United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Carlsbad Fish and Wildlife Office
6010 Hidden Valley Road
Carlsbad, California 92011

In Reply Refer To:
(FWS-OR/MCBCP-08B0352/08F0487)

APR 30 2008

Mr. Gene Fong
U.S. Department of Transportation
Federal Highway Administration
650 Capitol Mall, Suite 4-100
Sacramento, California 95814

Subject: Proposed Toll Road Corridor (Alignment 7 Corridor- Far East Crossover-Modified) Initial Alternative for the South Orange County Transportation Infrastructure Improvement Project

Dear Mr. Fong:

Please find enclosed the U.S. Fish and Wildlife Service's biological opinion.

If you have any questions, please feel free to contact me at (760) 431-9440, extension 211.

Sincerely,

Jim A. Bartel
Field Supervisor

Enclosure

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INTRODUCTION

This document transmits the U. S. Fish and Wildlife Service's (Service) biological opinion based on our review of the Proposed Toll Road Corridor (Alignment 7 Corridor- Far East Crossover-Modified; A7C-FEC-M; "toll road", "alignment" or "proposed project") Initial Alternative for the South Orange County Transportation Infrastructure Improvement Project (SOCTIIP), Orange and San Diego counties, California, and its effects on nine federally listed species in accordance with section 7 of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*). Your request for consultation was received on March 1, 2005.

This biological opinion is based on the following information: (1) the Federal Highway Administration's (FHWA) request for consultation submitted on March 1, 2005; (2) FHWA's Biological Assessment (BA) dated February 28, 2005; (3) the Draft Environmental Impact Statement/Subsequent Environmental Impact Report (DEIS) for SOCTIIP dated April 2004; (4) the Final Subsequent Environmental Impact Report (FSEIR) dated December 6, 2005; (5) spatial data in our office files on species occurrences, habitat maps, landownership, and a variety of physical and biological landscape features (*e.g.*, elevation, soils, and vegetation types); (6) written and oral communications, including numerous meetings between the Service, FHWA, the project proponent Transportation Corridor Agencies (TCA), California Department of Transportation (Caltrans), Marine Corps Base Camp Pendleton (MCBCP or Base or Camp Pendleton), other resource agencies; and (7) various reports and publications, as indicated by the citations herein. The project file addressing this consultation is maintained at the Carlsbad Fish and Wildlife office (CFWO).

Your consultation request indicated your determination of "may affect, likely to adversely affect" for the following nine species: the federally endangered least Bell's vireo (*Vireo bellii pusillus*, "vireo"), southwestern willow flycatcher (*Empidonax traillii extimus*, "flycatcher"), arroyo toad (*Bufo californicus*, "toad"), tidewater goby (*Eucyclogobius newberryi*, "goby"), Pacific pocket mouse (*Perognathus longimembris pacificus*, "PPM"), Riverside fairy shrimp (*Streptocephalus woottoni*), and San Diego fairy shrimp (*Branchinecta sandiegonensis*), and the federally threatened coastal California gnatcatcher (*Polioptila californica californica*, "gnatcatcher") and thread-leaved brodiaea (*Brodiaea filifolia*, "brodiaea"). We concur with that determination for the goby, PPM, brodiaea, toad, gnatcatcher, and vireo and provide our biological opinion for these species. For the San Diego fairy shrimp, Riverside fairy shrimp, and southwestern willow flycatcher, our determination of "not likely to adversely affect" follows.

Determination of Not Likely to Adversely Affect for San Diego Fairy Shrimp

The known locations of San Diego fairy shrimp proximal to the toll road project footprint are at the Radio Tower pools on Rancho Mission Viejo in Orange County and at San Onofre Beach State Park in San Diego County on lands leased to the State of California by the Department of Defense (Camp Pendleton). The toll road construction footprint is about 909.6 meters (m) (2,000 feet (ft)) away and downhill from the Radio Tower pools, which are located within the Habitat Reserve for the Orange County Southern Subregion Habitat Conservation Plan (HCP). Due to the distance and location of the construction footprint downhill from the pools, no direct impacts to San Diego fairy shrimp or their pools or pool watersheds are anticipated from toll road construction,

operations, or maintenance in the Orange County portion of the project. Due to their distance from the proposed alignment and their existing proximity to State Route 74 (Ortega Highway), the Radio Tower pools and associated habitat are not likely to have a measurable increased risk from toll road traffic-induced wildfire.

The San Onofre Beach State Park pools are located on a mesa area, north of the San Onofre Nuclear Generating Station (SONGS) and west of the frontage road that leads to the power plant. This frontage road is on the west side of Interstate 5. The construction footprint for the toll road connection to Interstate 5 will be to the east of this frontage road, and therefore no impacts to San Diego fairy shrimp or their pools or pool watersheds are anticipated from this project. Since these pools are currently bounded by a road to the east that has been in place for decades, we do not anticipate measurable additional indirect impacts such as increase in invasive plants or changes in fire frequency from construction or operation of the toll road connection in this area. Based on the above assessment of potential impacts to the two known locations of San Diego fairy shrimp proximal to the toll road project footprint, we have determined that the project as proposed is not likely to adversely affect the San Diego fairy shrimp.

Determination of Not Likely to Adversely Affect for Riverside Fairy Shrimp

There are two known locations of Riverside fairy shrimp within the general project area. The first is southwest of Camp Talega on Camp Pendleton in San Diego County and the second is at the Radio Tower pools on Rancho Mission Viejo in Orange County. The California Natural Diversity Database identifies two pool locations in the area southwest of Camp Talega that contain Riverside fairy shrimp. One pool surveyed in 1997 appears to be within the project footprint, the other surveyed in 2001 is outside the footprint. However, current information indicates that the 2001 survey identifies the same pool as the 1997 survey (labeled CPVM 16a). This has been confirmed by the biologist who conducted both surveys (T. Bomkamp, Glenn Lukos Associates, pers. comm. to J. Terp., Service, September 13, 2005). Because the 2001 survey uses more accurate mapping technology, we consider the 1997 mapped location to be in error and the single occupied pool within the project action area to be accurately represented by the 2001 mapped location.

The construction footprint is about 152.4 m (500 ft) away and downhill from the Camp Pendleton location and about 909.6 m (2,000 feet ft) away and downhill from the Radio Tower location. The project is not anticipated to directly impact Riverside fairy shrimp, their pools, or pool watersheds due to the distance and location of the construction footprint downhill from the pools. To further ensure that Riverside fairy shrimp will be avoided at the MCBCP pool during construction of the project, the watershed for the pool will be enclosed with silt fencing and flagged to direct any construction traffic away from the location (Appendix 1, Conservation Measure TE-8). We have considered that the Camp Pendleton pool may experience potential indirect effects as a result of increased fire frequency and non-native plant invasion due to its proximity to the road. However, the area faces existing risks from training-related wildfire and a substantial non-native plant community. We believe that any additional incremental risks to the area and species as a result of the project would not be detectable in the context of existing fire threats and current baseline habitat quality and composition and the project would not alter watershed functions or otherwise affect the species in this pool beyond baseline conditions. Due to its distance from the proposed

alignment and its existing proximity to State Route 74 (Ortega Highway), the Radio Tower location is not likely to encounter increased risk from toll road traffic-induced wildfire. Based on the above assessment of potential impacts to the two known locations of Riverside fairy shrimp proximal to the toll road project footprint, we have determined that the project as proposed is not likely to adversely affect the Riverside fairy shrimp.

Determination of Not Likely to Adversely Affect for Southwestern Willow Flycatcher

Willow flycatchers in southern California are designated as the listed subspecies (*Empidonax traillii extimus*, "southwestern willow flycatcher") if they are detected during breeding season protocol surveys. The listed subspecies and other non-listed subspecies may also be detected during migration (both described hereafter as "transients"); however, there is no consistently reliable way to distinguish between the subspecies during migration unless the bird is caught and evaluated in the hand. Therefore, transient flycatchers, which could be the listed entity, may also migrate through riparian areas in the vicinity of the toll road project. Breeding southwestern willow flycatchers and transient flycatchers have been found in the general project area along San Juan and Gobernadora creeks in Orange County. Locations of breeding southwestern willow flycatchers are along Gobernadora Creek approximately 457.2 m (1,500 ft) from the toll road alignment and transient flycatcher locations are at about the same distance from the alignment on San Juan Creek.

While detected on other drainages on Camp Pendleton in San Diego County, no breeding or transient flycatchers were detected in 2000 along San Onofre, San Mateo, or Cristianitos creeks within the Base (U. S. Geological Survey 2001). In 2007, one breeding location was detected on San Mateo Creek (J.B. Seaton, U. S. Marine Corps, pers. comm. to J. Bartel, Service, July 5, 2007); however, this location is outside the project's action area. Given the current known distribution of breeding southwestern willow flycatchers, it appears that no locations will be affected from toll road construction that removes riparian habitat. Nor is it anticipated that noise impacts from construction and operation of the toll road will adversely affect southwestern willow flycatchers because it is unlikely that project-generated noise at levels that would disrupt essential behavioral and ecological functions would carry the distance to known locations. Construction will occur over several years, and the road will operate long into the future; thus, southwestern willow flycatchers may, in the future, establish breeding territories in the project area during or after construction. Because project noise levels would exist at the time such territories were established, we anticipate that southwestern willow flycatchers will either have a tolerance for the noise and any project generated disturbances or they will establish breeding territories more distant from the project.

The DEIS indicates that about 13.8 hectares (ha) (34.2 acres (ac)) of riparian herb, mule fat, and other riparian communities will be impacted. These habitat types can support southwestern willow flycatchers; therefore, there will be a small reduction of potential habitat for the species. However, the project proposes to generally restrict removal of these habitat types to the period between mid-September and mid-March. While this minimization measure is targeted to remove habitat outside of the breeding season for least Bell's vireo, it also avoids the breeding season for the southwestern willow flycatcher and thus would minimize impacts to any breeding flycatchers that established territories in the project area in the future. Should habitat clearing need to take

place between mid-March to mid-September, TCA has committed to conducting focused surveys for southwestern willow flycatchers before clearing is conducted and, if breeding birds are detected, no work will take place within 152.4 m (500 ft) of nests. Based on the current known distribution of the southwestern willow flycatcher, and the avoidance and minimization measures that will be implemented for this species, we conclude that the project is not likely to adversely affect the southwestern willow flycatcher.

Designated and Proposed Critical Habitat

Currently no designated or proposed critical habitat exists in the action area of the toll road project. Critical habitat for seven species – tidewater goby, arroyo toad, Riverside fairy shrimp, San Diego fairy shrimp southwestern willow flycatcher, coastal California gnatcatcher, and thread-leaved brodiaea – was either designated or proposed within the action area at the time consultation was initiated by FHWA. Since consultation was initiated, critical habitat has either been re-designated or finalized for all seven species, though to reiterate, critical habitat no longer exists in the action area for the proposed project. Although FHWA also requested formal consultation on designated critical habitat for the vireo, no critical habitat for least Bell's vireo was designated within the project's action area at the time formal consultation was initiated, and no critical habitat for least Bell's vireo is designated currently. Therefore, critical habitat for the tidewater goby, arroyo toad, Riverside fairy shrimp, San Diego fairy shrimp, southwestern willow flycatcher, least Bell's vireo, coastal California gnatcatcher, and thread-leaved brodiaea are not considered further in this opinion.

CONSULTATION HISTORY

The SOCTIIP toll road project, the proposed southern extension of the existing State Route 241 Foothill Transportation Corridor-North, has been the subject of planning efforts for about 20 years. Working under the 1994 Memorandum of Understanding on National Environmental Policy Act/Clean Water Act Section 404 Integration Process for Surface Transportation Projects (NEPA/404 MOU), signatory agencies including FHWA, U. S. Environmental Protection Agency, U. S. Army Corps of Engineers, the Service, and Caltrans, along with TCA and MCBCP (collectively, the "SOCTIIP Collaborative") have met since the mid-1990s regarding development of the project. Between August 1999 and November 2000, the SOCTIIP Collaborative retained a facilitator to assist in developing a list of project alternatives to be evaluated in the environmental documents. In November 2000, the SOCTIIP Collaborative concurred on the alternatives to be evaluated in the technical studies and in August 2003 concurred on the alternatives to be carried forward and evaluated in the DEIS/SEIR. The DEIS/SEIR was issued in April 2004, and a Final SEIR was issued on December 7, 2005.

FHWA requested formal consultation on the project on March 1, 2005. The Service responded to FHWA's consultation initiation request on March 30, 2005. FHWA and the Service met to discuss the project and visit the project site multiple times since April 2005. On July 13, 2005, FHWA requested that the Service provide a "preliminary" jeopardy/non-jeopardy determination on the PPM to further the NEPA process for the project. We responded to that request on August 17, 2005, indicating that we would provide preliminary conclusions regarding the species potentially affected by the project by September 30, 2005.

On September 30, 2005, we provided a letter to FHWA that stated our "preliminary conclusions" for the PPM and the other species subject to the consultation. In that letter we indicated that, based on our draft analyses, our preliminary conclusion was that the project would not jeopardize the continued existence of the Riverside fairy shrimp, San Diego fairy shrimp, tidewater goby, southwestern willow flycatcher, least Bell's vireo, or thread-leaved brodiaea, nor adversely modify critical habitat for the San Diego fairy shrimp and tidewater goby. Our draft analyses for the PPM, arroyo toad, and the coastal California gnatcatcher and gnatcatcher-designated and proposed critical habitats identified significant project-related impacts to individuals, populations and habitat for these species. Regarding the toad and gnatcatcher, conservation measures identified in the DEIS to avoid and/or minimize impacts to these species provided the basis for preliminary no jeopardy/no adverse modification conclusions. However, we stated that our final no jeopardy/no adverse modification determinations would be strengthened by inclusion of additional conservation measures in the proposed project description. The additional measures, including additional habitat restoration proximal to the areas of impact, were discussed during subsequent consultation meetings. Some of the additional measures were incorporated, and some were not.

In the September 30, 2005, letter we indicated that maintenance of the San Mateo North population of PPM is necessary for the survival and recovery of the species because it is one of only four known extant populations of the species. The PPM recovery plan calls for stabilizing and protecting all existing populations and establishing 10 populations within the species' historic range. Based on our analysis, we determined that the proposed action, as described in the BA, would likely increase mortality risks to PPM at the San Mateo North site as a result of construction activities and the direct and indirect effects of toll road operation. We cited the loss of suitable PPM habitat, increased PPM road mortalities, increased lighting, higher fire frequency, and greater predator concentrations as likely adverse effects of the proposed project.

To address the increased vulnerability of PPM, TCA agreed to fund and implement (1) an adaptive management program for the San Mateo North PPM population and (2) project design features to address effects to PPM from road mortality, increased lighting, predator effects, and fire frequency. Based on TCA's commitment to fund and implement an adaptive management program and project design features, we made a preliminary determination that the proposed action would not threaten the viability of the San Mateo North PPM population and was not likely to jeopardize the continued existence of the species as a whole. We received a draft Pacific Pocket Mouse Resource Management Plan on July 28, 2006. In October 2006, we received the Draft Upper Chiquita Canyon Conservation Area Comprehensive Habitat Restoration Plan (Upper Chiquita HRP, dated October 2006), which describes proposed restoration of coastal sage scrub, native grassland, and oak woodland in the Upper Chiquita Canyon Conservation Area.

We provided a draft opinion to FHWA on April 30, 2007. We received FHWA, TCA, and Caltrans comments on the draft opinion on July 2, 2007, and Camp Pendleton comments on July 12, 2007. On September 21, 2007, we received a revised Pacific Pocket Mouse Resource Management Plan. On November 9, 2007, we received the Conceptual Habitat Mitigation and Monitoring Plan (Riparian HMMP, dated August 31, 2007) for impacts to areas within the jurisdiction of the U. S. Army Corps of Engineers (Corps), the California Department of Fish and

Game (CDFG), and the California Coastal Commission (Coastal Commission). On November 14, 2007, we received a letter from TCA regarding Caltrans comments on the draft opinion, primarily addressing Caltrans' concerns about what maintenance activities would be covered under the opinion and whether Caltrans would be responsible for maintaining exclusionary fencing created by TCA.

In two letters dated February 26 (P58174 and P58175) and one letter dated February 28, 2008 (P58200), FHWA requested formal consultation on a series of archeological investigations along the route of the proposed toll road. Because these impacts are associated with the proposed project and within the anticipated footprint, these activities are addressed in this analysis as part of the proposed project.

DESCRIPTION OF THE PROPOSED ACTION

The proposed SOCTIIP A7C-FEC-M Initial Alternative is a southern extension of existing State Route 241 (SR 241) in south Orange County, from the current terminus of SR 241 at Oso Parkway to Interstate 5 in the vicinity of the Orange/San Diego County line (Figure 1). The A7C-FEC-M Initial Alternative ("toll road"; A7C-FEC-M"; "alignment"; or "SR 241 extension") will be operated as a toll facility with Caltrans performing routine maintenance of the road facilities in perpetuity and TCA operating the toll system until the construction bonds are paid off. The corridor will operate as a closed barrier system, where all vehicles pay at least one toll. The corridor will include on- and off-ramp toll collection facilities and at least one mainline toll plaza.

The A7C-FEC-M is approximately 25.6 kilometers (km) (16 miles (mi)) long and includes approximately 1.3 km (0.8 mi) of improvements on Interstate 5 south of the Orange and San Diego county boundary (Figure 1). It will traverse the east side of Cañada Chiquita and extend south across San Juan Creek to Ortega Highway approximately 2.1 km (1.3 mi) east of the intersection of Antonio Parkway/Avenida La Pata. The alignment will then progress southeast from Ortega Highway, and then south crossing the west side of the Donna O'Neill Land Conservancy to the existing terminus of Avenida Pico. From Avenida Pico, the alignment continues south, crossing the inland part of the San Onofre State Beach lease on Camp Pendleton in San Diego County and extending across Cristianitos Road approximately 1.1 km (0.7 mi) north of Interstate 5. The alignment then turns to the southwest, crossing over San Mateo Creek and onto the Interstate 5. Interstate 5 would be widened in the area between 1 km (0.6 mi) and 2.2 km (1.4 mi) south of Basilone Road. A mainline toll collection plaza will be located approximately 3.7 km (2.3 mi) south of Oso Parkway within Cañada Chiquita and on- and off-ramps will have toll collection facilities.

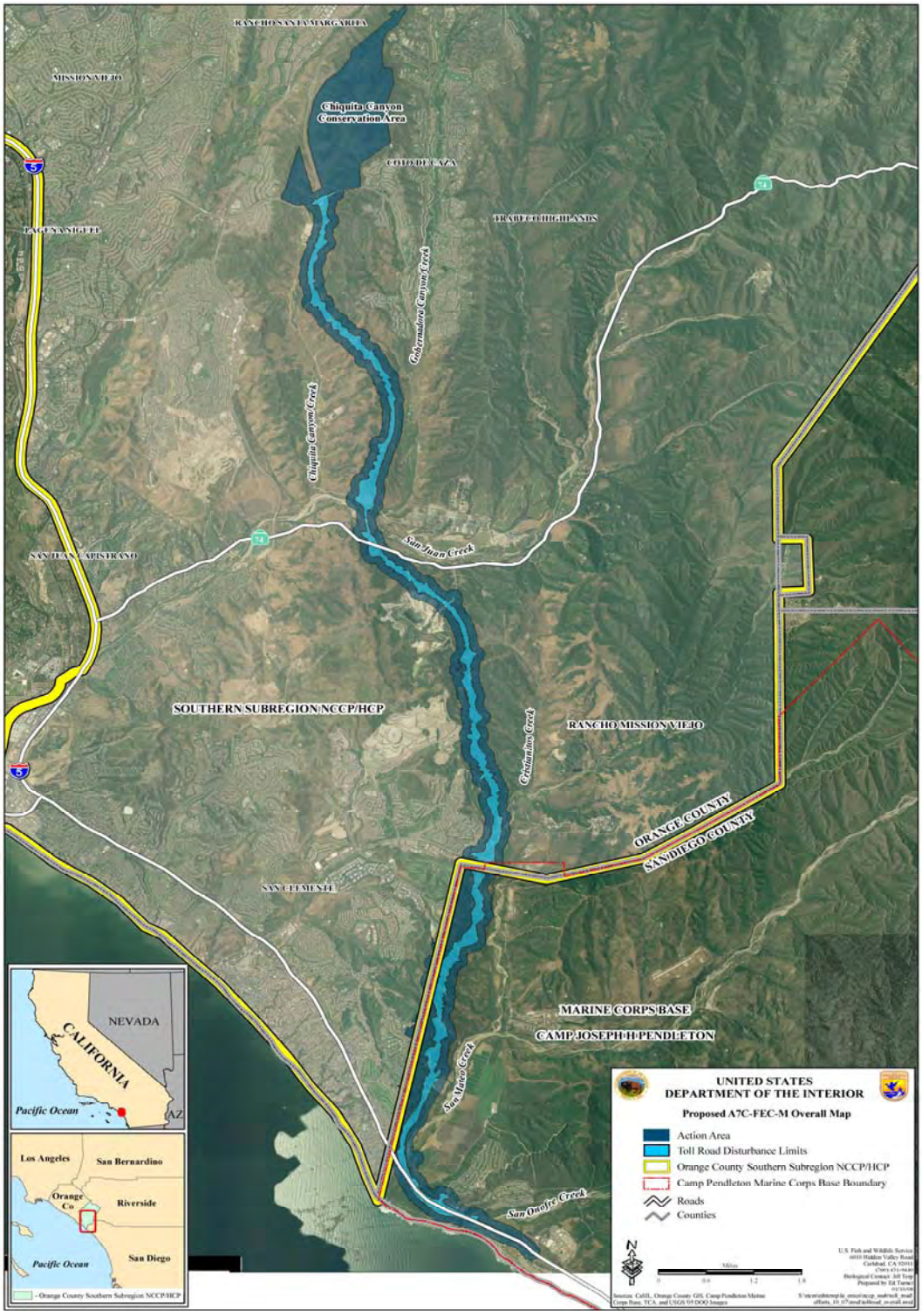

Figure 1. Proposed toll road project location and project action area, Orange and San Diego counties.

A direct connection is proposed between southbound lanes of the alignment and southbound Interstate 5, and between northbound Interstate 5 and the northbound lanes of the alignment. However, southbound traffic on the toll road needing to travel north on Interstate 5 will exit at the Cristianitos Road interchange and use Cristianitos Road to travel west to access the existing northbound Interstate 5 ramp. There is no interchange northbound on the toll road to either direction of Cristianitos Road; the Interstate 5 ramp to Cristianitos Road would be used for access. Other interchanges are proposed along the A7C-FEC-M at Oso Parkway; "C" Street, and Cow Camp Road within proposed development at Rancho Mission Viejo and Avenida Pico.

There are two typical cross sections for the roadway of the A7C-FEC-M. From Oso Parkway to Ortega Highway, the typical section from the edge of one outside shoulder to the edge of the other outside shoulder is 39 m (128 ft) wide. South of Ortega Highway to Interstate 5 the corridor typical section is 27.1 m (89 ft) wide. The segment north of Ortega Highway will accommodate two general purpose lanes in each direction and, if needed in the future, accommodate in the center median one High Occupancy Vehicle (HOV) lane in each direction. The segment south of Ortega Highway will accommodate two general purpose lanes in each direction, but to accommodate one future HOV lane in each direction, this section would have to be widened beyond the lanes. These additional future HOV lanes are considered part of the proposed action. Climbing and auxiliary lanes will also be provided along the corridor alternatives, as required by the *Caltrans Highway Design Manual*; these lanes add 3.7 m (12 ft) to roadway width. Grading for the current project will also encompass areas needed for future HOV lanes between Oso Parkway and Avenida Pico except for widening of bridge structures. Widening south of Avenida Pico may extend beyond the initial project's disturbance limit. Since habitat for federally listed species is anticipated to revegetate after the initial construction, we anticipate there may be additional impacts to habitat associated with widening. At the point in the future when widening will be done, updated biological surveys will be conducted and, as the Federal action agency, FHWA will determine if the widening may affect listed species. FHWA will provide any determination of effects and results of biological surveys to the Service for potential consultation under the Act.

Bridges will be constructed at the major waterway crossings including San Juan Creek, San Mateo Creek, and San Onofre Creek. In addition, a bridge facilitating wildlife movement will be constructed in the area known as "Chiquita Woods" in Cañada Chiquita. Large arch culverts or large-diameter corrugated metal pipes (CMP) will be placed in specific locations to permit wildlife movement under the alignment. Other arch culverts or CMP with a minimum 91.4 centimeter- (cm) (36 inch- (in)) diameter will be provided at crossings of smaller drainages and/or local roads to convey seasonal or perennial flows and/or maintain access for utilities, ranching, and other existing uses.

Construction is anticipated to take 36-48 months of continuous activity to complete; additional future HOV lanes will take about 12-15 months to complete and are anticipated to be built some time between 2020 and 2030. Finished road grade for the A7C-FEC-M will be accomplished using standard cut and fill grading operations. Construction equipment will be used for clearing and grubbing, grading, excavation, backfilling, materials and equipment delivery and removal, concrete and asphalt installation, and other construction activities. Typical heavy-duty

construction and earth moving equipment used for road grading and paving includes scrapers, dozers, loaders, dump trucks, etc. Typical equipment anticipated for bridge construction will consist of cranes, pile drivers, concrete and pump trucks, etc. Staging areas will be used during construction for materials storage, equipment and employee parking, temporary storage of soils, and other related activities. Stockpiling, laydown, and storing of vehicles and equipment are limited to previously paved, compacted and developed areas. Construction access will be via existing major arterials at Oso Parkway, Ortega Highway, Avenida Pico, existing Cristianitos Road, and other existing ranch and utility access roads; access to the project on Camp Pendleton will use existing Base roads or be within the described ground-disturbance limits. Parking, driving, and storing vehicles are limited to previously compacted and developed areas or within the described ground-disturbance limits; no off-road traveling will be authorized by MCBCP outside of the project boundary. Concrete box girder construction is anticipated at the bridge locations. Asphalt concrete will be used to pave the mainline of the road with concrete pavement used at selected locations. The TCA will ensure that construction and demolition debris resulting from construction activities will be properly disposed of, including asphalt or concrete, and must not be discarded onsite. In the event of excavation of asphalt or concrete, excess material will be disposed of in accordance with California Code of Regulations Title 14, Division 3, Article 5.9.

Impacts are anticipated from the following project features:

1. Paved road areas and any unpaved shoulder;
2. Sites for water quality best management practices (extended detention basins to control road runoff);
3. Bridge support structures;
4. Ramps and structures at interchange locations;
5. Drainage structures (including cross culverts);
6. Realignment of existing agricultural and utility access roads;
7. Overhead electrical tower relocations;
8. Mainline toll plaza and ramp plazas.
9. Cut and fill grading to establish final road elevations and remedial grading for geotechnical stability;
10. Erection of falsework for bridge construction;
11. Material storage areas;
12. Pull zones to string overhead utilities;
13. Archeological investigation sites.

Caltrans will perform routine maintenance on the above features numbered 1-5 after opening of the road; TCA is responsible for maintenance of the toll plaza and ramp plazas. Maintenance of the realigned access roads and utility relocations remain with the responsible party (*e.g.*, Rancho Mission Viejo, California State Parks, U. S. Marine Corps, utility companies, etc.).

Following grading, all cut and fill slopes and areas subject to temporary disturbance by project features 10-12 will be planted with an appropriate native plant palette that is anticipated, with time, to become established and provide some function and value for wildlife. Up to about 263 ha (650 ac) of upland habitat along the toll road will be replanted with native vegetation.

However, because no performance criteria are required for upland habitat restored along the cut and fill slopes, these areas are considered to be permanently impacted. As described in "Conservation Measures" below, riparian habitat along the major drainages (San Juan, San Mateo, and San Onofre creeks) will be temporarily impacted and restored, consistent with the Riparian HMMP. Caltrans will require ongoing access to cut and fill slopes, access roads, fencing, culverts, bridges, etc., within the right-of-way for routine maintenance that may include cutting, thinning and/or removal of replanted or naturalized vegetation, as described below.

Caltrans maintenance activities on the toll road will include maintaining extended detention basins (EDBs) through the clearing of sediment, debris, and vegetation; clearing of access roads on slopes planted with native seed mix for right-of-way fence repair; culvert maintenance including sediment, debris, and vegetation removal; mowing for fuel modification along the mow zone; application of herbicides; and routine maintenance of bridges, primarily for repair from scour and to improve the functionality of the bridge. EDBs will typically be cleared every two-three months, depending on the weather conditions. Mowing will typically occur within 4.3 m (14 ft) of the edge of asphalt, up to three times a year. Herbicides used on slopes will be Caltrans' approved and applied according to licensed standards. Herbicides will be sprayed around safety devices (for an approximate 0.9-m (3-ft) diameter); herbicides may be spot sprayed on slope areas but not within 3 m (10 ft) of an existing drainage structure. Safety devices include such items as guard rails and signs. The maintenance of such structures as culverts, fences, EDBs, bridges, and slope areas is on an as-needed basis, with the functionality of the structures typically assessed prior to the start of the rainy season. Routine maintenance ensures that road and safety features remain functional and will be performed to Caltrans maintenance standards.

When conducting maintenance activities described above, Caltrans will implement avoidance and minimization measures described in "Conservation Measures" below, but no additional offsetting measures are anticipated by the Service for impacts related to Caltrans' routine maintenance of road and safety features within the identified disturbance limits.

Prior to construction, TCA will conduct archeological investigations at 87 investigation sites along the length of the toll road. These investigation sites include shovel test pits, exploration units, hand auger sites, and trenching. The shovel test pits and exploration units will all be hand excavated with shovel and picks, and the auger sites will be excavated using a hand auger. Trenches will be dug with a small backhoe with rubber tires.

Conservation Measures

General and specific conservation measures are included in the project to further minimize impacts to species and habitats. These conservation measures are an integral part of the project that TCA, FHWA, and Caltrans are committed to implementing. The following is a summary of the conservation measures included in the proposed project. Most of the conservation measures are further detailed in Appendix 1, the Riparian HMMP, and Upper Chiquita HRP, and are incorporated herein by reference. Appendix 1 includes the conservation measures identified in the DEIS for the proposed project. For measures that are described in more detail elsewhere, the source of the conservation measures is identified in parentheses at the end of the measure.

General Avoidance and Minimization Measures

The alignment was adjusted to avoid some of the biologically sensitive resources within the south Orange County and northwestern San Diego County areas. In addition, the alignment was adjusted to avoid the current natural open space areas in the eastern and/or central portion of the SOCTIIP action area. These adjustments reduce the potential impacts to the Orange County Southern Subregion HCP in areas identified for conservation, although potential alignments to the west would have further minimized impacts. Additional shifts were made to avoid geotechnical hazards, thus reducing remedial grading.

Existing utilities will be avoided to the extent feasible to limit impacts associated with relocating utilities and providing ongoing access. Bridges were incorporated into the project at the major stream crossings to minimize hydrologic impacts, and the alignment was shifted or reduced in certain areas to reduce impacts to wetland habitats.

Construction-related impacts to habitat along the toll road will be minimized through onsite monitoring by a qualified biologist, marking of areas to be avoided, education of construction personnel, and submission of reports to the Service (Appendix 1, WQ1, WW1, 2, 4, 5, WV1, 2, 4-6, 8-10, and TE1, 2, 4).

Best Management Practices (BMPs) will be implemented, and prior to the start of soil-disturbing activity or vegetation removal a Runoff Management Plan (RMP) and a Storm Water Pollution Prevention Plan (SWPPP) will be prepared to minimize potential degradation of water quality during construction and operation of the toll road (WQ2-4, WW 7-10). A long-term operations, maintenance, and monitoring plan will be developed to ensure the functioning of water-quality measures along the toll road for the life of the project (WQ5, 6).

Bridges and culverts with the potential to be used by wildlife will be designed to accommodate wildlife movement. This includes restoring vegetation near the mouth of the undercrossing, avoiding or minimizing the use of rip-rap and other engineering features at the mouths of the bridges and culverts, eliminating or shielding artificial lighting, installing and maintaining wildlife exclusionary fencing adjacent to undercrossings, signage to warn motorists of potential wildlife crossings, monitoring use of undercrossings following project completion to ensure their effectiveness, and possible modification of undercrossing design (vegetation, lighting, fencing, etc.) based on the monitoring results (WV15-20).

Bridges and culverts will be designed to accommodate dispersal by fish (and other aquatic organisms).

A Biological Resources Management Plan (BRMP) will be developed, which will provide specific design and implementation features of the biological resources mitigation measures outlined in the resource agency approval documents. Issues to be discussed in the BRMP will include, but are not limited to, resource avoidance, minimization, and restoration guidelines, performance standards, maintenance criteria, and monitoring requirements, including construction monitoring programs for tidewater goby, thread-leaved brodiaea, arroyo toad, coastal California gnatcatcher, least Bell's vireo, and Pacific pocket mouse. A species-specific

management plans will be developed for arroyo toad (Arroyo Toad Resource Management Plan, "ATRMP") to address specific needs of these species during and post construction. This plan and the BRMP will be subject to review and approval by the Service before construction or habitat-disturbing activities are initiated (WW3, WV3, TE3). A Pacific Pocket Mouse Resource Management Plan (PPMRMP) dated September 20, 2007, was developed and submitted to the Service during formal consultation.

Species-Specific Avoidance and Minimization Measures

Pre-construction surveys for thread-leaved brodiaea will be conducted, and bulbs in the project footprint will be salvaged and relocated (TE6, 7).

To minimize impacts to goby and other aquatic resources, construction activities in San Mateo Creek will be limited to one year in duration. Scaffolding will be placed on the creek bed that will allow water to flow beneath the scaffolding, and the permanent supports for the bridge will be placed in the creek bed outside the active channel. No relocation of the active channel is anticipated at San Mateo Creek.

Depending on whether the existing I-5 bridge over San Onofre Creek is threatened by scouring, it may be necessary to relocate the active channel at San Onofre Creek during construction. If it is necessary to relocate the active channel, a new channel about 100 m (328 ft) in length will be created outside the construction area and will remain open and accessible to gobies during construction activities. The active channel will be relocated for no more than six months. If relocation of the active channel at San Onofre Creek is required, a goby relocation plan will be implemented as described above for San Mateo Creek. If relocation of the active channel is not necessary, scaffolding will be placed over the channel as at San Mateo Creek.

Pre-construction surveys for arroyo toad will be conducted, exclusionary fencing will be installed prior to construction, arroyo toads in the construction area will be captured and relocated, and non-native predators will be removed from areas identified for toad relocation. Arroyo toad breeding pools and gravel benches will be restored following temporary impacts. Permanent mesh fencing will be installed at the base of wildlife fencing to minimize vehicle strikes of arroyo toad (TE5, 11-17).

Pre-construction surveys will be conducted prior to vegetation clearing, and clearing will be monitored to avoid direct impacts to gnatcatchers and removing vegetation actively used by breeding gnatcatchers (TE18, 19).

Riparian habitats will typically be removed between September 15 and March 15, which is outside of the breeding season for vireo. Should habitat clearing need to take place during the vireo breeding season, focused surveys will be undertaken in the habitat for vireo ahead of the clearing, and measures will be implemented to avoid impacts to vireo nests and young. In addition, construction activities will be monitored to ensure that they do not disrupt nesting by vireo in nearby habitat (TE21, 22).

As described in the PPMRMP, TCA has committed to fund and implement an adaptive management program and project design features to minimize impacts to the PPM.

A. With the approval of and in coordination with Camp Pendleton, establish an endowment and hire an entity to adaptively manage the PPM population at San Mateo North. The amount of the endowment must be supported through a property analysis record[1] or another similar cost-calculation method that is indexed for inflation and fully funds (1) invasive species control, (2) habitat management and enhancement, (3) predator control, (4) control of public access, (5) PPM population monitoring and augmentation, and (6) contingencies.

B. Construction of a barrier to small mammal movement along the entire western edge of the roadway alignment in the San Mateo North area to prevent PPM from entering the roadway and being struck by vehicles.

C. Minimization and shielding of all roadway lighting, including light cast by vehicle head and taillights, from adjoining habitat areas. This measure may require the construction of a block wall or other solid shielding to prevent light from entering adjoining habitat. All walls constructed adjoining PPM habitat shall be constructed to minimize perching opportunities of owls and other avian predators.

D. Minimization of the potential for fire ignitions associated with toll road construction and usage to travel into adjoining habitat. This measure should minimize the width of any fire break by means of engineering (*e.g.*, block or crib walls adjoining habitat).

E. Development of a fire response plan in coordination with the local fire agencies to minimize the detrimental effects of fire suppression activities in the habitat should a fire occur.

Implementation of the PPMRMP will be conducted by a Management Committee which will consist of a representative from TCA, the Service, the Base, and California State Parks.

Habitat Conservation and Restoration

The 327 credits (132 ha/327 ac of coastal sage scrub) remaining in the Upper Chiquita Canyon Conservation Area will be debited for this project (WV11, TE25). Consistent with the Upper Chiquita HRP, 97.5 ha (241 ac) of coastal sage scrub and 37 ha (92 ac) of scrub/native grassland ecotone will be restored in the Upper Chiquita Canyon Conservation Area.

[1] The Property Analysis Record (PAR) is a computerized database methodology developed by the Center for Natural Lands Management to help land managers calculate the costs of land management for a specific project. The PAR helps analyze the characteristics and needs of the property, derive management requirements, define management tasks, and estimate management and administrative costs to provide the full cost of managing any property. The PAR generates a report which serves as a well-substantiated basis for long-term funding including endowments, special district fees, and other sources. The Service typically requires a PAR or similar financial assessment to establish endowment levels for conservation and/or restorations areas that will have long-term management.

Although the Riparian HMMP has not been approved by the Corps, CDFG, or Coastal Commission, and may be revised based on input from these agencies, we are incorporating the restoration proposed in the Riparian HMMP as part of the project analyzed by the opinion. Consistent with the Riparian HMMP, 3.5 ha (8.7 ac) of mulefat scrub, willow scrub and forest, and sycamore riparian woodland will be restored/created at several sites along the toll road, with most of the restoration occurring in Chiquita Canyon near Tesoro High School. Riparian habitat temporarily impacted at major drainages/bridge crossings, including San Juan Creek (2.7 ha/6.6 ac), San Mateo Creek (2.3 ha/5.8 ac), and San Onofre Creek (0.4 ha/1.1 ac), will be restored following project completion. Unlike the cut and fill slopes that will be replanted, but are considered to be permanently impacted, the riparian habitat at the bridge crossings is considered to be temporarily impacted. Restoration of temporarily impacted habitat at the major drainages will be conducted consistent with the Riparian HMMP. In addition to the restoration/creation of riparian habitat, the Riparian HMMP includes restoration of 2.0 ha (4.9 ac) of scrub/native grassland ecotone in the Chiquita Canyon site near Tesoro High School.

TCA has proposed to restore 60.7 ha (150.0 ac) of coastal sage scrub in Crystal Cove State Park. This restoration has not been approved by the California Department of Parks and Restoration, and the suitability of the all the proposed restoration sites in the park has not yet been evaluated by the Service. Nevertheless, TCA has committed to conduct the restoration either at Crystal Cove State Park and/or at another location reviewed and approved by the Service.

Native habitat types, including native grassland, coast live oak, elderberry woodland, freshwater marsh, and open water will be restored offsite at a ratio of at least one ha/ac restored per ha/ac impacted (WV12, 13, 38).

Cut and fill slopes and temporarily impacted areas will be replanted with native vegetation. However, no quantitative performance criteria will be required in these areas, and revegetated upland habitat on the cut and fill slopes will be subject to future small-scale impacts associated with routine maintenance by Caltrans. Therefore, impacts to upland habitat in the right-of-way are considered to be permanent (WV7).

TCA will remove 8.1 ha (20.0 ac) of *Arundo donax* (arundo) and other non-native invasive riparian species from drainages that support arroyo toad and least Bell's vireo. Arundo is a non-native invasive species that severely degrades arroyo toad and least Bell's vireo habitat (see Threats and Conservation Needs for these species). As much of the arundo removal as possible, including a minimum of 2.0 ha (5.0 ac), will be conducted within the drainages affected by the proposed project. Other locations for arundo removal will be selected in coordination with the Service and will be evaluated based on their proximity to the proposed project and the anticipated benefit of the proposed restoration to arroyo toad and least Bell's vireo. The arundo removal will be conducted consistent with an arundo removal plan, which will be reviewed and approved by the Service and attached as an appendix to the Riparian HMMP. The arundo removal plan will include measures to avoid and minimize impacts to vireo, toad, and flycatcher. These measures will include the following: conducting intensive vegetation removal activities outside the breeding season for these species; relocating any toads observed within the project footprint; minimizing the potential for inadvertent herbicide application to native species; implementation of standard BMPs to minimize impacts to water quality; monitoring of

vegetation removal by a qualified biologist; methodology that will be used to conduct arundo removal; and quantitative performance criteria for successful restoration of an area.

Avoidance and Minimization Measures for Caltrans Routine Maintenance Activities

With the exception of culvert cleanout, dredging of extended detention basins, and trimming and herbicide application along existing firebreaks, trails, access roads, and fence lines, Caltrans' routine maintenance activities will not result in removal of native vegetation.

Culvert cleanout activities will be conducted consistent with the Memorandum of Understanding (MOU) between California Department of Transportation District 12, Orange County and California Department of Fish and Game South Coast, Region 5 regarding Routine Maintenance Activities in Improved and Unimproved Channels, Notification #5-362-98. However, culvert cleanout activities anticipated under this biological opinion include some maintenance activities not authorized by the MOU, including maintenance of culverts that support native vegetation and sensitive species, including vireo and toad, provided that the maintenance is conducted consistent with the avoidance and minimization measures described here.

Caltrans will not use mechanized equipment in or adjacent to major drainages except on existing access roads or trails. Foot traffic in major drainages will be restricted to the minimum necessary to inspect and conduct routine maintenance on the bridges, and people on foot will avoid active flowing channels and adjacent standing pools to avoid impacts to goby and toad.

Toad exclusionary fencing will be installed around extended detention basins and maintained in perpetuity.

During culvert maintenance activities and dredging of extended detention basins, Caltrans shall not remove vegetation from March 1 to August 15 to minimize impacts to nesting birds. Vegetation may be removed during this time if a qualified biologist conducts a survey for nesting birds within one week of the vegetation removal and ensures no nesting birds could be impacted by the activity. If nesting birds are present, no work shall occur until the young have fledged and will no longer be impacted by the project.

During routine culvert maintenance, Caltrans will remove a total of no more than 0.05 ha (0.12 ac) of riparian and upland vegetation each year, will remove no more than 500 tons of sediment each year, and will disturb more than 74 sq m (800 sq ft) of sediment at any one culvert.

In areas with the potential to support listed species, a qualified biological monitor will be present during culvert cleanout activities involving vegetation removal or sediment disturbance to ensure that there are no unanticipated impacts to listed species.

Standard BMPs will be implemented during maintenance activities to minimize potential sedimentation and pollution of aquatic habitats.

Prior to conducting any maintenance activity with the potential to affect listed species, Caltrans will coordinate with the Service to ensure that the proposed activity is consistent with the routine maintenance activities anticipated in this biological opinion.

Avoidance and Minimization Measures for Archeological Investigations

There is a high likelihood that the archeological investigations will be initiated well ahead of other construction-related activities. If the archeological investigations are conducted before the resource management plans are complete and before other pre-project conservation measures, such as updated surveys, have been conducted, the following measures will be implemented. However, if the investigations are conducted after the resource management plans have been developed, and the standard conservation measures described above are implemented, it will not be necessary to implement the investigation-specific activities described below.

Before initiating the archeological investigations, the project proponent will submit the name of proposed arroyo toad, gnatcatcher, and PPM monitors and description of relevant experience to the CFWO and FHWA for approval. The monitors will be qualified biologists familiar with identification of these species. The monitors will direct crews to minimize impacts to potential habitat for toad, gnatcatcher, and PPM.

Before conducting soil disturbing or vegetation removal activities at sites in proximity to arroyo toad breeding habitat (Shovel Test Pit 305-317, 333-337, Unit Test Pit 207-210, 217-229, 230-231, 234-237, Trench 115-128, 131), the arroyo toad monitor will survey the site for any sign of arroyo toads in the anticipated impact area. If no arroyo toads or potential burrow sites are found, the investigation can commence under the guidance of the monitor. If arroyo toads and/or potential burrows are found, the site will be modified to avoid the toads and/or burrow sites. An adequate buffer from the toads and/or burrows, as determine by the arroyo toad monitor, shall be provided.

For sites within or adjacent to suitable gnatcatcher habitat, the gnatcatcher monitor will monitor all vegetation removal and soil disturbing activities. Between September 1 and February 15, the monitoring biologist will ensure that only the minimal amount of scrub communities will be removed for the investigation activities. The monitoring biologist will flush gnatcatchers and other birds from the vegetation prior to disturbance to ensure that no gnatcatchers are directly impacted during vegetation removal. The monitoring biologist has the authority to stop or re-direct activities having the potential to directly take gnatcatchers. If investigation activities are unavoidable during the gnatcatcher breeding season, which is between February 15 and August 31, a qualified biologist will conduct three surveys on separate days after the initiation of the nesting season to determine the presence of gnatcatchers, nest building activities, egg incubation activities, or brood rearing activities. These surveys will be conducted within the week prior to the investigation activities. One survey will be conducted the day immediately prior to the initiation of work. If no nest(s), nesting behavior, or brood rearing activities are detected within 61 m (200 ft) of the activities, work will commence. An investigation site will be delayed until after the breeding season if gnatcatchers activity is observed within 61 m (200 ft) of the investigation site.

Before conducting soil disturbing or vegetation removal activities at sites in proximity to known PPM habitat (Unit Test Pit 238-244, Auger Test Pit 406-409, 411-412), the PPM monitor will conduct trapping in the vicinity of the proposed investigation sites. The trapping will be conducted consistent with Service protocol (i.e., 5 nights of consecutive trapping between April 15 and August 31), and the proposed trapping locations will be submitted to the Service for review and approval prior to initiating the trapping. If no PPM or potential burrow sites are found, the investigation can commence under the guidance of the monitor. If PPM and/or potential burrows are found, the Service will be contacted to determine if additional avoidance and minimization measures are required.

If an archeological investigation site remains excavated overnight, any holes or trenches will be covered with boards or other stiff materials, and plastic sheeting will be placed over any loose soil that was excavated from the hole and anchored along the edges to minimize the potential for PPM or arroyo toad to burrow in the friable material during investigative activities.

Immediately following completion of archeological investigations at a particular site, the excavated material will be placed back in the hole or trench.

Native grassland species of local genetic stock will be broadcast throughout the areas affected by the trenching activities, which consist of ruderal vegetation and annual grasslands. The mixture will be broadcast in such a manner to provide even coverage throughout the designated area. Seeding shall be performed between October 1 and January 31 and during those periods when weather and soil conditions are suitable.

GENERAL EFFECTS OF THE ACTION

Placement of roadways within the natural landscape can cause direct loss of habitat and individuals, alter quality of adjacent habitats, disrupt hydrologic regimes, cause road kills, and fragment habitat. This in turn can result in the decline of certain species populations (particularly smaller populations that can be more susceptible to genetic isolation and local extinction), a loss in species diversity near roadways, and impede animal movements. The direct effects associated with new roadway construction are the permanent loss of habitat and direct mortality of individuals. Temporary impacts to habitat are also likely to occur during actual construction in conjunction with such activities as land contouring, construction staging and vehicle access, increased noise and dust generation, and the possible introduction of night lighting if construction is not limited to the dawn-to-dusk hours of daylight.

The habitat altering effects of new road construction include the creation of new microclimates and a change in other physical conditions extending beyond the road's edge, increase of exotic plant species, and direct mortality and/or relocation of flora and fauna from the area of the road as a result of habitat loss and/or physical disturbance (Spellerberg 1998). In general, the effects of roads on wildlife can extend beyond the road edge into an area described as the "road effect zone" (Forman *et al.* 1997). The road effect zone is the area from the road edge to some outer limit within which road traffic has significant ecological effects on wildlife. The width of the road effect zone is variable based on traffic intensity, the number of lanes in the roadway, the species present along the roadway, and a variety of ecological variables, such as vegetation and

topography. The threshold where the distance of the road effect zone ends varies for each species (Forman and Deblinger 1998).

The effects of roads on the physical environment include noise, light, dust and other particulates; metals such as lead, cadmium, nickel and zinc; and gases such as carbon monoxide and nitrogen-oxygen complexes (NO_X). Heavy metals are known to accumulate in the tissues of plants and animals up to 200 m (656 ft) away from roads (Trombulak and Frissell 2000). Noise and artificial lighting have been shown to affect some wildlife species given that many species rely on sight or sound to communicate, navigate, avoid danger, and find food. Car traffic has been correlated with a reduction in the density of breeding bird populations adjacent to roads (Reijnen *et al.* 1995 in Spellerberg 1998). Reijnen *et al.* (1995) documented a reduced ability of male willow warblers close to highways to attract and keep mates possibly due to the distortion of the song by traffic noise. The effects of road and traffic lighting on plants and animals appear to be wide ranging (Spellerberg 1998).

Roadways promote the dispersal and expansion of exotic species into adjoining habitat through frequent disturbance to roadside habitats associated with maintenance of fuel breaks and the function of vehicles as vectors for seed dispersal (Forman and Alexander 1998). Exotic species and disturbance tolerant species, such as non-native grasses and other weeds, are often common along roadsides.

Dust effects have been documented primarily on plants and include physical effects such as cell destruction and blocked stomata that can lead to reduced photosynthesis, respiration, and transpiration. In addition to dust, other road pollutants may cause physiological stress in some plants, making them more susceptible to pest attack, as has been shown by aphid infestations in roadside trees (Braun and Fluckiger 1984 in Spellerberg 1998).

Where roadways cross or parallel watercourses or drainage areas, changes to hydrology and water quality are likely to occur as a result of stream channel and floodplain constrictions and runoff from impervious road surfaces. Road construction can alter hydrological processes in a number of ways including velocity and flow direction. Shifts in velocity can result in increased scour, headcutting, and downstream sedimentation. Changes to hydrology from either redirecting flows or creating wet habitat where none previously existed can alter species' habitats. Potential contaminants emitted from vehicles onto roadways through tire wear, fluid leaks, brake-lining wear, rust, and exhaust are mostly transported through water flow (Forman *et al*. 2003). A review of toxic substances introduced into flowing water from roadways indicated that although a wide range of pollutants could be described, species responses were variable depending upon life form (plant or animal) and life-stage such that few generalizations can be made (Hellawell 1988 in Spellerberg 1998). Additionally, altered light regimes from shading the watercourse, such as bridge crossing, may alter species density and richness (Quinn *et al.* 1997; Broome and Craft 2003) and distribution (Marchetti and Moyle 2001).

Where roads bisect or abut areas with wildlife, mortality due to vehicular collisions is likely to occur. Wildlife collisions are influenced by vehicle speed, traffic volume, and the juxtaposition of the roadway in relation to habitat cover and movement corridors (Forman *et al.* 2003). Some species are attracted to roads and roadsides for thermoregulation and are more vulnerable to

traffic mortality and predation. Other species are attracted to roadways to scavenge road kills thereby increasing risk of mortality from vehicle collisions. Few comparative data are available regarding the significance of road mortality measured against the relative importance of natural sources of mortality such as predation (Forman *et al.* 2003). However, based on the studies conducted to date, road mortality is known to have significant effects on frogs and toads (Fahrig *et al.* 1995). Wide-ranging carnivores appear to be especially susceptible to road mortality. Vehicle collisions are likely the most important source of mortality for mountain lions in both Florida (Maehr *et al.* 1991) and the Santa Ana Mountains in southern California (Beier and Barrett 1993). Although the long-term effects on population dynamics of affected species is lacking, road kill seems to have the most detrimental effect on species with small or diminishing populations (Spellerberg 1998).

Fire frequency in southern California shrublands is positively correlated with human population density (Keeley and Fotheringham 2001), and the pattern of that fire is tightly associated with roadways (Jon Keeley, pers comm.). Roadways provide a ready source for fire ignitions in adjoining native habitat by means of vehicle sparks, discarded cigarettes, and access for arsonists. For example, along the already built northern section of the proposed toll road, a series of four fires have burned the majority of the surrounding open space since 1996. Only one of these fires was directly attributed to operation of the toll road, but the great majority of the recent fires in the area have resulted from human activity. Each species responds to fire differently. Some species are dependent on fire and experience population increases immediately following fires, but for most species, fire causes at least a temporary degradation in habitat quality. Depending on the frequency of fires in a particular environment and how fire-adapted the species and habitats in the fire footprint are, fire-related impacts can last from a few years to many years. If fires are too frequent, plant communities can be "permanently" converted from a stable native vegetation community, such as coastal sage scrub or chaparral, to non-native annual grassland (Keeley *et al.* 2005).

The most prominent indirect impact of roads is habitat fragmentation, which can result in a variety of negative effects to populations of many species. In southern California the effects of fragmentation have been shown to decrease the number of resident bird species, decrease the diversity of small rodents, and decrease the diversity and cover of native plant species (Soulé *et al.* 1988; Bolger *et al.* 1991; Alberts *et al.* 1993; Bolger *et al.* 1997b). Fragmentation can result in landscapes with many small habitat patches rather than few large patches. Small habitat patches tend to have altered species composition, reduced community diversity, and smaller population sizes for individual species. Species with greater susceptibility to the effects of reduced habitat patch size are more likely to be extirpated from these small patches. Reduced community diversity and altered species composition can change natural ecological functions, which can result in unpredictable effects given the complexity of community dynamics. Smaller populations are more susceptible to extirpation due to random fluctuations in population dynamics or catastrophic events (Ewens *et al.* 1987; Shaffer 1987). Small habitat patches also have high perimeter to area ratios, which increases edge effects that can result in even smaller populations. If small populations are isolated from nearby populations, they will be susceptible to deleterious genetic effects of inbreeding depression (Lande and Barrowclough 1987), and extirpated populations may not be replaced by dispersing individuals from other populations (Gilpin 1987). Fragmentation studies by Soulé *et al.* (1988) and Crooks and Soulé (1999)

concluded that the decline of top predators in fragmented landscapes could lead to the release of smaller predators that, in turn, strongly limit populations of prey species. This phenomenon, known as mesopredator release, has been implicated in the decline and extinction of prey species worldwide (Willis and Eisenmann 1979; Matthiae and Stearns 1981; Whitcomb *et al.* 1981; Wilcove *et al.* 1986; Soulé *et al.* 1988; Terborgh 1988; Sovoda *et al.* 1995; Crooks and Soulé 1999; Haas and Crooks 1999).

The effects of habitat fragmentation can be minimized by maintaining linkages (Soulé 1986; Saunders *et al.* 1991; Beier and Noss 1999). Linkages are connections between larger blocks of habitat that allow for wildlife movement, recruitment, and colonization between different core biological areas. Linkages are important for allowing species to move or disperse from their natal areas to sites where they may reproduce. Linkages that provide for successful movement between core population areas reduce genetic isolation and allow for recruitment into areas where populations have been extirpated due to natural or anthropogenic disturbances or stochastic events (Soulé and Simberloff 1986; Lande 1988).

Where roadways are widened or otherwise modified, direct effects similar to those described above for new roadways are likely to occur in areas beyond the existing roadbed. The incremental effects from road widening are dependent on the degree of the widening from the existing facility, changes in the level of use, and upgrades (*e.g.* dirt road to paved road, introduction of a median barrier) as well as the individual species movement patterns and ability to cross roads. Roadway improvements often provide for increased capacity and/or function resulting in increased volume, speed, and potentially total use time that will likely expand the extent of the road effect zone (*sensu* Forman as described above). The percentage of individual animals killed on roadways has been reported to increase with the width of the road and the number of vehicle trips (Carr and Fahrig 2001 in Longcore and Rich 2004). Forman *et al.* (2003) also reported that road mortality has been significantly correlated with vehicle speed. Depending upon a species' ability to move about and migration needs, widening roadways from as little as two to four lanes can sever population connections between habitats (Longcore and Rich 2004), thereby contributing incrementally to habitat fragmentation and possible species decline.

