potential dispersal route is a tributary to San Juan Creek east of Cristianitos Road that would require toads to disperse through dense and rugged chaparral at elevations of at least 600 feet. For toads potentially moving between San Juan Creek and Upper Cristianitos generally a 5,000 to 6,000 foot wide swath of natural vegetation between PAs 4 and 5 would be conserved, providing a robust connection between the two populations.

The connection between the Radio Tower Road and Cristianitos populations would be less direct. Currently the only physical obstacle between the two populations is the Oglebay Norton

Industrial Sands operation in Trampas Canyon. Intact natural vegetation directly links the two populations north and south of the mine. Upon development of PA 5 this existing potential link would be disrupted and toads would have to move either north or south of PA 5 development. Movements to the north possibly could occur along the face of the hill south of Ortega Highway or more indirectly via San Juan Creek. Movements to the south could occur along the constrained habitat linkage K between PA 5, the Prima Deshecha Landfill and the Talega development. Either route would substantially increase the required movement distance.

ADAPTIVE MANAGEMENT PROGRAM

Stressors

Management of the western spadefoot toad will consider several environmental stressors identified for the species, including:

- Exotic predators
- Altered fire regime
- Too frequent flood regime
- Too infrequent flood regime
- Precipitation
- Groundwater extraction
- Water quality
- Urbanization adjacent to Reserve
- Exotic plant invasion
- Cattle-related impacts
- Roads and trails
- Recreation

Beyond loss and conversion of habitat, one of the primary factors in the decline in amphibians in California appears to be the introduction of exotic species such as bullfrogs and fishes (Fisher and Shaffer 1996). The planting of mosquito fish for mosquito abatement programs in rain pools threatens some populations (Jennings and Hayes 1994) and predatory bullfrogs emigrating into rain pool breeding sites also pose a threat to western spadefoots (Hayes and Warner 1985; Morey and Guinn 1992). Fisher and Shaffer (1996) documented a general significant inverse relationship between declines in amphibians, including western spadefoot, and introduced exotics (bullfrogs and fish) in the Central Valley. They also found that most ponds with native amphibians lacked exotic species.

In principle, other stressors listed above that potentially alter breeding and non-breeding upland habitat such as fire (both destruction of vegetation and soil impacts such as erosion of uplands

and sedimentation of creeks and pools), altered flood regimes, surface and subsurface water sources, and roads and trails can have profound effects on spadefoot populations. For example, breeding pool duration is extremely important for successful reproduction. Morey (1998) found that successful metamorphosis in the Central Valley occurred in pools that were filled for at least 36 days, although successful metamorphosis may occur in as few as three weeks (Jennings and Hayes 1994). Also, metamorphosis occurs at a larger size in longer duration pools, which has important implications for terrestrial survival and fitness (*e.g.,* fatter toads are more resistant to starvation that leaner toads) (Morey 1998).

Cattle may have an impact on this species if cattle trample eggs masses and tadpoles and lower water levels when they drink at pools. However, a recent study of Central California vernal pools suggests a more complex relationship between cattle and vernal pool hydrology, where in some cases cattle grazing may enhance pool duration and the likelihood of vernal pool species completing their reproductive cycles (Pyke and Marty 2005; Marty 2005).

Collecting of toads at pools accessible by the public also is a potential threat to this species.

Goals

Goals for protecting and managing the western spadefoot toad and its habitat include the following:

1. Maximize the likelihood of the persistence of the physiographic diversity of riparian/wetland habitats, including vernal pools, and adjacent upland habitats in the Habitat Reserve.
2. Restore riparian/wetland habitats and enhance the quality of degraded riparian/wetland habitats and vernal pools in the Habitat Reserve such that the net habitat value of the existing riparian/wetland habitat system and vernal pools is preserved.
3. Manage fire regimes to sustain and enhance riparian/wetland and vernal pool habitat quality in the Habitat Reserve.
4. Manage exotic invasions of riparian/wetland habitats such as giant reed, pampas grass, tamarisk, and castor bean and invasives in vernal pools.
5. Protect and manage the western spadefoot toad and upland foraging and estivation areas in the Habitat Reserve.

Management and Monitoring Objectives (number of goal met by objective in parentheses)

Several of the objectives address the above goals at the landscape/vegetation community level even though the spadefoot toad occurs in a patchy distribution based on documented locations. Ecosystem-level management and monitoring, however, encompasses both known breeding areas and potential breeding areas and allows for future natural expansion of the existing population.

Objective 1: Implement Conservation Strategy to protect and manage riparian/wetland and vernal pool breeding habitat and suitable upland foraging and estivation habitat within a minimum 650-foot buffer between the conserved *important populations* in the Habitat Reserve and adjacent development (Goals 1 & 2).

Objective 2: Remap vegetation communities in Habitat Reserve within two (2) years of executing IA to establish a baseline for long-term tracking of the Reserve (Goals 1, 2 & 4).

Objective 3: Update vegetation community map at 5-year intervals (Goals 1, 2 & 4).

Objective 4: Collect regional climate, weather and air quality information to examine potential correlations between vegetation and population changes and environmental variables (Goals 1, 2 & 5)

Objective 5: Provide for no net loss of acreage and function of the waters of the U.S./State (Goals 1 & 2).

- Implement riparian/wetland restoration component of Habitat Restoration Plan.

Objective 6: Implement the vernal pool management and monitoring element of the HRMP as described *Part I, Chapter 7* (Goals 4 & 5).

Objective 7: Conduct periodic monitoring of documented and potential spadefoot breeding locations to measure population trends. The monitoring schedule will need to be flexibly tied to local climatic conditions, such as significant storm events and persistence of breeding pools (Goal 6).

Objective 8: Implement Wildland Fire Management Plan such that sub-basin watersheds, riparian/wetlands, and vernal pool breeding areas are protected to the extent feasible (Goals 1, 2, 3 & 5).

Objective 9: Implement coordinated Grazing Management Plan to protect vernal pools such that existing habitat values are maintained and enhanced (Goals 1, 2, 4 & 5).

- Exclude cattle from vernal pools during the breeding season. Toads are opportunistic breeders in relation to significant storm events but breeding

typically occurs winter-spring in association with winter storms. Timing of exclusions from vernal pools would be consistent with protecting fairy shrimp.

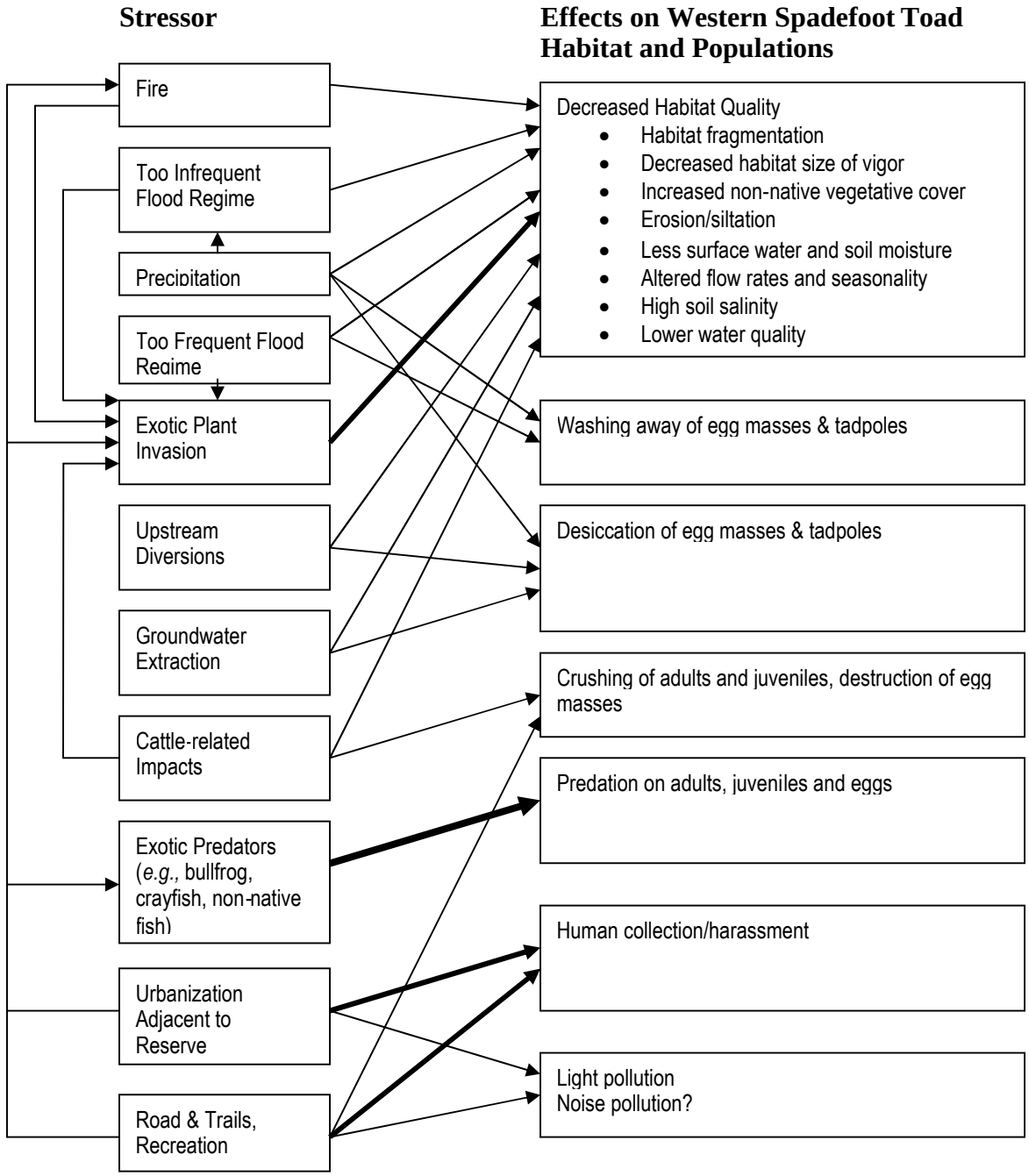
Objective 10: Implement Invasive Species Control Plan to manage invasive exotic species in riparian/wetland and vernal pool habitats (Goals 1, 2, 4 & 5).

- Control major infestations of giant reed in San Juan Creek and smaller infestations in GERA and Cristianitos Creek.
- Control major infestations of tamarisk in Cristianitos Creek and isolated clusters in Gabino and San Juan creeks.
- Control pampas grass infestation in San Juan Creek and Cristianitos Creek.
- Control substantial castor bean infestation Cristianitos Creek and scattered occurrences in San Juan Creek.
- Control Spanish sunflower occurrences Gobernadora Creek (GERA) and monitor/conduct early eradication in Chiquita Creek, San Juan Creek and Cristianitos Creek as needed.
- Control exotic species in vernal pools (bromes, wild oats, wild rye, rabbit's-foot grass, brass buttons, sharp-toothed timothy, and hyssop loosestrife) through various techniques, including timed grazing (Radio Tower Road pools only), prescribed burning (likely Radio Tower Road pools only), mowing, and selective weeding. Any use of herbicides within the contributing hydrological area of the vernal pools would need to be carefully controlled unless it can be demonstrated that the herbicides do not pose a risk to the spadefoot toad.
- Control bullfrogs and crayfish, and possibly non-native fishes, in areas that pose a risk to the western spadefoot toad.
- Assess and control Argentine ants where determined to pose a risk to western spadefoot toad.

Conceptual Model

Yes – See figure below.

Western Spadefoot Toad Conceptual Stressor Model



Regional and Subregional Management Information Needs

- Population trends and demographics.
- Significant factors affecting the overall population trends of spadefoots and other amphibians. Are they globally (*e.g.*, ultraviolet radiation, disease, global warming) or locally caused by anthropogenic sources (*e.g.*, habitat modification, introduction of exotic species) or some combination of both?
- The terrestrial life stage natural history of the species (*e.g.*, habitat selection, long distance overland dispersal movements, etc.) that relate to conservation and management of the species.
- Whether life history traits and ecological conditions covary in different parts of the western spadefoot toad's range that are relevant to management of the species, such as development patterns related to the timing and duration of breeding pools (*e.g.*, see Marty 2005).
- Effectiveness of habitat restoration, including revegetation and enhancement in supporting breeding populations of western spadefoot toads.
- The main threats to the western spadefoot toad during the non-breeding season.
- Disease as a significant risk factor for the western spadefoot toad.
- Aerial contaminants as a significant risk factor.
- Effectiveness of the variety of protection and management measures implemented to conserve the western spadefoot toad.
- The spatiotemporal pattern of breeding locations in the Habitat Reserve.
- Effects of reductions in groundwater extraction on breeding habitat quality in San Juan Creek**.**
- The extent to which invasive species controls in riparian/wetland and vernal pools habitats expand and enhance western spadefoot toad breeding habitat and what are the most effective control techniques.
- The extent to which breeding/recruitment success relates to rotational grazing patterns.
- The significant predators, if any, of spadefoot toads in the Habitat Reserve.
- The most effective methods for controlling bullfrogs and crayfish, and possibly non-native fishes, in the Habitat Reserve.
- The direct risk Argentine ants pose western spadefoot toads (*e.g.*, preying on metamorphs) in the Habitat Reserve and indirect risks through impacts on the native insect prey population.

- What risk, if any, urban-related predators pose to spadefoot toads in the Habitat Reserve.
- The relationship between breeding success and certain land and human uses and attendant impacts, such as noise, human activity, etc., adjacent to occupied spadefoot toad breeding habitat in the Habitat Reserve.

Level of Management and Monitoring Priority - Medium

The western spadefoot toad has a discrete, limited distribution in the Habitat Reserve, with five identified *important populations*, and several other small scattered locations. The western spadefoot toad is assigned a medium priority for management and monitoring because of the limited number of occupied sites and because there are clear habitat-based and species-specific stressors on this species, including giant reed and bullfrogs in San Juan Creek. Both of these stressors have been identified for management during Phase 1 of HRMP implementation. Most of the management actions that would benefit this species, as discussed below, are habitat-based (*e.g.*, invasive species controls, water quality management) and would also benefit other aquatic species. Also, the spadefoot toad can be monitored in conjunction with monitoring of the high priority Riverside and San Diego fairy shrimp populations in vernal pools on Chiquita Ridge and Radio Tower Road mesa, and the medium priority pond turtle in San Juan Creek and the upper Cristianitos stock pond.

Level of Monitoring (*e.g.*, Species-specific, habitat, landscape, combination)

Monitoring will be conducted both primarily at a species-specific level but also at a habitat landscape level.

Monitoring Variables

Listed below are suggested species- and habitat-based monitoring variables. The detailed monitoring program for the western spadefoot toad will be developed by the Reserve Manager and Science Panel.

Species-specific Monitoring Variables

1. Status of breeding population
2. Proportion of "suitable" habitat occupied (see MacKenzie *et al.* 2002)

Habitat-based Monitoring Variables

1. Vegetation communities long-term status
2. Relative cover of different native plant species
3. Proportion of exotic plant species/native plant species
4. Results of habitat restoration activities, including invasive species controls, riparian/wetland restoration, and creek and soils stabilization programs

Abiotic Monitoring Variables

1. Climate
2. Weather
3. Air quality
4. Water quality and runoff

Management Actions

Management actions to address these stressors and that would benefit the western spadefoot toad include: **(1)** conservation of downstream habitat in San Juan Creek by maintaining hydrology, water quality and sediment delivery and minimizing additional loadings of nutrients or toxics; **(2)** implementation of a bullfrog and crayfish control program within permanent and semi-permanent water bodies in San Juan Creek, identification of other bullfrog and crayfish breeding areas that may pose a risk to the spadefoot, and implementation of control programs where necessary; **(3)** maintenance/repair of stormwater flow characteristics comparable to existing conditions from Trampas Canyon into San Juan Creek to preserve breeding habitat; and **(4)** implementation of a management program for vernal pools and other ephemeral breeding sites for the spadefoot, including control of non-native species and minimization of human access. The coordinated GMP also would benefit this species by protecting vernal pools and potential breeding pools in San Juan Creek during the breeding season.

Habitat restoration activities that would benefit the western spadefoot toad include implementation of an invasive species control program for San Juan Creek on RMV between San Juan Capistrano and Bell Canyon to control giant reed and pampas grass in coordination with upstream control efforts by the County and the CNF.

Other management actions subject to discretionary implementation by the Reserve Manager and Science Panel that potentially could enhance breeding and upland estivation habitat value for the western spadefoot toad include implementation of an invasive species control program for lower Cristianitos Creek from the confluence with Gabino Creek and the RMV boundary to control tamarisk, pampas grass, bullfrogs and crayfish and implementation of a native grasslands restoration program in the upper portion of the Cristianitos sub-basin.

Potential Target Studies

Several regional and subregional information management needs relevant to management of the western spadefoot toad were listed above, some of which could be addressed at the subregional scale and would help inform management of the Habitat Reserve. Other regional and subregional information management needs, particularly those related to rangewide persistence of the species (*e.g.*, landscape habitat fragmentation) are best studied at a rangewide scale. The following are potential target studies that could be implemented at the subregional scale:

- Evaluation of impacts of exotic and urban-related predators on western spadefoot toads
- Assessment of impacts of Argentine ants and evaluation of controls
- Evaluation of restoration effects on breeding populations, including invasive species controls, active revegetation and upstream restoration in Gobernadora to reestablish natural creek meander and control fine sediments
- Evaluation of adverse edge effects on occupation and/or breeding success
- Evaluation of the exclusion of cattle from vernal pool areas during the ponded season.
- Evaluation of reduced groundwater extraction related to San Juan Creek with phasing out of agriculture and nurseries and orchards

SPECIES ACCOUNT

Rangewide and Regional Status

The western spadefoot toad is a California near endemic ranging from Shasta County southward into Baja California (Stebbins 1985). Its known elevation range extends from near sea level to 1,500 m (4,921 ft) (Zeiner *et al.*1990; Ervin *et al.* 2001). The known range of western spadefoot toad is restricted to west of the Sierran-desert range axis (Myers 1944).

The western spadefoot toad is a CDFG CSC and has a CNDDB rank of G3S3; per the CNDDB ranking, it is considered restricted/rare throughout its range in California (which is also essentially its global range). About 80 percent of the habitat once occupied by western spadefoot toad in southern California has been developed or converted to uses incompatible with successful reproduction or recruitment (Jennings and Hayes 1994). In addition, planting of mosquito fish for mosquito abatement programs in rain pools threatens some populations (Jennings and Hayes 1994) and bullfrogs emigrating into rain pool breeding sites also may pose a threat to this species as a predator (Hayes and Warner 1985; Morey and Guinn 1992). Finally, cattle grazing may have an impact on this species if cattle trample eggs masses and tadpoles and lower water levels when they drink at pools.

Table 2-27 summarizes the 243 records in the 2003 CNDDB database for the western spadefoot toad in California. Because there are numerous records, the table only tabulates the number of locations by county and does not include general location information. The toad is widespread in the central and southern coastal portions of the state. However, the table does not reflect the location of *major* or *important populations* or *key locations*.

TABLE 2-27
2003 CNDDB RANGEWIDE DISTRIBUTION OF THE WESTERN SPADEFOOT TOAD IN CALIFORNIA

County	No. of CNDDB Records
Alameda	1
Butte	1
Calaveras	2
Colusa	1
Fresno	11
Kern	4
Kings	7
Los Angeles	7
Madera	14
Merced	13
Monterey	22
Orange	7
Placer	4
Riverside	19
Sacramento	5
San Benito	15
San Diego	7
San Joaquin	11
San Luis Obispo	25
Santa Barbara	28
Stanislaus	11
Tehama	1
Tulare	10
Ventura	1
Yolo	2

Table 2-28 provides more detailed information for western spadefoot locations in southern California based on data from the various conservation planning programs. This information also should be considered as distributional and does not identify *major* or *important populations* or *key locations*. However, it is evident from *Table 2-28* that the spadefoot toad is still relatively widespread in its distribution in Orange, Riverside and San Diego counties.

TABLE 2-28
WESTERN SPADEFOOT TOAD LOCATIONS IN SOUTHERN CALIFORNIA

Conservation Planning Area/County	General Locations
San Diego County MHCP	Buena Vista Lagoon, Page Creek in north Escondido, San Marcos Creek in southeast Carlsbad, Daley Ranch in Escondido
San Diego County – Other Locations	San Dieguito River near Rancho Santa Fe, Sycamore Canyon on Camp Elliot Naval Reservation, west-southwest of Starvation Mountain, vernal pools near Carroll Canyon, off Highland Valley Road, South Fork of Moosa Creek, Carmel Mountain, 1.3 mi south of Horno Hill on Camp Pendleton, considered relatively widespread and abundant on Camp Pendleton (Camp Pendleton AARS 1998), substantial roadkills observed (1) along Cristianitos Road between junction with San Mateo Road and Camp Talega, (2) Basilone Road east of San Onofre housing area to the 52 area, (3) Old Highway 101 between Las Pulgas Road and the SDGE yard.
Riverside County MSHCP	South of Temecula near Interstate 15, south and east of the Lake Mathews Reserve, north of Lake Elsinore, Diamond Valley Reservoir, Canyon Lake, Murrieta, Lee Lake, City of Corona, Banning-Beaumont, Moreno Valley, Santa Ana River; Temescal Wash, Lake Perris, San Jacinto River near Nuevo, south of Lake Skinner, Rawson Canyon, Motte-Rimrock Reserve, Santa Margarita Ecological Reserve
Orange County Southern Subregion	Vernal Pools on Chiquita Ridge and Radio Tower Road, upper Chiquita Canyon, San Juan Creek south of Chiquita Ridge and at confluence with Verdugo Canyon, upper Cristianitos Canyon, lower Gabino Canyon, upper Aliso Watershed north of El Toro Road
Orange County - Other Locations	Bee Canyon, Dana Point, near junction of Santiago Canyon Road and landfill, lower Cristianitos Creek northeast of San Clemente.

Subregional Status

The NCCP database includes 24 discrete locations for the western spadefoot toad, all of which are in Subarea 1 (*Figure 176-M*). Bloom's pre-1998 data include four spadefoot locations: near the RMV headquarters above San Juan Creek; along San Juan Creek approximately 0.5 mile east of the headquarters; near the confluence of Bell Canyon and San Juan Creek; and in grassland along Avenida Pico approximately 1 mile west of Cristianitos Canyon. Subsequent SOCTIIP surveys found spadefoot toads in San Juan Creek and upper Cristianitos Canyon. Other surveys by Bloom in 1998 documented several new locations. Several individuals and their larvae were found on RMV land within 0.75 mile of a Ranch residence south of the Ortega Highway. Four

individuals were found near the confluence of Gabino Creek and Cristianitos Creek in the "Roundup/BBQ" area. Larvae also were found in vernal pools within Ladera Open Space on Chiquita Ridge. In addition, one spadefoot individual was found within Caspers Wilderness Park near the entrance. Pete DiSimone, in a personal communication to Pete Bloom, reported several larvae in a small pool on Starr Ranch. A spadefoot toad location from upper Chiquita Canyon was reported by Harmsworth Associates. The CNDDB includes records from Aliso Creek (not shown on map) and Bell Canyon at San Juan Creek. None of these locations numbered more than four adult individuals, suggesting relatively small populations in the subregion. Based on the existing database, no *major populations* occur in the Southern Subregion. However, five *important populations* are identified:

- Vernal pools on Chiquita Ridge in Ladera Open Space support an *important population* (No. 1 on *Figure 176-M*). These pools also support the Riverside and San Diego fairy shrimp and the special status plant mud nama.
- Vernal pools on Radio Tower Road support an *important population* (No. 2 on *Figure 176-M*). These pools also support the Riverside and San Diego fairy shrimp and mud nama.
- San Juan Creek from the RMV Headquarters to the confluence with Verdugo Canyon support an *important population* (No. 3 on *Figure 176-M*). These sites overlap with occupied and potential arroyo toad habitat.
- A stock pond in upper Cristianitos Canyon supports an *important population* (No. 4 on *Figure 176-M*). This site overlaps with an *important population* of the southwestern pond turtle.
- Lower Gabino Canyon supports an *important population* (No. 5 on *Figure 176-M*). This site overlaps with an *important population* of the arroyo toad.

Because all of these scattered locations appear to support small populations and none appear to be crucial for maintaining the species in the planning area, no *key locations* were identified.

The 1998 surveys began somewhat late in the spadefoot toad breeding season and some breeding sites may have been missed. Bloom believes that the toad is more widespread in the planning area than indicated in the database. However, it seems unlikely that any new locations would constitute a *major population* or a *key location*. Even though the survey probably was too late in the season to find all the locations, it seems unlikely that a *major population* would have been missed.

Biological Considerations

Western spadefoot toads inhabit coastal sage scrub, chaparral, and grasslands habitats, but are most common in grasslands with vernal pools or mixed grassland/coastal sage scrub areas (Holland and Goodman 1998). For reproduction and successful metamorphosis, western spadefoot toads require rain-filled pools ranging between 9 and 30 degrees C (48-86 degrees F) (Brown 1966, 1967) that hold standing water for more than three weeks (Feaver 1971). Riparian habitats with suitable water resources also may be used for reproduction (Holland and Goodman 1998). Breeding pools must lack fish, bullfrogs, and crayfish in order for western spadefoot toad to successfully reproduce and metamorphose (Jennings and Hayes 1994).

Breeding efforts probably are tied to the amount of rainfall (Holland and Goodman 1998), but artificial irrigation may elicit advertisement (reproductive) vocalizations during any month (Zeiner *et al.* 1990). After periods of warm rains, spadefoot toads emerge from burrows and form explosive, and sometimes large (>1,000 individuals) aggregations (Jennings and Hayes 1994). This typically occurs in late winter and early spring, but also may occur during the fall (Storer 1925; Feaver 1971; Jennings and Hayes 1994).

Because the critical thermal minimum is 9 degrees C (48 degrees F) (Brown 1966), spadefoot toads wait until water temperature is at least 10 degrees C (50 degrees F) before egg deposition (Jennings and Hayes 1994). Eggs are deposited in irregular small clusters about 25-30 cm (9.8-11.8 in) in diameter (Holland and Goodman 1998). They are attached to vegetation or debris (Storer 1925) in shallow temporary pools or ephemeral streamcourses (Stebbins 1985; Jennings and Hayes 1994). Egg clusters rarely number more than 42 eggs (Jennings and Hayes 1994). The rate of egg hatching is water temperature-dependent (Brown 1967); however, eggs usually hatch within six days. Complete development can rapidly occur within three weeks (Holland and Goodman 1998), but may last up to 11 weeks (Burgess 1950; Feaver 1971; Jennings and Hayes 1994).

Water temperature, water evaporation, water chemistry, and food resources regulate the rate of development of western spadefoot toad (Holland and Goodman 1998; Denver 1998; Denver *et al.* 1998; Newman 1998; Morey and Reznick 2003). Tadpoles experimentally subjected to water volume reduction showed significant acceleration of metamorphosis (Denver *et al.* 1998), but the rate of accelerated development was determined by rate of water reduction and was reversible (decelerated development) by replacement of water. An accelerated metamorphosis appears to be a response to reduced swimming volume and proximity to water surface (Denver *et al.* 1998). Morey and Reznick (2003) found that western spadefoots breed synchronously in relation to heavy spring rains. Also, they found that spadefoots vary both in age and size at metamorphosis in relation to food resources, with larger sizes and reduced age at metamorphosis under good resource conditions. Spadefoot tadpoles exhibit several other adaptations for breeding in

temporary pools, including cannibalism, production of growth inhibitors (to affect other tadpoles), and high heat tolerance (Low 1976).

After metamorphizing in the late spring, juvenile toads disperse after a short period of time (Zeiner *et al.* 1990). Western spadefoot toads apparently do not move far from their breeding pool during the year, with movements within a few hundred meters of breeding pools (Zeiner *et al.* 1990), and it is likely that their entire post-metamorphic home range is situated around a few pools. Toads estivate in upland habitats adjacent to potential breeding sites in burrows approximately 1 m (3.3 ft) in depth (Stebbins 1972). Although not observed specifically for this species, soil characteristics of burrow refuge sites likely become fairly hard and compact during the period of summer estivation (Jennings and Hayes 1994; Ruibal *et al.* 1969).

About 80 percent of the habitat once occupied by western spadefoot toad in southern California has been developed or converted to uses incompatible with successful reproduction or recruitment (Jennings and Hayes 1994). In addition, planting of mosquito fish for mosquito abatement programs in rain pools threatens some populations (Jennings and Hayes 1994) and bullfrogs emigrating into rain pool breeding sites also may pose a threat to this species as a predator (Hayes and Warner 1985; Morey and Guinn 1992). Finally, cattle grazing may have an impact on this species if cattle trample eggs masses and tadpoles and lower water levels when they drink at pools

Protection Recommendations

- Avoid impacts to vernal pools and their contributing hydrological sources along Radio Tower to support all life stages of the western spadefoot toad. The Chiquita Ridge pools are already protected in Ladera Open Space.
- Maintain and manage riparian and aquatic habitats along San Juan Creek to support all life stages the western spadefoot toad.
- Protect wetlands and adjoining upland habitat within 200 m (650 ft) of breeding sites in upper Cristianitos Canyon to support all life stages of western spadefoot toad.
- Protect the western spadefoot toad breeding population near the confluence of Gabino and Cristianitos creeks by avoiding direct impacts to breeding, foraging and estivating habitat (within 200 m [650 ft] of breeding sites), and avoiding indirect impacts to the watershed.

Management Recommendations

- Protect downstream habitat for the western spadefoot toad by maintaining hydrology, water quality and sediment delivery in San Juan Creek and minimizing additional loadings of nutrients or toxics.
- Implement a bullfrog eradication program for the Cal-Mat Lake within San Juan Creek and in the ponds north of lower Gabino Creek to help protect western spadefoot toads. Identify other bullfrog breeding areas that may pose a risk to western spadefoot and implement a bullfrog eradication program where necessary.
- Maintain stormwater flow characteristics comparable to existing conditions from Trampas Canyon into San Juan Creek to preserve breeding habitat for the western spadefoot toad.
- Implement a management program for vernal pools and other ephemeral breeding sites for the western spadefoot toad, including control of non-native species, management of grazing, and minimization of human access and disturbance as part of the Adaptive Management Program.
- Protect the integrity of the western spadefoot toad population in lower Gabino and Cristianitos creeks by implementing the Watershed and Sub-basin Planning Principles.

Restoration Recommendations

- In coordination with upstream eradication efforts, implement an invasive species eradication program for San Juan Creek between San Juan Capistrano and Bell Canyon to control giant reed and pampas grass.
- Implement an invasive species eradication program for lower Cristianitos Creek from the confluence with Gabino Creek and the RMV boundary to control tamarisk, giant reed and pampas grass.
- Implement a native grasslands restoration program in conjunction with the grazing techniques described above for the upper portion of the Cristianitos sub-basin that would benefit the western spadefoot toad.

2.15 CALIFORNIA GLOSSY SNAKE

Species:	California Glossy Snake (*Arizona elegans occidentalis*)
Federal Status:	None
State Status:	None
CNDDB Rank:	None
Science Advisors Group:	3
Covered Species:	Yes
Focal Monitoring Species:	No
Planning Species:	No

CONSERVATION GOAL

1. Protect and manage habitat of the California glossy snake to maximize the likelihood that populations are sustained in the planning area, and in doing so "provide for recovery" on a subregional basis and "contribute to recovery" on a rangewide basis.

CONSERVATION STRATEGY

1. Create a permanent subregional Habitat Reserve that provides sufficient habitat in large, contiguous patches to maximize the likelihood of the California glossy snake's persistence within the planning area.
2. Formulate a HRMP to provide for long-term protection and management of habitat for the California glossy snake.

HABITAT AND SPECIES CONSERVATION AND IMPACTS ANALYSIS

A landscape-level, habitat-based analysis primarily is applied to the California glossy snake because of its relatively broad habitat requirements and relative lack of site-specific occurrence data. Amount of habitat conserved and habitat patch size, contiguity and connectivity are considered for this species. Although the habitat analysis is at a landscape level, this species typically uses loose soils (sandy and loamy soils), but also rocky areas. For the purpose of estimating suitable habitat for the impact and conservation analysis, the following soils were considered potentially suitable for the glossy snake: Anaheim loam, Blasingame loam and stony loam, Botella loam, Capistrano sandy loam, Cieneba sandy loam, Cieneba-Blasingame-rock outcrop complex, Corralitos loamy sand, Exchequer-rock outcrop complex, Hanford sandy loam, Marina sandy loam, Mocho loam, Myford sandy loam, Modjeska gravelly loam, Ramona fine sandy loam, Riverwash, rock outcrop-Cieneba complex, San Andreas sandy loam, Soboba cobbly loamy sand, Soboba gravelly loamy sand, Soper loam, Soper gravelly loam, Soper-rock

outcrop compex, Sorrento loam, Yorba gravelly sandy loam and Yorba cobbly sandy loam. Vegetation communities/land covers used by the glossy snake include coastal sage scrub, chaparral, grassland, riparian, stream courses and woodlands and forest. Using GIS the suitable soils and vegetation communities/land covers were intersected with the proposed B-12 Alternative impact areas, Habitat Reserve and SOS.

Table 2-29 provides a summary of the existing conditions, proposed conservation, and permanent and temporary impacts of California glossy snake habitat in the planning area and within the Subarea 1 permit area. The description of impacts and conservation below is limited to Subarea 1 which is the permit action area. The planning area conservation and impact estimates reported in *Table 2-29* include SOS and potential impact areas in Subareas 2, 3 and 4 and do not reflect future planning within those Subareas that may result in changes to the SOS and impact estimates. For example, future planning in the Subarea 2 (Foothill-Trabuco Specific Plan Area) likely will result in changes to the open space and impact estimates.

TABLE 2-29
CALIFORNIA GLOSSY SNAKE CONSERVATION AND IMPACT SUMMARY

	Acres	Percent	Locations	Percent
Planning Area				
Existing Total	34,283		4	
Habitat Reserve	20,989	61%	4	100%
Supplemental Open Space	3,013	9%	0	0
Total Protected	24,002	70%	4	100%
Total Permanent Impact	6,425	19%	0	0%
Subarea 1				
Existing Total	28,433		4	
Habitat Reserve	20,989	74%	4	100%
Supplemental Open Space	2,300	8%	0	0
Total Protected	23,289	82%	4	100%
Total Permanent Impact	5,115	18%	0	0%
Total Temporary Impact	288		0	0%

Subarea 1 Impacts

The proposed Covered Activities would result in direct, permanent impacts to 5,115 acres (18 percent) of suitable habitat, as defined above and shown in *Table 2-29*. None of the four documented locations in Subarea 1 would be impacted (*Figure 202-M*). The proposed Covered Activities also would result in temporary direct impacts to 288 acres of habitat, but no sites (*Table 2-29*).

Subarea 1 Conservation

All four documented locations in Subarea 1 and 20,989 acres (74 percent) of habitat would be conserved in the Habitat Reserve (*Table 2-29* and *Figure 202-M*). An additional 2,300 acres (8 percent) of habitat are in Subarea 1 SOS, bringing the total conservation of habitat to 23,289 acres (82 percent).

There are no data on dispersal or other spatial behavior of the glossy snake. However, it seems reasonable to assume that glossy snakes are unlikely to disperse between highly isolated habitat patches through unsuitable habitat and that roads are a significant risk for the species due to vehicle collisions. Thus habitat patch size, contiguity and connectivity likely are key reserve design considerations for this species.

The results of the refined habitat block delineation used to analyze patch size are presented in *Part I, Chapter 13*, *Table 13-9* and depicted in *Figure 193-M*. The seven habitat blocks combined include about 28,489 acres (including habitat in SOS in Coto de Caza in Subarea 3) of suitable vegetation types.[3] Habitat within the blocks ranges from 809 acres in the Radio Tower Road mesa block to 13,694 acres in the Southeastern block.

- Habitat linkages likely to be important for the glossy snake also would be conserved, including: the north-south connection along Chiquita Ridge spanning the area from Ladera Open Space to Chiquita Creek (linkage C); the east-west connection from Arroyo Trabuco to Gobernadora and Caspers Wilderness Park via Chiquita Canyon (linkages B, D, H, I); the north-south connection along Chiquadora Ridge (linkage G); the floodplain along San Juan Creek and into Bell Canyon (linkage J); the linkage along and perpendicular to Verdugo Canyon (linkages L and M); the north-south linkages through the central and western portions of Trampas Canyon and Cristianitos Canyon (linkages J, K and N); and linkages O, P and Q in Gabino, La Paz and Talega canyons, respectively (see *Figure 193-M*). Where roads cross linkage areas wildlife movement and dispersal will need to be addressed. For example, bridges will be constructed across San Juan, Chiquita and Gobernadora creeks for Cow Camp Road, and San Juan Creek and Chiquadora Ridge for Cristianitos/"F" Street. For the extension of Cristianitos Road/"F" Street through Chiquita Canyon to Oso Parkway, wildlife culvert at Chiquita Narrows within the design of Cristianitos Road shall be included with the following dimensions: The culvert shall have a minimum dimension of 15 by 15 feet, the bottom of the culvert shall be of a natural substrate, light shall be visible from one end of the culvert to the other, vegetation installed at either end shall be native low growing to prevent predator-

[3] Note that the soils analysis was not applied to the habitat blocks. For the block analysis, it seemed reasonable to base the estimate on the conservation of suitable vegetation communities alone because intact, contiguous habitat areas in a block within which both suitable (sands, loams and rock outcrops) and unsuitable soils (clays and silts) occur function as an integrated habitat area.

prey stalking, and if required for public health and safety, all lighting on the road above the culvert shall be shielded to prevent spill-over effects (*NCCP Minimization Measure 8-1*).