General Effects from Roads on Specific Taxa

Fish

Fish species are likely to be negatively affected by changes to hydrology and water quality as a result of new and improved roadways. Fish can be affected by sedimentation, changes in water quantity and temperature, and road runoff. Sedimentation increases turbidity thereby reducing the amount of light in the water column and primary nutrient production. Significant sedimentation may also change streambed characteristics by increasing overall silt content of the bed (*e.g.*, Beschta 1978 in Forman and Alexander 1998; Bilby *et al.* 1989 in Forman and Alexander 1998) and potentially suffocating aquatic organisms, including previously deposited eggs. Changes in hydrology can favor non-native predatory species. Non-native predators such as exotic fish and frogs may negatively affect native fish, for example, by altering the native fish's behavior (*e.g.*, Bryan *et al*. 2004). Contaminants associated with road runoff can be

detrimental to reproduction and recruitment. Pollutants may negatively affect fish, for example, by suppressing the immune system thus increasing susceptibility to disease (*e.g*., Arkoosh *et al*. 1998). Many streams are already highly modified and are likely to be more susceptible to the additional effects of new roadways.

Amphibians

In general, amphibians and reptiles have highly restricted home ranges and frequently follow genetically-controlled migratory paths. They are, therefore, more susceptible to mortality and the effects of habitat fragmentation, and local or restricted populations may become rare (Jackson 1996; Forman and Deblinger 1998; Vos and Chardon 1998).

Amphibians are likely to be vulnerable to the effects of roadways as described above for fish species. In addition, many amphibian species require both aquatic and terrestrial habitats for survival. Narrow, linear disruptions next to streams can result in barriers or increased risk of mortality as species transit between upland and aquatic habitats. Amphibians with moist skin have highly permeable skin and are especially sensitive and vulnerable to pollutants (Hayes *et al.* 2002). Temporary pools of water created by road runoff may attract amphibians to breed therein, but juvenile survivorship and recruitment may be low due to the chemical and/or temporary nature of the pond, increased risk of road kill, frequent disturbances, and road-related pollution and contaminants. In addition, many amphibian species are highly sensitive to light; changes in the light regime may prohibit some species from foraging altogether leading to their extirpation from an area (Buchanan 1993; Jaeger and Hailman 1976 in Longcore and Rich 2004).

Birds

Edge effects associated with roads include increased light and noise, which can disrupt breeding and foraging behavior and communication necessary to successful mating (Reijnen *et al.* 1997; Bergen and Abs 1997 in Longcore and Rich 2004). The detrimental effects of road noise have been recorded for wetland avian species. A zone of significantly decreased density of birds extending from the roadway was measured to be from 500-600 m (1,640-1,969 ft) for rural roads and 1600-1800 m (5,250-5,906 ft) for highways (Van der Zande *et al.* 1980 in Longcore and Rich 2004).

In addition, changes to existing roadbeds, bridges, and/or barriers and guardrails can change sound characteristics in certain habitats, thereby altering ambient conditions for sensitive and/or threatened and endangered riparian bird species (Biological Assessment for the SR-38, Mill Creek Bridge Project, Caltrans District 8, San Bernardino County, California, December 2001). Non-migratory birds, such as the gnatcatcher, exhibit strong site tenacity. New roadway construction and/or the widening of existing roads may prevent movement across roadways or increase mortality of individuals attempting to cross (Forman and Godron 1986; Forman and Alexander 1998; Forman *et al.* 2003). The introduction of traffic or a significant increase in ambient traffic noise, volume, and speed associated with road widening may also disrupt bird communication that for some species is a significant factor in pair establishment (Longcore and Rich 2004).

Indirect effects of roads can also include increased access to previously remote areas by both humans and nest-predator species such as corvids and raptors that do well in human-modified environments (*e.g.*, crows, and ravens). For example, American crows frequently benefit from inhabiting areas changed by artificial lighting, and increased populations of crows can have detrimental effects to other native bird species (Gorenzel and Salmon 1995 in Longcore and Rich 2004).

Road Maintenance

Road maintenance can affect plant species in several ways. Direct effects include the loss of plants and habitat that are on or immediately adjacent to roads; this can occur when heavy equipment is used to clear debris off the roadway, create drainage leadouts, or clear culverts. Also, repeated grading over time may lower a roadbed below adjacent plant communities and can result in de-watering of those plant communities. A variety of indirect effects are also associated with road use: (1) dust and mud generated by motorized vehicles can cover plants and interfere with physiological functions ultimately affecting plant vigor, reproduction, and survival; (2) changes in hydrology from erosion control efforts may affect adjacent plant occurrences and habitats as water is redirected away from or toward the occurrences; and (3) invasive, non-native plants and animals can be transported into areas along roads (Farmer 1993; Forman and Deblinger 2000).

Effects of road maintenance on animals include the lethal effects associated with spillage of oil, fuel, or other toxic substances into waterways and the suffocation of fish and amphibian eggs and young from sediment transport caused by maintenance activities at stream crossings (*e.g.*, Beschta 1978 in Forman and Alexander 1998; Bilby *et al*. 1989 in Forman and Alexander 1998). The effect of this sedimentation is reduced in measure as the distance from the road crossing increases. The effects will vary depending on the amount of sediment introduced into the stream, the amount of stream flow, gradient and several other instream factors.

GENERAL ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 Federal Register §402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the action area that have undergone section 7 consultation and the impacts of State and private actions that are contemporaneous with the consultation in progress.

An Endangered Species Act section 10(a)(1)B incidental take permit for the Orange County Southern Subregion HCP was issued on January 10, 2007. The housing, commercial, and infrastructure development addressed by the HCP and evaluated within the biological opinion regarding issuance of the permit, along with the HCP's habitat conservation and management measures, are considered part of the environmental baseline for this and future section 7 consultations. There is significant overlap of the toll road project with development areas and roadways already authorized by the HCP. However, while we consider the HCP impacts as part of the environmental baseline in this biological opinion, the development may not take place for

many years, and it is possible that the toll road may impact areas prior to planned development by the permittee, Rancho Mission Viejo. TCA and Caltrans are not permittees under the HCP and do not have incidental take coverage for impacts to listed species included in the HCP. Thus, if the toll road project is implemented prior to clearing and grading activities covered by Rancho Mission Viejo's take permit, reinitiation of consultation will be necessary by FHWA to address additional project-related impacts to listed species and to provide any appropriate incidental take coverage within the toll road alignment where it overlaps with the Rancho Mission Viejo development footprint.

The proposed toll road project footprint in Orange County falls within the boundary of the Orange County Southern Subregion HCP, primarily on land owned and managed by Rancho Mission Viejo (Figure 2). Additional development beyond that proposed in the HCP is anticipated to be minimal in southern Orange County because the area is otherwise almost entirely built out. No urban or commercial growth attributable to the toll road is anticipated on Camp Pendleton and the State Park leased lands. Therefore, we do not anticipate potential growth-inducing effects as a result of the toll road project. Due to the distance of the Orange County Southern Subregion HCP to the nearest locations of goby and PPM on Camp Pendleton, we did not anticipate or evaluate impacts to PPM or goby from implementation of the HCP.

As noted above, road construction and operation can affect species and habitats by the direct removal of soil and vegetation, increased noise and lighting, changed hydrology, increased fire risk, and invasion of exotic plants, fragmenting habitats, and creating barriers to movement (*e.g.*, (Forman *et al.* 1997; Forman and Deblinger 2000; Brehme 2003). Forman and Deblinger (2000) estimated the maximum distance of direct ecological effects, including factors such as altered streams, road salt, habitat invasion by exotics, noise, and animal density, from a suburban highway averaged just over 300 m (984 ft) but noted a high degree of variability in that average. To address general road effects, we defined the action area for the toll road project to include the grading limits plus a 152.4 m (500 ft) area beyond those limits; we selected this as a reasonable distance based on Forman and Deblinger's (2000) maximum average of just over 300 m (984 ft) and in consideration of the high degree of variability they noted in that distance. The action area includes the disturbance limits as provided on Figure 1 (labeled as proposed toll road alignment on the figure), which includes areas subject to remedial grading for geotechnical stability and general construction disturbance areas (including access roads, materials storage areas, utility relocations, extended detention basins, realigned access roads for current users (*e.g.*, Rancho Mission Viejo, California State Parks, U. S. Marine Corps, utility companies, *etc*.)). In addition, the action area has been expanded to include areas where the road may isolate arroyo toads from breeding habitat in Cristianitos Creek. Arroyo toads have been observed on the west side of the toll road alignment where it runs parallel to the creek. The toll road is anticipated to separate arroyo toads on the west side of the road from their breeding habitat on the east side of the road. Therefore, the action area was extended to 1.1 km (0.7 mi) from the west edge of Cristianitos Creek, to include habitat and arroyo toads affected in this manner. This distance was used because it is the maximum distance that arroyo toads have been observed from the nearest

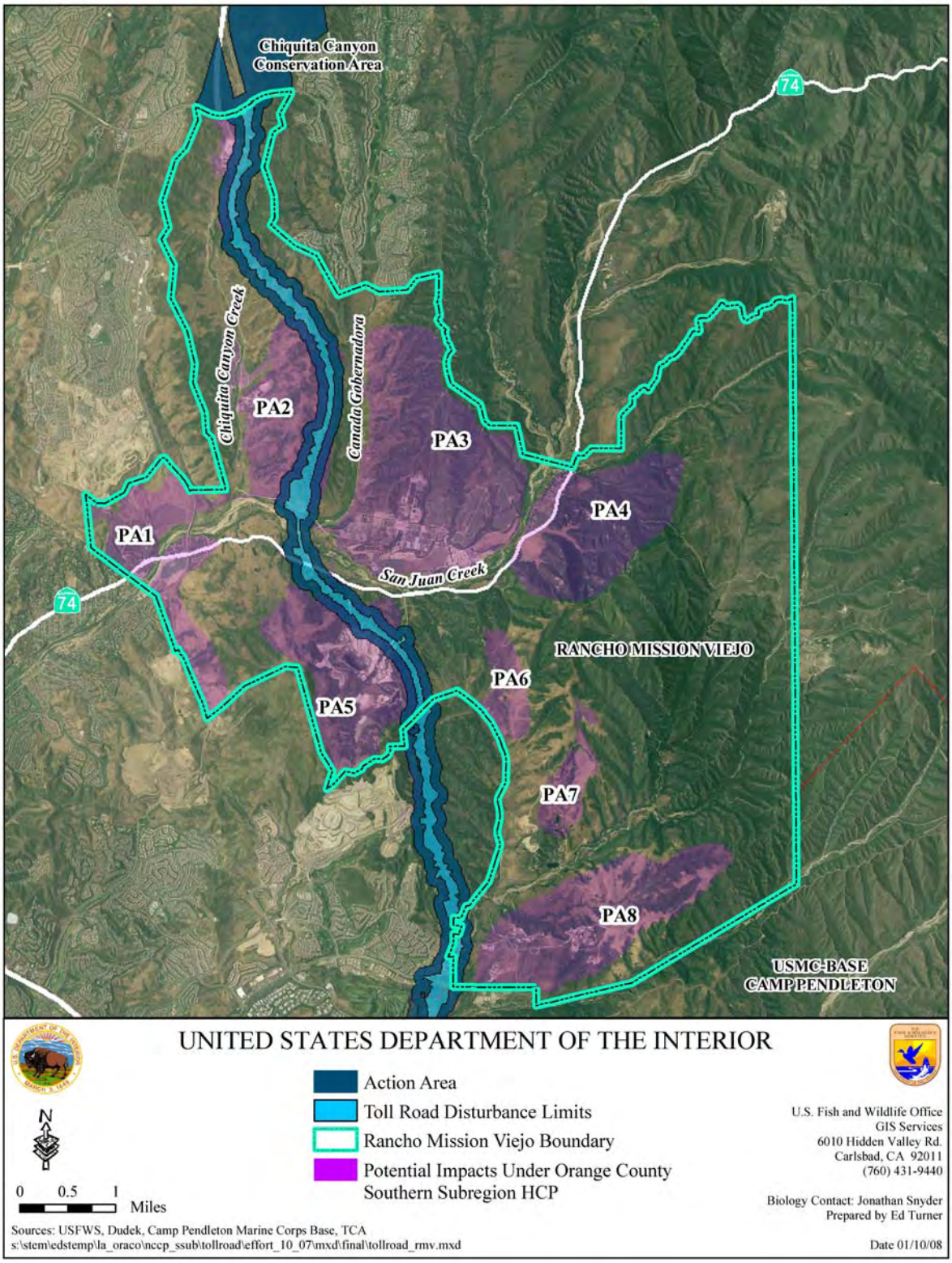

Figure 2. Development and conservation areas permitted under the Orange County Southern Subregion Habitat Conservation Plan on Rancho Mission Viejo.

riparian habitat (Holland and Sisk 2001), and thus is reasonable estimate for the distance that toads may extend into upland habitat west of Cristianitos Creek. Because the project includes the management (including habitat restoration) of the Upper Chiquita Conservation Bank and the San Mateo North PPM area, the action area also includes these areas. Lastly, because habitat restoration is proposed at Crystal Cove State Park, the action area includes this location as well. Because Crystal Cove State Park is geographically isolated from the rest of the action area, it is not shown in the figures depicting the action area along the toll road.

CUMULATIVE EFFECTS

We are unaware of other State, Tribal, local, or private actions in the area of the toll road that may affect the species considered in this biological opinion except for a proposal by Caltrans to widen and/or realign State Route 74 in the area of Rancho Mission Viejo. However, at this time, no plans with sufficient detail are available for our analysis and some portion of the realignment may be addressed through the HCP as a component of the proposed development infrastructure. Federal actions that affect federally listed species, such as activities by the U.S. Marine Corps on Camp Pendleton, are subject to section 7 consultation and are not considered in the cumulative effects section.

THREAD-LEAVED BRODIAEA
(*Brodiaea filifolia*)

Conservation Measures

In addition to the general avoidance and minimization measures described in Appendix 1, the following measure has particular relevance for thread-leaved brodiaea:

- Pre-construction surveys for thread-leaved brodiaea will be conducted (Appendix 1, TE-6), and bulbs in the project footprint will be salvaged and relocated, consistent with the BRMP (Appendix 1, TE-7).

Status of the Species

Listing Status

The Service listed *Brodiaea filifolia* (brodiaea) as threatened on October 13, 1998 (63 FR 54975). At the time of the listing, the Service determined that it was not prudent to designate critical habitat. On November 15, 2001, a lawsuit was filed against the Department of the Interior (DOI) and the Service by the Center for Biological Diversity and California Native Plant Society, challenging our "not prudent" determinations for eight plants, including brodiaea. A second lawsuit asserting the same challenge was filed against the DOI and the Service by the Building Industry Legal Defense Foundation on November 21, 2001. Both cases consolidated on March 19, 2002, and all parties agreed to remand the critical habitat determinations to the Service for additional consideration. In a July 1, 2002, order, the U. S. District Court for the Southern District of California directed the Service to publish a new prudency determination

and/or propose critical habitat for brodiaea on or before November 30, 2004. Proposed critical habitat for brodiaea was published in the Federal Register on December 8, 2004 (69 FR 71284). Final critical habitat was published in the Federal Register on December 13, 2005 (70 FR 73820); no critical habitat is designated in the project area. No recovery plan has been published for the species.

Species Description

Brodiaea is a perennial herb in the Lily family (Liliaceae) with dark-brown, fibrous-coated corms. The flower stalks (scapes) are 20.3- 40.6 cm (8-16 in) tall with several narrow leaves that are shorter than the scape. The bell-shaped flowers are violet in color (Munz 1974), bloom from March to June (CNPS 2001), and are arranged in a loose umbel. The fruit is a capsule (Munz 1974; Keator 1996; Service 1998).

Brodiaea filifolia is one of 13 species of the genus *Brodiaea*, a genus largely restricted to California (Keator 1996). *Brodiaea filifolia* belongs to the subgenus *Filifoliae*, a small group of three species (Niehaus 1971). *Brodiaea filifolia* can be distinguished from other species of *Brodiaea* that occur within its range (*B. orcuttii*, *B. jolonensis*, and *B. terrestris* spp. *kernensis*) by its narrow, pointed staminodia, rotate perianth lobes (*i.e.*, a saucer-shaped flower), and a thin perianth tube, which is split by developing fruit (Niehaus 1971; Munz 1974).

Habitat Affinities

Brodiaea typically occurs on gentle hillsides, valleys, and floodplains in semi-alkaline mudflats, vernal pools, mesic southern needlegrass grassland, mixed native-nonnative grassland, and alkali grassland plant communities in association with clay or alkaline silty-clay soils. Localities occupied by this species are frequently intermixed with, or near, vernal pool complexes (California Natural Diversity Database 2003; Service 1998).

Life History

The annual growth cycle of brodiaea begins with the above-ground appearance of a few grass-like leaves from each corm. The corms function similarly to bulbs in storing water and nutrients during the dormant season (Smith 1997). While corms are the principal means of perpetuation from one growing season to another (Niehaus 1971), the species also sets seeds. Brodiaea blooms from March through June (CNPS 2001). Upon maturity, the ovaries' three lobes split, revealing many small (2 to 3-cm (0.08 to 0.10-in) long) black seeds (Munz 1974). The seeds are then dispersed as wind rattles the capsules and releases the seeds (Smith 1997).

Brodiaea are self-incompatible, and pollination between individuals must take place in order to produce seed. A broad spectrum of insects visit brodiaea sp. flowers, but only tumbling flower beetles (Mordellidae) and sweat bees (Helictidae) were found to transport pollen between flowers (Niehaus 1971). The introduction of non-native honeybees, which tend to be species-generalists, may have increased the potential for hybridization (Service 1998). *Brodiaea filifolia* has been found in the San Mateo Wilderness Area near the northern border of San Diego and Riverside counties and in the Miller Peak area in the Santa Ana Mountains of western Riverside

County. These occurrences appear to include some hybrids between *B. filifolia* and *B. orcuttii* (69 FR 71284). Fire suppression that allows a dominant cover of introduced European annuals to be present may limit sexual reproduction. Sexual reproduction may occur in "pulses" when exotic cover is reduced ([S. Moray, *in litt.*, 1995] in Service 1998).

Status and Distribution

Brodiaea is endemic to southwestern cismontane California. Its historical range extends from the foothills of the San Gabriel Mountains in Los Angeles County (Glendora and San Dimas), east to the western foothills of the San Bernardino Mountains in San Bernardino County (Arrowhead Hot Springs), south through eastern Orange and western Riverside counties to northern San Diego County (Munz 1974; Keator 1996; CNDDB 2003). This species occurs from 40-1,219 m (130- 4,000 ft) elevation (CNPS 2001).

At the time of the listing in 1998, 48 populations or occurrences of brodiaea had been reported, with 9 populations having been extirpated, mostly from San Diego County, and 39 populations were presumed extant. About half of the extant populations occurred in northern San Diego County or the Santa Rosa Plateau in southwestern Riverside County. Over its entire range, the species occupied about 334 ha (825 ac) of suitable habitat at the time of the listing, with fewer than 2,000 individuals being observed at most populations. Most of these populations each occupied less than 5 ha (13 ac). As of late 2004, about 84 occurrences were known throughout the species' range (69 FR 71284).

Population Dynamics and Estimates

Individuals require several years to mature and frequently only a fraction of the mature individuals flower in a given year depending on environmental conditions. The size and extent of populations of brodiaea within suitable habitat vary in response to the timing and amount of rainfall, as well as temperature patterns. For example, estimates of the number of flowering plants in a population frequently vary by more than an order of magnitude from year to year (CNDDB 2003). Because only a fraction of bulbs flower in a given year, the number of bulbs in a population is estimated to be roughly 8 to 10 times the number of flowering individuals observed (CDFG 1995).

In Los Angeles County, two locations in Glendora and San Dimas have been detected, with up to 6,000 plants found at the San Dimas location. In San Bernardino County, two populations of brodiaea are presumed extant at Waterman Canyon (a few dozen plants in 1993) and Arrowhead Spring (1,000 plants in 1993) (CNDDB 2003). The largest extant population in Riverside County is about 30,000 individuals on about 15 ha (38 ac) on the Santa Rosa Plateau (Service 1998).

Brodiaea has been found at about 23 general locations in Orange County. Currently, between 11,650 and 17,900 individual brodiaea have been estimated from populations found on Rancho Mission Viejo (up to 5,500 plants), Aliso-Wood Canyons Wilderness Park (up to 3,000 plants), Talega and Forster Ranch developments (up to 9,250 plants), and at the Arroyo Trabuco golf course (up to 150 plants) (Orange County Southern Subregion 2003). The populations on

Rancho Mission Viejo and Aliso-Wood Canyons Wilderness Park are extant, and the population at Arroyo Trabuco was avoided during golf course project construction. The populations at Talega and Forster Ranch developments were transplanted; at Forster Ranch approximately 2,245 blooming brodiaea were documented from transplantation of the approximately 5,100 to 9,000 corms impacted (Natural Resource Consultants 2001). The 250 transplanted corms at Talega have also bloomed, but they are still in the early stages of success evaluation. On Rancho Mission Viejo, land in Chiquita and Gobernadora canyons contain clay, clay loam, or sandy loam and consist primarily of dry-land croplands and sagebrush-buckwheat scrub; these areas support two occurrences. In Cristianitos Canyon, lands are underlain by clay and sandy loam soils and consist primarily of annual grassland and needlegrass grassland. This area supports three occurrences, totaling about 3,000 plants, as well as several smaller occurrences and may provide for gene flow to other Orange County and northern San Diego County occurrences. Approximately 2,600 plants were observed in these and adjacent areas from surveys conducted in the 1990s (CNDDB 2003).

In San Diego County, brodiaea has been reported from the Base, Oceanside, Carlsbad, Vista, San Marcos, and unincorporated areas in the northern portion of the county; nearly 25 percent of the extant populations occur within the Multiple Habitat Conservation Program (MHCP) of Oceanside, San Marcos and Carlsbad. The MHCP anticipates conservation of 27 percent of potentially suitable habitat and may conserve 55 of 70 locations within the focused planning area. The largest population of 342,000 individuals was found in San Marcos in San Diego County on an isolated 16 ha (40-ac) parcel.

Brodiaea has been found at 22 general localities on the Base, some containing multiple sites within a given locality (Marine Corps 2001). Brodiaea was first reported on the Base during rare plant surveys in 1993. During the 1993 surveys, several large populations (up to 2,000 individuals) were discovered in the Bravo One and Bravo Two (formerly Sierra) training areas (Dudek 1993). In 1997, most of the known brodiaea sites were visited during a Base-wide rare plant survey (RECON 1999). The 1997 survey examined most of the potential brodiaea habitat, and an additional 14 sites were discovered. These new locations were all identified on clay pan soils within the Las Flores Mesa area of Oscar Two training area and in the Talega Canyon area of Charlie training area. Because brodiaea is a late-season blooming species, and the 1997 surveys were conducted early in the blooming season, these surveys may have failed to detect some brodiaea locations (RECON 1999). Brodiaea was located at seven additional sites in the Bravo One, Bravo Two, 52 Area, Alfa One, India, and Golf areas in 2000, and was also detected on Range 409 in 2000 and 2001 (Southwest Division Naval Facilities Engineering Command [SWDIV] 2001a, 2001b).

Threats and Conservation Needs

At the time of the listing, this species and its habitat were threatened by habitat destruction and fragmentation from urban development, agricultural activities, alteration of hydrology and floodplain dynamics, excessive flooding, off-road vehicle activity including military training, weed abatement, fire suppression practices (including disking and plowing), and competition from invasive plant species (Service 1998). Since brodiaea is associated with the alkaline silty-clay soils and other clay soil associations, the presence of undisturbed or minimally disturbed

soils is a significant factor in the long-term persistence of this species. Conservation of remaining high-quality habitat, including maintaining hydrological processes and pollinators, is important to the long-term survival of the species. The final critical habitat designation noted the importance of maintaining sufficient area (about 250 m (820 ft)) of vegetation surrounding each occurrence to provide for pollinator movement and habitat.

Implementation of Western Riverside County's large-scale Multispecies Habitat Conservation Plan (MSHCP) is expected to provide long-term protection for 11 of the 12 known occurrences of brodiaea within the plan area. The Orange County Southern Subregion HCP will conserve approximately 97 percent of brodiaea individuals within its plan area, including about 6,000 individuals in Cristianitos Canyon/Lower Gabino Canyon, which was identified as a "major" population under this plan. All other major and "important" populations as defined under the plan will largely be conserved, and management and monitoring will be implemented to address threats such as non-native plant species. Brodiaea is also addressed as a covered species under San Diego City and County multi-species plans; anticipated conservation includes 88 percent of the acreage supporting brodiaea in the San Diego Multiple Species Conservation Plan (MSCP) area and 93 percent of the point locations in San Diego MHCP. Non-regulatory protection is in place for the Glendora population, which is in private ownership; the Glendora Community Conservancy has indicated that it is willing to develop a management plan for brodiaea on the conservancy's property (70 FR 73820).

Environmental Baseline

Status of the Species in the Action Area

We used the toll road disturbance footprint and an additional 152.4-m (500-ft) distance as the action area as described in the project description above to address direct and indirect effects to brodiaea. About 11 locations of brodiaea are within the project action area. Three locations are on Rancho Mission Viejo (Figure 3), and 8 others are on Camp Pendleton (Figure 4). One location on Rancho Mission Viejo is on the ridge between Chiquita and Gobernadora canyons and east of the toll road alignment; this location has over 1,000 individuals. A second location in the same area is west of the alignment and has between 1-100 individuals. The third location is near the Talega development north of Pico Avenue; that location has about 300 individuals. The eight locations on the Base west of Cristianitos Creek are in proximity to one another and range in density from 5 individuals to about 450 individuals.

Factors Affecting the Species' Environment within the Action Area

Ongoing and potential threats to the brodiaea populations in Orange County and on the Base include construction, agricultural practices, military activities, wildfires, and invasive plants (70 FR 73820).

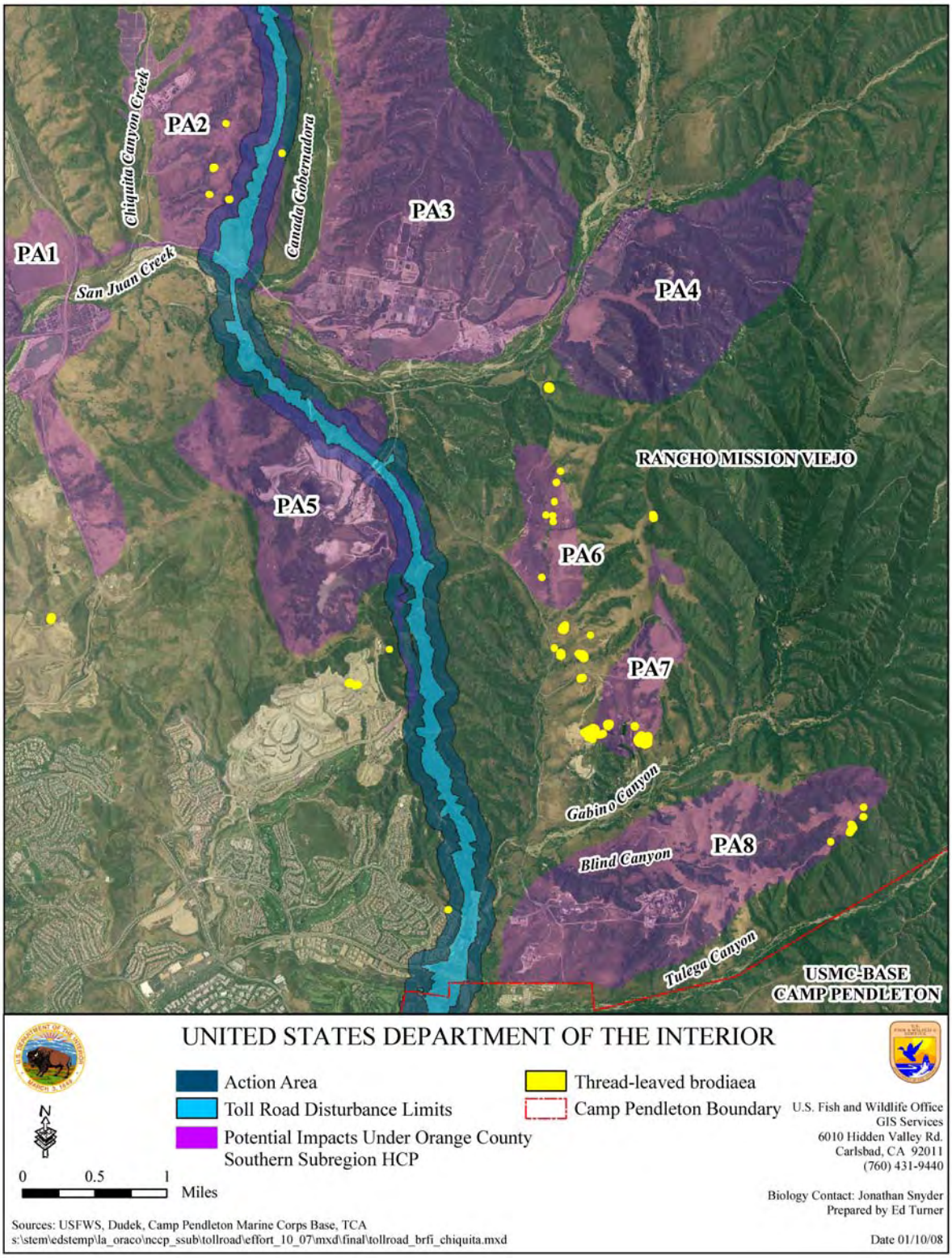

Figure 3. Thread-leaved brodiaea populations in the vicinity of the proposed toll road on Rancho Mission Viejo, Orange County, California.

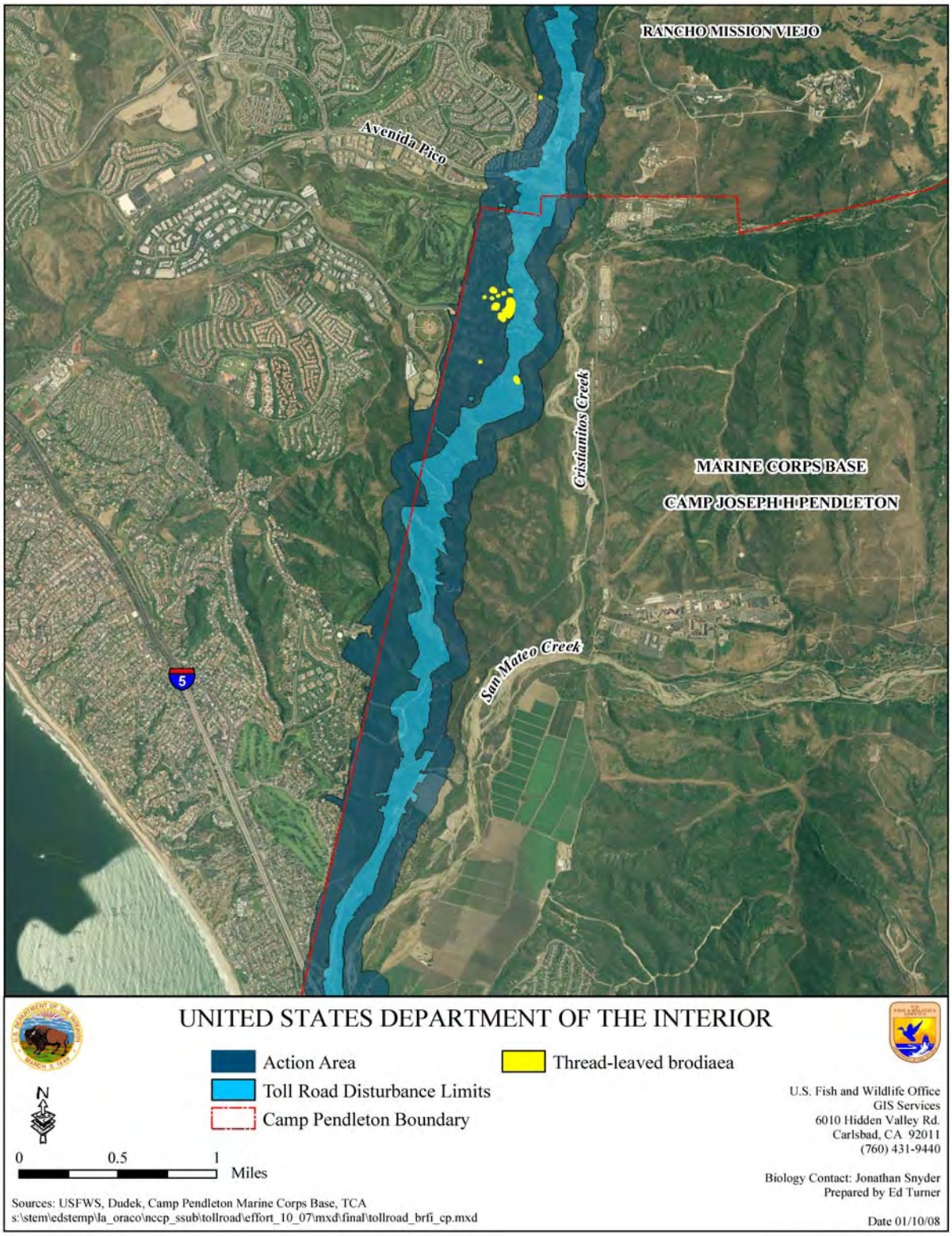

Figure 4. Thread-leaved brodiaea populations in the vicinity of the proposed toll road on Rancho Mission Viejo and Camp Pendleton, Orange and San Diego counties, California.

Camp Pendleton

Most brodiaea populations on Camp Pendleton are exposed to regular wildfires. As of 1998, most known populations of brodiaea were located in areas that had burned within the previous 6 years (Marine Corps 1998), with some locations having been burned up to 10 times in the previous 15 years. This relationship appears to indicate at least a high level of fire tolerance by brodiaea, if not a beneficial effect from wildfire. Any benefit to brodiaea from training-related wildfires on Camp Pendleton may be nullified if fire frequency is too high or occurs during above-ground flowering or fruiting of brodiaea. Additionally, high fire frequencies may promote exotic invasive plants that competitively exclude brodiaea.

Southern Orange County

In Orange County, the agricultural practice of disking on Rancho Mission Viejo may have impacted brodiaea. Disking can destroy corms and above-ground portions of the plants and promote exotic invasive plants. Repeated disking may alter soil conditions making an area unsuitable for brodiaea. However, these practices have a long history and most damage was likely done many decades ago. Cattle grazing may negatively affect brodiaea during its flowering period; cattle may consume or trample blooms and thus affect seed production. Under the Orange County Southern Subregion HCP, the location west of the toll road alignment with 1-100 individuals is anticipated to be impacted by development of Planning Area 2, while the location near the Talega development north of Pico Avenue is anticipated to be conserved and managed in perpetuity. The location on the ridge between Chiquita and Gobernadora canyons with over 1,000 individuals is within the limits of development anticipated for Planning Area 2, but development will be designed in a manner that avoids impacts to this occurrence and incorporates it into the Habitat Reserve system. Brodiaea populations on Habitat Reserve lands will be monitored and adaptively managed. Proposed management includes removal of invasive non-native plant species, such as artichoke thistle, which will benefit brodiaea populations, including those in the action area.

The area where brodiaea occurs in the toll road action area receives little to no training use; however, the Marine Corps reserves the right to train in this area. Range and Training Regulations and Environmental Operations Maps issued by the Marine Corps address military activities near known locations of rare plant species, including brodiaea. These regulations outline activities that should be avoided near known brodiaea locations including digging, vehicle/equipment operations, and bivouac and field support activities. These specific measures, in addition to general environmental constraints that are applied to all training activities, limit impacts to brodiaea on Camp Pendleton. The Service is currently in consultation with the Marine Corps on activities in the uplands areas of the Base; that consultation will assess impacts from training, fire management, and other activities and the benefits of proposed conservation programs for sensitive upland species, including brodiaea.

Effects of the Action

Habitat Loss and Construction Impacts

The project avoids direct impacts to the two brodiaea populations on Rancho Mission Viejo that are in the action area for the toll road and are anticipated to be avoided and conserved through implementation of the Orange County Southern Subregion HCP. These populations include the large population of over 1,000 individuals at Chiquita Canyon, which is about 107 m (350 ft) from the disturbance footprint and the population of about 300 individuals near the Talega Development north of Pico Avenue, which is about 122 m (400 ft) from the disturbance footprint.

The disturbance footprint crosses all or part of three populations on the Base (Figure 4). According to the CFWO GIS database, these populations contain 10, 150 and 8 flowering stalks and are 0.02, 0.8, and 0.1 ha respectively (0.05 ac, 1.9 ac, and 0.3 ac). It appears that the third population (8 flowering stalks, 0.1 ha (0.3 ac)) that is well within the footprint will be destroyed by construction of the road; the other small population will also be nearly destroyed, while the largest area will lose only a small portion of its eastern extent. The BA indicates that 23 plants within these three populations will be impacted.

Not all corms present in the soil will bloom in any given year. Therefore, as noted above in the *Population Dynamics* section, the impacts to brodiaea are likely greater many times greater than that indicated in the BA. While the loss cannot be exactly calculated, we can extrapolate from the BA information that about 180 individual brodiaea would be affected. There is no recovery plan for the species; however, in the final critical habitat designation for brodiaea, we defined significant occurrences as those containing 850 plants or more. These three locations affected by the project do not meet that definition. Thus, the entire loss of one location and the removal of portions of two other locations will not appreciably reduce the numbers, reproduction, or distribution of brodiaea since the locations lost are apparently small, and other protected brodiaea populations will remain within the action area and in southern Orange, northern San Diego, Western Riverside, and Los Angeles counties.

It is possible that the project will impact habitat that is suitable for thread-leaved brodiaea, but is either currently unoccupied or is occupied but was not documented as such during surveys. However, the best indicator of the quality of brodiaea habitat is the presence of brodiaea. Therefore, the analysis of project-related effects is focused on effects to the plant itself rather than to potentially suitable habitat.

Toll Road Operation and Maintenance

The brodiaea populations that remain immediately adjacent to the project may experience an increased fire frequency and non-native plant invasion risk and changes in the available habitat for pollinators due to their proximity to the toll road. The brodiaea affected by the project on Camp Pendleton currently have a fire risk from training-related wildfire (albeit low due to distance to live-fire ranges, which are typical ignition sources) and a substantial non-native plant community. After construction, the remaining brodiaea locations in the action area on Camp

Pendleton will be isolated between the toll road and development in the City of San Clemente. Therefore, the road will likely act as a fire break from the typical live-fire range ignition sources, but the road will introduce the risk of vehicle-induced fires. Fires occurring in late spring or early summer may on rare occasions burn aboveground parts of brodiaea (*i.e.*, leaves or flowering stalks), but they are unlikely to damage corms. In general, occasional burning of brodiaea sites is likely to reduce thatch buildup and thus reduce competition from non-native plants for light, moisture, nutrients, and living space and may be beneficial to brodiaea if flowering stalks are not consistently burned (*i.e.*, brodiaea reproduction occurs on at least an irregular basis). Therefore, in the case of brodiaea, the vehicle-induced fire risk is unlikely to be linked to impaired habitat functions or extirpation of the brodiaea populations from that area. The populations on Rancho Mission Viejo, however, are not currently subject to such risk; few ignition sources for wildfire are present, and exotic plants, like artichoke thistle, are controlled. Therefore, these locations may have an increased risk from vehicle-related fires. However, we anticipate this increased fire risk will not appreciably reduce the numbers, reproduction, or distribution of brodiaea in the action area. We base this on the continued existence of brodiaea on the Base in areas of repeated fire and because vehicle-induced fires will be less frequent than the fires experienced by the Base populations.

We expect that exotic plant control will continue on Rancho Mission Viejo under the Orange County Southern Subregion HCP as noted above in the *Threats and Conservation Needs* section above; thus, we do not anticipate a change to the brodiaea populations from competition with invasive exotic plants.

In our final rule designating critical habitat for brodiaea, where possible we used an area of 250 m (820 ft) as a distance around essential brodiaea locations to support pollinator movement and habitat. While the toll road will eliminate some of the potential pollinator habitat within 250 m (820 ft) of brodiaea locations in the action area, the remaining populations will still be contiguous with sufficient undeveloped open space (tens to hundreds of ha/ac) to support the native pollinator species needed for seed production in brodiaea. Therefore, we anticipate that these indirect effects will not appreciably reduce the numbers, reproduction, or distribution of brodiaea in the action area.

Because brodiaea bulbs will be salvaged and relocated out of the project footprint, future Caltrans maintenance activities in the right-of-way are not anticipated to affect brodiaea.

Summary of Conservation Measures

TCA has committed to implement measures to minimize project-related effects by developing and implementing a Biological Resources Management Plan (Appendix 1, Measure WV-3) to outline avoidance and minimization measures including delineation of sensitive resource areas (*i.e.*, brodiaea) to be mapped on construction plans and marked by fencing in the field for avoidance; conducting pre-construction surveys for brodiaea; and collecting corms impacted by the project, transplanting them in a dedicated open space area, and implementing a monitoring program to determine success of the transplants (Appendix 1, Measures TE-3, TE-6 and TE-7). The success of brodiaea translocation varies widely from project to project (Service 2004). All translocation efforts likely involve mortality of some of the translocated bulbs, but conducting

consistent monitoring and maintenance of the translocated individuals and their habitat greatly increases the likelihood of success, and brodiaea have been transplanted at two locations in southern Orange County (Forster Ranch and Talega developments). The transplant location for the salvaged brodiaea from the project has not yet been determined but will be done in coordination with TCA, the Base, and any other appropriate entities, to an appropriate receiver site with suitable soils and hydrology to support the transplanted corms over the long-term.

Summary of Effects to the Species and Recovery

The project will affect 3 of the 11 locations in the action area, but only 23 of the over 2,000 flowering plants observed in the action area, and many more brodiaea locations and thousands more individuals will remain on Rancho Mission Viejo's Habitat Reserve Lands outside the action area (Figure 3). In addition, affected individuals will be translocated to suitable receiver sites. The project may impact additional areas of suitable habitat, but by avoiding most of the documented brodiaea, the proposed project likely avoided most of the high-quality brodiaea habitat as well. Because most of the remaining habitat in the vicinity (on Rancho Mission Viejo conservation lands and MCBCP) is conserved and/or managed, sufficient habitat is anticipated to remain to support populations of pollinator species and population expansions and contractions necessary for species' long-term survival and recovery.

Conclusion

After reviewing the current status of the thread-leaved brodiaea, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that construction, operation, and maintenance of the toll road is not likely to jeopardize the continued existence of brodiaea. We based this conclusion on the following:

1. Only one small population (8 flowering stalks, 0.1 ha (0.3 ac)) will be completely destroyed, and only portions of two other populations will be destroyed; this minor impact will not appreciably reduce the number of individuals or the reproduction of this species, as many occurrences including thousands of plants will remain in other conserved and/or managed areas including occurrences on Camp Pendleton and Rancho Mission Viejo.

2. Brodiaea will remain viable for the foreseeable future in the action area. Thus, project implementation will not appreciably reduce the distribution of this species.

3. Measures to minimize impacts (*i.e.*, salvage, transplantation and monitoring) will be implemented.

TIDEWATER GOBY
(*Eucyclogobius newberryi*)

Conservation Measures

In addition to the general avoidance and minimization measures described in Appendix 1, the following measures have particular relevance for the tidewater goby. The location of each measure in this document is in parentheses at the end of the measure:

- Measures to benefit water quality including measures to limit sedimentation and pollution during and post-construction (Appendix 1, WQ-1 through WQ-6);

- Restoration of river and stream channels following temporary impacts (Appendix 1, WW-6);

- All structures/culverts placed within a stream where sensitive fish species do/may occur will be designed and maintained such that they do not constitute a barrier to upstream or downstream movement of aquatic life or cause an avoidance reaction by fish that impedes their upstream or downstream movement (Appendix 1, WV-21);

- Minimization of construction-related impacts to San Mateo Creek and San Onofre Creek through the use of scaffolding spanning the active channel and short construction times (Project Description);

- If diversion of active channel at San Mateo or San Onofre creeks is required, a goby relocation plan will be implemented so that gobies are not stranded and killed. The goby relocation plan will be developed in detail in the BRMP, but will include capture of gobies (by seining or other methods) in construction areas, relocating gobies outside of the construction area but within the same watershed as close as possible to the point capture (unless the biological monitor and the BRMP has other recommended release sites). Cofferdams at bridge footing locations will be used to minimize the need for relocating the active channel. Details regarding this measure will be developed more fully during preparation of the BRMP (Project Description);

- Caltrans routine maintenance activities will not affect the active channels at San Mateo or San Onofre creeks and will incorporate BMPs to protect water quality (Project Description).

Status of the Species

Listing Status

On February 4, 1994, the tidewater goby was listed as endangered throughout its entire historic range along the California coast from Tillas Slough at the mouth of the Smith River in Del Norte County near the Oregon border south to Agua Hedionda Lagoon in northern San Diego County

(59 FR 5494). Subsequently, on June 24, 1999, we published a proposed rule to delist populations of the tidewater goby in areas north of Orange and San Diego counties based on our re-evaluation of the species' status throughout its range (64 FR 33816).

On November 20, 2000, we designated critical habitat for the tidewater goby in Orange and San Diego counties (65 FR 69693). The critical habitat designation includes 10 coastal stream segments in Orange and San Diego counties, California, totaling approximately 14.5 km (9 linear mi) of streams. Eight of these 10 stream segments are located on the Base. We did not designate critical habitat for the northern populations of tidewater goby because, as noted above, we were considering delisting the northern populations. Subsequently, we withdrew our delisting proposal. As a result, the tidewater goby has remained listed as an endangered species throughout its historic geographic range since its original listing in 1994.

In 2001, Cabrillo Power L.L.C. ("Cabrillo") filed a lawsuit in the U. S. District Court for the Southern District of California challenging a portion of the final rule that designated the 10 critical habitat units in Orange and San Diego counties. In a consent decree dated February 27, 2003, the U. S. District Court: (1) remanded the final critical habitat rule in its entirety for reconsideration by the Service; (2) vacated that portion of the final rule covering Agua Hedionda Lagoon and Creek; (3) kept in place the remainder of the rule pending issuance of a new rule by the Service; and (4) directed the Service to promulgate a revised critical habitat rule that considers the entire geographic range of the tidewater goby and any currently unoccupied tidewater goby habitat. The consent decree required that the Service submit proposed and final rules to the Federal Register no later than November 15, 2006, and November 1, 2007, respectively.

We published a proposed critical habitat rule on November 26, 2006 (71 FR 68914). No "new" critical habitat was proposed in or near the action area because Camp Pendleton has an approved Integrated Natural Resources Management Plan (MCBCP 2001; revised in 2006) that provides a benefit to the tidewater goby. Thus, lands at Camp Pendleton were exempted from proposed critical habitat pursuant to section 4(a)(3) of the Act. The critical habitat rule exempting lands on Camp Pendleton, including the action area for the proposed project, was finalized on January 31, 2008 (73 FR 5920).

On December 7, 2005, we issued a final recovery plan for the tidewater goby.

Species Description

The goby is the only member of the genus *Eucyclogobius* in the family Gobiidae. It is a small, elongate fish no larger than 50 millimeters (mm) (1 in) in length. The goby is characterized by large, dusky pectoral fins and a ventral sucker-like disk formed by the complete fusion of the pelvic fins. Gobies are nearly transparent, with a mottled brownish upper surface, and often with spots or bars on dusky dorsal and anal fins. The mouth is large and oblique with the upper jaw extending nearly to the rear edge of the eye. The eyes are widely spaced.

Habitat Affinities

The goby is unique in that it is generally restricted to brackish water habitats in coastal lagoons and streams. The goby is often found at the upper end of lagoons in salinities less than 10 parts per thousand (ppt); however, this fish can tolerate a wide range of salinities and is frequently found throughout lagoons (65 FR 69693). They are usually collected in water less than 1 m (3.3 ft) deep (Wang 1982; Irwin and Soltz 1984; Swenson 1995), although they may occur in deeper waters (65 FR 69693). Gobies often migrate upstream into tributaries greater than 2 km (1.2 mi) from the estuary. In Santa Barbara County, they have been found as far as 5-8 km (3-5 mi) upstream in San Antonio Creek and the Santa Ynez River, while in San Diego County they have been found as far as 5 km (3 mi) upstream from the estuary in the Santa Margarita River (65 FR 69693).

The goby's feeding habitats suggest that it is a generalist feeding on small benthic invertebrates, crustaceans, snails, and aquatic insect larvae, particularly flies (65 FR 69693). In turn, gobies are preyed upon by a variety of native and non-native fish species. Some of the primary non-native predators of goby in southern California include sunfish (Centrarchidae), largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*), yellowfin gobies (*Acanthogobius flavimanus*), and mosquitofish (*Gambusia affinis*).

Life History

Peak nesting activities occur in late April through early May, but nesting may occur at any time that conditions are suitable (65 FR 69693). Male gobies dig a vertical nesting burrow 75 to 100 mm (3-3.9 in) deep. Although gobies have been shown to prefer to burrow in relatively unconsolidated, clean, coarse sand, they are often found breeding in silt-dominated muddy habitats. Suitable water temperatures for breeding range from 15 to 20 degrees Celsius (°C) (59 to 68 degrees Fahrenheit (°F)) with salinities of 0 to 25 ppt. Females lay about 100 to 1,000 eggs per clutch, averaging 400 eggs per clutch, depending on the size of both the male and the female. The male remains in the burrow to guard the eggs that are attached to sand grains in the walls of the burrow. Both males and females spawn more than once per season (Swenson 1995). Larval gobies are found midwater around vegetation until they become benthic (Swift *et al.* 1989). The potential for year-round spawning exists but is unlikely during seasonal low temperatures and disruptions of lagoons from winter storms.

Status and Distribution

The tidewater goby is endemic to California and historically ranged from Tillas Slough at the mouth of the Smith River (Del Norte County, near the California/Oregon border) to Agua Hedionda Lagoon (northern San Diego County). Areas of precipitous coastline preclude the formation of lagoons at stream mouths, thereby creating three gaps in the distribution of gobies. The southern populations of gobies have historically occupied the coastal lagoons formed at the mouths of small to large coastal rivers, streams, or seasonally wet canyons from Aliso Creek in Orange County to Agua Hedionda Lagoon in northern San Diego County (65 FR 69693). All known goby populations south of Malibu Creek occur on the Camp Pendleton (Holland *et al.* 2001). The species' current distribution ranges from Tillas Slough to the Santa Margarita River

in northern San Diego County; the species has apparently been extirpated from the three historically occupied lagoons south of the Santa Margarita River (*i.e.*, San Luis Rey, Buena Vista and Agua Hedionda), a reduction in the species' distribution of about 12 km (7.4 mi) (Service 2005).

At the time of the listing, the goby was believed to have more stringent habitat requirements and to be less likely to disperse successfully than recent research indicates (Service 1994; Lafferty *et al.* 1999). Also, at the time of the listing, it was believed that approximately 50 percent of the documented populations had been extirpated (Service 1994). More recent information indicates that about 17 percent of the known goby localities have been lost (Service 2005) but gobies are capable of recolonizing lagoons and estuaries from which they have been extirpated (Lafferty *et al.* 1999).

The recovery plan (Service 2005) indicates that there is increased understanding of the species' tolerance for a range of habitat conditions, and its resiliency and recovery following catastrophic events such as flood and drought. Those facts and the increased number of known extant populations suggest that the extinction threat for the species is less severe than thought at the time of listing (Service 2005).

The recovery plan describes presence of gobies at localities as regular, intermittent, or extirpated, and in terms of population density as abundant, variable, or rare. Of 124 historically occupied locations, 40 are regularly occupied and 55 intermittently occupied. Of the regularly-occupied areas 29 have abundant population densities and 6 have variable densities. Intermittently-occupied areas typically have variable population densities; of the 55 intermittently-occupied historic locations, 7 were described as abundant and 27 were described as variable population densities.

Population Dynamics and Estimates

The goby is primarily an annual species (Service 1994), with reproduction tied to annual hydrologic cycles of coastal lagoons and estuaries where it lives (65 FR 69693). No long-term monitoring program is available for the tidewater goby, and population dynamics are not well documented for this species. Deriving population size estimates for the tidewater goby is difficult because of the variability in local abundance. In addition, seasonal changes in distribution and abundance further hamper efforts to estimate population size, especially for this short-lived species. Additionally, capture data may not accurately reflect population size since thousands may be observed in the water column but not captured (Merkel and Associates 2005).

Tidewater goby populations also vary greatly with varying environmental conditions (*e.g.*, drought, El Niño) among years; this environmental variation is a normal phenomenon, but one that makes the determination of trends difficult (Service 2004). Estimating tidewater goby population size is complicated because the populations are controlled by environmental conditions. For example, when lagoons are breached due to flood events during the rainy seasons, tidewater goby populations can persist post-flood, and some lagoons where populations are extirpated may be recolonized through such flood events (Lafferty *et al.* 1999). The recovery plan (Service 2005) describes goby presence in the 8 lagoons on Camp Pendleton as regular or

intermittent. USGS's (2004) report for Camp Pendleton indicated that gobies were repeatedly present at small estuaries where the lagoon mouth closes to the ocean with the exception of estuaries (*e.g.,* French Creek) that do not contain sufficient water to support fish.

Risk of extirpation may exist at sites that are small or degraded; however, gobies are capable of persisting and recolonizing. Lafferty *et al*. (1999) monitored post-flood persistence of 17 tidewater goby populations in Santa Barbara and Los Angeles Counties during the heavy winter floods of 1995. All 17 populations persisted, and no significant changes in population sizes were determined. Gobies also are capable of recolonizing lagoons and estuaries from which they have been extirpated and have done so even where separated from the next nearest goby locations by 10 to 20 km (6.2 to 12.4 mi) (Lafferty *et al.* 1999). Also, some active reintroduction efforts have been successful. According to the recovery plan, two reintroductions of tidewater gobies were made in 1991, one to Waddell Creek and another into Malibu Creek; 52 fish were placed in Malibu Creek and slightly over 200 at Waddell. The Malibu Creek population increased to several thousand individuals, and gobies were still present in 2004; the Waddell Creek population increased to several thousand individuals by 1994 but was extirpated by high flows from 1998 winter storms. Reintroduction of gobies to San Mateo Creek was also undertaken after 1998 flood flows, which coupled with diversions for emergency railroad repairs, apparently extirpated the population. Gobies were reintroduced in early 2000 and have persisted, with typical fluctuating seasonal numbers, through the last reporting period of June 2004 (Merkel and Associates 2005); the persistence was likely enhanced by implementation of a concurrent exotic predator control program.

Gobies can often be the most abundant fish species present in lagoons. Density ranges at Camp Pendleton in October 1996 included 2 to 11 gobies per square meter in San Mateo Creek, 1 to 102 gobies per square meter in the creek at San Onofre Lagoon (October 1996), 0 to 4 gobies per square meter in Los Flores Creek (November 1996), 0 to 6 tidewater gobies per square meter in Hidden Creek (November 1996), and 1 to 51 tidewater gobies per square meter in French Creek Lagoon (October 1996) (Swift and Holland 1998).

Threats and Conservation Needs

The recovery plan identified threats to tidewater goby over its range including modification and loss of habitat as a result of coastal development, channelization of habitat, diversions of water flows, groundwater overdrafting, and alteration of water flows. Potential threats to the tidewater goby include discharge of agricultural and sewage effluents, increased sedimentation due to cattle grazing and feral pig activity, summer breaching of lagoons, upstream alteration of sediment flows into the lagoon areas, introduction of exotic gobies (*e.g.*, yellowfin, shimofuri gobies) and rainwater killifish (*Lucina parva*), habitat damage, and watercourse contamination resulting from vehicular activity in the vicinity of lagoons (Service 2005). If the tidewater goby's current habitat conditions are secured or enhanced, recovery of the species would likely be ensured. However, in some areas of the species' distribution, there continues to be competing demands on limited resources that directly and/or indirectly affect the quality of tidewater goby habitat (*e.g.*, upstream water diversions, pumping of groundwater, erosion, *etc*.). Furthermore, other anthropogenic activities and stochastic events are known to adversely affect tidewater gobies (*e.g.,* exotic predators/competitors, drought). The recovery strategy for the species is

designed to (1) preserve the diversity of tidewater goby habitats throughout the range of the species; (2) preserve the natural processes of recolonization and population exchange that enable population recovery following catastrophic events; and (3) preserve genetic diversity as it is understood now and in the future (Service 2005).