ADAPTIVE MANAGEMENT PROGRAM

Stressors

The California glossy snake has not been studied adequately to directly evaluate environmental stressors on the species. However, it can be assumed that general impacts to its habitat and prey base have an adverse effect on the species. In addition, direct impacts common to many snakes such as vehicle collisions and human harassment can be assumed. Thus the following land uses and activities that can be stressors on suitable habitat and/or individual snakes will be considered for management:

- Habitat loss and fragmentation
- Urbanization adjacent to Habitat Reserve
- Exotic plant invasions (especially those that choke sandy washes and streamcourses such as giant reed)
- Rodent controls (glossy snakes may use small mammal burrows as refugia, for foraging and for laying eggs)
- Urban-related predators such as dogs
- Roads and trails
- Argentine ants (through effects on native lizards that are important prey items for glossy snakes)
- Collection

Goals

Goals for protecting and managing the California glossy snake and its habitat include the following:

1. Protect and manage suitable habitat (with the exception of agriculture which will not be managed as wildlife habitat) to maintain approximate existing acreage in the Habitat Reserve.
2. Maintain the physiographic diversity of suitable habitat in the Habitat Reserve.
3. Manage exotic invasions of riparian and streamcourse habitats.
4. Protect and manage identified key habitat linkages to maximize the likelihood of habitat connectivity.

Management and Monitoring Objectives (number of goal met by objective in parentheses)

Objective 1: Implement Conservation Strategy to protect and manage approximately 20,989 acres of suitable habitat in Habitat Reserve (actual acreage will vary in relation to natural and anthropogenic environmental effects such as wildfires and drought) (Goals 1 & 2).

Objective 2: Remap vegetation communities in Habitat Reserve within two (2) years of executing IA to establish a baseline for long-term tracking of the Reserve (Goals 1 & 2).

Objective 3: Update vegetation community map at 5-year intervals (Goals 1 & 2).

Objective 4: Implement Invasive Species Control Plan to manage invasive exotic species in riparian and streamcourse areas (Goals 1, 2 & 3).

Objective 5: Implement management and monitoring of identified key habitat linkages to maximize the likelihood of continued function as "live in" and dispersal habitat for glossy snakes (Goal 4).

Conceptual Model

No. Insufficient data to develop conceptual model at this time.

Regional and Subregional Management Information Needs

- The general life history and autecology of the California glossy snake, including spatiotemporal behavior (*e.g.*, home range, territoriality, and dispersal) and key factors in habitat selection (*e.g.*, species composition, soil types, habitat structure, slope, aspect, etc.), especially in coastal areas.
- The current status and population trends of the California glossy snake, especially in the South Coast Ecoregion.
- The effects of habitat loss and fragmentation.
- Community relationships (*e.g.*, interspecific and predator-prey relationships).
- Significant sources of natural (*e.g.*, native predators) and human-related (*e.g.*, vehicle collisions, harassment, exotic predators) mortality.
- Effective and feasible management and monitoring methods.
- The spatial distribution of the glossy snake in the Habitat Reserve.

- Presence of other obstacles that could disrupt movement (*i.e.,* "Separation Barriers") within the Habitat Reserve.

Level of Management and Monitoring Priority - Low

There is a general lack of scientific information for the California glossy snake that can be used to directly inform conservation and management. Although the species appears to be very uncommon, with only four records in the planning area (and no recent records in pitfall trapping in the Central/Coastal Habitat Reserve; Fisher and Rochester 2000), there are no identified immediate threats to the species in Subarea 1 at this time that would warrant specific management and monitoring, particularly given the high level of habitat conservation (82 percent) and the high level of cost of conducting species-specific monitoring. At least through Phase 1 of the HRMP management and monitoring for the glossy snake, it is recommended that efforts focus on landscape-level management and, in particular, management and monitoring of identified habitat linkages where there is a concern about the ability of glossy snakes and other Covered Species and focal species to disperse through the landscape. At a species level, monitoring during Phase 1 will be based on anecdotal observations of the species (*e.g.,* observations of glossy snakes along standard wildlife/vegetation transects, roadkills, and other anecdotal observations). At some point in the future the Science Panel and Reserve Manager may recommend intensifying the monitoring effort for the suite of reptiles proposed for regulatory coverage, and the diversity and abundance of herpetofauna in general, through the use of pitfall trap arrays, or other species-appropriate survey methods, using standardized sampling protocols of sufficient statistical power (*i.e.,* some minimum number of sample sites monitored a minimum number of periods). Such a decision to intensify the monitoring effort likely would be based on regional information from the Wildlife Agencies or the USGS WERC that a species is at high risk of endangerment or a particular significant environmental stressor has been identified. In such a case, the Science Panel and Reserve Manager, through communications with the Wildlife Agencies would evaluate the situation in the context of the overall HRMP and determine the need for and feasibility of more intensive monitoring.

Level of Monitoring (*e.g.*, Species-specific, habitat, landscape, combination)

Monitoring will be conducted at both the habitat landscape and species-specific levels, but species monitoring will focus on anecdotal observations, not focused monitoring for the purpose of assessing spatiotemporal population trends.

Monitoring Variables

Listed below are suggested species- and habitat-based monitoring variables. A detailed monitoring program for the California glossy snake, if warranted, will be developed by the Reserve Manager and Science Panel.

Species-specific Monitoring Variables

1. Presence/absence
2. Estimates for the proportion of occupied habitat

Habitat-based Monitoring Variables

1. Vegetation communities long-term status
2. Relative cover of different native plant species
3. Proportion of exotic plant species/native plant species
4. Evidence of urban-related predators and mesopredators (*e.g.*, tracks, scat, direct observations)
5. Evidence of unauthorized public activities (*e.g.*, trespass, trampling, illegal trails, trash, shooting, etc.)

Management Actions

Management actions to benefit the glossy snake would be implemented primarily at a landscape level and include fire management and invasive species controls, including artichoke thistle controls in uplands and giant reed controls along washes that may be used for movement. Rodent controls will be prohibited within the Habitat Reserve, and the use of chemical pesticides in areas adjacent to the Habitat Reserve (*e.g.*, golf courses) will be minimized to the extent feasible and will be used in accordance with an approved Integrated Pest Management Program designed to avoid and minimize effects on native species and habitats. Control of urban-related predators such as cats and dogs will be controlled in the Habitat Reserve through public education and direct controls such as trapping to the extent necessary and feasible. Collecting of the glossy snake by the public would be prohibited within the Habitat Reserve. Signage along trails and bike paths in the Habitat Reserve will be used to inform the public of the risk to native species such as snakes and amphibians from recreational activities. Argentine ant controls will be implemented to reduce impacts on native lizards that are prey for the glossy snake. Habitat restoration activities implemented at the discretion of the Reserve Manager and Science Panel to benefit this species include CSS/VGL restoration on Chiquita Ridge, in Sulphur Canyon, and on Chiquadora Ridge.

Potential Target Studies

Several regional and subregional information management needs relevant to management of the California glossy snake were listed above, some of which could be addressed at the subregional scale and would help inform management of the Habitat Reserve. Other regional and subregional information management needs, particularly those related to rangewide persistence of the species (*e.g.*, general ecology, community relationships and landscape habitat fragmentation) are best studied at a rangewide scale. The following are potential target studies that could be implemented at the subregional scale:

- Effects of Argentine ant.
- Effects of urban-related predators.
- Effects of recreation activities.
- Effects of vehicles collisions (likely would be conducted as part of a general study of herpetofauna).
- Movement behavior within the Habitat Reserve in relationship to physical boundaries and obstacles such as urban edges and roads.

The Reserve Manager and Science Panel will determine and recommend to the RMVLC Board what target studies (possibly including studies not listed above) should be pursued, based on the identification and prioritization of management and monitoring issues and available funding.

SPECIES ACCOUNT

Rangewide and Regional Status

The full species of glossy snake occurs in the southwest United States and Mexico. Its range extends from southwest Nebraska to eastern Texas to central California, and from southern Utah to southern Baja, Mexico and southern Sinaloa, Mexico (Stebbins 1985). The subspecies California glossy snake (*A. e. occidentalis*) occurs in the Central Valley from about Mt. Diablo in Contra Costa County south to the northern portion of western Baja California and occupies all of Kings, Kern, Orange, San Bernardino, Riverside, San Diego, and Imperial counties (Zeiner *et al.* 1990) and most of Stanislaus, Merced, Inyo, and Los Angeles counties in cismontane habitats (Holland and Goodman 1998).

Despite its widespread distribution in California, there are few documented records for the glossy snake in southern California. Glossy snakes are primarily nocturnal and are rarely found under rocks and other surface objects typical of many other snakes (Stebbins 1985). Also, the CNDDB

does not contain records for the species because it is not a California special status species; *i.e.*, it is not a CSC and has no CNDDB global or state rank. The Western Riverside MSHCP database which covers 1.26 million acres, for example, only has three documented occurrences since 1984.

California glossy snake was identified for coverage because there is increasing concern for this species by biologists (P. Bloom, pers. comm. 2003) and there is a reasonable likelihood of listing of the species over the duration of the project.

Subregional Status

The NCCP Science Advisors report indicates that the planning area is one of only three locations in southern California where the species recently has been recorded. Bloom's data include four records of this species for the planning area: two records in coastal sage scrub along San Juan Creek at the entrance to Caspers Park; at the Caspers Park visitor center; and San Juan Creek at Cow Camp (*Figure 202-M*). However, based on this species' habitat associations, it potentially could occur in suitable habitat throughout the planning area landscape, and thus no *important populations* or *key locations* for the species have been identified.

Biological Considerations

The California glossy snake usually inhabits open areas with sandy or loamy soils, typically riparian areas and wash habitats, and also occurs in coastal sage scrub, chaparral, grassland and sparse oak woodlands, typically in areas with sparse vegetation and loose soils (Holland and Goodman 1998).

Rodriguez-Robles *et al.* (1999) found that glossy snake prey were predominately lizards (50 percent), followed by mammals (44 percent), birds (4 percent), and snakes (2 percent). The glossy snake has been observed foraging from a passive approach feeding on nocturnal mammals as well as from an active approach feeding on diurnal lizards (Rodriguez-Robles *et al.* 1999).

Glossy snakes are oviparous (egg-laying). Clutch size ranges from 3 to 23 eggs, with 8 or 9 an average, and are laid in loose soil a few centimeters below the surface, near the base of vegetation, or in abandoned mammal burrows (Zeiner *et al.* 1990). Eggs are laid in the summer and hatching occurs from late August to mid-September (Aldridge 1979; Holland and Goodman 1998).

The glossy snake mainly is nocturnal with some minor diurnal activity observed (Brattstrom 1952). It is active from April to October (Holland and Goodman 1998), but is most active during

May and June, and again following the first significant fall rain event (Zeiner *et al.* 1990). Hibernation most likely occurs during fall and winter.

Connectivity of suitable habitat for this species is impacted by human-induced separation barriers including highways, buildings, and pavement. Natural barriers include major rivers, lakes, ponds, or deep marshes (pertaining only to upland species and not wetland/aquatic types). According to Hammerson (NatureServe 2005), the separation distance for unsuitable habitat for *A. elegans* is one kilometer, and five kilometers for suitable habitat. The information available on movement of colubrid snakes is limited to a small minority of species. These data indicate that nearly all species have home ranges smaller than 62 acres (Rodriguez-Robles 2003). Evidence of genetic structure even over short distances (*e.g.*, 2-20 km) implies that gene flow among rat snake populations can be easily disrupted (Prior *et al.* 1997; cited on NatureServe 2005).

2.16 COAST PATCH-NOSED SNAKE

Species:	Coast Patch-nosed Snake (*Salvadora hexalepis virgultea*)
Federal Status:	None
State Status:	CSC
CNDDB Rank:	G5T3S2S3
Science Advisors Group:	2
Covered Species:	Yes
Focal Monitoring Species:	No
Planning Species:	No

CONSERVATION GOAL

1. Protect and manage habitat of the coast patch-nosed snake to maximize the likelihood that populations are sustained in the planning area, and in doing so "provide for recovery" on a subregional basis and "contribute to recovery" on a rangewide basis.

CONSERVATION STRATEGY

1. Create a permanent subregional Habitat Reserve that provides sufficient habitat in large, contiguous patches to maximize the likelihood of the coast patch-nosed snake's persistence within the planning area.
2. Formulate a HRMP to provide for long-term protection and management of habitat for the coast patch-nosed snake.

HABITAT AND SPECIES CONSERVATION AND IMPACTS ANALYSIS

A landscape habitat-based analysis primarily is applied to the coast patch-nosed snake due to its broad habitat associations, defined as coastal sage scrub, chaparral and grassland, and relatively little site-specific information in the planning area.

Table 2-30 provides a summary of the existing conditions, proposed conservation, and permanent and temporary impacts of coast patch-nosed snake locations and habitat within the planning area and within the Subarea 1 permit area. The description of impacts and conservation below is limited to Subarea 1 which is the permit action area. The planning area conservation and impact estimates reported in *Table 2-30* include SOS and potential impact areas in Subareas 2, 3 and 4 and do not reflect future planning within those Subareas that may result in changes to the SOS and impact estimates.

TABLE 2-30
COAST PATCH-NOSED SNAKE CONSERVATION AND IMPACT SUMMARY

	Acres	Percent	Locations	Percent
Planning Area				
Existing Total	44,640		3	
Habitat Reserve	23,111	52%	1	33%
Supplemental Open Space	9,426	21%	1	33%
Total Protected	32,537	73%	2	66%
Total Permanent Impact	8,067	18%	1	33%
Subarea 1				
Existing Total	32,729		3	
Habitat Reserve	23,111	71%	1	33%
Supplemental Open Space	3,461	11%	1	33%
Total Protected	26,572	81%	2	66%
Total Permanent Impact	6,254	19%	1	33%
Total Temporary Impact	205		0	0%

Subarea 1 Impacts

The proposed Covered Activities would result in direct, permanent impacts to 6,254 acres (19 percent) of suitable habitat and one of three documented locations in the planning area (the documented location is in the area identified for potential orchards where 381 acres of 431 acres ultimately would be conserved) (*Table 2-30* and *Figure 202-M*). The proposed Covered Activities also would result in temporary direct impacts to 205 acres of habitat, but no sites (*Table 2-30*).

Subarea 1 Conservation

One of the three documented locations in Subarea 1 and 23,111 acres (71 percent) of habitat would be conserved in the Habitat Reserve (*Table 2-30* and *Figure 202-M*). An additional documented location and 3,461 acres (11 percent) are in Subarea 1 SOS, bringing the total conservation of habitat to 26,572 acres (81 percent) and two of three documented locations.

There are no data on dispersal or other spatial behavior of the coast patch-nosed snake. However, as with the other snakes proposed for regulatory coverage, it seems reasonable to assume that coast patch-nosed snakes are unlikely to disperse between highly isolated habitat patches through unsuitable habitat and that roads are significant risks for the species due to vehicle collisions. Thus habitat patch size, contiguity and connectivity likely are key reserve design considerations for this species.

The results of the refined habitat block delineation used to analyze patch size are presented in *Part I, Chapter 13, Table 13-9* and depicted in *Figure 193-M*. The seven habitat blocks

combined include about 24,280 acres (including habitat in SOS in Coto de Caza in Subarea 3) of the 26,572 acres (91 percent) of conserved habitat (coastal sage scrub, chaparral and grassland) for the patch-nosed snake. Habitat within the blocks ranges from 732 acres in the Radio Tower Road mesa block to 11,985 acres in the Southeastern block.

- Habitat linkages likely to be important for the coast patch-nosed snake also would be conserved, including: the north-south connection along Chiquita Ridge spanning the area from Ladera Open Space to Chiquita Creek (linkage C); the east-west connection from Arroyo Trabuco to Gobernadora and Caspers Wilderness Park via Chiquita Canyon (linkages B, D, H, I); the north-south connection along Chiquadora Ridge (linkage G); the floodplain along San Juan Creek and into Bell Canyon (linkage J); the linkage along and perpendicular to Verdugo Canyon (linkages L and M); the north-south linkages through the central and western portions of Trampas Canyon and Cristianitos Canyon (linkages J, K and N); and linkages O, P and Q in Gabino, La Paz and Talega canyons, respectively (see *Figure 193-M*). Where roads cross linkage areas wildlife movement and dispersal will need to be addressed. For example, bridges will be constructed across San Juan, Chiquita and Gobernadora creeks for Cow Camp Road, and San Juan Creek and Chiquadora Ridge for Cristianitos/"F" Street. For the extension of Cristianitos Road/"F" Street through Chiquita Canyon to Oso Parkway, wildlife culvert at Chiquita Narrows within the design of Cristianitos Road shall be included with the following dimensions: The culvert shall have a minimum dimension of 15 by 15 feet, the bottom of the culvert shall be of a natural substrate, light shall be visible from one end of the culvert to the other, vegetation installed at either end shall be native low growing to prevent predator-prey stalking, and if required for public health and safety, all lighting on the road above the culvert shall be shielded to prevent spill-over effects (*NCCP Minimization Measure 8-1*).

ADAPTIVE MANAGEMENT PROGRAM

Stressors

The coast patch-nosed snake has not been studied adequately to directly evaluate environmental stressors on the species that inform management actions. However, it can be assumed that general impacts to its habitat and prey base have an adverse effect on the species. In addition, direct impacts common to many snakes such as vehicle collisions and human harassment can be assumed. Thus the following land uses and activities that can disturb suitable habitat and/or individual snakes are identified as potential stressors and thus will be considered for management:

- Habitat loss and fragmentation
- Urbanization adjacent to Habitat Reserve
- Exotic plant invasions (especially those that choke sandy washes and streamcourses such as giant reed)
- Rodent controls (snakes may use small mammal burrows as refugia, for foraging and for laying eggs)
- Urban-related predators such as dogs
- Roads and trails
- Argentine ants (through effects on native lizards that are prey items for patch-nosed snakes)
- Collection

Goals

Goals for protecting and managing the coast patch-nosed snake and its habitat include the following:

1. Protect and manage suitable habitat to maintain approximate existing acreage in the Habitat Reserve.
2. Maintain the physiographic diversity of suitable habitat in the Habitat Reserve.
3. Manage exotic invasions of riparian and streamcourse habitats.
4. Protect and manage identified key habitat linkages to maximize the likelihood of habitat connectivity.

Management and Monitoring Objectives (number of goal met by objective in parentheses)

Objective 1: Implement Conservation Strategy to protect and manage approximately 23,111 acres of suitable habitat in Habitat Reserve (actual acreage will vary in relation to natural and anthropogenic environmental effects such as wildfires and drought) (Goals 1 & 2).

Objective 2: Remap vegetation communities in Habitat Reserve within two (2) years of executing IA to establish a baseline for long-term tracking of the Reserve (Goals 1 & 2).

Objective 3: Update vegetation community map at 5-year intervals (Goals 1 & 2).

Objective 4: Implement Invasive Species Control Plan to manage invasive exotic species in riparian and streamcourse areas (Goals 1, 2 & 3).

Objective 5: Implement management and monitoring of identified key habitat linkages to maximize the likelihood of continued function as "live in" and dispersal habitat for patch-nosed snakes (Goal 4).

Conceptual Model

No. Insufficient data to develop conceptual model at this time.

Regional and Subregional Management Information Needs

- The general life history and autecology of the coast patch-nosed snake, including spatiotemporal behavior (*e.g.,* home range, territoriality, and dispersal) and key factors in habitat selection (*e.g.,* species composition, soil types, habitat structure, slope, aspect, etc.), especially in coastal areas.
- The current status and population trends of the coast patch-nosed snake, especially in the South coast Ecoregion.
- The direct and indirect effects of habitat loss and fragmentation.
- Community relationships (*e.g.,* interspecific and predator-prey relationships).
- Significant sources of natural (*e.g.,* native predators) and human-related (*e.g.,* vehicle collisions, harassment, exotic and urban-related predators) mortality.
- Effective and feasible management and monitoring methods.
- The distribution of the patch-nosed snake in the Habitat Reserve.
- Presence of other obstacles that could disrupt movement (*i.e.,* "Separation Barriers") within the Habitat Reserve.

Level of Management and Monitoring Priority - Low

There is a general lack of scientific information for the coast patch-nosed snake that can be used to directly inform conservation and management. The species appears to be very uncommon in southern California, with only three records in the planning area. In comparison, pitfall trapping in Orange County documented 13 captures at five sites in Peter's Canyon, Limestone Canyon and Weir Canyon between 1995 and 2000 (Fisher and Rochester 2000) and Brehme (2003) had only two captures in 9,600 trap nights in pitfall traps in southern San Diego County from April to December 2001 (compared with 259 orange-throated whiptail captures).

Although it is assumed to occur in low numbers, but throughout the Habitat Reserve in suitable habitat, there are no identified immediate threats to the coast patch-nosed snake in Subarea 1 at this time that would warrant specific management and monitoring. With the high level of habitat conservation (81 percent) and given the high cost of species-specific monitoring, at least through Phase 1 of the HRMP management and monitoring for the coast patch-nosed snake, it is recommended that efforts focus on landscape-level management. In particular, management and monitoring should focus on identified habitat linkages where there is a concern about the ability of patch-nosed snakes and other Covered Species and focal species to disperse through the landscape. At a species level, monitoring during Phase 1 will be based on anecdotal observations of the species (*e.g.*, observations of patch-nosed snakes along standard wildlife/vegetation transects, roadkills, and other anecdotal observations). At some point in the future the Science Panel and Reserve Manager may recommend intensifying the monitoring effort for the suite of reptiles proposed for regulatory coverage, and the diversity and abundance of herpetofauna in general, through the use of pitfall trap arrays, or other species-appropriate survey methods, using standardized sampling protocols of sufficient statistical power (*i.e.*, some minimum number of sample sites monitored a minimum number of periods). Such a decision to intensify the monitoring effort likely would be based on regional information from the Wildlife Agencies or the USGS WERC that a species is at high risk of endangerment or a particular significant environmental stressor has been identified. In such a case, the Science Panel and Reserve Manager, through communications with the Wildlife Agencies, would evaluate the situation in the context of the overall HRMP and determine the need for and feasibility of more intensive monitoring.

Level of Monitoring (*e.g.*, Species-specific, habitat, landscape, combination)

Monitoring will be conducted at both the habitat landscape and species-specific levels, but species monitoring will focus on anecdotal observations, not focused monitoring for the purpose of assessing spatiotemporal population trends.

Monitoring Variables

Listed below are suggested species- and habitat-based monitoring variables. The detailed monitoring program for the coast patch-nosed snake will be developed by the Reserve Manager and Science Panel.

Species-specific Monitoring Variables

1. Presence/absence
2. Estimates for the proportion of occupied habitat

Habitat-based Monitoring Variables

1. Vegetation communities long-term status
2. Relative cover of different native plant species
3. Proportion of exotic plant species/native plant species
4. Evidence of urban-related predators and other mesopredators (*e.g.*, tracks, scat, direct observations)
5. Evidence of unauthorized public activities (*e.g.*, trespass, trampling, illegal trails, trash, shooting, etc.)

Management Actions

Management actions to benefit the coast patch-nosed snake would be implemented primarily at a landscape level and include fire management and invasive species controls, including artichoke thistle controls in uplands and giant reed controls along washes that may be used for movement. Rodent controls will be prohibited within the Habitat Reserve, and the use of chemical pesticides in areas adjacent to the Habitat Reserve (*e.g.*, golf courses) will be minimized to the extent feasible and will be used in accordance with an approved Integrated Pest Management Program designed to avoid and minimize effects on native species and habitats. Control of urban-related predators such as cats and dogs will be controlled in the Habitat Reserve through public education and direct controls such as trapping to the extent necessary and feasible. Collecting of the coast patch-nosed snake by the public would be prohibited within the Habitat Reserve. Signage along trails and bike paths in the Habitat Reserve will be used to inform the public of the risk to native species such as snakes and amphibians from recreational activities. Argentine ant controls will be implemented to reduce impacts on native lizards that are prey for the coast patch-nosed snake. Habitat restoration activities implemented at the discretion of the Reserve Manager and Science Panel to benefit this species include CSS/VGL restoration on Chiquita Ridge, in Sulphur Canyon, and on Chiquadora Ridge.

Potential Target Studies

Several regional and subregional information management needs relevant to management of the coast patch-nosed snake were listed above, some of which could be addressed at the subregional scale and would help inform management of the Habitat Reserve. Other regional and subregional information management needs, particularly those related to rangewide persistence of the species (*e.g.*, general ecology, community relationships and landscape habitat fragmentation) are best studied at a rangewide scale. The following are potential target studies that could be implemented at the subregional scale:

- Effects of urban-related predators.
- Effects of recreation activities.
- Effects of vehicles collisions (likely would be conducted as part of a general study of herpetofauna).
- Movement behavior within the Habitat Reserve in relationship to physical boundaries and obstacles such as urban edges and roads.

The Reserve Manager and Science Panel will determine and recommend to the RMVLC Board what target studies (possibly including studies not listed above) should be pursued, based on the identification and prioritization of management and monitoring issues and available funding.

SPECIES ACCOUNT

Rangewide and Regional Status

The full species western patch-nosed snake is widely distributed throughout desert regions of the southwestern U.S, and northern mainland Mexico and all of Baja California (Stebbins 1985). The subspecies coast patch-nosed snake (*S. h. virgultea*) is widely distributed in the lowlands of southern California from sea level to 7,000 feet from about Santa Barbara south into the northern third of Baja California.

The subspecies coast patch-nosed snake is a CDFG CSC and has a CNDDB rank of G5T3S2S3; the full species is secure in its global range but the subspecies, as indicated in the T and S ranks, is considered restricted/rare to endangered in California. It is being proposed for coverage because biologists are becoming increasingly concerned about its status in southern California. Recent pitfall trapping programs in southern California, for example, have resulted in few captures of the patch-nosed snake, indicating that it is becoming rare (P. Bloom, pers. comm. 2003).

Subregional Status

There are three records of this species in the subregion, all of which are in Subarea 1 (*Figure 202-M*): in uppermost Cristianitos Canyon along Cristianitos Road just south of Ortega Highway; in Caspers Park on the ridge between Cañada Gobernadora and Bell Canyon; and from Starr Ranch just south of Fox Canyon and north of Crow Canyon. Based on this species' habitat associations, it potentially could occur in suitable habitat throughout the planning area landscape, and no *important populations* or *key locations* for the species have been identified.

Biological Considerations

The coast patch-nosed snake is found in coastal chaparral, desert scrub, washes, sandy flats, and rocky areas. As an active, diurnal snake, it will occasionally take refuge in rock crevices, in small mammal burrows, and under vegetation.

Its habitat and dietary requirements appear to be broad and opportunistic. The coast patch-nosed snake is an opportunistic feeder, preying on lizards (*e.g., Aspidoscelis, Coleonyx*), small mammals, and the eggs of lizards and snakes (Stebbins 2003).

Goldberg (1995) found that breeding generally occurs from July through October, but possibly as early as late spring. Clutch size typically ranges from 4 to 7 eggs (Wright and Wright 1957). Goldberg (1995) also found four females lacking yolk deposition in ovarian tissues in the month of April, suggesting that not all females breed each year. Under laboratory conditions, the incubation period of eggs is about 85 days (Stebbins 2003). Zeiner *et al.* (1990) has suggested that friable or sandy soil, or the presence of rodent burrows are required conditions for the reproductive cycle of patch-nosed snakes.

Patch-nosed snakes refuge and possibly overwinter in burrows or woodrat nests (Jennings and Hayes 1994). Therefore, there is likely a link between its habitat requirements and the presence of one or more burrowing/nesting mammals or rodents. Jennings and Hayes (1994) also found that the patch-nosed snake may adjust its activities around that of one of its prey, the whiptail lizard. Predators of patch-nosed snakes include raptors, roadrunners, most diurnal mammalian carnivores, kingsnakes and other snake predators.

2.17 NORTHERN RED-DIAMOND RATTLESNAKE

Species:	Northern Red-diamond Rattlesnake (*Crotalus ruber ruber*)
Federal Status:	None
State Status:	CSC
CNDDB Rank:	G4T3T4S2?
Science Advisors Group:	3
Covered Species:	Yes
Focal Monitoring Species:	No
Planning Species:	No

CONSERVATION GOAL

1. Protect and manage habitat of the northern red-diamond rattlesnake to maximize the likelihood that populations are sustained in the planning area, and in doing so "provide for recovery" on a subregional basis and "contribute to recovery" on a rangewide basis.

CONSERVATION STRATEGY

1. Create a permanent subregional Habitat Reserve that provides sufficient habitat in large, contiguous patches to maximize the likelihood of the northern red-diamond rattlesnake's persistence within the planning area.
2. Formulate a HRMP to provide for long-term protection and management of habitat for the northern red-diamond rattlesnake.

HABITAT AND SPECIES CONSERVATION AND IMPACTS ANALYSIS

The conservation analysis for the northern red-diamond rattlesnake is based on both site-specific information and landscape-level habitat due to its fairly broad habitat associations. Although it is designated as a Group 3 species by the Science Advisors, with specific recommendations for conservation and management, red-diamond rattlesnakes are expected to have a broad distribution across the planning area. Thus, amount of habitat conserved and habitat patch size, contiguity and connectivity are considered for this species.

Suitable habitat for the northern red-diamond rattlesnake in the planning area is defined as coastal sage scrub, chaparral, and grassland. Agriculture (*e.g.*, barley fields and orchards) may be used by red-diamond rattlesnakes but is not included here as suitable habitat because of its relative lack of cover. However, rattlesnakes may forage in agricultural area for rodents, especially along the ecotone between shrublands and agriculture.

Table 2-31 provides a summary of the existing conditions, proposed conservation, and permanent and temporary impacts of rattlesnake locations and habitat within the planning area and within the Subarea 1 permit area. The description of impacts and conservation below is limited to Subarea 1 which is the permit action area. The planning area conservation and impact estimates reported in *Table 2-31* include SOS and potential impact areas in Subareas 2, 3 and 4 and do not reflect future planning within those Subareas that may result in changes to the SOS and impact estimates.

TABLE 2-31
NORTHERN RED-DIAMOND RATTLESNAKE
CONSERVATION AND IMPACT SUMMARY

	Acres	Percent	Locations	Percent
Planning Area				
Existing Total	44,640		18	
Habitat Reserve	23,111	52%	9	50%
Supplemental Open Space	9,426	21%	3	17%
Total Protected	32,537	73%	12	67%
Total Permanent Impact	8,067	18%	6	33%
Subarea 1				
Existing Total	32,729		16	
Habitat Reserve	23,111	71%	9	56%
Supplemental Open Space	3,461	11%	1	6%
Total Protected	26,572	81%	10	63%
Total Permanent Impact	6,254	19%	6	37%
Total Temporary Impact	205		3	

Subarea 1 Impacts

The proposed Covered Activities would result in direct, permanent impacts to 6,254 acres (19 percent) of suitable habitat (coastal sage scrub, chaparral and grassland) and six of 16 (37 percent) documented locations in Subarea 1 (*Table 2-31* and *Figure 202-M*). The proposed Covered Activities also would result in temporary direct impacts to 205 acres of habitat and three locations (*Table 2-31*).

Subarea 1 Conservation

Nine of the 16 (56 percent) documented locations in Subarea 1 and 23,111 acres (71 percent) of habitat would be conserved in the Habitat Reserve (*Table 2-31* and *Figure 202-M*). An additional location and 3,461 acres (11 percent) are in Subarea 1 SOS, bringing the total conservation of red-diamond rattlesnakes to 10 locations (63 percent) and habitat to 26,572 acres (81 percent).

Rattlesnakes in general are capable of moving long distances, including by swimming, as evidenced by their colonization of islands (Klauber 1971). However, they are a slow-moving snake and can often be seen basking on warm paved roads in the morning or evening and thus are particularly vulnerable to vehicle collisions when crossing or basking on roads. Some data are available on movement patterns and spatiotemporal behavior by rattlesnakes in southern California that help inform an evaluation of the Habitat Reserve. A four-year radiotelemetry study by Brown *et al.* (2004) of red-diamond rattlesnakes in the MSCP in San Diego County documented highly variable home ranges between years and sexes, with male home ranges nearly three times that of females. "Resident" snake home ranges varied between 0.7 and 15.3 acres and "relocated" snake ranges varied between 3.9 and 44.5 acres; "relocated" snakes were those moved away from animal enclosures and pedestrian paths at the San Diego Wild Animal Park for safety purposes and thus were likely placed in unfamiliar territory. Fitch and Shirer (1971) observed average daily movements of about 150 feet by radio-telemetered snakes, but no movement at all on about half the days. About 10 percent of movements were greater than about 500 feet. Perhaps the most salient study of spatial behavior of red-diamond rattlesnakes for evaluating conservation is a radiotelemetry study by Tracey (2000; Tracey *et al.* 2005) showing that adult red-diamond rattlesnakes move within fairly limited home ranges and tend to have high site fidelity. A focused analysis of an exemplar adult individual by Tracey *et al.* (2005) demonstrated that this particular individual restricted its activities to areas away from urban development-habitat patch boundaries and did not cross a road between two substantial habitat patches. They analyzed this snake's movements using statistical models of individual movements in relation to landscape features (or objects) such as habitat-urban development edges and roads with variables such as animal-to-object distance and animal-to-object angle. For example, a rattlesnake's movement may shorten or change in angle as it moves closer to a habitat-urban edge if it is sensitive to the edge. Knowing this information would allow one to determine the effective use area of a habitat patch. Tracey *et al.* demonstrated using this modeling approach that the snake's response angles were very similar to a computer simulation of repulsive angles to a boundary; *i.e.*, it moved away from, or "had a strong repulsive response to" the patch boundary. On the other hand, there was no evidence that the snake altered its move distance as it approached a patch boundary. Tracey *et al.* state, "altering the move angles rather than the move distances was the primary mechanism that this particular rattlesnake used to avoid approaching the patch boundary and possibly crossing into roads of urban areas, thereby avoiding the risks involved in moving through the human-dominated landscape elements." (p 16) Tracey *et al.* also calculated the "apparent perceptual range" for this individual at which the snake showed avoidance of the patch boundary. They estimated an apparent perceptual range of 53.57 m (176 feet), with a range of 40.47 m (133 feet) to 72.37 m (237 feet) within a 95 percent confidence interval; *i.e.*, areas within at least 133 feet and up to 237 feet of a patch boundary are likely to be avoided by a rattlesnake. Tracey (2000) made three key conclusions relevant to the conservation of adult red-diamond rattlesnakes:

1. Habitat fragmentation has a greater effect on adult males than on females because males have larger home ranges and average move lengths.
2. Human-modified landscapes appear to be barriers to movement by adult snakes; he found no movements of radio-telemetered snakes into urban areas or across roads.
3. Strong site fidelity by adult snakes and avoidance of urban areas and roads suggests that narrow movement corridors may not be a useful strategy for preserving landscape connectivity for adult rattlesnakes. The importance of corridors for dispersing juveniles is unknown because they were not studied and their spatiotemporal behavior patterns likely are different from adults (Tracey 2000).

Based on Tracey (2000) and Tracey *et al.* (2005), habitat patch size, contiguity and connectivity are key reserve design considerations for this species. Larger "core" habitat blocks and broad habitat linkages between habitat blocks, versus narrow movement corridors, appear to be important for this species, especially adults, because of their avoidance of urban edges and roads. The results of the refined habitat block delineation used to analyze patch size are presented in *Chapter 13, Table 13-9* and depicted in *Figure 193-M*. The seven habitat blocks combined include about 24,280 acres (including habitat in SOS in Coto de Caza in Subarea 3) of the 26,572 acres (91 percent) of conserved habitat (coastal sage scrub, chaparral and grassland) for the red-diamond rattlesnake. Habitat within the blocks ranges from 732 acres in the Radio Tower Road mesa block to 11,985 acres in the Southeastern block. In comparison, the smallest Tracey *et al.* (2005) study site was a 105-acre "fragmented" habitat patch in Chula Vista within which six individuals (four males and two females) were radiotracked, so evidently red-diamond rattlesnakes do occur in relatively small habitat patches. Notably no mortalities of the 20 adult rattlesnakes radiotracked over this two-year study occurred, indicating that adult red-diamond rattlesnakes may have a relatively low risk of mortality, even in fragmented habitat patches. Juveniles likely are at greater risk of mortality because they probably are dispersing through unsuitable habitat or human-modified landscapes.

There are relatively few occurrences of red-diamond rattlesnake in Subarea 1, but of the 10 conserved locations, eight occur in large habitat blocks, with one in the Arroyo Trabuco block, one in the Chiquita Ridge block, one in the Wagon Wheel block, four in the Southeastern block, and one in the Northeastern block.

- Habitat linkages likely to be important for the red-diamond rattlesnake also would be conserved, including: the north-south connection along Chiquita Ridge spanning the area from Ladera Open Space to Chiquita Creek (linkage C), the east-west connection from Arroyo Trabuco to Gobernadora and Caspers Wilderness Park via Chiquita Canyon (linkages B, D, H, I); the north-south connection along Chiquadora Ridge (linkage G);

the floodplain along San Juan Creek and into Bell Canyon (linkage J); the linkage along and perpendicular to Verdugo Canyon (linkages L and M); the north-south linkages through the central and western portions of Trampas Canyon and Cristianitos Canyon (linkages J, K and N); and linkages O, P and Q in Gabino, La Paz and Talega canyons, respectively (see *Figure 193-M*). Except where crossed by roads, all these linkages are broad (minimum of 1,500 feet wide for linkage B connecting Arroyo Trabuco to Chiquita Canyon) and easily contain the width of a rattlesnake home range (typically less than 1,000 feet). Using the terminology of Tracey *et al.* (2005), these habitat linkages should provide adequate habitat beyond the "apparent perceptual range" of rattlesnakes within which they may show avoidance behavior of habitat-urban edges; *i.e.*, there should be adequate "interior" habitat to support the home range of individual snakes without the repelling effects of a habitat edge. Where roads cross linkage areas rattlesnake movement and dispersal will need to be addressed so that individuals do not have to directly cross roads. For example, bridges will be constructed across San Juan, Chiquita and Gobernadora creeks for Cow Camp Road, and San Juan Creek and Chiquadora Ridge for Cristianitos/"F" Street. For the extension of Cristianitos Road/"F" Street through Chiquita Canyon to Oso Parkway, wildlife culvert at Chiquita Narrows within the design of Cristianitos Road shall be included with the following dimensions: The culvert shall have a minimum dimension of 15 by 15 feet, the bottom of the culvert shall be of a natural substrate, light shall be visible from one end of the culvert to the other, vegetation installed at either end shall be native low growing to prevent predator-prey stalking, and if required for public health and safety, all lighting on the road above the culvert shall be shielded to prevent spill-over effects (*NCCP Minimization Measure 8-1*).

ADAPTIVE MANAGEMENT PROGRAM

Stressors

Management for the red-diamond rattlesnake will focus on stressors identified for this species that are primarily related to habitat loss and fragmentation. This loss and fragmentation of habitat and construction of roads has exposed the slow-moving and relatively docile red-diamond rattlesnake to a variety of chronic stressors beyond the immediate effect loss of habitat, including increased vehicle collisions, trampling by livestock such as horses, sheep, goats and cattle, and harassment by humans and pets (cats and dogs). Thus the following land uses and activities that can disturb suitable habitat and individual snakes are identified as potential stressors and will be considered for management:

- Habitat loss and fragmentation
- Urbanization adjacent to Habitat Reserve

- Urban-related predators (*e.g.*, cats and dogs)
- Livestock
- Roads and trails
- Human harassment

Environmental stressors on the northern red-diamond rattlesnake primarily are related to habitat loss and fragmentation, with an estimate by Jennings and Hayes (1994) of up to 20 percent of suitable habitat lost associated with urban development and conversion of steep, rocky habitats to drip agriculture such as avocado orchards. Loss of rocky areas is particularly devastating because these areas provide potential communal winter dens that may be used for several generations. Also, as discussed above, Tracey *et al.* (2005) demonstrated that actual rattlesnake movements in a small habitat patch are consistent with a movement model of repulsive angles to a habitat patch boundary.

Goals

Goals for protecting and managing the red-diamond rattlesnake and its habitat include the following:

1. Protect and manage suitable habitat to maintain approximate existing acreage in the Habitat Reserve.
2. Maintain the physiographic diversity of suitable habitat in the Habitat Reserve.
3. Protect and manage identified key habitat linkages to maximize the likelihood of habitat connectivity.

Management and Monitoring Objectives (number of goal met by objective in parentheses)

Objective 1: Implement Conservation Strategy to protect and manage approximately 23,111 acres of suitable habitat in Habitat Reserve (actual acreage will vary in relation to natural and anthropogenic environmental effects such as wildfires and drought) (Goals 1 & 2).

Objective 2: Remap vegetation communities in Habitat Reserve within two (2) years of executing IA to establish a baseline for long-term tracking of the Reserve (Goals 1 & 2).

Objective 3: Update vegetation community map at 5-year intervals (Goals 1 & 2).

Objective 4: Implement management and monitoring of identified key habitat linkages to maximize the likelihood of continued function as "live in" and dispersal habitat for red-diamond rattlesnakes (Goal 3).

Conceptual Model

No. Insufficient data to develop conceptual model at this time.

Regional and Subregional Management Information Needs

- The general life history and autecology of the red-diamond rattlesnake, including spatiotemporal behavior (*e.g.*, home range, territoriality, communal activity, and dispersal), key factors in habitat selection (*e.g.*, species composition, soil types, habitat structure, slope, aspect, etc.), especially in coastal areas, and reproductive behavior, particularly in relation to climatic factors.
- The current status and population trends of the northern red-diamond rattlesnake, especially in the South Coast Ecoregion.
- The effects of habitat loss and fragmentation.
- Community relationships (*e.g.*, interspecific and predator-prey relationships), particularly as related age-class.
- Significant sources of natural (*e.g.*, native predators) and human-related (*e.g.*, vehicle collisions, harassment, exotic predators) mortality.
- Effective and feasible management and monitoring methods.
- Location of any communal winter dens (hibernacula) in the Habitat Reserve
- Potential for impacts by livestock.
- Use of habitat linkages and wildlife corridors and presence of obstacles that could disrupt movement within the Habitat Reserve.

Level of Management and Monitoring Priority - Low

Beyond that discussed above, there is a general lack of scientific information for the red-diamond rattlesnake that can be used to directly inform conservation and management. The red-diamond rattlesnake, with 18 documented locations in the NCCP planning area (of which 16 are in Subarea 1) is not uncommon the planning area, but records for the species are still few enough to suggest that relatively intensive focused monitoring probably would be required to statistically evaluate population trends. In comparison, pitfall trapping in the Central/Coastal Habitat

Reserve documented 14 captures at nine sites between 1995 and 2000 (Fisher and Rochester 2000). These pitfall data included 97 captures at nine sites of the more common southern Pacific rattlesnake (*Crotalus virdis*). Brehme (2003) had only three captures of red-diamond rattlesnakes in 9,600 trap nights in pitfall traps in southern San Diego County from April to December 2001 (compared with 259 orange-throated whiptail captures). However, because red-diamond rattlesnakes are relatively inactive, "sit-and-wait" predators, pitfall traps may not be the most effective census technique. Direct visual survey techniques using standard or meandering transects, with a focus on suitable microhabitats such as rock outcrops or denning sites, may be more effective for this species (*e.g.,* as utilized by Tracey).

Although it is assumed to occur in low to moderate numbers throughout the Habitat Reserve in suitable habitat there are no identified immediate threats to the red-diamond rattlesnake in Subarea 1 at this time, with perhaps the exception of vehicle collisions, that would warrant specific management actions. Vehicle collisions will be addressed by construction of bridges and wildlife culverts in key habitat linkage/wildlife corridor areas and fencing to direct movements where feasible. At least through Phase 1 of the HRMP management and monitoring for the red-diamond rattlesnake, it is recommended that efforts focus on landscape-level management and, in particular, management and monitoring of identified habitat linkages where there is a concern about the ability of the rattlesnake and other Covered Species and focal species to disperse through the landscape. At a species level, monitoring during Phase 1 will be based on anecdotal observations of the species (*e.g.,* observations of red-diamond rattlesnakes along standard wildlife/vegetation transects, roadkills, and other anecdotal observations). Given the high level of habitat conservation (81 percent) and lack of identified significant threats, the high cost of focused monitoring for this species is not warranted. Also, the low capture rates for this species at other sites indicate that substantial effort would be required to collect adequate data for statistically valid trend analyses. At some point in the future the Science Panel and Reserve Manager may recommend intensifying the monitoring effort for the suite of reptiles proposed for regulatory coverage, and the diversity and abundance of herpetofauna in general, through the use of pitfall trap arrays, or other species-appropriate survey methods, using standardized sampling protocols of sufficient statistical power (*i.e.,* some minimum number of sample sites monitored a minimum number of periods). Such a decision to intensify the monitoring effort likely would be based on regional information from the Wildlife Agencies or the USGS WERC that a species is at high risk of endangerment or a particular significant environmental stressor has been identified. In such a case, the Science Panel and Reserve Manager, through communications with the Wildlife Agencies, would evaluate the situation in the context of the overall HRMP and determine the need for and feasibility of more intensive monitoring.

Level of Monitoring (*e.g.*, Species-specific, habitat, landscape, combination)

Monitoring will be conducted at both the habitat landscape and species-specific levels, but species monitoring will focus on presence/absence surveys, not monitoring for the purpose of assessing population trends.

Monitoring Variables

Listed below are suggested species- and habitat-based monitoring variables. The detailed monitoring program for the northern red-diamond rattlesnake will be developed by the Reserve Manager and Science Panel.

Species-specific Monitoring Variables

1. Presence/absence
2. Estimates for the proportion of occupied habitat
3. Roadkills

Habitat-based Monitoring Variables

1. Vegetation communities long-term status
2. Relative cover of different native plant species
3. Proportion of exotic plant species/native plant species
4. Evidence of urban-related predators and other mesopredators (*e.g.*, tracks, scat, direct observations)
5. Evidence of unauthorized public activities (*e.g.*, trespass, trampling, illegal trails, trash, shooting, etc.)

Management Actions

Two specific management issues that stem from habitat loss, fragmentation and urbanization adjacent to the Habitat Reserve are important for this species: vehicle collisions and harassment by humans. As part of the HRMP, "roadkill" data for the species will be collected to determine if there are specific areas within the Habitat Reserve with unusually high mortality rates. Establishing a reliable pattern of mortality likely would take several years of monitoring, and such areas would then need to be evaluated for ways to prevent or reduce mortality (*e.g.*, permanent drift fences to direct snakes away from the area). Urban-related predators such as cats and dogs will be controlled through public education and direct controls such as trapping where necessary and to the extent feasible. Signage along trails and bike paths in the Habitat Reserve will be used to inform the public of the risk to native species such as snakes and amphibians from recreational activities. Personnel involved in cattle and other agricultural operations and other facilities within the Habitat Reserve also will be trained to recognize and avoid harming all

rattlesnakes to the extent feasible. Whenever possible, animal control personnel will be contacted to remove rattlesnakes (without harming them) from areas located outside the Habitat Reserve or from non-reserve facilities located within the Habitat Reserve. All rattlesnakes removed by animal control personnel will be placed back into the wild in the nearest suitable habitat.

Other adaptive management actions that will directly benefit the red-diamond rattlesnake include:

- Management of coastal sage scrub, chaparral and grasslands, as outlined in *Part I, Chapter 7*
- Implementation of the Habitat Restoration Plan, and specifically restoration of coastal sage scrub
- Management of habitat linkages

Potential Target Studies

Several regional and subregional information management needs relevant to management of the northern red-diamond rattlesnake were listed above, some of which could be addressed at the subregional scale and would help inform management of the Habitat Reserve. Other regional and subregional information management needs, particularly those related to rangewide persistence of the species (*e.g.*, general ecology, community relationships and landscape habitat fragmentation) are best studied at a rangewide scale. The following are potential target studies that could be implemented at the subregional scale:

- Effects of Argentine ant.
- Effects of urban-related predators.
- Effects of recreation activities.
- Effects of vehicles collisions (likely would be conducted as part of a general study of herpetofauna).
- Movement behavior within the Habitat Reserve in relationship to physical boundaries and obstacles such as urban edges and roads.

The Reserve Manager and Science Panel will determine and recommend to the RMVLC Board what target studies (possibly including studies not listed above) should be pursued, based on the identification and prioritization of management and monitoring issues and available funding.

SPECIES ACCOUNT

Rangewide and Regional Status

The full species red-diamond rattlesnake ranges throughout Southern California from San Bernardino County south to Cabo San Lucas, Baja California (Stebbins 1985). In its northern reaches, the rattlesnake occupies coastal habitats to the desert slopes of the mountains, but is absent from the lower desert flats and mountain elevations above 5,000 feet. The subspecies northern red-diamond rattlesnake (*C. r. ruber*) ranges from about Pioneertown and Morongo Valley in San Bernardino County south on both the coastal and desert sides of the Peninsular Ranges and the Santa Ana Mountains to about Loreto in Baja California.

The northern red-diamond rattlesnake is a CDFG CSC and has CNDDB rank of G4T3T4S2?; There are 23 records for the rattlesnake in the CNDDB, 60 records in the Western Riverside County MSHCP and eight records in San Diego MSCP databases.

Although the full species appears to be globally secure there are some factors to cause concern about its status. Within its range, including much of Baja California, the subspecies northern red-diamond rattlesnake is considered to have a restricted range, but is apparently secure. In California the S2? rank indicates that the subspecies may be considered endangered, but that there is still some question as to its status. In recent years there has been growing concern for the northern red-diamond rattlesnake by biologists, the Wildlife Agencies and environmental groups. Concern regarding this subspecies primarily is habitat loss and fragmentation, particularly from the clearing of steep, rocky and brushy slopes for drip agriculture such as avocado orchards. Collisions with vehicles and harassment in populated areas also are increasing problems as former habitat areas become urbanized and interactions with humans increase.

Subregional Status

The northern red-diamond rattlesnake is widely distributed in the planning area (*Figure 202-M*). There are 18 locations for the subspecies in the NCCP data base, of which 16 are in Subarea 1. Rattlesnake locations include Arroyo Trabuco, Tijeras Creek at Chiquita Ridge, an area south of General Thomas F. Riley Wilderness Park, Chiquadora Ridge, east of Avenida La Pata at Ortega Highway, San Juan Creek just west of Chiquita Canyon, upper Cristianitos Canyon, and the Talega sub-basin (Dudek 1995; MBA 1996, Bloom database; Behrends, pers. obs.). This subspecies probably occurs wherever there is suitable habitat (coastal sage scrub, chaparral and grassland), but the Science Advisors considered the western portion of the planning area as particularly important.

Biological Considerations

The red-diamond rattlesnake occurs in desert habitats, dense chaparral, inland mesas and valleys, and the coastal regions and it most commonly associated with heavy brush, large rocks, and boulders (Klauber 1972).

Food sources for adult rattlesnakes include most small mammals such as mice, kangaroo rats, gophers, antelope ground squirrels, chipmunks, rabbits and tree and ground squirrels (Tevis 1943; Klauber 1971, 1972). Juveniles appear to prefer western whiptails. Other prey include amphibians, lizards, birds, other snakes, and occasionally skunks which are taken opportunistically according to the local habitat (Klauber 1972).

Reproduction appears to be dependent on local climatic conditions, but typically is annual with mating occurring in spring and birth in autumn. In colder climates, a biennial reproductive cycle appears to correlate with a shortened activity season. Live born young are carried by the female for approximately 140-150 days (Wright and Wright 1957); however Klauber (1972) found that gestation probably lasts four months, suggesting that this duration is speculative. Females have the ability to store sperm, resulting in variability between dates of mating and birth. Because mating may occur in the off-season and with sperm storage, it is possible for two broods to be produced from one mating or a single brood from multiple matings. Rattlesnakes are oviparous and females lay their first clutch at the age of three years. Newly born juveniles fend for themselves, receiving no protection from the mother. The number of young per brood varies greatly with species and size of the mother.

Survival of red-diamond rattlesnakes depends on external temperature gradients including substrate, air and sun's radiation to secure a desirable body temperature for daily activity requirements. Defensive behaviors include coloration and behavioral crypsis, fleeing, defensive posture, striking, and the sounding of its rattle. Klauber (1971) suggests rattlesnakes possess some limited (and voluntary) ability to change color following temperature changes. As temperature increases, the snake's color adjusts to a lighter shade, resulting from a contracting of the melanophores in the skin. This aids in the reflection of excess heat as temperature increases, and conversely, allows greater absorption with a darker shade prior to decreasing temperature.

Topography and climate determine the number of rattlesnakes sharing a den or hibernaculum. Where sites are abundant, the number of individuals will typically be less, and conversely, when dens are sparse, the number will be large. In the southern portion of its range, refuge selection of the rattlesnake appears to be an individual choice due to the short hibernation season (Klauber 1972). In southern California's mild climate, dens typically are brief refuges, such as rock crevices, mammal dens, or leaf piles.

Predators of rattlesnakes include raptors (especially red-tailed hawks and eagles), badgers, coyotes, cats, foxes, dogs, certain snakes, and hogs. Ungulates including deer, horses, antelope, sheep, goats, and cattle have been known to stomp the rattlers to death.

Spatial movements of rattlesnakes in southern California are discussed in greater detail above in the Conservation Analysis.

2.18 ORANGE-THROATED WHIPTAIL

Species:	Orange-throated Whiptail (*Aspidoscelis hyperythra*)
Federal Status:	None
State Status:	CSC
CNDDB Rank:	G5T2S2
Science Advisors Group:	2
Covered Species:	Yes
Focal Monitoring Species:	Yes
Planning Species:	Yes

CONSERVATION GOAL

1. Protect and manage habitat of the orange-throated whiptail to maximize the likelihood that populations are sustained in the planning area, and in doing so "provide for recovery" on a subregional basis and "contribute to recovery" on a rangewide basis.

CONSERVATION STRATEGY

1. Create a permanent subregional Habitat Reserve that provides sufficient habitat in large, contiguous patches to maximize the likelihood of the orange-throated whiptail's persistence within the planning area.

2. Formulate a HRMP to provide for long-term protection and management of habitat for the orange-throated whiptail.

HABITAT AND SPECIES CONSERVATION AND IMPACTS ANALYSIS

The conservation analysis for the orange-throated whiptail is based on both site-specific information (*i.e.,* documented occurrences and identified *important populations/key locations*) and on a landscape-level habitat basis, including amount of habitat conserved, defined as coastal sage scrub, chaparral and woodland and forest, and habitat patch size, contiguity and connectivity.

Table 2-32 provides a summary of the existing conditions, proposed conservation, and permanent and temporary impacts of orange-throated whiptail locations and habitat within the planning area and within the Subarea 1 permit area. The description of impacts and conservation below is limited to Subarea 1 which is the permit action area. The planning area conservation and impact estimates reported in *Table 2-32* include SOS and potential impact areas in Subareas

2, 3 and 4 and do not reflect future planning within those Subareas that may result in changes to the SOS and impact estimates.

TABLE 2-32
ORANGE-THROATED WHIPTAIL CONSERVATION AND IMPACT SUMMARY

	Acres	Percent	Locations	Percent
Planning Area				
Existing Total	32,151		174	
Habitat Reserve	18,803	58%	115	66%
Supplemental Open Space	6,242	19%	6	3%
Total Protected	24,992	78%	121	69%
Total Permanent Impact	5,641	18%	50	29%
Subarea 1				
Existing Total	25,812		169	
Habitat Reserve	18,803	73%	115	68%
Supplemental Open Space	2,860	11%	6	4%
Total Protected	21,663	84%	121	72%
Total Permanent Impact	4,149	16%	48	28%
Total Temporary Impact	101		8	

Subarea 1 Impacts

The proposed Covered Activities would result in direct, permanent impacts to 4,149 acres (16 percent) of suitable habitat and 48 of 169 (28 percent) documented locations in Subarea 1 (*Table 2-32* and *Figure 177-M*). The proposed Covered Activities also would result in temporary direct impacts to 101 acres of habitat and eight locations (*Table 2-32*).

A total of 37 of 47 (79 percent) of the whiptail locations in the Gobernadora/Central San Juan Creek *important population/key location* would be impacted in PA 3. Five individuals (9 percent) of the Chiquita Canyon/Wagon Wheel Ridgeline *important population/key location* would be impacted; one by development in PA 2 and four within the alignment for Cristianitos Road/"F" Street. The road also would bisect this population, resulting in potential fragmentation of the population (*Figure 177-M*). None of the 18 locations in the Chiquadora Ridge *important population/key location* would be directly impacted, but the population also would be bisected by Cristianitos Road/"F" Street.

Subarea 1 Conservation

A total of 115 (68 percent) documented locations in Subarea 1 and 18,803 acres (73 percent) of habitat would be conserved in the Habitat Reserve (*Table 2-32* and *Figure 193-M*). An additional six locations (4 percent) and 2,860 acres (11 percent) are in Subarea 1 SOS, bringing

the total conservation of the orange-throated whiptail to 121 locations (72 percent) and habitat to 21,663 acres (84 percent).

All 18 locations in the Chiquadora Ridge *important population/key location* would be conserved; however, the population would be bisected by Cristianitos Road/"F" Street. A portion of the ridge will be bridged and continuous habitat along Chiquadora Ridge will be conserved and maintain the functional connection within this population. Fifty-three of 58 locations (91 percent) in the Chiquita Canyon/Wagon Wheel Ridgeline *important population/key location* would be conserved, but the population would be bisected by Cristianitos Road/"F" Street. For the extension of Cristianitos Road/"F" Street through Chiquita Canyon to Oso Parkway, wildlife culvert at Chiquita Narrows within the design of Cristianitos Road shall be included with the following dimensions: The culvert shall have a minimum dimension of 15 by 15 feet, the bottom of the culvert shall be of a natural substrate, light shall be visible from one end of the culvert to the other, vegetation installed at either end shall be native low growing to prevent predator-prey stalking, and if required for public health and safety, all lighting on the road above the culvert shall be shielded to prevent spill-over effects (*NCCP Minimization Measure 8-1*).

There are no specific data on dispersal by the orange-throated whiptail, but whiptails (Teiids) in general can move hundreds of meters from one location to another (Fitch 1958; Jorgensen and Tanner 1963; McCoy 1965; Knopf 1966; Lewis and Saliva 1987; Anderson 1993; Eifler and Eifler 1998; as cited on NatureServe 2005). Thus it should be assumed that orange-throated whiptails are at least capable of dispersing distances of at least several hundred meters to a few kilometers and that roads separating habitat patches are a significant risk for the species. Thus habitat patch size, contiguity and connectivity likely are key reserve design considerations for this species.

The results of the refined habitat block delineation used to analyze patch size are presented in *Part I, Chapter 13, Table 13-9* and depicted in *Figure 193-M*. The seven habitat blocks combined include about 20,223 acres (including habitat in SOS in Coto de Caza in Subarea 3) of the 21,663 acres (93 percent) of conserved habitat (coastal sage scrub, chaparral and woodland and forest) for the orange-throated whiptail. Habitat within the blocks ranges from 228 acres in the Radio Tower Road mesa block to 9,853 acres in the Southeastern block. Of the 121 conserved whiptail locations, 102 (84 percent) are in large habitat blocks: 53 in the Wagon Wheel block; 20 in the Southeastern block; 13 in the Chiquita Ridge block; seven in the Northeastern block; four in the Radio Tower Road mesa block; three in the Upper Chiquita block; and two in the Arroyo Trabuco block.

Important habitat linkages for the orange-throated whiptail also would be conserved, including: the north-south connection along Chiquita Ridge spanning the area from Ladera Open Space to Chiquita Creek (linkage C); the east-west connection from Arroyo Trabuco to Gobernadora and

Caspers Wilderness Park via Chiquita Canyon (linkages B, D, H, I); the north-south connection along Chiquadora Ridge (linkage G); the floodplain along San Juan Creek and into Bell Canyon (linkage J); the linkages along and perpendicular to Verdugo Canyon (linkages L and M); the north-south linkages through the central and western portions of Trampas Canyon and Cristianitos Canyon (linkages J, K and N); and linkages O, P and Q in Gabino, La Paz and Talega canyons, respectively (see *Figure 193-M*). Where roads cross linkage areas wildlife movement and dispersal will need to be addressed. As discussed above, the two whiptail *important populations/key locations* on the Chiquita Canyon/Wagon Wheel Ridgeline and on Chiquadora Ridge will be affected by the construction of Cristianitos Road/"F" Street. A wildlife culvert under Cristianitos Road/"F" Street per *NCCP Minimization Measure 8-1* will be constructed to maintain the functional connection of the Chiquita Canyon population. A bridge spanning a portion of Chiquadora Ridge will maintain the functional connection within the Chiquadora population. For other linkages bridges will be constructed across San Juan, Chiquita and Gobernadora creeks for Cow Camp Road, and San Juan Creek.

ADAPTIVE MANAGEMENT PROGRAM

Stressors

Management of the orange-throated whiptail will consider several stressors that have been identified for the species, including:

- Habitat loss and fragmentation
- Precipitation (specifically extended drought)
- Argentine ants (through effects on native lizards that are prey items for whiptails)
- Frequent fire
- Exotic plant invasions
- Urban-related predators such as cats and dogs
- Paved roads

Several stressors have been identified for the orange-throated whiptail. Habitat loss and fragmentation is the main stressor on the species. Isolation of small populations can result in location extirpations from otherwise suitable habitat. The CDFG estimated that by 1990 the whiptail had been extirpated from 75 percent of its historic range (Jennings and Hayes 1994). CDFG (2003) also suggests that drought conditions from 1986-1990 may have depleted the whiptail's prey base; as a dietary specialist (termites [*Reticulitermes hesperus*]) the whiptail cannot easily shift to another prey. Invasive Argentine ants, which displace native invertebrates, may affect the prey as well. McGurty (1981) suggested that frequent fires, resulting in type conversion from shrublands to grasslands, reduces woody perennial shrubs that are food sources for termites. The lack of shrub cover resulting from frequent fires also may affect the whiptail's

ability to thermoregulate because the species use shade from bushes and possibly engage in arboreal behavior to dissipate heat. Also, the proliferation of dense, annual grasses and other exotic species may reduce available foraging area because substantial bare ground is required for foraging (McGurty 1981). Orange-throated whiptails may be vulnerable to predation by urban-related predators (cats and dogs) along urban/wildland edges. Orange-throated whiptail movements also appear to be inhibited by heavily trafficked roads (Brehme 2003).

Goals

Goals for protecting and managing the orange-throated whiptail and its habitat include the following:

1. Protect and manage suitable habitat (coastal sage scrub, chaparral, woodlands) to maintain approximate existing acreage in the Habitat Reserve.
2. Maintain the physiographic diversity of suitable habitat in the Habitat Reserve.
3. Manage fire regimes such that a natural diversity of age-stands is maintained throughout the Habitat Reserve and type conversion of shrublands to grassland is controlled.
4. Protect and manage identified key habitat linkages to maximize the likelihood of habitat connectivity.

Management and Monitoring Objectives (number of goal met by objective in parentheses)

Objective 1: Implement Conservation Strategy to protect and manage approximately 18,803 acres of suitable habitat (coastal sage scrub, chaparral, woodland) in Habitat Reserve (actual acreage will vary in relation to natural and anthropogenic environmental effects such as wildfires and drought) (Goals 1 & 2).

Objective 2: Remap vegetation communities in Habitat Reserve within two (2) years of executing IA to establish a baseline for long-term tracking of the Reserve (Goals 1 & 2).

Objective 3: Update vegetation community map at 5-year intervals (Goals 1 & 2).

Objective 4: Implement Habitat Restoration Plan to restore (including revegetation and enhancement) approximately 363 acres of coastal sage scrub in designated locations that currently are in agriculture, grazed, or otherwise do not currently support coastal sage scrub to enhance carrying capacity and connectivity (Goals 1, 2 & 4).

Objective 5: Implement Wildland Fire Management Plan to manage shrubland/woodland fire regimes such that a natural diversity of age-stands is maintained throughout the

Habitat Reserve and such that source populations are adequately protected (Goals 1, 2, 3 & 4).

Objective 6: Implement Invasive Species Control Plan to manage invasive exotic species (specifically Argentine ants) in whiptail habitat (Goals 1 & 4).

Objective 7: Implement management and monitoring of identified key habitat linkages to maximize the likelihood of continued function as "live in" and dispersal habitat for whiptails (Goal 4)

Conceptual Model

Yes. See figure below.

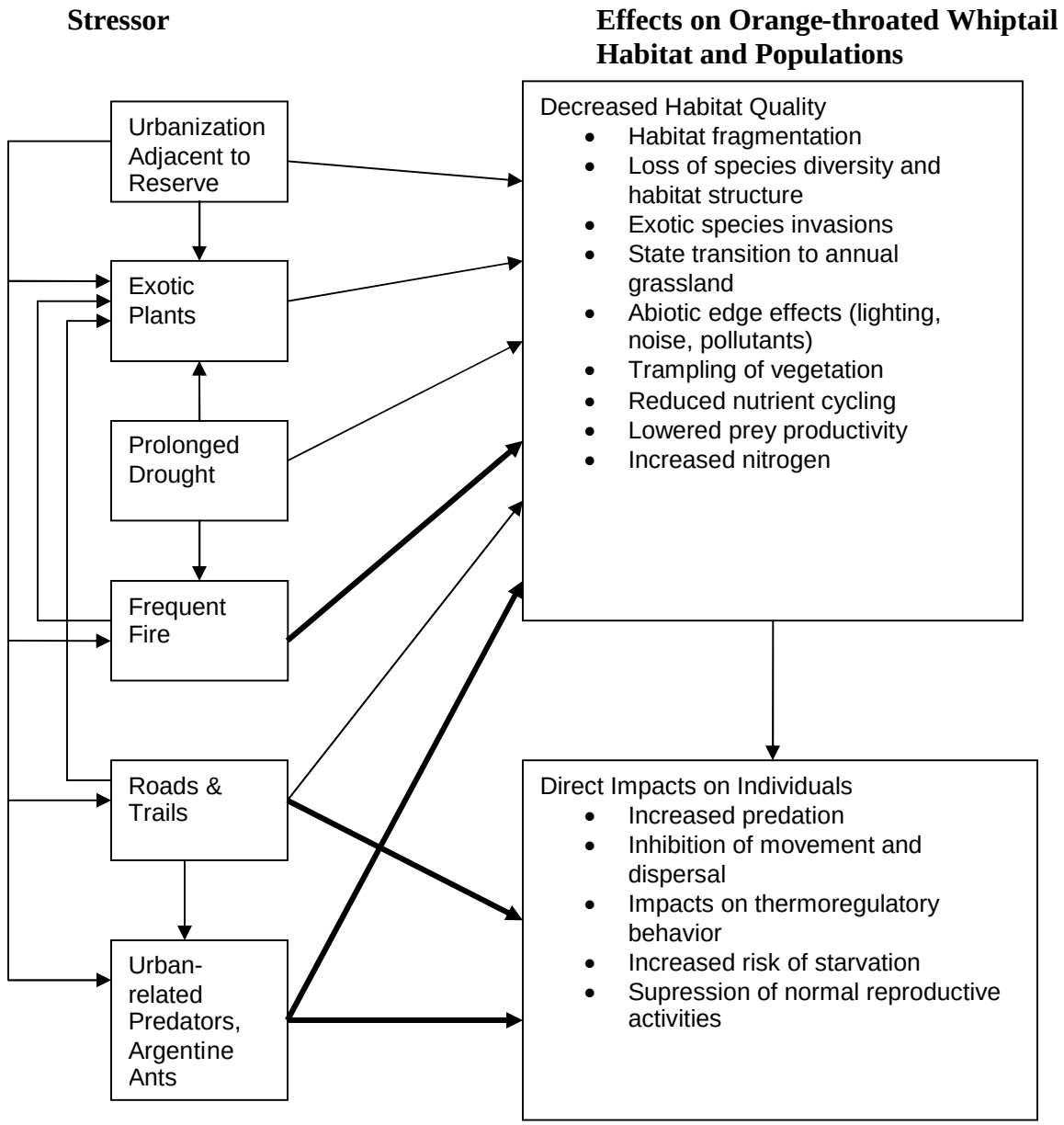
Regional and Subregional Management Information Needs

- Aspects of the general life history and autecology of the orange-throated whiptail such as survival, dispersal, home range, and territoriality and key factors in habitat selection (*e.g.*, species composition, soil types, habitat structure, slope, aspect, etc.), especially in coastal areas.
- The current status and population trends of the orange-throated whiptail, especially in the South coast Ecoregion.
- The effects of habitat loss and fragmentation on population persistence and individual behavior patterns.
- Community relationships (*e.g.*, interspecific and predator-prey relationships).
- Significant sources of natural (*e.g.*, native predators) and human-related (*e.g.*, vehicle collisions, harassment, exotic predators) mortality.
- Effective and feasible management methods.
- Risks of Argentine ants and urban-related predators on orange-throated whiptails in the Habitat Reserve.
- Presence of other obstacles that could disrupt movement (*i.e.*, "Separation Barriers") within the Habitat Reserve.

Level of Management and Monitoring Priority - Low

The orange-throated whiptail likely is broadly distributed throughout suitable habitat in the Habitat Reserve. Conservation of 84 percent of suitable habitat and 72 percent of documented

Orange-throated Whiptail Conceptual Stressor Model



locations suggest that management and monitoring of this Group 2 species can be addressed primarily at a habitat landscape level. At this time there are no imminent identified threats that warrant specific management and monitoring for this species during Phase 1 beyond the general management and restoration actions already identified for the Habitat Reserve, including fire management, management of edge effects (including Argentine ants), and upland habitat restoration. Recommended monitoring during Phase I is presence/absence based on general wildlife survey transects. As the development areas are built out and more Habitat Reserve-urban edge is created, the Reserve Manager and Science Panel may decide that more intensive monitoring, such as pit-fall trapping, is warranted to monitor population trends of the whiptail and other species.

Level of Monitoring (*e.g.*, Species-specific, habitat, landscape, combination)

Monitoring will be conducted at both the habitat landscape and species-specific levels, but species monitoring will focus on presence/absence surveys, not monitoring for the purpose of assessing population trends.

Monitoring Variables

Listed below are suggested species- and habitat-based monitoring variables. The detailed monitoring program for the orange-throated whiptail will be developed by the Reserve Manager and Science Panel.

Species-specific Monitoring Variables

1. Presence/absence
2. Estimates for the proportion of occupied habitat

Habitat-based Monitoring Variables

1. Vegetation communities long-term status
2. Relative cover of different native plant species
3. Proportion of exotic plant species/native plant species
4. Evidence of urban-related predators (cats and dogs) and other mesopredators (*e.g.*, tracks, scat, direct observations)
5. Evidence of unauthorized public activities (*e.g.*, trespass, trampling, illegal trails, trash, shooting, etc.)

Management Actions

Management of the coastal sage scrub, chaparral and oak woodland vegetation communities, as described in *Part I, Chapter* 7, will directly benefit the orange-throated whiptail Other specific

management actions to address identified stressors on the whiptail include: **(1)** implementation of the Wildland Fire Management Plan; **(2)** control of Argentine ants, and urban runoff and irrigation adjacent to the Habitat Reserve that attracts ants; and **(3)** control of urban-related predators such as cats and dogs in the Habitat Reserve through public education and direction controls such as trapping where necessary and to the extent feasible.

At the discretion of the Reserve Manager and Science Panel, habitat restoration activities that would benefit the whiptail include CSS/VGL restoration on Chiquita Ridge, in Sulphur Canyon, and on Chiquadora Ridge.

Potential Target Studies

Several regional and subregional information management needs relevant to management of the orange-throated whiptail were listed above, some of which could be addressed at the subregional scale and would help inform management of the Habitat Reserve. Other regional and subregional information management needs, particularly those related to rangewide persistence of the species (*e.g.*, general ecology, community relationships and landscape habitat fragmentation) are best studied at a rangewide scale. The following are potential target studies that could be implemented at the subregional scale:

- Effects of Argentine ant.
- Effects of urban-related predators.
- Effects of recreation activities.
- Effects of vehicles collisions.
- Movement behavior within the Habitat Reserve in relationship to physical boundaries and obstacles such as urban edges and roads.

The Reserve Manager and Science Panel will determine and recommend to the RMVLC Board what target studies (possibly including studies not listed above) should be pursued, based on the identification and prioritization of management and monitoring issues and available funding.

SPECIES ACCOUNT

Rangewide and Regional Status

The Belding's orange-throated whiptail (*A. h. beldingi*) is one two subspecies of orange-throated whiptail, the other being the cape orange-throated whiptail (*A. h. hyperythrus*) which is limited to the extreme southern portion of Baja California, Mexico. The Belding's orange-throated whiptail is simply called the orange-throated whiptail in this account since it is the only member

of the taxon in the U.S. The current range of the orange-throated whiptail includes southwestern California and Baja California. In California, this species is described as ranging from the southern edges of Orange (Corona del Mar) and San Bernardino (near Colton) counties southward to the Mexican border (Jennings and Hayes 1994). However, the CNDDB includes a single record from Tujunga Wash in Los Angeles County south of Interstate 210 near Sunland. This disjunct record suggests that the species is more common than described in the literature. They are located on the coastal slope of the Peninsular Ranges and extend from near sea level to 1,040 m (3,412 ft) northeast of Aguanga in Riverside County (Jennings and Hayes 1994).

The geographic distribution the orange-throated whiptail coincides with that of the subterranean termite (*Reticulitermes hesperus)*, the whiptail's primary prey item. For example, the Peninsular Mountain Range in Riverside and San Diego counties, where the termite is limited to its slopes, possibly restricts eastward and altitudinal expansion of orange-throated whiptail populations. Similarly, in San Bernardino County, the restriction of subterranean termites to the lower slopes of the Transverse and Peninsular ranges, and their local scarcity, possibly prevents eastward expansion of whiptails in that county. On the other hand, termites are abundant in Los Angeles and northern Orange counties, but orange-throated whiptails are considered to be absent from these areas (see description of range above) despite the availability of ostensibly suitable whiptail habitat. It is possible that urban, suburban and agricultural development activities may be effective dispersal barriers, but reason(s) for the absence of this species from habitat islands (*e.g.,* the Palos Verdes Peninsula) is(are) unknown.

The orange-throated whiptail is still relatively common in coastal sage scrub, chaparral and woodland habitats, but it is a CDFG CSC and has a CNDDB rank of G5T2S2; the full species is secure in its global range, but the subspecies Belding's orange-throated whiptail is considered endangered both in its entire range including Baja California and within California. The orange-throated whiptail was designated as one of the three target species for the NCCP coastal sage scrub pilot program in 1993, along with the California gnatcatcher and cactus wren. The main threat to the orange-throated whiptail has been habitat loss and fragmentation to development in recent decades. The CDFG estimated in 1990 that the orange-throated whiptail had been extirpated from 75 percent of its historic range (Jennings and Hayes 1994). The lower coastal floodplains have been developed, leaving the smaller, higher elevation and relatively isolated drainages and terraces as habitat for the whiptail. Because these areas are smaller and isolated, thus limiting dispersal opportunities, local populations have a greater risk of local extinction. The CDFG (2003) also suggests that the drought of 1986-1990 may have depleted the orange-throated whiptail's prey base, which poses a particular problem to a dietary specialist than cannot easily shift to another prey. As with the horned lizard, Argentine ants, that displace many native insects, also may influence the prey base of orange-throated whiptail (Jennings and Hayes 1994). Finally, McGurty (1981) suggested the frequent fires resulting in type conversion from scrub to

grassland habitat reduces woody shrubs and food sources for termites. Lack of cover caused by fires may also affect the whiptail's ability to thermoregulate.

Table 2-33 shows the distribution of the orange-throated whiptail lizard in California based 233 records in the 2003 CNDDB. The records are too numerous to include the general locations. Almost 88 percent of the occurrences are from San Diego and Riverside counties, with less than 10 percent from Orange County.

TABLE 2-33
DISTRIBUTION OF THE ORANGE-THROATED WHIPTAIL IN CALIFORNIA

County	No. of CNDDB Records
Los Angeles	1
Orange	23
Riverside	82
San Bernardino	4
San Diego	123

The orange-throated whiptail has been a focus of conservation planning programs in southern California. *Table 2-34* provides more detailed information on the conservation status of this species and its habitat in these programs.

TABLE 2-34
CONSERVATION STATUS OF THE ORANGE-THROATED WHIPTAIL

Conservation Planning Area	Number of Orange-throated Whiptail Locations and Percent Conserved	Potential Habitat Conserved
San Diego MSCP	514 locations, of which 62% conserved	56% of CSS and chaparral habitats and riparian scrub
Central/Coastal NCCP Reserve, Special Linkage and Existing Use Areas, Non-Reserve Open Space, and the Policy Plan Area	Number of locations not analyzed for conservation purposes	NA
North San Diego County MHCP	33 locations 55% proposed conservation	Proposed conservation of 11,691 acres (64%) of suitable habitat, including coastal sage scrub, maritime succulent scrub, chaparral, southern maritime chaparral, coastal sage scrub/chaparral mix.
Western Riverside MSHCP	140 locations 45% proposed conservation	Proposed conservation of 226,313 acres (59 %) of suitable habitat in the Plan Area, including chaparral, coastal sage scrub, desert scrub, Riversidean alluvial fan sage scrub, riparian scrub, woodland and forest.