Environmental Baseline

Status of the Species in the Action Area

As discussed in the project description above, we used the toll road disturbance footprint and an additional 152.4-m (500-ft) distance as the action area to address direct and indirect effects to the goby (Figure 5). The project crosses San Mateo and San Onofre creeks, which are occupied by gobies, in the area of the toll road's connection to Interstate 5. The recovery plan describes San Mateo and San Onofre creeks as medium-sized goby habitat areas having lagoons/ponds with a surface area of less than 2 ha (5 ac) but larger than 0.4 ha (1 ac), estuaries longer than 100 m (328 ft) but less than 1 km (0.6 mi), and/or streams less than 20 m (66 ft) bankful width. The recovery plan estimates the total amount of goby habitat, including the stream above the lagoon, to be 4 to 6 ha (10 to 15 ac) at San Mateo Creek and 2 to 4 ha (5 to 10 ac) at San Onofre Creek although the amount of goby habitat varies substantially with rainfall.

Based on surveys conducted since 1984, gobies occurred regularly or irregularly on eight different drainages on Camp Pendleton. Recent base-wide surveys to determine presence or absence conducted from 2002 to 2004 indicated that gobies were detected in each year at San Mateo, San Onofre, Las Flores, Hidden, Aliso, and Cockleburr creeks; gobies were not detected at French Creek or Santa Margarita River (USGS 2004). Gobies were noted as present in 2002 surveys at both San Mateo and San Onofre creeks. Two individuals at San Mateo Creek and 6 individuals at San Onofre Creek were detected in 2003; in 2004, 25 individuals were found at San Mateo Creek, and 3 individuals were found at San Onofre Creek (USGS 2004). Results of surveys done in June 2004 for a monitoring program at San Mateo Creek lagoon captured 1,770 gobies in 15 seine hauls (Merkel & Associates, Inc. 2005). Captures in June 2004 differ between the two surveys due to differing levels of effort (1 net haul [USGS 2004; surveys were to determine presence not abundance] vs. 15 net hauls [Merkel & Associates 2005; surveys to determine abundance]). Preliminary results from exotic predator control activities at San Mateo Creek lagoon indicated that 665, 94, and 95 individual gobies were seined, respectively, during three separate exotic predator removal actions in September 2005 (R. Baily, URS Corporation, October 3, 2005, email to D. Stadtlander, Service). As noted in the status of the species section for the goby and by the available data for these locations, seasonal changes in distribution and abundance make it difficult to estimate population size; however, these changes are typical for the species, and the USGS (2004) survey results and the recovery plan (Service 2005) indicate the persistence of gobies, intermittently or regularly, at these and other locations on Camp Pendleton.

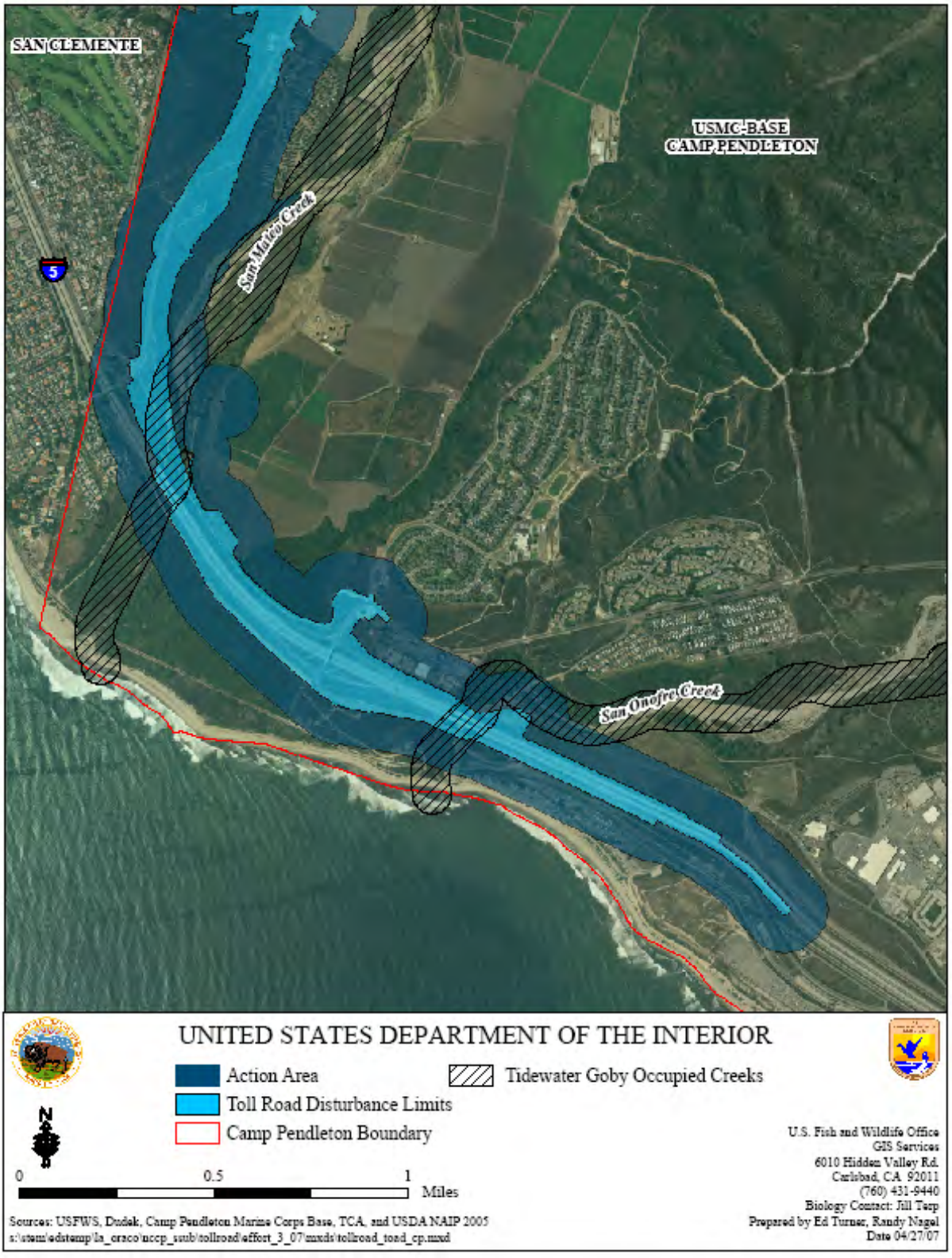

Figure 5. Proposed toll road project location and tidewater goby occupied creeks on Camp Pendleton, San Diego County.

Threats to gobies in the action area include decreased water quality due to highway/railroad runoff of transportation-related pollutants (*e.g.*, heavy metals, organic compounds) and, potentially, horticultural and urban runoff from developed areas on Camp Pendleton at the San Mateo and San Onofre housing areas (*e.g.*, nutrients, herbicides). Interstate 5 and the railroad cross both creeks, and agricultural fields, now fallow, are adjacent to San Mateo Creek. Runoff from these areas likely runs onto upland habitats adjacent to and into wetland areas occupied by gobies. We do not have information on where and how runoff from the housing areas is directed; it may be controlled and sent to sewer systems; if not, it may also run into goby-occupied areas. Pollutants may negatively affect fish in a variety of ways, such as suppressing the immune system thus increasing susceptibility to disease (*e.g.*, Arkoosh *et al*. 1998). Now that the agricultural fields are not actively farmed, there should no longer be chemical inputs from that source.

At both San Mateo and San Onofre creeks, non-native predators such as exotic fish and frogs may negatively affect gobies, for example, by altering goby behavior (*e.g.*, Bryan *et al*. 2004). Also, the presence of exotic invasive animals in the San Mateo and San Onofre creeks/lagoons may reduce increase competition with and predation on gobies. Conservation programs implemented under the programmatic biological opinion for riparian areas on Camp Pendleton benefit the goby through control of exotic fish, habitat enhancement, and water quality and population monitoring. The Marine Corps also issues Range and Training Regulations and Environmental Operations Maps to address military activities near known locations of sensitive resources. These regulations outline how activities should be conducted near goby locations including vehicle/equipment operations. These specific measures, in addition to general environmental constraints that are applied to all training activities, limit impacts to gobies on the Base. The Service is currently in consultation with the Marine Corps on activities in their upland areas, including agricultural lease areas; we anticipate discussion with the Marine Corps on the potential effects of agricultural practices on species.

Effects of the Action

Habitat Loss and Construction Impacts

Project-related impacts to goby would occur on Camp Pendleton at the San Mateo Creek and San Onofre Creek lagoons from the construction of bridges over the creeks. Because goby populations fluctuate dramatically over time, project-associated impacts to the species are evaluated primarily in terms of how much habitat will be affected. The area within the limits of potential disturbance is 2.3 ha (5.8 ac) at San Mateo Creek and 0.4 ha (1.1 ac) at San Onofre Creek. However, as described below, most of these impacts would consist of temporary disturbance to dry creekbed and riparian vegetation without gobies.

The recovery plan for the tidewater goby estimates that the amount of occupied habitat is about 4 to 6 ha (10 to 15 ac) at San Mateo Creek and 2 to 4 ha (5 to 10 ac) at San Onofre Creek and that the size of the lagoon at each location is between 0.4 and 2 ha (1 to 5 ac) (USFWS 2005). The size of the lagoon and the amount of suitable habitat vary substantially with rainfall. In general, the lagoon habitat for both San Mateo and San Onofre creeks is downstream of the Interstate 5 bridges and the proposed project footprint. The aquatic habitat under the Interstate 5 bridges at

San Mateo and San Onofre is usually in the form of a creek that occupies a small portion of the relatively wide creekbed as opposed to a lagoon that stretches from bank to bank. During storms, the creeks can expand to fill the entire channel, but under these conditions, the water is fast-moving and unlikely to support high numbers of gobies.

The new bridges over San Mateo Creek will span 0.5 ha (1.2 ac) of the creekbed and will be between 13 and 25 m (43 and 82 ft) above the existing grade. The new bridges over San Onofre Creek will span 0.09 ha (0.2 ac) of the creekbed and will be about 9 m (30 ft) above existing grade. If all of the habitat below the bridges was suitable for gobies, the San Mateo Creek bridges would span about 8.0 to 12.0 percent (0.5 of 4-6 ha) of the suitable goby habitat at this location, and the San Onofre Creek bridges would span about 2.3 to 4.5 percent (0.09 of 2-4 ha) of the suitable goby habitat at this location. However, as described above, most of the creekbed affected by shading is dry for much of the year, so the percent of goby habitat affected by shading will be much less than indicated by this analysis.

Shading from bridge span and piers may alter habitat by reducing light for vegetation growth and reducing water temperatures within the habitat below, but the shaded areas are transient as the sun passes overhead, and the vegetation that supports areas of cover from predators and substrate for invertebrates that gobies feed on is expected to continue to grow. For example, the Interstate 5 bridge at San Mateo Creek is about 17 m (55 ft) above grade, and the riparian habitat under the bridges is similar to the surrounding vegetation (Glenn Lukos Associates 2001). The bridge at San Onofre Creek is lower than the bridge at San Mateo Creek (about 9 m/30 ft above grade), and the vegetation below the San Onofre Creek bridge appears to be shaded for much of the day. Therefore, the riparian vegetation under the San Onofre Creek bridge may reduced in density and height as a result of shading, but there is still aquatic vegetation, such as cattails, and some woody riparian vegetation under the bridge. Gobies tolerate wide seasonal temperature variations, so it is likely that they will adjust to any temperature changes caused by bridge shading.

Permanent loss of potential goby habitat from bridge pilings in San Mateo Creek and San Onofre Creeks will be about 0.004 ha (0.01 ac) in each creek, which will remove up to 0.07 percent (0.004 of 6 ha) of the suitable goby habitat from San Mateo Creek and up to 0.10 percent (0.004 of 4 ha) of the suitable habitat in San Onofre Creek.

Construction in San Mateo Creek will be completed within one year. During construction at San Mateo Creek, scaffolding will be placed in the creek bed with footings on either side of the active channel. Temporary access roads and staging areas will also be created on the creek bed outside the active channel. If a storm occurs during construction, any equipment within the creek bed will be removed, and the active channel may expand and flow over temporary access roads and staging areas and around the footings of the scaffolding. After storms, the temporary access roads and staging areas will be recreated. Thus, because the access roads and staging areas will be out of the active channel and not in use during flooding events, there will be no construction-related loss of goby habitat during most of the construction period. During the wet season and expansion of the active channel, the footings from the scaffolding may exclude gobies from a very small portion of the creek bed. No diversion of the active channel in San Mateo Creek is anticipated during construction.

Construction in San Onofre Creek may involve excavation of the creekbed to reinforce the footings on the existing Interstate 5 bridge to protect the bridge from scour. If further analysis reveals that this excavation is unnecessary, the construction at San Onofre Creek will be similar to that at San Mateo Creek (i.e., scaffolding will be created over the active channel and temporary access roads and staging areas may be on the creekbed, but will be outside the active channel). If excavation is necessary, about 100 m (328 ft) of the stream under the bridge will be diverted into a man-made channel created in the creekbed outside the construction footprint. The excavation and channel diversion will take place outside the rainy season. The channel will remain open and accessible to gobies during construction activities.

Dewatering and flow diversion in San Onofre Creek could result in death or injury of gobies and temporarily eliminate goby breeding, feeding, and sheltering habitat. However, minimization measures for water diversions will be implemented to ensure that sufficient area and sufficient flows to support extant populations are present, and construction methods will minimize the footprint within the species' lagoon habitat and adjacent upland. Individuals could be stranded in inadequate depth and/or quality of water, but the conservation measures include the capture and relocation of gobies within areas subject to dewatering (see Conservation Measures below). Any gobies in the dewatered area that are not captured and relocated will die. We anticipate, however, that few adults, eggs, or young will be missed by the seining efforts since the action area at the creek crossings is small, limiting the areas that will need to be seined.

Erosion and runoff from construction can increase siltation in the creeks, smothering goby eggs, reducing visibility for predator avoidance and decreasing available oxygen in the water for goby respiration. However, avoidance of erosion into and siltation of the creeks from construction cut and fill and disturbance of low oxygen sediments in the lagoon will be addressed through implementation of best management practices (BMP) for construction, which are anticipated to minimize sedimentation and pollution potentially resulting from construction activities.

Toll Road Operation and Maintenance

Goby breeding habitat could be adversely affected due to reduced water quality from toll road runoff contaminants, such as petroleum products. The project will implement specific measures (Appendix 1; *e.g.*, WQ-6, WW-9) incorporating best management practices and runoff management. These include road design features include construction and maintenance of extended detention basins that are designed to capture "first flush" rainfall off the roadway to filter contaminants in a natural filtration system and return water in a condition that meets discharge standards and maintains the flow regimes of drainages crossed by the alignment through the use of appropriately sized culverts to convey flows. Implementation of these plans should ensure that road runoff will meet water quality standards set by responsible agencies (*e.g.*, California Regional Water Quality Control Board, U. S. Environmental Protection Agency). The implementation of these measures should result in no significant difference in conditions for the goby at San Mateo and San Onofre creeks due to the toll road project. While the extended detention basins will not capture runoff from the railroad or agricultural and developed areas, they will capture first flush flows from portions of Interstate 5 that are not currently controlled. Therefore, the project will likely improve water quality to some degree as flows from Interstate 5 are retained and contaminants have an opportunity to be removed. We do not anticipate changes to the exotic

invasive animal populations that may be present in San Mateo and San Onofre creeks from the toll road project. Camp Pendleton is implementing a predator control program separate from the toll road project that is addressing this threat to gobies.

Routine Caltrans maintenance activities will not involve disturbance of the active channel at San Mateo or San Onofre creeks, and standard BMPs will minimize the potential for these activities to increase pollution or sedimentation in occupied goby habitat. Therefore, routine Caltrans maintenance activities are not anticipated to affect goby populations.

Summary of Conservation Measures

In addition to the measures to minimize effects of construction activities and road operation on sedimentation and pollution in potential goby habitat, a capture and relocation plan will be implemented to minimize impacts to individuals that would otherwise be directly affected by dewatering or construction activities.

The goby relocation plan will be developed in detail in the BRMP, but will include capture of gobies (by seining or other methods) in construction areas, relocating gobies outside of the construction area but within the same watershed as close as possible to the point capture (unless the biological monitor and the BRMP has other recommended release sites), and using cofferdams at bridge footing locations to minimize the need for dewatering. We cannot predict the number of adults, juveniles, and/or eggs in the action area during project construction given the wide fluctuations in the species' abundance from year to year. To the extent possible, capture and dewatering will take place outside of the spawning season when population levels are typically lowest. Gobies are typically seined or dip netted, counted, measured and released. These are typically accepted monitoring methods, and experts indicate that gobies are hearty and can withstand these methods.

Adult gobies and young could become stressed and die as a result of the capture and holding process for relocation. We anticipate that the number of gobies killed during capture and relocation will be low because 1) only qualified individuals knowledgeable of goby biology and ecology will be implementing the relocation actions and 2) techniques of capture will follow the measures outlined in the goby recovery plan (Service 2005; Appendix F) or other Service-approved methodology to minimize capture effects. Finally, while some gobies may not survive relocation due to increased competition or predation, the size of the areas dewatered will be small relative to the remaining habitat and sufficient area for relocated gobies will be present in the lagoons; thus, we expect the risk of increased predation and competition will be small.

Summary of Effects to the Species and Recovery

The avoidance and minimization measures are anticipated to ensure that gobies persist in San Mateo and San Onofre creeks during construction, and following project completion, gobies are anticipated to continue to persist at population levels similar to pre-project conditions. No measures are proposed to directly offset the limited effects of temporary relocation and impacts to habitat, but the project is not anticipated to impact the persistence of gobies at these locations or

the possible use of these sites as potential donor or receiver sites should translocation of gobies be determined to be necessary for the recovery of the species in the future.

Conclusion

After reviewing the current status of the tidewater goby, the environmental baseline for the action area, the direct and indirect effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that construction, operation, and maintenance of the toll road is not likely to jeopardize the continued existence of the goby. We base this conclusion on the following:

1. Direct impacts to tidewater goby are limited to bridge construction activities at San Mateo and San Onofre creeks; construction may require temporary dewatering of a small stretch of San Onofre Creek, and the dewatering will likely occur outside the spawning season for goby to avoid and minimize impacts to goby reproduction.

2. Gobies in the area of the potential dewatering activities will be captured by seining and released away from the construction footprint. Any gobies missed during these efforts will die, and the relocation effort could result in the death of some gobies, but the number killed will likely be low due to the methods of capture used, the small area of the creeks impacted, and the availability of the surrounding habitat to support the relocated animals; thus, gobies are expected to remain in the creeks during and following construction, and no appreciable reduction in the number of animals or distribution of the species is expected.

3. Both temporary and permanent habitat impacts are very small, with permanent impacts limited to bridge footings and a small amount of potential habitat degradation due to shading. Sufficient habitat will remain in the lagoons sufficient to support existing goby populations and carry out its intended conservation function for the species.

4. Impacts to water quality will be addressed through implementation of specific BMPs to control runoff and through project design features including extended detention basins.

ARROYO TOAD
(*Bufo californicus*)

Conservation Measures

In addition to the general avoidance and minimization measures described in Appendix 1, including replanting of cut and fill slopes and temporarily impacted habitat, the following measures have particular relevance for the arroyo toad:

- Measures will be implemented to benefit water quality and prevent sedimentation (Appendix 1, WQ-1 through WQ-6);

- River and stream channels will be restored and breeding pools and gravel benches will be re-created following temporary impacts (Appendix 1, WW-6 and TE-16);

- Riparian habitat temporarily impacted at major drainages/bridge crossings, including San Juan Creek (2.7 ha/6.6 ac) and San Mateo Creek (2.3 ha/5.8 ac), will be restored following project completion (Riparian HMMP);

- Removal of 8.1 ha (20.0 ac) of arundo and other non-native invasive riparian plant species will be conducted in drainages that support arroyo toads, including at least 2.0 ha (5.0 ac) in drainages affected by the toll road;

- Toad exclusionary fencing will be installed at the base of wildlife fencing and maintained in perpetuity to minimize vehicle strikes of arroyo toad (Appendix 1, TE-5).

- Avoidance and minimization measures for toad will be implemented to minimize potential effects during Caltrans routine maintenance activities: toad exclusionary fencing will be installed and maintained around extended detention basins near arroyo toad breeding habitat; a qualified biologist will be present during culvert cleanout activities with the potential to affect arroyo toads; BMPs will be implemented to minimize potential effects to water quality; and no activities will be conducted in arroyo toad breeding habitat that could harm toads or disturb their habitat (Project Description);

- The following measures will be implemented to minimize construction-related effects: Pre-construction surveys for arroyo toad; exclusionary fencing during construction, capture and relocation of arroyo toads in the construction area; limited removal of non-native predators in areas identified for toad relocation; and other construction-related minimization measures for arroyo toad, all of which will be more fully described in the ATRMP (Appendix 1, TE-11 through TE-17);

- All structures/culverts placed within a stream where sensitive fish species do/may occur will be designed and maintained such that they do not constitute a barrier to upstream or downstream movement of aquatic life or cause an avoidance reaction by fish that impedes their upstream or downstream movement. This measure should maintain water flow from tributaries into main channels where toads have been observed breeding and potentially allow toads to disperse through the structures/culverts (Appendix 1, WV-21).

Status of the Species

Listing Status

The Service listed the arroyo toad (toad) as endangered on December 16, 1994 (59 FR 63264), and a recovery plan was published in July 1999 (Service 1999). Critical habitat was designated for the toad on February 7, 2001 (66 FR 9414), but it was vacated by court order on October 30, 2002, and remanded for re-designation. Critical habitat for the toad was re-proposed on April 28, 2004 (69 FR 23254), and it was finalized on April 13, 2005 (70 FR 19562); no critical

habitat is within the project area. A recovery plan for the toad was completed on September 24, 1999 (Service 1999).

Species Description

The toad is a small, dark-spotted toad of the family Bufonidae. The parotoid glands, located on the top of the head, are oval-shaped and widely separated. A light/pale area or stripe is usually present on these glands and on top of the eyes. The toad's underside is buff-colored and usually without spots (Stebbins 1985). Recently metamorphosed individuals will easily blend with the substrate and are usually found adjacent to water. At the time of listing, the toad was described as the arroyo southwestern toad (*Bufo microscaphus californicus*). Gergus (1998) published genetic justification for the reclassification of the arroyo southwestern toad as a full species (*i.e.*, arroyo toad (*Bufo californicus*)).

Habitat Affinities

Toads require shallow, slow-moving streams, and riparian habitats that have natural flooding regimes which maintain areas of open, sparsely vegetated, sandy stream channels and terraces (Service 2001). Optimal breeding habitat consists of low gradient stream reaches that have shallow pools with fine textured substrates (*i.e.*, sand or gravel). Upland habitats used by toads during both the breeding and non-breeding seasons include alluvial scrub, coastal sage scrub, chaparral, grassland, and oak woodland (Griffin *et al.* 1999; Service 2001). This species has been observed moving approximately 1.6 km (1 mi) within a stream reach and up to 1.1 km (0.7 mi) away from the stream, into native upland habitats (Holland and Goodman 1998a; Sweet 1992) or agricultural areas (Griffin *et al.* 1999). Holland and Sisk (2001) found on Cristianitos Creek on Camp Pendleton that 88.73 percent (323 of 364) of captures of adult and subadult toads were within the riparian area and 11.26 percent (41 of 364) were in upland habitats; no metamorphic toads were captured in uplands. Of the 41 captures, distances from the edge of the riparian area varied greatly from 25-1,142 m (82-3,747 ft) (mean 539 m (SD=330 m)). Movement distances may be regulated by topography and channel morphology (Holland and Sisk 2000). Toads are critically dependent on upland terraces and the marginal zones between stream channels and upland terraces during the non-breeding season, especially during periods of inactivity, generally late fall and winter (Sweet 1992). Adult and juvenile toads burrow into loose soils in stream terraces and in uplands, where they may remain during daylight hours or for longer periods during the dry season (Sweet 1989).

Life History

Toads typically breed from February to July on streams with persistent water (Griffin *et al.* 1999). Female toads must feed for a minimum of approximately two months to develop the fat reserves needed to produce a clutch of eggs (Sweet 1992). Eggs are deposited, and larvae develop in shallow pools with minimal current and little or no emergent vegetation, and the substrate in these pools is generally sand or fine gravel overlain with silt. Toad eggs hatch in 4 to 5 days, and the larvae are essentially immobile for an additional 5 to 6 days. They then begin to disperse from the pool margin into the surrounding shallow water, where they spend an average of 10 weeks. After metamorphosis (June-July), the juvenile toads remain on the

bordering gravel bars until the pool no longer persists (usually from 8 to 12 weeks depending on site and yearly conditions) (Sweet 1992). Male toads reach adulthood in 1 to 2 years, and females become sexually mature in 2 to 3 years. Individuals may become sexually mature by the following spring if conditions are favorable (Sweet 1992, 1993).

Toad larvae feed on loose organic material such as interstitial algae, bacteria, and diatoms. They do not forage on macroscopic vegetation (Sweet 1992; Jennings and Hayes 1994). Juvenile toads rely on ants almost exclusively (Service 1999). By the time they reach 1.8 to 2.3 cm (0.7 to 0.9 in) in length, they take more beetles, along with ants (Sweet 1992; Service 1999). Adult toads probably consume a wide variety of insects and arthropods including ants, beetles, spiders, larvae, caterpillars, and others.

Status and Distribution

The toad was historically found in California from Monterey County to San Diego County and southward to the vicinity of San Quintín, Baja California, Mexico. They have been extirpated from an estimated 75 percent of their former range in the United States, and they now occur primarily in small, isolated areas in the middle to upper reaches of streams. The current distribution of the toad in the United States is from the Salinas River Basin in Monterey County, south to the Tijuana River and Cottonwood Creek Basin along the border with Mexico. Although the toad occurs principally along coastal drainages, it also has been recorded at several locations on the desert slopes of the Transverse Range (Patten and Myers 1992; Jennings and Hayes 1994). The current elevational range for most toad populations in San Diego County is about 304.8 to 1,402.1 m (1,000 to 4,600 ft), although they were historically known to extend into the lower portions of most river basins (Service 1999), and populations on Camp Pendleton extend down to just above sea level (Holland and Goodman 1998a).

Population Dynamics and Estimates

Toad populations vary considerably from year to year, depending on environmental conditions. Approximately three-fold changes have been observed from one year to the next (Sweet 1993), and greater variations would likely be observed with more data on toad populations. Because female toads lay an average of approximately 5,000 eggs during the breeding season (Sweet 1992), there is the potential for rapid increases in population size given favorable conditions, but toad recruitment reflects the inherent variability of their environment. During years of drought, pools may dry before larvae have reached metamorphosis, and females may forego breeding altogether. If flooding occurs after eggs have been laid, a large percentage of the eggs and larvae can be lost. Finally, heavy predation pressure by birds, mammals, reptiles, and other amphibians on metamorphosing and newly metamorphosed juveniles can drastically reduce recruitment. Once toads have reached the subadult stage, survivorship is higher. Annual mortality of adults and subadults has been estimated between 35 percent and 70 percent (Sweet 1993; Holland and Sisk 2000, 2001), which would mean that few toads survive past 5 years in the wild.

Stream order, elevation, and floodplain width are important factors in determining the size and long-term viability of a toad population (Sweet 1992; Barto 1999; Griffin 1999). Streams with the greatest potential to support self-sustaining populations are typically of a high stream order

(*i.e.*, 3rd to 6th order), at low elevations (below 914.4 m (3,000 ft)), with wide floodplains (Sweet 1992; Barto 1999; Griffin 1999). Because of the dynamic nature of toad populations and their habitat, movements of individuals are likely important for colonizing areas where toads have been locally extirpated or where new habitat has been created due to flooding events or changes in human management.

Toad populations have been detected in 22 drainages in the coastal and desert areas of 9 southern California counties. Insufficient information regarding population dynamics and suitable habitat is available to estimate the range-wide toad population (Service 1999). The density of toads is unevenly distributed in space and time, with particular sites having high densities of larvae, metamorphs, subadults, and adults present under favorable ecological conditions, but absent during poor conditions (Holland *et al.* 2001). Dramatic natural fluctuations in all life-stage categories and difficulty in detecting adult toads under all but the most optimal conditions make accurate estimation of populations difficult. Due to the mobility of toads and other factors affecting their spatial and temporal heterogeneity, estimating toad densities (per unit area) at given sites may be considered to be inaccurate.

In southern Orange County, Bloom (2001) found over 200 adults near the confluence of Lucas Canyon Creek with San Juan Creek, over 25 in Bell Canyon Creek, and over 25 downstream in the main San Juan Creek channel below the confluence of Bell Canyon. Several detections of adult and metamorphs were in the general area of the toll road project's crossing of San Juan Creek, and one adult was detected further downstream about 300 m (984.3 ft) east of the Antonio Parkway Bridge over San Juan Creek. In 2004, surveys near Ortega Highway bridge over San Juan Creek about 2.4 km (1.5 mi) west of the project did not detect toads; however, the survey notes that conditions were generally dry and less suitable for detecting toads (LSA 2004). Camm Swift noted one metamorph in summer 2005 during fish surveys in the vicinity of the La Novia Bridge in the City of San Juan Capistrano.

Three toad populations are located on Camp Pendleton; two of these are associated with San Onofre and San Mateo creeks. Toad populations on Camp Pendleton are considered to be relatively large compared to other populations (Holland and Goodman 1998a). While toads are found on San Onofre Creek, the CFWO GIS database indicates that the nearest toad location is 718 m (0.45 mi) upstream of the I-5 crossing on this creek. The populations on Camp Pendleton represent the relatively few remaining low elevation coastal populations (Service 1999).

Threats and Conservation Needs

Many arroyo toad populations were reduced in size or extirpated due to extensive habitat loss from 1920 to 1980 (Service 1999), mainly because toad habitats (*i.e.*, broad, flat floodplains in southern California) are favored sites for flood control projects, agriculture, urbanization, and recreational facilities such as campgrounds and off-highway vehicle parks. The loss of habitat, coupled with habitat modifications due to the manipulation of water levels in many central and southern California streams and rivers, as well as predation from introduced aquatic species, caused toads to disappear from a large portion of their previously occupied habitat in California (Jennings and Hayes 1994). In 2001, a telemetry study of toads in San Juan Creek indicated that exotic predators and vehicle traffic were the cause of mortality for 2 of the 13 study animals

(Cadre Environmental 2003). One toad was tracked by its transmitter to the gut of a bullfrog, and another was tracked to the treads of a dump truck that had driven on a dip-crossing through San Juan Creek. Other observations from the telemetry study included the desiccation of toad larvae in pools along the creek that dried up prior to the completion of toad metamorphosis (Cadre Environmental 2003). The authors speculated that drying of these pools may have been due to decreased rainfall or to groundwater pumping for agricultural practices that affected creek water levels.

Threats to toad populations include stream alteration, urban and rural development, mining, recreation, grazing, drought, wildfire, large flood events, and presence of exotic animal and plant species, such as the bullfrog (*Rana catesbeiana*), crayfish (*Procambarus* spp.), salt cedar (*Tamarix* spp.), and giant reed (*Arundo donax*) (59 FR 63264, 69 FR 23254). Conservation needs, as described in the recovery plan, include protecting and managing breeding and non-breeding habitat throughout the range of the species, monitoring existing populations to ensure recovery actions such as exotics removal are successful, identifying additional toad habitat and populations, obtaining research data to guide management efforts, and conducting outreach and public education regarding the toad.

Several incidental take permits pursuant to Section 10(a)(1)(B) of the Act have been issued for the arroyo toad addressing the effects of urban development on this species. In 1997 and 1998, the Service issued permits to the City of San Diego and the County of San Diego, respectively, for Multiple Species Conservation Plans. In 2004, the Service issued a permit for the Western Riverside County MSHCP. In 2007, the Service issued permits for the Orange County Southern Subregion HCP. These plans are expected to provide long-term protection for toads and toad habitat in western Riverside, Orange, and San Diego counties. For example, all known locations and about 78 percent of riparian suitable habitat will be conserved by the San Diego MSCP; conservation of 93 percent of toad locations (39 of 42 locations) is anticipated under the Western Riverside MSHCP; 75 percent of modeled toad habitat (535 ha; 1,322 ac) will be conserved and managed under the Orange County Southern Subregion HCP. Conservation of toads through these HCPs address, at least in part, task 3 of the recovery plan of identifying and securing additional populations and suitable habitat (on non-Federal lands).

In September of 2005, the U. S. Forest Service published a Land Management Plan for the southern California National Forests (U. S. Forest Service 2005), which identified the distribution of arroyo toads in southern California forests, including Cleveland National Forest adjacent to the proposed project, proposed no new roads or trails in the area occupied by toads, and stated that any new project in an area occupied by toads or other federally listed species should “promote the conservation and recovery of these species and their habitats.”

Environmental Baseline

Status of the Species in the Action Area

Focused surveys for toads have not been conducted recently within the action area of the toll road project on San Juan, Cristianitos, San Mateo, and San Onofre creeks; however, arroyo toads have been found in past surveys in the action area along these creeks (Figures 6 and 7). Since

the nearest documented location on San Onofre Creek is 718 m (0.45 mi) upstream of the project footprint, no impacts to toads are anticipated on this creek within the action area. Available information on arroyo toads in the vicinity of the project is discussed below.

On San Juan Creek, surveys done in 1997 and 2001 indicate toads inhabited the creek within the vicinity of the proposed toll road bridge crossing (Figure 6). On Cristianitos Creek, surveys done between 1996 and 2001 indicate toad locations along the entire stretch of Cristianitos Creek that parallels the toll road project with some of the locations within uplands habitats on either side of the toll road footprint, including several observations in the action area (Figure 7). Surveys done between 1996 and 1998, along San Mateo Creek from the Cristianitios Creek confluence to downstream of Interstate 5 indicate that toads were found all along this creek, with locations east and west of the project footprint area (Figure 7). One of the largest populations of toads on Camp Pendleton appears to exist in this lower reach of San Mateo Creek, downstream from the confluence with Cristianitos Creek (Holland *et al.* 2001). Although it is assumed that toad abundance in upland habitats is greatest adjacent to riparian areas with large breeding populations, information on toad abundance and distribution in upland habitat is limited. Surveys in the upland habitat on either side of the toll road have not been repeated in recent years, but surveys in breeding habitat in Cristianitos and San Mateo creeks on Camp Pendleton from 2003 through 2005 have documented the continued presence of arroyo toad populations (Brehme *et al.* 2006). Observations from these more recent surveys are not included in Figure 7 because including these data does not affect our analysis of project-related effects.

Factors Affecting the Species' Environment within the Action Area

Ongoing and potential threats to the toad populations in southern Orange County and/or on Camp Pendleton include construction, military training activities, roads, agriculture, introduced exotic plants and animals, fire, and stream degradation (Service 1994; National Biological Service 1996; Holland and Goodman 1998b). Management activities that benefit toad populations in southern Orange County and/or on Camp Pendleton include control of unauthorized activities such as off-road vehicles, removal of invasive plant species such as giant reed and artichoke thistle, and removal of non-native predators such as bullfrogs and crayfish.

Camp Pendleton

Within the action area, an extended detention basin will be constructed within a Camp Pendleton restoration site required by a Biological Opinion (BO 1-6-99-F-20). This site was established to offset impacts to arroyo toad upland habitat impacted from the construction of the Helicopter Outlying Landing Field (HOLF) on Camp Pendleton. The 15.8 ha (38.9 ac) of coastal sage scrub was restored on lands previously leased by the Base for agriculture.

A programmatic biological opinion (BO 1-6-95-F-02) for activities affecting riparian habitat on the Base estimated a total of 40 adult toads per year are harmed or harassed on Camp Pendleton due to training (including vehicle use) and maintenance activities within riparian areas. Since the completion of that programmatic biological opinion that addressed riparian areas in 1995, about 38 ha (95 ac) of riparian toad habitat have been permanently or temporarily impacted, and about 88 ha (217 ac) of upland habitat known or suspected to support foraging or aestivating

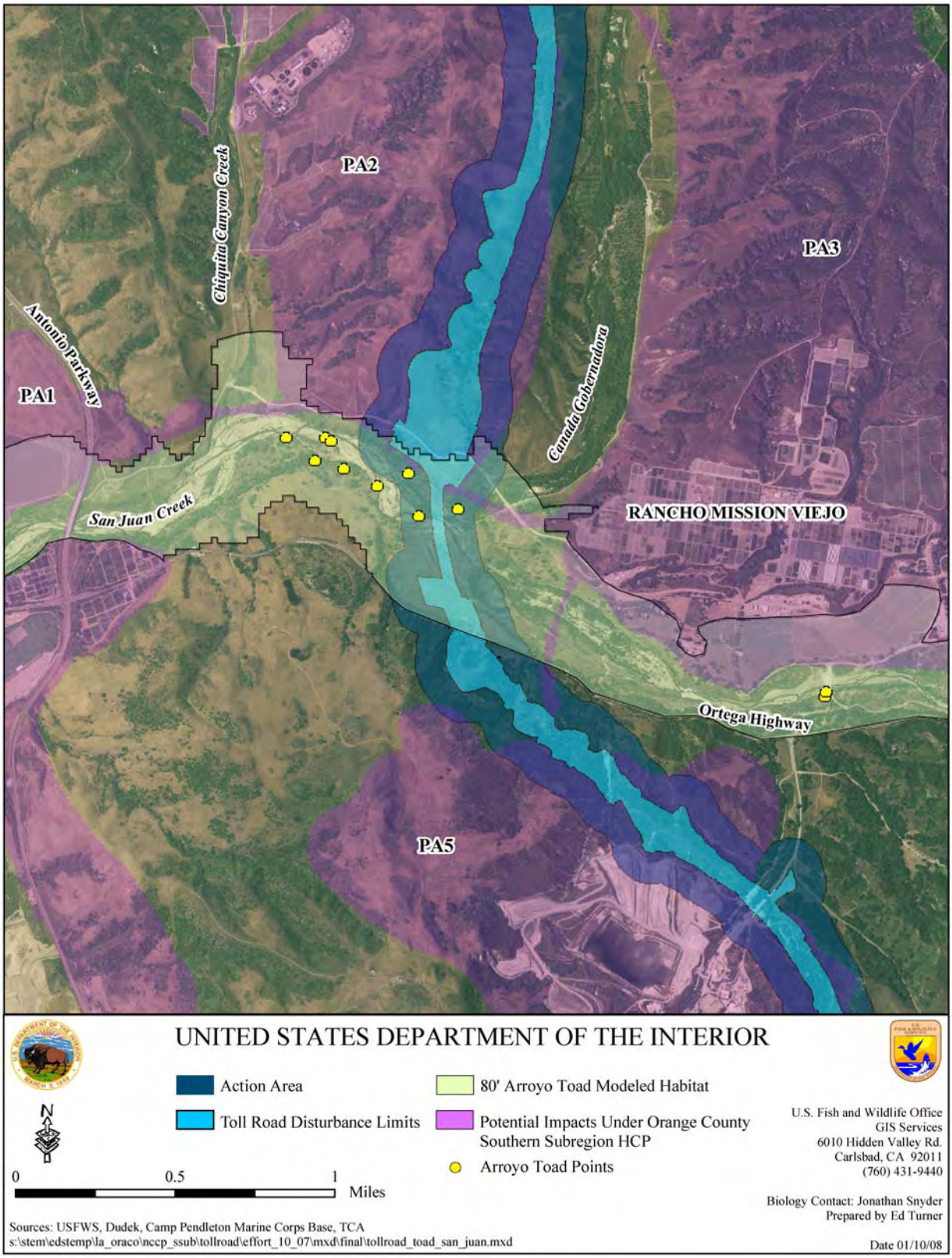

Figure 6. Action area, toll road disturbance limits, and arroyo toad locations at San Juan Creek, Orange County, California.

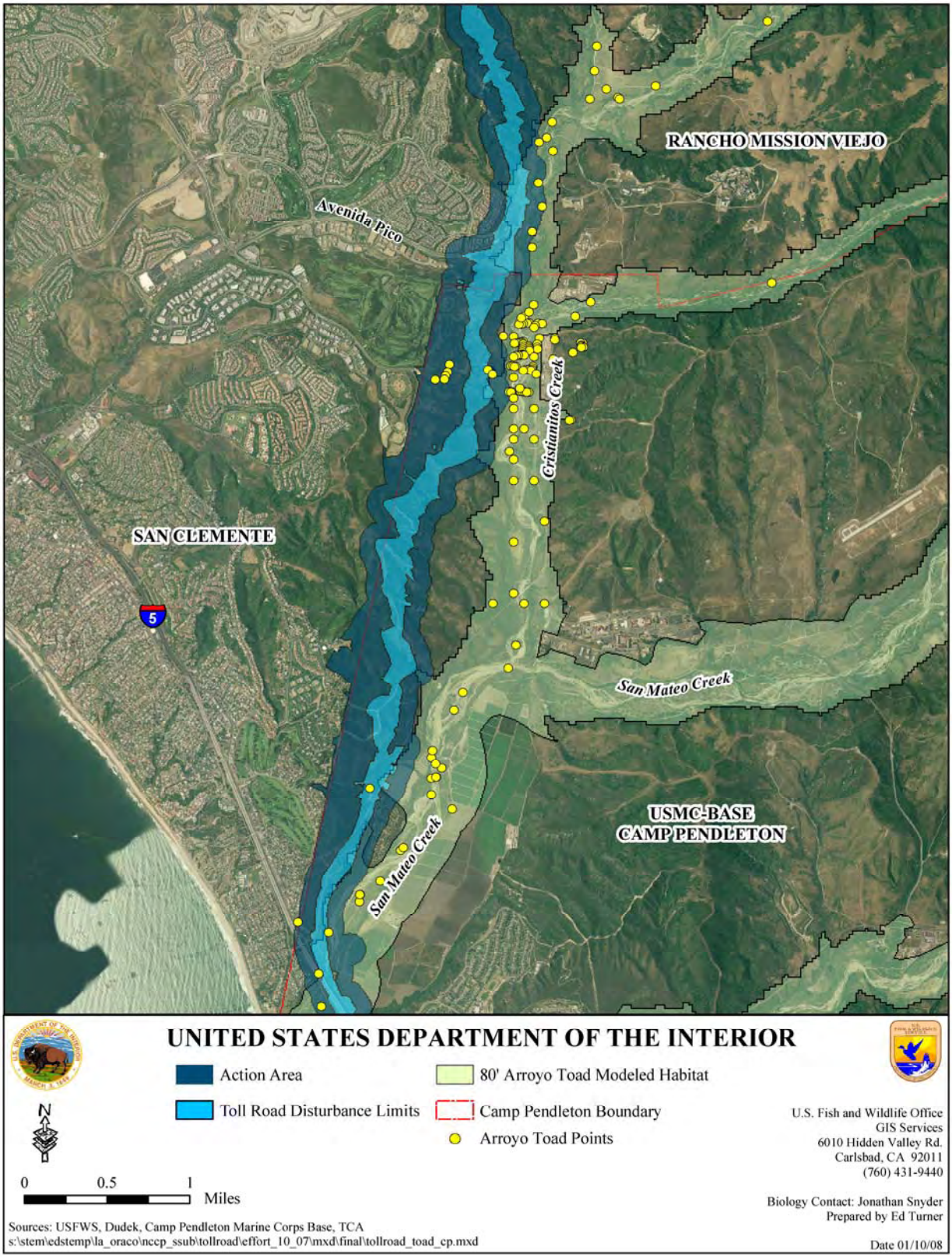

Figure 7. Action area, toll road disturbance limits, and arroyo toad locations at Cristianitos and San Mateo Creeks, Orange and San Diego counties, California.

toads have been impacted. Impacts to riparian habitat on Camp Pendleton have primarily been offset through the Base's conservation program of habitat restoration and removal of giant reed in riparian areas. To date, approximately 314 ha (775 ac) of giant reed and other riparian weeds within approximately 2,833 ha (7,000 ac) of watershed have been treated for removal on the Base (D. Bieber, Camp Pendleton Environmental Security, pers. comm. to J. Terp, Service, 2006). With the eradication program and re-establishment of native vegetation and normal stream processes, an additional nearly 275 ha (680 ac) is or will become available, much of it in known toad-occupied locations. This conservation program supports recovery plan task 1.1.5 of securing populations through monitoring and removing exotic vegetation.

On- and off-road vehicle activity in areas near to riparian toad habitat is an ongoing source of toad mortality on Camp Pendleton. Holland and Goodman (1998b) asserted that roads and stream crossings on the Base are a "major source of mortality" to toads, including eggs, larvae, and breeding adults. No assessment of toad mortality caused by existing on- or off-road vehicle use on the Base has been conducted; however, when illegal off-road activity in San Mateo Creek caused the death of two toads in 2006, the Marine Corps took immediate measures to curtail such activities in that area.

In addition to conservation programs implemented under the programmatic biological opinion for riparian areas on Camp Pendleton, the Marine Corps issues Range and Training Regulations and Environmental Operations Maps to address military activities near known locations of sensitive resources. These regulations outline how activities should be conducted near toad locations including addressing foot traffic, vehicle/equipment operations, and bivouac and field support activities. These specific measures, in addition to general environmental constraints that are applied to all training activities, minimize impacts to toad on Camp Pendleton and support recovery plan task 1.1.2 of limiting access to breeding habitats during breeding season. The Service is currently in consultation with the Marine Corps on activities in the uplands areas of the Base; that consultation will assess impacts from training, fire management, and other activities and the benefit of proposed conservation programs for sensitive upland species, including toad.

Southern Orange County

On December 19, 2002, the Service issued a biological opinion to FHWA for emergency bridge repairs and related activities on Interstate 5 at San Mateo Creek (FWS-MCBCP-3062.2). As part of the consultation, we worked with FHWA and Caltrans on actions to minimize take of arroyo toad. In 2004, we issued a biological opinion to the U. S. Army Corps of Engineers for a detention basin that would serve the Talega housing development (FWS-OR-1226.14) along an unnamed tributary to Cristianitos Creek. Actions to minimize take of toads during this project were implemented, including erection of exclusionary fencing. While some take of toads was authorized, none was documented for either project. Suitable habitat was temporarily unavailable to toads from these projects; however, both projects are now completed, and habitat is again available for occupation by toads.

In January 2007, the Service issued an incidental take permit for the Orange County Southern Subregion HCP authorizing impacts to 179 ha (442 ac) of modeled upland habitat for the arroyo

toad, with most of the impacts occurring along San Juan Creek. Activities authorized under the Orange County Southern Subregion HCP that may occasionally impact arroyo toads, but will not result in a permanent loss of habitat, include cattle grazing, prescribed burns, and infrastructure maintenance. There is significant overlap of the toll road project with development areas and roadways authorized by the HCP.

The Donna O'Neill Land Conservancy and areas on Rancho Mission Viejo outside of the authorized development footprint and road alignments were identified as part of the Habitat Reserve system in the HCP. The Habitat Reserve system was anticipated to be conserved and managed in perpetuity for the benefit of covered species, including the toad, to offset impacts resulting from development and other authorized impacts in the plan area.

In the vicinity of the action area near San Juan Creek, developments authorized under the Orange County Southern Subregion HCP include the following: Planning Areas 1 through 5; creation of a new road (Cow Camp Road) to the north of San Juan Creek; improvements to Ortega Highway south of San Juan Creek; and improvements to Cristianitos Road, which passes over San Juan Creek. The toll road alignment would pass through the development area for PA 2 and PA 5 and partially overlaps the authorized impact area for Cristianitos Road.

In the vicinity of Cristianitos Creek, authorized developments include Planning Area 8 and the extension of Avenida Pico over Cristianitos Creek. The proposed alignment would pass through Donna O'Neill Land Conservancy and west of Planning Area 8, so little of the previously authorized development along Cristianitos Creek is within the action area.

Recovery Goals within the Action Area

According to the arroyo toad recovery plan, "the recovery strategy for the arroyo toad is focused on providing sufficient breeding and upland habitat to maintain self-sustaining populations of arroyo toads throughout the historic range of the species in California and minimizing or eliminating impacts and threats to arroyo toad populations" (Service 1999). Specific recovery tasks within the action area include developing and implementing a management plan for the populations on federal lands and reducing adverse effects to toads on private land by acquiring land, establishing conservation easements and agreements to manage land, and/or developing multiple species habitat conservation plans that accomplish these goals. Among other recovery criteria, downlisting requires that the populations on Camp Pendleton be demonstrated to be self-sustaining, and de-listing requires the conservation and management of the San Juan Creek population. In large part, the identified recovery tasks for this location are being implemented, although ongoing monitoring is necessary to determine whether the toad populations will continue to be self-sustaining. As described above, Camp Pendleton has developed and is implementing a management plan for toad populations on the Base in the form of the programmatic biological opinion for activities affecting riparian areas, and the Orange County Southern Subregion HCP provides for the conservation and management of the most important toad populations on private lands, including the population along San Juan Creek.

Effects of the Action

Habitat Loss and Construction Impacts

In general, effects from constructing the toll road include the temporary and/or permanent removal of feeding, breeding, sheltering, and dispersal habitat and death or injury of individual toads from construction of the road at bridge creek crossings and within the upland project areas. Some toads may be isolated from reaching the creeks due to the road alignment and thus effectively removed from the breeding population. The analysis of potential effects on arroyo toads is based on modeled habitat rather than the number of occurrences. The arroyo toad observations are distributed throughout the identified breeding habitat, and the number of toads at a particular location varies greatly depending on the environmental conditions at the time, so in this instance analyzing impacts and conservation of habitat provides a better indication of likely effects on the population.

For the purposes of this analysis, modeled toad habitat includes potential breeding and upland habitat and is defined as habitat within 24.3 m (80 ft) elevation of a streamcourse in which arroyo toad breeding has been observed. Unsuitable habitats, such as developed areas, were excluded. As described above, because toads congregate and are more active in the breeding habitat, the great majority of toad observations/occurrences (88.7 percent along Cristianitos Creek in a recent study [Holland and Sisk 2001]) are in the stream courses and riparian areas, but upland areas are also essential for the toad as they provide habitat for foraging, dispersal, and aestivating.

The modeled toad habitat likely includes the majority of toads in the upland habitat, but toads occur outside the modeled habitat as well. For example, a study of arroyo toad distribution adjacent to Cristianitos Creek and Santa Margarita River found that 76 percent of successful pitfall traps in the upland environment were inside the 24.3 m (80 ft) elevation boundary (Service 2004 using data from Holland and Sisk 2000), while 24 percent of the successful upland pitfall traps were outside the boundary. Along the west side of Cristianitos Creek where the toll road is proposed, there are a number of arroyo toad occurrences well beyond the 24.3 m (80 ft) elevation boundary (Figure 7).

Excluding areas previously authorized to be impacted under the Orange County Southern Subregion HCP, the toll road will impact about 8.5 ha (20.9 ac) of modeled toad habitat within and adjacent to San Juan Creek, including temporary impacts to 3.1 ha (7.7 ac) of toad breeding habitat resulting from the construction of a bridge over San Juan Creek. During construction of the bridge over San Juan Creek, the temporarily impacted portion of the creekbed will be unavailable for arroyo toad breeding activities. Toads in the project footprint that are not removed consistent with project-associated avoidance and minimization measures will likely be crushed during construction activities.

The area directly beneath the bridge (about 1.4 ha/3.4 ac) will be subject to some shading effects and limited habitat degradation, but the bridge at San Juan Creek will be 12-15 m (40-50 ft) high, which will allow riparian and stream vegetation to grow, providing habitat for cover and

foraging. Bridge pilings under San Juan Creek will permanently remove 0.02 ha (0.05 ac) of toad breeding habitat.

Within the action area on Rancho Mission Viejo and Camp Pendleton, up to 38.1 ha (94.2 ac) of modeled toad habitat proximal to the large breeding populations of toads on Cristianitos and San Mateo creeks will be impacted by construction of the roadway (Figure 7). Most of these impacts will be permanent impacts to upland habitat, but the construction of side-by-side bridges over San Mateo Creek will temporarily impact up to 2.3 ha (5.8 ac) of toad breeding habitat. Construction activities in San Mateo Creek will exclude breeding arroyo toads from the project footprint for up to one year, which is the maximum duration of construction activities at this location. Toads in the project footprint along Cristianitos and San Mateo creeks that are not removed consistent with project-associated avoidance and minimization measures will likely be crushed during construction activities.

The area directly beneath the bridges at San Mateo Creek (about 0.5 ha/1.2 ac) may be subject to some permanent shading and limited habitat degradation, but the bridges are anticipated to be high enough to allow riparian and stream vegetation to grow, providing habitat for cover and foraging. Bridge pilings under San Mateo Creek will permanently remove 0.004 ha (0.01 ac) of toad breeding habitat.

In addition to the direct loss of habitat caused by the toll road, habitat on the west side of Cristianitos and San Mateo creeks will be separated from the creek by the new road. The habitat isolated on the west side of the road is beyond the 24.3 m (80 ft) elevation boundary, so it is not modeled as upland toad habitat, but it does include several arroyo toad observations (Figure 7). If toads are able to move through culverts that will be created under the toll road, there will be some level of connectivity between the upland habitat west of the toll road and the Cristianitos Creek population. However, where the toll road parallels Cristianitos and San Mateo creeks, the culverts are mostly over 100 m (328 ft) in length. While some studies show that amphibians use culverts (*e.g.*, Dodd *et al.* 2004), little is known about amphibian movements using very long length culverts (Jackson and Griffin 2000) that are necessary to pass under the proposed toll road. Arroyo toads isolated on the west side of the toll road where it runs parallel to Cristianitos and San Mateo creeks will likely experience increased mortality and be effectively removed from the breeding population as a result of being separated from creek habitat. Because of the likely effects to toads on the west side of the toll road, the action area includes habitat on the west side of the road with the potential to support toads.

Impacts to 9.3 ha (23.1 ac) of modeled habitat adjacent to Cristianitos Creek and 8.5 ha (20.9 ac) within and adjacent to San Juan Creek will be within the Orange County Southern Subregion HCP Habitat Reserve system, which was anticipated to be conserved and managed in perpetuity for the benefit of covered species, including the toad. Remaining arroyo toad habitat in the Habitat Reserve along San Juan Creek and Cristianitos Creek north of Camp Pendleton will stay in conservation and continue to be managed for the toad and other species. The project will also impact about 3.6 ha (9.0 ac) of the HOLF mitigation site (see Environmental Baseline section above).

We anticipate that construction within toad habitat along San Juan, Cristianitos, and San Mateo creeks will kill or injure any foraging, dispersing or aestivating toads in the affected area, although the number of toads killed during construction will be minimized by implementing the conservation measures described below, including trapping and relocating toads in construction zones and the use of exclusionary fencing around construction areas in toad habitat.

In addition to direct mortality and isolation of toads from breeding habitat, loss of upland areas for foraging, aestivation, and dispersal could affect toad populations through increased competition for limited resources or increased predation risk. However, as described below, substantial areas of upland toad habitat will remain outside the toll road footprint and be available for toad foraging, sheltering, and dispersal (Figure 6, 7).