Subregional Status

The NCCP database includes 174 locations for the orange-throated whiptail, of which 169 locations are in Subarea 1 (*Figure 177-M*). Whiptails are broadly distributed throughout the planning area, ranging from the Saddleback Meadows area in the northwest to the Talega sub-basin in the southeast. While the orange-throated whiptail occurrences are widely scattered, based on the database there appears to be three distinct clusters of occurrences that may be considered *important populations* in *key locations*: **(1)** a cluster of 59 occurrences in coastal sage scrub along the ridge between Chiquita Canyon and Wagon Wheel Canyon south of Oso Parkway; **(2)** a cluster of 18 occurrences along Chiquadora Ridge; and **(3)** a cluster of 47 occurrences in the Gobernadora/Central San Juan Creek sub-basins north and east of the Colorspot Nursery. However, identifying these three areas as *important populations* in *key locations* must be qualified. These clusters occur within survey areas for the FTC-S (SOCTIIP) surveys and thus probably reflect, at least in part, the greater survey effort in this portion of the planning area. Given the wide distribution of this species in the planning area, and its fairly general habitat requirements, it is likely to occur in substantial numbers in many other locations within the planning area.

Biological Considerations

The orange-throated whiptail inhabits coastal sage scrub, chaparral, non-native grassland, oak woodland, alluvial fan scrub and riparian areas. This species is presumably tied to perennial vegetation because its major food source, termites, requires perennial plants as a food base (Bostic 1966a). California buckwheat appears to be an important indicator of suitable habitat for the orange-throated whiptail because it generally is associated with habitats with 10-40 percent bare ground (McGurty 1981). Substantial bare ground apparently is required for foraging and thermoregulatory behavior by this species (McGurty 1981). California buckwheat commonly occurs in coastal sage scrub and chaparral and often is associated with other perennial species such as coastal sagebrush and sages (*Salvia* spp.) that may be food sources for termites. Friable soils also appear to be necessary for excavating burrows and hiding eggs (Bostic 1965). Analyses of soil grain size preferences indicate that orange-throated whiptail select only the two finest grain sizes for bury (Brattstrom 1989). However, these findings are complicated by the fact that lizards sometimes bury in larger grains in loose soil aprons brought up from the sub-surface by rodents (Brattstrom 1989).

Unlike several species in the whiptail genus, the orange-throated whiptail does not reproduce through parthenogenesis (development of an individual from a female gamete without fertilization by a male gamete). Based on examining reproductive structures throughout the year, Bostic (1966b) inferred from the presence of enlarged testes that males are reproductively active from the first week of April through the first week of July. The male cycle begins with regressed

testes as they emerge from hibernation. By late April, maximum testicular volume is achieved, followed by a decrease throughout the rest of the summer and complete regression by August. Orange-throated whiptails generally were found to reach maturity in the spring following hatching in the previous summer based on examination of the gonads and accessory reproductive structures of male and female dissected lizards.

The average clutch size for the orange-throated whiptail is approximately 2.3 eggs (Bostic 1966b). Reproductive potential is lower in yearlings than in adults of two years of age or older, with a recorded a maximum clutch size of two eggs for yearlings and three for older lizards (Bostic 1966b). The number of egg clutches deposited each season by orange-throated whiptails in not known; however, multiple clutches may be laid, one in June and again in mid-July (Milstead 1957a; Bostic 1966b; Parker 1972; Crews *et al.* 1986). Rainfall may influence clutch size (Mitchell 1979; Crews *et al.* 1986; Pianka 1986). Incubation of hatchlings appears to be approximately 50-55 days based on the time interval between the last record of females with oviductal eggs (mid-July) to dates hatchlings were last observed in the field.

Bostic (1965) recorded an average home range of 0.04 ha (0.10 ac) for adult orange-throated whiptails. Female ranges were slightly larger than male ranges at 0.06 ha (0.15 ac) versus 0.03 ha (0.07 ac), respectively. Female home ranges overlap extensively with other females' ranges as well as male ranges. Bostic (1965) also noted some overlap among male home ranges, but not as extensive as for females.

Termites comprise 72-92 percent of the orange-throated whiptail's diet (Bostic 1966a). In late summer, however, when termites migrate deep into the soil to avoid high surface temperatures, alternate prey items dominate the whiptail's diet. Orange-throated whiptails feed primarily on prey of a secretive nature and low activity, and depend primarily on chemoreception when hunting such prey (Bostic 1966a). When hunting prey of intermediate or high activity (*e.g.*, lepidopterans), vision is most often employed.

The daily activity cycle of whiptails is dominated and controlled by thermoregulatory needs (*e.g.*, Cowles 1940; Carpenter 1961; Bogert 1949; Fitch 1958). Through thermoregulatory behaviors, whiptails are able to maintain their body temperatures within a narrow range. Most of the year whiptails are active throughout the day when near-surface temperatures are between 36-41 degrees C (96-106 degrees F). They become bimodally diurnal on hot summer days, meaning that their surface activity peaks twice a day when temperatures are appropriate; otherwise they spend the warmest part of the day in shade or an underground retreat (Milstead 1957b; Mitchell 1979; Pianka 1986). Whiptails usually only emerge when near-surface temperatures reach about 28 degrees C (82 degrees F). During low early morning temperatures, they move slowly while foraging and frequently stop to bask in open or sparsely covered grass areas between bushes. As mid-morning temperatures increase, basking becomes infrequent and

of shorter duration and foraging largely occurs in shaded or semi-shaded areas around bushes. Movements between bushes are very rapid. Few whiptails are observed foraging as midday temperatures increase and as they retreat to cooler areas (*e.g.*, rodent burrows, shade beneath bushes, or they excavate shallow retreats in the substrate). Additional thermoregulatory behavioral patterns may include arboreal behavior to aid in the dispersal of heat to the cooler upper air strata, although Bostic (1966c) found that substrate temperatures appear to be more important role in regulating body temperature than do air temperatures. Adult orange-throated whiptails usually enter into hibernation in late July through most of September, and immatures in December (Bostic 1966c). Favored hibernation, and likely oviposition sites, appear to be on well-isolated, south-facing slopes (Jennings and Hayes 1994).

Protection Recommendations

- Protect the orange-throated whiptail locations on the ridgeline between Chiquita Canyon and Wagon Wheel Canyon that comprise an *important population* in a *key location*.
- Protect the orange-throated whiptail locations on Chiquadora Ridge that comprise an *important population* in a *key location.*
- Protect the major north-south connection to Central San Juan Creek by providing a habitat linkage between Chiquita Creek and the eastern edge of the Ladera Open Space and by restricting new impervious surfaces west of Chiquita Creek in order to maintain habitat integrity between the creek and Chiquita Ridge.
- Maintain east-west biological connectivity by protecting habitat linkages and wildlife corridors between Arroyo Trabuco, Chiquita Canyon, and Gobernadora Canyon. Biological connectivity should be maintained between Chiquita, Gobernadora and Arroyo Trabuco by protecting habitat linkages at minimum of three locations within the sub-basin: **(1)** via rim-to-rim preservation of Sulphur Canyon (approximately 2,000 to 2,500 feet wide); **(2)** at the "Narrows" where the canyon is only 700-800 feet wide (approximately 3,000 feet south of Tesoro High School) and connects to Sulphur Canyon; and **(3)** in contiguous patches of coastal sage scrub through the major canyon north and east of the wastewater treatment plant.
- Maintain a continuous upland habitat linkage along the east-facing slopes of Chiquadora Ridge between San Juan Creek and Sulphur Canyon.
- Provide floodplain and upland linkage habitat adjacent to San Juan Creek for "live-in" and dispersal habitat for the orange-throated whiptail.
- Maintain upland north-south habitat linkages through the central and western portions of the Trampas Canyon subunit to provide "live-in" and dispersal habitat for the orange-throated whiptail.

- Protect a habitat linkage, consisting of the Donna O'Neill Land Conservancy and an area along the east side of Cristianitos Creek, to provide dispersal opportunities for the orange-throated whiptail in the upper portion of the sub-basin with other populations in lower Gabino Creek and Camp Pendleton along lower Cristianitos/San Mateo Creek, and to maintain habitat integrity through connectivity within the Donna O'Neill Land Conservancy at Rancho Mission Viejo.
- Maintain an east-west habitat linkage from Gabino Creek to the confluence with Cristianitos Creek as "live-in" habitat and dispersal opportunities for the orange-throated whiptail between Gabino Canyon and the Donna O'Neill Conservancy at Rancho Mission Viejo.
- Protect, to the extent feasible, patches of coastal sage scrub in the Verdugo Canyon sub-basin with a focus on maintaining contiguous habitat patches that provide "live-habitat" and north-south dispersal opportunities for the orange-throated whiptail between the Lucas Canyon sub-basin to the north, and the Gabino Canyon/Blind Canyon and La Paz sub-basins to the south.
- Maintain contiguity and connectivity of coastal sage scrub in the upper Gabino Canyon subunit to provide "live-in" and dispersal habitat for the orange-throated whiptail.
- Protect a north-south habitat linkage through Middle Gabino to provide "live-in" habitat and dispersal opportunities for the orange-throated whiptail.
- Maintain contiguity and connectivity of coastal sage scrub in the Talega Canyon sub-basin to provide "live-in" habitat and dispersal opportunities for the orange-throated whiptail.

Management Recommendations

- Implement a management program for protected habitat suitable for the orange-throated whiptail, including control of non-native species such as the Argentine ant, management of fire and grazing and minimization of human access and disturbance (*e.g.*, collecting), as part of the Adaptive Management Program.

Restoration Recommendations

- Implement a CSS/VGL restoration program to enhance habitat value and connectivity. Potential restoration areas that would benefit the orange-throated whiptail include Chiquita Ridge, Sulphur Canyon, Chiquadora Ridge, upper Cristianitos Canyon and upper Gabino Canyon.

2.19 RED COACHWHIP

Species:	Red Coachwhip (*Masticophis flagellum piceus*)
Federal Status:	None
State Status:	None
CNDDB Rank:	None
Science Advisors Group:	None
Covered Species:	Yes
Focal Monitoring Species:	No
Planning Species:	No

CONSERVATION GOAL

1. Protect and manage habitat of the red coachwhip to maximize the likelihood that the species is sustained in the planning area, and in doing so "provide for recovery" on a subregional basis and "contribute to recovery" on a rangewide basis.

CONSERVATION STRATEGY

1. Create a permanent subregional Habitat Reserve that provides sufficient habitat in large, contiguous patches to maximize the likelihood of the red coachwhip's persistence within the planning area.
2. Formulate a HRMP to provide for long-term protection and management of habitat for the red coachwhip.

HABITAT AND SPECIES CONSERVATION AND IMPACTS ANALYSIS

The conservation analysis for the red coachwhip focuses primarily on landscape level habitat conservation because of its broad habitat associations and relative lack of site-specific occurrence information. Conservation is assessed in terms of overall habitat conservation, habitat blocks, and habitat contiguity and connectivity.

Suitable habitat for the red coachwhip in the planning area is defined as coastal sage scrub, chaparral, and grassland. Agriculture (*e.g.*, barley fields and orchards) may be used by red-coachwhips but is not included here as suitable habitat because of its relative lack of cover. However coachwhips may forage in agricultural area for rodents, especially along the ecotone between shrublands and agriculture. *Table 2-35* provides a summary of the existing conditions, proposed conservation, and permanent and temporary impacts of red coachwhip habitat in the planning area and within the Subarea 1 permit area. The planning area conservation and

impact estimates reported in *Table 2-35* include SOS and potential impact areas in Subareas 2, 3 and 4 and do not reflect future planning within those Subareas that may result in changes to the SOS and impact estimates.

TABLE 2-35
RED COACHWHIP CONSERVATION AND IMPACT SUMMARY

	Acres	Percent	Locations	Percent
Planning Area				
Existing Total	44,640		3	
Habitat Reserve	23,111	52%	2	67%
Supplemental Open Space	9,426	21%	0	0%
Total Protected	32,537	73%	2	67%
Total Permanent Impact	8,067	18%	1	33%
Subarea 1				
Existing Total	32,729		3	
Habitat Reserve	23,111	71%	2	67%
Supplemental Open Space	3,461	11%	0	0%
Total Protected	26,572	81%	2	67%
Total Permanent Impact	6,254	19%	1	33%
Total Temporary Impact	205		0	0%

Subarea 1 Impacts

The proposed Covered Activities would result in direct, permanent impacts to 6,254 acres (19 percent) of suitable habitat (coastal sage scrub, chaparral and grassland) and one of three (33 percent) documented locations in Subarea 1 (*Table 2-35* and *Figure 202-M*). The proposed Covered Activities also would result in temporary direct impacts to 205 acres of habitat, but no locations (*Table 2-35*).

Subarea 1 Conservation

Two of the three (67 percent) documented locations in Subarea 1 and 23,111 acres (71 percent) of habitat would be conserved in the Habitat Reserve (*Table 2-35* and *Figure 202-M*). An additional 3,461 acres (11 percent) are in Subarea 1 SOS, bringing the total conservation of habitat to 26,572 acres (81 percent).

There are some data on the spatial behavior of the coachwhip indicating that they are quite wide ranging and active for a colubrid snake. In the eastern Mojave Desert, Secor (1995; cited at www.natureserve.org) documented average "activity ranges" of 131 acres, movements on 76 percent of days monitored, and average daily movements of more than 600 feet. Based on available movement information for other colubrid snakes, NatureServe sets the "Separation

Distance" through unsuitable habitat at 1 km (3,280 feet) and through suitable habitat at 5 km (3.1 miles); other colubrids exhibit home ranges between about 7 and 62 acres, although large colubrids have larger home ranges. Based on other colubrid species, it is reasonable to assume that coachwhips are unlikely to disperse between highly isolated habitat patches through unsuitable habitat and that paved, heavily used roads are a significant risk for the species. Thus habitat patch size, contiguity and connectivity likely are key reserve design considerations for this species.

The results of the refined habitat block delineation used to analyze patch size are presented in *Part I, Chapter 13, Table 13-9* and depicted in *Figure 193-M*. The seven habitat blocks combined include about 24,280 acres (including habitat in SOS in Coto de Caza in Subarea 3) of the 26,572 acres (91 percent) of conserved habitat (coastal sage scrub, chaparral and grassland) for the red coachwhip. Habitat within the blocks ranges from 732 acres in the Radio Tower Road mesa block to 11,985 acres in the Southeastern block.

- Habitat linkages likely to be important for the red coachwhip also would be conserved, including: the north-south connection along Chiquita Ridge spanning the area from Ladera Open Space to Chiquita Creek (linkage C); the east-west connection from Arroyo Trabuco to Gobernadora and Caspers Wilderness Park via Chiquita Canyon (linkages B, D, H, I); the north-south connection along Chiquadora Ridge (linkage G); the floodplain along San Juan Creek and into Bell Canyon (linkage J); the linkage along and perpendicular to Verdugo Canyon (linkages L and M); the north-south linkages through the central and western portions of Trampas Canyon and Cristianitos Canyon (linkages J, K and N); and linkages O, P and Q in Gabino, La Paz and Talega canyons, respectively (see *Figure 193-M*). Where roads cross linkage areas wildlife movement and dispersal will need to be addressed. For example, bridges will be constructed across San Juan, Chiquita and Gobernadora creeks for Cow Camp Road, and San Juan Creek and Chiquadora Ridge for Cristianitos/"F" Street. For the extension of Cristianitos Road/"F" Street through Chiquita Canyon to Oso Parkway, wildlife culvert at Chiquita Narrows within the design of Cristianitos Road shall be included with the following dimensions: The culvert shall have a minimum dimension of 15 by 15 feet, the bottom of the culvert shall be of a natural substrate, light shall be visible from one end of the culvert to the other, vegetation installed at either end shall be native low growing to prevent predator-prey stalking, and if required for public health and safety, all lighting on the road above the culvert shall be shielded to prevent spill-over effects (*NCCP Minimization Measure 8-1*).

ADAPTIVE MANAGEMENT PROGRAM

Stressors

The red coachwhip has not been studied adequately to directly evaluate environmental stressors on the species that would provide the basis for management actions. However, it can be assumed that general impacts to its habitat and prey base have an adverse effect on the species. In addition, direct impacts common to many snakes such as vehicle collisions and human harassment can be assumed. Thus the following land uses and activities that can disturb suitable habitat and/or individual snakes are identified as potential stressors and will be considered for management:

- Habitat loss and fragmentation
- Urbanization adjacent to Habitat Reserve
- Exotic plant invasions (especially those that choke sandy washes and streamcourses such as giant reed)
- Rodent controls (coachwhips may use small mammal burrows as refugia, for foraging and for laying eggs)
- Urban-related predators such as cats and dogs
- Roads and trails
- Argentine ants (through effects on native lizards that are prey items for coachwhips)

Goals

Goals for protecting and managing the red coachwhip and its habitat include the following:

1. Protect and manage suitable habitat (with the exception of agriculture which will not be managed as wildlife habitat) to maintain approximate existing acreage in the Habitat Reserve.
2. Maintain the physiographic diversity of suitable habitat in the Habitat Reserve.
3. Manage exotic invasions of riparian and streamcourse habitats.
4. Protect and manage identified key habitat linkages to maximize the likelihood of habitat connectivity.

Management and Monitoring Objectives (number of goal met by objective in parentheses)

Objective 1: Implement Conservation Strategy to protect and manage approximately 23,111 acres of suitable habitat in Habitat Reserve (actual acreage will vary in relation to

natural and anthropogenic environmental effects such as wildfires and drought) (Goals 1 & 2).

Objective 2: Remap vegetation communities in Habitat Reserve within two (2) years of executing IA to establish a baseline for long-term tracking of the Reserve (Goals 1 & 2).

Objective 3: Update vegetation community map at 5-year intervals (Goals 1 & 2).

Objective 4: Implement Invasive Species Control Plan to manage invasive exotic species in riparian and streamcourse areas (Goals 1, 2 & 3).

Objective 5: Implement management and monitoring of identified key habitat linkages to maximize the likelihood of continued function as "live in" and dispersal habitat for red coachwhips (Goal 3).

Conceptual Model

No. Insufficient data to develop conceptual model at this time.

Regional and Subregional Management Information Needs

- The general life history and autecology of the red coachwhip, including spatiotemporal behavior (*e.g.*, home range, territoriality, and dispersal) and key factors in habitat selection (*e.g.*, species composition, soil types, habitat structure, slope, aspect, etc.), especially in coastal areas.
- The current status and population trends of the red coachwhip, especially in the South coast Ecoregion.
- The effects of habitat loss and fragmentation.
- Community relationships (*e.g.*, interspecific and predator-prey relationships).
- Significant sources of natural (*e.g.*, native predators) and human-related (*e.g.*, vehicle collisions, harassment, exotic predators) mortality.
- Effective and feasible management and monitoring methods.
- The distribution of the coachwhip in the Habitat Reserve.
- Presence of other obstacles that could disrupt movement (*i.e.*, "Separation Barriers") within the Habitat Reserve.

Level of Management and Monitoring Priority - Low

There is a general lack of scientific information for the red coachwhip that can be used to directly inform conservation and management. Although a very wide-ranging species in Southern California, with only three records the coachwhip appears to be uncommon in the subregion, and the Southern Ecoregion in general. Pitfall trapping in Orange County, including arrays on Starr Ranch. documented only eight total captures at two sites between 1995 and 2000; five at UC Irvine and three at Chino Hills (Fisher and Rochester 2000). Elsewhere in southern California, Brehme (2003) had no captures of the coachwhip in 9,600 trap nights in pitfall traps in southern San Diego County from April to December 2001 and Dudek (2002) had no captures of the species in 3,000 trap nights in pitfall traps in the Badlands area of western Riverside County.

Although it is assumed to occur in low numbers, the coachwhip likely occurs throughout the Habitat Reserve in suitable habitat. There are no identified immediate threats to the red coachwhip in Subarea 1 at this time that would warrant specific management actions. Given the high level of habitat conservation (81 percent), at least through Phase 1 of the HRMP management and monitoring for the red coachwhip, it is recommended that efforts focus on landscape-level management and, in particular, management and monitoring of identified habitat linkages where there is a concern about the ability of coachwhips and other Covered Species and focal species to disperse through the landscape. At a species level, monitoring during Phase 1 will be based on anecdotal observations of the species (*e.g.,* observations of red coachwhips along standard wildlife/vegetation transects, roadkills, and other anecdotal observations). At this time intensive, the high cost of focused monitoring for this species does not seem to be justified because of the high level of habitat conservation and the lack of identified significant threats. Further, the low capture rates for this species at other sites suggest that a substantial effort would be required to collect adequate data for statistically valid trend analyses. At some point in the future the Science Panel and Reserve Manager may recommend intensifying the monitoring effort for the suite of reptiles proposed for regulatory coverage, and the diversity and abundance of herpetofauna in general, through the use of pitfall trap arrays, or other species-appropriate survey methods, using standardized sampling protocols of sufficient statistical power (*i.e.,* some minimum number of sample sites monitored a minimum number of periods). Such a decision to intensify the monitoring effort likely would be based on regional information from the Wildlife Agencies or the USGS WERC that a species is at high risk of endangerment or a particular significant environmental stressor has been identified. In such a case, the Science Panel and Reserve Manager, through communications with the Wildlife Agencies, would evaluate the situation in the context of the overall HRMP and determine the need for and feasibility of more intensive monitoring.

Level of Monitoring (*e.g.*, Species-specific, habitat, landscape, combination)

Monitoring will be conducted at both the habitat landscape and species-specific levels, but species monitoring will focus on presence/absence surveys, not monitoring for the purpose of assessing population trends.

Monitoring Variables

Listed below are suggested species- and habitat-based monitoring variables. The detailed monitoring program for the red coachwhip will be developed by the Reserve Manager and Science Panel.

Species-specific Monitoring Variables

1. Presence/absence
2. Estimates for the proportion of occupied habitat

Habitat-based Monitoring Variables

1. Vegetation communities long-term status
2. Relative cover of different native plant species
3. Proportion of exotic plant species/native plant species
4. Evidence of urban-related predators and other mesopredators (*e.g.*, tracks, scat, direct observations)
5. Evidence of unauthorized public activities (*e.g.*, trespass, trampling, illegal trails, trash, shooting, etc.)

Management Actions

Adaptive management of the coastal sage scrub, chaparral and grassland vegetation communities, as described in *Part I, Chapter 7*, will benefit the red coachwhip. Management actions would be implemented primarily at a landscape level and include fire management and invasive species controls, including artichoke thistle controls in uplands and giant reed controls along washes that may be used for movement. Rodent controls will be prohibited within the Habitat Reserve, and the use of chemical pesticides in areas adjacent to the Habitat Reserve (*e.g.*, golf courses) will be minimized to the extent feasible and will be used in accordance with an approved Integrated Pest Management Program designed to avoid and minimize effects on native species and habitats. Urban-related predators such as cats and dogs will be controlled in the Habitat Reserve through public education and direct controls such as trapping where necessary and to the extent feasible. Signage along trails and bike paths in the Habitat Reserve will be used to inform the public of the risk to native species such as snakes and amphibians from recreational activities. Collecting of the red coachwhip snake by the public would be prohibited within the

Habitat Reserve, although this issue is not as great for the coachwhip as for more docile snakes because it is difficult to catch and very aggressive when handled. Argentine ant controls will be implemented to reduce impacts on native lizards that are prey for the red coachwhip. Habitat restoration activities implemented at the discretion of the Reserve Manager and Science Panel to benefit this species include CSS/VGL restoration on Chiquita Ridge, in Sulphur Canyon, and on Chiquadora Ridge.

Potential Target Studies

Several regional and subregional information management needs relevant to management of the red coachwhip were listed above, some of which could be addressed at the subregional scale and would help inform management of the Habitat Reserve. Other regional and subregional information management needs, particularly those related to rangewide persistence of the species (*e.g.,* general ecology, community relationships and landscape habitat fragmentation) are best studied at a rangewide scale. The following are potential target studies that could be implemented at the subregional scale:

- Effects of Argentine ants on native prey.
- Effects of urban-related predators.
- Effects of recreation activities.
- Effects of vehicles collisions (likely would be conducted as part of a general study of herpetofauna).
- Movement behavior within the Habitat Reserve in relationship to physical boundaries and obstacles such as urban edges and roads.

The Reserve Manager and Science Panel will determine and recommend to the RMVLC Board what target studies (possibly including studies not listed above) should be pursued, based on the identification and prioritization of management and monitoring issues and available funding.

SPECIES ACCOUNT

Rangewide and Regional Status

The full species coachwhip is a wide-ranging species found throughout the southern U.S. from coast to coast and into northern Mexico (Stebbins 2003). They range in elevation from below sea level (in the desert) to about 7,700 feet. The subspecies red coachwhip (*M. f. piceus*) occurs throughout the arid desert regions of the southwest, including the Great Basin, Mojave, Colorado and Sonora deserts, as well as coastal southern California from the Central Valley south to the

border with Baja California. Coachwhips in the southwestern U.S. typically occur in open, dry, vegetative associations with very few or no trees. They appear to be most abundant in grass, desert, scrub, chaparral, and pasture habitats (Zeiner *et al.* 1990).

The subspecies red coachwhip is not a California Special Status species and thus has no CDFG designation or CNDDB rank. However, similar to the other snakes proposed for regulatory coverage, biologists are becoming increasingly concerned about this subspecies in coastal southern California due to loss and fragmentation of habitat (P. Bloom, pers. comm. 2003) and it has a reasonable likelihood of listing over the duration of the project. This species is threatened not only due to a historically restricted geographic range, but also by continued extensive land use changes over the last 15 years. Some of the most detrimental changes include the first-time conversion of large areas of valley grassland or shadscale scrub associates to crop agriculture, such as in the San Joaquin Valley to cotton, grapes, kiwi fruit, and various vegetables (Brattstrom and Warren 1953). These land conversions eliminate both food resources and mammal burrows coachwhips depend upon for refuge sites. In addition, urban development in the inner Coast Ranges threatens the long-term survival of the species. Habitat loss combined with four years of drought (1986-1990), for example, appears to have reduced the available lizard food base for the coachwhip in many areas and may have significantly contributed to the reduction and fragmentation of the population.

Subregional Status

There are three documented locations for the red coachwhip in the planning area, all of which are in Subarea 1 (*Figure 202-M*). Two locations are in Arroyo Trabuco and one is at the confluence of Chiquita and San Juan creeks. Because of its broad habitat associations – coastal sage scrub, chaparral and grassland – this species could occur throughout suitable habitat in the planning area

Biological Considerations

The red coachwhip occurs in open, dry, vegetative associations with very little to no trees. It is most abundant in grass, desert, scrub, chaparral, and pasture habitats (Wilson 1970; Stebbins 2003). The coachwhip likely requires mammal associates for their unoccupied burrows. They seek cover and deposit their eggs in rodent and mammal burrows, and will also take refuge in bushes, trees, and rock piles (Stebbins 2003; Miller and Stebbins 1964). This species hibernates in sand or soil approximately one foot subsurface, occasionally at the base of vegetation (Wright and Wright 1957).

Coachwhips feed on rodents, lizards and eggs, snakes (including rattlesnakes), birds and eggs, young turtles, insects, and carrion (Cowles 1946; Stebbins 2003; Wright and Wright 1957;

Carpenter 1958; Cunningham 1959; Miller and Stebbins 1964). They search actively for food in burrows or trees, using both vision and olfaction to detect prey (Stebbins 2003; Miller and Stebbins 1964) which are then eaten live and whole (Ortenburger 1928; Stebbins 2003).

Little is known about the reproductive cycles and nest sites of this species. One nest site was recorded on the bank of a highway drainage ditch, approximately one foot below the ground surface (Wright and Wright 1957). Mating is thought to occur in May and oviposition in June or early July. Clutch size ranges from 4 to 20 granular-surfaced eggs (Stebbins 1985). Young hatch from July to September.

2.20 "SAN DIEGO" COAST HORNED LIZARD

Species:	**"**San Diego" Coast Horned Lizard (*Phrynosoma coronatum*) (blainvillei population)
Federal Status:	None
State Status:	CSC
CNDDB Rank:	G4T3T42S2S3
Science Advisors Group:	2
Covered Species:	Yes
Focal Monitoring Species:	Yes
Planning Species:	Yes

CONSERVATION GOAL

1. Protect and manage habitat of the San Diego horned lizard to maximize the likelihood that populations are sustained in the planning area, and in doing so "provide for recovery" on a subregional basis and "contribute to recovery" on a rangewide basis.

CONSERVATION STRATEGY

1. Create a permanent subregional Habitat Reserve that provides sufficient habitat in large, contiguous patches to maximize the likelihood of the San Diego horned lizard's persistence within the planning area.
2. Formulate a HRMP to provide for long-term protection and management of habitat for the San Diego horned lizard.

HABITAT AND SPECIES CONSERVATION AND IMPACTS ANALYSIS

The conservation analysis for the San Diego horned lizard is based both on site-specific information (*i.e.,* documented occurrences and identified *important populations/key locations*) and landscape-level habitat factors including amount of habitat conserved (defined as coastal sage scrub and chaparral), and habitat patch size, contiguity and connectivity.

Table 2-36 provides a summary of the existing conditions, proposed conservation, and permanent and temporary impacts of horned lizard habitat in the planning area and within the Subarea 1 permit area. The description of impacts and conservation below is limited to Subarea 1 which is the permit action area. The planning area conservation and impact estimates reported in *Table 2-36* include SOS and potential impact areas in Subareas 2, 3 and 4 and do not reflect future planning within those Subareas that may result in changes to the SOS and impact

estimates. For example, future planning in the Subarea 2 (Foothill-Trabuco Specific Plan Area) will result in changes to the open space and impact estimates.

TABLE 2-36
SAN DIEGO HORNED LIZARD CONSERVATION AND IMPACT SUMMARY

	Acres	Percent	Locations	Percent
Planning Area				
Existing Total	29,529		50	
Habitat Reserve	17,385	59%	36	72%
Supplemental Open Space[1]	5,737	19%	3	6%
Total Protected	23,122	78%	39	78%
Total Permanent Impact	5,011	17%	12	24%
Subarea 1				
Existing Total	23,479		48	
Habitat Reserve	17,385	74%	36	75%
Supplemental Open Space	2,507	11%	0	0%
Total Protected	19,892	85%	36	75%
Total Permanent Impact	3,585	15%	12	25%
Total Temporary Impact	81		0	

Subarea 1 Impacts

The proposed Covered Activities would result in direct, permanent impacts to 3,585 acres (15 percent) of suitable habitat (coastal sage scrub and chaparral) and 12 of 48 (25 percent) documented locations in Subarea 1 (*Table 2-36* and *Figure 177-M*). The proposed Covered Activities also would result in temporary direct impacts to 81 acres of habitat, but no locations (*Table 2-36*).

Five of the 14 individuals in the Cristianitos Canyon *important population/key location* are in PA 6 in the area targeted for potential future orchards. In addition, within the Chiquita Canyon/Wagon Wheel Ridgeline *important population/key location*, the alignment of Cristianitos Road/"F" Street extending to Oso Parkway isolates two horned lizard locations within this population from the rest of the population east of the alignment, effectively reducing the size of the population in the absence of measures to maintain the functional connection within this population.

Subarea 1 Conservation

Thirty-six of the 48 (75 percent) documented locations in Subarea 1 and 17,385 acres (74 percent) of habitat would be conserved in the Habitat Reserve (*Table 2-36* and *Figure 177-M*).

An additional 2,507 acres (11 percent) of habitat are in SOS, bringing the total habitat conservation to 19,892 acres (85 percent).

All 15 locations in the Chiquita Canyon/Wagon Wheel Ridgeline *important population/key location* would be the Habitat Reserve. However, as noted above, the construction of Cristianitos Road/"F" Street would isolate two of the 15 locations on the west side of the road, so the ultimate conserved population is located to the east of the road (but see discussion of wildlife undercrossing below). Nine of the 14 locations in the Cristianitos Canyon *important population/key location* are in the Habitat Reserve. Reflecting the somewhat scattered distribution of the horned lizard in the Habitat Reserve, 12 of the 36 conserved locations were not mapped within *important populations*.

There are no dispersal data for the San Diego horned lizard, but horned lizards as a group show limited home ranges, usually less than 5 acres (*e.g.*, Munger 1984), and daily movements of the closely related *P. cornutum* averaged about 150 feet per day (Whitford and Bryant 1979). Radiotelemetry of several dozen San Diego horned lizards in southern California locations over a 5-year period documented annual home range sizes of about 3 to 3.5 acres, with the likelihood that, across years, home range areas could be larger (unpublished data, Suarez, pers. comm. 2005). Because of their limited movements and relatively small home ranges, horned lizards are considered to be relatively sedentary animals and roads separating habitat patches likely are a significant barrier to dispersal. Large, unfragmented habitat blocks thus are considered important for this species.

Based on the refined habitat block analysis (*Part I, Chapter 13, Table 13-9*), seven habitat blocks combined include about 18,684 acres (including habitat in SOS in Coto de Caza in Subarea 3) of the 19,892 acres (94 percent) of conserved habitat (coastal sage scrub and chaparral) for the horned lizard. Habitat within the blocks ranges from 211 acres in the Radio Tower Road mesa block to 9,307 acres in the Southeastern block. The Wagon Wheel habitat block that includes the Chiquita Canyon/Wagon Wheel Ridgeline *important population/key location* contains 610 acres of habitat.

Of the 36 conserved horned lizard locations, 34 (94 percent) are in large habitat blocks: 14 in the Wagon Wheel block of which 13 comprise an *important population/key location*; 14 in the Southeastern block, of which nine are part of the Cristianitos *important population/key location;* and six in the Chiquita Ridge block, of which two are in the Chiquita Canyon/Wagon Wheel Ridgeline *important population/key location.* As discussed below, a wildlife undercrossing to maintain the connection of this population will be important.

Important habitat linkages for the San Diego horned lizard also would be conserved, including: the north-south connection along Chiquita Ridge spanning the area from Ladera Open Space to

Chiquita Creek (linkage C); the east-west connection from Arroyo Trabuco to Gobernadora and Caspers Wilderness Park via Chiquita Canyon (linkages B, D, H, I); the north-south connection along Chiquadora Ridge (linkage G); the floodplain along San Juan Creek and into Bell Canyon (linkage J); the linkages along and perpendicular to Verdugo Canyon (linkage L and M); the north-south linkages through the central and western portions of Trampas Canyon and Cristianitos Canyon (linkages J and K); and linkages O, P and Q in Gabino, La Paz and Talega canyons, respectively (see *Figure 193-M*). For the extension of Cristianitos Road/"F" Street through Chiquita Canyon to Oso Parkway, wildlife culvert at Chiquita Narrows within the design of Cristianitos Road shall be included with the following dimensions: The culvert shall have a minimum dimension of 15 by 15 feet, the bottom of the culvert shall be of a natural substrate, light shall be visible from one end of the culvert to the other, vegetation installed at either end shall be native low growing to prevent predator-prey stalking, and if required for public health and safety, all lighting on the road above the culvert shall be shielded to prevent spill-over effects (*NCCP Minimization Measure 8-1*).

ADAPTIVE MANAGEMENT PROGRAM

Stressors

Management for the San Diego horned lizard will consider a variety of environmental stressors identified for the species, including:

- Habitat loss and fragmentation due to urban and agricultural development
- Precipitation (extended drought, but also wet periods promoting spread of Argentine ants resulting from higher moisture content along urban/wildland interfaces)
- Argentine ants (through effects on native lizards that are prey items for horned lizards)
- Frequent fire
- Exotic plant invasions
- Cattle-related impacts
- Off-road vehicles
- Urban-related predators (primarily cats)
- Paved roads
- Human harassment and collection

The primary stressor on the San Diego horned lizard is habitat loss and fragmentation, with approximately 45 percent of habitat extirpated as of 1988 (Jennings 1988). In addition to habitat loss, Jennings and Hayes (1994) identified several other threats to the horned lizard, including collection by humans (including for commercial uses), off-road vehicles, livestock grazing, conversion of habitat to agriculture, invasion by Argentine ants, firebreaks and prescribed burning (although the latter two may actually create open microhabitats used by horned lizards).

The stationary defensive behavior of horned lizards makes them particularly vulnerable to collection and crushing by vehicles and cattle. The invasion of habitat by Argentine ants in California recently has become a high profile threat, not only to the horned lizard, but also to other native species. While Argentine ants have been in California for at least 93 years (Holway 1995), studies of the species date back only to the 1970s. It is now clear that Argentine ants disrupt natural communities by displacing native ants and other arthropods and disrupting ant-plant and ant-aphid mutualisms (evolved interdependent associations) (Holway 1995). Fisher *et al.* (2002), for example, found in a pitfall-trapping study conducted throughout southern California that the presence of horned lizards was correlated with the absence of Argentine ants and presence of native harvester ants.

Goals

Goals for protecting and managing the San Diego horned lizard and its habitat include the following:

1. Protect and manage suitable habitat (coastal sage scrub and chaparral) to maintain approximate existing acreage in the Habitat Reserve.
2. Maintain the physiographic diversity of suitable habitat in the Habitat Reserve.
3. Manage fire regimes such that a natural diversity of age-stands is maintained throughout the Habitat Reserve and type conversion of shrublands to grassland is controlled.
4. Protect and manage identified key habitat linkages to maximize the likelihood of habitat connectivity.

Management and Monitoring Objectives (number of goal met by objective in parentheses)

Objective 1: Implement Conservation Strategy to protect and manage approximately 17,385 acres of suitable habitat (coastal sage scrub and chaparral) in the Habitat Reserve (actual acreage will vary in relation to natural and anthropogenic environmental effects such as wildfires and drought) (Goals 1 & 2).

Objective 2: Remap vegetation communities in Habitat Reserve within two (2) years of executing IA to establish a baseline for long-term tracking of the Habitat Reserve (Goals 1 & 2).

Objective 3: Update vegetation community map at 5-year intervals (Goals 1 & 2).

Objective 4: Implement Habitat Restoration Plan to restore (including revegetation and enhancement) approximately 363 acres of coastal sage scrub in designated locations that currently are in agriculture, grazed, or otherwise do not currently

support coastal sage scrub to enhance carrying capacity and connectivity (Goals 1, 2 & 4).

Objective 5: Implement Wildland Fire Management Plan to manage shrubland fire regimes such that a natural diversity of age-stands is maintained throughout the Habitat Reserve and such that source populations of the San Diego horned lizard are adequately protected (Goals 1, 2, 3 & 4).

Objective 6: Implement Invasive Species Control Plan to manage invasive exotic species (specifically Argentine ants) in horned lizard habitat (Goals 1 & 4).

Objective 7: Implement management and monitoring of identified key habitat linkages to maximize the likelihood of continued function as "live in" and dispersal habitat for horned lizards (Goal 4)

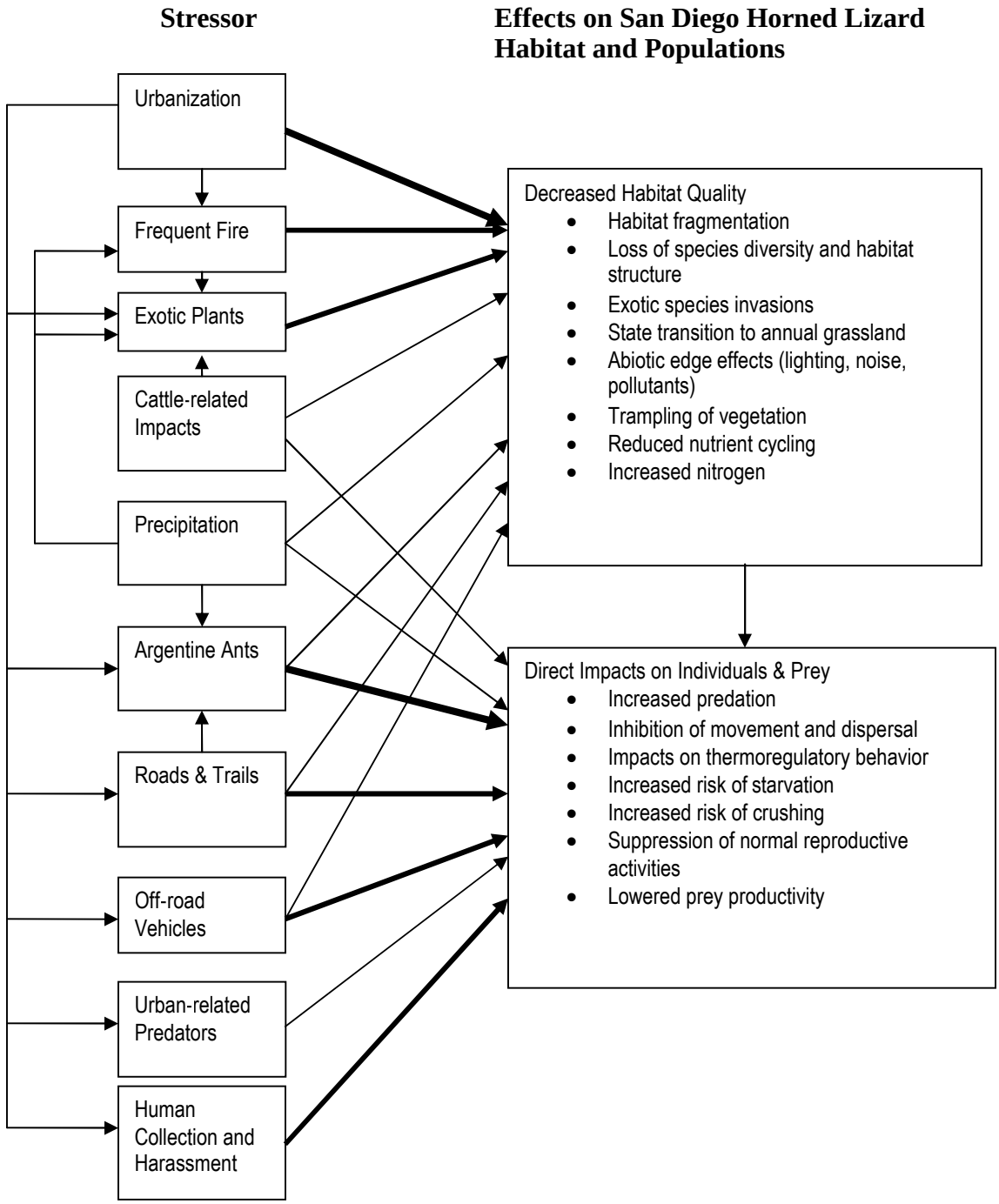
Conceptual Model

Yes. See figure below.

Regional and Subregional Management Information Needs

- The general life history and autecology of the San Diego horned lizard, including spatiotemporal behavior (*e.g.,* home range, territoriality, communal activity, and dispersal) and key factors in microhabitat selection (*e.g.,* species composition, soil types, habitat structure, slope, aspect, etc.), especially in coastal areas (Fisher *et al.* 2002 provide preliminary data for presence/absence and abundance, but their coarse-grained data still only account for a small proportion of the variation, suggesting the need for more study at fine-grained microhabitat scales of analysis).
- The current status and population trends of the San Diego horned lizard, especially in the South Coast Ecoregion.
- The long-term effects of habitat loss and fragmentation.
- Community relationships (*e.g.,* interspecific and predator-prey relationships).
- Significant sources of natural (*e.g.,* native predators) and human-related (*e.g.,* vehicle collisions, harassment, exotic predators) mortality.
- Effective and feasible management and monitoring methods.

San Diego Horned Lizard Conceptual Stressor Model



- The relative spatial distributions of horned lizards and Argentine ants in the Habitat Reserve and whether Argentine ants are an existing limiter on the distribution and abundance of horned lizards.
- Presence of other obstacles that could disrupt movement (*i.e.*, "Separation Barriers") within the Habitat Reserve.

Level of Management and Monitoring Priority – Medium

The recommended level of management and monitoring priority for the San Diego horned lizard is medium at this time. In addition to general habitat loss and fragmentation, Argentine ants are a demonstrated stressor on this species in Southern California in areas with substantial urban development. However, within the Southern Subregion, an urgent threat to this species has not been identified. It is recommended that initial management and monitoring for the horned lizard primarily be habitat-based, but include species-specific monitoring in association with the standard transects as described below.

Level of Monitoring (*e.g.*, Species-specific, habitat, landscape, combination)

Monitoring will be conducted at both the habitat landscape and species-specific levels using standardized transects in suitable habitat as a component of the periodic vegetation/wildlife species surveys. Monitoring of the San Diego horned lizard for at least the first five years of the program will focus on transect-based presence/absence surveys rather than quantitatively assessing population trends, which would require a much more intensive and expensive effort (*e.g.*, pitfall trapping). Colonies of the horned lizard's main prey, native harvester ants (*Pogonomyrmex* and *Messor* spp.), carpenter ants (*Camponotus* sp.) and the genus *Crematogaster* (see Fisher *et al.* 2002), within sample plot transects also will be mapped. Presence/absence of Argentine ants also will be assessed. To the extent possible, all directly observed horned lizards will be assigned a general age class (*e.g.*, juvenile or adult) based on snout-vent length (SVL) to generally characterize population age distributions.

Monitoring Variables

Listed below are suggested species- and habitat-based monitoring variables. The monitoring program for the San Diego horned lizard will be developed by the Reserve Manager and Science Panel.

Species-specific Monitoring Variables

1. Presence/absence (direct observation of individuals or diagnostic scat).
2. Age-class distribution

Habitat-based Monitoring Variables

1. Vegetation communities long-term status
2. Relative cover of different native plant species
3. Proportion of exotic plant species/native plant species
4. Soil characteristics of occupied areas
5. Presence/absence of harvester, carpenter and *Crematogaster* ant colonies
6. Presence/absence of Argentine ants
7. Evidence of urban-related predators such as cats and dogs (*e.g.,* tracks, scat, direct observations)
8. Evidence of unauthorized public activities (*e.g.,* trespass, trampling, illegal trails, trash, shooting, etc.)

Management Actions

The management actions that likely will have the greatest direct benefit on the horned lizard are implementation of the Invasive Species Control Plan, and specifically the control of Argentine ants, and controls on urban-related predators such as cats and dogs. The Wildland Fire Management Plan also will be important because horned lizards likely will benefit from maintaining healthy stands of chaparral and coastal sage scrub, including openings, although they may be adversely affected in the short-term by construction of fire breaks. Also prescribed fire will have to be carefully implemented because the horned lizard is directly vulnerable to fire (*e.g.,* prescribed fire may need to be limited to areas where vegetation cover is sufficiently high as to exclude horned lizards).

The reader is referred to the individual management plans for more details.

Potential Target Studies

Several regional and subregional information management needs relevant to management of the San Diego horned lizard were listed above, some of which could be addressed at the subregional scale and would help inform management of the Habitat Reserve. Other regional and subregional information management needs, particularly those related to rangewide persistence of the species (*e.g.,* general ecology, community relationships and landscape habitat fragmentation) are best studied at a rangewide scale. The following are potential target studies that could be implemented at the subregional scale:

- Effects of Argentine ant.
- Effects of urban-related predators.
- Effects of recreation activities.

- Effects of vehicles collisions (likely would be conducted as part of a general study of herpetofauna).
- Movement behavior within the Habitat Reserve in relationship to physical boundaries and obstacles such as urban edges and roads.

The Reserve Manager and Science Panel will detemine and recommend to the RMVLC Board what target studies (possibly including studies not listed above) should be pursued, based on the identification and prioritization of management and monitoring issues and available funding.

SPECIES ACCOUNT

Rangewide and Regional Status

The full species coast horned lizard (*Phrynosoma coronatum*) occurs throughout much of California west of the Sierra Nevada and Cascade ranges (Stebbins 1985). It is absent from the humid rainforests of northwest coastal California. Until recently the subspecies San Diego horned lizard (*P. c. blainvillei*) was treated as a valid taxon. The 2005 CDFG Special Animals list now treats the former "San Diego" horned lizard as the coast horned lizard (blainvillei population); *i.e., P. c. blainvillei* is no longer treated as a separate subspecies by CDFG. For consistency with the commonly used terminology for the "blainvillei" population in the literature, however, the common name "San Diego horned lizard" is retained in this discussion. The geographic range of the San Diego horned lizard includes the Transverse Ranges in Kern, Los Angeles, Santa Barbara, and Ventura counties southward through the Peninsular Ranges of southern California to Baja California (Jennings 1988). The known elevation range of this species is from 10 m (33 ft) at the El Segundo dunes in Los Angeles County to approximately 2,130 m (6,988 ft) at Tahquitz Meadow in the San Jacinto Mountains in Riverside County.

The San Diego horned lizard was once common on coastal plains and in riparian and coastal sage scrub habitats on the old alluvial fans in southern California (Hayes and Guyer 1981; Bryant 1911; Van Denburgh 1922), but appears to have been extirpated from about 45 percent of its former range in southern California (Jennings 1988). The San Diego horned lizard (*i.e.,*blainvillei population) is a CDFG CSC and has a CNDDB rank of G4T3T4S2S3. The full species coast horned lizard is apparently secure but some factors such as loss of habitat rangewide are a cause for some concern. The San Diego horned lizard is considered restricted/rare to apparently secure throughout its range, including Baja California, but within California, per the CNDDB ranking, it is considered restricted/rare to endangered. In addition to direct habitat loss, urbanization is changing adjacent native habitats used by the horned lizards. Non-native Argentine ants, for example, displace native harvester ants and thus are considered a threat to horned lizards (Suarez *et al.* 2001). Because Argentine ants tend to invade the urban-wildland interface, habitat fragmentation is an important issue for the horned lizard. In addition

to habitat loss and Argentine ants, Jennings and Hayes (1994) identified several other threats to the San Diego horned lizard, including collection by humans, off-road vehicles, livestock grazing, conversion of habitat to agriculture, firebreaks and prescribed burning (although the latter two may actually create open microhabitats used by horned lizards).

Table 2-37 provides distributional information for the San Diego Horned lizard by county based on 350 records in the 2003 CNDDB. Records are too numerous to include general locations within the counties. These data do not identify *major* or *important populations* or *key locations*. *Table 2-37* shows that the vast majority of the San Diego horned lizard observations are in the five Southern California counties, with San Diego having the greater number of occurrences, followed by Riverside, Los Angeles, San Bernardino and Orange.

TABLE 2-37
2003 CNDDB RANGEWIDE DISTRIBUTION OF THE SAN DIEGO HORNED LIZARD IN CALIFORNIA

County	No. of CNDDB Records
Kern	1
Los Angeles	70
Orange	26
Riverside	82
San Bernardino	45
San Diego	124
Ventura	2

The San Diego horned lizard has been the focus of conservation planning programs in southern California. *Table 2-38* provides detailed information on the conservation status of this subspecies in these programs.

Subregional Status

The NCCP database for the San Diego horned lizard includes 50 occurrence records, with virtually all in coastal sage scrub. The San Diego horned lizard is found in the following locations within the planning area: lower Arroyo Trabuco; the northern portion of the Upper Chiquita Canyon Conservation Area; in the "Narrows" area of Chiquita Canyon and along ridgeline separating the Chiquita Canyon and Wagon Wheel Canyon sub-basins; the southern portion of Chiquita Ridge; Chiquadora Ridge south and southeast of the wastewater treatment plant; upper Cristianitos Canyon; the confluence of Cristianitos and Gabino creeks; La Paz Creek; upper Blind Canyon; and upper Gabino Canyon (*Figure 177-M*). Although there is wide scattering of horned lizard occurrences, there appear to be two clusters of occurrences that may be considered *important populations* in *key locations*:

TABLE 2-38
CONSERVATION STATUS OF THE SAN DIEGO HORNED LIZARD

Conservation Planning Area	Number of Horned Lizard Locations and Percent Conserved	Potential Habitat Conserved
San Diego MSCP	291 locations 63% conserved	56% of coastal sage scrub and chaparral habitats and riparian scrub
Central/Coastal NCCP Reserve, Special Linkage and Existing Use Areas, Non-Reserve Open Space, and the Policy Plan Area	Number of locations not analyzed for conservation purposes	NA
North San Diego County MHCP	30 locations 38% proposed conservation	Proposed conservation of 13,992 acres (57%) of potential habitat, including chaparral, southern maritime chaparral, coastal sage scrub, coastal sage scrub/chaparral mix, grassland, oak woodlands
Western Riverside MSHCP	135 locations 42% proposed conservation	Proposed conservation of 407,036 acres (56%) of suitable habitat in the Plan Area including coastal sage scrub, desert scrub, Riversidean alluvial fan sage scrub, grassland, and chaparral

- A cluster of 16 occurrences in coastal sage scrub along the ridge between Chiquita Canyon and Wagon Wheel Canyon south of Oso Parkway (No.1 on *Figure 177-M*).

- A cluster of 14 occurrences in the upper Cristianitos and southern Trampas Canyon sub-basin located between Cristianitos Road and Cristianitos Creek (No. 2 on *Figure 177-M*).

Identifying these two areas as *important populations* in *key locations* must be qualified. These clusters occur within the survey area for the SOCTIIP project and thus probably reflect the greater survey effort in this portion of the planning area. On the other hand, even within the SOCTIIP survey area, these two locations stand out as having exceptionally high numbers of horned lizards. Given the wide distribution of this species in the planning area, and its fairly general habitat requirements, it is likely to occur in many other locations within the planning area, but perhaps not in the concentrations found in these two areas. The Science Advisors considered the San Diego horned lizard a Group 2 species that can be conserved at a habitat or landscape level. For that reason, the protection recommendations below reflect conservation of these *important populations* in *key locations* as well as broader habitat and landscape protection.

Biological Considerations

The San Diego horned lizard is found in a wide variety of vegetation types, including coastal sage scrub, annual grassland, chaparral, oak woodland, riparian woodland and coniferous forest (Klauber 1939; Stebbins 2003). In inland areas, this species is restricted to areas with open microhabitats, often created by natural or anthropogenic disturbances (*e.g.*, floods, fire, roads, grazed areas, fire breaks) (Jennings and Hayes 1994).

In southern California, the male reproductive cycle begins during mid- to late-March and ends in June (Goldberg 1983). Female horned lizards lay a clutch of 6 to 17 eggs between May and July each year (Stebbins 1954; Howard 1974; Goldberg 1983). Goldberg (1983) found that *P. coronatum* has the potential to produce multiple clutches during the spring. Hatchlings appear in late July to early August, and require two to three years to reach reproductive age (Howard 1974; Pianka and Parker 1975; Goldberg 1983). San Diego horned lizards emerge from hibernation in March, and become surface active in April through July, after which most adults estivate (summer hibernation) (Hagar 1992). The adults reappear again briefly in late summer and return to overwintering sites between August and early October depending upon elevation (Klauber 1939; Howard 1974; Hagar 1992).

Horned lizards in general (*i.e.*, the genus *Phrynosoma*) primarily are ant-eating reptiles with relatively well-known dietary habits (Montanucci 1989; Pianka and Parker 1975; Powell and Russell 1984; Rissing 1981; Turner and Medica 1982). Up to 90 percent of the diet of San Diego horned lizard consists of native harvester ants (*Pogonomyrmex* spp.) (Pianka and Parker 1975). However, the San Diego horned lizard does not appear to eat non-native Argentine ants (*Linepithema humile*) (Jennings and Hayes 1994), which displace native ants wherever they are introduced (Suarez *et al.* 2001), and as described in more detail below. In addition, other slow moving insects, such as beetles, flies, and caterpillars are consumed opportunistically by horned lizards when encountered (Presch 1969; Pianka and Parker 1975).

The daily diurnal activity of San Diego horned lizards is tied closely to surface temperatures. As surface temperatures reach at least 19 degrees C (66 degrees F) just prior to sunrise lizards emerge from burial sites in the substrate into a position that allows them to bask in the first rays of the sun (Heath 1965; Hagar 1992). Although horned lizards emerge at relatively low temperatures, the optimum temperature range for horned lizard activity is 29-39 degrees C (84-102 degrees F). Midday temperatures over 40 degrees C (104 degrees F) are avoided as San Diego horned lizards bury themselves in the substrate, reemerging in the later afternoon when it is cooler to resume activities of foraging and reproduction. High site fidelity appears to be related to effective thermoregulation, because maintaining optimum temperatures requires familiarity with their surroundings (Heath 1965).

There are no specific data for the home range of San Diego horned lizards. However, Whitford and Bryant (1979) study of the closely related *P. cornutum* and found that individuals moved an average of only 46.8 m (53.5 ft) per day (range = 9-91 m [29.5-298.5 ft]). They also found that an individual horned lizard moved over a zigzag course during a day but rarely crossed its own trail. Tollestrup (1981) suggested that olfactory cues are important in the horned lizard's daily activities, including courtship, feeding, sex recognition, and conspecific interactions. In addition, they apparently mark sites by partially extruding their cloaca and rub it back and forth on the substrate.

Horned lizards are prey for a variety of natural predators, such as coyotes, badgers, foxes, small raptors (kestrels, falcons, shrikes, burrowing owls), roadrunners, and several other lizards and snakes (Zeiner *et al.* 1990). Their main defenses against predators are their cryptic appearance and freezing behavior (Jennings and Hayes 1994). Klauber (1939) observed changes in body coloration to match the soil or sand on which they were found. If discovered or disturbed horned lizards defenses include hissing, inflating their lungs to increase apparent size (Pianka and Parker 1975; Munger 1984; Sherbrooke 1981), raising their horns by lowering their snout (Pianka and Parker 1975; Sherbrooke 1981), squirting blood from the corner of the eye (which seems to repel dogs and cats) (Presch 1969; Pianka and Parker 1975), tilting the body when irritated (Milne and Milne 1950; Smith 1946; Tollestrup 1981), presenting a bristling of scales of the back while standing well up on the legs (Bryant 1911), and running a short distance before flattening out or burrowing several centimeters under the ground (Presch 1969). When a horned lizard flattens its body, it usually tucks its head down, exposing its horns, and often charges the enemy (Winton 1916).

The invasion of habitat by Argentine ants in California recently has become a high profile threat, not only to the horned lizard, but also to other native species. Although Argentine ants have been in California for at least 93 years (Holway 1995), studies of the species date back only to the 1970s. It is now clear that Argentine ants disrupt natural communities by displacing native ants and other arthropods and disrupting ant-plant and ant-aphid mutualisms (evolved interdependent associations) (Holway 1995). Argentine ants spread by two mechanisms: diffusion and jump-dispersal. Diffusion involves typically slow, continuous spreading often along riparian corridors. Jump-dispersal can transport ants quickly and across long distances and can be human-mediated (*e.g.*, potted plants, foodstuffs) or natural (*e.g.*, floating wood rafts along streams).

Protection Recommendations

- Protect the San Diego horned lizard locations on the ridgeline between Chiquita Canyon and Wagon Wheel Canyon that comprise an *important population* in a *key location*.

- Protect the San Diego horned lizard locations in the upper Cristianitos Canyon and southern Trampas Canyon sub-basins between Cristianitos Creek and Cristianitos Road that comprise an *important population* in a *key location.*
- Protect the major north-south connection to Central San Juan Creek by providing a habitat linkage between Chiquita Creek and the eastern edge of the Ladera Open Space and by restricting new impervious surfaces west of Chiquita Creek in order to maintain habitat integrity between the creek and Chiquita Ridge.
- Maintain east-west biological connectivity by protecting habitat linkages and wildlife corridors between Arroyo Trabuco, Chiquita Canyon, and Gobernadora Canyon. Biological connectivity should be maintained between Chiquita, Gobernadora and Arroyo Trabuco by protecting habitat linkages at minimum of three locations within the sub-basin: **(1)** via rim-to-rim preservation of Sulphur Canyon (approximately 2,000 to 2,500 feet wide); **(2)** at the "Narrows" where the canyon is only 700-800 feet wide (approximately 3,000 feet south of Tesoro High School) and connects to Sulphur Canyon; and **(3)** in contiguous patches of coastal sage scrub through the major canyon north and east of the wastewater treatment plant.
- Maintain a continuous upland habitat linkage along the east-facing slopes of Chiquadora Ridge between San Juan Creek and Sulphur Canyon.
- Protect Sulphur Canyon rim-to-rim to maintain a functional biological connection from Gobernadora to Gen. Thomas F. Riley Regional Park in Wagon Wheel Canyon and upper Chiquita Canyon.
- Provide floodplain and upland linkage habitat adjacent to San Juan Creek for "live-in" and dispersal habitat for the San Diego horned lizard.
- Maintain upland north-south habitat linkages through the central and western portions of the Trampas Canyon subunit to provide "live-in" and dispersal habitat for the San Diego horned.
- Protect a habitat linkage, consisting of the Donna O'Neill Land Conservancy and an area along the east side of Cristianitos Creek, to provide dispersal opportunities for the San Diego horned lizard in the upper portion of the sub-basin with other populations in lower Gabino Creek and Camp Pendleton along lower Cristianitos/San Mateo Creek, and to maintain habitat integrity through connectivity within the Donna O'Neill Land Conservancy at Rancho Mission Viejo.
- Maintain an east-west habitat linkage from Gabino Creek to the confluence with Cristianitos Creek as "live-in" habitat and dispersal opportunities for the San Diego horned lizard between Gabino Canyon and the Donna O'Neill Land Conservancy.

- Protect, to the extent feasible, patches of coastal sage scrub in the Verdugo Canyon sub-basin with a focus on maintaining contiguous habitat patches that provide "live-habitat" and north-south dispersal opportunities for the San Diego horned lizard between the Lucas Canyon sub-basin to the north, and the Gabino Canyon/Blind Canyon and La Paz sub-basins to the south.
- Maintain contiguity and connectivity of coastal sage scrub in the upper Gabino Canyon subunit to provide "live-in" and dispersal habitat for the San Diego horned lizard.
- Protect a north-south habitat linkage through Middle Gabino to provide "live-in" habitat and dispersal opportunities for the San Diego horned lizard.
- Maintain contiguity and connectivity of coastal sage scrub in the Talega Canyon sub-basin to provide "live-in" habitat and dispersal opportunities for the San Diego horned lizard.

Management Recommendations

- Implement a management program for protected habitat suitable for the San Diego horned lizard, including control of non-native species such as the Argentine ant, non-native mesopredators (cats and dogs), management of fire and grazing and minimization of human access and disturbance (*e.g.*, collecting), as part of the Adaptive Management Program.

Restoration Recommendations

- Implement a CSS/VGL restoration program to enhance habitat value and connectivity. Potential restoration areas that would benefit the San Diego horned lizard include Chiquita Ridge, Sulphur Canyon, Chiquadora Ridge, upper Cristianitos Canyon and upper Gabino Canyon.

2.21 SOUTHWESTERN POND TURTLE

Species:	Southwestern Pond Turtle (*Emys [=Clemmys] marmorata pallida*)
Federal Status:	FSC
State Status:	CSC
CNDDB Rank:	G3G4T2T3S2
Science Advisors Group:	3
Covered Species:	Yes
Focal Monitoring Species:	Yes
Planning Species:	Yes

CONSERVATION GOALS

1. Protect and Manage habitat and populations of the southwestern pond turtle to maximize the likelihood that existing populations are sustained in the planning area, and in doing so "provide for recovery" on a subregional basis and "contribute to recovery" on a rangewide basis.
2. Provide for unconstrained long distance movements between breeding locations.

CONSERVATION STRATEGY

1. Create a permanent subregional Habitat Reserve that provides sufficient breeding habitat, adjacent upland foraging and estivation habitat, and dispersal habitat to support all *important populations/key locations* in Subarea 1: **(1)** four locations in and adjacent to San Juan Creek; **(2)** the stock pond in upper Cristianitos Canyon; and **(3)** Jerome's Lake in upper Gabino Canyon.
2. Formulate a HRMP to provide for long-term protection and management of the southwestern pond turtle and its habitat and provide for enhancement of breeding habitat.

HABITAT AND SPECIES CONSERVATION AND IMPACTS ANALYSIS

The conservation analysis for the southwestern pond turtle focuses on specific documented locations, including *important populations/key locations*, uplands adjacent to breeding sites and habitat linkages to support both within stream dispersal by turtles and overland long-distance movements between the San Juan Creek and San Mateo Creek watersheds. Because conservation of breeding sites is site-specific, a landscape-level habitat analysis was not conducted, except for the purpose of assessing overland dispersal and migration opportunities.

Subarea 1 Impacts

The proposed Covered Activities would result in impacts to the two pond turtle locations next to the Colorspot Nursery; the site in the tributary to San Juan Creek, which is part of the *important population/key location* and the site along the northern edge of the nursery which is not considered an *important population* (*Figure 176-M*). The stock pond and adjacent grassland habitat in upper Cristianitos Canyon is within the footprint for potential orchards in PA 6. This site will be avoided.

Subarea 1 Conservation

Six of the eight known locations of the southwestern pond turtle would be conserved in the Habitat Reserve, including the site in Cristianitos Canyon that is within the PA 6 potential orchard area (*Figure 176-M*). All conserved sites are considered *important populations/key locations*. In addition, all conserved sites would have adequate buffers of at least a 300-foot radius (about 7-8 acres in area) from adjacent development and southern exposures to provide for nesting and overwintering sites. The undisturbed San Juan Creek floodplain would provide within stream dispersal habitat between pond turtle sites located along the creek (*Figure 176-M*).

Habitat connections between the San Juan Creek and San Mateo Creek watersheds would be maintained to allow for possible, but likely infrequent, long-distance dispersal movements between populations in San Juan Creek and upper Cristianitos Creek. The Southeastern habitat block south of San Juan Creek between PA 4 (East Ortega) and PA 5 (Trampas Canyon) is about 6,000 feet wide (*Figure 176-M*). The most likely dispersal route, considering terrain and vegetation, is along the riparian corridor east of Trampas Canyon connecting to the alkali wetland/drainage and stockpond supporting turtles in upper Cristianitos Canyon. Although Ortega Highway would remain in service, the construction of Cow Camp Road north of Ortega Highway likely would reduce traffic volumes on Ortega Highway and the risk of vehicle collisions with turtles attempting to cross the highway.

ADAPTIVE MANAGEMENT PROGRAM

Stressors

Management for the pond turtle will consider a variety of environmental stressors identified for the species, including:

- Exotic predators (introduced and urban-related; corvids?)
- Altered fire regime
- Too frequent flood regime
- Too infrequent flood regime
- Precipitation
- Upstream diversion
- Groundwater extraction
- Water quality
- Urbanization adjacent to Reserve
- Exotic plant invasion
- Cattle-related impacts
- Roads and trails
- Recreation
- Disease

Rangewide the main stress factors to the southwestern pond turtle have been habitat loss and fragmentation and commercial exploitation. Over 90 percent of wetland habitat within the historic range of the pond turtle in California has been eliminated by agricultural and urban development and water diversion projects (USFWS 1992, 1993d). Introduced predators such as bullfrogs, bass and catfish (bullheads) and urban-related predators (*e.g.*, dogs), competition with non-native turtles (Holland 1991), contaminant spills, grazing, off-road vehicle use and roadkill (Holland 1994) also are identified as stressors. Other stressors that specifically could affect breeding/nesting habitat quality include excessive groundwater extraction, water quality degradation and invasive plant species such as giant reed and tamarisk that alter hydrology and channel morphology. Collecting by children also would be a logical threat in areas with recreation and close to urban areas.

In principle, other stressors listed above that potentially alter breeding and non-breeding upland habitat such as fire (both destruction of vegetation and soil impacts such as erosion of uplands and sedimentation of creeks and pools), altered flood regimes, surface and subsurface water sources, and roads and trails could have profound effects on pond turtle populations. Finally, turtles in Washington were affected by an upper respiratory disease in 1990, but there is no evidence of disease in turtle populations in California.

Goals

Goals for protecting and managing the southwestern pond turtle and its habitat include the following:

1. Maximize the likelihood of the persistence of the physiographic diversity of riparian/wetland habitats, including occupied stock ponds and adjacent upland habitats in the Habitat Reserve.
2. Restore riparian/wetland habitats and enhance the quality of degraded riparian/wetland habitats in the Habitat Reserve such that the net habitat value of the existing riparian/wetland habitat system is preserved.
3. Manage fire regimes to sustain and enhance riparian/wetland habitat quality in the Habitat Reserve.
4. Manage exotic invasions of riparian/wetland habitats such as giant reed, pampas grass, tamarisk, and castor bean.
5. Protect and manage the southwestern pond turtle and upland foraging and wintering areas in the Habitat Reserve.

Management and Monitoring Objectives (number of goal met by objective in parentheses)

Several of the objectives address the above goals at the landscape/vegetation community level even though the pond turtle occurs in a patchy distribution based on documented locations. Ecosystem-level management and monitoring, however, encompasses both known breeding areas and potential breeding areas and allows for future natural expansion of the existing population.

Objective 1: Implement Conservation Strategy to protect and manage riparian/wetland breeding habitat and suitable upland foraging and wintering habitat within a minimum 300-foot buffer between the conserved *important populations* in the Habitat Reserve and adjacent development. Suitable habitat includes areas with microhabitats or microsites that contain basking and refugia sites for adults (*e.g.*, logs and branches, boulders, rocks, ledges, holes, and submerged stems of tules and cattails) and for hatchlings (*e.g.*, water less than 12 in deep with emergent vegetation such as juncus, sedges, tules and cattails that may be critical for recruitment; see Holland 1991) (Goals 1 & 2).

Objective 2: Remap vegetation communities in Habitat Reserve within two (2) years of executing IA to establish a baseline for long-term tracking of the Reserve (Goals 1, 2 & 4).

Objective 3: Update vegetation community map at 5-year intervals (Goals 1, 2 & 4).

Objective 4: Collect regional climate, weather and air quality information to examine potential correlations between vegetation and population changes and environmental variables (Goals 1, 2 & 5)

Objective 5: Provide for no net loss of acreage and function of the waters of the U.S./State (Goals 1 & 2).

- Implement riparian/wetland restoration component of Habitat Restoration Plan.

Objective 6: Conduct periodic monitoring of documented and potential pond turtle breeding locations to measure population trends. The monitoring schedule will need to be flexibly tied to local climatic conditions, such as significant storm events and persistence of breeding pools (Goal 5).

Objective 7: Implement Wildland Fire Management Plan such that sub-basin watersheds and riparian/wetland breeding areas are protected to the extent feasible (Goals 1, 2, 3 & 5).

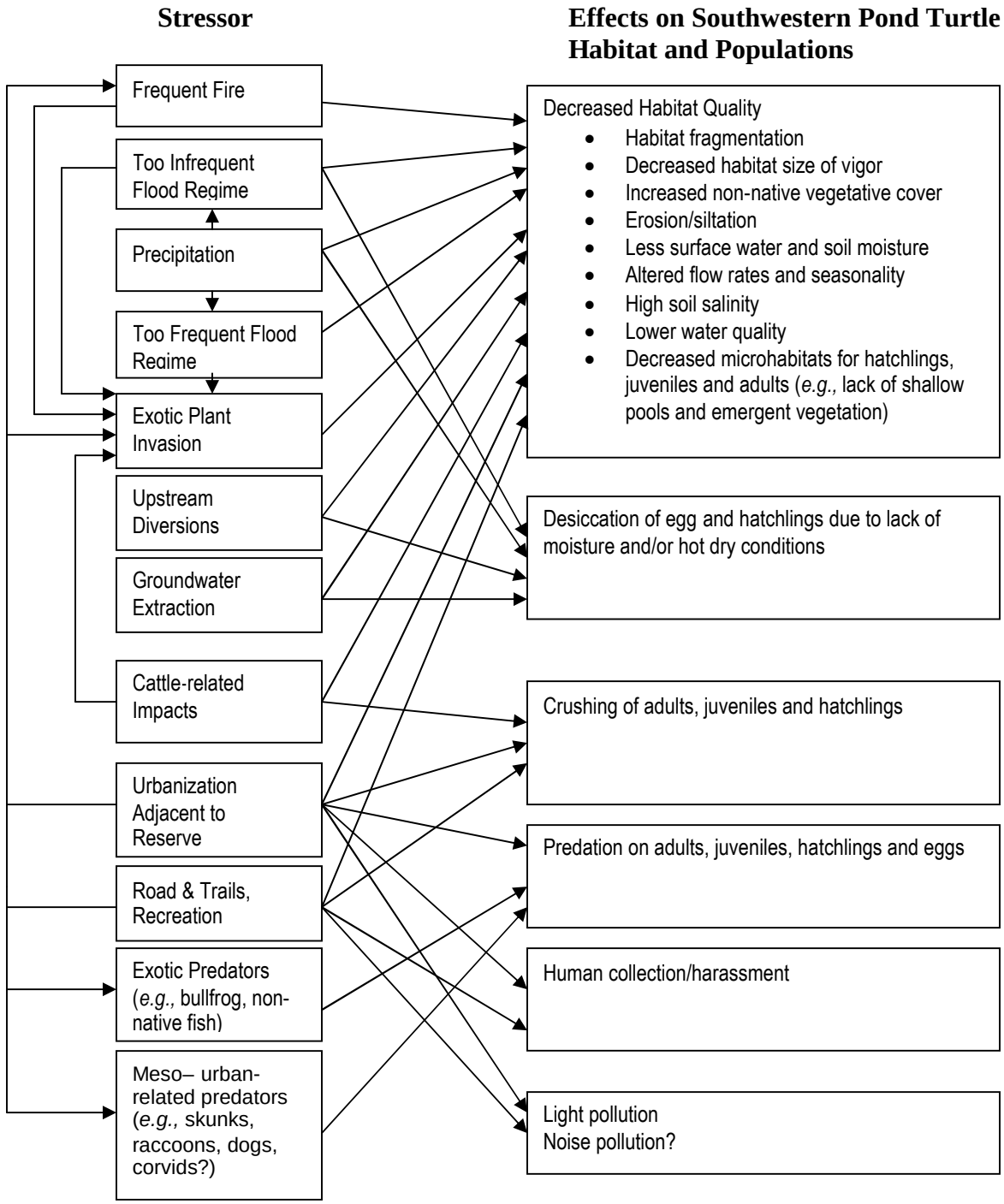
Objective 8: Implement Invasive Species Control Plan to manage invasive exotic species in riparian/wetland habitats (Goals 1, 2, 4 & 5).

- Control major infestations of giant reed in San Juan Creek and smaller infestations in GERA and Cristianitos Creek.
- Control major infestations of tamarisk in Cristianitos Creek and isolated clusters in Gabino and San Juan creeks.
- Control pampas grass infestation in San Juan Creek and Cristianitos Creek.
- Control substantial castor bean infestation Cristianitos Creek and scattered occurrences in San Juan Creek.
- Control Spanish sunflower occurrences Gobernadora Creek (GERA) and monitor/conduct early eradication in Chiquita Creek, San Juan Creek and Cristianitos Creek as needed.
- Control bullfrogs and possibly non-native fishes, in areas that pose a risk to the southwestern pond turtle.
- Assess and control if necessary impacts by urban-related predators.

Conceptual Model

Yes – See figure below.

Southwestern Pond Turtle Conceptual Stressor Model



Regional and Subregional Management Information Needs

- Overall population trends of the full species and subspecies *E. m. pallida*.
- Relationship between age-class distribution and productivity (*e.g.*, are populations adult biased?).
- The significant factors affecting the overall population trends of this species. Are they globally or locally caused by anthropogenic sources (*e.g.*, habitat modification, introduction of exotic species) or some combination of both?
- The terrestrial life stage natural history of the species, and particularly long-distance overland movements.
- The relationship between successful breeding and precipitation cycles, duration and amount.
- The effectiveness of habitat restoration, including revegetation and enhancement, and particularly microhabitat features that support basking such as rocks, logs and branches, and ledges in supporting breeding populations of southwestern pond turtles.
- The main threats to the southwestern pond turtle during the non-breeding season.
- Whether disease is a significant risk factor for the southwestern pond turtle.
- Whether aerial contaminants are a significant risk factor.
- The spatiotemporal pattern of breeding locations in the Habitat Reserve and whether there are functional connections among the three main breeding areas in San Juan Creek, upper Cristianitos and upper Gabino.
- Effects of reductions in groundwater extraction on breeding habitat quality in San Juan Creek
- The use of upland wintering sites adjacent to breeding and nesting areas and whether there are management actions that could enhance upland habitats, such as by creating suitable microhabitats.
- The extent to which invasive species controls in riparian/wetland habitats could expand and enhance southwestern pond turtle breeding habitat and what are the most effective control techniques.
- The significant predators, if any, of pond turtles in the Habitat Reserve.
- The most effective methods for controlling bullfrogs and possibly non-native fishes, in the Habitat Reserve.
- What risk, if any, urban-related predators such as cats and dogs pose to pond turtles in the Habitat Reserve.