Toll Road Operation and Maintenance

Because the road crosses through toad habitat, operation of the road could cause death or injury of toads that attempt to cross the road during upland foraging and dispersal. Cleaning of culverts that involves vegetation and sediment removal could kill or injure arroyo toads in the affected area. Culverts and culvert cleanout activities are proposed only in tributaries that do not contain breeding arroyo toad populations, but these culverts often drain into the major drainages that do support breeding arroyo toads. Thus, the areas affected by culvert cleanout may contain a low density of toads that are dispersing, foraging, or aestivating. During routine culvert maintenance, Caltrans will remove a total of no more than 0.05 ha (0.12 ac) of riparian and upland vegetation each year and will disturb no more than 74 sq m (800 sq ft) of sediment at any one culvert. Therefore, the number of toads affected by culvert cleanout activities is anticipated to be small. Routine maintenance and inspection of the bridges at the major drainages that support breeding arroyo toad populations is not anticipated to result in vegetation removal, disturbance of substrate with mechanized equipment, or any activity in the active creek channel, so routine maintenance is not anticipated to affect arroyo toads in the major drainages. Toad breeding habitat could be adversely affected due to reduced water quality from road runoff contaminants such as petroleum products, although conservation measures below are anticipated to minimize potential effects of sedimentation and pollution.

Increased fire frequency could result in increased sedimentation in creeks for the first few years following a fire, which could, in turn, temporarily reduce arroyo toad reproduction. Fires could kill toads in the upland environment that are above-ground at the time of the fire or, if the fire is hot enough, could kill aestivating toads as well. However, arroyo toads are not dependent on a mature vegetation community in the riparian or upland environment, so fire-related effects of the road are not anticipated to permanently degrade the suitability of the habitat for toad unless there is large-scale type conversion of upland habitat into non-native grassland.

Archeological Investigations

Because the investigations involve digging and trenching in upland habitat adjacent to occupied breeding habitat, there is the potential for these activities to kill or injure any arroyo toads aestivating in the investigation sites. However, the investigations will impact a very small

amount of habitat (0.02 ha/0.04 ac), so the number of toads killed or injured, if any, is likely to be very small.

Summary of Conservation Measures

TCA has committed to implementing measures, as described in the DEIS, BA, Project Description, and Riparian HMMP to avoid and minimize impacts to toads during construction including implementation of construction site best management practices and a storm water pollution prevention plan (Appendix 1, WQ-2, WQ-3); and preparation of a general biological resources management plan and toad-specific management plan (Arroyo Toad Resource Management Plan (ATRMP); Appendix 1, TE-10) which the Service will review. These plans will include measures to minimize impacts to toad during grading, clearing, and construction activities including 1) use of exclusion fencing, 2) focused toad surveys prior to ground-disturbing impacts in areas within or adjacent to suitable or occupied habitats, 3) capture and relocation of toads to outside of the impact area, 4) post-construction restoration of affected toad breeding habitat within creeks, and 5) implementation of an exotic predator removal program (Appendix 1, TE-10 through 17). These measures, frequently used in southern California as minimization measures for construction projects, will likely minimize death or injury to the majority of toads within the project footprint. Implementation of an effective predator removal program prior to reintroducing toads may temporarily increase toad survival and reproduction in the action area.

In general, it is anticipated that work in upland areas will be phased to coincide, where possible, with the breeding season of the toad, such that most toads will be in or near creek breeding habitats. Exclusion fencing and pit-fall trapping will be used to capture and relocate toads dispersing from upland to breeding habitats. Some toads could be killed, injured, or stressed during capture and relocation efforts. We anticipate that this number will be very low since these activities will be conducted during periods when only low numbers of toads are expected in upland habitats and the trapping and relocation efforts will be conducted by individuals knowledgeable of toad biology and ecology whose qualifications will be subject to review by the Service.

TCA will create a toad exclusionary fence in areas near toad habitat along the roadway to reduce the likelihood of death or injury of toads from road kill (Appendix 1; Measure TE 5). We anticipate that fencing will act as a barrier that keeps toads off the road and acts as a drift fence to funnel toads to culverts that cross under the road. The road parallels a substantial length of Cristianitos and San Mateo creeks that support a significant a population of toads, and toad locations are as close as 9 m (30 ft) from the road footprint. Therefore, it is likely that toads dispersing and foraging in uplands adjacent to these creeks may attempt to cross the road, especially during wet weather conditions that elicit toad movement. During years where toads have a significant successful breeding event, this could mean that hundreds of juvenile and adult toads will disperse, many of which could move onto the road. Exclusionary fencing at the base of chain link fencing or other fencing at the right of way limits will be an effective toad barrier only as long as it is intact (*e.g.*, no burrowing animals have undermined the fence, no openings in the mesh are present, no debris or soil has piled up to form a “ramp,” toads are unable to climb the mesh). FHWA has indicated that minimization measures of exclusion fencing will be

implemented, and maintenance will be done to a predetermined performance standard (M. Gray, FHWA, letter to J. Bartel, Service, October 27, 2005). The efficacy and maintenance of a barrier is crucial to preventing road kill of toads during road operation. It is possible that arroyo toads may be killed occasionally if the barrier fails at a time when arroyo toads are dispersing.

The project will implement specific measures (Appendix 1; *e.g.*, WQ-6, WW-9) incorporating best management practices and runoff management. These road design features include construction and maintenance of extended detention basins that are designed to capture "first flush" rainfall off the roadway to filter contaminants in a natural filtration system and return water in a condition that meets discharge standards and maintains the flow regimes of drainages crossed by the alignment through the use of appropriately sized culverts to convey flows. Extended detention basins are anticipated to improve water quality by removing runoff pollutants that would otherwise reach the watershed (DeBusk 1999; Interstate Technology and Regulatory Council 2003). Implementation of these plans should ensure that road runoff will meet water quality standards set by responsible agencies (*e.g.*, California Regional Water Quality Control Board, U. S. Environmental Protection Agency). The implementation of these measures should result in no significant difference in conditions for the toad at San Juan and San Mateo creeks due to the toll road project.

Removal of 8.1 ha (20.0 ac) of arundo and other invasive non-native aquatic vegetation will be enhance the quality of the restored habitat for breeding, foraging, dispersing, and aestivating by arroyo toads. At least 2.0 ha (5.0 ac) of arundo removal will be conducted in drainages affected by the toll road, but there may not be infestations of arundo available to conduct all 8.1 ha (20.0 ac) of restoration at these locations, so this measure may benefit arroyo toad populations at other locations in southern California. Removal of non-native aquatic vegetation has the potential to kill or injure individual toads in the affected area, particularly when mechanized equipment is used. Avoidance and minimization measures will minimize negative impacts to arroyo toad associated with non-native vegetation removal. These measures include the following: conducting non-native vegetation removal outside the toad breeding and dispersal season; having a qualified biological monitor present during vegetation removal and soil disturbing activities; and relocating any toads observed in the project footprint. Furthermore, the long term benefit to arroyo toad populations resulting from arundo removal is much greater than the potential impact of harming a few individuals during arundo removal activities.

Caltrans maintenance activities will be conducted in a manner that minimizes potential effects to arroyo toads. Toad exclusionary fencing around extended detention basins will prevent toads from being killed or injured during routine maintenance activities in the basins, and a monitoring biologist will ensure that potential impacts to toad habitat associated with culvert cleanout are kept to the minimum necessary. No impacts to toad breeding habitat are anticipated in association with routine maintenance.

Effects in a Landscape Context (Including Lands outside the Action Area)

There are an estimated 1,073.5 ha (2,652.6 ac) of modeled arroyo toad habitat along San Juan Creek outside the project footprint. Thus, the 8.5 ha (20.9 ac) of project-related impacts along San Juan Creek constitute about 0.8 percent of the modeled toad habitat along the creek. The

great majority of the remaining habitat along San Juan Creek is within the Habitat Reserve and the Cleveland National Forest. Remaining toad habitat within the Habitat Reserve is anticipated to be conserved and managed in perpetuity, and consistent with the Land Management Plan for Southern California National Forests (U. S. Forest Service 2005), no new roads or trails are anticipated in occupied toad habitat in the Cleveland National Forest. The toll road will create a barrier to dispersal through the upland environment immediately north and south of San Juan Creek. However, a telemetry study of toads in San Juan Creek documented dispersal of toads primarily within the wide, sandy creek bottom as opposed to the adjacent upland environment, so there should continue to be connectivity within the San Juan Creek population following construction of the toll road.

Of the impacts along Cristianitos and San Mateo creeks, most of the affected area (24.6 ha/60.9 ac) will be along the west side of the creeks. About 310.3 ha (766.7 ac) of modeled arroyo toad habitat will remain outside the project footprint along the west side of Cristianitos and San Mateo creeks. Thus, the project will impact an estimated 7.3 percent of the remaining habitat on the west side of the creek. With the exception of the creek crossing at San Mateo Creek and impacts associated with the on/off ramps, all of the habitat on the east side of Cristianitos and San Mateo creeks will remain unaffected. For toads on the west side of the creek, the toll road will create a substantial barrier to north/south dispersal through the upland environment. However, consistent with observations from other populations, most north/south dispersal for the Cristianitos and San Mateo creek populations is likely to occur within the sandy creek channel, and the toll road will not create a barrier to dispersal within the creek channel itself.

Summary of Effects to the Species and Recovery

The proposed project will permanently impact about 41.2 ha (101.6 ac) of modeled toad habitat consisting primarily of upland habitat. The project will temporarily impact 5.4 ha (13.5 ac) of modeled toad habitat consisting primarily of toad breeding habitat. In addition, the project will isolate an unquantified amount of upland habitat that is occupied by toads but not captured by the model. Habitat that will be isolated lies west of the future toll road, where the road parallels Cristianitos and San Mateo creeks. The impacts to and isolation of upland arroyo toad habitat are not offset by the proposed project. Loss of upland areas for foraging, aestivation, and dispersal could affect toad populations through increased competition for limited resources or increased predation risk. However, as described above, a great majority of the upland habitat will remain outside the toll road footprint (Figure 6, 7), which is anticipated to support toad foraging, sheltering, and dispersal activities.

The removal of 8.1 ha (20.0 ac) of arundo from arroyo toad breeding habitat is anticipated to enhance breeding habitat for the species. At least 2.0 ha (5.0 ac) of the arundo removal will be conducted in the drainages impacted by the toll road, and this will enhance habitat for arroyo toad breeding, foraging, aestivating, and dispersal for the affected populations.

Because of the impacts to upland toad habitat and connectivity, the proposed project will not benefit toad recovery, but it is not anticipated to substantially impair recovery. Following project completion, sufficient upland habitat and connectivity is anticipated to remain for local toad populations to continue to be self-sustaining, and most of the effects to breeding habitat will be

temporary. The major recovery tasks for the area, including a management plan for toad populations on federal land (i.e., Camp Pendleton) and conservation and management of populations on private land (i.e., Rancho Mission Viejo) are already in place and will continue to be implemented following project completion. The arundo removal will assist these efforts, and with the additional proposed conservation measures, the proposed project will not prevent these plans from accomplishing the recovery goals.

Conclusion

After reviewing the current status of the arroyo toad, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that construction, operation, and maintenance of the proposed toll road is not likely to jeopardize the continued existence of the toad. We base this conclusion on the following:

1. Most of the impacts to toad breeding habitat (5.5 ha/13.5 ac) will be temporary; only a small amount of breeding habitat will be permanently lost.

2. Within the action area, the toll road will permanently remove up to 41.1 ha (101.6 ac) of modeled toad habitat, consisting primarily of toad upland habitat. Despite the substantial net loss of habitat associated with the project, the great majority of habitat along San Juan, Cristianitos, and San Mateo creeks within and outside the action area will remain available to support the upland habitat needs of the species.

3. Removal of 8.1 ha (20.0 ac) of arundo and other non-native invasive riparian plant species will enhance habitat for breeding, foraging, aestivating, and dispersal by the arroyo toad. At least 2.0 ha (5.0 ac) of the arundo removal is anticipated to benefit arroyo toad populations affected by the toll road.

4. Connectivity will be maintained within and between the major drainages supporting toad in the action area because large bridges will span San Juan and San Mateo creeks and no bridges will be placed in Cristianitos Creek.

5. The number of individual toads killed by road construction in breeding and upland habitats will be minimized through trapping and relocation efforts conducted by qualified individuals knowledgeable of toad biology.

6. Impacts to water quality will be addressed through implementation of specific runoff management plans and project design features.

7. Construction and maintenance of a toad barrier will minimize road kill of toads over the life of the project.

8. With implementation of the conservation measures, the impacts associated with the proposed toll road are not expected to appreciably reduce the numbers, reproduction, or distribution of the toad in the action area or throughout the species' range. The arroyo toad populations in each of the major drainages affected by the toll road are anticipated to remain viable for the foreseeable future following project implementation.

COASTAL CALIFORNIA GNATCATCHER
(*Polioptila californica californica*)

Conservation Measures

In addition to the general avoidance and minimization measures described in Appendix 1, including replanting of cut and fill slopes and temporarily impacted habitat, the following measures have particular relevance for the gnatcatcher:

- Pre-construction surveys will be conducted prior to vegetation clearing, and clearing will be monitored to avoid direct impacts to gnatcatchers including the removal of vegetation being actively used by breeding gnatcatchers (Appendix 1, TE-18 and TE-19);

- Conservation of 327 credits (132.3 ha/327.0 ac) of coastal sage scrub in the Upper Chiquita Canyon Conservation Area (Appendix 1, TE-25);

- 97.5 ha (241.0 ac) of coastal sage scrub and 37.2 ha (92.0 ac) of scrub/native grassland ecotone will be restored in the Chiquita Canyon Conservation Area (Project Description, Upper Chiquita HRP); 2.0 ha (4.9 ac) of scrub/native grassland ecotone will be restored in association with the restoration site in Chiquita Canyon near Tesoro High School; 60.7 ha (150.0 ac) of COASTAL SAGE SCRUB will be restored in Crystal Cove State Park (Project Description, Riparian HMMP).

Status of the Species

Listing Status

The Service listed the gnatcatcher as threatened on March 30, 1993 (58 FR 16742). Pursuant to section 4(d) of the Act, on December 10, 1993, the Service defined specific conditions associated with certain land use activities under which incidental take of gnatcatchers associated with loss of their habitat would not be a violation of section 9 of the Act (58 FR 65088). The Service published a final rule designating critical habitat for the gnatcatcher on October 24, 2000 (65 FR 63680). As a result of various lawsuits and court decisions, the Service reconsidered the critical habitat and its economic analysis. The Service re-proposed critical habitat for the gnatcatcher on April 24, 2003, and in the same rule we sought comments and information to consider changing the listing of the gnatcatcher subspecies as a distinct vertebrate population segment rather than a subspecies on the endangered species list (68 FR 20228). We published a notice of availability of a draft economic analysis for the proposed critical habitat on April 8, 2004 (69 FR 18516). On April 3, 2007, the Service announced the reopening of the public comment period on the 2003 proposed designation. The Service published the revised final designation of critical habitat for the gnatcatcher on December 19, 2007 (72 FR 72010). No critical habitat for gnatcatcher is designated within the action area.

Species Description

The coastal California gnatcatcher (gnatcatcher) is a small, long-tailed member of the thrush family (Muscicapidae) that is endemic to cismontane southern California and northwestern Baja California, Mexico (Atwood 1980, 1988, 1990, 1991; American Ornithologists' Union (AOU) 1983, 1989). Its body plumage is dark blue-gray above and grayish-white below, while the tail is mostly black above and below. The male has a distinctive black cap that is absent during the winter and both sexes have a distinctive white eye-ring. Vocalizations of this species include a call consisting of a rising and falling series of three kitten-like mew notes. The gnatcatcher is distinguished from the black-tailed gnatcatcher (*Polioptila melanura*) by its darker body plumage, less extensive white on tail feathers (rectrices 5 and 6), and longer tail.

Habitat Affinities

The gnatcatcher is an insectivorous species that typically occurs in or near coastal sage scrub, which is composed of relatively low-growing, dry-season deciduous, and succulent plants. Characteristic plants of these communities include California sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), laurel sumac (*Malosma laurina*), lemonade berry (*Rhus integrifolia*), bush penstemon (*Keckiella antirrhinoides*), *Salvia* spp., *Encelia* spp., and *Opuntia* spp. (Atwood 1990; Beyers and Wirtz 1997; Braden *et al.* 1997a; Weaver 1998).

Coastal sage scrub has been estimated to have historically covered nearly 1 million ha (2.5 million ac) of coastal California (Barbour and Major 1977), although anthropogenic development and land conversion have substantially depleted this habitat (Kirkpatrick and Hutchinson 1977; Axelrod 1978; Klopatek *et al.* 1979; Westman 1987; O'Leary 1990), with potentially less than 15 percent of the original acreage of coastal sage scrub remaining (Westman 1981a, 1981b). In addition to agricultural use and urbanization, increased fire frequency and the introduction of exotic plants have had an adverse impact on coastal sage scrub (O'Leary 1990).

Coastal sage scrub is patchily distributed throughout the range of the gnatcatcher, and gnatcatchers are not uniformly distributed within the structurally and floristically variable. Gnatcatchers occur most frequently within California sagebrush-dominated stands of coastal sage scrub (Atwood 1990; Atwood *et al.* 1998a, 1999; Beyers and Wirtz 1997), and Weaver (1998) found that gnatcatcher densities in northern San Diego County are highest in areas where California buckwheat or California encelia (*Encelia californica*) are co-dominant with sagebrush. Despite these general habitat preferences, all shrub species within coastal sage scrub are used by gnatcatchers. Gnatcatchers are typically found in stands of coastal sage scrub that have moderate shrub canopy cover (40-80 percent) (Atwood 1980, 1988; Beyers and Wirtz 1997). The relative density of shrub cover influences gnatcatcher territory sizes, with territory sizes increasing as shrub cover decreases, probably due to limited resource availability. Gnatcatchers will use sparsely vegetated coastal sage scrub as long as perennial shrubs are available, although there appears to be a minimum cover threshold below which the habitat becomes unsuitable (Beyers and Wirtz 1997). Braden *et al.* (1997a) found that gnatcatcher fitness is positively correlated with the structural complexity of vegetation within territories; however, structural complexity does not necessarily equate to canopy cover or habitat maturity (G. Braden, pers. comm. to C. Collier; Service, 2000).

Gnatcatchers also use chaparral, grassland, and riparian plant communities where they occur adjacent to, or intermix with, coastal sage scrub (Campbell *et al.* 1998). The use of these atypical habitats appears to be most frequent during late summer, autumn, and winter, with smaller numbers of birds using non-coastal sage scrub areas during the breeding season. However, breeding territories have been documented in non-coastal sage scrub (*e.g.*, chaparral, grassland, ruderal habitats).

Fire is a natural component of coastal sage scrub ecology (Holland and Keil 1995), but frequent fires may alter species composition of the community by breaking the reproductive cycles of some species, like California sagebrush and California buckwheat (Zedler *et al.* 1983; Malanson and Westman 1985; Holland and Keil 1995). Frequent fires may lead to the conversion of coastal sage scrub into grasslands (Callaway and Davis 1993). Due to loss of shrub cover, recently burned areas are used infrequently by gnatcatchers, and 4 to 5 years may be the minimum period of vegetation recovery necessary before gnatcatchers establish territories within completely burned areas (Wirtz *et al.* 1997; Atwood and Bontrager 2001). The period of habitat recovery necessary before gnatcatchers reoccupy burned areas depends on fire intensity, existence of unburned refugia within or adjacent to the burn perimeter, seasonal timing of the burn, soil type, post-fire rainfall patterns, topography, and pre-fire habitat conditions (Atwood *et al.* 2000).

For example, in the Central and Coastal Orange County NCCP/HCP Reserve, a fire burned approximately 2,720 ha (6,721 ac) of coastal sage scrub in the San Joaquin Hills in 1993 (Bontrager *et al*. 1995). Prior to the fire, an estimated 127 gnatcatcher pairs occupied the burn area in 1992 (Bontrager *et al*. 1995). In 1996, an estimated 8 pairs of gnatcatchers occurred in the burn area, but by 1999, approximately 79 pairs occurred in the burn area (Harmsworth Associates 2000). The most recent survey for gnatcatchers specifically occupying the burn area was conducted in 2001 for which 79 pairs were again observed (Harmsworth Associates 2001).

Life History

Gnatcatchers are nonmigratory and exhibit strong site tenacity (Atwood 1990). Gnatcatcher pairs strongly defend territories during the breeding season against other gnatcatchers and predators, while some gnatcatcher pairs will also defend territories throughout the year (Preston *et al.* 1998). Breeding season territories range in size from less than 1 ha to greater than 10 ha (2.5 ac to 25 ac) (Atwood *et al.* 1998b; Preston *et al.* 1998), with mean territory size generally being greater for inland populations than coastal populations. In the non-breeding season, the area used by individual gnatcatchers may be almost twice as large as that used during the breeding season (Preston *et al.* 1998).

Most gnatcatchers first breed at 1 year of age (Atwood and Bontrager 2001). The gnatcatcher breeding season extends from late-February through early-August with the peak of nesting attempts occurring from mid-March through mid-May (Grishaver *et al.* 1998; Atwood and Bontrager 2001). Nests are constructed over a 4-10 day period and are most often placed in perennial species of coastal sage scrub about 1.2 m (3.9 ft) above the ground (Atwood 1990). Gnatcatchers do not show any significant preference or avoidance of any coastal sage scrub species for use in the placement of nests (Grishaver *et al.* 1998). Gnatcatchers typically lay

clutches of 3 to 5 eggs (Atwood 1990; Galvin 1998; Grishaver *et al.* 1998), and clutch sizes may be influenced by the amount of precipitation immediately preceding nest initiation (Patten and Rotenberry 1999). The egg incubation period is 14 days, and the nestling period is 10 to 15 days (Grishaver *et al.* 1998). Both sexes participate in all phases of the nesting cycle, and gnatcatcher pairs may produce more than one brood in one nesting season (Atwood 1990; Grishaver *et al.* 1998). Predation is the most common cause of nest failure, accounting for up to 66 percent of nest failures in some areas (Braden *et al.* 1997b; Grishaver *et al.* 1998). Over 30 percent of all nests may be parasitized by the brown-headed cowbird (*Molothrus ater*) in the absence of cowbird trapping, but because many parasitized nests are eventually depredated, the negative effects of parasitism may be outweighed by the much larger effects of predation (Braden *et al.* 1997b).

Juveniles stay within their natal territories up to 5 weeks after fledging from the nest (Grishaver *et al.* 1998), with juveniles subsequently dispersing to find their own foraging and nesting territories. Juveniles have been observed to disperse up to 10.0 km (6.2 mi) from their natal territory (Atwood and Bontrager 2001), but they generally disperse less than 3.0 km (1.9 mi) on average (Bailey and Mock 1998; Galvin 1998; Atwood and Bontrager 2001). Dispersing gnatcatchers are apparently able to traverse highly human-modified landscapes for at least short distances (Bailey and Mock 1998).

Similar to other passerine species, gnatcatcher mortality is highest for the youngest age class, with much of this attributable to predation of young in nests (Atwood 1990; Braden *et al.* 1997b) and high mortality rates among dispersing juveniles, as indicated by low re-sighting of banded birds (Bailey and Mock 1998; Galvin 1998). Sources of mortality for gnatcatchers have not been well-studied, although physiological stress during cold, wet winter months when food availability may be low is probably the main source of mortality among adults and dispersing juveniles (Atwood 1990; Atwood and Bontrager 2001). Mean average survivorship of gnatcatchers during their first year is estimated to be 29 percent, with annual survivorship for adults 57 percent, although there is probably a high annual variation within and between populations (Atwood and Bontrager 2001). The oldest documented individual was a female at least 8 years old (Atwood and Bontrager 2001).

Status and Distribution

The gnatcatcher is found on the coastal slopes of southern California, from southern Ventura southward through Los Angeles, Orange, Riverside, San Bernardino, and San Diego counties into Baja California, Mexico to approximately 30 degrees North latitude near El Rosario (AOU 1957; Atwood 1980, 1990; Service 2000, 2003). Today, approximately 94 percent of the gnatcatchers in the United States are found in Orange, western Riverside, and San Diego counties (Atwood and Bontrager 2001). Small, extremely isolated populations remain in portions of its former range in Los Angeles, San Bernardino, and Ventura counties; however, wildland fires may have adversely affected the status of gnatcatchers in some of these areas.

Gnatcatchers were considered locally common in the mid-1940s, but they had declined substantially in the United States by the 1960s (Atwood 1980). Although observed declines in numbers and distribution of the gnatcatcher resulted from numerous factors, habitat destruction,

fragmentation, and degradation are the principal reasons for the Federal listing of the gnatcatcher as threatened in 1993 (58 FR 16742).

Urban development projects are currently the primary source of gnatcatcher habitat loss and fragmentation. Since the listing of the gnatcatcher, the Service has worked with project proponents to offset the loss of occupied or potential gnatcatcher habitat caused by development projects. This has been achieved through conservation, enhancement, and/or restoration of coastal sage scrub on or near project sites, as agreed to during interagency consultation or the habitat conservation planning (HCP) process. Gnatcatcher habitat conservation, enhancement, and restoration since the listing of the gnatcatcher are likely to have offset coastal sage scrub loss to some degree and buffered any decline in the gnatcatcher population caused by habitat destruction. Restored habitat has the potential to support gnatcatchers when there is a source population nearby that can access the restored site (O'Connell and Erickson 1998; Miner *et al.* 1998). When combined with conserved coastal sage scrub, enhanced and restored coastal sage scrub has the potential to support a stable gnatcatcher population. For example, in 1993, the Coyote Hills East Preserve area had about 12 pairs of gnatcatchers on approximately 40.5 ha (100 ac) before development impacts and the implementation of habitat restoration associated with the HCP. By 2001, 24 pairs of gnatcatchers and 2 single males were present (Natural Resource Consultants 2001) and in 2005, about 22 gnatcatcher pairs were estimated to be present on the site which now consists of about 24.3 ha (60 ac) of preserved habitat and 24.3 ha (60 ac) of restored habitat (Center for Natural Lands Management 2006).

Population Dynamics and Estimates

The abundance of gnatcatchers at a given locale can fluctuate extensively on an annual basis (Atwood *et al.* 1998a; Erickson and Miner 1998; Preston *et al.* 1998); population declines or increases of greater than 50 percent between successive years have been reported regularly. Population fluctuations appear to be influenced by precipitation (Atwood *et al.* 1998a; Erickson and Miner 1998; Patten and Rotenberry 1999), with over-winter survivorship being negatively affected and subsequent productivity being positively affected by high winter precipitation. This dynamic relationship between winter precipitation, survivorship and productivity has been noted for other resident bird species in coastal southern California (Kus and Beck 2001) and the Pacific coast (Nott *et al.* 2002).

Stability of gnatcatcher populations may be negatively affected by increasing fragmentation (Atwood and Bontrager 2001), with populations in small, isolated fragments more susceptible to extirpation from stochastic (*i.e.*, drought) or catastrophic (*i.e.*, wildfire) events. Gnatcatcher conservation efforts are directed at preserving relatively large, contiguous patches of coastal sage scrub suitable for gnatcatchers (Service 1993, 2000, 2003).

In 1993, the Service estimated that approximately 2,562 pairs of gnatcatchers remained in the United States. Of these, 30 pairs (1.2 percent) occurred in Los Angeles County, 757 pairs (29.5 percent) occurred in Orange County, 261 pairs (10.2 percent) occurred in Riverside County, and 1,514 pairs (59.1 percent) occurred in San Diego County. In October 1996, the Service estimated the total number of gnatcatchers in the United States at 2,899 pairs (Service 1996). Because the amount of coastal sage scrub available to the gnatcatcher is believed to have

decreased from 1993 to 1996, the increase in estimated abundance from 1993 to 1996 may have reflected increased sampling effort and stochastic effects rather than an upward trend in the gnatcatcher population. In the most recent assessment of the range-wide gnatcatcher population, the Service determined that there was insufficient quantitative data to determine whether the overall gnatcatcher population had increased or decreased from 1996 to 1999 (Service 1999). To begin to address gnatcatcher populations quantitatively, a study was conducted in 2002 by the Service. Preliminary results for the 32,343-ha (79,923-ac) study area of public and quasi-public lands in Orange and San Diego counties indicated differing estimates of populations for the sampled area based on differing sample methods. Over the 32,343 ha (79,923 ac), a distance sampling method (arithmetic average) estimated 1,767 pairs, an auditory removal method (arithmetic average) estimated 1,324 pairs, a presence/absence method (naïve estimator) estimated 2,625 pairs, and a presence/absence method (Royle and Nichols estimator) estimated 3,009 pairs (Service unpublished data). We caution that these estimates apply only to the areas surveyed for a specific period of time and that they have not been fully agency or peer-reviewed.

All the population estimates described above were calculated prior to catastrophic fires in San Diego County in 2003 and San Diego and Orange Counties in 2007. These fires are assumed to have temporarily reduced the overall gnatcatcher population because of the temporary loss of gnatcatcher occupied habitat. In the 2007 firestorm, approximately 11,401 ha (28,173 ac) of coastal sage scrub burned in Orange County in the vicinity of Santiago Canyon and approximately 34,075 ha (84,202 ac) of coastal sage scrub burned in San Diego County in several separate locations. The Orange County fire was particularly devastating to the loss of occupied gnatcatcher habitat in the central portion of the Central and Coastal NCCP/HCP Reserve. However, gnatcatcher populations remain to the north and south of the Santiago Canyon burn area and are connected to the burn area through habitat corridors. Further, we expect that much of the burned coastal sage scrub will recover and be suitable for gnatcatchers in several years as discussed above in *Habitat Affinities* if fire does not recur too frequently in these areas. The Service is working with the management entities for the regional HCP reserve areas in San Diego and Orange Counties to determine the progress of the recovery of coastal sage scrub and the re-establishment of gnatcatcher territories in the burn areas.

Threats and Conservation Needs

It is estimated that up to 90 percent of coastal sage scrub was lost as a result of development and land conversion (Barbour and Major 1977; Westman 1981a, 1981b), and it is considered to be one of the most depleted habitat types in the U. S. (Kirkpatrick and Hutchinson 1977; O'Leary 1990). Although declines in numbers and distribution of the coastal California gnatcatcher have resulted from numerous factors, the loss, fragmentation, and adverse modification of habitat are considered to be the principal reasons for the federally threatened status (58 FR 16742). In addition, agricultural use, such as grazing and field crops, urbanization, air pollution, increases in fire frequency, and the introduction of exotics have all had an adverse impact on coastal sage scrub. Finally, nest-parasitism by the brown-headed cowbird (Unitt 1984) and nest predation threaten the gnatcatcher (Atwood 1980; Unitt 1984).

A consequence of urbanization that is contributing to the loss, degradation, and fragmentation of coastal sage scrub is an increase in wildfire frequency (Keeley and Fotheringham 2001). High

fire frequencies and the lag period associated with recovery of the vegetation may significantly reduce the viability of affected gnatcatcher subpopulations (Dudek 2000). Increased fire frequency also can lead to type-conversion to non-native grasses (Stephenson and Calcarone 1999). Fire history maps of most of Orange, western Riverside, and San Diego Counties dating back to the early 20th century are available. The Service is working with the management entities for the regional HCP reserve areas in San Diego, western Riverside and Orange counties to determine if type-conversion is occurring and if gnatcatcher subpopulations previously effected by fire are recovering.

Although fire continues to be a threat, the several large regional HCPs in southern California mentioned above have addressed many other effects of urban development on this species. These plans are expected to provide long-term protection of occurrences of gnatcatchers and gnatcatcher habitat in western Riverside, Orange, and San Diego counties. For example, for the San Diego MSCP, Central/Coastal Orange County HCP, and Western Riverside MSHCP, between 42 and 80 percent of gnatcatcher locations are expected to be conserved; also for these plans, 52 to 76 percent of gnatcatcher habitat acres are expected to be conserved. The Orange County Southern Subregion HCP anticipates conservation of 86 percent of locations and 88 percent of suitable habitat. Additional management and restoration of coastal sage scrub on public and private lands as part of HCPs or through other conservation efforts will improve dispersal linkages and breeding habitat and will further aid the persistence and recovery of the species.

Status of Gnatcatchers in the Vicinity of the Proposed Project

Populations of gnatcatchers are found within the general project area in Chiquita Canyon (Figure 8) and along the northwestern boundary of Camp Pendleton at the Orange and San Diego county line (Figure 9). According to the Orange County Southern Subregion HCP, 737 locations of gnatcatchers (which may be pairs or individuals) were present in the planning area for southern Orange County (County of Orange 2006). Greater Chiquita Canyon (which includes the "horseshoe" area at the north end of Coto de Caza, the Chiquita Canyon Conservation Area, middle and lower Chiquita Canyon, the Chiquita/Gobernadora ridge area and Wagon Wheel Canyon) is identified as a major population with about 404 locations and is also identified as a key location because it is central to several other important populations in the subregion as well as populations to the south on Camp Pendleton (County of Orange 2006). Of the 404 locations in greater Chiquita Canyon, about 153 locations (38 percent) are in middle and lower Chiquita Canyon, which we will refer to simply as Chiquita Canyon. These gnatcatcher locations are based on two cumulative datasets produced by Dudek and Associates in 1997 and 2001 (County of Orange 2006) as described in the effects section in more detail. Briefly, these two Dudek datasets compiled cumulative survey efforts along all of the proposed toll road alignments including the proposed project and other unrelated gnatcatcher survey efforts as shown in Figure 8. Including gnatcatcher locations from other years did not clarify the analysis of project-related effects, so only data from 1997, 2001, and 2003 (on the Base only) are included in the figures.

The first surveys for gnatcatchers on Camp Pendleton were conducted in 1989 (Tutton 1991) and detected 169 gnatcatcher territories, excluding the State Park lease area, which the action area

falls within. A study in 1994 (Griffith Wildlife Biology (GWB) 1997) detected 479 territories, also excluding the State Park lease area. Surveys for gnatcatchers in 1998 (Atwood *et al.* 1999) identified 620 territories, including the State Park lease area. Surveys conducted in 1999 at a subset of locations surveyed in 1998 showed an 83 percent increase in the estimated number of gnatcatchers in 1999 versus 1998 at these locations (Atwood *et al.* 2000). In 2003, 316 gnatcatcher territories were identified (GWB 2004). Thirty of the territories (9.5 percent) were in the area between San Mateo Creek and the Base's northwestern boundary along the Orange/San Diego County line in the State Park lease area and another 10 (3.2 percent) were in the vicinity of toll road connections to and improvements on Interstate 5. Draft gnatcatcher survey data for 2006 provided by Camp Pendleton indicated about 668 territories on the Base (Eric Kershner pers. comm. 2007); this is over twice as many territories as were observed in 2003. However, the territory numbers in the San Mateo Creek/State Park portion of the Base do not appear to have experienced this increase and have apparently declined slightly. Approximately 28 territories were noted in 2006 between San Mateo Creek and the Base's northwestern boundary where 30 territories were noted in 2003. Because the gnatcatcher locations from 2003 are the most recent data we have in a format that can be mapped and were gathered throughout the southern portion of the project, they are depicted in Figure 9 in addition to the 1997 and 2001 data. Based on past surveys, it appears that most of the coastal sage scrub within the action area in the southern section is occupied, although the portion of the toll road alignment within 4.8 km (3.0 mi) of the coast is particularly dense with gnatcatcher territories.

GWB (1997) attributed the increase in the estimated gnatcatcher population from 1989 to 1994 to an increase in survey effort plus a real increase in the population. Atwood *et al.* (1999) attributed increases between the 1994 and 1998 population estimates to differences in survey effort and the 1999 increase to greater survey effort and a potential population increase (Atwood *et al.* 2000). An overall lack of comparability between these studies' methodologies and level of effort limits the ability to evaluate gnatcatcher population trends on Camp Pendleton, but it is likely that a real increase occurred between 1989 and 1998. Potential population increases from 1989 to 1998 may be the result of normal population fluctuations (Atwood *et al.* 2000), an increase in habitat acreage, improvement in habitat quality, and/or a decline in cowbird parasitism. GWB (2004) attributed the decline in the estimated gnatcatcher population between 1998 and 2003 to differences in survey timing and probable real declines in the gnatcatcher population in that time period. It is possible that prevailing precipitation cycles influenced the gnatcatcher population on the Base similar to that observed at other sites (Erickson and Miner 1998; Patten and Rotenberry 1999); the 2003 surveys were at the end of a drought period, while the 1998 surveys were conducted during a relatively wet cycle. The approximately 50 percent decline in the population is comparable to that occasionally witnessed at other sites (Erickson and Miner 1998; Preston *et al.* 1998). Since the results from 2006 surveys on the Base are still being analyzed, and no accompanying report has been prepared, no explanation has yet been provided about differences between the 2006 results and previous surveys.

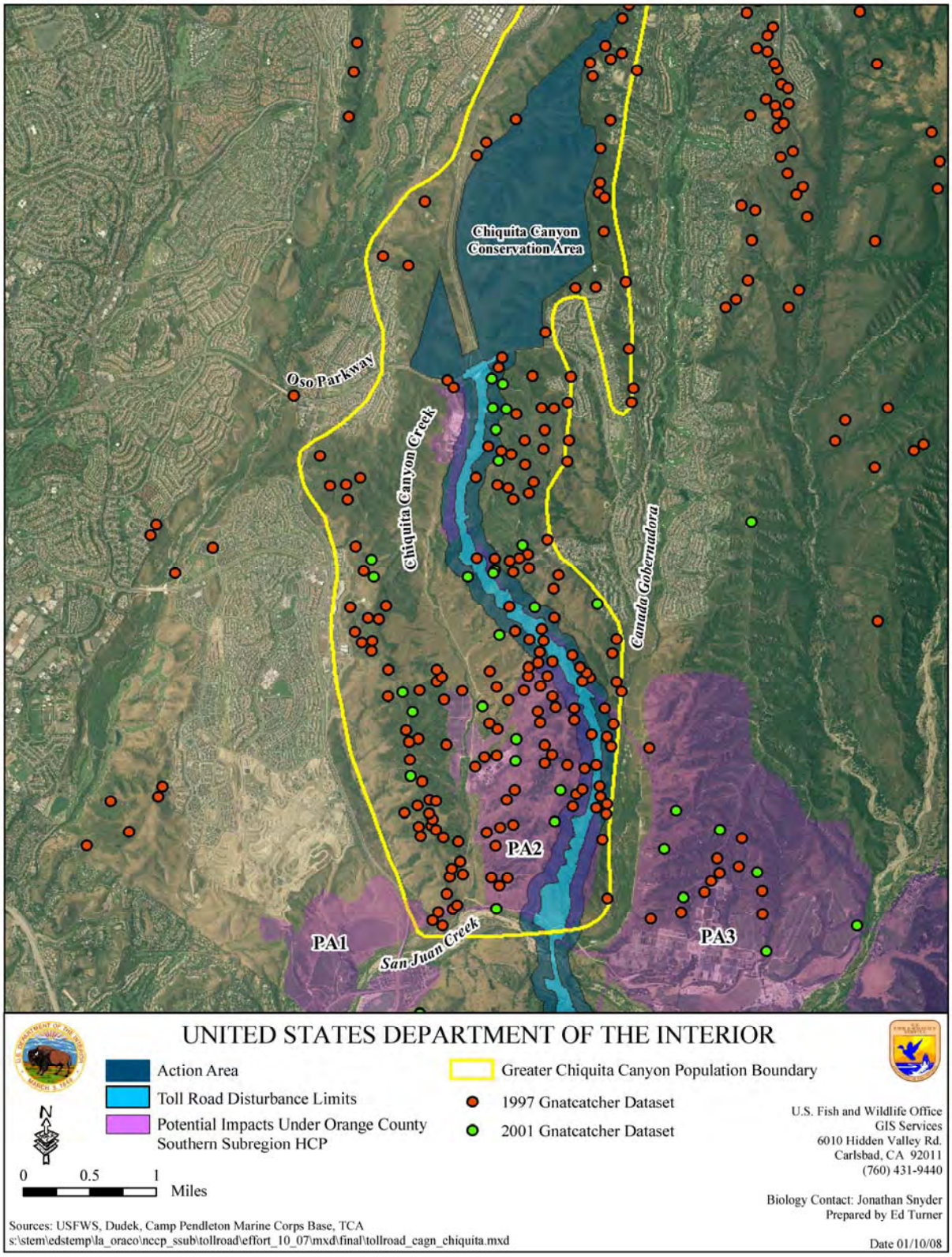

Figure 8. Coastal California gnatcatcher territories in the proposed toll road project area in Chiquita Canyon, Orange County, California.

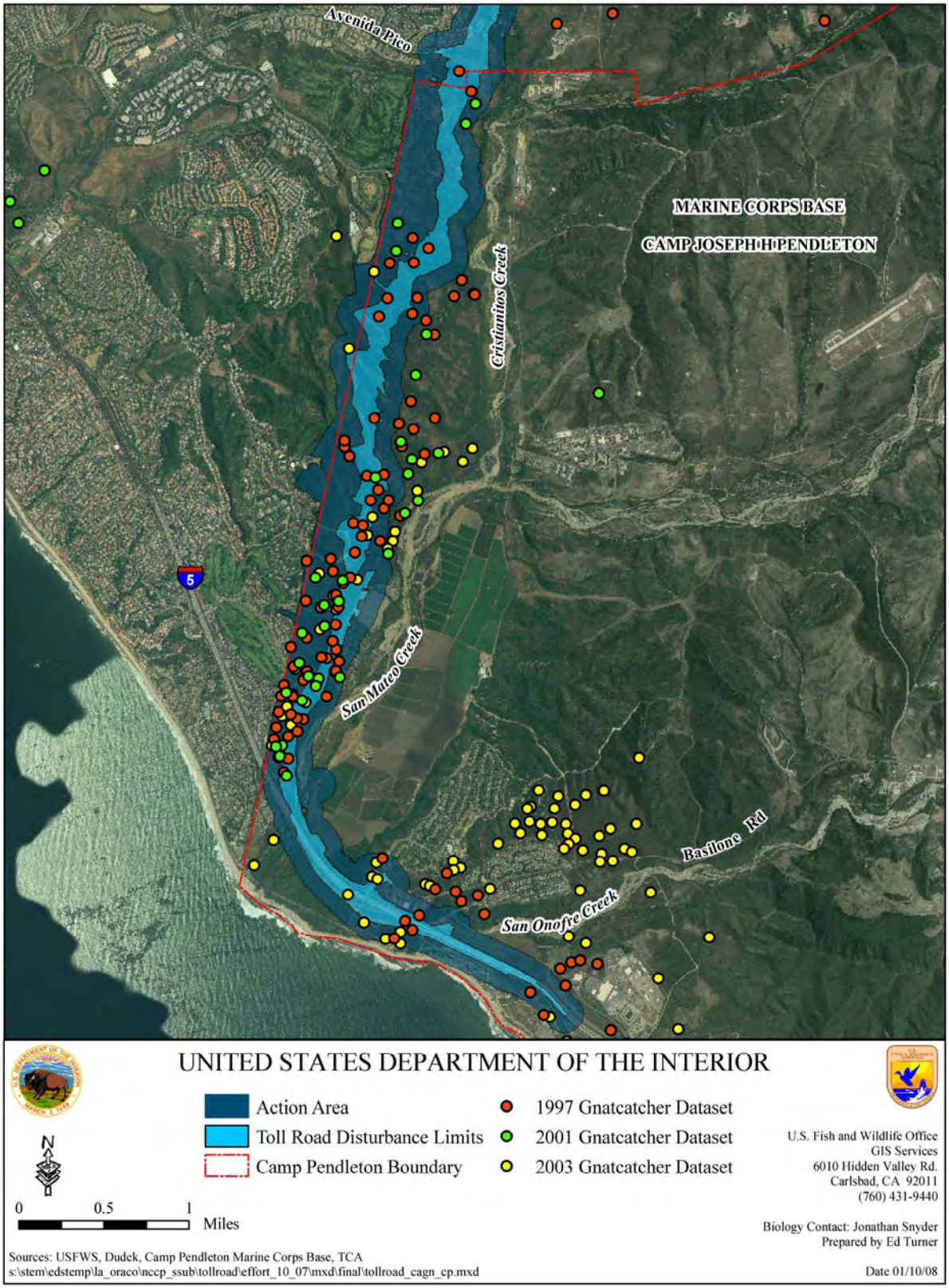

Figure 9. Coastal California gnatcatcher territories in the proposed toll road project area on Camp Pendleton in San Diego County, California.

Factors Affecting the Species' Environment in the Vicinity of the Proposed Project

Ongoing and potential threats to gnatcatcher populations and their habitat include urbanization, military training activities, cowbird parasitism, predation, habitat degradation, and fire (Service 1993; GWB 1997).

Southern Orange County and Camp Pendleton were used for agriculture and ranching for several centuries (Baumgartner 1989; Zedler *et al.* 1997). Agricultural practices, such as dry farming, orchard production, and cattle grazing continue in Orange County on Rancho Mission Viejo, but the most substantive losses of coastal sage scrub as a result of these practices on the Ranch likely took place many decades ago. Urban development in the past century in southern Orange County has further reduced the distribution of coastal sage scrub; however, the more recent developments (*e.g.*, Forster Ranch, Talega, Ladera, Coto de Caza) have had measures incorporated to minimize and offset coastal sage scrub impacts, including conservation easements covering preserved, enhanced, or restored areas of coastal sage scrub.

Camp Pendleton

In the 1940s, the Department of Defense acquired Camp Pendleton and subsequently reduced agriculture and ranching in that area. Coastal sage scrub distribution and quality are likely to have progressively changed as a result of military training and reduction of agricultural operations, leading to the present distribution and condition of habitat on the Base. The most intense military training (*i.e.*, live fire training) has historically been focused towards the center of the Base, away from the communities adjacent to the perimeter of the installation. The current distribution of higher quality coastal sage scrub and gnatcatchers on the perimeter of Camp Pendleton is a reflection of all past activities on this land and the cumulative impacts associated with military training activities.

Since the listing of the gnatcatcher, the Marine Corps has formally consulted on project-related impacts to approximately 41.5 ha (102.5 ac) of coastal sage scrub considered to be occupied by or suitable for gnatcatchers. About 36.4 ha (90.0 ac) have been impacted by military projects, while 5.1 ha (12.5 ac) have been impacted by right-of-way and easement holders (*e.g.*, utilities, transportation agencies, *etc.*). During formal consultation on military projects, the Marine Corps has committed to offset the projected 36.4 ha (90.0 ac) of temporary and permanent impacts by enhancing or restoring approximately 51.4 ha (127.0 ac) of coastal sage scrub on the Base, including restoration of the 8.1-ha (20-ac) Pio Pico coastal sage scrub site near the O'Neill Heights housing area. Enhancement and restoration sites on the Base are not set aside as habitat preserves and, therefore, may be subject to subsequent training-related impacts over time. The Marine Corps historically has not allowed compensatory restoration on Camp Pendleton for any coastal sage scrub permanently impacted by non-military projects, although they require project proponents to restore temporarily impacted coastal sage scrub to its pre-impact condition. For non-military projects on the Base since the listing of the gnatcatcher, project proponents have committed to restore all 1.8 ha (4.5 ac) of temporarily impacted coastal sage scrub and have purchased approximately 7.7 ha (19.0 ac) of coastal sage scrub credits from conservation banks off of the Base to compensate for 3.2 ha (8.0 ac) of permanently impacted coastal sage scrub. Since the listing of the gnatcatcher, a net total of 41.5 ha (102.5 ac) of coastal sage scrub

impacted on the Base by various projects have been offset by 60.9 ha (150.5 ac) of coastal sage scrub conservation, enhancement, and restoration, leading to a potential net gain in coastal sage scrub available to gnatcatchers on Camp Pendleton and other areas within their range.

Cowbird trapping on Camp Pendleton intended to protect and conserve vireo and flycatcher populations has virtually eliminated nest-parasitism of these annually-monitored riparian species (GWB 2001; Kus 2001). Cowbird parasitism of gnatcatcher nests has probably also been greatly reduced as a consequence of this program (GWB 1997); however, the extent of any reduction is not known.

Prior to the listing of the gnatcatcher, training on Camp Pendleton is likely to have caused regular mortality of adult gnatcatchers, nest destruction, and incremental habitat degradation and destruction. Since the listing of the gnatcatcher, the Marine Corps has instituted Range and Training Regulations that restrict ground-disturbing activities, habitat removal, and training activities within occupied gnatcatcher habitat. These restrictions are likely to have reduced the incidence of gnatcatcher mortality, nest destruction, and habitat degradation and destruction caused by training activities, although impacts probably still occur on occasion.

The single biggest consequence of military training leading to the mortality of gnatcatchers and coastal sage scrub degradation and destruction is likely training-caused wildfires, which can lead to substantial impacts to coastal sage scrub containing gnatcatchers. Gnatcatchers and their habitat on Camp Pendleton have historically been exposed to wildfire on a periodic basis, either through natural ignitions or from anthropogenic sources before and after European settlement (Lewis 1973; Minnich 1983; Zedler *et al.* 1997; Mensing *et al.* 1999). However, current training activities lead to an artificially high return rate of wildfires (Minnich 1983; Zedler *et al.* 1997; U. S. Marine Corps 1998). All types of training may ignite wildfires but the great majority of fires are likely to result from live-fire training (U. S. Marine Corps 1998). Live-fire exercises have historically occurred in the same locations (particularly around the larger impact areas in the center of the Base) on a regular and repeating basis and have generated multiple wildfires in and on the periphery of those areas. Over time, repeated wildfires in and around these areas are likely to have converted what was historically dense shrublands to grasslands, savannahs, and sparse shrublands (Minnich 1983; Zedler *et al.* 1997). Grasslands and disturbed areas contain "flashy fuels" that ignite easily and burn quickly but do not generally carry hot fires. These areas ignite on a regular basis, but the resulting wildfires are usually contained with minimal burning of shrubland.

In contrast, areas on the perimeter of Camp Pendleton removed from the traditional live-fire areas generally contain mature shrublands and major gnatcatcher population centers and carry higher fuel loads. Wildfires caused by live-fire training have occasionally carried into these peripheral areas with higher fuel loading, causing extensive damage to high quality coastal sage scrub and other shrublands; this usually occurs during hot, dry weather when strong offshore winds ("Santa Ana conditions") occur in autumn and winter. When the conditions are right, these perimeter areas on Camp Pendleton are susceptible to large wildfire events.

The Base contains about 20,639 ha (51,000 ac) of potentially suitable habitat for the gnatcatcher, including about 15,280 ha (37,760 ac) of coastal sage scrub, about 4,006 ha (9,900 ac) of coastal

sage scrub/chaparral, and about 1,538.1 ha (3,800 ac) of other habitats used by gnatcatchers (*e.g.*, grassland ecotone, chaparral/grass ecotone; U. S. Marine Corps 2000). Of the total potentially suitable habitat, gnatcatchers occupy an estimated 3,342 ha (8,260 ac). An additional 17,310.4 ha (42,775 ac) is unoccupied of which about 13,307 ha (32,884 ac) are coastal sage scrub. The Marine Corps has estimated that between 1993 and 1997, 7.5 percent (213.7 ha (528 ac)) of all occupied gnatcatcher habitat on the Base burned, and as many as 33 individual gnatcatchers were killed by wildfires. Areas containing all or portions of 6 gnatcatcher territories (*i.e.*, up to 12 individual gnatcatchers) in 1998 were burned between 1998 and 2002 (GWB 2004). Since 1992, updated fire control and suppression measures have been enacted that have substantially reduced wildfire frequency and acreage burned.

However, in October 2007 during a strong "Santa Ana" wind event, a fire (source currently unknown) burned approximately one third (5,106 ha/12,619 ac) of the coastal sage scrub on Camp Pendleton primarily in an area sparsely occupied by gnatcatchers east of Interstate 5 and west of Basilone Road (Service, unpublished data). Most of the gnatcatcher-occupied habitat which occurs on the perimeter of Camp Pendleton remains intact. Habitat within the action area for the proposed project was not burned. The Service is working with Camp Pendleton on a more detailed post-fire assessment regarding the loss of gnatcatcher occupied habitat and damage to coastal sage scrub conservation and restoration areas mentioned above.

Southern Orange County

Planning for development and open space for southern Orange County since the early 1990s was guided, in part, by the listing of the gnatcatcher as threatened in 1993 under the Act. Pursuant to section 4(d) of the Act, interim planning guidelines were created which included placing a limit of impacts from development at 5 percent of the habitat in southern Orange County that supported the gnatcatcher (coastal sage scrub) if the impacts met specific criteria. A review of extant coastal sage scrub at the time indicated that up to 530.1 ha (1,310 ac) could be permitted to be lost to development or other projects during the planning process; by 2006, impacts to approximately 359.8 ha (889 ac) of the 530.1 ha (1,310 ac) had been permitted.

Past projects that have affected coastal sage scrub and/or gnatcatchers in southern Orange County in the general project area include impacts to 0.7 ha (1.7 ac) for Tesoro High School (FWS-OR-2597); Santa Margarita Water District projects including 2.7 ha (6.7 ac) for Chiquita Ridge water reservoirs (FWS-OR-2595), up to 0.3 ha (0.8 ac) for a force main/non-domestic water project (FWS-OR-4453.1), and 0.1 ha (0.3 ac) for Chiquita Canyon Reservoir geotechnical investigation (FWS-OR-4610.1); for Transportation Corridor Agencies (TCA) geotechnical investigations for the subject project of 4.5 ha (11 ac) (FWS-OR-1041); and 12.7 ha (31.3 ac) for Villages 5 and 6 of the Talega development and associated detention basin (FWS-OR-1226.10). These impacts have been offset by habitat restoration and/or payment into an in-lieu fee program for the planning area; fees collected will be used to acquire, manage, and/or restore habitat in the Orange County Southern Subregion HCP planning area. As noted in the General Environmental Baseline, while we consider the HCP impacts as part of the baseline, there remains the practical concern that the toll road project may precede development authorized by the HCP. Take authorization would apply to the entity (FHWA or Rancho Mission Viejo) that first impacts the toll road project area.

In January 2007, the Service issued an incidental take permit for the Orange County Southern Subregion HCP authorizing the loss of 98 locations of gnatcatchers and 1,003 ha (2,479 ac) of coastal sage scrub. There is significant overlap of the toll road project with development areas and roadways authorized by the HCP in the San Juan Creek watershed. In addition to development, activities authorized under the Orange County Southern Subregion HCP that may occasionally impact gnatcatchers, but will not result in a permanent loss of habitat, include cattle grazing, prescribed burns, and infrastructure maintenance.

The areas on Rancho Mission Viejo not authorized for development, including the Donna O'Neill Land Conservancy, were identified as part of the Habitat Reserve system in the HCP. The Habitat Reserve system was anticipated to be conserved and managed in perpetuity for the benefit of covered species, including the gnatcatcher, to offset impacts resulting from development and other authorized impacts in the HCP area. The Habitat Reserve system provides breeding habitat and connectivity for the gnatcatcher essential to its recovery.

The Upper Chiquita Conservation Area consists of about 478.3 ha (1,182 ac) and was conserved by the TCA in 1996 to offset biological impacts resulting from construction of the Foothill Transportation Corridor Oso segment and to provide conservation credit to offset future projects. Some of the conservation area has burned, and the most recent fire in 2002 burned a total of 289.4 ha (715 ac), including 131.1 ha (324 ac) of coastal sage scrub, although the burned coastal sage scrub appears to be recovering (Paul Galvin pers. comm. 2007). The Upper Chiquita Conservation Area is addressed in the Orange County Southern Subregion HCP as part of the "prior RMV" lands, which are existing conserved lands that "add substantial value to the conservation goal of maintaining connectivity for gnatcatchers as well as additional habitat and gnatcatcher locations" (Service 2007).

Crystal Cove State Park is the proposed location for 60.7 ha (150.0 ac) of coastal sage scrub restoration. The park is geographically isolated from the toll road (about 30 km/19 miles northwest of the project site), but it is an important component of the coastal subarea of the Reserve System established through the Central/Coastal Orange County Natural Community Conservation Plan/Habitat Conservation Plan. The park is a total of 1,136 ha (2,807 ac) and supports a substantial number of gnatcatcher pairs (about 27 pairs on the coastal mesas and an additional unquantified number of pairs farther inland; D. Pryor, pers. comm. 2008), which contribute to the gnatcatcher population in the subregion. Habitat at the park is monitored and managed for the benefit of a variety of sensitive biological resources, including the gnatcatcher.