- The relationship between breeding success and certain land and human uses and attendant impacts, such as noise, human activity, etc., adjacent to occupied pond turtle breeding habitat in the Habitat Reserve.

Level of Management and Monitoring Priority - Medium

The documented population of southwestern pond turtles in the Habitat Reserve is relatively small, with only few individuals observed in San Juan Creek, the stockpond in upper Cristianitos Canyon and Jerome's Lake in upper Gabino Canyon. The southwestern pond turtle is assigned a medium priority for management and monitoring because of the limited number of occupied sites and because there are clear habitat-based and species-specific stressors on this species, including giant reed and bullfrogs in San Juan Creek. Both of these stressors have been identified for management during Phase 1 of HRMP implementation. Most of the management actions that would benefit this species, as discussed below, are habitat-based (*e.g.,* invasive species controls, water quality management) and would also benefit other aquatic species. Also, the pond turtle can be monitored in conjunction with monitoring of the medium priority western spadefoot toad in San Juan Creek and the upper Cristianitos stock pond.

Level of Monitoring (*e.g.*, Species-specific, habitat, landscape, combination)

Monitoring will be conducted primarily at a species-specific level but also at a habitat landscape level. For the Phase 1 period of HRMP implementation, and in consideration of the fact that two of the three general locales for the pond turtle are in the San Mateo Watershed, it is recommended that monitoring initially be limited to presence/absence visual surveys as opposed to intensive population census techniques such as trapping. While visual surveys can reveal relative abundance information, they have limited value in tracking actual population trends because survey conditions such as air and water temperatures can affect detectability of turtles (*e.g.,* a negative relationship between basking and water temperature). In addition, determining age class distributions, which is an important component of tracking population trends, based on visual observations is difficult because different populations may exhibit different growth rates; *i.e.,* relative size may not be a valid measure of age class (Germano and Bury 2001). At some point, if conditions warrant more intensive monitoring of the pond turtle, the Reserve Manager and Science Panel may implement trapping to collect more direct information on population trends and demographics (*e.g.,* growth rates and age structure).

Monitoring Variables

Listed below are suggested species- and habitat-based monitoring variables. The detailed monitoring program for the southwestern pond turtle will be developed by the Reserve Manager and Science Panel.

Species-specific Monitoring Variables

1. Status of breeding population
2. Proportion of "suitable" habitat occupied (see MacKenzie *et al.* 2002)

Habitat-based Monitoring Variables

1. Vegetation communities long-term status
2. Relative cover of different native plant species
3. Proportion of exotic plant species/native plant species
4. Results of habitat restoration activities, including invasive species controls, riparian/ wetland restoration, and creek and soils stabilization programs

Abiotic Monitoring Variables

1. Climate
2. Weather
3. Air quality
4. Water quality and runoff

Management Actions

Management and restoration actions addressing hydrology and water quality to benefit the pond turtle include maintaining hydrology, water quality and sediment delivery to San Juan Creek and minimizing additional loadings of nutrients or pollutants through the Gobernadora Multi-purpose Basin in Gobernadora Creek above GERA. (See the WQMP as a "Coordinated Management Plan" and the Draft Watershed Planning Principles consistency analysis in *Part I, Chapter 8*.) This involves a restoration program which addresses: **(1)** potential restoration of the historic creek meander above the knickpoint; **(2)** upstream land use-induced channel incision and erosion through the Gobernadora Multi-purpose Basin, including potentially excessive surface and groundwater originating upstream; and **(3)** identification of likely causes of erosion in Gobernadora Creek and potential measures to rectify causes of headcutting in the lower portion of the creek. Management will also address maintenance and/or repair of flow characteristics comparable to existing conditions from Trampas Canyon into San Juan Creek to preserve breeding habitat in San Juan Creek. Invasive species control/habitat restoration activities to benefit the pond turtle will include implementation of a giant reed control program for San Juan Creek within RMV boundaries in coordination with upstream County and CNF control efforts to

protect and enhance breeding habitat and provide more water downstream to support breeding areas. The CSS/VGL restoration program in upper Cristianitos and Gabino canyons and soils stabilization programs to control erosion, implemented at the discretion of the Reserve Manager and Science Panel, also would benefit the pond turtle.

Other management actions include: **(1)** the Wildland Fire Management Plan to help prevent erosion and siltation impacts on breeding habitats; **(2)** a bullfrog and non-native turtle control program in potential breeding areas where necessary; **(3)** protection of occupied nesting locations of the pond turtle from human disturbance and collection; **(4)** control of urban-related predators such as dogs through public education and direct controls such as trapping where necessary and to the extent feasible; and **(5)** signage along trails and bike paths in the Habitat Reserve to inform the public of the risk to native species such as pond turtles, and other reptiles and amphibians from recreational activities. In addition to these management actions, any pond turtles that are found in development areas will be salvaged and translocated to the nearest suitable conserved habitat.

Potential Target Studies

Several regional and subregional information management needs relevant to management of the southwestern pond turtle were listed above, some of which could be addressed at the subregional scale and would help inform management of the Habitat Reserve. Other regional and subregional information management needs, particularly those related to rangewide persistence of the species (*e.g.,* landscape habitat fragmentation) are best studied at a rangewide scale. The following are potential target studies that could be implemented at the subregional scale:

- Effects exotic predators on southwestern pond turtles.
- Effects of Argentine ants and evaluation of the effects of ant controls.
- Evaluation of restoration effects on breeding populations, including invasive species controls, active revegetation and upstream restoration in Gobernadora to reestablish natural creek meander and control fine sediments.
- Adverse edge effects on occupation and/or breeding success.

SPECIES ACCOUNT

Rangewide and Regional Status

The historic range of the full species of the pond turtle (*E. marmorata*) extended along most of the west coast of North America, primarily west of the Cascade-Sierra crest, from western British Columbia to northern Baja California (Ernst *et al.* 1994). The subspecies southwestern

pond turtle (*E. m. pallida*) ranges south of San Francisco Bay to northern Baja California, Mexico, and intergrades with the northwestern pond turtle (*E. m. marmorata*) over a large area in central California (Bury 1970; Stebbins 1985). Isolated populations of the southwestern pond turtle are known to exist as far into the Mojave Desert in Afton Canyon and in the Amargosa River (Lovich 1999). The elevational range for the species is from brackish estuarine waters at sea level to over 2,000 m (6,562 ft), but it is uncommon over 1,530 meters (5,020 ft) (Stebbins 1954; Bury 1963; Holland 1994).

A number of threats have been identified for the southwestern pond turtle, with the greatest threat the loss and alteration of aquatic habitat, but also predation of young by introduced aquatic predators, collection for pets, competition with non-native turtles, contaminant spills, grazing, off-road activity, and vehicle collisions on roads. The southwestern pond turtle is a CDFG CSC and has a CNDDB rank of G3G4T2T3S2. Globally the full species is considered restricted/rare to apparently secure, but with some concerns such as narrow habitat associations or continuing threats. The subspecies southwestern pond turtle is considered restricted/rare to endangered in its range, which extends south into northern Baja California, and within California, per the CNDDB ranking, it is considered endangered.

Table 2-39 illustrates the distribution of the southwestern pond turtle by county in California based on 277 records in the 2003 CNDDB. Specific locations for pond turtles are suppressed in the CNDDB to prevent collection from the sites. These data illustrate the general distribution of the southwestern pond turtle and do not identify *major* or *important populations* or *key locations.*

Harmsworth Associates (1998b) conducted visual, seine netting and funnel trapping surveys for the pond turtle in all natural and semi-natural watercourses, artificial lakes and reservoirs, and channelized culverts and flood control channels in the Central and Coastal NCCP Subregion in 1997 (excluding MAS Tustin, the North Ranch Policy Plan Area and Cleveland National Forest). Of about 123 separate study sites the pond turtle was observed at 17 locations (locations are not described in detail here), with most occurring in the Central Subarea. The Southern Subregion NCCP planning area supports approximately seven discrete locations, as described in more detail below.

Subregional Status

There are currently 12 individual pond turtle occurrences from about eight discrete locations in the NCCP database, all of which are in Subarea 1 (*Figure 173-M*). The largest population is in the stock pond and adjacent grassland habitat in upper Cristianitos Canyon; several pond turtles have been observed in this area since the early 1990s, with the most recent observation during FTC-S (SOCTIIP) surveys of two individuals basking in the stockpond in 2001. There are four observations of single pond turtles within and adjacent to San Juan Creek, two of which were

TABLE 2-39
2003 RANGEWIDE DISTRIBUTION OF THE SOUTHWESTERN POND TURTLE IN CALIFORNIA

County	No. of CNDDB Records
Alameda	1
Kern	19
Los Angeles	30
Monterey	19
Orange	26
Riverside	10
San Bernardino	7
San Diego	30
San Luis Obispo	75
Santa Barbara	35
Santa Clara	2
Santa Cruz	3
Ventura	22

observed in CalMat Lake, one in uplands just north of the lake in a tributary drainage to San Juan Creek adjacent to Colorspot Nursery and one in uplands along the north edge of Colorspot Nursery. There is an observation of a single individual in grassland just west of Jerome's Lake in upper Gabino Canyon. Determinations of pond turtle locations are based on visual surveys (*i.e.*, as opposed to trapping), which tend to underestimate actual population sizes, so these data should be considered locational only. Additional survey work would be required to establish the population sizes at each of the occupied sites. However, given the few numbers visually observed at the sites, it is assumed that the populations are relatively small. Because the pond turtle is relatively rare in the planning area, all occupied sites except the location along the northern edge of Colorspot Nursery are considered *important populations* in *key locations*. The Colorspot Nursery site is not considered an *important population* in a *key location* because the area does not support suitable breeding habitat and the current high level of human activity in the area poses a risk to turtles (*e.g.*, potential collisions with vehicles and equipment). It seems unlikely that a population could persist in this area under existing conditions.

The CNDDB also includes a 1993 record in the planning area at an urbanized site disjunct from the main reserve study area; Oso Creek between La Paz and Jeronimo Road in Mission Viejo.

Biological Considerations

Southwestern pond turtles inhabit slow-moving permanent or intermittent streams, small ponds, small lakes, reservoirs, abandoned gravel pits, permanent and ephemeral shallow wetlands, stock ponds, and sewage treatment lagoons (Rathbun *et al.* 1992; Holland 1994). Pools within streams are the preferred habitat (Bury 1972). Abundant logs, rocks, submerged vegetation, mud, undercut banks, and ledges are necessary habitat components for cover, as well as a water depth greater than 2 m (6.6 ft) (Brattstrom and Messer 1988; Holland 1994). Additionally, emergent basking sites, emergent vegetation and the availability of suitable terrestrial shelter and nesting sites are characteristic of occupied habitat. Adjacent upland areas provide overwintering and estivation sites that are used for 1-2 months in southern California (Holland 1994).

Reproductive activity by southwestern pond turtles has been observed from February through November (Holland1988; Buskirk 1991; Goodman 1997a). Depending on latitude, peak nesting season is from late May through early July, but extends from late April through August (Holland 1994). Goodman (1997a) found that females begin laying eggs at a carapace length greater than 11 cm (4.3 in) and Holland (1994) suggests that females first reproduce at age 6 to 7 years.

Availability and selection of suitable nesting sites is a key factor in pond turtle distribution. If suitable nesting sites are not available, females have been observed to travel up to 1.9 km (1.2 mi) along a waterway to lay their eggs (Rathbun *et al.* 1992). Nests typically are located along stream or pond margins, but may be located over 100 m (328 ft) from water on adjacent hillsides, apparently with a southern exposure. Six terrestrial nest locations inspected by Rathbun *et al.* (1992) were all found in open, grassy areas with a southern exposure. Goodman (1997a) observed a similar pattern at two study sites in southern California: Aliso Creek in Chino Hills State Park and along the West Fork of the San Gabriel River. Nest sites were generally on south-facing slopes ranging from 2-60 degrees and an average of 16.2 m (53.1 ft) from the watercourse (range: 1.5-48.2 m [4.9-158.1 ft]) at Aliso Creek and an average of 28.7 m (94.1 ft) from the watercourse (range: 18.3-47.3 m [60.0-155.2 ft]) at the San Gabriel River. A southern exposure likely is important for thermal regimes related to egg development. Goodman also noted dominant vegetation at nest sites. At the Aliso Creek site the dominant vegetation was non-native grasses, usually in association with black mustard. The average percent cover at the Aliso Creek nest sites was a 17 percent (range: 5-33 percent). At the San Gabriel River site, there was more variability in the dominant vegetation communities at nest sites, and included moss, buckwheat, scrub oak, chamise, yucca and non-native grasses. The average percent cover at the San Gabriel River nests sites was 28 percent (range: 0-80 percent). Goodman (1997a) did not analyze whether there was specific nest site selection based on vegetation or soils. Holland (1991) noted that most nests sites discovered up to that time were on dry, well-drained soils with significant clay/silt content and low (<15 degrees) slope.

Nesting forays onto land may require several days (Holland 1994), and Rathbun *et al.* (1992) reported an overnight trip. In the Rathbun *et al.* (1992) study, nest cavities were pear-shaped and measured 6.5-8.0 cm (2.6-3.1 in) deep with a 2.6-2.8 cm (6.5-7.0 in) wide egg chamber and a 1.4-1.6 cm (3.5-4.0 in) mouth. Usually nest excavation occurs in the morning or evening (Storer 1930).

Average clutch sizes are about 6 eggs, with a range of 1 to 13. Clutch size, and possibly egg width, appear to be correlated with body size (Holland 1994; Goodman 1997a). Double-clutching was observed in 3 of 7 females in San Bernardino County (Goodman 1997b). First clutches were laid between May 4 and 14 and second clutches between June 10 and 20.

Incubation is typically 80 to 126 days and varies with latitude and temperature (Goodman1997a; Holland 1994; Lardie 1975; Feldman 1982). As is common in turtles, incubation temperature is a factor in sex determination in pond turtles. Ewert *et al.* (1994) found that males are produced below 30 degrees C (86 degrees F) and females above this temperature.

Complete failure of pond turtle nests is not uncommon in some years or locations (Holland 1994). Goodman (1997a) observed an 80 percent hatchling success rate for 15 eggs in three nests; however, Holland (1994) reports an overall average of 70 percent. In the northern portions of their range, hatchlings remain in the nest through the winter, although in southern California, most emerge in the early fall (Holland 1994). Also, many females do not lay eggs every year (Goodman 1997a).

The southwestem pond turtle is an omnivore with a broad feeding niche (Bury 1986). It is an opportunistic forager, both scavenging and taking live prey. Pond turtles prefer live or dead animal food, but ingest plants as part of their diet to provide nutrients when live prey are unavailable. Food items eaten by pond turtles include aquatic plants such as the pond lily (*Nuphar polysepalum*), water beetles, mallard duck carrion, adult larval insects, coyote scat, and snails (Pope 1939; Evenden 1948; Carr 1952; Holland 1988; Bury 1986; Goodman and Stewart 1998).

Pond turtles aggressively compete for spatially limited habitat resources (*e.g.*, basking sites) that result in aggregated distributions of turtles around pools (Bury 1972). For example, an aggregation of 19 southwestern pond turtles located in a single crevice of granitic rock near a stream was reported by Holland and Goodman (1996). Agonistic behaviors to secure preferred basking sites include biting, ramming and pushing.

In a radiotelemetry study by Rathbun *et al.* (1992), daily movements of four females during one month from May 20 to June 21, 1989, averaged 28 m (91 ft), 55 m (108 ft), 61 m (200 ft), and 87 m (285 ft), respectively.

Longer-term home range sizes vary between age and sex classes. Bury (1972) studied a population in a northern California stream and found that adult males had the largest home range, averaging a mean linear length (*i.e.*, point to point) of 976 m (3,202 ft). Adult female home ranges averaged 248 m (814 ft), while juveniles had home ranges with a mean length of 363 m (1,190 ft). While moving between pools within the stream system, average distances were 354 m (1,161 ft) for males, 169 m (554 ft) for females, and 142 m (466 ft) for juveniles. Goodman (1997a) conducted radiotelemetry studies of pond turtles in Aliso Creek in Chino Hills State Park and the West Fork of the San Gabriel River from 1992 to 1994. In the Aliso Creek population, the minimum linear range for nine females averaged 1,273 m (4,176 ft) (range: 708-4,263 m [2,323-13,986 ft]) and two males had ranges of 319 m and 709 m (1,046 and 2,326 ft), respectively. In contrast, the minimum linear ranges for turtles on the San Gabriel River were significantly shorter for females, with an average of 335 m (1,099 ft) (range: 48-966 m [157-3,169]) for 11 females and a range of 1,610 m for a single male. Goodman suggested that the relative lack of water in the Aliso Creek study area compared to the San Gabriel River may account for the longer movements of the Aliso population because individuals may have had to move farther to obtain the resources necessary for survival.

For the most part, overwintering sites in the Goodman (1997a) study were relatively close to water. At the Aliso Creek site, the mean distance of overwintering sites from water for seven turtles was 7.3 m (23.9 ft) (range: 1.5-10.7 m [4.9-35.1 ft]). At the San Gabriel River site the mean distance of overwintering sites for 20 turtles was 32.7 m (107.3 ft) (range: 12.8-60.2 m [42.0-197.5 ft]). However, Holland (1994) reports overwintering sites up to 500 m (1,640 ft) from the watercourse. In addition Holland (1994) reports that pond turtles have been found up to 1 km (3,280 ft) from watercourses and are capable of moving up to 5 km (3.1 mi) between drainages. Although pond turtles are capable of moving long distances, they generally are characterized as relatively sedentary animals. Holland and Goodman (1996) state that "most animals appear to remain within a given watercourse for extended periods of up to several years."

Overwintering sites appear to have more cover than nesting sites. Dominant vegetation at seven overwintering sites at the Aliso Creek studied by Goodman (1997a) included mule fat, willows, black mustard and tree tobacco, with cover ranging averaging 65 percent (range: 25-90 percent). At 20 overwintering sites the San Gabriel River study area dominant vegetation consisted of scrub oak, yucca, chamise, ceanothus, laural sumac, bay tree, canyon oak, white sage, black sage, poison-oak, Douglas-fir, monkeyflower, giant rye grass, ash (dead), and non-native grasses. Percent cover at the 20 sites averaged 64 percent (range: 20-100 percent).

A number of threats have been identified for the southwestern pond turtle. Loss and alteration of aquatic habitat is the greatest threat to the southwestern pond turtle. Over 90 percent of wetland habitat within its historic California range has been eliminated by agricultural development,

flood control, water diversion projects, and urbanization (USFWS 1992, 1993d). Additionally, predation on young by introduced aquatic species (*e.g.*, bullfrogs, bass, and catfish), collection for pets, urban-related predation pressures (*e.g.*, dogs raccoons, skunks), competition with non-native turtles (Holland 1991), contaminant spills, grazing, off-road vehicle use and vehicle strikes on roads (Holland 1994) have all contributed to the sharp decline this species has experienced in recent decades. Dams and channelization have greatly reduced the availability of suitable habitat (Brattstrom and Messer 1988). Reese and Welsh (1988) determined that the quality of western pond turtle habitat has been reduced by alteration of channel morphology and flow rates associated with dam construction. Invasion of exotic vegetation species such as tamarisk (*Tamarix* sp.) is another threat to the pond turtle. Establishment of tamarisk results in changes to hydrology and channel morphology which degrades pond turtle habitat.

Protection Recommendations

- Maintain and manage riparian and aquatic habitats along San Juan Creek for breeding populations of the southwestern pond turtle.
- Protect the stockpond and other wetlands in the upper Cristianitos Watershed to support the nesting population of the southwestern pond turtle.
- Protect Jerome's Lake in upper Gabino Canyon to support the nesting population of the southwestern pond turtle.
- Protect upland habitat within 100 m (328 ft) adjoining occupied aquatic and riparian habitats and on southern exposures along San Juan Creek, upper Cristianitos and Jerome's Lake to support nesting and overwintering sites for the southwestern pond turtle.

Management Recommendations

- Within Gobernadora Creek, protect downstream habitat for the southwestern pond turtle by maintaining hydrology, water quality and sediment delivery in San Juan Creek and minimizing additional loadings of nutrients or toxics.
- Implement a bullfrog eradication program in southwestern pond turtle breeding areas where necessary, including Cal-Mat Lake, the stock pond in upper Cristianitos, and Jerome's Lake.
- Maintain flow characteristics comparable to existing conditions from Trampas Canyon into San Juan Creek to preserve breeding habitat for the arroyo toad population and other aquatic species in San Juan Creek.
- Protect occupied nesting locations of the southwestern pond turtle from human disturbance and collection.

- Manage, to the extent feasible, the impact of potential mesopredators on southwestern pond turtle nesting areas, including raccoons, skunks, and feral dogs.
- Pursuant to the Grazing Management Plan, implement grazing management techniques to help protect the southwestern pond turtle and its habitat, promote perennial grasses including native grasses, allow for continued cattle grazing sufficient to support cattle ranching operations, and, where appropriate reduce fuel loads for fire.

Restoration Recommendations

- In coordination with upstream eradication efforts, implement a giant reed removal program for San Juan Creek within RMV boundaries to protect southwestern pond turtle habitat and other riparian areas.
- Implement a restoration program in Gobernadora Creek which addresses **(1)** the historic creek meander above the knickpoint; and **(2)** upstream land use induced channel incision and erosion, including potentially excessive surface and groundwater originating upstream.
- Identify likely causes of erosion in Gobernadora Creek and potential measures to rectify causes of headcutting in the lower portion of the creek.

2.22 ARROYO CHUB

Species:	Arroyo Chub (*Gila orcutti*)
Federal Status:	FSC
State Status:	CSC
CNDDB Rank:	G2S2
Science Advisors Group:	3
Covered Species:	Yes
Focal Monitoring Species:	Yes
Planning Species:	No

CONSERVATION GOAL

1. Protect and manage habitat and populations of the arroyo chub to maximize the likelihood that existing populations are sustained in the planning area, and in doing so "provide for recovery" on a subregional basis and "contribute to recovery" on a rangewide basis.

CONSERVATION STRATEGY

1. Create a permanent subregional Habitat Reserve that protects sufficient aquatic habitat to support the arroyo chub.
2. Formulate a HRMP to provide for long-term protection and management of the arroyo chub and its habitat and provide for enhancement of breeding habitat.

HABITAT AND SPECIES CONSERVATION AND IMPACTS ANALYSIS

The conservation analysis for the arroyo chub includes an analysis of some minor permanent direct and temporary indirect impacts resulting from bridge placements across San Juan and Gobernadora creeks, but mostly focuses on potential future long-term impacts on habitat quality such a hydrologic and geomorphic processes and water quality.

Subarea 1 Impacts

The proposed Covered Activities would in result in minor direct impacts to habitat of the arroyo chub. The proposed crossings of San Juan Creek by the bridges for Cristianitos and Cow Camp roads would require piers that would impact a total of 0.06 acre in the streambed. However, the piers would not adversely affect natural streambed processes such as base flows and sediment transport and deposition and would not be a barrier to fish movement. San Juan and

Gobernadora creeks would be subject to temporary alteration or diversion to accommodate grading and construction for the circulation system of the B-12 Alternative resulting in short-term direct and indirect impacts associated with implementation of the proposed Covered Activities. Suitable habitat for the chub in Gobernadora Creek extends approximately 3,000 feet upstream of the potential impact areas and would not be affected by construction activities. Construction along or across San Juan Creek could potentially impact the quality of the natural habitats supporting the chub. Factors that could potentially impact these areas in the short-term include: **(1)** the temporary blockage or diversion of water flow in San Juan Creek; **(2)** increased siltation from grading or movement of construction equipment; and **(3)** the degradation of water quality by the disturbance of anaerobic (low oxygen) sediments. Because most of the high quality habitat areas in San Juan Creek are upstream of RMV in Caspers Wilderness Park (including Bell Canyon) and extending into the Cleveland National Forest, the potential impacts would not be considered substantial. Potential long-term impacts include hydrologic conditions of concern such as changes in rates of erosion or sedimentation and the generation of pollutants of concern such as metals. These potential indirect effects are addressed below.

Subarea 1 Conservation

All documented occupied aquatic habitat for the arroyo chub would be in the Habitat Reserve. As described above, the proposed Covered Activities would result in some minor direct impacts to habitat of the arroyo chub where the proposed crossings of San Juan Creek by the bridges for Cristianitos and Cow Camp roads would require piers. The piers would not adversely affect natural streambed processes such as base flows and sediment transport and deposition and would not be a barrier to fish movement. Also, based on conceptual designs, significant shading impacts to San Juan Creek would not occur because both proposed bridges are 50 feet or higher. Thus sufficient light would reach below the bridge structures to promote growth of typical riparian species such as mule fat and willows. These project design features also are referenced in the SAMP USACE Permit Special Condition I.D.1.a regarding bridge crossings. In addition, the existing Cow Camp culvert crossing of San Juan Creek is addressed by Special Condition I.D.3 which addresses the retrofit or relocation of the existing crossing to allow for fish passage. Finally, Special Condition II.9 requires arroyo chub surveys within 1,000 feet downstream of each PA prior to construction to address construction-related turbidity.

Conservation of this species in the Habitat Reserve thus primarily will rely on short-term protection during construction activities and long-term management of hydrologic and geomorphic processes and water quality, as described below.

ADAPTIVE MANAGEMENT PROGRAM

Stressors

A variety of environmental stressors identified for the arroyo chub will be considered for management, including:

- Habitat loss and fragmentation
- Degraded water quality from temperature changes, salinity and pollution
- Fire and related erosion/sedimentation of habitat
- Flood control and water diversion
- Altered hydrology
- Precipitation cycles
- Invasive plants
- Introduced exotic predators and competing species

The arroyo chub currently is scarce within its native range because the low-gradient streams in which it generally thrives have largely disappeared. Its native range is largely coincident with the Los Angeles metropolitan area where most streams are degraded and populations have been reduced and fragmented (Moyle *et al.* 1995). The potential effects of introduced species, combined with the continued degradation of the urbanized streams that constitute much of its habitat, pose a significant threat to this species despite its relatively wide geographic range. The high level of fragmentation of remaining populations make the arroyo chub especially vulnerable to random events, environmental factors, and loss of genetic variability due to insularization of populations. Random events such as floods, fires, variations of annual weather patterns, predation and associated demographic uncertainty exacerbate already marginal habitat conditions for the species. Threats to the arroyo chub may be generalized into three categories; habitat based-threats (*e.g.*, degradation, fragmentation, destruction), biological threats (*e.g.*, predation, competition), and water quality threats (*e.g.*, temperature, salinity, pollution).

Goals

Goals for protecting and managing the arroyo chub and its habitat include the following:

1. Maximize the likelihood of the persistence of the physiographic diversity of riparian/wetland habitats in the Habitat Reserve.
2. Restore riparian/wetland habitats and enhance the quality of degraded riparian/wetland habitats in the Habitat Reserve such that the net habitat value of the existing riparian/wetland habitat system is preserved.

3. Manage fire regimes to sustain and enhance riparian/wetland quality in the Habitat Reserve.
4. Manage exotic invasions of riparian/wetland habitats such as giant reed, pampas grass, tamarisk, and castor bean.
5. Protect and manage occupied arroyo chub habitat in the Habitat Reserve.

Management and Monitoring Objectives (number of goal met by objective in parentheses)

Objective 1: Implement Conservation Strategy to protect and manage suitable habitat in Arroyo Trabuco, San Juan Creek and Gobernadora Creek (Goals 1 & 2).

Objective 2: Remap vegetation communities in Habitat Reserve within two (2) years of executing IA to establish a baseline for long-term tracking of the Reserve (Goals 1, 2 & 4).

Objective 3: Update vegetation community map at 5-year intervals (Goals 1, 2 & 4).

Objective 4: Collect regional climate, weather and air quality information to examine potential correlations between vegetation and population changes and environmental variables (Goals 1, 2 & 5)

Objective 5: Provide for no net loss of acreage and function of the waters of the U.S./State (Goals 1 & 2).

- Implement riparian/wetland restoration component of Habitat Restoration Plan.

Objective 6: Maintain/restore riparian/wetland ecosystem integrity and maintain and/or restore floodplain connection (Goals 1 & 2).

- Address historic meander conditions and excessive sediment input from upstream land uses in Gobernadora Creek, including construction of a detention/water quality basin below Coto de Caza.
- Conduct riparian/wetland restoration on a case-by-case basis over the long-term management and monitoring of the Habitat Reserve.

Objective 7: Maintain and/or restore sediment sources and transport equilibrium (Goals 1 & 2).

- Monitor channel morphology using transect lines for measuring cross-sectional profiles to monitor sediment movement (transport and deposition), peak discharges and changes in stream morphology.

Objective 8: Conduct periodic fish surveys to assess population status (Goals 1, 2, 4 & 5).

Objective 9: Maintain adequate stream and groundwater hydrology (Goals 1 & 2).

- Monitor stream hydrology through stream gages placed at representative sites in major drainages or other locations determined to be relevant to management of the Habitat Reserve and the arroyo chub.
- Monitor groundwater through collection of well data where groundwater plays a significant role in streamcourse hydrology

Objective 10: Implement Wildland Fire Management Plan such that sub-basin watersheds, riparian/wetlands, and arroyo chub habitat is protected to the extent possible (Goals 1, 2, 3 & 5).

Objective 11: Implement Invasive Species Control Plan to manage invasive exotic species in riparian/wetland habitats (Goals 1, 2, 4 & 5).

- Control major infestations of giant reed in San Juan Creek and Arroyo Trabuco, and smaller infestations in GERA.
- Control isolated clusters of tamarisk in Gabino and San Juan creeks.
- Control pampas grass infestation in Arroyo Trabuco and San Juan Creek.
- Control castor bean in Arroyo Trabuco and San Juan Creek.
- Control Spanish sunflower occurrences Gobernadora Creek (GERA) and monitor/conduct early eradication in Arroyo Trabuco and San Juan Creek as needed.
- Control bullfrog and crayfish populations in San Juan Creek and Arroyo Trabuco.

Conceptual Model

No – insufficient information to prepare a conceptual model.

Regional and Subregional Management Information Needs

- The rangewide status and overall population trends of the species.
- The genetic effects of rangewide habitat fragmentation and isolation of populations.
- Life history traits and demographic processes (*e.g.*, growth rates, age structure, survival).
- Effects of altered hydrology and/or barriers on dispersal.
- The effectiveness of habitat restoration, including revegetation and enhancement in supporting the arroyo chub and whether restored areas can function as "self-sufficient ecosystems."

- Water quality/contaminants as a significant risk factor for the arroyo chub.
- Effects of exotic predators on the arroyo chub.
- Interspecific competition/interference with introduced fishes.
- Potential impacts by high bacteria levels, protozoa and viruses (*e.g.*, Egan *et al.* 1992).

Other regional and subregional information management needs are more focused or site-specific and can be addressed by the HRMP. Priority in the HRMP will be given to site-specific issues. Habitat Reserve-specific regional and subregional information management needs include:

- The extent to which invasive species controls will expand and enhance arroyo chub habitat.
- The potential predation and competition impacts of introduced fishes and other non-native aquatic species such as crayfish, bullfrogs and African clawed frogs.
- Whether cattle-related impacts in San Juan Creek have an adverse effect on arroyo chub habitat in the Habitat Reserve.

Level of Management and Monitoring Priority - High

The arroyo chub has a very restricted range in southern California and the populations in southern Orange County in San Juan and Trabuco creeks are among largest remaining natural habitats for the species rangewide. Management of aquatic habitats is an important element of the Phase 1 HRMP, with invasive species such as giant reed and pampas grass identified as significant stressors of aquatic habitat in San Juan Creek and Arroyo Trabuco. Also, non-native species controls of crayfish and bullfrogs will be conducted during Phase 1 in San Juan Creek. Further, the existing Cow Camp culvert crossing of San Juan Creek is addressed by Special Condition I.D.3 which addresses the retrofit or relocation of the existing crossing to allow for fish passage. Finally, Special Condition II.9 requires arroyo chub surveys within 1,000 feet downstream of each PA prior to construction to address construction-related turbidity.

Level of Monitoring (*e.g.*, Species-specific, habitat, landscape, combination)

Monitoring will be conducted both at a species-specific and habitat landscape level.

Monitoring Variables

Listed below are suggested species- and habitat-based monitoring variables. The detailed monitoring program for the arroyo chub will be developed by the Reserve Manager and Science Panel.

Species-specific Monitoring Variables

1. Distribution and spatiotemporal trends of arroyo chub population
2. Proportion of stream segments occupied (PAO; see *Appendix O* for discussion of PAO)
3. Status of introduced predators and potential competitors such as bullfrog, crayfish and non-native fishes.

Habitat-based Monitoring Variables

1. Vegetation communities long-term status
2. Relative cover of different native plant species
3. Proportion of exotic plant species/native plant species
4. Results of habitat restoration activities, including invasive species controls, riparian/wetland restoration, and creek and soils stabilization programs

Abiotic Monitoring Variables

1. Climate
2. Weather
3. Air quality
4. Water quality (*e.g.*, turbidity, pollutants, salinity, temperature, and bacteria) and runoff

Management Actions

Management for the arroyo chub will focus on potential long-term indirect impacts to San Juan, Gobernadora and Arroyo Trabuco creeks that could affect arroyo chub habitat quality. These potential impacts include hydrologic conditions of concern such as changes in rates of erosion or sedimentation and the generation of pollutants of concern such as metals. Several management and restoration actions could benefit the chub and enhance recovery of the species in the Habitat Reserve. First, Verdugo Canyon hydrology would be maintained to protect sources of sediment that would be important for maintaining suitable chub breeding habitat in downstream areas of San Juan Creek (see Draft Watershed Planning Principles analysis in *Part I, Chapter 9*). Second, potential spawning sites in San Juan Creek would be conserved by maintaining hydrology and water quality, including flow characteristics of episodic events, and minimizing additional loadings of nutrients or toxics (*e.g.*, metals) through implementation of the WQMP. Stormwater flow characteristics would be maintained to preserve the natural succession of riparian habitat and the overall natural hydrologic/geomorphic conditions. Third, as part of the HRMP, bullfrog

and crayfish control programs to help protect chub eggs, fry and juveniles would be implemented, with a special focus on permanent and semi-permanent water bodies that provide source concentrations of bullfrogs and crayfish. Fourth, habitat restoration and enhancement activities to benefit the arroyo chub would include a giant reed control program on RMV property within San Juan Creek in coordination with upstream control efforts by the County and CNF and giant reed and pampas grass control in Arroyo Trabuco. Control of giant reed and pampas grass in these two drainages will result in more potential spawning habitat both by providing for more native riparian vegetation and increasing water supplies necessary to sustain water throughout the spawning season. Fifth, implementation of a restoration program in Gobernadora Creek which addresses **(1)** the historic creek meander above the knickpoint, and **(2)** existing upstream land use-induced channel incision and erosion through the Gobernadora Multi-purpose Basin, including potentially excessive surface and groundwater originating upstream.

The coordinated GMP will help protect arroyo chub habitat in San Juan Creek through exclusion of cattle from the sympatric arroyo toad breeding habitat once such areas are dedicated.

Potential Target Studies

Several regional and subregional information management needs relevant to management of the arroyo chub were listed above, some of which could be addressed at the subregional scale and would help inform management of the Habitat Reserve. Other regional and subregional information management needs, particularly those related to rangewide persistence of the species (*e.g.*, landscape habitat fragmentation) are best studied at a rangewide scale. The following are potential target studies that could be implemented at the subregional scale:

- The extent to which invasive species controls may expand and enhance arroyo chub habitat.

- The potential predation and competition impacts of introduced fishes and other non-native aquatic species such as crayfish, bullfrogs and African clawed frogs.

- Evaluation of seasonal exclusion of cattle from San Juan Creek and effects on arroyo chub habitat and populations.

SPECIES ACCOUNT

Rangewide and Regional Status

The native range of the arroyo chub includes the Los Angeles, San Gabriel, San Luis Rey, Santa Ana, and Santa Margarita rivers and also Malibu and San Juan creeks (Wells and Diana 1975).

This species is common at three localities within its native range, namely the upper Santa Margarita River and its tributary, De Luz Creek; Trabuco Creek below O'Neill Park and San Juan Creek drainage; and Malibu Creek. It is present, but scarce in Big Tujunga Canyon (Pacoima Creek above Pacoima Reservoir), and in the Sepulveda Flood Control Basin, Los Angeles River drainage; upper San Gabriel River drainage; and middle Santa Ana River tributaries between Riverside and the Orange County line (Swift *et al.* 1993).

Introduced populations occur at Santa Maria-St. Inez, Mojave, Santa Clara, and Cuyama river drainages, and a portion of San Felipe Creek (Miller 1968; Moyle 1976; Bell 1978; Sigler and Sigler 1987; Page and Burr 1991). Within the literature, there is some disagreement regarding the extent of this species' native distribution. Miller (1968) and Bell (1978) conclude that the Santa Clara population is probably introduced while Moyle (1976), and Page and Burr (1991) indicated that this population is native. Fish fossils at Rancho La Brea, including arroyo chub (Swift 1989) indicate local, permanent stream conditions, and not stream transport from distant mountainous areas.