Environmental Baseline

Status of the Species in the Action Area

To better understand the baseline number of gnatcatchers and their habitat at different locations, we divided the action area into three sections: 1) a north section from Oso Parkway south to the south side of San Juan Creek, including middle Chiquita Canyon and the Chiquita and Gobernadora Ridge on Rancho Mission Viejo; 2) a central section from the south side of San Juan Creek south to the Camp Pendleton boundary including portions of Rancho Mission Viejo in Trampas Canyon and the Donna O'Neill Land Conservancy to the north side of Avenida Pico;

and 3) a south section from the south side of Avenida Pico through Camp Pendleton and the State Park lease area to the terminus of the project near Basilone Road and Interstate 5.

We looked at cumulative gnatcatcher survey data compiled by Dudek in 1997 and 2001 (County of Orange 2006) for the entire alignment area and a one-year survey of gnatcatchers collected in 2003 (GWB 2004) for Camp Pendleton and overlaid these gnatcatcher locations and the proposed toll road disturbance limits on a 2002 infrared photo. We then identified gnatcatcher locations that fell within the road footprint and within 152.4 m (500 ft) of the alignment, a distance that disturbance (*e.g.*, noise, human activity) from road construction and operation can be anticipated. The gnatcatcher datasets dated 1997 and 2001 are a compilation by Dudek & Associates of surveys conducted from 1994 to 1996 and between 1997 and 2001 along the entire toll road alignment including Camp Pendleton. These compilations applied 4.5-ha (11-ac) buffers around initially observed gnatcatcher locations to obtain a better estimate of the area occupied by a pair of gnatcatchers (County of Orange 2006, page 3-7). The 4.5-ha (11-ac) area was based upon non-breeding territory size delineations on Rancho Mission Viejo in Chiquita Canyon 12.9 to 16.9 km (8 to 10.5 miles) from the coast (Bontrager 1991). Gnatcatcher observations from subsequent years that fell within a previously identified 4.5-ha (11-ac) buffer area were collapsed into the original buffer area and counted as one gnatcatcher territory to control for double-counting of gnatcatcher territories within this cumulative dataset. Further, the 1997 and 2001 datasets are additive. That is, each gnatcatcher location in the 2001 dataset was either collapsed into previously identified 4.5-ha (11-ac) gnatcatcher territories from the 1997 dataset (no geographically new territories) or was identified as a geographically new gnatcatcher territory (no overlap with 1997 data) and mapped. Thus, we combined these datasets when looking at the cumulative number of gnatcatcher territories in the toll road alignment as shown in Table 1. The gnatcatcher data collected in 2003 on Camp Pendleton (GWB 2004) identified gnatcatcher pairs/territories without applying a specific acreage or buffer to each location, but this is not a cumulative (multiple year) dataset, so double counting the same territory between years was not a concern. Then, based on information in the Orange County Southern Subregion HCP (County of Orange 2006, p. 13-65), we assumed that 60-70 percent of these collapsed gnatcatcher locations/gnatcatcher breeding territories are occupied at any one point in time, for example when grading or grubbing of coastal sage scrub may occur in a particular area (Table 1).

We reviewed these three datasets (1997, 2001, and 2003) because they represent the best available survey data and also allow a comparison of gnatcatcher numbers and distribution in the project area between the mid-1990's and early 2000's. We are mindful that these are not static gnatcatcher locations, since individuals move about, and territories both within or between years will shift, expand, and/or contract based on habitat availability and population size and that the 1997 and 2001 datasets represent adjusted cumulative gnatcatcher territories. Using GIS, we also calculated the extent of overlap between the toll road alignment and coastal sage scrub for each section of the road (Table 1). Because the toll road alignment also overlaps development bubbles and roads anticipated in the Orange County Southern Subregion HCP, we excluded areas that the HCP authorized to be impacted when calculating the baseline of coastal sage scrub and gnatcatcher territories in the action area.

Table 1. Gnatcatcher territories and coastal sage scrub in the action area using 1997 and 2001 (County of Orange 2006), and 2003 (GWB 2004) datasets.

Location	***Gnatcatcher Territories***			***Coastal Sage Scrub (ca. acres)***
North Section Chiquita Canyon	**1997 and 2001 combined datasets**	**60-70% of 1997 and 2001 datasets**	**2003**	
Within disturbance footprint	6	4	No data	19.7 ha (48.8 ac)
Within 152.4 ha (500 ft) of disturbance footprint	23	14-16	No data	
Central Section Trampas Canyon/ O'Neill Conservancy				
Within disturbance footprint	0	0	No data	16.8 ha (41.5 ac)
Within 152.4 ha (500 ft) of disturbance footprint	0	0	No data	
South Section Camp Pendleton				
Within disturbance footprint	36	22-25	9	88.5 ha (218.7 ac)
Within 152.4 ha (500 ft) of disturbance footprint	43	26-30	18	

However, we were concerned that the methodology developed by Dudek to collapse all overlapping gnatcatcher locations into a 4.5-ha (11-ac) buffer area was not meant for application along the southern section of the toll road on Camp Pendleton because gnatcatcher territories are generally smaller in size closer to the coast (Phil Behrends, pers. comm. 2007). The 4.5-ha (11-ac) buffer was meant for application around Chiquita Canyon and other similar inland areas in southern Orange County but was also applied to the Camp Pendleton portion of the 1997 and 2001 datasets when analyzing the impacts in southern Orange County because the Camp Pendleton data was a part of the larger datasets.

Therefore, in addition to using the methodology described above, we calculated the amount of gnatcatchers likely to be present based on the amount of suitable habitat, estimated territory size, and average percent of territories occupied. For the northern section of the toll road in Chiquita Canyon, we divided the available habitat by the estimated territory size in Chiquita Canyon (4.5 ha/11 ac) and then estimated 60-70 percent occupancy.

No estimate of the number of gnatcatcher territories was conducted in the central section of the toll road since coastal sage scrub occur as a dispersed mosaic within a more abundant chaparral, grassland and woodland matrix, and surveys have not detected gnatcatchers here. The central section appears to be unoccupied by gnatcatchers. Again, we excluded areas that the Orange

County Southern Subregion HCP authorized to be impacted when calculating the area of coastal sage scrub and number of gnatcatcher territories in the project footprint and action area.

For the southern section, we estimated territory size to be 2.3 ha (5.7 ac) and estimated 60-70 percent occupancy. Atwood *et al.* (1998b) used an adaptive-kernel method (90 percent point contour) to estimate a gnatcatcher use area of approximately 2.3 ha (std. dev. = 0.7 ha) (5.7 ac; std. dev. =1.8 ac) for the entire breeding season at Rancho Palos Verdes, California, which is a location with similar proximity to the coast as a majority of the gnatcatcher locations along the southern section of the toll road on Camp Pendleton.

Table 2. Gnatcatcher territories and coastal sage scrub using the maximum number of gnatcatcher territories supported by the available coastal sage scrub in the project footprint and then applying a 60-70 percent correction factor.

Location	***Coastal Sage Scrub (approximate hectares (acres))***	***Estimated Maximum Number of Gnatcatcher Territories Based on Territory Size***	***Estimated Gnatcatcher Territories based on 60-70% Occupancy of Available Territories[1]***
North Section Chiquita Canyon[2]	19.7 ha (48.8 ac)	4-5	2-4
Central Section Trampas Canyon/ O'Neill Conservancy[3]	16.8 ha (41.5 ac)	0	
South Section Camp Pendleton[4]	88.5 ha (218.7 ac)	39	23-27

Effects of the Action

Habitat Loss and Construction Impacts

The estimate of gnatcatcher territories in the project footprint based on available habitat and territory size indicates that up to about 4 gnatcatcher territories in Chiquita Canyon and up to 27 gnatcatcher territories on Camp Pendleton could be impacted by the proposed toll road project (Table 1). These numbers are similar to the numbers in Table 1 that estimate impacts to known geographically distinct gnatcatcher territories within the project footprint using the 1997 and 2001 datasets combined after applying the correction factor: 4 gnatcatcher territories in Chiquita and up to 25 gnatcatcher territories on Camp Pendleton.

The north section of the toll road (Chiquita Canyon) is within the area addressed by the Orange County Southern Subregion HCP. Under the HCP, the 19.7 ha (48.8 ac) of coastal sage scrub that will be impacted by this section of road was anticipated to be conserved and managed in

[2]Estimated territories based on a 4.5 -ha (11-ac) breeding use area (from Bontrager 1991).
[3]Territories not estimated due to dispersed distribution of coastal sage scrub and lack of gnatcatcher detections.
[4]Estimated territories based on a 2.3-ha (5.7-ac) seasonal use area (from Atwood et al. 1998b).

perpetuity for the benefit of gnatcatcher and other covered species to offset project-related impacts.

The central section of the toll road (Trampas Canyon/O'Neill Conservancy) will also impact 16.8 ha (41.5 ac) of coastal sage scrub that was anticipated to be conserved and managed in perpetuity for the benefit of gnatcatcher and other covered species. This section appears not to support nesting gnatcatchers, but the habitat may be used by gnatcatchers for dispersal and foraging.

Up to an estimated 27 pairs of gnatcatchers will be impacted by removal of about 88.5 ha (218.7 ac) of coastal sage scrub on Camp Pendleton.

With the permanent loss of coastal sage scrub in Chiquita Canyon and on Camp Pendleton, the carrying capacity of gnatcatchers in these two areas will be lower since there will be less coastal sage scrub available to support the existing population, displaced birds, and future population expansions. However, as discussed in Effects in a Landscape Context below, most of the habitat in greater Chiquita Canyon and Camp Pendleton will remain.

We do not anticipate that adult or juvenile gnatcatchers will be killed or injured during the habitat removal since these individuals are mobile enough to get out of the path of equipment; however, they will be displaced from the areas cleared of habitat. Conservation measures (Appendix 1; Measures TE 18 and 19) will be implemented to minimize impacts to the species including removing habitat between September and February, which is outside of the breeding season for gnatcatchers. Should habitat clearing need to take place when gnatcatchers may be breeding, focused surveys will be undertaken in the habitat for gnatcatchers ahead of the clearing and other measures will be taken to avoid impacts to gnatcatcher nests and nestlings (*i.e.*, no work will be done within 152.4 m (500 ft) of active gnatcatcher nests and non-nesting birds will be flushed from habitat to be cleared; Appendix 1, TE-19). Based on the conservation measures, which indicate clearing will be done outside the breeding season or only after surveys for nests in the impact area, we do not anticipate that gnatcatcher eggs or nestlings will be killed or injured during habitat clearing or grading activities.

Gnatcatchers are resident birds and are site tenacious. Clearing of their habitat can significantly disrupt their normal behaviors exposing them to increased predation pressure and increased competition for any remaining available habitat, which can lead to reduced reproduction and/or death. For birds whose use areas that are completely destroyed or significantly reduced, the search for suitable habitat exposes them to increased predation pressure and may cause stress and energy expenditure beyond normal behavior. Additional coastal sage scrub will be created in the adjacent Upper Chiquita Canyon Conservation Area (see *Conversation Measures* below), where some displaced birds from Chiquita Canyon near Oso Avenue may be able to establish new territories. Displaced birds that do not find suitable replacement habitat may starve or otherwise die from lack of shelter or from predation. Those that do find suitable habitat may not retain their mate or find new mates to successfully reproduce, at least initially after disturbance.

Gnatcatchers remaining in the project area may be subject to increased noise and disturbance levels associated with road construction that may impair communication or other essential behaviors that reduce reproductive capacity, although construction-related minimization

measures are anticipated to minimize effects to nearby nesting gnatcatchers. Construction-related effects are expected to occur while the road is being constructed, which is a period of 36 to 48 months. Using the estimates of territory size described above (i.e., 4.5-ha/11-ac territories along the northern section; no gnatcatchers along the middle section; 2.3 ha/5.7 ac along the southern section) and 60-70 percent occupancy of territories as described above, we estimate that the 116.2 ha (287.0 ac) of coastal sage scrub within 152.4 m (500 ft) of the proposed project contain about 42-49 pairs of gnatcatchers. These gnatcatchers will likely be exposed to increased noise, lighting, and other construction-related effects. The effects of construction and other human activities on gnatcatcher survival, reproduction, and populations have not been well documented, but there is the potential for effects such as disrupting breeding activity due to increased noise and activity levels and increasing predation risk by increasing light levels.

Toll Road Operation and Maintenance

The project proposes to revegetate slopes graded for the toll road along the entire alignment with a native plant palette that mirrors the adjacent extant habitat, likely mostly coastal sage scrub species. Therefore, as the revegetated habitat matures over time, gnatcatchers may use it for breeding, feeding, or dispersal despite its location adjacent to the toll road; a few 2003 gnatcatcher locations on Camp Pendleton were less than 61 m (200 ft) from the Interstate 5 freeway, and restored areas adjacent to other toll roads in Orange County have been occupied by gnatcatchers despite potential disturbance from the noise, lights, and human activity as discussed in the General Effects section and above. Birds that establish territories within or adjacent to the road and dispersing birds using the revegetated side slopes will also have some risk of being struck by a vehicle and injured or killed when crossing the road.

Caltrans may need to conduct maintenance on revegetated slopes that are within the right of way, including keeping a non-vegetated road edge and fence clearance. However, maintenance should rarely affect gnatcatchers since it is expected to occur on a regular basis, which should keep habitat at the immediate road edge and along fence lines from reaching a structure and composition that is attractive for bird use. In the event that maintenance is deferred and habitat must be removed to meet Caltrans standards, we anticipate that this type of removal will be linear and narrow in nature (along the road edge and fencing) and minor in terms of acreage since not all maintenance would likely be undertaken at one time. Further, Caltrans will implement standard procedures related to seasonal restrictions of habitat removal to avoid the breeding season. Therefore, we anticipate that no eggs or nestlings will be affected and that adults and juveniles will be mobile enough to move away from the maintenance activities and will not be injured or killed.

Increased risk to habitat supporting gnatcatchers from invasive non-native plants due to disturbance from construction will be addressed by conservation measures to restore disturbed areas after construction. Risk to habitat and individual gnatcatchers from vehicle-induced fires will increase with road operation since the road alignment traverses rural areas that currently do not have any or much traffic (except for the areas at Oso Parkway, Cristianitos Road, and Interstate 5). Vehicle-induced fire is anticipated to be sufficiently infrequent so that death or injury of individual gnatcatchers from fire will not imperil the surrounding populations. However, if the fire frequency is sufficiently increased, it could lead to conversion of coastal

sage scrub to habitat dominated by annual grasses and other non-native species, which could, in turn, lead to reduced carrying capacity for gnatcatchers in the surrounding environment. The precise extent of an increase in fire frequency associated with the road is difficult to determine, but as described in the introduction, fire frequency in southern California shrublands is positively correlated with human population density (Keeley and Fotheringham 2001), and the pattern of that fire is tightly associated with roadways (Jon Keeley, pers comm.)

Another effect of operations is the fragmentation of habitat supporting the gnatcatcher. As noted in the General Effects section, smaller habitat patches tend to have altered species composition, reduced community diversity, and smaller population sizes and populations with a greater likelihood of extirpation. The toll road will increase habitat fragmentation by reducing east/west gnatcatcher dispersal in the Habitat Reserve system for the Orange County Southern Subregion HCP and by creating a new impediment to dispersal between Camp Pendleton to the east of the toll road and open space in San Clemente to the west. Relative to the road system currently approved in the Orange County Southern Subregion HCP, the toll road will accommodate faster speeds, greater traffic volume, and an increased project footprint, which will likely cause fewer gnatcatchers to attempt to cross the road and increased mortality for individuals that attempt to cross. However, substantial areas of habitat will remain in Chiquita Canyon, Trampas Canyon and on Camp Pendleton that will continue to function in supporting breeding and dispersal albeit at a somewhat reduced level.

As with construction activities, ongoing operation of the toll road will increase noise and lighting levels in the adjacent coastal sage scrub. Using the estimates of territory size described above and 60-70 percent occupancy of territories, we estimate that the 116.2 ha (287.0 ac) of coastal sage scrub within 152.4 m (500 ft) of the proposed project contain about 42-49 pairs of gnatcatchers that will likely be exposed to increased noise, lighting, and other road-related effects. The effects of adjacent roads on gnatcatcher survival, reproduction, and populations have not been well documented, but there is the potential for effects such as disrupting breeding activity due to increased noise and activity levels and increasing predation risk by increasing light levels.

Archeological Investigations

The proposed investigations have the potential to disrupt gnatcatcher foraging and breeding behavior, although with the proposed conservation measures (conducting investigations outside the breeding season or over 61.0 m/200 ft from nesting gnatcatchers), these effects are anticipated to be minimal. Direct impacts to gnatcatcher habitat associated with the investigations will be negligible.

Summary of Conservation Measures

The conservation measures (Appendix 1, TE-18 and TE-19) of the project include minimization measures to limit impacts to nesting gnatcatchers. In addition, TCA proposes to offset the loss of coastal sage scrub and impacts to individual gnatcatchers by using its existing 327 credits (equivalent to conserving 132.3 ha [327 ac] of coastal sage scrub) and by restoring an additional 97.5 ha (241 ac) of coastal sage scrub and 37.2 ha (92 ac) of scrub/native grassland ecotone

habitat at the Upper Chiquita Canyon Conservation Area. In addition, 2.0 ha (4.9 ac) of scrub/native grassland ecotone will be restored in association with restoration site in Chiquita Canyon near Tesoro High School, and 60.7 ha (150.0 ac) of will be restored in Crystal Cove State Park and/or another location approved by the Service. The restoration site near Tesoro High School is primarily intended to create riparian vegetation, but includes restoration of scrub/native grassland ecotone as well. The 327 credits from the Upper Chiquita Canyon Conservation Area were created according to an agreement with the Service and the California Department of Fish and Game for the purpose of offsetting impacts from this project. The credits reflect the benefit to the gnatcatcher resulting from the conservation of the Upper Chiquita Canyon Conservation Area in 1996. As described in the "Status and Baseline" section, the conservation area was under threat of development at the time of its purchase. Based on the 4.5-ha (11-ac) non-breeding territory size (County of Orange 2006, page 3-7) estimated for greater Chiquita Canyon, the 132.3 ha (327 ac) of credit to be used in the Chiquita Canyon Conservation Area could support a maximum of about 30 gnatcatcher territories, with about 18 to 21 gnatcatcher pairs present in a given year.

Based on a 4.5-ha (11-ac) non-breeding territory size (County of Orange 2006, page 3-7), successful restoration of 97.5 ha (241 ac) of coastal sage scrub in the Upper Chiquita Canyon Conservation Area could support an additional 24 gnatcatcher territories, with about 14 to 17 pairs present in a given year. The restoration of 37.2 ha (92 ac) of scrub/native grassland ecotone could support a few additional gnatcatcher pairs and/or provide supplementary habitat for gnatcatcher foraging, sheltering, and dispersal. The restoration at the conservation area may not immediately benefit the birds displaced from Chiquita Canyon since restored areas may not be mature enough to support those birds, depending on when the restoration is started in relation to habitat removed by toll road construction. The conservation and restoration in Upper Chiquita Canyon will supplement the population in the Orange County southern subregion and enhance connectivity by supporting a greater number of breeding pairs and dispersing juveniles near the interface between the north edge of the southern subregion and the south edge of the central subregion.

The restoration of 60.7 (150.0 ac) of coastal sage scrub at Crystal Cove State Park will support additional gnatcatcher pairs. Because the proposed restoration is in proximity to the coast, we estimate that the proposed restoration could support about 16 to 18 pairs of gnatcatchers (based on 2.3-ha/5.7-ac territory size and 60-70 percent occupancy).

A total of about 263 ha (650 ac) of cut and fill slopes and temporarily impacted areas along the toll road will be replanted with coastal sage scrub species. The methodology and maintenance commitments regarding this restoration will be provided in the BRMP (Appendix 1, TE-3), but there is no requirement that the restoration will include quantitative performance criteria. The replanted cut and fill slopes and temporarily impacted areas may ultimately be available for use by the gnatcatcher population for dispersal, foraging, and potentially breeding habitat.

Areas to be restored are disturbed habitats that likely receive occasional use by gnatcatchers for foraging and dispersal. Some gnatcatchers may be subject to increased human disturbance from habitat restoration activities adjacent or within their use areas. However, the disturbance is anticipated to be minimal since planting will typically take only a few days, not all gnatcatcher-

occupied areas will be subject to disturbance at the same time, and again, the restoration activities will take place in areas less used by the species. Subsequent monitoring activities will likely involve periodic brief sampling of vegetation composition and bird use which are unlikely to cause death or injury of gnatcatchers.

Effects in a Landscape Context (Including Lands outside the Action Area)

The toll road will impact 19.7 ha (48.8 ac) of the roughly 1,115 ha (2,754 ac) of coastal sage scrub in greater Chiquita Canyon, as defined in the Orange County Southern Subregion HCP (Figure 8). These impacts constitute about 1.8 percent of the coastal sage scrub in greater Chiquita Canyon. Although the impacts represent a small percentage of the total amount of habitat, the road will bisect the greater Chiquita Canyon population. We anticipate that gnatcatchers will occasionally disperse over the toll road, but connectivity between the eastern and western halves of the population will be much less frequent. The population of gnatcatchers in the greater Chiquita Canyon is a regionally important population, supporting a high density of gnatcatchers in a large, contiguous area of open space identified for conservation, and it connects populations south of San Juan Creek with populations further north in central Orange County.

The toll road will impact 88.5 ha (218.7 ac), which represents about 28 percent of the approximately 314 ha (776 ac) of coastal sage scrub in the section of the Base west of Cristianitos and San Mateo creeks but only 0.58 percent of the 15,280 ha (37,760 ac) of coastal sage scrub Base-wide. The loss of 88.5 ha (218.7 ac) of coastal sage scrub on Camp Pendleton would currently represent approximately 0.87 percent of the 10,174 ha (25,141 ac) of coastal sage scrub remaining after the fire of October 2007. However, we are anticipating that much of the coastal sage scrub that was burned in this fire will recover unless this area is subjected to high fire frequency.

The area of native habitats between San Mateo Creek and the Camp Pendleton/Orange County boundary represents not only a breeding area for gnatcatchers but also provides an important habitat linkage for gnatcatcher populations in San Diego County to those in Orange County. Gnatcatcher populations are connected via coastal sage scrub on Camp Pendleton through the Talega and Cristianitos Creek watersheds across San Juan Creek and into Chiquita Canyon. Another important linkage occurs via coastal sage scrub on Camp Pendleton through areas of open space within the City of San Clemente, San Juan Capistrano and unincorporated portions of Orange County to Chiquita Canyon. The loss of 88.5 ha (218.7 ac) of coastal sage scrub on Camp Pendleton in such a long configuration across the landscape is expected to substantially reduce connectivity between Camp Pendleton east of the proposed toll road alignment and the coastal sage scrub to the west in the cities. However, we do expect that a gnatcatcher will occasionally disperse across the toll road in this area. Gnatcatchers may also utilize dispersal opportunities along riparian corridors under toll road bridges at Chiquita Woods, San Juan Creek, and San Mateo Creek at the intersection with I-5. Further, the existing habitat linkage between Camp Pendleton east of the proposed toll road alignment and Rancho Mission Viejo through the Talega and Cristianitos watersheds will remain intact. Thus, we anticipate that gnatcatchers should be able to maintain genetic exchange between populations.

Greater Chiquita Canyon and Camp Pendleton both support large gnatcatcher populations. Greater Chiquita Canyon contains about 242 to 283 pairs (based on cumulative gnatcatcher locations compiled by the County of Orange (2006) and a 60-70 percent correction factor), and Camp Pendleton contains about 668 pairs (USMC unpublished data). Thus, the impacted pairs represent a small percentage of the population in the area (about 1.4 to 1.7 percent of Chiquita Canyon and 4.0 percent of Camp Pendleton). The total project-related impacts to 44 gnatcatcher pairs represent a small percentage (1.5 percent) of the 1996 range-wide gnatcatcher population estimate of 2,899 pairs. These numbers do not reflect what was lost in the 2003 and 2007 fires that occurred in San Diego and Orange Counties. Although we expect that much of the burned coastal sage scrub will recover over time, we are monitoring these burned areas for problems including the spread of non-native invasive plants and habitat type-conversion.

Crystal Cove State Park is geographically isolated from the toll road (about 30 km/19 miles northwest of the project site), but it is an important component of the coastal subarea of the Reserve System established through the Central/Coastal Orange County Natural Community Conservation Plan/Habitat Conservation Plan (NCCP/HCP). Thus, the proposed restoration at the park will benefit the species as a whole and the population(s) within the coastal subregion of the NCCP/HCP, but it will not directly benefit the birds impacted by the proposed project.

As described in the "Status and Baseline" section, the gnatcatcher populations in Chiquita Canyon that are not impacted by the toll road will be monitored and managed as prescribed in the Orange County Southern Subregion HCP; the Camp Pendleton gnatcatcher populations will be monitored and overall population and occupied habitat goals maintained under the forthcoming programmatic biological opinion on Marine Corps activities in upland habitats. Thus, we anticipate that gnatcatchers will maintain viable populations after construction that will contribute to the species' survival and recovery.

Summary of Effects to the Species and Recovery

In summary, the negative effects of the proposed project on gnatcatchers include loss of habitat for a substantial number of gnatcatcher pairs (23 to 27) on Camp Pendleton and several gnatcatcher pairs (2 to 4) on Rancho Mission Viejo. The proposed project will increase fragmentation of gnatcatcher habitat by creating a road through the Habitat Reserve and through remaining habitat west of San Mateo Creek. Connectivity between the large gnatcatcher populations on Camp Pendleton and southern Orange County will also be reduced. Finally, the proposed project could increase fire frequency in habitat surrounding the road, which could, in turn, lead to habitat degradation over the long term.

Benefits of the proposed project for gnatcatchers include 1) conservation and management of habitat anticipated to support 18 to 21 gnatcatcher pairs once it recovers from fire and 2) restoration of habitat anticipated to support about 30 to 35 gnatcatcher pairs. In addition, the conserved and restored habitat will maintain and enhance connectivity between southern Orange County and central Orange County.

Thus, following the successful restoration of habitat in upper Chiquita Canyon and at Crystal Cove State Park, the total number of gnatcatchers rangewide is anticipated to remain similar or

increase slightly upon completion of the proposed project. In addition, habitat for 18 to 21 pairs will be conserved. Other than replanting the cut and fill slopes adjacent to the road with coastal sage scrub species, no restoration or conservation of coastal sage scrub proximal to the impacts on Camp Pendleton is proposed. Thus, the proposed conservation and restoration will benefit the gnatcatcher populations in greater Chiquita Canyon and the coastal subregion of the NCCP/HCP, but due to the distance between the Base and the conservation area, this conservation measure will not directly offset project impacts to the gnatcatcher population at Camp Pendleton or to connectivity between Camp Pendleton and southern Orange County.

Conclusion

After reviewing the current status of the coastal California gnatcatcher, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that construction, operation, and maintenance of the toll road is not likely to jeopardize the continued existence of the gnatcatcher. No critical habitat is designated within the action area of the toll road project; thus, none will be affected. We base this conclusion on the following:

1. The overall distribution of the gnatcatcher south of Ventura County remains roughly the same since the listing in 1993, but today many of the largest gnatcatcher populations are conserved and managed in the regional NCCP/HCP reserves. Additionally, within and between Orange, San Diego, and Riverside counties, many of the gnatcatcher populations are connected with existing or planned linkages and corridors.

2. An estimated 4 pairs in Chiquita Canyon and 27 pairs of gnatcatchers on Camp Pendleton will lose their primary breeding, foraging, and sheltering habitat. Some, but not all, of these birds are expected to die or suffer a reduction in fitness and productivity. This number of birds represents a small percentage (about 1.5 percent) of the species' overall population based on 1996 rangewide survey data.

3. Hundreds of hectares (acres) of habitat will remain in the project area to support the overall survival and recovery of the species and to maintain the important genetic linkage between San Diego and Orange counties.

4. With implementation of the conservation measures, we anticipate that no adult, juvenile, or nestling gnatcatchers or eggs will be killed or injured during habitat clearing; a small number of birds may be killed by vehicle strikes during toll road operation over the life of the facility; none are anticipated to be killed or injured during maintenance or habitat restoration activities.

5. Following completion of the proposed restoration, we anticipate that the number of gnatcatcher pairs rangewide will be similar to or slightly greater than pre-project conditions. We anticipate that restoration of 136.7 ha (337.9 ac) of suitable habitat for the gnatcatcher and the additional conservation and permanent protection of 132.3 ha (327.0 ac) of existing coastal sage scrub along with the other conservation measures will help sustain gnatcatchers in southern Orange County, and restoration of 60.7 ha (150.0

ac) in Crystal Cove State Park will contribute to the long-term stability of the gnatcatcher population in coastal Orange County.

LEAST BELL'S VIREO
(*Vireo bellii pusillus*)

Conservation Measures

In addition to the general avoidance and minimization measures described in Appendix 1, including replanting of temporarily impacted habitat, the following measures have particular relevance for the vireo:

- Riparian habitats will typically be removed between September 15 and March 15, which is outside of the breeding season for vireo. Should habitat clearing need to take place between March 15 to September 15, focused surveys will be undertaken in the habitat for vireo ahead of the clearing, and measures will be implemented to avoid impacts to vireo nests and young (*i.e.*, no construction within 150 m (500 ft) of active nests) (Appendix 1, TE-21).

- Minimization measures related to construction noise levels near occupied habitat will be implemented, including the use of sound barriers and noise monitoring (*e.g.*, noise not to exceed 60 dBA adjacent to territory) (Appendix 1, TE-22). A biological monitor will be responsible for determining effects of construction noise on vireo and determining additional measures to further reduce noise adjacent to vireos.

- Riparian habitat is proposed to be restored in a dedicated open-space area on Chiquita Creek just south of Oso Parkway at a ratio of one acre restored for each acre impacted by the project. The details regarding the proposed restoration will be included in the BRMP (Appendix 1, TE-3). This measure is further refined in the Conceptual Riparian HMMP, which proposes the restoration/creation of 3.5 ha (8.7 ac) of mulefat scrub, willow scrub and forest, and sycamore riparian woodland at several sites along the toll road, with most of the restoration occurring in Chiquita Canyon near Tesoro High School. Habitat temporarily impacted at major drainages/bridge crossings, including San Juan Creek (2.7 ha/6.6 ac), San Mateo Creek (2.3 ha/5.8 ac), and San Onofre Creek (0.4 ha/1.1 ac), will be restored following project completion (Project Description).

- Removal of 8.1 ha (20.0 ac) of arundo and other non-native invasive riparian plant species will be conducted in drainages that support vireo. The restored habitat will include at least 2.0 ha (5.0 ac) in drainages affected by the toll road;

- Caltrans will implement avoidance and minimization measures for vireo associated with routine maintenance activities. These measures include restricting vegetation clearing to the areas around culverts and extended detention basins; removing riparian vegetation outside the vireo breeding season or surveying areas to be cleared prior to clearing; and monitoring of vegetation clearing activities by a qualified biologist.

Status of the Species

Listing Status

In response to the dramatic decline of the vireo population and widespread loss of its riparian habitat, the vireo was listed as endangered on May 2, 1986 (51 FR 16474). Critical habitat was designated for the vireo on February 2, 1994 (59 FR 4845), and encompasses about 15,379 ac (38,000 ac) at 10 locations in Santa Barbara, Ventura, Los Angeles, San Bernardino, Riverside, and San Diego counties. No critical habitat is within the proposed project's action area. Primary constituent elements that support feeding, nesting, and sheltering are essential to the conservation of the least Bell's vireo and include riparian woodland vegetation that generally contains both canopy and shrub layers and some associated upland habitats (Service 1994). A draft recovery plan was published in March 1998 (Service 1998); no final plan has been published. We completed a five-year review for vireo in September 2006 in which we indicated that, due to new information on the species and an improved understanding of ongoing recovery actions to reduce threats, the recovery goals and strategies should be modified and refined. In addition, we recommended that the vireo should be downlisted from endangered status to threatened status because of a ten-fold increase in population size since its listing in 1986, expansion of locations with breeding vireo throughout southern California, and conservation and management of suitable breeding habitat throughout its range (Service 2006).

Species Description

The least Bell's vireo is a small migratory songbird that is olive-gray above and mostly white on its underparts, with a tinge of gray on the upper breast and yellow on the flanks (Coues 1866; Service 1998). The vireo has indistinct white spectacles and two faint wing bars, with males and females having identical plumage. Male vireos are easily distinguished by their song, a rapid series of harsh, slurred notes that increase in intensity as the song progresses (Grinnell and Storer 1924; Pitelka and Koestner 1942; Barlow 1962; Beck 1996). Phrases of the vireo song are alternatively slurred upward and downward and exhibit a "question-and-answer" quality (Grinnell and Storer 1924; Beck 1996). The least Bell's vireo is in the family Vireonidae and is one of four subspecies of Bell's vireo (*Vireo bellii*) that have been recognized (AOU 1957), with each subspecies isolated from one another throughout the year (Hamilton 1962; Service 1998).

Habitat Affinities

Vireos are obligate riparian breeders, typically inhabiting structurally diverse woodlands along watercourses that feature dense cover within 0.9-1.8 m (3-6 ft) of the ground and a dense, stratified canopy (Goldwasser 1981; Salata 1983; Gray and Greaves 1984; Service 1998). The understory within this riparian habitat is typically dominated by mulefat, California wild rose (*Rosa californica*), poison oak (*Toxicodendron diversiloba*), sandbar willow (*Salix hindsiana*), young individuals of other willow species, and several perennial species (Service 1998). Important canopy species include mature arroyo willows (*S. lasiolepis*) and black willows (*S. gooddingii*), and occasional cottonwoods (*Populus* spp.), western sycamore, or coast live oak (*Quercus agrifolia*). Vireos primarily forage and nest in riparian habitat, but they may also use adjoining upland scrub habitat (Salata 1983; Kus and Miner 1989).

Life History

Vireos primarily feed on invertebrates, especially lepidopteran larvae, within willow stands or associated riparian vegetation (Miner 1989; Brown 1993). Vireos occasionally forage in nonriparian vegetation such as coastal sage scrub, chaparral, and oak woodlands, although foraging in these other habitats usually occurs within 30.5 m (100 ft) of the edge of riparian vegetation (Salata 1983; Gray and Greaves 1984; Kus and Miner 1989). Vireo feeding behavior largely consists of gleaning prey from leaves or woody surfaces while perched or hovering, and less frequently by capturing prey by aerial pursuit (Salata 1983; Miner 1989). Vireos concentrate most of their foraging between 0 to 6.1 m (0 to 20 ft) above ground level (Salata 1983; Miner 1989).

Vireos generally arrive in southern California breeding areas by mid-March to early April, with males arriving before females and older birds arriving before first-year breeders (Service 1998). Vireos generally remain on the breeding grounds until late September, although some post-breeding migration may begin as early as late July (Service 1998). Male vireos establish and defend breeding territories through singing and physically chasing intruders (Barlow 1962; Beck 1996; Service 1998). Although territories typically range in size from 0.2 to 3.0 ha (0.5 to 7.5 ac) (Service 1998), no relationship appears to exist between territory size and various measures of territory quality (Newman 1992).

Nest building commences a few days after pair formation, with the female selecting a nest-site location and both sexes constructing the nest (Pitelka and Koestner 1942; Barlow 1962; Service 1998). Nests are typically suspended in forked branches within 0.9 m (3 ft) above the ground with no clear preference for any particular plant species as the nest host (Nolan 1960; Barlow 1962; Gray and Greaves 1984; Service 1998). Typically 3 or 4 eggs are laid on successive days shortly after nest construction (Service 1998). The eggs are incubated by both parents for about 14 days with the young remaining in the nest for another 10-12 days (Pitelka and Koestner 1942; Nolan 1960; Barlow 1962). Each nest appears to be used only once with new nests constructed for each nesting attempt (Greaves 1987). Vireos may attempt up to five nests within a breeding season, but they are typically limited to one or two successful nests within a given breeding season (Service 1998).

Multiple long-term monitoring studies indicate that approximately 59 percent of nests successfully produce fledglings, although on average only 1.8 chicks fledge per nest (Service 1998). Although vireo nests appear to be more accessible to terrestrial predators because of their relatively low placement (Franzreb 1989), western scrub-jays (*Aphelocoma californica*) have been documented to account for the majority of documented depredation events (Peterson 2002; Peterson *et al.* 2004); depredation by jays and other avian predators may have selected for relatively low nest placement (Ferree 2002). Predation rates can exceed 60 percent of the vireo nests in a given area within a year (Kus 1999), but typical nest predation rates average around 30 percent (Franzreb 1989), which is comparable to predation rates for other North American passerines (Martin and Clobert 1996; Grishaver *et al.* 1998; Ferree 2002).

Nest parasitism by cowbirds is another major source of failure for vireo nests (Franzreb 1989; Service 1998; Kus 1999, 2002; Griffith and Griffith 2000; Sharp 2002); nests that are parasitized

are either abandoned or fledge cowbird chicks rather than vireos. It is believed that cowbirds did not historically occur within the vireo's range, and therefore vireos have not evolved adequate defenses to avoid loss of productivity due to parasitism (Franzreb 1989; Kus 2002). Parasitism of vireo nests may exceed 42 percent in some locations (Kus 1999), but extensive cowbird trapping and focused nest monitoring can substantially reduce parasitism or its effects (Franzreb 1989; Service 1998; Griffith and Griffith 2000; Kus 2002).

Some individual vireos have been documented to live at least 7 years (Brown 1993; Service 1998), but the average lifespan for this species is substantially lower. First year survivorship has been estimated to average approximately 25 percent (Greaves and Labinger 1997; Service 1998), typical for small passerines, with annual survivorship in subsequent years estimated to be approximately 47 percent (Service 1998). Annual survival of females appears to be slightly lower than that for males, presumably due to the higher energetic costs of egg production by females (Service 1998).

Fledgling vireos expand their dispersal distances from about 10.7 m (35 ft) the first day to about 70.0 m (200 ft) several weeks after fledging (Hensley 1950; Nolan 1960). This distance has been shown to increase to at least 1.6 km (1 mi) prior to their first fall migration (Gray and Greaves 1984). Banding records indicate that while most first-year breeding vireos return to their natal drainage after winter migration, some disperse considerable distances to other breeding locations (Greaves and Labinger 1997; Service 1998; Kus and Beck 1998). Movement by vireos between drainages within San Diego County is not uncommon (Kus and Beck 1998). Additionally, several vireos banded as nestlings in San Diego County have been resighted as breeding adults in Ventura County, and the opposite movement from Ventura to San Diego has also been observed (Greaves and Labinger 1997). The maximum dispersal distance currently documented is approximately 209.2 km (130 mi) (Service 1998), but this is probably an underestimate due to the limited number of vireos that are banded and insufficient re-sighting efforts. Although movement between sites by older birds may occur, site fidelity by vireos after the first breeding season is generally high, and most dispersal between sites occurs between the time that vireos fledge from their nest and their first breeding season (Service 1998).

Status and Distribution

The vireo historically occupied willow riparian habitats from Tehama County, in northern California, southward to northwestern Baja California, Mexico, and as far east as Owens Valley, Death Valley, and the Mojave River (Grinnell and Miller 1944; Service 1998). Although originally considered to be abundant locally, regional declines of this subspecies were noticeable by the 1940s (Grinnell and Miller 1944), and the vireo was believed to have been extirpated from California's Central Valley by the early 1980s (Franzreb 1989). Except for a few outlying pairs, the vireo is currently restricted to southern California south of the Tehachapi Mountains and northwestern Baja California (Wilbur 1980; Garrett and Dunn 1981; Franzreb 1989; U. S. Geological Survey (USGS) 2002). The largest current concentrations of vireos are in San Diego County along the Santa Margarita River on the Base and in Riverside County at the Prado flood control basin (Service 2006).

Historically, the San Joaquin and Sacramento Valleys were considered to be the center of the vireo's breeding range (60 to 80 percent of the historic population; 51 FR 16474), but the vireo has not yet meaningfully re-colonized those areas. In 2005 and 2006, the first breeding pair of vireos detected in the San Joaquin Valley since the listing of the vireo successfully bred at the San Joaquin National Wildlife Refuge in Stanislaus County (Service 2006). There have been no sightings of vireos in the Sacramento Valley since prior to the listing, and it is unlikely that any breeding vireos have occurred within recent years in the Sacramento Valley (Service 2006).

Greater than 99 percent of the remaining vireos were concentrated in southern California (Santa Barbara County and southward) at the time of the listing in 1986 (51 FR 16474), with San Diego County containing 77 percent of the population. Greater than 99 percent still remain in southern California, although the populations are now more evenly distributed in southern California with 54 percent of the total population occurring in San Diego County and 30 percent of the population occurring in Riverside County (Service 2006); however, there has been only a slight shift northward in the species' overall distribution. Thus, despite a significant increase in overall population numbers, the population remains restricted to the southern portion of its historic range (Service 2006).

Population Dynamics and Estimates

Causes for decline of the least Bell's vireo included destruction or degradation of habitat, river channelization, water diversions, lowered water tables, gravel mining, agricultural development, and cowbird parasitism (Service 1986, 1994, 1998). Habitat losses had fragmented most remaining populations into small, disjunct, widely dispersed subpopulations (Franzreb 1989). Habitat fragmentation negatively affects abundance and distribution of neotropical migratory songbirds, in part by increasing incidence of nest predation and parasitism (Whitcomb *et al.* 1981; Small and Hunter 1988; Yahner and DeLong 1992; Sharp 2002; Peterson 2002). Vireos nesting in areas containing a high proportion of degraded habitat have lower productivity (*e.g.*, hatching success) than those in areas of high quality riparian woodland (Pike and Hays 1992).

The vireo population in the U. S. has increased 10-fold since its listing in 1986, from 291 to 2,968 known territories (Service 2006). The population has grown during each 5-year period since the original listing, although the rate of increase has slowed over the last 10 years. Population growth has been greatest in San Diego County and Riverside County, with lesser but significant increases in Orange County, Ventura County, San Bernardino County, and Los Angeles County. The population in Santa Barbara County has declined since the listing in 1986, although it is uncertain whether this population was historically significant. Kern, Monterey, San Benito, and Stanislaus counties have had a few isolated individuals and/or breeding pairs since the original listing, but these counties have not supported any sustained populations (Service 2006).

Threats and Conservation Needs

At the time of the listing, loss of habitat due to agricultural practices, urbanization, and exotic plant invasion was identified as a major threat to vireo populations. Since the listing of the vireo, destruction and modification of riparian habitat within its current range has been curtailed

significantly, primarily as a consequence of protections provided by the original listing in 1986 (51 FR 16474), the subsequent designation of critical habitat in 1994 (59 FR 4845), and other Federal and State regulatory processes. Other efforts not driven by regulatory processes have also promoted increased conservation and restoration of riparian habitat since the listing of the vireo in 1986 (Service 2006).

Agriculture and grazing continue to threaten riparian habitat within the larger historic range, particularly the Salinas, San Joaquin, and Sacramento valleys (Service 1998). Urbanization appears to have displaced former agriculture and grazing operations in many areas within southern California, thereby indirectly reducing riparian habitat degradation caused by these activities. On the other hand, occupied vireo habitat that is adjacent to highly urbanized areas or within major river systems continues to be impacted by flood control and water impoundment projects and may be subject to ongoing and future habitat loss or degradation (Service 2006).

Several large, regional Habitat Conservation Plans in southern California have addressed the effects of urban development on this species. These plans are expected to provide long-term protection of core occurrences of vireos in western Riverside, Orange, and San Diego counties. For example, for the San Diego MSCP and MHCP and Western Riverside MSHCP, between 85-100 percent of vireo locations were expected to be conserved; also for these plans and Central/Coastal Orange County HCP, 67-100 percent of vireo habitat acres were expected to be conserved. Compliance-driven and voluntary riparian restoration activities throughout the historic range may have contributed to an increase in riparian habitat since the listing of the vireo (Service 2006), although this cannot be established without a thorough evaluation of riparian habitat within California. Starting in 2007, the Riparian Habitat Joint Venture ("RHJV"; a cooperative association of Federal, State, and private organizations) began systematically mapping existing riparian habitat in California starting (RHJV 2006), which should provide a more objective measure of ongoing changes to riparian habitat in California.

Within the past decade, control of giant reed and other exotic plants has been and continues to be systematically conducted on both the Santa Ana River and on the Base. Giant reed removal has also been initiated within several other watersheds within southern California (Natural Resources Conservation Service 2006; Service 2006). In general, giant reed removal has been effective but will require continued annual efforts to achieve local eradications and address new invasions. Although control of giant reed has made great progress since the original listing of the vireo, invasions by other exotic plants (*e.g., Tamarix* species, perennial pepperweed (*Lepidium latifolium*)) continue to degrade existing riparian habitat (Kus and Beck 1998; Hoffman and Zembal 2006).

The 1986 listing rule identified brood parasitism by cowbirds as a substantial threat to the vireo, and it remains the most significant threat to the recovery of the vireo (Service 2006). Cowbird trapping has proven a successful tool to halt vireo population declines over the short term within a limited area, but Kus and Whitfield (2005) have argued that trapping may not be the best method for long-term recovery of the vireo because maintaining cowbird populations at low levels may not allow the vireo to evolve resistance to cowbird parasitism. It remains unclear as to the best way to manage this threat over the long term, and additional research is needed to

determine whether there are any alternatives to the intensive cowbird trapping programs currently being implemented (Service 2006).

Status of Vireo in the Vicinity of the Proposed Project

In the general vicinity of the proposed project, there are a number of vireo locations in southern Orange County, and Camp Pendleton supports the largest population of vireo throughout its range. There are an estimated 46 vireo locations anticipated to be conserved and managed for the benefit of vireo in the Habitat Reserve under the Orange County Southern Subregion HCP (Service 2007). These vireos are concentrated at locations on lower Arroyo Trabuco a few miles west of the proposed project and in lower Cañada Gobernadora, which is a tributary to San Juan Creek, within the Gobernadora Ecological Restoration Area (GERA), about 304.8 m (1,000 ft) east of the toll road disturbance limits. Additional vireo locations are scattered throughout southern Orange County including locations in San Juan Creek, Chiquita Canyon, Cristianitos Creek, and smaller tributaries.

In 2005, there were an estimated 827 vireo locations including 576 known pairs on Camp Pendleton (Rourke and Kus 2006). The greatest concentration of vireo (336 pairs) was along Santa Margarita River. Las Flores Creek, San Onofre Creek, San Mateo Creek, and Pilgrim Creek also had relatively large concentrations (over 20 pairs at each location). The wildfires in October 2007 burned habitat that supported about 120 vireo locations (USMC unpublished data), which is about 15 percent of the population on Camp Pendleton. However, because there is an active program to remove non-native invasive plant species on the base and because riparian habitat tends to be relatively resilient to disturbance in the absence of invasive plant species (Dwire and Kauffman 2003), we anticipate this habitat to recover fully.

Environmental Baseline

Status within the Action Area

As noted in the project description section, we defined the action area as the disturbance footprint of the toll road and an additional 152.4-m (500-ft) distance beyond the disturbance limit. We used this distance based on temporary construction and/or permanent roadway effects that are typically detected beyond a footprint of ground disturbance. The riparian and adjacent upland habitat that support vireo within 152.4 m (500 ft) of the disturbance limits are considered to be in the action area.

We considered the available data on the vireo in our discussion of the environmental baseline and in our effects analysis that follows. The most recent vireo surveys on Rancho Mission Viejo lands (*i.e.*, San Juan and Chiquita creeks) took place about seven years ago in 2001 (County of Orange 2006). Annual surveys have been conducted on Base lands along Cristianitos, San Mateo, and San Onofre creeks, although 2005 is the most recent year for which we have GIS data. The surveys on Rancho Mission Viejo lands documented the presence of an important vireo population in lower Cañada Gobernadora, which is a tributary to San Juan Creek, within the Gobernadora Ecological Restoration Area (GERA). In 2001, the GERA supported about 12-15 nesting vireos (Figure 10). These GERA vireo locations are approximately 304.8 m (1,000 ft)

from the toll road disturbance limits and thus outside the action area. Other vireo locations are within San Juan Creek, within about 200.0 m (656.2 ft) of the disturbance limits but also outside the action area for the project.

Although the observed San Juan Creek and GERA nesting locations are outside the action area, they are in proximity to the project footprint. This information is included in this discussion because vireo distribution has expanded since 2001, and the area along San Juan Creek within the project footprint has not been surveyed in recent years; thus, it is not only possible, but likely, that the riparian habitat in the action area in the vicinity of the San Juan Creek and GERA vireo locations is now or could become occupied by vireo prior to project construction.

The 2001 survey data indicate several vireo locations in Chiquita Creek, with two locations in the action area between 45.7-152.4 m (150-500 ft) of the toll road disturbance limits near Tesoro High School (Figure 10).

The vireo nesting locations in Cristianitos Creek are contiguous with numerous nest sites in lower Cristianitos and San Mateo creeks and should be considered part of the major population on Camp Pendleton that is outside of the southern Orange County planning area (Figure 11). Surveys conducted along Cristianitos, San Mateo, and San Onofre creeks have documented that Cristianitos Creek consistently supports scattered vireo locations whereas San Onofre and particularly San Mateo creeks consistently support high numbers of breeding vireo (Figure 11). Because the 2005 survey on Camp Pendleton is the most recent survey for which we have GIS data and a report describing the survey effort (Rourke and Kus 2006) and because the 2005 surveys provided similar results to other recent surveys on the Base, only the project-wide surveys from 2001 and the 2005 surveys from the Base are included in Figure 11. Although the toll road will not cross Cristianitos Creek, the 2001 surveys documented four vireo locations within 52.4 m (500 ft) of the toll road alignment. The 2001 surveys also documented two vireo locations within 152.4 m (500 ft) of the project at San Mateo Creek. The 2005 surveys documented no vireo within 152.4 m (500 ft) of the project at Cristianitos Creek but documented two locations in the project footprint and four locations within 152.4 m (500 ft) at San Mateo Creek. The 2005 surveys also documented three vireo locations within 152.4 m (500 ft) at San Onofre Creek.

In summary, known locations of vireos are included in the action area in Chiquita Creek, Cristianitos Creek, and lower San Mateo and San Onofre creeks. In addition, riparian habitat in San Juan Creek in proximity to known vireo locations may be occupied or become occupied prior to project construction.

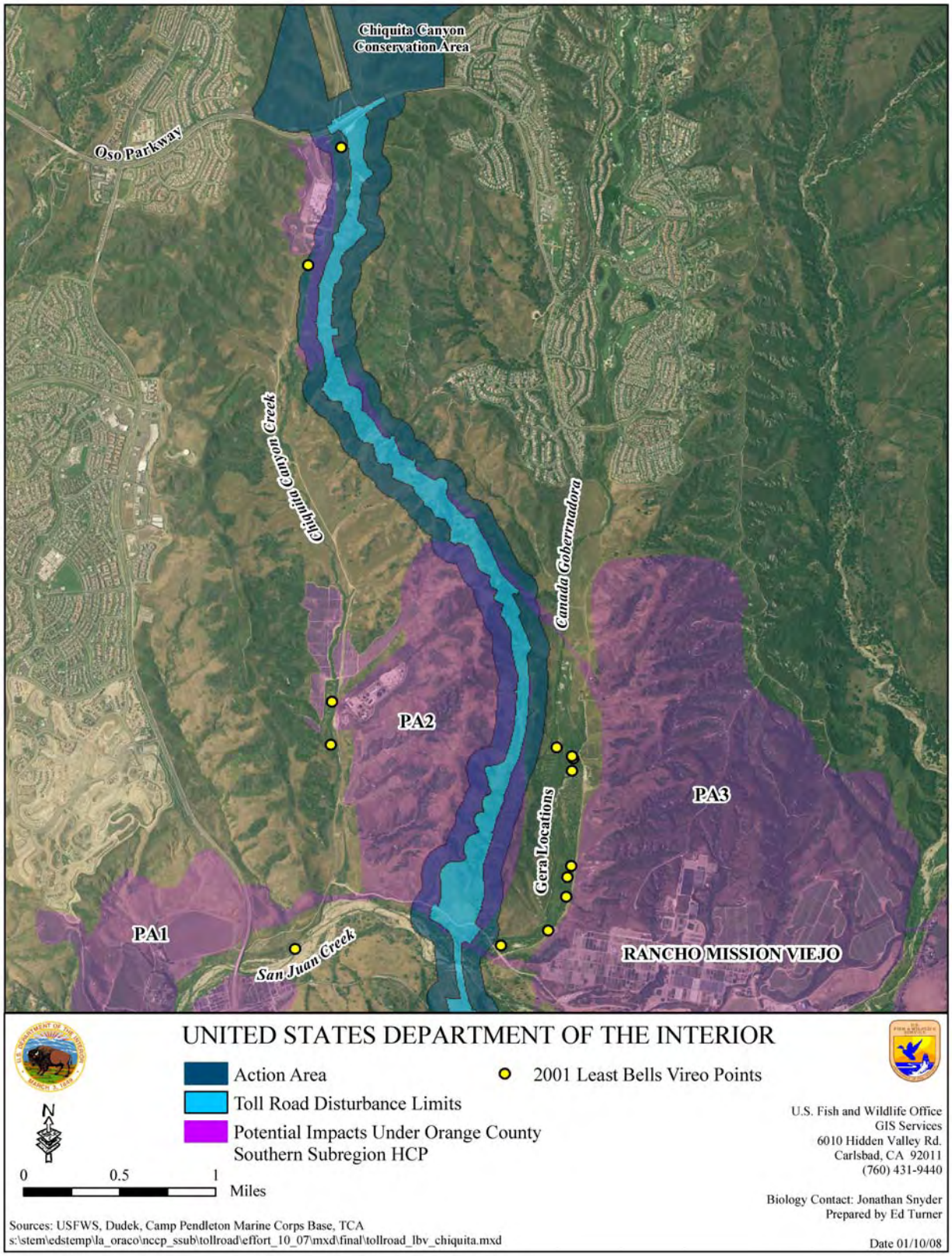

Figure 10. Least Bell's vireo locations on Rancho Mission Viejo, Orange County, California.

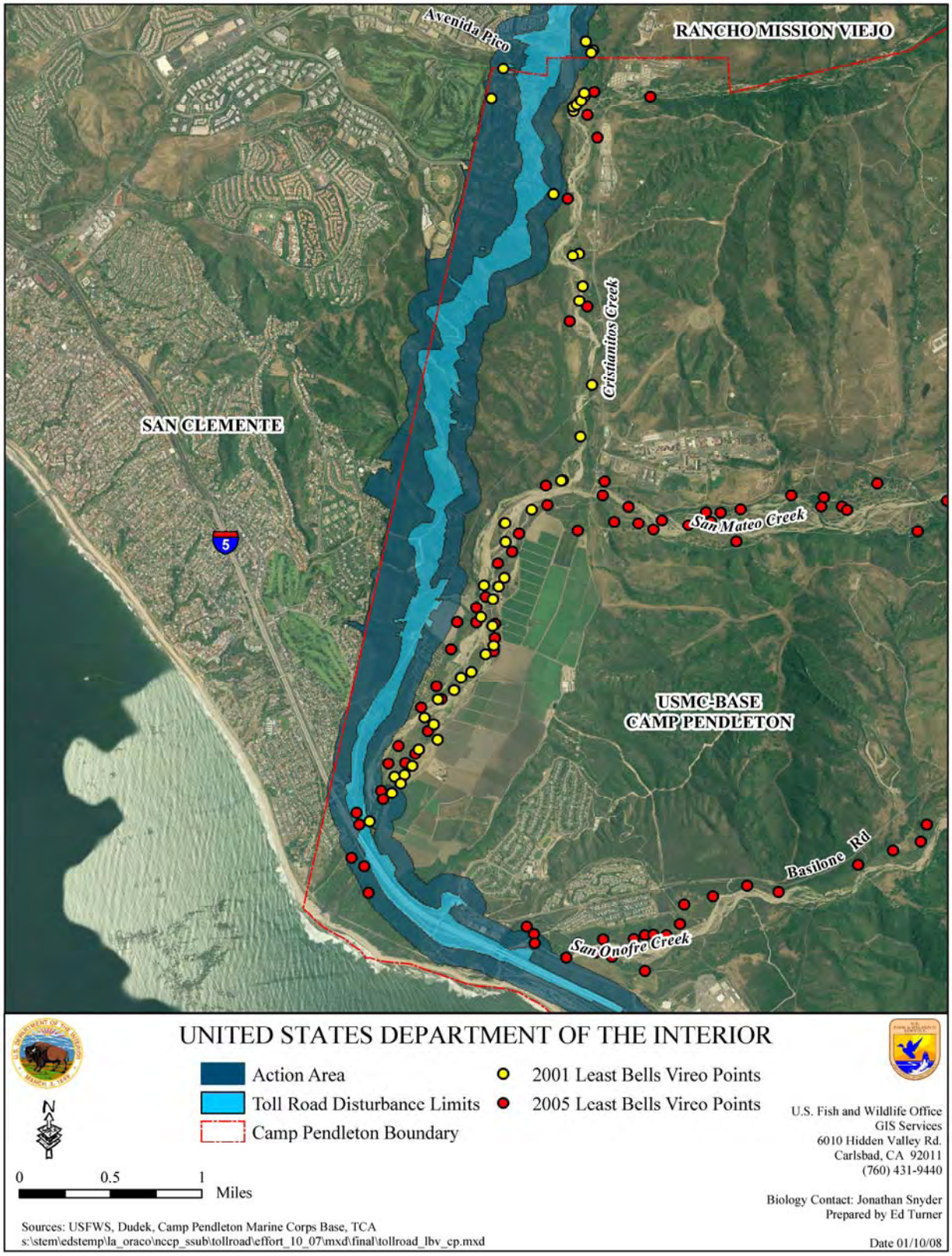

Figure 11. Least Bell's vireo locations on Rancho Mission Viejo and Camp Pendleton, Orange and San Diego counties, California.

Factors Affecting the Species' Environment within the Action Area

Ongoing and potential threats to vireo populations include construction and/or military training activities that lead to degradation and loss of riparian habitat, groundwater pumping, exotic plant invasion, cowbird parasitism, and predation (Service 1986, 1998; GWB 2001a, 2001b).

Camp Pendleton

A consultation for a habitat restoration project in San Mateo Creek on Camp Pendleton was completed in early 2005 (FWS-MCBCP-1351.13). We determined that no vireos would be killed or injured by the project and that an additional 3.2 ha (7.9 ac) of habitat suitable for vireo would be available when the restored habitat reached performance standards.

A programmatic biological opinion issued in 1995 for the Base that addressed riparian areas (1-6-95-F-02) estimated a total of 25 vireos per year are being harmed or harassed due to military training, facilities maintenance, specific construction projects, and other human activities within and near riparian areas on the Base. Impacts to riparian habitat on the Base have primarily been offset through habitat restoration and removal of giant reed in riparian areas. To date, approximately 313.6 ha (775 ac) of giant reed and other riparian weeds within approximately 2,832.9 ha (7,000 ac) of watershed have been treated for removal on the Base (D. Bieber, Base, pers. comm. to J. Terp, Service, 2006). Ongoing cowbird trapping to protect and conserve vireo (and flycatcher) populations has virtually eliminated nest-parasitism of these annually-monitored riparian species (Griffith and Griffith 2000; GWB 2001c; Kus 2002). On the Base, vireos increased dramatically between the late 1970s and 2000, from about 100 territories to over 800 territories; the number of territories in 2005 was 825 representing approximately 27 percent of all vireo territories range-wide.

Southern Orange County

The Service has conducted two informal consultations for vireo in Orange County in the vicinity of the toll road project within the past several years. One project was for a culvert in Cañada Gobernadora in 2004 (FWS-OR-4183.1) and another for a detention basin near Cristiantios Creek at the east end of Pico Avenue in 2005 (FWS-OR-1226.18). Both consultations resulted in determinations of "not likely to adversely affect" for the vireo based on project timing and/or conservation measures to be implemented.

The Service issued an incidental take permit in January 2007 for activities covered by the Orange County Southern Subregion HCP. These activities will permanently impact 29.1 ha (72 ac) (10 percent) of the approximately 283.3 ha (700 ac) of suitable habitat for least Bell's vireo and 7 of the known 53 vireo nest sites on Rancho Mission Viejo and Prima Deshecha landfill. Temporary impacts to 14.6 ha (36 ac) (5 percent) of suitable habitat will occur and affect 2 known nest sites. Most of the permanent impacts to nest sites (6 of 7) will occur at the Prima Deshecha Landfill, and the other impacts will occur on Rancho Mission Viejo from construction of a pump station. Implementation of the HCP's avoidance and minimization measures will ensure that habitat will only be removed outside of the breeding season; thus, impacts to vireo eggs and nestlings are not expected. Conservation anticipated by the HCP includes 248.9 ha (615 ac) of suitable riparian

habitat and 43 (81 percent) of known vireo nesting locations. Implementation of the habitat reserve management plan will minimize potential impacts, including managing grazing to minimize impacts to riparian habitat and implementing habitat restoration to improve stream stability (*e.g.*, reduce incision and erosion). The impacts to 9 (7 permanent and 2 temporary) vireo locations in the plan area represent approximately 0.30 percent of the 2,968 known territories. The Service determined that this impact to the vireo and its habitat associated with HCP implementation would not jeopardize the species. Further, the HCP's conservation measures, including efforts to remove giant reed and other riparian weeds from the San Juan Creek and Cristianitos Creek watersheds, are likely to improve habitat conditions and contribute to the range-wide conservation of the vireo.

Vireo habitat in the action area for the toll road, including habitat along San Juan Creek, Chiquita Creek, and the portion of Cristianitos Creek in Orange County, was anticipated to be conserved and managed within the Habitat Reserve under the Orange County Southern Subregion HCP. Areas within 152.4 m (500 ft) of the project boundary will continue to be conserved and managed, but they will now be subject to disturbance from operation of the toll road, as discussed below. Areas within the toll road footprint will be permanently or temporarily impacted.

Effects of the Action

Habitat Loss and Construction Impacts

About 8.9 ha (22.0 ac) of suitable nesting habitat for vireo (willow woodland, mulefat scrub, and sycamore riparian woodland, which often contains mulefat scrub understory suitable for vireo) will be impacted by construction, operation, and maintenance of the toll road (TCA 2007), including about 5.4 ha (13.3 ac) in major drainages (San Juan, San Mateo, and San Onofre creeks) that have a high likelihood of supporting nesting vireo. Most of the impacts in the major drainages will be temporary, although some of the restored habitat will likely be less suitable for vireo following project completion because bridges will span some of the restored habitat (see below).

Riparian habitats will typically be removed outside the breeding season for vireo. If habitat clearing is conducted during the breeding season, focused surveys will be undertaken in vireo habitat prior to the clearing, and measures will be implemented to avoid impacts to nests and young. Therefore, we do not expect that vireo adults, eggs, or nestlings will be killed or injured during the habitat removal. In addition, since measures will be taken to ensure that nesting vireos are not exposed to noise levels over 60 dB during construction activities, vireo nesting activities adjacent to road construction are not anticipated to be disrupted.

The following amount of vireo habitat will be impacted in the major drainages during toll road construction: 2.7 ha (6.6 ac) in San Juan Creek, 2.3 ha (5.7 ac) in San Mateo Creek, and 0.4 ha (1.0 ac) in San Onofre Creek. Permanent removal of habitat will be restricted to those areas impacted by bridge pilings and abutments on the creeks' banks: 0.1 ha (0.3 ac) at San Juan Creek, 0.004 ha (0.01 ac) at San Mateo Creek, and 0.004 ha (0.01 ac) at San Onofre Creek. Temporarily impacted riparian habitat will be replanted, but the presence of bridges over

replanted habitat in the major drainages will likely reduce the suitability of the restored habitat for vireo, as discussed below.

At San Juan Creek, the bridge will be between 12.2-15.2 m (40-50 ft) above the creek bed; thus, we anticipate that habitat temporarily disturbed for bridge construction will ultimately return to the current condition since significant shading effects are not anticipated. However, vireos will likely perceive the 1.2 ha (2.9 ac) of riparian habitat under the bridge as less suitable since they typically forage and nest where riparian canopies are open overhead. For example, despite multiple years of observing nesting vireo immediately upstream and downstream of the existing Interstate 5 bridge over San Mateo Creek, vireo have not been foraging, nesting, and flying under bridge, despite the presence of riparian vegetation (D. Kamada, pers. comm. 2007).

The Interstate 5 bridge currently at San Mateo Creek allows sufficient light to reach and support riparian habitat below. The additional bridges associated with the toll road will be at a similar height to the current Interstate 5 bridge, such that shading effects on the habitat will not completely preclude regrowth of riparian vegetation. However, as noted above for San Juan Creek, vireos will likely perceive the 0.5 ha (1.2 ac) of riparian habitat under the new bridges as less suitable since they typically forage nest where riparian canopies are open overhead.

At San Onofre Creek, riparian habitat suitable for vireo is not expected to return post-construction under the bridge resulting in a functional loss of about 0.04 ha (0.1 ac). The existing Interstate 5 and frontage road bridges' low elevation relative to the creekbed (about 9 m/30 ft) significantly shade the creek below, and the additional toll road lanes at San Onofre Creek will exacerbate that condition.

Based on territories typically ranging in size from 0.2 to 3.0 ha (0.5 to 7.5 ac) (Service 1998), we estimate that two vireo territories at San Juan Creek, two vireo territories at San Mateo Creek, and one at San Onofre Creek could be affected by bridge construction through removal of some portion of their territories. About 3.4 ha (8.4 ac) of vireo habitat will be impacted outside the major drainages, but because past surveys have documented very few vireo in these unnamed tributaries, we estimate that the impacted habitat outside the major drainages will support no nesting vireo, although the habitat in these drainages could be used for dispersal and short-term sheltering and foraging.

In areas where occupied vireo nesting habitat is removed, we anticipate that vireos will shift their territories to avoid the areas directly affected by construction; however, we do not anticipate that these birds will die as a result of the construction-related disturbances. Riparian habitat will remain in the immediate area, and any vireos affected are likely to relocate to the nearest available habitat.

For example, at the Prima Deshecha landfill in Orange County, we anticipated that 8 of 9 vireo territories would be harmed by the removal of their nesting habitat and the realignment of Prima Deshecha drainage to remediate a landslide (Biological Opinion dated February 11, 2002; FWS-OR-703.7). Monitoring of the remaining habitat indicated that birds returning from migration crowded into the remaining habitat; the first year after habitat removal, six territories were present, and vireo pairs within five of these territories fledged young. As restored habitat in the

realigned channel has matured and become available for occupancy, the birds have redistributed within available habitat, and the number of territories has rebounded yearly through 2005 when 10 territories were present, and each of these territories fledged young (BonTerra Consulting 2002, 2003, 2004, 2005).

None of the Prima Deshecha birds were banded, so the fate of the remaining birds occupying at least three additional territories was not known. While we cannot be certain of their fate, some of the vireos displaced in that initial post-habitat removal may have died, or they may have found other suitable habitat in the general area, perhaps on San Juan or Cristianitos creeks, which are in proximity to the landfill. However, from this study at Prima Deshecha, we can expect that vireos over time will reoccupy an area where habitat is temporarily removed and then restored.

Habitat will be removed, to the maximum extent, when vireos are at wintering locations outside of the U.S. When vireos, which have high site fidelity, return in spring to breeding areas where habitat has been removed they will be forced to compete for adjacent suitable habitat or to seek other riparian habitat further away. If they remain in the same area, they may be subject to the effects of crowding and may be delayed in the initiation of, or prevented from, nest building, resulting in fewer nesting attempts per season, a reduced clutch size per attempt, and overall reduction in reproductive output.

For example, surveys were conducted during the 2004 and 2005 breeding seasons on San Diego Creek in Orange County where habitat had been removed to address flood risk. While we do not have information on number and productivity of territories before habitat was removed, a post-removal breeding study was conducted. Four territories where habitat was removed produced a total of 5 young (1.25 young/pair). Two other territories, which did not have habitat removed, produced a total of 8 young (4 young/pair) (Chambers Group, Inc. 2006.) During 20 years of surveys in the Prado Basin, the lowest average number of estimated young per breeding pair was 1.8 (in 1986 when only 19 pairs were present) (Pike *et al*. 2005). Thus, the San Diego Creek pairs that had habitat removed apparently experienced a reduction in productivity.

Toll Road Operation and Maintenance

As discussed in the Project Description, vireos within 152.4 m (500 ft) of the toll road may be exposed to effects, such as noise and activity, associated with operation of the road. The most pronounced effect to vireo outside the limits of direct disturbance is likely to be an increase in noise levels above 60 dB, which occurs within about 91.4 m (300 ft) of busy roads (Dooling and Popper 2007), such as the future toll road. While vireos often continue to occupy areas subject to noise levels above 60 dBA, studies have documented significantly reduced reproductive success (Marine Corps 1995) and delayed reproduction (BonTerra Consulting 2000) due to noise impacts.

A total of 61.5 ha (151.9 ac) of vireo habitat is within 152.4 m (500 ft) of the toll road alignment as it runs through and adjacent to the major drainages, although 14.8 ha (36.6 ac) of this habitat is already within 152.4 m (500 ft) of the existing Interstate 5 and, therefore, exposed to road-related effects. A total of 36.2 ha (89.5 ac) of vireo habitat in the major drainages is within 91.4 m (300 ft) of the toll road alignment, including 5.4 ha (13.2 ac) within 91.4 m (300 ft) of the

existing Interstate 5. Thus, the toll road will expose a substantial amount of vireo habitat to road-related effects such as increased noise levels.

Not all habitat adjacent to the toll road is occupied by vireo. Surveys in 2001 documented a total of four vireo locations within 91.4 m (300 ft) of the toll road alignment (one at Chiquita Creek, two at Cristianitos, and one at San Mateo). Surveys in 2005 did not include habitat at Rancho Mission Viejo, but they documented three vireo locations within 91.4 m (300 ft) of the toll road alignment on Camp Pendleton. Thus, based on surveys from 2001 and 2005, about four to five pairs of vireo along the toll road alignment are likely to experience reduced fitness as a result of increased noise levels adjacent to the toll road.

Increased risk to habitat supporting vireos from invasive non-native plants due to disturbance from construction will be addressed by conservation measures to restore disturbed areas after construction. In addition, invasive non-native riparian plants will continue to be managed on the Base and Rancho Mission Viejo consistent with the programmatic biological opinion addressing riparian areas on Camp Pendleton and the Orange County Southern Subregion HCP, respectively.

Risk to habitat and individual vireos from vehicle-induced fires will increase with road operation since the road alignment traverses rural areas that currently do not have any or much traffic (except for the area at Interstate 5). Threats to vireo from fire include loss of individuals and their nests and short and long-term degradation of habitat. Even with the toll road, fires are anticipated to be infrequent events, so death or injury of individuals from fire is not anticipated to substantially affect adjacent populations. Riparian habitat is generally well-adapted to a high frequency of disturbance from flooding, and in the absence of non-native invasive species, tends to be relatively resilient following fires as well (Dwire and Kauffman 2003). In riparian areas where arundo is present, fire can result in long-term negative effects because arundo is often able to recolonize burned areas more quickly than the native vegetation (Bell 2003). However, because of the proactive arundo removal efforts on Camp Pendleton and Rancho Mission Viejo, a native riparian community is anticipated to be maintained near the toll road, even if fire frequencies increase. Death or injury of vireo due to vehicle strikes is likely to be infrequent, as vireo will easily be able to fly over the toll road.

Caltrans' maintenance activities are anticipated to result in minimal impacts to vireo. The only anticipated impacts to riparian vegetation will be in extended detention basins and at culvert mouths. Extended detention basins are expected to be maintained on a regular basis, and so are rarely anticipated to support habitat suitable for vireo. During routine culvert maintenance, Caltrans will remove a total of no more than 0.05 ha (0.12 ac) of riparian and upland vegetation each year. Furthermore, culvert maintenance activities would only affect riparian vegetation in tributaries, which based on previous survey results, have not supported vireo. Conservation measures including removing habitat outside the breeding season and/or conducting pre-project surveys for nesting birds will ensure that no vireo adults, eggs, or nestlings are killed or injured as a result of routine Caltrans maintenance.

Summary of Conservation Measures

In addition to avoiding and minimizing impacts to vireo and restoring temporarily affected habitat, 3.5 ha (8.7 ac) of vireo habitat will be created, and 8.1 ha (20.0 ac) will be restored/enhanced through arundo removal. Temporary impacts to potential vireo habitat in major drainages (5.4 ha/13.3 ac) will be restored in place, although 1.7 ha (4.2 ac) of the restored habitat will be under the new bridges and, therefore, will likely be less suitable for vireo. Planting and maintenance of the restoration areas will be conducted at times and in a manner that causes no adverse effects to nesting vireo.

Most of the proposed creation of potential vireo habitat (3.1 ha/7.7 ac) will take place in a dedicated open space area in Chiquita Creek just south of Oso Parkway. This area is adjacent to the toll road within the defined action area and, therefore, subject to the same indirect effects described above. The restoration site currently consists of wet meadow and annual grassland and will be converted into a combination of willow woodland, mulefat scrub, wet meadow, and native grassland/coastal sage scrub ecotone. Restoration in the conservation area will enhance the population in Chiquita Canyon as opposed to replacing affected habitat in San Juan, San Mateo, and San Onofre creeks.

In addition to the restoration in Chiquita Canyon, a smaller (0.4 ha/1.0 ac) site along Interstate 5 between San Mateo and San Onofre creeks will be converted from inactive agricultural fields into willow woodland. As with the proposed restoration site in Chiquita Canyon, this site will be subject to indirect effects from the adjacent roadway.

The removal of 8.1 ha (20.0 ac) of arundo and other non-native invasive vegetation from drainages occupied by vireo is anticipated to restore foraging and nesting habitat for vireo. A minimum of 2.0 ha (5.0 ac) of the restored habitat will be within the drainages affected by the toll road.

Following completion of restoration, the temporarily impacted habitat that is not under the bridges should support a similar number of vireo pairs to the number currently supported. Combined, the habitat creation and arundo removal should create/restore habitat for about seven vireo pairs, including at least three in the drainages affected by the toll road.

Effects in a Landscape Context (Including Lands outside the Action Area)

As described above, the toll road will affect vireo populations/clusters of breeding pairs at Chiquita, San Juan, Cristianitos, San Mateo, and San Onofre creeks. A brief summary of anticipated effects to vireos in each of the drainages follows. For the amount of habitat affected in each of the drainages, please refer to the analysis above.

The toll road passes near Chiquita Creek, but its construction will not result in any habitat removal. A small amount of habitat will likely be affected by road-related impacts such as increased noise levels. Most of the proposed habitat creation is adjacent to Chiquita Creek, so the proposed project will likely result in a net benefit for vireo in Chiquita Creek.

The toll road will impact vireo habitat in San Juan Creek associated with a proposed bridge crossing. Affected habitat in and adjacent to San Juan Creek is within the Habitat Reserve established under the Orange County Southern Subregion HCP and was anticipated to be conserved and managed in perpetuity. Nonetheless, these effects will be limited to a relatively small stretch of San Juan Creek, and San Juan Creek appears to be sparsely occupied by vireo. Suitable habitat will remain along the great majority of the creek, and the important population in Canada Gobernadora will be unaffected. Remaining habitat on San Juan Creek on Rancho Mission Viejo lands will continue to be managed consistent with the Orange County Southern Subregion HCP.

The toll road will pass near Cristianitos Creek and will result in increased noise levels and other road-related effects outside the limits of disturbance, but its construction will not result in any direct removal of habitat. The portion of Cristianitos Creek in Orange County is within the Habitat Reserve established under the Orange County Southern Subregion HCP and was anticipated to be conserved and managed in perpetuity. The affected habitat is a small portion of the suitable habitat along Cristianitos Creek, and vireo are anticipated to persist within the remaining habitat outside the action area and within the habitat adjacent to the roadway.

New bridges at San Mateo and San Onofre creeks will impact habitat that appears to be heavily used by vireo. Most of the habitat next to the new bridges is also in proximity to the existing Interstate 5 and, therefore, already exposed to effects such as noise. A small amount of vireo habitat is proposed for restoration between San Onofre and San Mateo creeks, but this restoration is not anticipated to offset impacts to these two populations. Nonetheless, the toll road will affect only a small portion of the habitat along each of these creeks. Most of the habitat and vireo populations along these creeks will remain within Camp Pendleton and will continue to be managed consistent with the programmatic biological opinion addressing activities affecting riparian habitat on the Base.

Summary of Effects to the Species and Recovery

Overall, the proposed project will result in a net increase of about 9.8 ha (24.2 ac) of potential vireo habitat (not including restored habitat under the bridges), but it will increase fragmentation of remaining habitat and expose a greater amount of habitat to increased noise levels and other road-related effects. As described above, the project includes creation of 3.5 ha (8.7 ac) and enhancement of 8.1 ha (20.0 ac) of vireo habitat as opposed to permanent loss of 0.13 ha (0.32 ac), temporary impacts to 5.4 ha (13.3 ac), and likely degradation of 1.7 ha (4.2 ac) under new bridges. Not including habitat adjacent to the existing I-5, a total of about 30.9 ha (76.3 ac) of suitable vireo habitat and four to five pairs of vireo will be within 91.4 m (300 ft) of the new road, where they will likely be exposed to noise levels above 60 dB and other road-related effects. The project includes bridges over San Juan Creek, San Mateo Creek, and San Onofre Creek. These bridges may reduce movement of vireo back and forth through the habitat, but vireo will be able to fly over the bridges to access habitat on either side of the road.

Anticipated impacts and restoration represent a small proportion of the available habitat in each drainage, and following project completion, each drainage will continue to support vireos and contribute to the recovery of the species.

Conclusion

After reviewing the current status of the least Bell's vireo, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that construction, operation, and maintenance of the toll road is not likely to jeopardize the continued existence of the vireo. We base this conclusion on the following:

1. The least Bell's vireo population in the U.S. has increased 10-fold since the species' listing in 1986, from 291 to 2,968 known territories, with significant population growth documented in southern California counties, including Orange County (Service 2006).

2. No adult vireos, nestlings, or eggs will be killed or injured from removal of habitat.

3. Only 5.4 ha (13.3 ac) of occupied vireo habitat in the major drainages (San Juan, San Mateo, and San Onofre creeks) will be removed, affecting up to five vireo territories. Most of these impacts will be temporary, although about 1.7 ha (4.2 ac) will be permanently degraded due to the presence of bridges overhead. Vireos occupying these territories will likely experience reduced productivity, but suitable habitat will remain in proximity.

4. Increased noise due to toll road traffic could reduce the suitability of riparian habitats near the toll road for about four to five vireo locations; however, given the vireo's population status, the effect of reduced reproduction within this limited number of locations from toll road noise and other indirect effects is not likely to appreciably reduce the numbers or distribution of vireo in the action area or throughout the species' range.

5. Creation of 3.5 ha (8.7 ac) of vireo habitat and restoration/enhancement of 8.1 ha (20.0 ac) of arundo will create sufficient habitat for about seven pairs of vireo throughout their range and help offset the direct loss of habitat associated with the toll road. All of the habitat creation and at least 2.0 ha (5.0 ac) of the arundo removal will directly benefit populations affected by the toll road. These beneficial actions will support recovery of the vireo.

PACIFIC POCKET MOUSE
(*Perognathus longimembris pacificus*)

Conservation Measures

In addition to the general avoidance and minimization measures described in Appendix 1, the following conservation measures specific for PPM that are identified in the Final Environmental Impact Report for the project dated December 6, 2005, include the following:

- During final project design, an undercrossing shall be provided in the vicinity of the San Mateo North population of the PPM for any alternative selected that occurs within this area. The undercrossing shall allow for potential movement of PPM under the alignment. The exact placement and design of the undercrossing shall be determined by the Project

Biologist, in coordination with the Base and Service during the section 7 consultation (Measure TE-23);

- Prior to the initiation of construction in areas within or proximal to known sites occupied by the Pacific pocket mouse, a Pacific Pocket Mouse Resource Management Plan (PPMRMP) shall be prepared and submitted to the Service for review to determine compliance with the biological opinion and incorporated into the Biological Resources Management Plan. This plan shall identify the strategies available for minimizing impacts and measures to restore impacted suitable habitat (Measure TE-24).

Measures specifically described as part of the project description or that are otherwise included in the PPMRMP (Wildlife Science International, Inc. and BonTerra Consulting 2007) are as follows

- Construction related minimization includes erecting temporary exclusionary fencing prior to construction and trapping animals from within the construction footprint for removal and release into adjoining habitat or retaining them for a captive breeding program if such a program is deemed necessary by the Service.

- Prior to construction of the toll road, a permanent chain-link or similar fencing will be erected around a Management Area (PPM Management Area) that is to the west of the current alignment of Cristianitos Road to prevent domestic cats, pedestrians and mountain bikes from gaining entry to areas known to be occupied by PPM or to areas that are proposed for habitat enhancement.

- Construction of an 18” curb barrier to small mammal movement along the entire western edge of the roadway alignment in the San Mateo North area to prevent PPM from entering the roadway and being struck by vehicles.

- In conjunction with final design, TCA or other implementing agencies shall incorporate low-light design features adjacent to the PPM Management Area, unless Caltrans prohibits use of some of these low lighting features for safety reasons. One or more of the following design options shall be used, if feasible, recognizing the constraints of roadway lighting requirements: (1) low intensity street lamps; (2) low-elevation light poles; or (3) shielding by internal silvering of the globes or external opaque reflectors.

- Steps shall be taken to deter perching by raptors within the PPM Management Area. These steps will include removal of all unused telephone and/or utility poles and installation of devices such as spikes to deter perching raptors.

- To minimize the effects of fragmentation, TCA will construct: (1) A 98-m (320-ft) long, 6-m (20-ft) wide arc-culvert that is intended to serve as a wildlife and utility-vehicle undercrossing about 305 m (1000 ft) north of the entrance to San Mateo Campground; (2) A 160-m (525-ft) long, 1.37 m (54-in) diameter reinforced concrete pipe culvert near the Gun Club/State Park access road and entrance to San Mateo State Beach; (3) A 116-m

(380-ft) long, 91-cm (36-in) diameter reinforced concrete pipe culvert about 229-m (750-ft) south of the Gun Club/State Park culvert; and (4) A 29-m (95-ft) long, 91-cm (36-in) diameter reinforced concrete pipe culvert under Cristianitos Road where it intersects with El Camino Real.

- With the approval of and in coordination with the Base, TCA proposes to finance and hire an entity to adaptively manage the PPM population at San Mateo North. The funding commitment will be supported through a property analysis record study (Center for Natural Lands Management 2006) which will be used to determine the initial and capital investment needed to manage the San Mateo North site as well as the endowment needed to fully fund annual ongoing tasks in perpetuity. Tasks to be funded by the endowment include: (1) invasive species control, (2) habitat management and enhancement, (3) predator control, (4) control of public access, (5) PPM population monitoring, and (6) unspecified contingencies.

- Adaptive Management of the San Mateo North site will be governed by the PPM RMP (Wildlife Science International, Inc. and BonTerra Consulting 2007). The PPM RMP proposes that a Project Manager be retained to administer, manage, protect and maintain a Management Area that is to the west of the current alignment of Cristianitos Road, and that a Project Mammalogist be retained to design, implement and report on monitoring efforts in addition to providing input on management actions. Implementation of the PPM RMP will be overseen by a Management Committee whose members will include the Transportation Corridor Agencies, U.S. Fish and Wildlife Service, Marine Corps Base Camp Pendleton and California State Parks. The Management Committee will be responsible for making decisions on the prioritization, selection, modification, and implementation of conservation measures; review and approval of annual work plans; and decisions on contingencies. The Management Committee shall fulfill its responsibilities until the Service determines that the goals of the Management Plan have been met or the Management Committee has determined that the goals are unattainable.

- The PPMRMP proposes to implement specific enhancement actions within the PPM Management Area using an adaptive management approach that is consistent with the recovery goals for PPM. Measures that are proposed to enhance PPM habitat include removal of existing trails, concrete pads and invasive vegetation. Measures proposed to be investigated for the potential to enhance PPM habitat include the control of invasive ants, soil augmentation in areas formerly used for agriculture, and use of hand thinning or prescribed fire to thin vegetation in areas that have a dense cover of sage scrub which may be detrimentally affecting the population density and distribution of PPM.

- The PPMRMP will include a public outreach component that will involve informational kiosks and mailings to homeowners to educate the public about PPM conservation issues and the benefit of removing invasive plants from adjoining private property.

- The following measures are proposed to address the increased risk of fire associated with construction and usage of the toll road: 1) No pre-suppression activities are proposed to

address the spread of fire from toll road construction or use other than best management construction practices and standard Caltrans roadway maintenance measures. However, if the Management Committee determines that a fire break within the Management Area is needed to reduce the risk of catastrophic fire then one may be implemented within the San Mateo North site; 2) Prior to installation of fencing surrounding the Management Area, the Project Manager shall develop a Strategic Fire Response Plan in coordination with the Orange County Fire Authority and MCBCP to minimize the detrimental effects of fire suppression activities in the Management Area; 3) A post-fire response plan will be developed by the Project Manager and a habitat restoration specialist in collaboration with the Management Committee, MCBCP, and the USFWS within the first year of convening the Management Committee. This plan will identify restoration actions and budget resources needed to achieve restoration of PPM habitat.

Status of the Species

Listing Status

The Pacific pocket mouse (PPM) was emergency listed by the Service on February 3, 1994 (59 FR 5306), following the rediscovery of a single population at the Dana Point Headlands in southern Orange County in 1993. Upon expiration of the emergency rule, the species was federally listed as endangered on September 29, 1994, in accordance with the Act (59 FR 49752).

Three additional occurrences of PPM, all within the bounds of Camp Pendleton in northern San Diego County, were subsequently discovered (or rediscovered) during small mammal surveys performed in 1995 (Service 1998a). Two of these occurrences consist of small pockets of animals detected immediately north and south of San Mateo Creek that are referred to as the San Mateo North and San Mateo South occurrences, respectively. The third occurrence on Camp Pendleton occurs on a marine terrace north of the Santa Margarita River in an area that spans the Oscar One and Edson Range troop training areas. This is generally referred to as the "Oscar One/Edson Range population."

Critical habitat for PPM was not designated at the time of listing because the only known, confirmed population of the Pacific pocket mouse at that time was on private property where Federal involvement in land-use activities was not expected to occur (59 FR 49752). A recovery plan for PPM was completed on September 28, 1998 (Service 1998a).

Species Description

PPM is the smallest subspecies of the little pocket mouse (*Perognathus longimembris*; PELO) (Hall 1981). While Hall (1981) recognized 19 subspecies and Williams and others (1993) recognized 16 subspecies of *P. longimembris*, Williams (1986) previously indicated this species group "needs to be reviewed, especially the relationships among *P. l. pacificus*, *brevinasus*, *bangsi*, *internationalis* and *bombycinus* of southern California." Later in a study comparing mitochondrial cytochrome b haplotype diversity within and among extant PELO populations with those obtained from museum samples collected more than 70 years ago, Swei et al (2003)

reported that the genetic structure of the five described subspecies of PELO in southern California is poorly reflected in the existing subspecific taxonomy. Moreover, McKnight (2005) in a subsequent mitochondrial genetic study of PELO, which included all of preserved specimens deposited in GenBank (accession numbers AY152409–AY152417) by Swei et al. (2003), implied that the Dana Point Headlands and Oscar One populations of PPM may actually represent different subspecies.

Like all members of the family Heteromyidae, the PPM is characterized as nocturnal granivores with external, fur-lined cheek pouches. The body pelage of the PPM is silky (spineless) and predominately brown, pinkish buff or ochraceous buff above and light brown, pale tawny, buff, or whitish below. There are typically two small patches of lighter hairs at the base of the ear. The tail can be either distinctly or indistinctly bicolored (Hall 1981). Body length ranges in size from about 10.9-13.2 cm (4.3-5.2 in) from nose to tip of tail with weight varying between 5.1-7 grams (g) (0.18-0.25 ounces (oz.)) (Hall 1981).

Habitat Affinities

Two key habitat components important to PPM are soils and vegetation. Soils in occupied areas have been described as alluvial river bottom sand (Bailey 1939; Grinnell 1933; Mearns 1898; von Bloeker 1931a), loose sandy soils, fine-grain sandy soil (Brylski 1993), dry, rocky and gravely soils (M'Closkey 1972; Meserve 1976a), and tidal flats (Mearns 1898). Available soils mapping for each of the known extant PPM occurrences (Dana Point, San Mateo North, San Mateo South, and Oscar One) indicates that PPM have been found in areas classified by the Soil Conservation Service as sand, loamy sand, sandy loam, loam, clay loam, and terrace escarpments (U.S. Soil Conservation Service 1973, 1978).

A number of studies have been performed to better understand PPM soil preferences. In 1996, prior to discovery of PPM in the Edson Range training area, Germano (1997) conducted an examination of the soils at each of the known extant PPM sites and one historic site. At all sites, he found the soils at the surface and at 20 cm (7.9 in) depth contained 95-97 percent sand, and classified the soils as sands, fine sands, loamy sands, and fine loamy sands.

Bornyasz (2003) also evaluated soils at three of the extant PPM occurrences (San Mateo North, San Mateo South, and Dana Point) as part of a study to assess the suitability of identified potential receiver sites where a new population could be established per the goals of the PPM recovery plan (Service 1998a). Bornyasz found that each of the occupied sites was dominated by loamy sands on the surface and sands and loamy sands below the surface. Surface soils ranged from 80 to 94 percent sand and never exceeded 3 percent clay. He also found soil depths at the known extant PPM sites to range from 20 cm (7.9 in) to greater than 60 cm (23.6 in). As part of his study, Bornyasz developed a modified "Soil Development Index" (SDI) to infer suitability for PPM across each site. However, the results of his SDI lack agreement with the known distribution of PPM at the extant sites, suggesting the need for further refinement/testing before his SDI can be used in a predictive context.

A study of the relationship between soil parameters associated with occurrences of mice in just the Oscar One training area portion of the southernmost population of PPM on Camp Pendleton

suggests that PPM primarily occur on well-drained loamy sand soils with less than 10 percent clay, a bulk density averaging 1.3 gm/cm^3 (4.6 oz/in^3), and gravel content under 5 percent by weight (Winchell *et al.* 1999). However, this study did not examine soil affinities in the Edson Range portion of this PPM population, nor has it been replicated or tested at other extant sites.

Based on descriptions of the historical localities for the species and the above studies, PPM prefer sandy soils with low clay or silt content. Spencer (2005) stated that PPM "strongly select for deep (>30 cm), fine-grained, loamy sands (not sandy loams) having less than about 7 percent by volume of clay and less than 4 percent by weight of gravel and rock." Nonetheless, the Oscar One soil study specifically excluded sampling in areas where soil had been visibly disturbed and/or anthropogenically altered. PPM have been documented in soft, friable road berms along dirt roads on the Base that were mechanically created in areas with sandy loam to clay loam soils (Boggs 1996; Service 1999a). PPM have also been found in areas mapped as loam, clay loam and terrace escarpments (Montgomery 2003, Boggs 1996). Spencer (2007) recently re-documented PPM in portions of Edson Range with loam soils where no sandy soils are evident. PPM were originally documented in these areas in 1998 (Montgomery 2003). Thus, while PPM appears to have an affinity for sandy soils, these findings suggest PPM is capable of occupying and persisting in a wider range of soils than has been reported.

Based on, in part, on presence-absence surveys at San Mateo North and San Mateo South populations, surveyors have concluded that historical farming and other agricultural activities have a lasting adverse effect on PPM distribution and habitat quality (Montgomery 2003; Ogden 1997). Aside from the direct mortality associated with cultivation, the apparent negative relationship between previous agricultural uses and present PPM distribution suggests that the cultivation of soils renders these areas unsuitable for PPM. In this regard, Montgomery (2005a) noted that the top layer of soils appears to have been removed in some portions of the historical agriculture area. Direct field observations reveal that the soils are composed of a mixture of compacted, non-suitable soils, with inclusions of friable loamy fine sands that appear suitable for PPM (Ogden 1997; S. Montgomery pers. comm. to W. Miller, Service; M. Pavelka, Service, pers. obs.). However, a close examination of series of historical aerial photos reveal that number of PPM capture records at the San Mateo North population fall within and near the outer boundary of areas historically cultivated. While Spencer (2008) continues to maintain that "former ag lands are unsuitable for PPM," he further stated that this hypothesis "has not been rigorously tested and should not be accepted as a foregone conclusion to rule out potential for PPM occupancy in former agricultural fields." Regarding the San Mateo North population, this issue is discussed further under the *Factors Affecting the Species' Environment within the Action Area* section.

Historically, individual PPM have been collected or observed in various plant communities, including coastal strand, coastal dunes, ruderal vegetation on river alluvium, and coastal sage scrub (von Bloeker 1931a; Grinnell 1933; Meserve 1972; M'Closkey 1972; Germano 1997). Most PPM had been caught in either open, sparsely vegetated areas, or in small open patches within dense stands of vegetation (von Bloeker 1931a; Williams 1986; Erickson 1993). Recorded plant species composition varied between occupied sites with annual grasses, in relatively low abundance, being the only consistent component. At one PPM site in the San Joaquin Hills in Orange County, California, M'Closkey (1972) conducted vegetation transects

with the following results for percent cover: 30 percent open sand, 30 percent California buckwheat (*Eriogonum fasciculatum)*, 17 percent California sagebrush (*Artemisia californica)*, and 14 percent grasses. Meserve (1976a) reported that no telegraph weed (*Heterotheca grandiflora*) was present at the site studied by M'Closkey. Telegraph weed had been reported at several other occupied PPM sites (von Bloeker 1931b).

Vegetation at the four extant PPM sites is primarily composed of coastal sage scrub, native grasslands, and non-native grasslands. Dominant shrub species at the three northern sites include California buckwheat, California sagebrush, California broom (*Lotus scoparius*), and white sage (*Salvia apiana*) (Germano 1997; Michael Brandman Associates and LSA Associates 1997; Dodd *et al.* 1999; Dodd and Montgomery 2000). At one of the sites, Germano (1997) found that areas occupied by PPM contained 57 percent shrub cover and 33 percent bare ground, and habitat presumed unoccupied by PPM contained 74 percent shrub cover and 15 percent bare ground. Another study characterized vegetative cover in presumed occupied and unoccupied areas at the same site based on the height of the vegetation above ground (Dodd *et al.* 1999). This study suggests that the vegetation layer 0-10 cm (0-3.9 in) from the ground is the layer that most influences PPM because this is where PPM concentrate their activity. Cover values for the 0-10 cm (0-3.9 in) layer where PPM had been captured were bare ground 35 percent, forbs/grasses 18 percent and shrub cover 9 percent. Cover values where PPM were not detected were bare ground 43 percent, forbs/grasses 23 percent and shrub cover 19 percent. Based on their observations the investigators hypothesized that PPM were avoiding the higher shrub cover in this layer as well as areas where there was greater cover by exotic forbs and grasses (18 percent versus 10.5 percent when exotic/non-natives are broken out separately) (Dodd *et al.* 1999). Moreover, little difference in the amount of shrub cover in the next layer, 10-30 cm (3.9-11.8 in), was noted from the ground in occupied versus unoccupied habitat (57 percent versus 59 percent, respectively), while slightly higher shrub cover was observed in occupied versus unoccupied habitat from 30-200 cm (11.8-78.7 in) above ground (43 percent versus 48 percent, respectively). Total forb/grass cover was similar above 10 cm (3.9 in) in the presumed occupied versus unoccupied areas (Dodd *et al.* 1999).

The Service conducted vegetation transects at two locations within a population of PPM at the southern end of the Base (Service 1996a). One location, where only three PPM were captured, was on clay loam soils and had only 16 percent shrub cover. The litter or ground cover was comprised of 3 percent forb litter, 86.5 percent grass litter and 10.5 percent bare soil. Subsequent surveys at this location have failed to capture PPM (Service 1999a; Service unpublished data). The other site, at which nine PPM were originally captured and hundreds have since been captured, was on fine loamy sands and had 79 percent shrub cover. The litter was comprised of 64 percent forb litter and 19 percent grass litter, and 17 percent bare soil. Dominant plants at the second site were California croton (*Croton californicus*), longstem buckwheat (*Eriogonum elongatum*), California-aster (*Lessingia filaginifolia*), and white sage. The report noted, however, that the dominant shrub species had open growth forms and did not form a dense, closed canopy such as that formed by California sagebrush. Telegraph weed was also present at the site.

Spencer and others (2000a) hypothesized that the floristic and structural composition of the plant community is less important to determining habitat suitability for PPM than soil texture. Loda *et*

al. (1999) compared the dominant floristic components between 20 sites occupied by PPM and 32 sites not occupied with PPM but geographically interspersed with the occupied sites. Loda *et al.* (1999) found that grids where PPM were not detected had a higher prevalence of California sagebrush and suggested that higher shrub density (canopy) and/or high grass density may preclude PPM from occupying an area. However, Loda *et al*. (1999) found no significant relationship between the composition of shrubs and the occurrence of PPM, supporting the idea that PPM can tolerate a range of plant associations.

Several researchers have proposed that PPM prefer more open habitat with less shrub cover than is present in the mature coastal sage scrub surrounding some of the known PPM populations (Loda *et al.* 1999;: Service 1999a; Spencer *et al.* 2000b; Montgomery 2005a). However, in the desert environment PELO is associated with shrub cover (Brown and Lieberman 1973; Kenagy 1973; Thompson 1982a; Kotler 1984; Bowers 1986; Jones and Longland 1999) where it tends to concentrate its foraging activity (Thompson 1982a). Foraging beneath shrubs is thought to confer greater safety to PELO from predators relative to foraging in the open (Thompson 1982b; Kotler 1984; Longland and Price 1991).

Differences in the amount of shrub cover in coastal versus desert environments suggest "shrubbiness" may be a relative term. Shrub removal experiments in desert environments resulted in increases in the activity of kangaroo rats but not increases in *Perognathus* species of similar size to PPM (Rosenzweig 1973). Conversely, Price *et al.* (1994) reported that the San Diego pocket mouse (*Chaetodipus fallax*) and PELO increased more in the treated plots versus the reference plots in a shrub removal study in western Riverside County. In addition, Thompson (1982b) in another study manipulated "interplant" distances in a desert environment by deploying cardboard shelters that were fashioned to simulate shrub cover, thus increasing the "shrubbiness" of the habitat. He found that PELO occurred at lower densities on his experimental plots than would have been predicted from population trajectories on adjacent control plots. This appears to have been associated with invasion of the experimental plots by two habitat generalists in the genus *Peromyscus* (Thompson 1982b). Thus, PPM likely benefit by some level of shrub cover, but a threshold may exist beyond which increasing shrub cover detrimentally affects habitat suitability by altering resource levels or favoring other members of the small mammal community.

To study whether manipulation of shrub cover can enhance habitat for PPM, some small-scale experimental hand-thinning of shrubs and litter removal was performed in areas of dense cover adjoining PPM capture locations at the Dana Point Headlands, California (Dodd and Montgomery 2000). Vegetation was also manipulated by means of a small, 1.4-hectare (ha) (3.4-acre (ac)) prescribed burn that was carried out adjoining the San Mateo North PPM population in January 2001 (Service 2000; Montgomery 2005a).

At Dana Point Headlands in Orange County shrub cover was reduced from approximately 70 percent to 28 percent and bare ground was increased from 7-19 percent to 19- 44 percent on the hand-thinned plots. Initial trapping results suggested PPM responded quickly and positively to the shrub thinning by redistributing themselves into the treated areas (Spencer 2005), but a number of factors complicate the interpretation of results. First, it is not known if vegetation thinning affected detection probabilities. Second, the vegetation thinning appears to have

preceded a period of apparent population decline at Dana Point providing small sample sizes for comparison of results. Finally, trapping of the same individuals in thinned and unthinned areas and recorded animal movements larger than the scale of the thinning plots, suggest that it will be difficult to attribute a population response at the scale of the vegetation manipulations performed.

Within the footprint of the prescribed burn at San Mateo North on the Base, shrub cover was initially reduced from approximately 51 percent to 9 percent, and bare ground was increased from approximately 5 percent to 47 percent. Since then there has been a significant increase in the density of herbs with more gradual increases in shrub cover (Montgomery 2005a). Investigators were hopeful that PPM would move, either through juvenile dispersal or through adult relocations, from the adjoining area into the study area following the prescribed burn. However, no PPM have been captured in the burn area to date, and very few have been captured in the area immediately adjoining the prescribed burn. Failure of PPM to colonize the prescribed burn may be due to the small number of animals available to disperse from the adjoining area, the large percent cover of herbs, particularly 0-10 cm (0-3.9 in) from the ground (58 percent in 2003), that became established following the burn. In addition, because the prescribed burn falls within a former agricultural field that was cultivated from, at least, 1941 to 1955, this prolonged soil disturbance and perhaps other factors related to habitat suitability account for this failure of PPM to colonize the burn area.

PPM is a strong seed specialist, though their diets may occasionally include insects and green vegetation (Reichman and Price 1993). In feeding trials with captive PPM, Meserve (1976b) reported that PPM prefer grass seeds to forbs or shrubs. However, wild PPM consumed a higher proportion of forbs in the spring, and higher proportion of grasses at other times of the year. Hayden *et al.* (1966) reported that PELO consumed green vegetation and grasses eagerly in the laboratory. Brown and Lieberman (1973) found that in desert environments, PELO were highly specialized and selected seeds averaging 1.4 mm (0.06 in) in size. They also found that rodents in general consumed seeds proportional to their body size and suggested that similar-sized rodents, such as PELO and the western harvest mouse (*Reithrodontomys megalotus*), may compete for the same seeds. Others have not observed a pattern of dietary preferences on the basis of seed size in heteromyid rodents (Stamp and Ohmart 1978; Reichman and Price 1993) and argue that patterns in seed size selection are likely correlated with seed availability in preferred microhabitats.

In conclusion, PPM appear to be associated with shrublands, grasslands, forblands and/or grassland-sage scrub ecotonal areas that have a moderate level of cover for predator avoidance with a degree of openness and bare soils to support foraging behavior (Thompson 1982b; Reichman and Price 1993; Dodd and Montgomery 2000). At sites where shrub cover is low to absent, large stature forbs and native grasses appear to function like shrubs in providing cover (Montgomery 2005a). Because they have not been documented in dense non-native grasslands, which are often associated with loam to clay soils, it is suspected that the density of vegetation at ground level in combination with soil conditions make this vegetation community unsuitable for PPM.

Studies with desert subspecies show that PELO forage under shrubs and likely rely upon vegetation cover to avoid predation (Thompson 1982b; Kotler 1984). Other studies suggest that too much shrub cover may be detrimental to PELO (Thompson 1982b). Given that Spencer (2008) reported that the general consensus among PPM biologists is that the animal does not require shrub cover, the high cover of mature coastal sage scrub at the Dana Point and San Mateo North PPM populations likely is detrimentally affecting the distribution of PPM at these locations.

Life History

The life history of PELO has been extensively studied for subspecies occurring in desert environments (Allred and Beck 1963; Bartholomew and Cade 1957; Beatley 1969; Bowers 1982; Bowers 1986; Brown and Lieberman 1973; Burge and Jorgensen 1973; Chew and Butterworth 1964; Chew *et al.* 1967; Cramer and Chapman 1990; Flake and Jorgensen 1969; French 1976; French *et al.* 1974; French *et al.* 1967; French 1977; Jorgensen 1968a; Jorgensen 1968b; Kenagy 1973; Kenagy and Bartholomew 1985; Kotler 1984; Kotler 1985; Larsen 1986; Lemen and Freeman 1986; Maza *et al.* 1973; Price *et al.* 2000; Thompson 1982a; Thompson 1982b; Thompson 1985; Veech 2001). However, significantly fewer studies have focused on the specific factors governing the life history of coastally occurring PPM (M'Closkey 1972; Meserve 1976a; Meserve 1976b; Service 2008a). From what has been learned about PPM behavior and population dynamics, apparently periods of resource uncertainty and the need to conserve energy in an unpredictable environment have similarly shaped the life history of PPM, and the coastal PELO share many of the same attributes as desert-occurring subspecies. Therefore, the following discussion assumes that much of what is known about desert-occurring subspecies applies to PPM, unless otherwise noted.

Births

Reproduction in PELO is highly correlated with rainfall and seed availability (Beatley 1969; French *et al.* 1974; Kenagy and Bartholomew 1985). PELO may breed only once in the spring between the months of April and June, though occasionally they may extend the breeding season and produce two litters in a year (Chew and Butterworth 1964; Cramer and Chapman 1990; Flake and Jorgensen 1969; French *et al.* 1967; Meserve 1972; O'Farrell *et al.* 1975; Kenagy and Bartholomew 1985; Service 2008a). However, their seasonal dormancy restricts the length of the reproductive season, which may limit their ability to adjust the frequency of litters (Kenagy and Bartholomew 1985).

Gestation for PELO typically lasts 23 days, and young are weaned after 30 days (Hayden *et al.* 1966). PELO become sexually mature at 41 days of age and can breed in their natal year during favorable conditions (Brylski 1993; French *et al.* 1974; Hayden *et al.* 1966; Service 2008a). Meserve (1972) captured pregnant and lactating PPM from April through June and captured juveniles from June through September. Trapping studies at the Base have documented pregnant females in April and as late as mid-September, with many of the later pregnancies likely occurring in young of the year (Service 2008a).

PELO produce between four to six offspring per litter if conditions are suitable (Cramer and Chapman 1990; Hayden *et al.* 1966; Kenagy and Bartholomew 1985*).* French *et al.* (1974) found mean litter sizes to vary from 5.1 for females less than 1 year old to 6.0 for animals 3 years of age, but comparisons did not reveal significant differences in litter size among age groups. In years of poor resource availability (*e.g.*, drought) *Perognathus* may delay breeding or forego breeding altogether resulting in little to no recruitment to the overall population (Beatley 1969; Conley *et al.* 1977; French *et al.* 1967; Kenagy and Bartholomew 1985; O'Farrell *et al.* 1975; Service 2008b; Spencer 2007; D. Shier pers. comm. 2007). However, changes in the age structure of the population following years of good or poor recruitment appears to have little influence on the overall reproductive performance of the population (French *et al.* 1974; O'Farrell *et al.* 1975).

PPM can rapidly recruit individuals into the population under favorable conditions because of their large litter sizes, the ability to breed more than once in a year, the ability to reproduce during their natal year, and the ability of older animals to continue to (Beatley 1969; Conley *et al.* 1977; French *et al.* 1974; Service 2008a). In simulations, Conley *et al.* (1977) show that 4-fold population increases are possible within 1 year with 90 percent of adults and no young reproducing, or with 50 percent of adults and 50 percent of young of the year reproducing. Assuming greater than 50 percent of adults will reproduce when conditions are favorable enough to promote reproduction in young, and two litters for each adult female within the same year; even higher population growth rates are possible (Conley *et al.* 1977). A demographic study of PPM on the Base documented an 8.9-fold increase in PPM abundance between May and September of 2003 at one monitoring location based on numbers of unique captures, but formal population estimates suggest the rate of population increase may have even been higher during this interval (Service 2008a). Such rapid rates of population increase are likely to occur on an infrequent basis under ideal conditions.

Longevity/Survivorship/Death

PELO are exceptionally long-lived for an animal of its size (Brown and Harney 1993; Conley *et al.* 1977; Edmonds and Fertig 1972; French *et al.* 1967). French *et al.* (1967) reported on 25 PELO that survived from 3 to 5 years in the wild. Egoscue *et al.* (1970) maintained wild caught individuals for up to 7 years 10 months in captivity. Edmonds and Fertig (1972) reported a wild caught, mature, animal in captivity for 8 years and 1 month.

Adaptations that are likely to be associated with their longevity are their fossorial habit and seed-caching behavior in combination with their physiological capacity to enter torpor. The ability to remain below ground through the use of stored food and/or torpor is likely to be an effective predator avoidance strategy (Brown and Harney 1993). Facultative use of torpor also confers significant metabolic energy savings during periods of environmental stress (Bartholomew and Cade 1957; French 1976). In laboratory trials PELO adjusted the amount of time they spent in torpor to food availability (Bartholomew and Cade 1957; French 1976). Finally, because torpor slows metabolic processes, it is likely to delay cellular senescence (French *et al.* 1967; Hayden and Lindberg 1976).

The above records of animals surviving for 5+ years are likely to represent the maximum end of the longevity curve, while mean individual survivorship is likely to be much lower. Hayden and Lindberg (1976) reported that most PELO are unlikely to survive more than a year. Chew and Butterworth (1964) recaptured 19 of 62 PELO (30.6 percent) 11 to 12 months following their date of first capture. Kenagy (1973) reported that overwinter survivorship was 82 percent, 56 percent and 36 percent in 3 consecutive years, which he correlated with population size and resource availability (*i.e.*, larger population sizes and greater survivorship were positively associated with rainfall and annual plant seed availability). However, his methods did not account for the possibility that low animal return rates could be associated with dispersal or a failure to detect individuals during subsequent trapping bouts.

A recent (2003-2006) demographic study of PPM at the Base that employed population estimators accounting for detectability and temporary emigration (*e.g.*, the inavailability of some animals to detection during some sampling periods due to torpor behavior) but not permanent emigration (*i.e.*, animals that permanently emigrate are confounded with animals that die), estimated distinct monthly survivorship rates during the summer and winter (Service 2008a). Monthly summer survivorship on two grids was estimated at 0.81 (S.E. 0.05) and 0.75 (S.E. 0.05), and monthly winter survivorship was estimated at 0.92 (SE 0.03) and 0.91 (S. E. 0.02), respectively. On one of the two grids support was found for lower overwinter survivorship during the winter of 2004-2005 (0.66 S.E. 0.04), which is likely associated with near record rainfall during that winter and spring causing lower survivorship at that location. Assuming that each survivorship rate applies for 6 months of the year, then for the grid with better overall survivorship, this rate would result in an annual survivorship rate of around 17 percent. Combined across the two grids, three individuals have been documented surviving in the wild for at least 2 years and 7 months

Contrary to the findings of Kenagy (1973), French *et al.* (1967) suggested a correlation exists between longevity of PELO and seasonal adversity, with animals seeming to survive longer during poor environmental conditions. They hypothesize that during years of good resource availability animals remain active a greater proportion of the time, thus exposing themselves to higher risks of mortality. Similarly, if there is a cost in terms of reduced survivorship associated with reproduction, as is often suggested by reproductive theory, the ability of PELO to forego reproduction during years of poor plant production should improve their prospects for survivorship (Conley *et al.* 1977).

These factors suggest that PPM may be capable of shifting demographic strategies depending on resource availability. Under periods of high rainfall and plant production PPM are likely to exhibit maximum reproduction and relatively low survival rates, while minimum reproductive rates and maximum survival rates would be expected during times of drought and poor primary production (Conley *et al.* 1977).

The direct causes of PPM mortality are poorly known but, similar to desert subspecies, PPM are likely to be prey for a large suite of vertebrate predators including snakes, owls, foxes, weasels, raccoons, coyotes, bobcat, feral and/or domestic cats, and possibly lizards (Brylski 1993; French *et al.* 1967; Kotler 1985; Ogden 1997; Pietruszka *et al.* 1981; Price and Brown 1983; Service 1998a). Feral and domestic cats have the ability to deplete a rodent population very quickly

(Pearson 1964) and may pose a particular predatory threat to PPM populations adjacent to residential developments where cat owners, by providing food, boost cat populations far beyond carrying capacity (Crooks and Soulé 1999).

During population monitoring, dead PPM have been encountered in traps that were captured with other PPM or that had been mobbed by ants (Service 2004c; Service 2006). Because heteromyids are known to be intolerant of one another, the deaths within traps may be the result of one animal "winning out" over another during hostile interactions inside the trap. Under natural conditions, it is likely that avoidance behavior or the ability of animals to flee from one another minimizes fatal encounters between individuals of this species. However, observations of injured animals and a greater tendency to observe double captures of animals during the breeding season suggest that animals fight over access to mates. With regards to dead animals encountered in traps that had been mobbed by ants, it is not clear whether the ants were able to opportunistically kill animals that were confined in traps or if the animals were otherwise subdued by other factors (*e.g.*, exposure) prior to attack by ants. Thus, ants may be a predator of PPM, but it is unclear how important ants are to PPM population dynamics under natural conditions.