The arroyo chub is a CDFG CSC and has a CNDDB rank of G2S2; it is considered endangered throughout its range. The chub is subject to a number of threats that are habitat-, biologically- and water quality-based, most significantly introduced fish species and continued degradation of the urbanized streams that constitute much of its habitat. Because existing habitat is degraded and fragmented the arroyo chub likely is highly vulnerable to random events, environmental factors, and genetic isolation and demographic instability. Floods, fires, variations of annual weather patterns, predation, and associated demographic uncertainty can result in local extirpations, that, because of isolation and physical barriers, cannot be recolonized. Other impacts on the arroyo chub and their habitat include human recreational use of rivers and streams that can disturb spawning and feeding behavior and cattle urine and feces that increase ammonia and nitrate levels that result in increased oxygen consumption by nitrifying bacteria and a concomitant decrease in oxygen available for fish, and toxins that can be deleterious in chronic amounts (*e.g.*, Thurston *et al.* 1986). In Orange County, mosquito fish and minnows have been introduced into Trabuco and San Juan creeks and the interaction between these fish species is not known.

Subregional Status

Currently, only a few creeks within their native range support stable populations. One of the largest remaining natural populations occurs in Orange County in San Juan and Trabuco creeks. Surveys conducted in San Juan Creek in 2004 detected arroyo chub downstream of the RMV boundary near the La Novia Bridge and it is expected that they continue to occupy areas within RMV and Caspers Wilderness Park, extending well into the Cleveland National Forest, which exhibits the largest areas of suitable habitat. Surveys conducted by MBA in 1995 also report the

arroyo chub in Gobernadora Creek, upstream of San Juan Creek; however, this population is isolated from San Juan Creek due to impassable areas in Gobernadora Creek immediately upstream of the confluence with San Juan Creek that allow only movement from Cañada Gobernadora to San Juan Creek but not from San Juan Creek to Gobernadora. Surveys by Johnston (1998) for the Arroyo Trabuco Golf Course project documented the chub in lower Arroyo Trabuco.

Biological Considerations

The chub prefers clean, clear pools or flowing streams with cobble and riffles. It appears to be subject to predation from other fish and often occurs in stream segments with the partially-armored threespine stickleback. When creeks flood in the winter and spring, the chub is able to invade the newly created flowing habitats and persist until these reaches dry in the summer and fall. In general, they prefer slow moving stream segments or backwater pools of warm to cool streams with substrates of sand or mud (Moyle 2002). The depth of the stream is typically greater than 10 inches. Although arroyo chub may have a few refugia populations within a creek, there may be annual, or at least periodic, geneflow between these populations and the maintenance of the intermediate creek stretches may be important for long-term persistence.

The arroyo chub is omnivorous, feeding primarily on algae (Greenfield and Deckert 1973), but also ingesting other plants, aquatic insects and their larvae, small crustaceans, and feeding extensively on roots of a floating water fern (*Azolla*) infested with nematodes (Moyle 2002).

Arroyo chubs are fractional spawners that breed more or less continuously from February through August, although most spawning takes place in June and July (Tres 1992). Most spawning occurs in pools or in quiet edge water, at temperatures of 57 to 72 degrees Fahrenheit during March and April (Moyle *et al.* 1995). Chubs attach their eggs to trailing vegetation in flowing water, at least in captive situations (Tres 1992). After hatching, the fry spend the first three to four months in quiet water, in the water column and usually among vegetation or other flooded cover. They begin to reproduce at the age of one year. Age and growth in arroyo chubs remains to be thoroughly investigated, but Moyle (2002) reports that they seldom exceed 2.95 inches. Tres (1992) found that arroyo chubs live three to four years.

Castleberry and Cech (1986) demonstrated in laboratory studies that this species is physiologically adapted to survive hypoxic conditions and the wide fluctuations in temperatures common in south coastal streams. They are adapted for surviving the warm fluctuating streams of the Los Angeles Plain which historically shifted naturally between muddy torrents in the winter and clear intermittent brooks in the summer (Moyle 2002).

Natural dispersal is typically up- or downstream as conditions and suitable habitat permit, and is typically facilitated by flooding events (Moyle 2002). Fisher and Swift (1998), for example, noted that arroyo chub dispersal within the mainstem of the Santa Margarita River appeared to increase dramatically after El Nino rains produce flood waters that heavily scour the vegetation within the drainage, widening channels and reducing channel depths, creating habitat conditions that favor the chub and reduce exotic fish presence. The larvae and juveniles of the species tend to invade standing backwaters and/or disperse downstream from upstream spawning areas (*e.g.*, Swift 2001).

Arroyo chub are now considered scarce within their native range, because they prefer lower gradient streams that have largely disappeared. The majority of the arroyo chub population occurs within areas of large human populations associated with the Los Angeles metropolitan area, and consequently should be monitored closely (Moyle 2002).

Dams and reservoirs greatly reduce the natural variability in environmental conditions, resulting in the domination of non-native fish faunas (Moyle 2002; Herbold and Moyle 1986; Moyle and Light 1996). High disturbance systems support groups of species that would probably not coexist under natural conditions. For example, 3-4 species of predatory bass commonly live within reservoirs on California rivers, while rarely are more than two species found together in natural systems (Moyle and Light 1996). Cornell and Lawton (1992) argue that ecological communities are rarely saturated with species, thus, even complex systems may be invaded relatively easily. Successful invasions are most likely to occur when native assemblages have been temporarily disrupted or depleted (Moyle and Light 1996). The match between an invader and the hydrologic regime seems to be the most important factor in determining the success of an invasion, rather than the biotic resistance (Moyle and Light 1996; Case 1991). However, most invasions do not result in direct extirpation, except in the case of piscivores, or when invaders can hybridize with native species (Moyle and Light 1996). In relatively unmodified streams, such as Deer Creek (Tehama County), the natural hydrologic regime prevents repeated invasions of nonnative fish (Moyle and Light 1996).

Management considerations for the arroyo chub should include careful consideration of several factors that appear to be influencing the population demographics of the species. Preservation of existing connected habitat areas for the species within the mainstem of the rivers and their associated tributaries, as well as restoration of additional habitat areas within the mainstem of the rivers and any appropriate tributaries to promote the maximum genetic flow and widest distribution possible for the species is paramount.

To support conservation and restoration activities, accurate characterization and mapping of seasonally restricted habitat areas and migration barriers should be conducted, as should identification of tributaries and mainstem areas that provide the most appropriate spawning,

rearing, and adult foraging habitats for arroyo chub. Management activities should target reduction or removal of bullfrogs and exotic predatory fish species, especially within areas of potential habitat for the arroyo chub, and consider the effects that other non-native species such as crayfish, and African clawed-frogs may be having on the species. Management will also need to address water quality including, pollutants, turbidity and nutrients.

2.23 PARTIALLY-ARMORED THREESPINE STICKLEBACK

Species:	Partially-armored Threespine Stickleback
Federal Status:	None
State Status:	None
CNDDB Rank:	None
Science Advisors Group:	3
Covered Species:	Yes
Focal Monitoring Species:	Yes
Planning Species:	No

CONSERVATION GOAL

1. Manage habitat and populations of the partially-armored threespine stickleback to maximize the likelihood that existing populations are sustained in the planning area, and in doing so "provide for recovery" on a subregional basis and "contribute to recovery" on a rangewide basis.

CONSERVATION STRATEGY

1. Create a permanent subregional Habitat Reserve that protects sufficient aquatic habitat to support the partially-armored threespine stickleback.
2. Formulate a HRMP to provide for long-term protection and management of the partially-armored threespine stickleback and its habitat and provide for enhancement of breeding habitat.

HABITAT AND SPECIES CONSERVATION AND IMPACTS ANALYSIS

The conservation analysis for the partially-armored threespine stickleback includes an analysis of some minor permanent direct and temporary indirect impacts resulting from bridge placements across San Juan and Gobernadora creeks, but mostly focuses on potential future long-term impacts on habitat quality such a hydrologic and geomorphic processes and water quality.

Subarea 1 Impacts

The proposed Covered Activities would in result in minor direct impacts to habitat of the partially-armored threespine stickleback. The proposed crossings of San Juan Creek by the bridges for Cristianitos and Cow Camp roads would require piers that would impact a total of 0.06 acre in the streambed. However, the piers would not adversely affect natural streambed

processes such as base flows and sediment transport and deposition and would not be a barrier to fish movement. San Juan and Gobernadora creeks would be subject to temporary alteration or diversion to accommodate grading and construction for the circulation system of the B-12 Alternative resulting in short-term direct and indirect impacts associated with implementation of the proposed Covered Activities. Suitable habitat for the stickleback in Gobernadora Creek extends approximately 3,000 feet upstream of the potential impact areas and would not be affected by construction activities. Construction along or across San Juan Creek could potentially impact the quality of the natural habitats supporting the stickleback. Factors that could potentially impact these areas in the short-term include: **(1)** the temporary blockage or diversion of water flow in San Juan Creek; **(2)** increased siltation from grading or movement of construction equipment; and **(3)** the degradation of water quality by the disturbance of anaerobic (low oxygen) sediments. Because most of the high quality habitat areas in San Juan Creek are upstream of RMV in Caspers Wilderness Park (including Bell Canyon) and extending into the Cleveland National Forest, the potential impacts would not be considered substantial. Potential long-term impacts include hydrologic conditions of concern such as changes in rates of erosion or sedimentation and the generation of pollutants of concern such as metals. These potential indirect effects are addressed below.

Subarea 1 Conservation

All documented occupied aquatic habitat for the partially-armored threespine stickleback would be in the Habitat Reserve. As described above, the proposed Covered Activities would result in some minor direct impacts to habitat of the partially-armored threespine stickleback where the proposed crossings of San Juan Creek by the bridges for Cristianitos and Cow Camp roads would require piers. The piers would not adversely affect natural streambed processes such as base flows and sediment transport and deposition and would not be a barrier to fish movement. Also, based on conceptual designs, significant shading impacts to San Juan Creek would not occur because both proposed bridges are 50 feet or higher. Thus sufficient light would reach below the bridge structures to promote growth of typical riparian species such as mule fat and willows. These project design features also are referenced in the SAMP USACE Permit Special Condition I.D.1.a regarding bridge crossings. In addition, the existing Cow Camp culvert crossing of San Juan Creek is addressed by Special Condition I.D.3 which addresses the retrofit or relocation of the existing crossing to allow for fish passage. Finally, Special Condition II.9 requires partially-armored threespine stickleback surveys within 1,000 feet downstream of each PA prior to construction to address construction-related turbidity.

Conservation of this species in the Habitat Reserve thus primarily will rely on short-term protection during construction activities and long-term management of hydrologic and geomorphic processes and water quality, as described below.

ADAPTIVE MANAGEMENT PROGRAM

Stressors

A variety of environmental stressors identified for the partially-armored threespine stickleback will be considered for management, including:

- Habitat loss and fragmentation
- Degraded water quality from temperature changes, salinity and pollution
- Fire and related erosion/sedimentation of habitat
- Flood control and water diversion
- Altered hydrology
- Precipitation cycles
- Invasive plants
- Introduced exotic predators and competing species

The partially-armored threespine stickleback is listed as in decline by the CDFG (Moyle *et al.* 1995). It has widely disappeared throughout this region due to a variety of factors including dewatering, habitat alteration such as channelization, precipitation cycles (*e.g.,* drought), and introduction of exotic predator species (Moyle *et al.* 1995; Moyle 2002). Currently, only San Juan and Trabuco creeks within their native range are considered to support stable populations. In addition to habitat loss, the taxonomy and natural history of this species has contributed to its rarity. Specifically, stickleback populations in California (as throughout their range) include two basic forms: robust anadromous forms and smaller non-migratory freshwater forms. Because each non-migratory population is independently derived from anadromous sticklebacks, each drainage course with a non-migratory population could be considered an endemic taxon (species or subspecies); however, this is not reflected in the current taxonomic treatments. According to Swift (2005) the current range of what is taxonomically classified as *G. a. microcephalus* includes San Juan Creek extending into the Cleveland National Forest, Bell Canyon in Caspers Wilderness Park, upper portions of Trabuco Creek and two or three locations in northern Baja, Califomia.

Threats to the partially-armored threespine stickleback may be generalized into three categories; habitat based-threats (*e.g.*, degradation, fragmentation, destruction), biological threats (*e.g.*, predation, competition), and water quality threats (*e.g.*, temperature, salinity, pollution). Significant predators apparently include trout and other piscivorous fish (*e.g.,* pikeminnows), garter snakes and birds such as kingfishers and herons (Moyle 2002).

Goals

Goals for protecting and managing the partially-armored threespine stickleback and its habitat include the following:

1. Maximize the likelihood of the persistence of the physiographic diversity of riparian/wetland habitats in the Habitat Reserve.
2. Restore riparian/wetland habitats and enhance the quality of degraded riparian/wetland habitats in the Habitat Reserve such that the net habitat value of the existing riparian/wetland habitat system is preserved.
3. Manage fire regimes to sustain and enhance riparian/wetland quality in the Habitat Reserve.
4. Manage exotic invasions of riparian/wetland habitats such as giant reed, pampas grass, tamarisk, and castor bean.
5. Protect and manage occupied partially-armored threespine stickleback habitat in the Habitat Reserve.

Management and Monitoring Objectives (number of goal met by objective in parentheses)

Objective 1: Implement Conservation Strategy to protect and manage suitable habitat in Arroyo Trabuco, San Juan Creek and Gobernadora Creek (Goals 1 & 2).

Objective 2: Remap vegetation communities in Habitat Reserve within two (2) years of executing IA to establish a baseline for long-term tracking of the Reserve (Goals 1, 2 & 4).

Objective 3: Update vegetation community map at 5-year intervals (Goals 1, 2 & 4).

Objective 4: Collect regional climate, weather and air quality information to examine potential correlations between vegetation and population changes and environmental variables (Goals 1, 2 & 5)

Objective 5: Provide for no net loss of acreage and function of the waters of the U.S./State (Goals 1 & 2).

- Implement riparian/wetland restoration component of Habitat Restoration Plan.

Objective 6: Maintain/restore riparian/wetland ecosystem integrity and maintain and/or restore floodplain connection (Goals 1 & 2).

- Address historic meander conditions and excessive sediment input from upstream land uses in Gobernadora Creek, including construction of a detention/water quality basin below Coto de Caza.
- Conduct riparian/wetland restoration on a case-by-case basis over the long-term management and monitoring of the Habitat Reserve.

Objective 7: Maintain and/or restore sediment sources and transport equilibrium (Goals 1 & 2).

- Monitor channel morphology using transect lines for measuring cross-sectional profiles to monitor sediment movement (transport and deposition), peak discharges and changes in stream morphology.

Objective 8: Conduct periodic fish surveys to assess population status (Goals 1, 2, 4 & 5).

Objective 9: Maintain adequate stream and groundwater hydrology (Goals 1 & 2).

- Monitor stream hydrology through stream gages placed at representative sites in major drainages or other locations determined to be relevant to management of the Habitat Reserve and the partially-armored threespine stickleback.
- Monitor groundwater through collection of well data where groundwater plays a significant role in streamcourse hydrology

Objective 10: Implement Wildland Fire Management Plan such that sub-basin watersheds, riparian/wetlands, and partially-armored threespine stickleback habitat is protected to the extent possible (Goals 1, 2, 3 & 5).

Objective 11: Implement Invasive Species Control Plan to manage invasive exotic species in riparian/wetland habitats (Goals 1, 2, 4 & 5).

- Control major infestations of giant reed in San Juan Creek and Arroyo Trabuco, and smaller infestations in GERA.
- Control isolated clusters of tamarisk in Gabino and San Juan creeks.
- Control pampas grass infestation in Arroyo Trabuco and San Juan Creek.
- Control castor bean in Arroyo Trabuco and San Juan Creek.
- Control Spanish sunflower occurrences Gobernadora Creek (GERA) and monitor/conduct early eradication in Arroyo Trabuco and San Juan Creek as needed.
- Control bullfrog and crayfish populations in San Juan Creek and Arroyo Trabuco.

Conceptual Model

No – insufficient population-specific information to prepare a conceptual model.

Regional and Subregional Management Information Needs

- The taxonomic relationships and genetic effects of rangewide habitat fragmentation and isolation of populations.
- The status and trends of the various endemic populations or independently evolved forms.
- Life history traits and demographic processes (*e.g.*, growth rates, age structure, survival) as they relate to endemic populations.
- Effects of altered hydrology and/or barriers on dispersal and migration.
- The effectiveness of habitat restoration, including revegetation and enhancement in supporting the partially-armored threespine stickleback and whether restored areas can function as "self-sufficient ecosystems."
- Water quality variables (*e.g.*, turbidity, pollutants, nutrients, temperature) as significant risk factors for the partially-armored threespine stickleback.
- Site-specific effects of exotic predators on the partially-armored threespine stickleback.
- Interspecific competition/interference with introduced fishes.
- The effect of reductions in groundwater extraction on breeding habitat quality in San Juan Creek.
- The extent to which invasive plant species controls may expand and enhance partially-armored threespine stickleback habitat.
- The potential predation and competition impacts of introduced fishes and other non-native aquatic species such as crayfish, bullfrogs and African clawed frogs and adaptive responses of local populations.
- Whether cattle-related impacts in San Juan Creek have an adverse effect on partially-armored threespine stickleback habitat in the Habitat Reserve.

Level of Management and Monitoring Priority - High

The partially-armored threespine stickleback has a very restricted range in southern California and the populations in southern Orange County in San Juan and Trabuco creeks are among largest remaining natural habitats for the species rangewide. Management of aquatic habitats is

an important element of the Phase 1 HRMP, with invasive species such as giant reed and pampas grass identified as significant stressors of aquatic habitat in San Juan Creek and Arroyo Trabuco. Also, non-native species controls of crayfish and bullfrogs will be conducted during Phase 1 in San Juan Creek. Further, the existing Cow Camp culvert crossing of San Juan Creek is addressed by Special Condition I.D.3 which addresses the retrofit or relocation of the existing crossing to allow for fish passage. Finally, Special Condition II.9 requires partially-armored threespine stickleback surveys within 1,000 feet downstream of each PA prior to construction to address construction-related turbidity.

Level of Monitoring (*e.g.*, Species-specific, habitat, landscape, combination)

Monitoring will be conducted both at a species-specific and habitat landscape level.

Monitoring Variables

Listed below are suggested species- and habitat-based monitoring variables. The detailed monitoring program for the partially-armored threespine stickleback will be developed by the Reserve Manager and Science Panel.

Species-specific Monitoring Variables

1. Distribution and spatiotemporal trends of partially-armored threespine stickleback population
2. Proportion of stream segments occupied (PAO; see *Appendix O* for discussion of PAO)
3. Status of introduced predators and potential competitors such as bullfrog, crayfish and non-native fishes.

Habitat-based Monitoring Variables

1. Vegetation communities long-term status
2. Relative cover of different native plant species
3. Proportion of exotic plant species/native plant species
4. Results of habitat restoration activities, including invasive species controls, riparian/wetland restoration, and creek and soils stabilization programs

Abiotic Monitoring Variables

1. Climate
2. Weather
3. Air quality
4. Water quality (*e.g.*, turbidity, pollutants, salinity, temperature, and bacteria) and runoff

Management Actions

Management for the partially-armored threespine stickleback will focus on potential long-term indirect impacts to San Juan, Gobernadora and Arroyo Trabuco creeks that could affect partially-armored threespine stickleback habitat quality. These potential impacts include hydrologic conditions of concern such as changes in rates of erosion or sedimentation and the generation of pollutants of concern such as metals. Several management and restoration actions could benefit the stickleback and enhance recovery of the species in the Habitat Reserve. First, Verdugo Canyon hydrology would be maintained to protect sources of sediment that would be important for maintaining suitable stickleback breeding habitat in downstream areas of San Juan Creek (see Draft Watershed Planning Principles analysis in *Part I, Chapter 9*). Second, potential spawning sites in San Juan Creek would be conserved by maintaining hydrology and water quality, including flow characteristics of episodic events, and minimizing additional loadings of nutrients or toxics (*e.g.*, metals) through implementation of the WQMP. Stormwater flow characteristics would be maintained to preserve the natural succession of riparian habitat and the overall natural hydrologic/geomorphic conditions. Third, as part of the HRMP, bullfrog and crayfish control programs to help protect stickleback eggs, fry and juveniles would be implemented, with a special focus on permanent and semi-permanent water bodies that provide source concentrations of bullfrogs and crayfish. Fourth, habitat restoration and enhancement activities to benefit the partially-armored threespine stickleback would include a giant reed control program on RMV property within San Juan Creek in coordination with upstream control efforts by the County and CNF and giant reed and pampas grass control in Arroyo Trabuco. Control of giant reed and pampas grass in these two drainages will result in more potential spawning habitat both by providing for more native riparian vegetation and increasing water supplies necessary to sustain water throughout the spawning season. Fifth, implementation of a restoration program in Gobernadora Creek which addresses **(1)** the historic creek meander above the knickpoint, and **(2)** existing upstream land use-induced channel incision and erosion through the Gobernadora Multi-purpose Basin, including potentially excessive surface and groundwater originating upstream.

The coordinated GMP will help protect partially-armored threespine stickleback habitat in San Juan Creek through exclusion of cattle from the sympatric arroyo toad breeding habitat once such areas are dedicated.

Potential Target Studies

Several regional and subregional information management needs relevant to management of the partially-armored threespine stickleback were listed above, some of which could be addressed at the subregional scale and would help inform management of the Habitat Reserve. Other regional and subregional information management needs, particularly those related to rangewide persistence of the species (*e.g.*, landscape habitat fragmentation) are best studied at a rangewide

scale. The following are potential target studies that could be implemented at the subregional scale:

- The extent to which invasive species controls may expand and enhance partially-armored threespine stickleback habitat.
- The potential predation and competition impacts of introduced fishes and other non-native aquatic species such as crayfish, bullfrogs and African clawed frogs.
- Evaluation of seasonal exclusion of cattle from San Juan Creek and effects on partially-armored threespine stickleback habitat and populations.
- Evaluation of water quality (*e.g.,* turbidity, pollution, nutrients, and temperature).

SPECIES ACCOUNT

Rangewide and Regional Status

The native range of the partially-armored threespine stickleback includes the Los Angeles, San Gabriel, San Luis Rey, Santa Ana, and Santa Margarita rivers and also Malibu and San Juan creeks (Wells and Diana 1975). This species is common at three localities within its native range, namely the upper Santa Margarita River and its tributary, De Luz Creek; Trabuco Creek below O'Neill Park and San Juan Creek drainage; and Malibu Creek. It is present, but scarce in Big Tujunga Canyon (Pacoima Creek above Pacoima Reservoir), and in the Sepulveda Flood Control Basin, Los Angeles River drainage; upper San Gabriel River drainage; and middle Santa Ana River tributaries between Riverside and the Orange County line (Swift *et al.* 1993).

Introduced populations occur at Santa Maria-St. Inez, Mojave, Santa Clara, and Cuyama river drainages, and a portion of San Felipe Creek (Miller 1968; Moyle 1976; Bell 1978; Sigler and Sigler 1987; Page and Burr 1991). Within the literature, there is some disagreement regarding the extent of this species' native distribution. Miller (1968) and Bell (1978) conclude that the Santa Clara population is probably introduced while Moyle (1976), and Page and Burr (1991) indicated that this population is native. Fish fossils at Rancho La Brea, including partially-armored threespine stickleback (Swift 1989) indicate local, permanent stream conditions, and not stream transport from distant mountainous areas.

The partially-armored threespine stickleback is a CDFG CSC and has a CNDDB rank of G2S2; it is considered endangered throughout its range. The stickleback is subject to a number of threats that are habitat-, biologically- and water quality-based, most significantly introduced fish species and continued degradation of the urbanized streams that constitute much of its habitat. Because existing habitat is degraded and fragmented the partially-armored threespine stickleback

likely is highly vulnerable to random events, environmental factors, and genetic isolation and demographic instability. Floods, fires, variations of annual weather patterns, predation, and associated demographic uncertainty can result in local extirpations, that, because of isolation and physical barriers, cannot be recolonized. Other impacts on the partially-armored threespine stickleback and their habitat include human recreational use of rivers and streams that can disturb spawning and feeding behavior and cattle urine and feces that increase ammonia and nitrate levels that result in increased oxygen consumption by nitrifying bacteria and a concomitant decrease in oxygen available for fish, and toxins that can be deleterious in chronic amounts (*e.g.*, Thurston *et al.* 1986). In Orange County, mosquito fish and minnows have been introduced into Trabuco and San Juan creeks and the interaction between these fish species is not known.

Subregional Status

Currently, only a few creeks within their native range support stable populations. One of the largest remaining natural populations occurs in Orange County in San Juan and Trabuco creeks. Surveys conducted in San Juan Creek in 2004 detected partially-armored threespine stickleback downstream of the RMV boundary near the La Novia Bridge and it is expected that they continue to occupy areas within RMV and Caspers Wilderness Park, extending well into the Cleveland National Forest, which exhibits the largest areas of suitable habitat. Surveys conducted by MBA in 1995 also report the partially-armored threespine stickleback in Gobernadora Creek, upstream of San Juan Creek; however, this population is isolated from San Juan Creek due to impassable areas in Gobernadora Creek immediately upstream of the confluence with San Juan Creek that allow only movement from Cañada Gobernadora to San Juan Creek but not from San Juan Creek to Gobernadora. Surveys by Johnston (1998) for the Arroyo Trabuco Golf Course project documented the stickleback in lower Arroyo Trabuco.

Biological Considerations

The following description of threespine stickleback biology is excerpted almost in full from Moyle (2002), with an emphasis on the life history traits most relevant to conservation and management of the species. The reader is directed to Moyle (2002) for the full account of the species.

> *Threespine sticklebacks are quiet-water fish, living in shallow, weedy pools and backwaters or among emergent plants at stream edges over bottoms of gravel, sand and mud. The water has to be clear enough so that aquatic plants, required for building nests, will grow. As long as water quality is fairly high, sticklebacks are capable of living in shallow, urbanized streams that support few other fish, at least in northern California. … By and large they require cool water (<23-24°C) for long-term survival. They will seek areas with optimum temperatures for various activities such as feeding*

and digestion. It is unusual to find them in turbid water because they are visual feeders. Sticklebacks have broad salinity tolerances; even individuals from freshwater populations can be readily reared in seawater.

The life history characteristics of populations adapted to living in different areas are genetically based, indicating that selection pressures to maintain them are strong. … R.J. Snyder found that migratory versus non-migratory stickle backs from the Navarro River differed in such characters as age at first reproduction (195 days versus 220 days), initial clutch size of females (63 versus 57 eggs), egg size (1.7 mm versus 1.76 mm), and growth rates. The tendency to migrate is also an inherited trait. …

Individual sticklebacks (and populations) specialize in feeding on a rather limited number of organisms (e.g., chironomid midge larve, ostracods) and are rather slow to learn to exploit new sources of food. …

The small size, slow movements, and shallow water habitats of sticklebacks seem to make them ideal prey for avian and piscine predator. …sticklebacks are frequently important prey of salmonids and birds.

Predation is also a strong determinant of stickleback distribution within habitats. In waters with piscivorous fish they typically are found in beds of aquatic plants or in other dense cover, such as among branches of fallen trees. In the Pajaro River sticklebacks are found either in slow, shallow pools where predatory fish are absent and algal mats are abundant or in deep pools with cover. In the Eel River invasion of predatory pikeminnows caused sticklebacks to shift from using a wide variety of habitats in pools (mean depth used, 95 cm) to concentrating in shallow edge water (mean depth, 46 cm), among cover. In flowing water mean depth shifted from 55 cm to 37 cm. In some areas pikeminnow predation largely eliminated sticklebacks, which showed relatively poor avoidance response. This may explain in part the scattered distribution of sticklebacks in many California river systems, including those in the Central Valley. For example, in San Francisco Bay streams they are largely absent from areas containing predatory fish.

Most sticklebacks complete their life cycle in 1 year. Usually a majority in one area are of uniform size, although the presence of occasional large individuals indicates that a few live for 2 or possibly 3 years.

In a study of the status and distribution of the fishes in the Santa Margarita River drainage, Warburton *et al.* (2000) also noted that exotic predators are a limiter of the threespine stickleback and suggest that removal of exotic species would be favorable to increasing habitat for the stickleback.

This implication of these observations is that the life history traits of each population need to be characterized in the context of the local habitat and selection pressures, such as local predators, water quality, migration/dispersal opportunities and other habitat characteristics.

Management considerations for the partially-armored threespine stickleback include protection and management of existing connected habitat areas for the species within the mainstem of the rivers and their associated tributaries, as well as restoration of additional habitat areas within the mainstem of the rivers and any appropriate tributaries to promote the maximum genetic flow and widest distribution possible for the species is paramount.

To support conservation and restoration activities, accurate characterization and mapping of seasonally restricted habitat areas and migration barriers within each watershed should be conducted, as should identification of tributaries and mainstem areas that provide the most appropriate spawning, rearing, and adult foraging habitats for partially-armored threespine stickleback. Management activities should target reduction or removal of bullfrogs and exotic predatory fish species, especially within areas of potential habitat for the partially-armored threespine stickleback, and consider the effects that other non-native species such as crayfish, bullfrogs and African clawed-frogs may be having on the species. Management will also need to address water quality including, pollutants, turbidity and nutrients.

2.24 RIVERSIDE FAIRY SHRIMP

Species:	Riverside Fairy Shrimp (*Streptocephalus woottoni*)
Federal Status:	Endangered
State Status:	None
CNDDB Rank:	G1S1
Science Advisors Group:	3
Covered Species:	Yes
Focal Monitoring Species:	No
Planning Species:	Yes

CONSERVATION GOAL

1. Protect and manage vernal pools and associated hydrological sources and populations of the Riverside fairy shrimp to maximize the likelihood that existing populations are sustained in the planning area, and in doing so "provide for recovery" on a subregional basis and "contribute to recovery" on a rangewide basis.

CONSERVATION STRATEGY

1. Create a permanent subregional Habitat Reserve that protects the two vernal pool areas in Subarea 1: **(1)** vernal pools on Chiquita Ridge in Ladera Open Space; and **(2)** vernal pools on Radio Tower Road.

2. Formulate a HRMP to provide for long-term protection and management of the Riverside fairy shrimp and its habitat and provide for enhancement of vernal pool habitat.

HABITAT AND SPECIES CONSERVATION AND IMPACTS ANALYSIS

The conservation analysis for the Riverside fairy shrimp focuses on the protection and management of vernal pools supporting the species in the Habitat Reserve.

Subarea 1 Impacts

The only potential direct impact to the Riverside fairy shrimp is to Pool 7 on the Radio Tower Road mesa (*Figure 173-M*). Through project site design Pool 7 and its hydrological sources would be protected (*e.g.*, by limiting the grading to below the grade of the pools) (see the Ranch Plan GPA/ZC EIR MM 4.9-35). Potential direct and indirect impacts that could adversely affect pools supporting the Riverside fairy shrimp over the long term include impacts on hydrology, water quality, invasive exotic species and human disturbance. Cattle-related impacts (*e.g.*,

trampling pools, impacts on water quality, etc.) are an issue for Pools 2 and 7 on Radio Tower Road mesa. These potential impacts are addressed in the management section below.

Subarea 1 Conservation

All three vernal pools supporting the Riverside fairy shrimp and their contributing hydrological resources on Chiquita Ridge (Pool 4) and the Radio Tower Road mesa (Pools 2 and 7) would be conserved and managed in the Habitat Reserve (see *Figure 173-M*), assuming avoidance of Pool 7 through project site design (see the Ranch Plan GPA/ZC EIR MM 4.9-35).

ADAPTIVE MANAGEMENT PROGRAM

Stressors

Stressors of Riverside fairy shrimp and vernal pools that will be considered for adaptive management include:

- Hydrology
- Water quality
- Cattle-related impacts
- Invasive exotic species
- Human disturbance

Hydrology is a key management issue because the flora and fauna of the vernal pools have evolved adaptations to the unique hydrological conditions of vernal pools. Although dramatic year-to-year variations in rainfall occur, and vernal pools species are well-adapted to this variation, over the long term too little inundation may not support the full life cycle of the vernal pool species and extended inundation may lead to mortality of the species that are not truly adapted to an aquatic existence (Barry 1998; USFWS 1998c). Extended runoff from developed areas can be a substantial problem for vernal pools (*e.g.*, Clark *et al.* 1998). Hydrological alterations of the vernal pools in the Habitat Reserve due to direct disturbance of the local contributing watershed (*e.g.*, from grading) or increased urban runoff, are not anticipated to be management issues because existing and planned development areas are at least 1,000 feet from the vernal pools and at lower elevations. However, effects of cattle (for the Radio Tower Road mesa pools) and exotic species on hydrology are considered to be important management issues and, thus, are addressed below.

The Radio Tower Road vernal pools are located in an active pasture and grazing is planned in this area in the future as part of planned long-term cattle operations. Grazing can have both positive and negative impacts on vernal pools and associated species. Grazing can help control

the proliferation of invasive exotics species such as annual grasses that choke out native plants and alter the natural hydrology of the pool and local contributing watershed (*e.g.*, Barry 1998). Marty (2005) noted that exotic species can decrease the pool's hydroperiod, possibly because of increased evapotranspiration rates associated with abundant vegetation in and around pools. On the other hand, poorly controlled grazing can result in trampling of fairly shrimp cysts and hatchlings, as well as increase water turbidity. Ironically, however, some dispersal likely is mediated by cattle that move through or wallow in vernal pools.

The relationship between cattle grazing and vernal pool hydrology is complex. As stressed by Barry (1998), "When resource managers and landowners develop plans to conserve vernal pool habitats, it is imperative they recognize that the current vernal pool landscape has been altered with the proliferation of exotic plant species and the impact of livestock grazing." (p. 237). Marty (2005) found that removing cattle from some vernal pool areas in California's Central Valley decreased pool inundation periods by 50 to 80 percent, making it difficult for some vernal pool species to complete their life cycle. Marty attributes this to the reduction of vegetation in and around the vernal pools by cattle and the fact that vernal pool species are adapted to some level of grazing that has occurred in California grasslands back to the Pleistocene. However, Marty cautions that any beneficial effects of cattle likely will interact with seasonal and site-specific variations in rainfall; *e.g.*, where rainfall levels are higher, the positive effect of grazing may be less prominent. Whether this beneficial effect of cattle on vernal pools in the Central Valley holds for the pools in the Subregion would require further study.

In addition to trampling of cysts and hatchlings and increasing water turbidity, cattle may have other negative impacts on water quality. Vernal pool species have adapted to specific water quality tolerances, and alterations in pH, and water temperature may have significant impacts on these species (Simovitch *et al.* 1996). Cattle are potential sources of nutrients such as phosphorus and nitrogen, as well as organic wastes (manure and urine), that may trigger rapid growth of microorganisms (and thus increased biochemical oxygen demand) and/or aquatic macrophytes (*e.g.*, algae) (Bowling and Jones 2003).

The management issue for the Radio Tower Road pools thus is timing and controlling grazing in way that helps control non-native plants, but does not interfere with the functions and values of the vernal pools, most importantly, the reproductive cycle of vernal pool plant and animal species. Lis and Eggeman (2000) describe an adaptive management study where a combination of grazing and burning was used to control invasive species in vernal pools in the Dales Lake Ecological Reserve in Tehama County, California. They found that carefully timed grazing did not interfere with fairy shrimp reproduction or cause any immediate negative effects on rare

plants. They concluded that while grazing "may not return the vernal pool landscape to its condition five hundred years ago…it is likely to move the landscape in that direction." (p. 23)[4].

As described above, invasive exotic species threaten vernal pools because they compete with and displace native plants, and they also interfere with normal surface runoff patterns in the local contributing watershed essential for sustaining vernal pool hydrology (*e.g.*, Barry 1998). The problem with most non-natives occurs in drier years when moisture conditions are conducive to annual grasses such as bromes (*Bromus* spp.) and wild oats (*Avena* spp.) (USFWS 1998c). During wetter years these annual grasses are reduced, but several other non-native species such as rabbit's-foot grass (*Polypogon monspeliensis*), wild rye (*Lolium* spp.) and brass-buttons (*Cotula coronopifolia*) still can dominate vernal pools (USFWS 1998c). Invasive plants observed within ponds on RMV include sharp-toothed timothy (*Crypsis vaginifolia*) and hyssop loosestrife (*Lythrum hyssopifolium*). As discussed above, grazing, and possibly prescribed burns, may be used to control exotic species at the Radio Tower Road pools, but other control methods would be required at the Chiquita Ridge pools because cattle are excluded from the area and prescribed burns may not be feasible so close to residential development.

Human disturbances, primarily trampling and vehicular impacts on species and soils, are ongoing threats to vernal pools throughout the state. Because the vernal pools in both the Chiquita Ridge and Radio Tower Road areas are at least 1,000 feet from the nearest residential development, human disturbance may be less of a long-term problem in the Habitat Reserve than typically observed elsewhere. Nonetheless human activities would have to be addressed in the AMP.

Goals and Objectives

The overall goal is to maintain existing vernal pools and Riverside fairy shrimp within the Habitat Reserve. This will be accomplished using the "Vernal Pool Functional Assessment" conducted by PCR (2003b) as a guideline. The management objectives designed to meet this goal are as follows:

Objective 1: Conduct monitoring of vernal pools and associated species in a manner that allows the Reserve Manager to track the long-term status of the vernal pools and species.

[4] Lis and Eggeman (2000) also found that vernal pools burned during a wildfire on the Hog Lake Plateau, resulting in the burning of dense mats of dried spikerush, had no apparent adverse effect on the hatching of fairy shrimp. The study is ongoing, but Lis and Eggeman suggest that timed grazing and prescribed burning may be effective management tools to control non-natives in vernal pools. Prescribed burning as a management tool for grasslands generally, and for vernal pools specifically, also is recommended by Pollack and Kan (1998) based on studies on the Jepson Prairie Preserve showing that late-spring burning reduces non-native grasses and increases the dominance of native species. They also suggest that a combined burning-grazing regime can be used to reduce fire intensity.

Objective 2: Manage the hydrological regime of the pools by maintaining the existing local contributing hydrological sources (*i.e.*, the local contributing watershed of the vernal pool).

Objective 3: Eliminate or control any identified existing threats to existing vernal pools, including poorly-timed or controlled grazing and invasion of pools and the local contributing watershed by non-native species.

Objective 4: Develop management tools to control the proliferation of non-native species, including time-grazing, prescribed burns, mowing and selective weeding.