Most captured PPM have not shown evidence of disease or heavy parasite loads (Montgomery 2003; Ogden 1997; W. B. Miller, M. Pavelka, Service, pers. obs.), although this observation has not been specifically studied. At one of the PPM populations, co-occurring desert woodrats (*Neotoma lepida*) have been observed with severe skin infections, possibly of fungal origin, but it is not known whether a risk of transmission to PPM exists outside of possible exposure from trapping studies (Montgomery 2003; W. Miller, Service, pers. obs.). PPM at the Base are also occasionally observed with yellow-orange mites around their tail and genitals, and at least one individual has been observed with mange (W. Miller, Service, pers. obs.). If disease or parasites are a significant factor in PPM mortality, then larger more dispersed populations would be evolutionarily favored. Trapping records suggest PPM occur in relatively concentrated and contiguous populations, thereby suggesting that disease and parasites could be a significant factor during episodic events. However, no such events have been documented, and the importance of chronic low levels of infestation by mites to population processes is unknown.

Within the fire-adapted plant community, coastal sage scrub, fire may represent an occasional source of mortality for PPM. Fires, even grass fires, can cause mortality of mice due to heat and/or suffocation (Howard *et al.* 1959). Fires typically raise surface soil temps to 95-720^{o}C (203-1,328°F) and below surface temps, down to 3-4 cm (1.2-1.6 in) below ground, to 50-80^{o}C (122-176°F). The actual temperature and duration are dependent on fuel distribution and moisture content (DeBano *et al.* 1998). However, in an experiment to test the effects of fire on rodents, Howard *et al.* (1959) reported that some rodents died due to suffocation, while all others died when surrounding temperatures reached 59-60^{o}C (138-140°F). Because PELO have been known to use burrows only 1 cm (0.39 in) below the surface and the physiological capacity of heteromyid rodents to withstand temperatures above thermoneutrality is not great (Kenagy 1973), it is likely that fire could result in the direct mortality of PPM inhabiting an area.

Unique Physiological Adaptations

As discussed above, PELO have several key adaptations that facilitate persistence under highly stochastic environmental conditions. These adaptations include spending much of their time beneath ground in burrows where they hoard food and the use of daily or seasonal torpor (aestivation/hibernation).

Hoarding behaviors evolve under selective pressures imposed by seasonal food shortages or by seasonal difficulties in foraging. PELO is an example of the latter whereby it cannot forage during the cold part of the year because of the extremely high energetic cost of maintaining homeothermy (Vaughan 1978). PELO therefore remain in their burrows during periods of inclement weather or food shortages and rely on seed caches stored during more favorable conditions.

PELO are among the smallest mammals known to hibernate, generally from September/October to March/April (Kenagy 1973; Kenagy and Bartholomew 1985; Meserve 1976a; O'Farrell 1974), although hibernation periods may vary with environmental conditions and food availability (Kenagy 1973; Kenagy and Bartholomew 1985). In contrast to other hibernators that accumulate fat reserves, PELO feed on seed caches stored in their burrows (Brown and Lieberman 1973; Kenagy 1973), and cessation of above-ground foraging activity is not obligatorily dependent on torpor, though both may occur simultaneously in cold temperatures (French 1977). Some individuals may remain active and forage above ground throughout winter if seeds are available (Kenagy 1973). However, when deprived of food PELO are observed to become torpid (Bartholomew and Cade 1957; French 1977).

Periods of inactivity, either through exploitation of seed caches or through hibernation and aestivation, may have neither a strictly daily or seasonal pattern. Emergence from hibernation in spring generally correlates with availability of forb and grass seeds (Meserve 1976b) but can vary among years (Kenagy 1973; Kenagy and Bartholomew 1985; O'Farrell 1974) and may relate to the vertical temperature gradient in the soil profile (French 1977). Based on laboratory studies, French (1977) reported that emergence from hibernation is a gradual process whereby animals initially emerge for short periods divided by periods of torpor, then gradually increase their time above ground over several weeks. Males are likely to emerge from hibernation prior to females (O'Farrell *et al.* 1975). The timing of onset of the hibernation period can vary widely (French *et al.* 1967) but generally follows a pattern of adult males beginning hibernation first, then adult females, then juveniles (French 1977).

Based on studies of a similar sized species of *Perognathus* in the Great Basin, O'Farrell *et al.* (1975) observed that individual components of the population had brief periods of activity above ground on an annual basis. Once they commenced above ground activities the Great Basin pocket mice (*P. parvus*) were trappable for an average of 60 days during years of adequate food supplies and an average of 90 days during years that food was scarce. However, during productive years, trapping late in the year primarily captured subadults that were produced from late litters and animals that had been captured earlier in the year had already ceased surface activity (O'Farrell *et al.* 1975). In laboratory trials, French (1977) observed that PELO stopped foraging even when food was always made available to them, suggesting that mice stay below

ground once reproduction is completed and sufficient food stores are accumulated. This pattern of brief periods of above-ground activity among components of the population appears to be consistent with results of PPM population monitoring efforts at the Base (Service 2008a).

In conclusion, annual variation in timing of emergence and onset of hibernation, the asynchronous manner in which individuals enter or emerge from winter hibernation, and the potentially low probability of detecting individuals that are only active above ground for short intervals confound efforts to understand PPM distribution, estimate population abundance, and track population dynamics, particularly during the early and late portion of their seasonal activity.

Home Range and Immigration/Emigration

Normal movements of small mammals are difficult to infer from trapping studies because 1) the spacing of traps can significantly affect the distance between captures and estimated animal range, 2) the size of the trapping area may be too small to detect larger distance movements, and 3) the regular movement pattern of the animal can be altered by the placement of traps and the additional food resources in their use area (Gurnell and Gipps1989; Smith 1971; Thompson 1982a; Hayne 1950). Trapping studies typically employ a grid or other systematic arrangement of traps. As trap spacing increases, the proportion of animals that are captured in only one trap (*e.g*., a movement distance of zero meters) increases, thereby decreasing the overall range estimate for the population (Hayne 1950; Gurnell and Gipps1989). Likewise traps spaced too closely can result in animals being captured repeatedly before utilizing their entire home range, again decreasing mean range estimate (Stickel 1954; Allred and Beck 1963). If the size of the trapping grid is small relative to the movement distances of the animals, the estimated range will be biased low due to the lack of captures at either end of the longer distance movements (*e.g*., only more sedentary individuals are captured multiple times within the limited trapping area). Lastly, trapping between 2003 and 2006 showed PPM can become acclimated to live-traps and the associated seed reward in their environment by becoming "trap-happy" (*e.g*., the probability of being recaptured is greater than the probability of being captured the first time) (Service 2008a). Such animals tends to be drawn to the same location repeatedly thus reducing the number of traps in which animals are captured and the observed range of animals during the sample period.

Another issue, specific to the biology of PPM, is the pattern of animals going undetected for one or more trapping periods and then reappearing on trapping grids during subsequent monitoring efforts (Service 2008a). Often this appears to coincide with seasonal dormancy, as marked animals often reappear at or near the same trap stations the following spring (Meserve 1976a; Service 2008a). However, PELO are known to make occasional long-distance forays that appear to be exploratory sallies rather than part of their routine activity (Jorgensen 1968a; Maza *et al.* 1973). In another *Perognathus* species, Maza *et al.* (1973) observed that "long-distance excursions beyond their home range" are predominantly made by males and are highest in frequency during spring months, suggesting a correlation between reproductive activity and such excursions.

Despite these issues, a number of studies have attempted to characterize the movements and home range of PELO, and PPM in particular. Kenagy (1973) reported that nightly distances moved by individual PELO was much less than 50 m (164 ft), and animals were never observed to move between his trapping grids. Chew and Butterworth (1964) found that from year to year, 95 percent of recaptured PELO moved 100 m (328 ft) or less.

More rigorous efforts to characterize home ranges of PELO in desert environments have typically involved calculation of a circular home range that is based on a theoretical center to that range approximated from two or more capture locations. The area of the home range is then characterized by a radius within which a given proportion of recaptures would be expected to fall (Burge and Jorgensen 1973; Jorgensen 1968b; Kenagy 1973). Based on recapture data from 26 males and 41 females, Jorgensen (1968b) calculated recapture radii of 41.89 m (137.4 ft) and 44.45 m (145.8 ft), respectively, within which 95 percent of PELO recaptures would be predicted to occur. Based on 480 recaptures of females and 341 recaptures of males, Burge and Jorgensen (1973) developed another method to predict with 99 percent confidence that 95 percent of female PELO would be recaptured within a radius of 36.09 m (118.4 ft) and 95 percent of males would be recaptured within a radius 38.8 m (127.3 ft). Based on 7 years of monthly trapping data, Maza *et al.* (1973) reported a mean circular home range for PELO that would be predicted to encompass 86 percent of an animal's activity within a radius of 38 m (124.7 ft), and 99 percent of an animal's activity within a radius of 57 m (187 ft). Maza *et al.* (1973) also found that home range size varied among years and was smaller at high population densities. It is unclear whether this represents a response to greater resource availability that is correlated with higher population densities, or is a response to increased social interactions (French *et al.* 1974). Finally, O'Farrell (1978) reported that PELO had the smallest annual composite home range of the nine rodents examined in a Nevada study. He indicated that the circle home range for PELO, where the probability of the animal being present is 95 percent, was 0.46 hectares, whereas using the preferable principal component method, which yields a 95 percent probability area, the home range was 0.33 hectares.

Trapping studies of PPM indicate movement distances of a similar magnitude. Dodd *et al.* (1999) found that 95 percent of PPM captured at the Dana Point Headlands in 1998 had a maximum observed distance between captures of 46 m (150.9 ft) or less within 5 to 10 nights of trapping. Dodd and Montgomery (2000) found similar results at Dana Point the following year. During each 4-10 night trapping period conducted for population monitoring on the Base, 95 percent of all PPM had a maximum observed distance between capture locations of 36 m (118.1 ft) or less (Service 2008a). The Service also noted that the maximum distance was highly variable between individuals, that males consistently moved greater distances than females, that movement distances were greatest in the spring and least in the summer, and that short term measurements of PPM range lengths tended to be largest when population densities were low.

Shier (2007b) found a mean PPM range of 59.2 m^2 ± 49.1 m^2 (637.2 ft^2) based on 3 to 18 captures per individual during July and August 2006. Assuming circular ranges, Shier's results yield a mean diameter of 8.8 m (28.9 ft), which is consistent with the mid-summer distances detected by the Service in 2004 and 2005 (Service 2008a). Shier also used radio-tracking in the absence of traps to assess the movements of four juvenile PPM. Ranges based on telemetry were significantly lower than those based on trapping, but the telemetry was conducted over a limited

3-6 day interval in July 2006. In all cases, there was substantial individual variation in the reported ranges (Shier 2007b).

Because the measured range of an animal is also a function of time, the longer one observes an animal the more of its range it will be observed using and the larger the estimated range will be (Hayne 1950). Thus, because of the limited trapping and telemetry period used for the range estimates of Shier (2007b), the result of this study should be interpreted with caution. Dodd and Montgomery (2000) noted larger PPM movement distances when looking across multiple seasons. The Service reported that when only considering PPM captured across time intervals ranging from 1.5 to several months, 95 percent of PPM captured moved 81 m (265.7 ft) or less. The maximum distance between captures decreased (95 percentile = 59 m (193.6 ft)) when all records of all individuals were used due to the inclusion of a large number of individuals that were captured only a few times during a single 4-10 night trapping period (Service 2008a).

While the exact relationship between the trap revealed range and the true range of PPM is unknown, the distance of 81 m (265.7 ft) is likely the best approximation available since this distance is based on capture locations recorded during sample efforts separated by more than a month, which helps to minimize the influence of behavioral factors (*e.g.*, "trap happiness") on recorded movements. This range is virtually identical to the PELO home range diameter calculated by Jorgensen (1968b), and generally consistent with the findings of Chew and Butterworth (1964), Burge and Jorgensen (1973), Maza *et al.* (1973), and Dodd and Montgomery (2000).

Not much is known about the dispersal capabilities of PELO. Flake and Jorgensen (1969) removed all the PELO from a 6.3-ha (15.6-ac) area and measured the colonization rate of the trapped-out area. They found during the first year of their removals that adult PELO rapidly colonized the trapped-out area, with the highest rates of invasion (3.6 animals/day) immediately following animal removals. They suggest that initial invaders were likely to be animals with home ranges along the border of the study site that responded to the removal of animals with which their home ranges overlapped. The first year of their study coincided with poor reproduction in the surrounding PELO population, to which they attributed low invasion rates during subsequent months. However, in each year of their study they observed a decrease in the mean age of invaders over the course of the summer that coincided with the appearance of young in the surrounding population. During the second year of their study, low initial densities in the surrounding population correlated with low initial invasion rates of the trapped-out area. However, extremely high invasion rates (24.8 animals/day) of young animals were observed late in the summer, coinciding with rapid population growth in the surrounding population. Overall, they were unable to detect significant differences in the ratio of invading males and females from the surrounding population or in the mean age of invaders, leading them to conclude that invasion rates varied widely and were mainly influenced by the structure and density of the surrounding population (Flake and Jorgensen 1969).

To study small mammal dispersal, Allred and Beck (1963) spaced traps at 22.8 m (75.0 ft) intervals on 6.3-ha (15.6-ac) grids, or similarly spaced traps in lines radiating from a central point, within a number of plant communities that were either undisturbed or within which nuclear detonations had taken place. Of the few PELO with which they were able to detect

movements, they recorded maximum dispersal distances of 229 m (751.3 ft) and 235 m (771.0 ft) for a male and female, respectively, over about 1 month intervals. Average range of movement was 71 m (232.9 ft) for males and 57 m (187.0 ft) for females, but relatively few animals were recaptured at stations other than where they were first caught, suggesting their trap spacing exceeded the average range of movement of most mice.

In conclusion, conservative estimates suggest that most PPM home ranges have a diameter of about 81 m (265.7 ft) or less, but over their lifetime they may make occasional long distance exploratory forays or dispersal movements. Home range size or movement activity may vary seasonally or on an annual basis in response to population densities, with larger home ranges likely at lower population densities (Maza *et al.* 1973, Service 2008a). Animals appear to be able to quickly colonize unoccupied suitable habitat adjoining areas of occupancy, but the rate of invasion of such areas appears to depend on the density of the surrounding population (Flake and Jorgensen 1969). Much remains to be learned about the dispersal capabilities of PPM. Based on field observations, movements detected on grids, and studies of other PELO subspecies, PPM appear to be capable of moving moderate distances over short time intervals. However, the likelihood that animals will travel long distances across unsuitable habitat to disperse into discontiguous areas with suitable soils is unknown.

Population Dynamics

In a review of literature on heteromyid population dynamics, Brown and Harney (1993) concluded that heteromyid populations exhibit "large irregular fluctuations in response to a variable environment, but the magnitude of these fluctuations is moderated by life history traits that promote survival of adults through unfavorable periods at the expense of rapid recruitment of juveniles during favorable times" (p.624). More detailed studies confirm that PELO populations undergo dramatic fluctuations and suggest that PELO and other *Perognathus* species have the capacity to rapidly recruit juveniles into a population during periods of resource abundance (Beatley 1969; French *et al.*1974; Service 2008a). Conley *et al.* (1977) simulated population dynamics for a "prototypical *Perognathus* species" using demographic parameters estimated from studies of a number of *Perognathus* species (including PELO) in Utah and concluded that "*Perognathus* populations have the capacity either to exhibit high rates of increase during years of favorable conditions or to persist during extended adverse periods without reproducing." In 2003, the Service documented an annual population increase of around 8-fold for PPM at one monitoring location (Service 2008a), and French *et al.* (1974) documented over a 5-fold increase in the number of PELO observed on one of their trapping grids between 1964 and 1966, figures consistent with Conley *et al.*'s (1977) simulated rates of potential population increase.

Conley *et al.*'s (1977) simulations also suggest that PELO population dynamics can lead to unstable age distributions. During periods of low resource abundance, populations will be comprised predominantly of non-reproductive adults. These circumstances lead to the attrition of individuals from the population, and population persistence relies solely upon high survivorship and/or immigration from elsewhere.

A prolonged reproductive period when conditions are favorable or a prolonged reproductive life-span may be of little value to an increasing population, but it is of considerable importance to a declining population as it slows the rate of decline (French *et al.* 1974). In PELO, the long lifespan may be interpreted as an adaptation to fluctuating environmental conditions. Therefore, PELO have adapted to resisting population contraction rather than exploiting and colonizing new areas (French *et al.* 1974). They have evolved methods of resisting environmental stress through their ability to become torpid when food is scarce and through a long reproductive lifespan.

Using an island biogeographic approach, Bolger *et al.* (1997a) studied the effects of habitat fragmentation on native rodents in southern California and found that species with highly stochastic populations were more frequently extirpated from smaller fragments. This effect may be, in part, because the reduction in area that is available for the species to occupy effectively reduces the size of the population that can be attained during population growth. With a reduced number of individuals in the population at the beginning of a period of decline, the population is less able to sustain itself until the next period of favorable conditions.

Some have speculated that PPM went undetected for a long period (22 years) because the species persisted in just a few remnant populations where low population levels, high survivorship, and the ability to sustain itself for a large proportion of time during periods of environmental adversity in an inactive or torpid condition made its detection elusive. Prior to its listing, Meserve (1976a) and M'Closkey (1972) were the only individuals known to have specifically studied PPM demography. They documented a relatively stable small population of PPM in the San Joaquin Hills from 1969-71 during a period of normal rainfall with PPM being undetectable for as much as 7 months of the year (M'Closkey 1972; Meserve 1976a).

Studies of PPM population dynamics since its listing have been confounded by a number of factors including competing study objectives, uneven sampling efforts, and low detection probabilities. To gain better insight into PPM population dynamics and monitoring methods, the Service recently implemented standardized monitoring protocols several times a year in two separate areas of the Oscar One Training Area on the Base as part of a demographic study of PPM conducted from May of 2003 to April of 2006 (Service 2008a). The Oscar One PPM population represents the densest known concentration of this species and therefore was considered to provide the best opportunity for understanding population dynamics specific to PPM. This study and other trapping efforts in Oscar One confirm that PPM have low detection probabilities, can have high survivorship, may forego or be unsuccessful at reproducing during some years, have the capacity to rapidly recruit juveniles into the population, demonstrate large population fluctuations both within and among years, and population dynamics can vary across fairly short distances (Service 2008a; Service 2008b; D. Shier pers comm. 2007; Spencer 2007).

Relative to conclusions from other survey efforts, the Oscar One demographic study found that a number of factors influence individual PPM detectability including sex, age, time (*e.g.*, different nightly detectability that may relate to environmental variables), behavior (*e.g.*, "trap-happiness"), and heterogeneity within the population (*i.e.*, certain segments of the population are easier to detect than others) (Service 2008a). The Service (2008a) concluded that "the factors underlying PPM detectability are complex, with time, behavior, heterogeneity, and the individual covariates of sex, age, and weight all supported as factors influencing detectability at various

times." Moreover, the "use of live trapping data to conservatively estimate PPM movements suggests that individual PPM range over a fairly small area during each 4- to 10-night sampling bout (mean individual within-bout observed range length = 16 meters), but larger range length estimates over longer time intervals (mean consecutive-bout observed range length = 23.8 meters) suggest PPM adjust their space utilization over time and have appreciably larger lifetime ranges" (Service 2008a). Finally, periodic low individual detection probabilities of PPM combined with the above observation suggests that 4 to10 nights of consecutive trapping high trap densities (e.g., 131 traps/hectare) may be required to reliably detect PPM during periods of low abundance (Service 2008a).

The pattern of irregular fluctuating population dynamics has been observed within PPM population monitoring grids at the Base. In July 2002, following low annual rainfall totals (Montgomery 2005a), 5 nights of trapping on a 600-trap grid detected just 19 adult individuals, none of which appeared to be reproductively active (Service 2008b). The small number of individuals detected relative to prior trapping efforts and the failure to observe signs of reproductive activity or juvenile animals at this time of year suggest that little to no recruitment occurred at this location in 2002. During 2003, sampling on two larger 600-trap grids over the course of the spring and summer, detected an increase in the number of unique individuals captured on one grid from 17 to 152 and from 101 to 257 on the second grid. On both grids, juveniles were first detected in May, but they became the predominant age class captured during later trapping bouts, and young of the year females were commonly observed to be pregnant in late summer. The high population densities achieved by late summer in 2003 were sustained on the trapping grids in 2004, with the number of unique individuals on the two grids in June of 2004 being 224 and 229, respectively.

In contrast, surveys in 2005 show a dramatic decline in the number of unique individuals captured on one of the two grids, and a more moderate decline on the second grid (Figure 12). Differential overwinter apparent survivorship estimates (which jointly estimate losses from death and permanent emigration) among the grids (0.66 S.E. 0.04 versus 0.92 S.E. 0.03) suggest that the near record rainfall of the winter of 2004-2005 resulted in greater mortality or dispersal of PPM on one of the grids relative to the other (Service 2008a). While vegetation data were not collected during this study, qualitative observations suggest that changes to the structure of the plant community on the grid experiencing the greater population decline may have altered habitat suitability by increasing the predominance of annual grasses. This may have impeded the ability of the PPM to recover at this location as population numbers remained depressed until the end of the study in April 2006, while the population at the other location exhibited more typical seasonal fluctuations over the remaining sampling periods.

Thus, the population dynamics of the two grids inferred from the number of unique individuals captured appear to be distinct, despite being on the same aspect and less than 2 km (1.2 mi) apart. At the start of the study in May 2003, much higher population densities were found on one grid relative to the other, and the grid with the lower density exhibited a much higher rate of increase over the following months. In spring 2004, the grid with lower population density again experienced a more rapid rate of population increase such that by September 2004 both grids had similar population densities. Most significantly, the apparent crash of the population on one of the monitoring grids extending through to April 2006 illustrates that information from one site

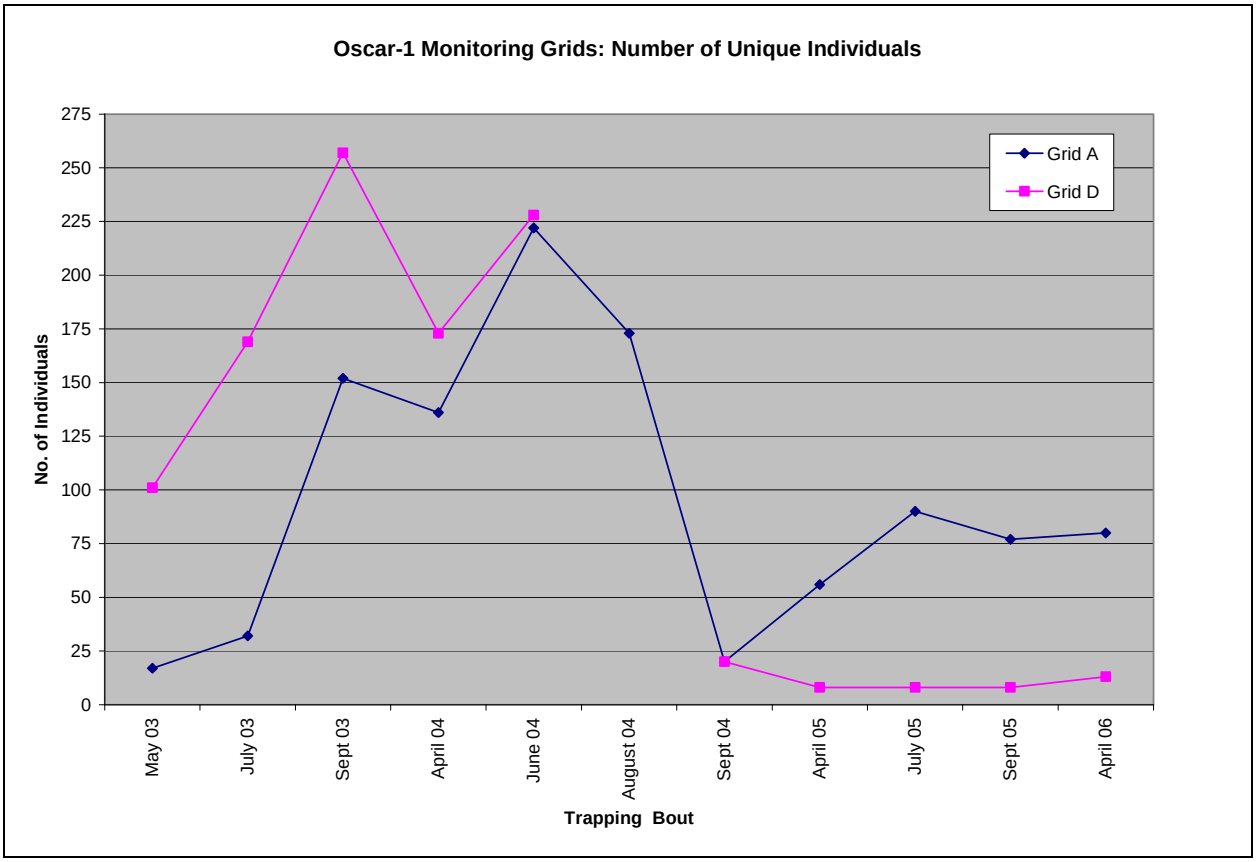

Figure 12. Number of unique PPM captured at two monitoring grids in the Oscar One Training Area, Marine Corps Base Camp Pendleton between 2003 and 2006 (Service 2008a).

may be misleading in predicting the activity level or status of PPM at another site, even if the other site is in proximity.

In summary, PPM populations may persist at low densities for a number of years (M'Closkey 1972; Meserve 1976a; Dodd and Montgomery 2000) that are punctuated by occasional population eruptions (Swei *et al.* 2003; Service 2008a), a pattern typical for PELO (Beatley 1969; French *et al.* 1974). Longer life-spans of several years for a few individuals may allow persistence of small local populations until conditions are favorable for reproductive bursts (French *et al.* 1967; Hayden and Lindberg 1976). However, fluctuating population dynamics, their apparently sedentary nature, and the severe loss and fragmentation of available habitat suggest PPM populations are highly susceptible to local extinctions as a result of further habitat fragmentation or environmental and demographic stochasticity (Bolger *et al.* 1997a; Service 1998a).

Status, Genetics, Connectivity, and Distribution

Historically, PPM was endemic to the immediate coast of southern California from Marina del Rey and El Segundo in Los Angeles County, south to the vicinity of the Mexican border in San Diego County (Erickson 1993; Hall 1981; Williams 1986). PPM has not been recorded outside

of California (Erickson 1993; Williams *et al.* 1993) and has not been reliably reported more than 4 km (2.5 mi) from the coast or above 182.9 m (600 ft) in elevation (Erickson 1993). Range-wide surveys and all other relevant information indicate that the PPM was and is a patchily-distributed species that was never more than just locally common (Bailey 1939; Service 1998a, 59 FR 49752), but the PPM has become increasingly rare as a result of agricultural and urban development in southern California (59 FR 49752). The primary reason for listing of the PPM was extensive loss, degradation, and fragmentation of suitable habitat due to development of these areas for residential and commercial uses (59 FR 49752). Additionally, predation by domestic cats may threaten isolated populations where larger predators such as coyotes have been forced out by development (59 FR 49752; Crooks and Soulé 1999).

Currently, PPM are known from only four locations, the Dana Point Headlands in Orange County, and three locations on Camp Pendleton, San Diego County. Six of the eight sites historically known to harbor PPM have been developed or significantly degraded through human activity (59 FR 49752; Erickson 1993). Extensive surveys in the remaining habitat at and adjacent to historically occupied areas, as well as throughout the species' range have been conducted since 1994, but no additional populations have been detected.

The Dana Point Headlands support the northernmost of the four extant occurrences and is the only one on privately owned land. The other three occurrences, identified as San Mateo North, San Mateo South, and Oscar One, are approximately 13.7, 16.1, and 37.0 km (8.5, 10, and 23 mi) south (respectively) of the Dana Point Headlands population and are all on the Base. The San Mateo North occurrence is on land leased from the military by the California Department of Parks and Recreation (State Parks), while the other two occurrences fall within active military training areas.

Spencer *et al.* (2000a) described the Dana Point Headlands population as "totally isolated by development, with no chance for natural dispersal to other habitat areas," while they asserted the small San Mateo North and San Mateo South populations "have limited opportunity to serve as sources of natural recolonization due to dispersal barriers and distance to other potentially suitable habitats." In describing the uncertainty "whether any demographic or genetic interchange currently occurs between the [San Mateo North and San Mateo South] sites," Spencer *et al.* (2000a) speculated that "occasional interchange may occur in the long term, despite several barriers to movement (agricultural fields, a road, and the creek)." The Service (1998) similarly noted that "some impediments to movement now exist, including a roadway, cultivated agricultural lands, and San Mateo Creek wash." Despite the observation of PPM successfully crossing a two-lane paved road in the Oscar One Training Area (Mark Pavelka, Service, pers. obs.), however, Brehme (2003), in a study of the responses of small terrestrial vertebrates to roads in a coastal sage scrub in San Diego County, did not observe any successful crossings of secondary paved roads or highways by three species of mice, including the San Diego pocket mouse (*Chaetodipus fallax*). She concluded that mice perceived even a two-lane paved rural road as a boundary (Brehme 2003). Wilkins (1982) in a study of rodent dispersal across two- and four-lane highways in southwest Texas noted that none of the eight marked hispid pocket mice (*Chaetodipus hispidus*) crossed roads. While traffic level may play a role, Oxley et al (1974) indicated "that traffic alone does not inhibit road crossings by mammals." Moreover, McGregor et al (2008) concluded in a recent study of the effects of roads to small

mammals that their "results suggest that small mammals avoid the road surface itself rather than traffic noise or other emissions." They also maintained that their "results imply that the barrier effect of roads on these species cannot be mitigated by measures aimed at reducing traffic amount; other measures such as wildlife passages would be needed." As a result, all four PPM populations appear today to be completely isolated.

Swei et al (2003), in comparing the cytochrome b haplotype diversity within and among extant PPM populations with those obtained from museum samples collected more than 70 years ago, concluded that "the pattern of population differentiation and diversity was in place before the post-World War II exponential urbanization of Southern California." Spencer (2005) noted that the results of this study, which he co-authored, demonstrated that gene flow among PPM populations is "quite low, both in historical and current times." Spencer (2005) further clarified that the results of this genetic study "suggest that the Dana Point population has been relatively small, as well as isolated, for some time. Slightly higher gene flow measures and haplotype diversity were recorded among the three sites on Camp Pendleton (San Mateo North and South and Oscar One)." In addition, Spencer (pers. comm. 2005) asserted that "the genetic results [from Swei et al (2003)] are consistent with the hypothesis that these two sites [i.e., San Mateo North and San Mateo South] represent two samples of genetic diversity from a once larger, more continuous population." While the relative number of shared haplotypes among the four PPM populations may be used to suggest population lineages (Table 3), such theorized population relationships do not substantiate any recent connectivity between these populations any more than the shared haplotypes with Oscar One and San Mateo South, and with Dana Point Headlands and San Mateo South provide evidence of recent connectivity. To reiterate, regardless of the genetic relationship between San Mateo North and San Mateo South populations, connectivity between these two populations likely was affected by the farming of the lower San Mateo canyons in the early 1900s and likely completely lost with the realignment and widening of the Cristianitos Road for the construction of the San Mateo Campground in 1991.

Table 3. Cytochrome b Haplotype Diversity among PPM Populations (Swei et al 2003).

	Number of Individuals Sampled	***Number of Unique Haplotypes***	***Number of Haplotypes Shared with Other Populations (shared population)***
Dana Point Headlands (DP)	27	9	1 (SMS)
San Mateo North (SMN)	5	4	2 (SMS)
San Mateo South (SMS)	10	10	1 (DP), 2 (SMN), 1 (OO)
Oscar One-Edson Range (OO)	6	6	1 (SMS)

Surveys have been conducted sporadically at the four known extant sites since each was found to support PPM. Most of the efforts to delimit or characterize various PPM populations have employed presence-absence sampling methods that were not designed for formal population estimation. Formal population estimates using mark-recapture techniques rely upon systematic spatial sampling schemes that have a probability of detecting every individual in the sampling frame that is being used as the basis for inference. If the area is suspected of supporting heterogeneous habitat quality, it still is essential to sample areas of low habitat quality to validly extrapolate results across the entire survey frame. Population estimators that include the

estimation of detection probability and that generate confidence intervals surrounding abundance estimates should also be used so that estimates from different time periods can be validly compared. A final feature specific to the biology of PPM may be the need to perform several survey efforts in the same location during a given year due to the ability of PPM to sustain periods of inactivity by means of seed caches and torpor (Chew and Butterworth 1964; French 1977; Kenagy 1973; M'Closkey 1972; Meserve 1976a), along with variable patterns of surface activity among years that have been observed in pocket mice and that appear to be related to food availability (French 1977; O'Farrell *et al.* 1975). Because most of the capture data that has been collected within the known populations has been done on a sporadic basis without the use of spatially explicit systematic sampling schemes, little reliable information exists with which to make conclusions about population trends at any given site.

Dana Point Headlands

After approximately 20 years during which no records of an active PPM population were confirmed, PPM were rediscovered at the Dana Point Headlands in 1993 (Brylski 1993). Using presence-absence survey techniques, Brylski captured 25 to 36 individuals within about 1.5 ha (3.8 ac) of habitat on a 49-ha (121-ac) site proposed for development. Brylski identified an additional 16.8 ha (41.4 ac) of the site as suitable and potentially occupied. The discovery of this population and the pending development proposal prompted the emergency listing of the species on February 3, 1994 (59 FR 5306).

In July 1996, the Orange County Central and Coastal Subregions Natural Community Conservation Plan/Habitat Conservation Plan (NCCP/HCP) conditionally approved development of the 49-ha (121-ac) Dana Point Headlands site, subject to an 8-year delay of development on 8.9 ha (22.0 ac) of the property that included the area where PPM had been detected. The 8-year "Temporary Preserve" period afforded the Service and California Department of Fish and Game ("Fish and Game") an opportunity to study the feasibility of translocating the Dana Point population to another location within the NCCP/HCP Reserve System and to determine whether the 8.9-ha (22.0-ac) area was essential to the conservation of the species.

In 2000, the Dana Point Headlands landowners proposed to permanently conserve the Temporary Preserve as part of a revised development proposal for the overall Dana Point Headlands site. The revised development proposal received final approval from the City of Dana Point in February 2005 and involves residential and commercial development on a majority of the 40-ha (99-ac) site surrounding the Temporary Preserve. Grading for the developed portion of the property was initiated in the spring 2005 and is ongoing.

As part of the development entitlement, the Temporary Preserve was sold to the Center for Natural Lands Management (CNLM) and permanently conserved via a conservation easement, whose purpose is to maintain the site in its natural condition for the benefit of the public. A non-profit philanthropic organization, the Harry and Grace Steele Foundation, also provided funding to CNLM to establish an endowment sufficient to manage the Temporary Preserve in a manner compatible with the long term conservation of PPM. As a requirement of the entitlement and the conservation easement, the CNLM was to develop a controlled public access trail within the

preserve. In April 2007 the trail was constructed within the Temporary Preserve, though the trail is not yet open to the public.

The Dana Point site is dominated by loamy sand soils and coastal sage scrub. The U. S. Soil Conservation Service (1978) classified the soils on the site as Marina Sandy Loam. However, Germano (1997) found the soils in the area identified as occupied by Brylski (1993) to contain approximately 95 percent sand, yielding a textural classification of loamy sand. Bornyasz (2003) mapped soil types for the majority of the site and classified most of the surface and sub-soils at the site as either sands or loamy sands. The vegetation is characterized as coastal sage scrub dominated by California buckwheat and California sage (Dodd *et al*. 1999). Germano (1997) measured percent shrub cover as 57 percent in areas occupied by PPM and 74 percent in unoccupied areas. Vegetation surveys in 1998 and 1999 indicated a slightly higher percent shrub cover and noted greater cover by exotic forbs and grasses in areas not occupied by PPM (Dodd *et al.* 1999; Dodd and Montgomery 2000).

Ten trapping efforts have occurred on the Dana Point Headlands since 1993, nine within the Temporary Preserve and one outside the bounds of the Temporary Preserve in adjoining areas now being developed (Table 4). Most of the efforts employed different methods and different levels of survey effort, making direct comparison of survey results difficult.

The first survey effort following approval of the NCCP/HCP (Service 1996c) used presence-absence methods (*e.g.*, wandering transects) to confirm occupancy of the Temporary Preserve by PPM and quantify PPM distribution on the site. During this effort, eight unique individuals were detected and two animals were captured outside the bounds of the 1.5-ha (3.8-ac) area originally identified as occupied by Brylski (1993). The two subsequent survey efforts employed a 196-trap grid over approximately $1/10^{th}$ of the area delineated as occupied by Brylski (1993), in combination with wandering transects that were distributed throughout the site (Dodd *et al.* 1998; Dodd *et al.* 1999). The 196-trap grid was employed to obtain an estimate of population density within the historically documented occupied habitat, and wandering transects were used to further characterize the distribution of PPM on site. The combined capture locations from these efforts expanded the area of presumed occupancy on site from 1.5 ha (3.8 ac) to 3.1 ha (7.6 ac), but also documented fewer unique individuals than Brylski's initial trapping efforts.

These results, in combination with findings elsewhere, led investigators to hypothesize that much of the site has too much shrub cover to support PPM. Thus, 11 small (40-trap) monitoring grids were established in 1991 in association with a vegetation thinning experiment that was implemented in January 2000. This experiment involved hand-thinning of vegetation in four separate 0.14-ha (1/3-ac) plots that overlapped eight of the monitoring grids, to test whether vegetation thinning enhances habitat for PPM. Initial trapping results in 2000 following the vegetation thinning suggested that PPM responded positively to the thinned areas, but the small number of individuals detected, trapping of the same individuals in thinned and unthinned areas, and animal movements larger than the scale of the thinning plots suggested that it would be difficult to attribute localized population responses to the scale of the vegetation manipulations performed.

Table 4. Pacific Pocket Mouse Survey Efforts at Dana Point Headlands, 1995 to 2007.

Date	Reference	Purpose	Effort (trap nights)	# of PPM Captured
1993: 7/19-8/5	Brylski[1]	Presence/absence	648	25-36
1996: 8/28-9/6	Service[2]	Presence/absence	815	8
1997: 8/19-8/28	Dodd[3]	Population assessment	2782	21
1998: 7/24-8/4	Dodd[4]	Population assessment	3325	19
1999: 4/28-5/5	Dodd[5]	Vegetation thinning experiment	3710	11
1999: 8/7-8/14	Dodd[5]	Vegetation thinning experiment	3710	4
2000: 5/5-5/11	Dodd[5]	Vegetation thinning experiment	3080	9
2000: 8/2-8/8	Dodd[5]	Vegetation thinning experiment	3080	6
2001: 5/30-6/5	Service[6]	Population assessment	4835	4
2002: 8/5-8/13	Service[7]	Population assessment	2916	2
2002: 8/18 -9/1	URS[8]	Survey outside Temporary Preserve Area	3035	None
2007: 4/12-4/20	Service[9]	Salvage trapping along trail alignment	925	1

[1](Brylski 1993), [2](Service 1996c), [3](Dodd *et al.* 1998), [4](Dodd *et al.* 1999), [5](Dodd and Montgomery 2000), [6](Service 2002a), [7](Service 2002b), [8](URS 2002), [9](Service 2007).

Following the vegetation thinning experiment, the few individuals detected in 2000 (nine and six, respectively) and apparent low level of reproductive activity in the population (one juvenile detected during summer trapping) was a concern. As a result, a formal trapping grid employing unbiased trap placements was established for the first time in spring 2001 over all accessible areas within the Temporary Preserve to obtain a statistically valid population estimate for the site (Service 2002a). However, this effort only detected four individuals (two male and two female), which was too small a sample size to employ statistical population estimators. Investigators were also concerned during the trapping effort that if the population was as small as suggested by initial results that an inadvertent trap death would particularly imperil the population and the trapping was terminated prior to the end of the scheduled trapping interval.

In 2002, another trapping grid was employed again over much of the Temporary Preserve to obtain an improved population estimate for the site (Service 2002b). To better focus this effort, traps were not placed in some of the peripheral areas that were sampled in 2001 where habitat was deemed unsuitable by the investigators (*e.g.*, areas of dense non-native vegetation). However, the trapping grid was still expansive and systematically surveyed all areas where PPM had historically been detected, in addition to adjoining areas with suitable native vegetation. This effort only detected two adult PPM, one animal of each sex.

The most recent trapping effort implemented in April 2007 was performed prior to construction of a public access trail within the Temporary Preserve area and was designed to salvage animals whose home ranges might fall within the trail alignment. One animal was captured during this effort and held in temporary captivity until construction of the trail was completed. The animal was then released in the vicinity of its original capture using "soft release" methods (*i.e.*, with the use of an artificial burrow). Because traps were confined to areas within or immediately adjoining the trail alignment this effort did not provide an accurate assessment of the status of the PPM population at Dana Point other than to confirm continued presence of the species at this location.

Threats and Conservation Needs

The status of the Dana Point Headlands population of PPM is uncertain. While the Temporary Preserve is conserved as natural open space in perpetuity, it includes only 8.9 ha (22.0 ac) of land of which several acres are cliff face. The loss of potentially suitable surrounding habitat for residential and commercial development and creation of a public access trail within the preserve suggests that intensive site management of this limited area will be needed to offset the impacts of historic habitat fragmentation and ongoing human presence. Invasion by alien annual grasses into otherwise suitable PPM habitat is an ongoing threat for all PPM populations, including Dana Point Headlands.

Other ongoing threats include predation by domestic cats and other predators (Montgomery 2003). Domestic cats are extremely effective recreational hunters that will continue to hunt when prey availability is low (Crooks and Soulé 1999), and they have potential to reduce a rodent population very quickly (Pearson 1964). Based on surveys of cat owners adjoining habitat fragments in San Diego County, Crooks and Soulé (1999) conservatively estimated that cats from a residential neighborhood of about 100 homes surrounding a moderately sized habitat fragment (~20 ha (~49 ac)) have the capacity to return as many as 840 rodents to the residences each year, two-thirds of which may be native species.

In addition, invasion by non-native Argentine ants may threaten this PPM population because of its proximity to the urban environment. The non-native Argentine ant is associated with mesic habitats (Holway 2004; Holway *et al.* 2002), such as irrigated landscaping. Once established in irrigated areas, they can spread into adjoining coastal sage scrub, a habitat type that is usually unsuitable to them (Holway 2004; Holway *et al.* 2002; Suarez *et al.* 1998).

Argentine ants have a generalized diet that includes nectar, insects, seeds, carrion, and honeydew secreted by Homopterans (Suarez *et al.* 1998). Argentine ants are ubiquitous in habitat fragments in coastal southern California and appear to have profound effects on the structure of ground-foraging ant communities (Suarez *et al.* 1998). Suarez *et al.* (1998) found that the number of native ant species in habitat fragments declined in the presence of Argentine ants, with army ants (*Neivamyrmex* spp.) and harvester ants (genera *Messor* and *Pogonomyrmex*) exhibiting the greatest sensitivity to Argentine ant presence (Suarez *et al.* 1998).

Because harvester ants, like PPM, are seed specialists, they likely exert an important influence on the structure of the plant community. The differential foraging response of ants and rodents on seed resources in desert communities has been shown to have qualitatively different effects on the plant community, with ants increasing species diversity of annuals by harvesting numerically dominant species (Inouye *et al.* 1980). Changes in habitat structure associated with the invasion of exotic or weedy species or the loss of a significant seed consumer (such as harvester ants) could alter the suitability for PPM by altering competitive relationships with co-occurring small mammals and/or increasing risks of predation (Brown and Heske 1990; Thompson 1982b).

Conservation of PPM at this site will rely on the details of site management over the long term and upon close coordination between the CNLM, Fish and Game, and Service in pursuing management and recovery of PPM at the site. The apparent small size of the Dana Point

population also suggests that population augmentation may be needed to bolster this population. In summarizing the status of the Dana Point Headlands population along with the San Mateo North and San Mateo South populations, Spencer *et al.* (2000a) concluded that these areas "may not represent viable population areas, at least in the long term."

San Mateo North

The San Mateo North occurrence is located in the northwest corner of Camp Pendleton. The site is 21 km (13 mi) southeast of the Dana Point Headlands population and 2.4 km (1.5 mi) northwest of the San Mateo South PPM occurrence. Because the action area for the proposed project encompasses this site, the status of this occurrence is fully discussed in the environmental baseline section of the biological opinion.

San Mateo South

The San Mateo South site is located approximately 3.2 km (2 mi) from the coastline, on the ridge between San Mateo and San Onofre creeks. The PPM was first detected at the San Mateo South site in 1995 (Ogden 1995). This site is approximately 2.4 km (1.5 mi) southeast of the San Mateo North PPM occurrence, and approximately 31.2 km (13.2 mi) northwest of the Oscar One PPM population. The site is bounded on the south by Basilone Road and military housing, to the west by military housing, and to the north by extensive and recently fallowed agricultural fields. The potential eastern boundary of the population is not clearly defined because no obvious changes in soil or vegetation structure can be identified near the eastern-most PPM captures that would suggest a limit to habitat suitability. A fire break, with similar and apparent suitable habitat on both sides, occurs approximately 150 m (492 ft) to the east of the San Mateo site. In 1997, the potential limits of occupied habitat were estimated at 13 hectares (32 ac) (Ogden 1997).

Topography at the San Mateo South site is characterized as a west-sloping east-west ridge with moderately sloping sides to the north and south. Several dirt roads traverse the site, which provide access to power-line structures and a covered water storage facility adjacent to occupied habitat.

The U. S. Soil Conservation Service (1973) classified the soils at the San Mateo South site as fine sandy loam (30-50 percent slopes) and loamy coarse sand (9-30 percent slopes). The fine sandy loams cover most of the site including part of the ridgeline and the majority of the slopes extending down from the ridge to the more recently deposited alluvial soils of the San Onofre valley floor. The loamy coarse sands represent an old marine terrace and are primarily located along the main ridgetop. Germano (1997) reported the soils in the area where PPM were trapped in 1995 as consisting of 96.7 percent sand on the surface and 94.8 percent sand at 20.0 cm (7.9 in.) depth, leading to a textural classification of sand rather than sandy loam. Bornyasz (2003) identified the majority of soils at the site as either coarse sand or loamy coarse sand from the surface down to 60.0 cm (23.6 in.). Ogden (1997) noted that soils similar to those where PPM were detected appear to extend significantly beyond the limits of the 13 ha (32 ac) that they delineated as occupied habitat.

Little work has been done to characterize the vegetation at the San Mateo South site. Germano (1997) described the vegetation as coastal scrub dominated by California sagebrush, California buckwheat, California broom, and white sage. Ogden (1997) listed California sagebrush, white sage, and California buckwheat as the most common shrub species, with *Erodium* sp., *Croton* sp., and annual grasses as the most common ground cover in the areas where PPM were captured. Although Ogden (1997) characterized the vegetation as sparse to moderate shrub cover with sparse to very sparse ground cover, Germano (1997) reported 47 percent shrub cover, 43 percent grass and forb ground cover, and only 15.5 percent bare ground. Michael Brandman Associates and LSA Associates (1997) characterized the vegetation as "within the range shown at other known occupied sites."

Of the four extant PPM occurrences, the least effort has been expended at San Mateo South to characterize the abundance, distribution, and range of PPM. Seven trapping efforts targeting PPM have occurred at and around the San Mateo South site since the species was first detected in 1995. Each effort was designed to answer a specific question and employed a different methodology. None of the efforts were designed to estimate overall abundance, and therefore, there is insufficient information to make reliable inferences about the size or dynamics of this population. Survey results are presented in Table 5.

Table 5. Pacific Pocket Mouse Survey Efforts at San Mateo South, 1995 to 2005.

Date	Investigator	Purpose	Effort (trap nights)	# of PPM Captured
1995: May	Ogden[1]	Presence/absence	unreported	2
1995: 7/6-10/18	MBA[2]	Seasonal activity monitoring	735	13
1996: 8/15-9/21	Ogden[3]	Base Wide survey	~2,000	19
1999: 8/2-8/6	MBA[4]	Focused Surveys for PPM	500	6
2003: 7/7	Montgomery[5]	Control trapping for SDGE surveys outside known range	15	1
2003: 8/ 20	Montgomery[5]	Control trapping for SDGE surveys outside known range	12	1
2005: 7/12-14	Montgomery[6]	Trap and relocation	Unreported	8

[1](Ogden 1995), [2](Michael Brandman Associates and LSA Associates 1997), [3](Ogden 1997), [4](Michael Brandman Associates 1999), [5](Montgomery 2003), [6](Montgomery 2005b)

Of the extant PPM occurrences, San Mateo South and San Mateo North are closest to one another, suggesting the potential for movement of individuals between them. Presently these two sites are separated by fallow agricultural fields and associated roads in the San Mateo floodplain, San Mateo Creek, a State Park campground, and Cristianitos Road. The sandy soils and native vegetation in the San Mateo floodplain likely once supported suitable movement habitat for PPM. Spencer (pers. comm. 2005) concluded that "the two San Mateo sites represent two remnants of what was once a much larger, more continuous population of PPM occupying fine sandy soils near the mouths of San Mateo and San Onofre Creeks."

In 2006, the Base elected not to renew the agricultural lease in the San Mateo floodplain, and the fields have been fallow for over a year. This area, which has been colonized by weeds and weedy native vegetation, may be used in the future for a combination of active military training and habitat restoration (W. Berry, USMC, pers. comm. 2007). Regardless of the fate of the

fallowed lands, the status of PPM at San Mateo South remains uncertain given its relatively small size, which makes this occurrence vulnerable to edge effects and other small population risk factors.

Threats and Conservation Needs

Ongoing and potential threats to this PPM population on the Base include infrequent military training activities; non-prescribed fires; road, firebreak, fuelbreak and public utilities maintenance; recreation activities; predation, and habitat fragmentation (Service 1998a; Ogden 1997, USMC 2007a, Service 2007). PPM at the San Mateo South site also appear to occupy a relatively small area, suggesting this population is vulnerable to edge effects and other factors that place small populations at risk. At present, the San Mateo South area is not regularly used by the Marine Corps for training, although it may be subject to occasional on-road military vehicle use and on- and off-road foot traffic training. Based on the apparent infrequent use of this site for training activities, few PPM likely are affected by training activities.

No recorded fire has been noted within the area of the San Mateo South population in the past 33 years (Service 2005). Given the high fuel load at this site combined with the limited known extent of this occurrence, an unplanned fire at San Mateo South may have extremely adverse consequences to this occurrence by burning all vegetative cover and negatively impacting all individuals at this location.

Maintenance of the ridgeline firebreak within the known-occupied PPM habitat has been suspended pending completion of formal consultation between the Service and Marine Corps regarding all Base activities in upland habitats. Maintenance of a firebreak immediately north and east of the San Mateo South PPM population, running from the ridgeline down into the San Onofre watershed, has been discontinued and the firebreak is being actively restored to native vegetation. Continuing maintenance of the firebreak along the ridgeline to the east of the known-occupied PPM habitat occurs annually by means of disking or blading the ground to bare mineral soil. This ongoing maintenance may disturb, injure, or kill an unknown number of PPM annually that are dispersing or taking up residence in this area by covering or crushing animals in burrows.

As with the Dana Point Headlands population, predation by domestic cats is an ongoing threat because of the proximity to residential development (Montgomery 2003). Moreover, recreation activities associated with housing developments near the San Mateo South PPM population may be negatively affecting this population. This site is occasionally traversed by mountain bikers who create trails that may be fragmenting and disturbing occupied PPM habitat and soils. Also like the Dana Point Headlands population, invasion by non-native Argentine ants may threaten this PPM population because of its proximity to the urban environment.

<u>Oscar One/Edson Range</u>

The southernmost of the populations on the Base is located in the Oscar One and Edson Range training areas, which adjoin one another immediately north of the Santa Margarita River. PPM were first detected in Oscar One in a vernal pool complex in 1995 (Service 1996a). This

prompted extensive presence-absence surveys in 1996 that determined PPM to be patchily distributed across a 380-ha (939-ac) area within the Oscar One training area (Service 1999a). In 1998, the area circumscribing occupancy was expanded to include an additional 254 ha (628 ac) to the northwest by surveys conducted in the immediately adjoining Edson Range training area, where PPM were also found to be patchily distributed (Montgomery 2003). Thus, the Oscar One/Edson Range occurrence is the largest of the PPM populations and is distributed over a significantly larger area than any of the other known populations. The only population that can be confidently called "viable", the site approaches 900 ha in area consisting of a mosaic of occupied, suitable and generally unoccupied habitats with hundreds of individuals (Spencer *et al.* 2000a). Recently, the Service (2008a) emphasized the importance of this population for "maintenance of the subspecies, since it is the only known population of appreciable size and extent where large numbers and re-colonization dynamics are likely to protect against localized extirpations."

The Oscar One portion of this population is in an area that is actively used for recruit training and includes an extensive training/obstacle course (Crucible Course), live firing ranges, buildings, bivouac sites, toilet facilities, and remnant sewage settling ponds. The Marine Corps received a non-jeopardy biological opinion from the Service (Service 1996b) regarding construction of the Crucible Challenge Course. The Base minimized direct losses to occupied or suitable PPM habitat to 3.2 ha (8.0 ac) from the location of specific course elements. Historically, the ongoing recruit training associated with the Crucible Course has largely been confined to a network of paved and dirt roads and trails. The biological opinion for the Crucible Course anticipated take of one PPM per company of recruits using the Crucible Course and one PPM per year due to road maintenance activities (Service 1996b).

During 2006, an expansion of training activities in Oscar One was not addressed in the context of the biological opinion for the Crucible Challenge Course (USMC 2007, *in litt*.). Observed direct impacts from this expansion included removal or reduction of vegetation, soil compaction, addition of new structures (*e.g*., erection of posts, construction of foxholes/pits), increased foot traffic, and off-road vehicle activity in areas occupied by PPM. Following site visits and discussions with the Service, the Base took steps to reduce impacts within higher quality PPM habitat. However, these impacts combined with the drought conditions of 2007 may have reduced this population beyond a threshold of resiliency (see discussion below on 2007 PPM surveys at Oscar One). At present, the Marine Corps and Service are consulting informally to quantify and evaluate the significance of these impacts to the Oscar One PPM population, and the Base has committed to address the new training activities and any corrective actions needed through interagency consultation under section 7 of the Act (Service letter to Marine Corps dated October 5, 2007).

The Edson Range portion of this occurrence is also used for recruit training and shares similar facilities such as dirt roads and outbuildings, in addition to live firing ranges. A rifle firing range is a predominant feature within Edson Range. To minimize the potential for wildfire to escape from the rifle range in association with ammunition strikes, vegetation within the firing range is managed by frequent prescribed fires with much of the range being burned on an annual or more frequent basis.

Topography in these training areas includes steep cliffs rising from the Santa Margarita River to the east and south leading to a gently sloping plane divided by a number of drainages and erosion gullies to the west. Though the U. S. Soil Conservation Service (1973) characterized the soils in the Oscar One and Edson Range training areas as ranging from sand to clay loam, a fine scale analysis of soils in undisturbed areas on which PPM were found in Oscar One showed that the soils are predominately on loamy sands, or small sandy inclusions within soils mapped as sandy loam, loam or clay loam (Germano 1997; Montgomery 2003; Service 2008c).

Within Edson Range, Montgomery (2003) found PPM in areas mapped with soils classified as loam, clay loam and on terrace escarpments where sandy soils were not evident. A recent trapping effort re-documented PPM in many of these same areas (Spencer 2007) suggesting that Montgomery's captures were not aberrant results due to chance encounters with dispersing individuals. Rather, PPM may have the ability to persist in Edson Range in areas without sandy soils. In addition, individual PPM have been observed in non-sandy soils in Oscar One in the earthen berms adjoining dirt roads that were created by periodic blading of those roads for their maintenance. Vegetation throughout the occupied areas is dominated by various sub-associations of coastal sage scrub and grasslands (Service 1996a; Loda *et al.* 1999; Montgomery 2003).