Objective 5: Manage water quality to emulate baselines conditions in the vernal pools in the Habitat Reserve known to support the Riverside and San Diego fairy shrimp.

Conceptual Model

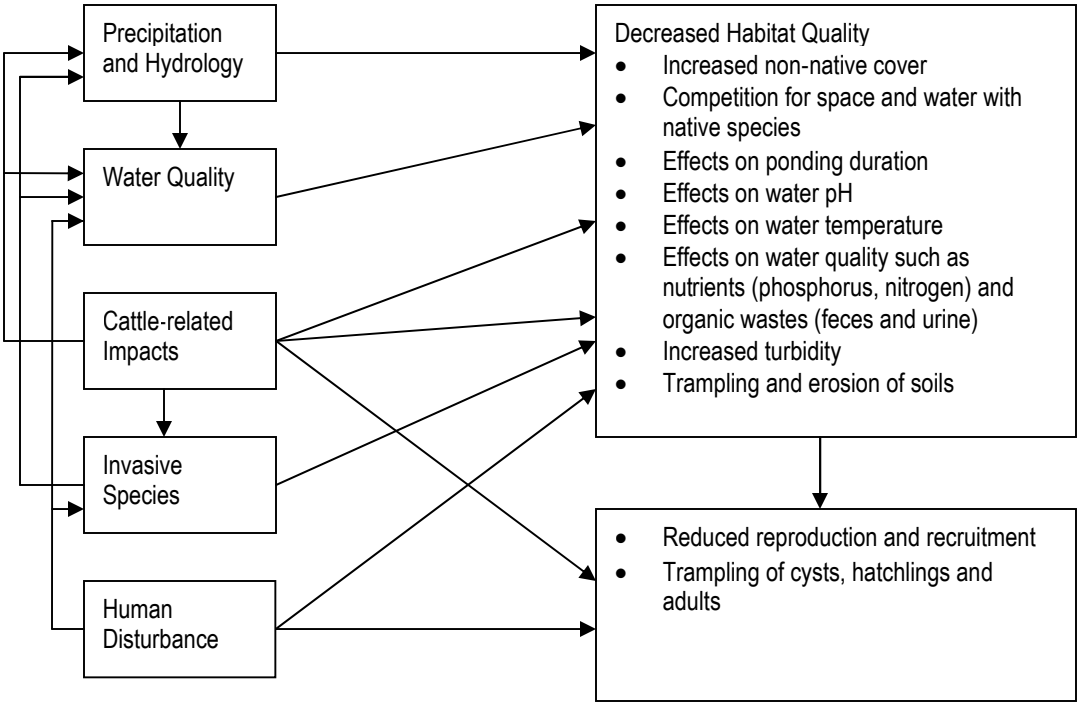
Yes – See figure below.

Regional and Subregional Management Information Needs

- The genetics relationships among sub-populations, with low genetic variability a possible concern for long-term viability of the species.
- Population trends and demographics such as survivorship.
- Dispersal, although it is assumed that dispersal vectors include waterfowl, cattle, sheep, dogs, vehicles.
- Whether life history traits and ecological conditions covary in different parts of the Riverside fairy shrimp's range that are relevant to management of the species, such as development patterns related to the timing and duration of breeding pools (*e.g.*, see Marty 2005).
- Aerial contaminants as a significant risk factor.
- Effectiveness of the variety of protection and management measures implemented to conserve the Riverside fairy shrimp.
- Long-term condition, variation and function of vernal pools in the Habitat Reserve (using the PCR [2003b] Vernal Pool Functional Assessment as a baseline study).

Riverside Fairy Shrimp Conceptual Stressor Model

Stressor | **Effects on Riverside Fairy Shrimp Habitat and Populations**



- Role of cattle-related impacts and long-term effect of cattle exclusion from the Radio Tower Road vernal pools during the wet season.
- Effective management techniques to control the proliferation of exotic plant species in and around vernal pools, including timed grazing, prescribed burns, mowing and selective weeding.

Level of Management and Monitoring Priority - High

The Riverside fairy shrimp has a discrete, limited distribution in the Habitat Reserve, with two identified *important population* areas – the vernal pools located on Chiquita Ridge and the Radio Tower Road mesa. The Riverside fairy shrimp is assigned a high priority for management and monitoring because of the limited number of occupied sites and because there are clear potential habitat-based and species-specific stressors on this species, including cattle-related impacts and non-native species. Both of these stressors have been identified for management during Phase 1 of HRMP implementation. The management actions benefiting this species, as discussed below, are habitat-based and would also benefit other vernal pool species such as the San Diego fairy shrimp and western spadefoot toad. Also, the Riverside fairy shrimp can be monitored in conjunction with monitoring of the San Diego fairy shrimp and spadefoot toad.

Level of Monitoring (*e.g.*, Species-specific, habitat, landscape, combination)

Monitoring will be conducted both primarily at a species-specific level but also at a habitat landscape level.

Monitoring Variables

Listed below are suggested species- and habitat-based monitoring variables. The detailed monitoring program for the Riverside fairy shrimp will be developed by the Reserve Manager and Science Panel.

Species-specific Monitoring Variables

1. Status of population

Habitat-based Monitoring Variables

1. Vernal pool and contributing hydrological area long-term status
2. Relative cover of different native plant species
3. Proportion of exotic plant species/native plant species

Abiotic Monitoring Variables

1. Climate
2. Weather
3. Air quality
4. Water quality and runoff

Management Actions

Management of two occupied Radio Tower Road mesa vernal pools primarily will be implemented through timed grazing per the coordinated GMP for exotic species control during the vernal pool dry season and seasonal exclusion of grazing during the wet season to allow the fairy shrimp to complete their life cycle. Experimental prescribed burns may also be used as an exotics control technique. Because cattle grazing has already been excluded from the occupied Chiquita Ridge vernal pool within existing Ladera Open Space and because prescribed burns probably are not feasible due to the close proximity to existing development in Ladera Ranch, management primarily will be implemented through exotics controls by means of mowing and/or selective weeding.

The HRMP also will include monitoring of the Radio Tower Road mesa and Chiquita Ridge vernal pools and Riverside fairy shrimp populations (including the two small pools on Chiquita Ridge and the one pool on Radio Tower Road mesa lacking documented Riverside fairy shrimp), managing hydrological regimes by maintaining the existing local contributing hydrological sources, managing water quality to emulate baseline conditions, and controlling public access, especially during the wet season.

Potential Target Studies

Several regional and subregional information management needs relevant to management of the Riverside fairy shrimp were listed above, some of which could be addressed at the subregional scale and would help inform management of the Habitat Reserve. Other regional and subregional information management needs, particularly those related to rangewide persistence of the species (*e.g.*, landscape habitat fragmentation) are best studied at a rangewide scale. The following are target studies that could be implemented at the subregional scale:

- Evaluation of cattle-related impacts and exclusion vernal pools and the fairy shrimp.

- Long-term condition, variation and function of vernal pools in the Habitat Reserve (using the PCR [2003b] Vernal Pool Functional Assessment as a baseline study).

- Effective management techniques to control the proliferation of exotic plant species in and around vernal pools, including timed grazing, prescribed burns, mowing and selective weeding.

SPECIES ACCOUNT

Rangewide and Regional Status

Riverside fairy shrimp is restricted to southwestern California and northwestern Baja California. It occurs from southern Ventura County south and east through Orange and western Riverside counties to coastal San Diego County (primarily Camp Pendleton and Otay Mesa) and the vicinity of Baja Mar north of Ensenada in Baja California, Mexico. With the exception of the Riverside populations, all populations are within 15 km (9.3 mi) of the coast (Eriksen and Belk 1999). All known populations lie between 30 m (98 ft) and 415 m (1,361 ft) in elevation.

The *Recovery Plan for Vernal Pools of Southern California* (USFWS 1998c) identified six Management Areas for the Riverside fairy shrimp:

1. **Los Angeles/Orange County:** This Management Area includes three areas in southern Orange County known to support the Riverside fairy shrimp – Saddleback Meadows/Foothill-Trabuco area, RMV property, and El Toro.

2. **Riverside County:** This Management Area includes three areas in western Riverside County – Temecula, Skunk Hollow, and the Santa Rosa Plateau. Recent data have revised and refined this distribution to include at least five extant populations in western Riverside County, including Skunk Hollow, Santa Rosa Plateau, Murrieta, Alberhill, and Lake Elsinore populations, plus an unnamed location that apparently includes a series of private stockponds (USFWS 2001d). Other undiscovered populations may occur in this area (Dudek 2002). The Skunk Hollow pool is protected as part of a mitigation bank and the Santa Rosa Plateau complex is on the Ecological Reserve owned and managed by The Nature Conservancy.

3. **San Diego North Coastal Mesas:** This Management Area includes MCB Camp Pendleton and Carlsbad. The Pendleton pool complexes are located in the Wire Mountain Housing Area, Cockleburr Mesa, Las Pulgas, Stuart Mesa, San Mateo and on lands leased to State Parks. The Pendleton complexes represent one of the largest populations of the Riverside fairy shrimp (USFWS 2001d). The Carlsbad pools are located at the Poinsettia Land Station and are mitigation lands.

4. **San Diego Central Coastal Mesas:** This Management Area includes the Marine Corps Air Station Miramar. Only one complex supporting the Riverside fairy shrimp is known from this Management Area. This complex is in the Miramar Marine Corps Air Station (MCAS) and is managed by the Department of Defense (DOD).

5. **San Diego South Coastal Mesas:** This Management Area includes Otay Mesa. Six complexes in the Otay area support Riverside fairy shrimp, of which five are on private property and one is on City of San Diego property. Two of the five private complexes and the City site are on mitigation land.

6. **Transverse:** This Management Area is located in inland valleys and mesas north of the Los Angeles Basin in association with the Transverse Mountain Ranges. The Riverside fairy shrimp is known from the Carlsberg Ranch vernal pool in Moorpark, on the northern edge of the Santa Monica Mountains in Ventura County. This vernal pool represents a northern limit of the species, and is now in preserved open space under the management of the Santa Monica Mountains Conservancy.

The Riverside fairy shrimp is federally-listed as endangered. Its CNDDB rank is G1S1; it is considered extremely endangered throughout its range in both California and Baja California. The Riverside fairy shrimp has suffered substantial loss of vernal pool habitat in southern California due to conversion to agriculture and urbanization and existing pools are often degraded by habitat fragmentation, cattle grazing, contaminants, off-road vehicles and exotic species (USFWS 1998c).

Subregional Status

The Riverside fairy shrimp is known from vernal pools on Saddleback Meadows in Subarea 2 in the northwest portion of the planning area, two pools near the intersection of Antonio Parkway and the FTC-North segment, a very large population in a large pool on Chiquita Ridge (Pool 4) and in two pools located on the Radio Tower Road mesa (Pools 2 and 7) (*Figure 173-M*). Because this species is rare in the subregion, all vernal pools supporting the Riverside fairy shrimp are considered *important populations* in *key locations*.

The geology of the vernal pools in the planning area is different from that underlying mima mounds found on the mesas of San Diego County. The Chiquita Ridge and Radio Tower Road pools originate from young bedrock slides associated with the Cristianitos fault zone. The formation of these vernal pools apparently derives from the differential settling of fine-grained materials (high clay content) from San Onofre Breccia, Monterey and Topanga formations. These pools are underlain by Soper gravelley loam on 15-30 percent slopes and Alo clay on 0-15 percent slopes.

Biological Considerations

Vernal pools that support the Riverside fairy shrimp primarily occur on mesas and other level terrain generally less than 10 percent. These areas often exhibit a characteristic microrelief called Gilgai or mima mound formation. The species may also occur in ditches and road ruts, but only in areas associated with degraded vernal pool habitat. Because of the distinctive topography supporting vernal pools, pools typically are clustered in "complexes," including dense clusters of small pools or scattered clusters of large pools that often share a common watershed (USFWS 2001d).

Vernal pools in general are associated with heavy soils that prevent the percolation of water. Southern California vernal pools are most often found in alluvial soils with clay or clay loam subsoils. Basaltic or granitic substrates or indurated hardpan layers may contribute to poor drainage and retention of water (USFWS 1998c). The size of vernal pools can vary dramatically, from just a few square meters to the size of small lakes (*e.g.*, Skunk Hollow in western Riverside County). The size of the vernal pool is related to the watershed of the pool and the local micro-relief.

The Riverside fairy shrimp is restricted to deep seasonal vernal pools, vernal pool-like ephemeral ponds, and stock ponds and other human modified depressions (Eng *et al.* 1990; USFWS 1993c; USFWS 2001d). Riverside fairy shrimp prefer warm-water pools that have low to moderate dissolved solids, are less predictable, and remained filled for extended periods of time (Eriksen and Belk 1999). Basins that support Riverside fairy shrimp are typically dry a portion of the year, but usually are filled by late fall, winter or spring rains, and may persist through May (USFWS 2001d). All known vernal pool habitat lies within annual grasslands, which may be interspersed through chaparral or coastal sage scrub vegetation.

Females produce between 17 and 427 cysts over their lifetime (Simovich and Hathaway 1997). Presumably because of the ephemeral and unpredictable nature of the pool resource, few of the available cysts hatch at a time (Eriksen and Belk 1999). Cysts may hatch when water temperature is at 10 degrees C (50 degrees F) but develop slowly below 15 degrees C (59 degrees F) (Eriksen and Belk 1999). Hathaway and Simovich (1996) found that Riverside fairy shrimp hatched in seven to 12 days when water temperatures were between 10 and 20 degrees C (50 and 68 degrees F) and maturity was noted between 48 to 56 days.

On RMV, the Riverside fairy shrimp was found in pools ranging in depth from 22 to 41.9 cm (8.7 to 16.5 in) (PCR 2003b). Water temperatures of these pools ranged from 15 to 20 degrees C (59 to84 degrees F). The percent dissolved oxygen was 0.02 to 6.0 and the total dissolved solids was 61-364 parts per million.

Dispersal in fairy shrimp is likely mediated by vectors such as waterfowl, cattle, sheep, dogs and even off-road vehicles (*e.g.*, rubber-tired or tracked vehicles) that move through or wallow in inhabited wet or dry pools. Wildlife and vehicles transport cysts or pregnant or mature adults between dry depressions or extant pools. Cysts may also disperse like some plant seeds by passing through an animal's gut after it ingests pregnant females or cysts in drinking water and then eliminates in other suitable depressions or pools.

Protection Recommendations

- Protect the two vernal pools that support the Riverside fairy shrimp and their contributing hydrologic sources along Radio Tower Road. The Chiquita Ridge pools are already protected in Ladera Open Space.

Management Recommendations

- Implement a management program for vernal pools, including control of non-native invasive species, management of grazing and minimization of human access and disturbance as part of the Adaptive Management Program.

2.25 SAN DIEGO FAIRY SHRIMP

Species: San Diego fairy shrimp (*Branchinecta sandiegonensis*)
Federal Status: Endangered
State Status: None
CNDDB Rank: G1S1
Science Advisors Group: 3
Covered Species: Yes
Focal Monitoring Species: No
Planning Species: Yes

CONSERVATION GOAL

1. Protect and manage vernal pools and associated hydrological sources and populations of the San Diego fairy shrimp to maximize the likelihood that existing populations are sustained in the planning area, and in doing so "provide for recovery" on a subregional basis and "contribute to recovery" on a rangewide basis.

CONSERVATION STRATEGY

1. Create a permanent subregional Habitat Reserve that protects the two vernal pool areas in Subarea 1: **(1)** vernal pools on Chiquita Ridge in Ladera Open Space; and **(2)** vernal pools on Radio Tower Road.
2. Formulate a Habitat Reserve Management Program (HRMP) to provide for long-term protection and management of the San Diego fairy shrimp and its habitat and provide for enhancement of vernal pool habitat.

HABITAT AND SPECIES CONSERVATION AND IMPACTS ANALYSIS

The conservation analysis for the San Diego fairy shrimp focuses on the protection and management of vernal pools supporting the species in the Habitat Reserve. The conservation analysis presented here is similar to that presented above for the San Diego fairy shrimp because the issues are the same.

Subarea 1 Impacts

The only potential direct impact to the San Diego fairy shrimp is to Pool 7 on the Radio Tower Road mesa. Through project site design Pool 7 and its hydrological sources would be protected (*e.g.,* by limiting the grading to below the grade of the pools) (see the Ranch Plan GPA/ZC EIR

MM 4.9-35). Potential direct and indirect impacts that could adversely affect the pools supporting the San Diego fairy shrimp over the long term include impacts on hydrology, water quality, invasive exotic species and human disturbance. Cattle-related impacts (*e.g.*, trampling pools, impacts on water quality, etc.) are an issue for Pools 1, 2 and 7 on Radio Tower Road mesa. These potential impacts are addressed in the management section below.

Subarea 1 Conservation

All five vernal pools supporting the San Diego fairy shrimp and their contributing hydrological resources on Chiquita Ridge (Pools 4 and 6) and the Radio Tower Road mesa (Pools 1, 2 and 7) would be conserved and managed in the Habitat Reserve (see *Figure 173-M*), assuming avoidance of Pool 7 through project site design (see the Ranch Plan GPA/ZC EIR MM 4.9-35).

ADAPTIVE MANAGEMENT PROGRAM

Stressors

Stressors of San Diego fairy shrimp and vernal pools that will be considered for adaptive management include:

- Hydrology
- Water quality
- Cattle-related impacts
- Invasive exotic species
- Human disturbance

Hydrology is a key management issue because the flora and fauna of the vernal pools have evolved adaptations to the unique hydrological conditions of vernal pools. Although dramatic year-to-year variations in rainfall occur, and vernal pools species are well-adapted to this variation, over the long term too little inundation may not support the full life cycle of the vernal pool species and extended inundation may lead to mortality of the species that are not truly adapted to an aquatic existence (Barry 1998; USFWS 1998c). Extended runoff from developed areas can be a substantial problem for vernal pools (*e.g.*, Clark *et al.* 1998). Hydrological alterations of the vernal pools in the Habitat Reserve due to direct disturbance of the local contributing watershed (*e.g.*, from grading) or increased urban runoff, are not anticipated to be management issues because existing and planned development areas are at least 1,000 feet from the vernal pools and at lower elevations. However, effects of cattle (for the Radio Tower Road mesa pools) and exotic species on hydrology are considered to be important management issues and, thus, are addressed below.

The Radio Tower Road vernal pools are located in an active pasture and grazing is planned in this area in the future as part of planned long-term cattle operations. Grazing can have both positive and negative impacts on vernal pools and associated species. Grazing can help control the proliferation of invasive exotics species such as annual grasses that choke out native plants and alter the natural hydrology of the pool and local contributing watershed (*e.g.*, Barry 1998). Marty (2005) noted that exotic species can decrease the pool's hydroperiod, possibly because of increased evapotranspiration rates associated with abundant vegetation in and around pools. On the other hand, poorly controlled grazing can result in trampling of fairly shrimp cysts and hatchlings, as well as increase water turbidity. Ironically, however, some dispersal likely is mediated by cattle that move through or wallow in vernal pools.

The relationship between cattle grazing and vernal pool hydrology is complex. As stressed by Barry (1998), "When resource managers and landowners develop plans to conserve vernal pool habitats, it is imperative they recognize that the current vernal pool landscape has been altered with the proliferation of exotic plant species and the impact of livestock grazing." (p. 237). Marty (2005) found that removing cattle from some vernal pool areas in California's Central Valley decreased pool inundation periods by 50 to 80 percent, making it difficult for some vernal pool species to complete their life cycle. Marty attributes this to the reduction of vegetation in and around the vernal pools by cattle and the fact that vernal pool species are adapted to some level of grazing that has occurred in California grasslands back to the Pleistocene. However, Marty cautions that any beneficial effects of cattle likely will interact with seasonal and site-specific variations in rainfall; *e.g.*, where rainfall levels are higher, the positive effect of grazing may be less prominent. Whether this beneficial effect of cattle on vernal pools in the Central Valley holds for the pools in the Subregion would require further study.

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The management issue for the Radio Tower Road pools thus is timing and controlling grazing in way that helps control non-native plants, but does not interfere with the functions and values of the vernal pools, most importantly, the reproductive cycle of vernal pool plant and animal species. Lis and Eggeman (2000) describe an adaptive management study where a combination of grazing and burning was used to control invasive species in vernal pools in the Dales Lake Ecological Reserve in Tehama County, California. They found that carefully timed grazing did not interfere with fairy shrimp reproduction or cause any immediate negative effects on rare

plants. They concluded that while grazing "may not return the vernal pool landscape to its condition five hundred years ago…it is likely to move the landscape in that direction." (p. 23)[5].

As described above, invasive exotic species threaten vernal pools because they compete with and displace native plants, and they also interfere with normal surface runoff patterns in the local contributing watershed essential for sustaining vernal pool hydrology (*e.g.*, Barry 1998). The problem with most non-natives occurs in drier years when moisture conditions are conducive to annual grasses such as bromes (*Bromus* spp.) and wild oats (*Avena* spp.) (USFWS 1998c). During wetter years these annual grasses are reduced, but several other non-native species such as rabbit's-foot grass (*Polypogon monspeliensis*), wild rye (*Lolium* spp.) and brass-buttons (*Cotula coronopifolia*) still can dominate vernal pools (USFWS 1998c). Invasive plants observed within ponds on RMV include sharp-toothed timothy (*Crypsis vaginifolia*) and hyssop loosestrife (*Lythrum hyssopifolium*). As discussed above, grazing, and possibly prescribed burns, may be used to control exotic species at the Radio Tower Road pools, but other control methods would be required at the Chiquita Ridge pools because cattle are excluded from the area and prescribed burns may not be feasible so close to residential development.

Human disturbances, primarily trampling and vehicular impacts on species and soils, are ongoing threats to vernal pools throughout the state. Because the vernal pools in both the Chiquita Ridge and Radio Tower Road areas are at least 1,000 feet from the nearest residential development, human disturbance may be less of a long-term problem in the Habitat Reserve than typically observed elsewhere. Nonetheless human activities would have to be addressed in the AMP.

Goals

The overall goal is to maintain existing vernal pools and San Diego fairy shrimp within the Habitat Reserve. This will be accomplished using the "Vernal Pool Functional Assessment" conducted by PCR (2003b) as a guideline. The management objectives designed to meet this goal are as follows:

Objective 1: Conduct monitoring of vernal pools and associated species in a manner that allows the Reserve Manager to track the long-term status of the vernal pools and species.

[5] Lis and Eggeman (2000) also found that vernal pools burned during a wildfire on the Hog Lake Plateau, resulting in the burning of dense mats of dried spikerush, had no apparent adverse effect on the hatching of fairy shrimp. The study is ongoing, but Lis and Eggeman suggest that timed grazing and prescribed burning may be effective management tools to control non-natives in vernal pools. Prescribed burning as a management tool for grasslands generally, and for vernal pools specifically, also is recommended by Pollack and Kan (1998) based on studies on the Jepson Prairie Preserve showing that late-spring burning reduces non-native grasses and increases the dominance of native species. They also suggest that a combined burning-grazing regime can be used to reduce fire intensity.

Objective 2: Manage the hydrological regime of the pools by maintaining the existing local contributing hydrological sources (*i.e.*, the local contributing watershed of the vernal pool).

Objective 3: Eliminate or control any identified existing threats to existing vernal pools, including poorly-timed or controlled grazing and invasion of pools and the local contributing watershed by non-native species.

Objective 4: Develop management tools to control the proliferation of non-native species, including time-grazing, prescribed burns, mowing and selective weeding.

Objective 5: Manage water quality to emulate baselines conditions in the vernal pools in the Habitat Reserve known to support the San Diego and Riverside fairy shrimp.

Conceptual Model

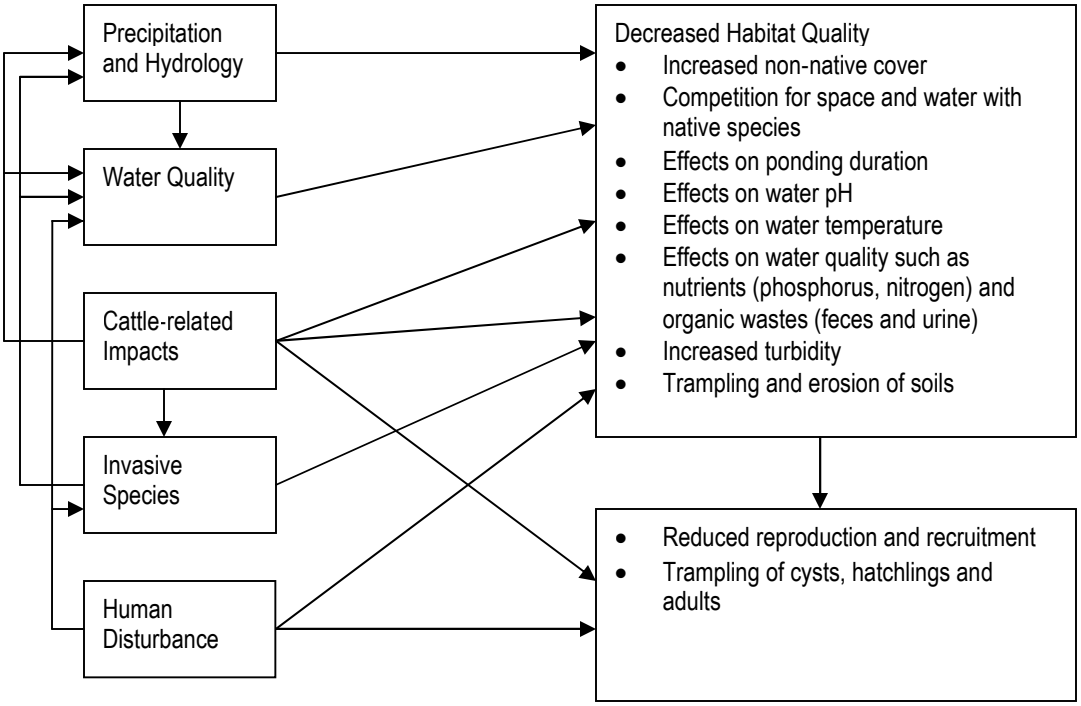
Yes – See figure below.

Regional and Subregional Management Information Needs

- The genetics relationships among sub-populations, with low genetic variability a possible concern for long-term viability of the species.
- Population trends and demographics such as survivorship.
- Dispersal, although it is assumed that dispersal vectors include waterfowl, cattle, sheep, dogs, vehicles.
- Whether life history traits and ecological conditions covary in different parts of the San Diego fairy shrimp's range that are relevant to management of the species, such as development patterns related to the timing and duration of breeding pools (*e.g.*, see Marty 2005).
- Aerial contaminants as a significant risk factor.
- Effectiveness of the variety of protection and management measures implemented to conserve the San Diego fairy shrimp.
- Long-term condition, variation and function of vernal pools in the Habitat Reserve (using the PCR [2003b] Vernal Pool Functional Assessment as a baseline study).

San Diego Fairy Shrimp Conceptual Stressor Model

Stressor | **Effects on San Diego Fairy Shrimp Habitat and Populations**



- Role of cattle-related impacts and long-term effect of cattle exclusion from the Radio Tower Road vernal pools during the wet season.
- Effective management techniques to control the proliferation of exotic plant species in and around vernal pools, including timed grazing, prescribed burns, mowing and selective weeding.

Level of Management and Monitoring Priority - High

The San Diego fairy shrimp has a discrete, limited distribution in the Habitat Reserve, with two identified *important population* areas – the vernal pools located on Chiquita Ridge and the Radio Tower Road mesa. The San Diego fairy shrimp is assigned a high priority for management and monitoring because of the limited number of occupied sites and because there are clear potential habitat-based and species-specific stressors on this species, including cattle-related impacts and non-native species. Both of these stressors have been identified for management during Phase 1 of HRMP implementation. The management actions benefiting this species, as discussed below, are habitat-based and would also benefit other vernal pool species such as the Riverside fairy shrimp and western spadefoot toad. Also, the San Diego fairy shrimp can be monitored in conjunction with monitoring of the Riverside fairy shrimp and spadefoot toad.

Level of Monitoring (*e.g.*, Species-specific, habitat, landscape, combination)

Monitoring will be conducted both primarily at a species-specific level but also at a habitat landscape level.

Monitoring Variables

Listed below are suggested species- and habitat-based monitoring variables. The detailed monitoring program for the San Diego fairy shrimp will be developed by the Reserve Manager and Science Panel.

Species-specific Monitoring Variables

1. Status of population

Habitat-based Monitoring Variables

1. Vernal pool and contributing hydrological area long-term status
2. Relative cover of different native plant species
3. Proportion of exotic plant species/native plant species

Abiotic Monitoring Variables

1. Climate
2. Weather
3. Air quality
4. Water quality and runoff

Management Actions

Management of three occupied Radio Tower Road mesa vernal pools primarily will be implemented through timed grazing per the coordinated GMP for exotic species control during the vernal pool dry season and seasonal exclusion of grazing during the wet season to allow the fairy shrimp to complete their life cycle. Experimental prescribed burns may also be used as an exotics control technique. Because cattle grazing has already been excluded from the two occupied Chiquita Ridge vernal pools within existing Ladera Open Space and because prescribed burns probably are not feasible due to the close proximity to existing development in Ladera Ranch, management primarily will be implemented through exotics controls by means of mowing and/or selective weeding.

The HRMP also will include monitoring of the Radio Tower Road mesa and Chiquita Ridge vernal pools and San Diego fairy shrimp populations (including the small pool on Chiquita Ridge lacking documented San Diego fairy shrimp), managing hydrological regimes by maintaining the existing local contributing hydrological sources, managing water quality to emulate baseline conditions, and controlling public access, especially during the wet season.

Potential Target Studies

Several regional and subregional information management needs relevant to management of the San Diego fairy shrimp were listed above, some of which could be addressed at the subregional scale and would help inform management of the Habitat Reserve. Other regional and subregional information management needs, particularly those related to rangewide persistence of the species (*e.g.*, landscape habitat fragmentation) are best studied at a rangewide scale. The following are target studies that could be implemented at the subregional scale:

- Evaluation of cattle-related impacts and exclusion vernal pools and the fairy shrimp.

- Long-term condition, variation and function of vernal pools in the Habitat Reserve (using the PCR [2003b] Vernal Pool Functional Assessment as a baseline study).

- Effective management techniques to control the proliferation of exotic plant species in and around vernal pools, including timed grazing, prescribed burns, mowing and selective weeding.

SPECIES ACCOUNT

Rangewide and Regional Status

The San Diego fairy shrimp is restricted to vernal pools in coastal southern California and Baja California, Mexico. Its current range in coastal southern California includes western San Diego County and southern and central Orange County. All known localities of the species are below 700 m (2,300 ft) and are within 64 km (40 mi) of the Pacific Ocean (USFWS 2000c). The largest concentration of vernal pools supporting the San Diego fairy shrimp is in San Diego County, with an estimated 82 ha (202 ac) of occupied vernal pool basins in the County at the time of the species' listing in 1997. Of this occupied habitat, approximately 70 percent is on military lands, including the Miramar MCAS and Camp Pendleton (USFWS 2000c). The USFWS (2000c) concluded that vernal pool habitat in Los Angeles and Orange counties has been almost completely lost.

The *Recovery Plan for Vernal Pools of Southern California* (USFWS 1998c) identified five Management Areas for the San Diego fairy shrimp:

1. **Los Angeles/Orange County:** This Management Area includes Fairview Regional Park in Orange County that supports a vernal pool complex of about eight pools on 25 ha (62 ac) inhabited by the San Diego fairy shrimp (USFWS 2000c). This park is located east of the Santa Ana River and north of Victoria Street in Costa Mesa. The other Management Area is Rancho Mission Viejo, as described below under Subregional Status. Another Orange County population is known from Newport Banning Ranch (T. Bomkamp, pers. comm. 2002).

2. **San Diego North Coastal Mesas:** This Management Area includes complexes and pools on the coastal terraces on Camp Pendleton such as the State Park lease area, San Mateo, O'Neill, Stuart Mesa, Cockleburr Mesa, Las Pulgas, Basilone and Wire Mountain. This Management Area also includes two sites in the City of Carlsbad: a complex north of Poinsettia Lane between I-5 and Highway 1 (Carlsbad Boulevard) in the vicinity of the Poinsettia Lane train station and a complex between College Boulevard and Palomar Airport Road in the vicinity of Palomar Airport. The Poinsettia Lane location is on mitigation land.

3. **San Diego Central Coastal Mesas:** This Management Area includes pools and complexes on Del Mar Mesa, Kearney Mesa, Miramesa, MCAS Miramar, and Tierrasanta associated with coastal terraces and mesas in central San Diego County from the San Dieguito River to the Sweetwater River. As of 1998, the Central Coastal Mesas were known to support 41 complexes with San Diego fairy shrimp. Of these, 29 are on DOD land, five on private lands, three on City of San Diego land, one each on Grossmont College and City of San Diego School District lands, and two on Caltrans lands. Of the 29 on DOD land, 25 are managed for biological resources, three were proposed as refuge in 1998, and one was developed. Of the five complexes on private lands, two are mitigation land. One of the three City of San Diego complexes is mitigation and both of the Caltrans complexes are mitigation.

4. **San Diego Inland Valley:** This Management Area includes a large set of complexes in the Ramona area (Santa Maria Valley). These inland complexes are generally isolated from maritime influences and are representative of pools associated with alluvial or volcanic soil types. Although some of these pools are known to support the San Diego fairy shrimp, the occupancy status of all the pools is not known (USFWS 2000c). As of 1998, six complexes were known to support the San Diego fairy shrimp, of which five are on private land and one within San Diego County's Ramona Airport boundaries.

5. **San Diego South Coastal Mesas:** This Management Area includes pools and complexes from the Sweetwater River to the Mexican border. Vernal pools with San Diego fairy shrimp are located in the Tijuana Estuary Wildlife Refuge, western and eastern Otay Mesa, the Otay Lakes area, and Proctor Valley. As of 1998, seven complexes in this Management Area were known to support the San Diego fairy shrimp (USFWS 1998c). Of these seven, five are on private land, one is on City of San Diego land, and one is on Navy land. Three of the privately owned complexes and the City of San Diego complex are mitigation lands.

The San Diego fairy shrimp is federally-listed as endangered. Its CNDDB rank is G1S1; it is considered extremely endangered throughout its range in both California and Baja California. The San Diego fairy shrimp has suffered substantial loss of vernal pool habitat in southern California due to conversion to agriculture and urbanization and existing pools are often degraded by habitat fragmentation, cattle grazing, contaminants, off-road vehicles and exotic species (USFWS 1998c).

Subregional Status

The San Diego fairy shrimp occurs in two locations in the planning area: in the large and small vernal pools on Chiquita Ridge (pools 4 and 6) and in three pools located on the Radio Tower

Road mesa (pools 1, 2 and 7) (*Figure 173-M*). Because this species is rare in the region, all locations are *important populations* in *key locations*.

The geology of the vernal pools in the planning area is different from that underlying mima mounds found on the mesas of San Diego County. The Chiquita Ridge and Radio Tower Road pools originate from young bedrock slides associated with the Cristianitos fault zone. The formation of these vernal pools apparently derives from the differential setting of fine-grained materials (high clay content) from San Onofre Breccia, Monterey and Topanga formations. These pools are underlain by Soper gravelley loam on 15-30 percent slopes and Alo clay on 0-15 percent slopes.

Biological Considerations

Vernal pools that support the San Diego fairy shrimp primarily occur on mesas and other level terrain generally less than 10 percent. These areas often exhibit a characteristic microrelief called Gilgai or mima mound formation. The species may also occur in ditches and road ruts, but only in areas associated with degraded vernal pool habitat. Because of the distinctive topography supporting vernal pools, pools typically are clustered in "complexes," including dense clusters of small pools or scattered clusters of large pools that often share a common watershed (USFWS 2000c).

Vernal pools in general are associated with heavy soils that prevent the percolation of water. Southern California vernal pools are most often found in alluvial soils with clay or clay loam subsoils. Basaltic or granitic substrates or indurated hardpan layers may contribute to poor drainage and retention of water (USFWS 1998c). The size of vernal pools can vary dramatically, from just a few square meters to the size of small lakes (*e.g.,* Skunk Hollow in western Riverside County). The size of the vernal pool is related to the watershed of the pool and the local micro-relief.

The San Diego fairy shrimp occurs in small, shallow vernal pools ranging in depth from 5.1 to 30.5 cm (2 to 12 in) and in water temperatures from 10 and 14.5 degrees C (50 to 58 degrees F). Water temperature and chemistry are important factors in the species' distribution. Adults are usually observed in January-March when pools hold water from winter rains, although the breeding season may be extended in association with early winter or mid-spring rains (USFWS 2000c). Eggs are either dropped to the pool bottom or remain in the brood sac until the adult female dies and sinks. The shrimp hatch and mature in seven days to two weeks, depending on water temperature. "Resting eggs" of cysts are capable of withstanding heat, cold and prolonged drying (USFWS 2000c). Because the high variability rainfall in southern California, and thus the success of any given breeding season, only a fraction of cysts may hatch in a given year and reproductive success can be spread out over several years (USFWS 2000c).

On RMV, the San Diego fairy shrimp was found in pools ranging in depth from 17.0 to 41.9 cm (6.7 to 16.5 in) (PCR 2003b). Water temperatures of these pools ranged from 11 to 23 degrees C (52 to 73 degrees F). The percent dissolved oxygen was 2.3 to 5.36 and the total dissolved solids was 51-166 parts per million.

Dispersal in fairy shrimp is likely mediated by vectors such as waterfowl, cattle, sheep, dogs and even off-road vehicles (*e.g.*, rubber-tired or tracked vehicles) that move through or wallowing in inhabited wet or dry pools. Wildlife and vehicles transport cysts or pregnant or mature adults between dry depressions or extant pools. Cysts may also disperse like some plant seeds by passing through an animal's gut after it ingests pregnant females or cysts in drinking water and then eliminates in other suitable depressions or pools.

Protection Recommendations

- Avoid impacts to the three vernal pools (1, 2 and 7) that support the San Diego fairy shrimp and their contributing hydrologic sources along Radio Tower Road. The Chiquita Ridge pools are already protected in Ladera Open Space.

Management Recommendations

- Implement a management program for vernal pools, including control of non-native invasive species, management of grazing and minimization of human access and disturbance as part of the Adaptive Management Program.