Approximately 46 trapping efforts have occurred within Oscar One and Edson Range since 1994. Each effort was designed to answer a specific question and employed a different methodology. Given the extensive area covered by this population and ongoing refinements to sampling methodologies, an effort to estimate the overall abundance of PPM in the Oscar One and Edson Range training areas has not yet been implemented. The results of trapping efforts are summarized in Table 6.

In 1995, a single PPM was captured in a pitfall array designed to capture herpetofauna within a vernal pool complex in the Oscar One training Area. In response to the finding, the Base contracted with the Service to trap at the location where the PPM was captured and estimate the size of the population. The Service established a 200-trap grid with radiating assessment lines centered on the capture location. Only three PPM were captured on this grid (Service 1996a). Additional trapping in more suitable PPM habitat nearby, but outside the area covered by the grid, resulted in the capture of 51 additional PPM.

In 1996, the Base altered its training patterns in the Oscar One Training Area and contracted the Service to determine the range of the PPM population and initiate the development of a monitoring program. The monitoring study initially employed four 100-trap grids with traps spaced at 10.0 m (32.8 ft), in combination with adjoining assessment lines (Service 1999b) . One of the grid locations was selected to estimate the abundance of PPM near a new training obstacle (Grid D), and the remaining three grids were placed in an area distant from routine training activity (Grids A, B and C). Several deficiencies of the program were noted, including an insufficient number of captures of PPM from the trapping grids to generate reliable abundance estimates, lack of observed movements among traps by individuals suggesting trap spacing should be closer to improve detection probabilities and collect movement data, and the inability to permanently and individually mark PPM for capture/recapture based demographic data collection.

Table 6. Pacific Pocket Mouse Survey Efforts at Oscar One, 1995 to 2007.

Date	Investigator	Location	Purpose	Effort (trap nights)	# of PPM Captured
1995: 8/14-8/26	Service[1]	Oscar-1	Presence/absence	2219	51
1995: 5/28-6/10	Service[1]	Oscar-1	Localized grid trapping	4000	3
1996: 5/13-8/10	Service[2]	Oscar-1	Distribution assessment	6965	221*
1996: 7/8-7/15	Boggs[3]	Edson	project related trapping	1100	1
1996: 7/15-7/20	Boggs[3]	Oscar	project related trapping	1395	14*
1996: 7/22-8/1	Boggs[3]	Oscar	project related trapping	1327	13
1996: 8/12-8/22	Service[4]	Oscar-1	Localized grid trapping	4800	112
1996: 9/4-9/18	Church[5]	Oscar	project related trapping	478	4
1997: 7/16-8/8	Dodd[6]	Oscar-1	Localized grid trapping	4800	70
1997: 8/5-8/15	Service[7]	Oscar-1	Localized grid trapping	3920	55
1997: 9/14-9/27	Service[7]	Oscar-1	Localized grid trapping	3920	44
1998: 4/21-5/1	Service[7]	Oscar-1	Localized grid trapping	3920	21
1998-2003	Service[8]	Oscar-1	Soil study		47*
1998: 6/22-8/23	Montgomery[9]	Edson	Distribution assessment	5337	21
2002: July	Service[10]	Oscar-1	trapping grid “D”	3000	19
2003: May	Service[11]	Oscar-1	trapping grids “A/D”	5400 / 5400	17 / 101
2003: July	Service[11]	Oscar-1	trapping grids “A/D”	4800 / 6000	32 / 169
2003: Sept.	Service[11]	Oscar-1	trapping grids “A/D”	6000 / 4512	152 / 257
2004: April	Service[11]	Oscar-1	trapping grids “A/D”	3600 / 6000	136 / 173
2004: June	Service[11]	Oscar-1	trapping grids “A/D”	3600 / 3000	222 / 228
2004: Aug.	Service[11]	Oscar-1	trapping grids “A”	3600	173
2004: Sept.	Service[11]	Oscar-1	trapping grids “A/D”	2400 / 3600	20 / 20
2005: April	Service[11]	Oscar-1	trapping grids “A/D”	4200 / 2400	56 / 8
2005: July	Service[11]	Oscar-1	trapping grids “A/D”	3000 / 3600	90 / 8
2005: Sept.	Service[11]	Oscar-1	trapping grids “A/D”	3000 / 3000	77 / 8
2006: April	Service[11]	Oscar-1	trapping grids “A/D”	3600 / 3000	80 / 13
2006: July	Shier[12]	Oscar-1	Behavioral observations on trapping grid	1365	16
2006: August	Shier[12]	Oscar-1	Behavioral observations on trapping grid	546	6*
2006: Sept.	Shier[12]	Oscar-1	Behavioral observations on trapping grid	91	0
2006: October	Shier[12]	Oscar-1	Behavioral observations on trapping grid	91	0
2006: Nov.	Shier[12]	Oscar-1	Behavioral observations on trapping grid	91	0
2007: 6/25-6/29	Spencer[13]	Oscar-1	Impact assessment	3200	0
2007: 6/30-7/4	Spencer[13]	Oscar-1	Impact assessment	3360	0
2007: 7/6-7/10	Spencer[13]	Edson	Impact assessment	2080	7
2007: 7/11-7/15	Spencer[13]	Oscar-1	Impact assessment	3360	0
2007: 3/26-5/25, 5/28-9/20.	Shier[14]	Oscar 1	Behavioral observations,	11440	15
2007: : 3/26-5/25, 5/28-9/20	Shier[14]	Oscar 1	Behavioral observations,	11440	9
2007: : 3/26-5/25, 5/28-9/20	Shier[14]	Oscar 1	Behavioral observations,	11440	29
2007: : 3/26-5/25, 5/28-9/20	Shier[14]	Oscar 1	Behavioral observations,	11440	2
2007: : 6/3-7/5	Shier[14]	Oscar 1	Search for prospective translocation donor sites	1225	0

2007: 3/26-5/25	Shier[14]	Oscar 1	Search for prospective translocation donor sites	2940	1
2007: 3/26-5/25	Shier[14]	Oscar 1	Search for prospective translocation donor sites	2940	0
2007: 3/26-5/25	Shier[14]	Oscar 1	Search for prospective translocation donor sites	2940	1
2007: 6/3-7/5.	Shier[14]	Oscar 1	Search for prospective translocation donor sites	1225	0
2007: 6/3-7/5	Shier[14]	Oscar 1	Search for prospective translocation donor sites	1225	0
2007: 6/3-7/5.	Shier[14]	Oscar 1	Search for prospective translocation donor sites	1225	0

* Represents total captures of PPM – number of unique individuals is unknown.
[1](Service 1996a), [2](Service 1999a), [3](Boggs 1996), [4](Service 1999b), [5](Church 1996), [6](Dodd and Montgomery 1997), [7](Service 2002c), [8](Service unpublished data), [9](Montgomery 2003), [10](Service 2008b), [11](Service 2008a), [12](Shier 2007a), [13](Spencer 2007),[14] (Shier 2007b)

In 1997, Dodd and Montgomery (1997) used two 100-trap grids to conduct a study comparing the relative efficacy of grids with 3.0- and 7.0-m (9.8- and 23.0-ft) trap spacing. Based on their results, the Service increased the number of traps on each grid to 196 and decreased trap spacing to 3.0 m (9.8 ft) for population monitoring conducted in 1997 and 1998 (Service 2002c). This methodology improved detection of animal movements, but estimates of abundance and demographic parameters were still hindered by small sample sizes and the lack of a permanent marking method (Service 2002c). Grid-based trapping for the purpose of population abundance and demographic estimates was not implemented again until 2002, when a suitable permanent marking technique had been decided upon. Population sampling in 2002 consisted of a single 5-night effort conducted in July at the historic Grid D trapping location, which employed a 600 trap grid at 3.0-m (9.8-ft) trap spacing. Despite the large number of traps, this effort only detected 19 unique individuals (Service 2008b).

In May 2003, the Service commenced a systematic demographic study at the historic Grid A and Grid D trapping locations which involved repeated sampling at each location during Spring and Summer when PPM are most active. This study maintained the number of traps per grid at 600 but increased trap spacing to 5.0 m (16.4 ft) to increase the geographic coverage of each grid, with the aim of increasing the number of captured animals. These methods were consistently implemented from 2003 through April 2006 and provide the most consistent and reliable data for inferring PPM population dynamics and estimating demographic parameters. However, distinct population dynamics at the two locations and the limited number and selective placement of monitoring grids prevents valid extrapolation of these results to the Oscar One/Edson Range PPM population as a whole (Service 2008a).

As discussed above in the section on PPM population dynamics, the 2003-2006 study shows population dynamics for the Oscar One population that are similar to those cited for other PELO subspecies (Figure 12). Observed population fluctuations also resemble the idealized population dynamics of a generic species in the genus *Perognathus* modeled by Conley *et al.* (1977). Based on prior trapping results, the 2003-2006 demographic study appears to have witnessed a population eruption at the monitoring grids in Oscar One during the summer of 2003, with high population densities being maintained through the summer 2004. Near record rainfalls during

the winter of 2004-2005 then appears to have significantly reduced overwinter survivorship on monitoring Grid D, with a lesser over-winter decline in abundance being observed on Grid A (Service 2008a). The population crash observed on Grid D persisted into the spring 2006, while Grid A in 2005 appears to have resumed a normal pattern of seasonal population dynamics suggested by the prior years of monitoring data.

Although the demographic study was concluded in April 2006, additional trapping studies have been performed in Oscar One and Edson Range since then. Notable among these was a trapping effort initiated by the San Diego Zoological Society division of Conservation and Research for Endangered Species in the spring 2007 that targeted several areas throughout Oscar One where PPM had historically been captured or that had good habitat attributes for their prospective use as PPM donor sites in support of a translocation study (Shier 2007b). That effort found lower densities of animals on Grid A than during prior years but, strikingly, was unsuccessful at capturing any PPM within portions of Grid D known historically to support PPM. Additionally, of seven trapping locations on the mesa south of MACS Road where trapping data shows PPM to have once been broadly distributed, extensive trapping only detected a total of two individuals at two locations (*i.e.*, one animal at each location).

A more systematic trapping study was also performed throughout Oscar One and Edson Range in 2007 south of MACS Road in support of a road improvement project that is proposed by the Marine Corps throughout this area. To contrast population densities of PPM along roads relative to areas away from roads, that effort randomly located 31 trapping grids of 40 traps each along roads in Oscar One, and 31 similar trapping grids in habitat away from roads. Another 13 trapping grids were placed along roads in Edson Range. During four nights of trapping on each of the 75 trapping grids, only seven individual PPM were detected at five locations along roadways in Edson Range. This result was again striking given that no PPM were detected throughout Oscar One where historic trapping data suggests PPM are broadly distributed.

The results of Spencer (2007) and Shier (2007b) may be explained by the drought conditions experienced throughout southern California in 2006 and 2007, which may be associated with a broad scale population decline. If such a decline occurred, it coincided with the expansion of training activities in Oscar One discussed above, which likely exacerbated the population decline and should slow the recovery of the Oscar One/Edson PPM population through increased fragmentation and degradation of habitat quality.

Observations at Oscar One suggest several key factors about PPM population dynamics. First, PPM population abundance can fluctuate widely between years rendering even relatively large populations vulnerable to extirpation at localized and possibly larger scales. Second, even though the two monitoring grids in Oscar One are in proximity and are connected by a mosaic of suitable and unsuitable habitats, their population dynamics differ, suggesting that factors regulating population dynamics work on relatively small scales. Lastly, a threshold may exist below which segments of the population cannot recover and immigration is essential to their long-term persistence.

Threats and Conservation Needs

Ongoing and potential threats to the PPM at Oscar One include project construction; military training activities (including wildfires ignited by live fire training); prescribed and non-prescribed fires; road, firebreak, fuelbreak and public utilities maintenance; recreation activities; predation by native and domestic animals; and further habitat fragmentation (Service 1998a; Ogden 1997, USMC 2007a, Service 2007). Since the listing of the PPM in 1994, the Service has consulted with the Marine Corps only once on a construction project that directly impacted PPM habitat (Service 1996b), which was at Oscar One. The Crucible Challenge Course project involved the loss of 3.2 ha (8.0 ac) of occupied or suitable PPM habitat within Oscar One and anticipated a limited amount of annual take of PPM as a result of training and maintenance activities associated with use of the Crucible Course (Service 1996b).

Military training within Oscar One primarily involves recruit training using various elements of the Crucible Course. Training activities have historically been largely confined to specific training/obstacle course elements and a network of dirt roads and trails, although Oscar One also contains firing ranges, bivouac sites, and associated facilities. As discussed above, the Marine Corps expanded the level of training activity in 2006 within Oscar One beyond that which was addressed by the Crucible Course biological opinion. This activity resulted in additional impacts to occupied PPM habitat. Continued use of these areas may result in permanent loss of PPM habitat and further fragment the Oscar One and Edson Range PPM population. The Base is working cooperatively with the Service to assess these impacts and to develop a long-term solution for the necessary recruit training while adequately conserving PPM at Oscar One (Service letter to Marine Corps dated October 5, 2007).

Edson Range contains elements of the Crucible course that are used for recruit training along with live firing ranges. Associated with operation of the firing ranges is the frequent use of prescribed fire in adjoining habitat to prevent ignitions caused by ordnance from escaping the vicinity of Edson Range. One fuelbreak, in particular, that spans Oscar One and Edson Range has been maintained through annual prescribed burns, though the Oscar One portion of this fuelbreak has not been maintained by fire over the past several years. Wildfire ignitions from live-fire training and other sources are also known (*e.g.*, fire ignited by discarded car ashtray contents in Oscar One, July 25, 2006).

The Camp Pendleton Fire Department follows measures proposed by the Assistant Chief of Staff, Environmental Security (AC/S, ES) to minimize the impact of prescribed fires and related activities on PPM. Nevertheless, it is likely that prescribed and unprescribed fires result in some injury and mortality of individual PPM that reside within the burn perimeter and adjoining areas used for staging by fire crews. The long-term impact of fire at the population level is unknown, with potential for both positive and detrimental affects. For instance, the use of prescribed fire in Edson Range may be protecting the larger Oscar One area from overly frequent burning that would otherwise be caused by live ammunition training. Similarly, occasional wildfire may be beneficial to PPM if fire frequency and intensity remains low enough to support open-canopy costal sage scrub thought to be preferred by PPM, and enough individuals survive to repopulate burned areas. However, if fires occur frequently or at the wrong time of year, seed availability will be significantly diminished and/or non-native grasses and forbs can be favored to invade and

displace native forbs and shrubs that are preferred cover for PPM (D'Antonio and Vitousek 1992; Haidinger and Keeley 1993; Keeley *et al.* 2005). Based on the high frequency of fires at Edson Range, fire is likely suppressing the PPM population in this area.

The Base's Facilities Maintenance Department (FMD) maintains most roads on the Base, unless those roads are regularly maintained by right-of-way holders (such as public utilities) or lessees (*e.g.*, agriculture lessees). Routine maintenance of roads within occupied PPM habitat requires approval from the AC/S, ES. AC/S, ES typically requires that the FMD follow practices that avoid and minimize the potential to injure or kill PPM. Therefore, routine road maintenance likely results in very few, if any, individual PPM injured or killed on an annual basis. The Base is proposing a major upgrade to 24,123 linear meters (15.0 miles) of roadway throughout the Oscar One and Edson Range training areas, including at least 10,461 meters (6.5 miles) of roadway through occupied or potential PPM habitat (USMC 2007a). The draft biological assessment for the proposed project indicates that up to 33.6 ha (83.0 ac) of suitable habitat for PPM may be directly affected, with additional indirect effects from habitat fragmentation, redirected drainage, and altered road use patterns. We anticipate that the Base will initiate formal consultation with the Service regarding potential impacts to PPM after completion of the biological assessment.

Utility companies (San Diego Gas & Electric (SDG&E), Southern California Edison (SCE)) maintain dirt roads to provide access for maintenance of power lines, power poles and towers, and other structures. SDG&E powerlines and roads bisect all three PPM populations on the Base while SCE powerlines and roads bisect San Mateo South. Ongoing road and facility maintenance activities occasionally involve soil and habitat disturbance that could result in disturbance, injury, or mortality of PPM (Service 1999c; Montgomery 2005b). SDG&E conducts road and facility maintenance actions according to a habitat conservation plan that specifies that SDG&E will generally avoid impacts to occupied PPM habitat, but some incidental take of PPM within their plan area is authorized (Service 1995). SDG&E routinely coordinates with the Service to avoid and minimize take of PPM to the maximum extent practicable (Service 2004a, b). SDG&E's routine maintenance likely results in a few individual PPM being injured or killed on an annual basis. SCE does not have incidental take authorization for activities associated with maintenance of their facilities, although SCE has informed the Service that they are developing avoidance and minimization protocols for activities within occupied or suitable PPM habitat.

Invasion by alien annual grasses into otherwise suitable PPM habitat is an ongoing threat for all PPM populations. Although PPM occur within portions of the Oscar One Training Area dominated by grassland habitats, PPM appear to be in greatest abundance in areas where native grasses are a component of a grassland community that also includes native forbs, bare soils, and interdigitated shrubs (*e.g.*, ecotonal native grasslands). Grasslands dominated by alien grasses and forbs are often dense, have complete vegetative cover, and accumulate thatch. These conditions appear to favor other small mammals, such as the western harvest mouse, and decrease suitability for burrowing mammals such as PPM. Recent observations at one of the PPM monitoring plots in the Oscar One Training Area following heavy rainfall during the winter of 2004-2005 are consistent with this prediction. Increased predominance of non-native grasses and large stature forbs at this site appears to be associated with a change in the small mammal

community from one that was numerically dominated in 2003 and 2004 by PPM with a few western harvest mice present, to one that is presently numerically dominated by western harvest mice with only a few PPM present (Service 2008a). Additional observations in the Oscar One Training Area suggest PPM are absent or in undetectably low abundance in areas with suitable soils that are vegetated with dense alien grasses (Service 2008a). A variety of factors can increase the susceptibility of PPM habitat to invasion by grasses including introduction or spread of alien grasses in proximity to PPM habitat, changes in fire frequency, and increase in the amount of available water.

The Marine Corps continues to work cooperatively with the Service to conserve PPM on the Base. The Marine Corps is currently in formal consultation with the Service regarding all Marine Corps activities in upland habitats on the Base, and the Marine Corps has committed to continue to conserve and monitor PPM on the Base and promote research and other actions that lead to the recovery of this species. Over the past several years, the Marine Corps has funded a large portion of an intensive Service study of PPM demographics in Oscar One. The Marine Corps has also recently endorsed and provided access to the Base for the San Diego Zoological Society's Division of Conservation and Research for Endangered Species (CRES) to conduct behavioral research on PPM. This research by CRES will provide a fine-scale examination of social relationships, home ranges, and dispersal characteristics that are necessary to understand prior to establishing new populations of PPM.

In conclusion, the Oscar One/Edson Range PPM population is the only unquestionably viable population (Spencer *et al*. 2000a) and most robust extant PPM population with capture records bounding an area of 634 ha (1567 ac) containing a mosaic of suitable and unsuitable habitats. Monitoring efforts reveal that this population is capable of achieving exceptionally high densities. However, recent training expansions by the Marine Corps coupled with natural population dynamics suggest that even this population or segments of it may be vulnerable to extirpation from environmental and human factors.

Environmental Baseline

Status of the Species in the Action Area

Management actions for PPM are part of the proposed action in the area of San Mateo North, so the action area in this vicinity includes areas where project-related impacts will occur as well as areas where management actions to minimize and offset those impacts are proposed. To assist in the identification of the action area for the PPM, we delimited a broad boundary around the documented occupied PPM habitat area and contiguous areas with appropriate soils and vegetation that suggest these additional lands could be restored for the species (Figure 13). The action area includes approximately 65.8 ha (162.6 ac) of restorable land on both sides of Cristianitos Road, which is bounded by the city of San Clemente to the west, Interstate 5, and Cristianitos Road to the south, the San Mateo Creek to the east, and unsuitable soils and native vegetation to the north. Another 3.9 ha (9.7 ac) of existing development (*e.g.*, roads) and non-restorable lands occur as well within the broadly delimited action area.

Figure 13. PPM action area with PPM capture locations, toll road disturbance limits, and depiction of historical extent of agriculture, fuel breaks, and roadway-related impacts.

Vegetation within this area is predominated by mixed sage scrub, sagebrush-coyote bush sage scrub, and lemonade berry chaparral with other sub-associations of sage scrub and patches of ornamental and ruderal vegetation present (BonTerra Consulting 2007). Within areas where PPM were trapped in 1995 Michael Brandman Associates and LSA Associates (1997) surveyed the vegetation and reported a mosaic of sagebrush scrub, white sage scrub, and open sandy outcrops. In this area, vegetation transects resulted in percent cover estimates ranging from 50 to 100 percent with dominant shrub species including California sagebrush (54 percent relative cover), white sage (17 percent), deerweed, coyote bush, California encelia, and lemonade berry (Michael Brandman Associates and LSA Associates 1997). Much of the vegetation to the south of PPM capture locations and east of Cristianitos Road has been mapped as sagebrush-coyote bush sage scrub and also has high vegetation cover values (BonTerra Consulting. 2007).

Soils within the 162.6-ac PPM action area are predominantly sandy loams and loamy sands with some soils classified as terrace escarpment adjoining the western side of San Mateo Creek (U. S. Soil Conservation Service 1973). More fine-scaled mapping conducted in 1995 in the approximate 4-ha (10-ac) area where PPM were detected at that time concluded soils are approximately 50 percent loamy sands and 50 percent sandy loams in that area; however, all soil types were noted as "very friable at the surface and containing considerable amounts of sand" (Michael Brandman Associates and LSA Associates 1997). Germano (1997) reported the soils in the same area as consisting of 96.7 percent sand on the surface and 94.8 percent sand at a 20-cm (8-in) depth, leading to a textural classification of sand rather than loamy sand or sandy loam. Also in the same area, Bornyasz (2003) found a mix of sands, loamy sands and sandy loams on the surface with a predominately sandy base below 8 to 61 cm (3 to 24 in).

TCA and AP Engineering and Testing Inc. (2007) recently performed a sieve analysis on soil samples obtained from Soil Conservation Service mapped soil polygons outside the immediate area of PPM capture locations to characterize the clay content in these areas. This effort combined a small number of soil samples from within each mapped soil unit to obtain average clay content for that soil polygon. For example, from within an area mapped as Myford Sandy Loam (9-30 percent slopes, eroded) AP Engineering and Testing Inc. combined two samples from two depths within a single test pit (with 10 and 44 percent clay content, respectively) and a single sample from another test pit (16 percent clay content) to conclude that areas mapped with Myford Sandy Loams (9-30 percent slopes) have an average clay content of 23 percent. The texture descriptions of soil samples collected by TCA and AP Engineering and Testing Inc. (2007) are generally consistent with Soil Conservation Service mapping, which indicates that the overall PPM habitat area supports a mosaic of sands, loamy sands, and sandy loams that appear suitable for PPM.

Twelve trapping efforts targeting PPM have occurred at and around San Mateo North since PPM were first detected at the site in 1995. Each effort was designed to answer a specific question and employed a different methodology. No effort was designed to estimate overall abundance of PPM at this location. As discussed earlier, formal population estimates using mark-recapture techniques rely upon systematic and spatially explicit sampling schemes that have a probability of detecting every individual in the area across which one wishes to make inference. If the area is suspected of supporting heterogeneous habitat quality, sampling should also include areas of low habitat quality to validly extrapolate results across the entire survey frame. Population

estimators that include the estimation of detection probability and that generate confidence intervals surrounding abundance estimates should also be used so that estimates from different time periods can be validly compared. A final feature specific to the biology of PPM may be the need to perform several survey efforts in the same location during a given year due to the ability of PPM to sustain periods of inactivity by means of seed caches and torpor (Chew and Butterworth 1964; French 1977; Kenagy 1973; M'Closkey 1972), along with variable patterns of surface activity among years that have been observed in pocket mice and which appear to be related to food availability (French 1977; O'Farrell *et al.* 1975).

Because the various survey efforts employed at San Mateo North lack these features, we do not have information to make reliable inferences about population size or dynamics at this site. For example, the 1995 and 1996 survey efforts at San Mateo North arguably represent the best attempts to document the number of individual PPM occurring at this location. Although the 1995 survey effort attempted to implement a specified number of trap nights in each identified survey polygon, survey polygons did not cover the entire area that was ultimately delimited as representing the area of occupancy for PPM; traps were placed along various wandering transects from which it is impossible to make density estimates, and trap locations were identified in the field "…based on a combination of local soil conditions, slope, vegetation, amount of disturbance, and accessibility" (Michael Brandman Associates and LSA Associates 1997). Additionally, the sampling period extended into late September and early October, a period during which PPM have been documented to become inactive and/or certain components of the population have ceased above ground activity (Erickson 1993; Meserve 1976a; Michael Brandman Associates and LSA Associates 1997; O'Farrell *et al.* 1975; Service 2008a). Thus, while it is valid to report the number of unique individuals that were captured during each effort, extrapolating these results to the entire survey boundary or comparing results among years is questionable because the entire area of presumed occupancy was not surveyed, the use of subjective trap placements involved a technique that was not systematic and repeatable, these efforts did not estimate detection probabilities to allow one to correct for differences in the number of captures of unique individuals that may be due to factors other than true differences in animal abundance, and it is likely that the trapping effort extended into a period of relative inactivity for the animal. Michael Brandman Associates and LSA Associates (1997) caution about comparing their own 1995 and 1996 survey results because the 1996 survey effort was "considerably reduced" from 1995 (p. 21).

All subsequent survey efforts at San Mateo North share many of the same methodological shortcomings for population estimation. Other than Montgomery's 2001-2003 efforts to document colonization of a prescribed burn area (Montgomery 2005a), surveys subsequent to 1995 primarily concentrated on delineating the boundaries of the PPM population relative to the proposed toll road project. Thus, while acknowledging that the 1999 through 2003 survey results are not encouraging relative to the number of PPM that were detected, we must also consider that these efforts did not use appropriate methods for population estimation, that they often were initiated late during the period of activity of the mice at a time the overall population or certain components thereof could be ceasing surface activity (French 1977; O'Farrell *et al.* 1975, Service 2008a), and that a considerable proportion of this effort was expended outside the area of previously documented occupancy.

A majority of the trapping effort during the most recent survey at San Mateo North (Natural Resources Assessment, Inc. 2003) was performed outside the area of documented occupancy (75 percent, 1,650 of 2,200 trap nights). This effort documented four unique individuals in an area not previously documented as being occupied by PPM. As a result, we conclude that San Mateo North continues to support what is likely a small population of PPM whose distribution may change over time in response to changing environmental conditions. Survey results for San Mateo North are summarized in Table 7.

Based on the capture records from 1995 and 1996, Michael Brandman Associates (1999) estimated that 1.9 ha (4.2 ac) of the 65.8-ha (162.6-ac) San Mateo North site were occupied by the PPM. To reach this conclusion, a minimum convex polygon likely was constructed around all capture locations and calculated the resultant area. Minimum convex polygons are typically drawn using telemetry data, point mapping, and/or capture locations to delineate home ranges of individual study organisms or to infer areas of occupancy of populations on the basis of observations of multiple individuals. Such polygons are simple, repeatable, and conservative because the boundaries are highly affected by outliers and, as such, include significant amounts of unsuitable habitat (Nagel and Pavelka 2006). In addition, minimum convex polygons are unimodal and, as a result, the bounded areas does not discriminate between high and low density areas (Nagel and Pavelka 2006). Because minimum convex polygons are a function of the period of observation (MacMillen 1964), the area of occupancy inferred from the polygon delineated based on initial trapping efforts at San Mateo North has been expanded with subsequent trapping data. Including all PPM captures to date, the minimum convex polygon circumscribing all capture records for PPM would be 5.6 ha (13.8 ac).

Factors Affecting the Species' Environment within the Action Area

The San Mateo North site was effectively isolated from other PPM populations prior to 1938 by the urbanization of San Clemente; the construction, multiple realignments, and use of Cristianitos Road; and the prolonged cultivation of lands adjacent to the population. As discussed above, the San Mateo North site remains isolated from all extant PPM populations by the existing re-realigned Cristianitos Road and otherwise currently unsuitable habitat (e.g., former cultivated fields, non-sage scrub or non-grassland). Historically, any historic PPM habitat distributed to the west of the San Mateo North population was lost with the urbanization of San Clemente. Moreover, any habitat to the south of the PPM population likely was isolated and impacted by the first realignment of Cristianitos Road, which included the placement of fill and construction of a through cut. The original alignment joined the then U.S. 101 along the present-day Avenida Dolores in San Clemente. Further isolating the San Mateo North population and likely impacting the PPM, lands adjoining the original and realigned Cristianitos Road were cultivated, at least, from 1938 until 1955 (Figure 14). Sometime between 1946 and 1970, much of the western portion of the San Mateo North population evidently was disked or graded, at least briefly (Figure 14). While this level of surfacial disturbance appears less dramatic than the clearly cultivated fields to the south and east, remnant terraces from this land disturbance are visible even in recent aerial photos. All of the agricultural activity, the disking/grading and the prolonged cultivation south and east of the San Mateo North population, ceased between 1955 and 1970, and prior to the establishment of the San Onofre State Beach in 1971.

Table 7. Pacific Pocket Mouse Survey Efforts at San Mateo North, 1995 to 2003.

Date	Reference	Purpose	Effort (trap nights)	# of PPM Captured
1995: 8/14-8/20	MBA[1]	Survey to assess distribution	3,836	33
1996: 7/21-9/24	MBA[1]	Survey to assess distribution	4,783 total, less than half within the known PPM range	22. Some animals could have been counted twice.
1999: 7/18-8/6	MBA[2]	Focused surveys for PPM	6,400 total, about half within the known PPM range	2 captures of likely 1 individual, male
2000: July	Dodd[3]	Genetic sampling	Unreported	8
2001: 6/4-6/9	USDOT[4]	Confirm activity level	2,600	2
	Montgomery[5]	Post Burn / Habitat Improvement Monitoring – part of effort to confirm activity level listed above	250 – subset of 2,600 above	2 – same captures as listed immediately above
2001: 7/10-7/14	Montgomery[5]	Post Burn / Habitat Improvement Monitoring outside known occupied area	1,250	0
2001: 7/2-7/6	USDOT[4]	Confirm activity level	900	1
2002: 7/8-7/12	Montgomery[5]	Post Burn / Habitat Improvement Monitoring	310	0
2002: 7/8-7/12	Montgomery[5]	Post Burn / Habitat Improvement Monitoring outside known occupied area	1,150	0
2003: 7/17-7/21	Montgomery[5]	Post Burn / Habitat Improvement Monitoring	290	0
2003: 7/17-7/21	Montgomery[5]	Post Burn / Habitat Improvement Monitoring outside known occupied area	1,060	0
2003: 9/4-9/14	NRA[6]	Confirmation of presence / define range limits	2,200 total, one third within the known PPM range.	4

[1](Michael Brandman Associates and LSA Associates 1997), [2](Michael Brandman Associates 1999), [3](Dodd 2000), [4](U. S. Department of Transportation 2005), [5](Montgomery 2005a), [6](Natural Resources Assessment, Inc. 2003).

Coupled with major improvements to Interstate 5 in the San Clemente area, Caltrans completed the construction the existing interchange for Cristianitos Road in 1982. The new interchange prompted the third realignment of Cristianitos Road to its current configuration. The asphalt concrete surface of the abandoned portion of Cristianitos Road was removed shortly after the road was realigned to its current location, which was used for the construction of the San Mateo Campground in 1990. Two 2003 PPM capture locations were made from the area of the former road bed or road shoulder of the original Cristianitos Road. The former road bed and shoulder in

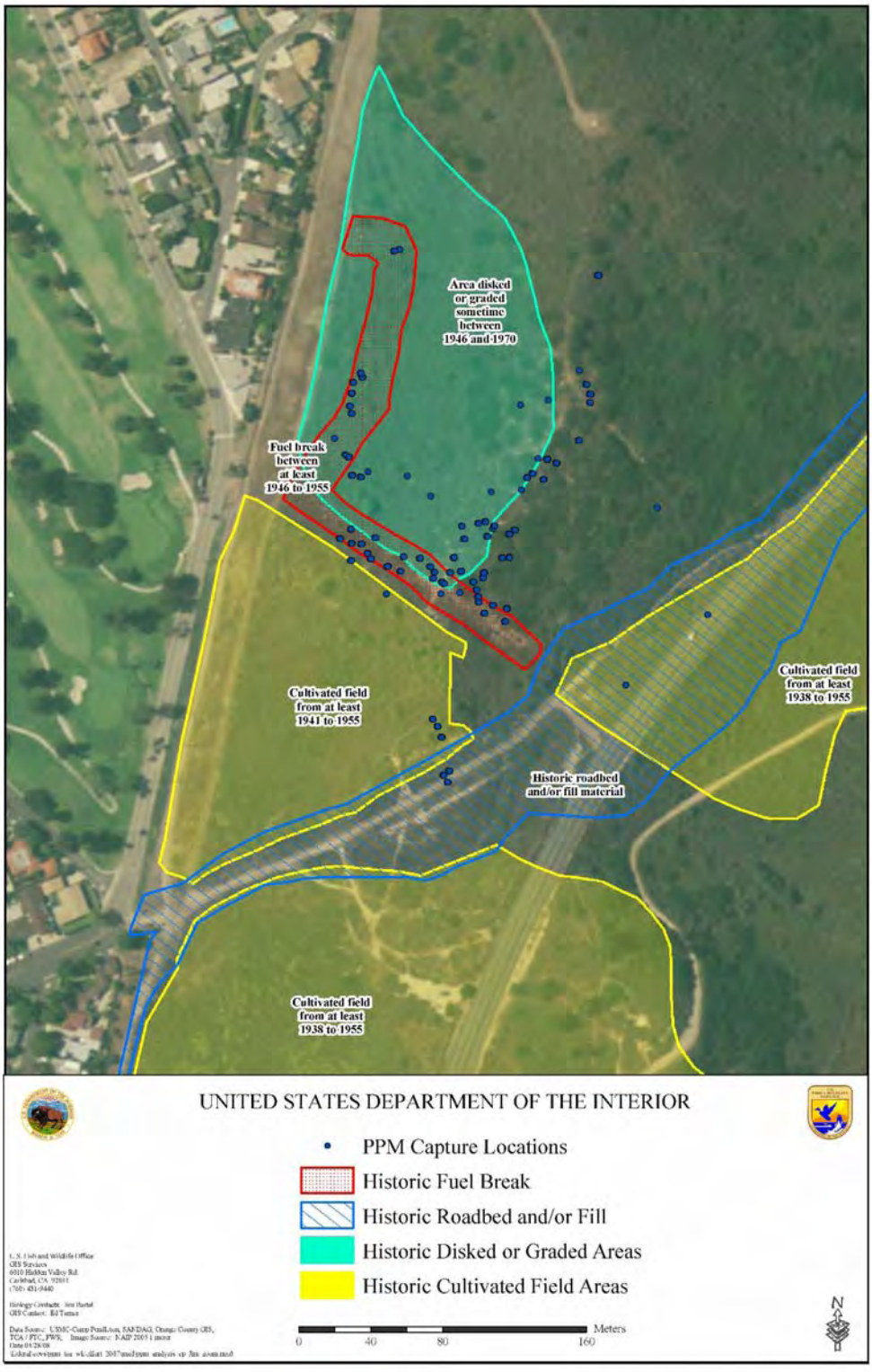

Figure 14. Close up of San Mateo North site with detailed discussion of historic anthropogenic activities within vicinity of PPM capture locations.

this area sit atop 6-11 m (20-35 ft) of fill material, which was expanded significantly to the southwest to facilitate the crossing of a small canyon by the third realignment of Cristianitos Road. In our attempt to chronicle the recorded disturbance history of the San Mateo North site (Figure 14), PPM capture locations appear to be correlated with areas or edges of areas that were or are moderately disturbed (*e.g.*, former fuel breaks, former disked or graded areas, road bed edges or shoulders, trails), while capture locations are rarely found in areas of dense vegetation or historically cultivated areas.

Much of the land not impacted by anthropogenic actions has been effectively lost, at least for the time being, by encroaching shrubs and small trees due to the absence of fire for at least 67 years. In comparing aerial photos from 1941 to 1980, the extent of dense lemonade berry chaparral has expanded largely from the east-northeast of the majority of the PPM capture locations. This observation can be explained by the results of a study of lemonade berry in coastal chaparral in southern California; Lloret and Zedler (1991) reported that terrestrial animals in the process of foraging for lemonade berry fruits inadvertently disperse some seeds and promote the establishment of seedlings outside the canopy of the parent plant. Lemonade berry shrubs are "top-killed" and resprout vigorously from the stump following fire (Lloret and Zedler 1991; Keeley 2006). Though the species does not produce seedlings following fire (Keeley 2006), lemonade berry after stump sprouting will continue to establish more plants and gradually increase its canopy in the absence of fire (Lloret and Zedler 1991). In summing up the species in coastal chaparral, Lloret and Zedler (1991) maintained that lemonade berry seedlings can grow up through the canopy of other species and eventually assume canopy dominance, and that canopy gaps are not required for population expansion. In the absence of fire for 50 years or more, Lloret and Zedler (1991) predicted a gradual increase in lemonade berry that may effect a type conversion of areas, like that potentially occurring adjacent to the San Mateo North population, "to a somewhat taller and more structurally heterogeneous woodland in which [lemonade berry] shares dominance with other large evergreen non-seeding sprouters" like shrub oak (*Quercus berberidifolia*) and toyon (*Heteromeles arbutifolia*). Similarly, Wirtz (1982) noted that 20 years after fire in southern California chaparral, "burrowing heteromyids have declined in abundance as the shrub canopy closes in and ground level open space is eliminated." Relatedly, a small winter-deciduous tree, Mexican elderberry (*Sambucus mexicanus*), appears to be invading the lower southwestern portion of the PPM population. These past actions and impacts, and the ongoing habitat degradation have reduced and confined the San Mateo North population to its present small size.

In 2000, a prescribed fire intended to enhance habitat for PPM was performed on 1.4 ha (3.4 ac) adjacent to the capture locations from 1995 and 1996 (Montgomery 2005a). Though a review of the fire history on the Base indicated that the San Mateo North site had not burned since the date of their first fire records in 1972 (Service 2005), the changing extent of lemonade berry chaparral visible in a series of historical aerial photos strongly suggests that the San Mateo North population has not burned for more than 67 years. In the historically cultivated burn area, the vegetation was senescent and the combined shrub, forb, and grass cover approached 100 percent in many areas. Montgomery (2005a) hypothesized that the condition of the vegetation precluded the use of this area by PPM. After the burn in 2000, shrub cover was reduced from approximately 51 percent to 9 percent, and bare ground was increased from approximately 5 percent to 47 percent (Montgomery 2005a). The density of native forbs was significantly

increased in the year following the burn. Though PPM were expected to move, either through juvenile dispersal or through adult relocations, from the occupied area into the study area following the controlled burn no PPM were captured in the burn area, and few individuals were captured within a small strip of the adjacent known occupied area for 3 years following the fire (Montgomery 2005a). In light of the formerly cultivated soils and because the prescribed fire coincided with an apparent period of low population density in adjoining habitat, additional investigation is warranted before using prescribed fire as a tool for enhancing PPM habitat. Regardless, absent fire or grubbing, much of the population site likely will become eventually a closed canopy of lemonade berry or lost to invasive Mexican elderberry.

The PPM population at the San Mateo North site is "very small" (Spencer, pers. comm. 2005) and the PPM occupy a relatively small area, thereby making it vulnerable to fragmentation, edge effects, and environmental and demographic stochasticity. This population, along with the Dana Point Headlands and San Mateo South populations, is "highly susceptible to extirpation" (Spencer, pers. comm. 2005). Specific factors that threaten the San Mateo North occurrence include human recreational activities, domestic and feral cats, unplanned fire and fire suppression activities, and habitat degradation and direct mortality of PPM associated with traffic on Cristianitos Road. All of these factors likely lead Spencer (2005) to conclude that the three small PPM populations, including San Mateo North, are not "large enough to be potentially self-sustaining without active intervention."

The California Department of Parks and Recreation permits the use of the dirt trails and a firebreak within the San Mateo North site for hiking and bicycle recreation. In 1997, it was noted that bicyclists from the adjacent housing area were removing vegetation and moving soil to create a track with jumps and banked turns at the exact locations where PPM were captured in 1995 and 1996. In response, California Department of Parks and Recreation installed three-strand fencing along the official roads and trails and erected an educational kiosk. While it appeared at one time that the fencing, signage, and limited patrolling resulted in the abandonment of the bicycle track, recent trail use and mountain bike activity, including the building of banked corners, has resumed through the PPM population area (J Bartel, pers. obs, April 1, 2008), including continued use of another unauthorized trail nearby. This recreational use by mountain bikers, hikers, and runners, and bike trail construction likely is impacting PPM through crushing of animals, burrows, and/or habitat degradation.

Domestic and feral cats are known to prey upon PPM (Brylski 1998 (in Service 1998a p.26)) and have the potential to significantly reduce rodent populations (Crooks and Soulé 1999; Pearson 1964). Montgomery (2003) reported that domestic pet activity is heavy at this site. Montgomery (2003) further noted that controlling house cats in this area, as well as maintaining natural populations of large native predators to help reduce the presence or abundance of cats and other mesopredators, may be important to PPM.

Fire and fire suppression activities may have detrimental effects on PPM occupying a burned area or the burn perimeter, though the long-term effects on the overall population are unknown. For example, wildfire may be beneficial to PPM if fire frequency and intensity remains low enough to support open-canopy coastal sage scrub thought to be preferred by PPM, and enough individuals survive to repopulate the burned area. However, if fires occur frequently or at the

wrong time of year, seed availability will be significantly diminished and/or invasive alien grasses and forbs will be favored over native forbs and shrubs that are preferred cover for PPM. For these reasons, the area selected for the controlled burn conducted in 2000 was adjacent to, and not directly over, the known PPM capture points and was a location that had not burned in at least 30 years (Service 2005). This effort differed from a wildfire in that the limits of the burn were predefined and carefully controlled, fire suppression hoses and foam were in place prior to ignition of the fire, a large fire fighting force was in attendance with extensive prior planning, and the fire was ignited under the direction of a fire crew when weather conditions were optimal for preventing the spread of fire into occupied habitat.

If a wildfire consumes the entire San Mateo North site, the fate of the PPM population is uncertain. However, Shaffer and Laudenslayer (2006), citing work by Wirtz (1995), reported that the California pocket mouse (*Perognathus californicus*) survived fire in southern California chaparral and began to appear in burned sites 6 to 7 months post fire. Nonetheless, precluding a wildfire from consuming the entire San Mateo North site may be difficult based on time of year, location of the ignition, direction and intensity of prevailing winds, maturity of the vegetation, and site topography. Any fire suppression activities other than those confined to existing roads and the fire break along the western boundary of the site would likely impact PPM through habitat and soil alterations. For example, fire suppression activities in the Oscar One population have resulted in soil and habitat impacts that are detrimental to PPM (Service 1998b). In conclusion, the extent that wildfire threatens the San Mateo North site will likely continue. However, careful planning and habitat management can minimize the risks of wildfire.

The existing Cristianitos Road adjoins the eastern edge of existing PPM habitat at the San Mateo North site. As discussed above, the paved two-lane Cristianitos Road acts as a barrier to small mammal movement, including the PPM (Oxley et al 1974; Brehme 2003; McGregor et al 2008). McGregor et al (2008) concluded that their study "results imply that the barrier effect of roads on these species cannot be mitigated by measures aimed at reducing traffic amount; other measures such as wildlife passages would be needed." Nonetheless, some PPM may have been killed over the years while attempting to cross the original road or realigned version. The overall effect of this road-related PPM mortality is not known. Moreover, some habitat degradation may be occurring along the margins of Cristianitos Road due to altered runoff patterns, trash accumulation, illegal dumping of waste, and dispersal of alien plant seeds. Overall, Cristianitos Road is likely having a negative effect on the PPM population at San Mateo North through habitat degradation, fragmentation, and potential mortality of individual mice.

Effects of the Action

Referred to as three sites (i.e., Dana Point Headlands, San Mateo Creek, and Oscar One) in the PPM recovery plan, the Service identified two components to the recovery strategy: 1) Stabilize existing populations by protecting currently occupied habitat and search for and protect any additional populations found; 2) Establish additional populations through natural colonization/recolonization into nearby and adjacent habitats, coupled with habitat management in these areas and translocation and/or release of captive-bred individuals. Furthermore, the PPM recovery plan emphasizes that "Unless or until sufficient, additional viable populations are discovered and/or established and protected, it is imperative that existing populations be

protected and expanded through active management. Loss or degradation of any of the populations at the three known extant locales could irretrievably diminish the likelihood of the subspecies' survival." (Service 1998).

Direct Effects

Habitat Impacts

Because all PPM capture records occur west of the existing Cristianitos Road and the project footprint does not cross west of this existing road in the vicinity of the mapped minimum convex polygon encompassing the PPM habitat population, the proposed toll road will not directly impact a known occupied PPM habitat.

Death or Injury from Salvage and Relocation

A conservation measure that is proposed to minimize the potential for direct loss of PPM individuals in association with project grading and construction is to erect exclusionary fencing and perform removal trapping to move animals from within the construction footprint to nearby adjoining suitable habitat. In areas where PELO are in surrounding habitat, they have been shown to respond quickly to the relaxation of population pressure from removal trapping by rapidly re-colonizing habitat where animals were removed (Flake and Jorgensen 1969). Translocated heteromyids also can exhibit high site fidelity and will circumvent exclusionary fencing to return to their former use areas if there are any opportunities to do so (*e.g.*, breaches in fencing or the fencing can be scaled by animals) (W.B. Miller pers. obs. in association with 5th Street Bridge Replacement Project, City of Highland, California, Biological Opinion FWS-SB-1162). This suggests that if there is any potential for animals to gain access to the construction footprint subsequent to animal removals and prior to construction, they could be killed by project construction and grading of burrows.

Live trapping also, in and of itself, imposes unavoidable risks to individuals associated with double captures of animals in traps, animals getting caught in trap doors, risk of death due to exposure, predation by ants, and human error. During the initial survey efforts at San Mateo North an animal was killed in association with trapping activities, and monitoring of PPM at Oscar One has occasionally resulted in animal deaths (Service 1996a; Service 1999a; Service 1999b; Service 2004c, Service 2006). Thus, while acknowledging that salvage actions are recommended for projects where impacts cannot be completely avoided, they do not eliminate the potential for PPM mortality.

Furthermore, attempts to translocate heteromyids have had limited success (Williams *et al*. 1993; O'Farrell 1992, 1999; Montgomery 1997; Germano 2001; Shier 2007b). Aside from the mortality of individuals that may occur during the initial trapping and handling of the animals or follow up monitoring (LSA 2002), post-release dispersal away from the release site and mortality are the greatest causes of translocation failure (Griffith *et al*. 1989; Kleiman 1989; Short *et al*. 1992; Shier and Swaisgood 2006). Post-release dispersal can be due to competition for resources (Maynard Smith and Parker 1976), a lack of conspecifics (Stamps 1988; Shier and Swaisgood 2006), differences between the physical characteristics of the release site and the source habitat

on which the animals are imprinted (Davis and Stamps 2004; Stamps and Swaisgood 2007), and animals attempting to return to their natal site (Fritts and Mech 1984; Miller and Ballard 1982). Post release mortality is highest in the first few days to weeks following release (LSA 2002; Montgomery 1997) and may be due to predation, stress response to novel environments, the lack of established seed caches, and/or competition for resources (*e.g.*, territories) with conspecifics (Shier and Swaisgood 2006). Though a translocation of 14 San Bernardino kangaroo rats (*Dipodomys merriami parvus*) included habitat enhancement at the release site, fencing to prevent dispersal, and creation of artificial burrows, none of the translocated SBKR were known to be alive 6 months post release (LSA 2002). Another translocation of 40 Stephens' kangaroo rats (*Dipodomys stephensi*) failed as the release site was nearly devoid of SKR 1 year post-release, and only 1 individual was found 18 months post-release. These studies suggest the translocation of rodents, particularly heteromyids, is still very experimental and relocation of animals outside the project disturbance limits may still result in the loss of individuals.

Roadway Associated Mortality

Construction of the toll road and the associated increase in intensity in vehicle use could affect survivorship of PPM through roadway associated mortality. As discussed above, San Mateo North population is now adjacent to the realigned Cristianitos Road, which is minor rural road with traffic volume of 5,000 average daily trips (ADT). The proposed project involves realigning and maintaining the existing Cristianitos Road as a two-lane facility, constructing six additional travel lanes for the toll road, and connecting Cristianitos Road to the toll road by means of on-ramps and off-ramps in this vicinity.

In general, small mammals are often reluctant to cross paved highways, and roadways can exert strong inhibitory effects on their movement (Garland and Bradley 1984; Swihart and Slade 1984). However, Conrey and Mills (2001) reported that a two-lane highway with 1,300 to 2,400 ADT, which is less than half the present condition with the existing Cristianitos Road, will typically allow more small mammals to successfully cross the road than 7,000 ADT four-lane interstate highways. As discussed above, Brehme (2003), in a study of the responses of small terrestrial vertebrates to roads in a coastal sage scrub in San Diego County, did not observe any successful crossings of secondary paved roads or highways by three species of mice, including the San Diego pocket mouse. She concluded that mice perceived even a two-lane paved rural road as a boundary (Brehme 2003). Moreover, McGregor et al (2008) concluded in a recent study of the effects of roads to small mammals that their "results suggest that small mammals avoid the road surface itself rather than traffic noise or other emissions." In addition, barriers such as median walls, curbs, and sound walls can serve as physical barriers that further reduce the likelihood of roadway associated mortality.

To minimize any potential for roadway mortality in association with the project, TCA will construct a 46-cm (18-in) curb barrier to small mammal movement along the entire western edge of the roadway alignment in the San Mateo North site. The barrier curb is also intended to convey PPM to culverts and undercrossings proposed in the area. A 46-cm (18-in) curb will minimize, but not eliminate, the potential for road kill since PPM may occasionally be able to circumvent a barrier of this height, particularly if debris and vegetation comes to rest on the barrier, making it possible for small animals, such as PPM, to climb over it. Additionally, we cannot properly evaluate the potential efficacy of this measure since detailed plans for its

implementation are not yet developed. If this barrier is implemented at the top of slope in association with the right-of-way boundary, or mid-slope, in association with drainage culverts as some design discussions have suggested, it likely will be less effective than if it were to be constructed closer to the road edge. Nonetheless, the 46-cm (18-in) curb proposed along the western boundary of the toll road should minimize the potential for PPM from accessing the roadway.

Habitat Connectivity

As discussed above, the San Mateo North population of PPM is now isolated and confined to the west of the existing Cristianitos Road. The proposed roadside curb barrier will minimize any potential roadway mortality; it may also funnel PPM to proposed undercrossings to improve connectivity from baseline conditions. To promote safe passage of wildlife in general under the toll road and to maintain at least some potential for PPM to move between suitable habitats east and west of the toll road, TCA will construct: (1) A 98-m (320-ft) long, 6-m (20-ft) wide arc-culvert that is intended to serve as a wildlife and utility-vehicle undercrossing about 305 m (1000 ft) north of the entrance to San Mateo Campground; (2) A 160-m (525-ft) long, 1.37 m (54-in) diameter reinforced concrete pipe culvert near the Gun Club/State Park access road and entrance to San Mateo State Beach; (3) A 116-m (380-ft) long, 91-cm (36-in) diameter reinforced concrete pipe culvert about 229-m (750-ft) south of the Gun Club/State Park culvert; and (4) A 29-m (95-ft) long, 91-cm (36-in) diameter reinforced concrete pipe culvert under Cristianitos Road where it intersects with El Camino Real (Exhibit 6, Wildlife Science International, Inc. and BonTerra Consulting 2007).

The wildlife and utility vehicle undercrossing north of San Mateo Creek Campground will incorporate a road bed for vehicle travel and will convey animals beneath the toll road but not Cristianitos Road. The 160-m (575-ft) culvert near the Gun Club/State Park access road is intended to convey drainage as well as animal movements and also travels beneath the toll road alignment but not Cristianitos Road. The 116-m (380-ft) culvert to the south of the Gun Club/State Park access road will also convey drainage and traverses under both the toll road and the new alignment of Cristianitos Road. The culvert near the intersection of Cristianitos Road and El Camino Real is proposed specifically to support animal movements and will place eastbound animals in a triangular shaped area to the east of Cristianitos Road that is bound by the toll road to the east, I-5 to the southwest and Cristianitos Road to the northwest. This area falls entirely within the project footprint where habitat alterations from grading and construction are anticipated. Animals headed toward San Mateo Creek from this area are to be conveyed about 134 m (440 ft) to the south by the 46-cm (18-in) barrier curb adjoining the toll road where the overpass joining the toll road with I-5 will provide them an opportunity to travel beneath the toll road.

While these features may afford PPM a limited opportunity to cross beneath the toll road and/or Cristianitos Road, substantial constraints are associated with each potential corridor. The west entrance to wildlife/utility vehicle undercrossing north of San Mateo Creek Campground is proposed in an area outside of the PPM Management Area and the undercrossing will incorporate a roadbed to accommodate utility vehicles, which may inhibit PPM movements. The west entrance to the culvert near the Gun Club/State Park access road is approximately 365 m

(1,200 ft) from the closest PPM capture locations. Aside from proximity, this culvert will have a concrete bottom and will contain rip-rap at both entrances, which would further inhibit use by PPM. The eastern exit of this undercrossing opens near the entrance to the San Mateo Creek Campground to the east of the proposed toll road. Thus, animals attempting to cross the roadway in either of these locations will be required to travel long distances through what are likely to be unsuitable conditions for PPM**.**

The 116-m (381-ft) long culvert south of the Gun Club/State Park Access Road traverses under the proposed toll road and re-realigned Cristianitos Road and connects with sagebrush-coyote bush sage scrub on both sides, but the western entrance is approximately 230 m (750 ft) from the closest PPM capture locations. Aside from proximity, the eastern entrance will be surrounded by rip rap and the western entrance will contain a grate and a vertical drop, making the culvert unsuitable for use by PPM.

The southernmost of the culverts in the vicinity of El Camino Real and Cristianitos Road is the shortest of the undercrossings and may be the most likely to support successful animal movements. This undercrossing is at the southern edge of PPM Management Area, about 790 m (2,600 ft) from the closest recorded PPM capture location. Because this culvert is not situated in a drainage, the culvert likely will not carry water or have rip-rap at either end. Habitat on the both sides of the realigned Cristianitos Road is sagebrush-coyote bush sage scrub, though the eastern exit falls within the road construction disturbance limits. Construction activities, such as staging of heavy equipment and possibly grading are anticipated to temporarily remove this sage scrub. After construction, this area will be reseeded with native species and returned to San Onofre State Beach for management. However, the PPM Management Area does not include management for this area where construction activities likely will compact the soils, making them less suitable or unsuitable for PPM occupancy. From the east side of the culvert, animals will need to travel 134 m (440 ft) to the south to cross beneath the toll road overpass which spans San Mateo Creek and connects the toll road with I-5. Aside from proximity, much of the habitat along this route will have been impacted and reseeded following construction, so while it may be suitable for PPM dispersal, it will have reduced potential to support PPM occupancy.

In their study of tunnels, culverts and underpasses in southern California, Ng *et al*. (2004) recorded successful passage of deer mice (*Peromyscus* spp.) and woodrats (*Neotoma* spp.) beneath roadways using some of the undercrossings they studied. Their study confirmed that some rodent species will take advantage of roadway undercrossings. However, their results showed that suitable habitat on either side of a passage was an important factor in predicting use by wildlife (Ng *et al*. 2004). In another study involving heavily used (*i.e.*, 20,000 ADT during the day and 5,000 ADT at night) four-lane transportation corridors in Banff National Park in Alberta, Canada, McDonald and St. Clair (2004) concluded that small crossing structure diameter (< 0.3 m) and overhead cover near crossing structure entrances improve success for relocated murid rodents. While Ng et al. (2004) did not provide information about such undercrossing attributes (*e.g.*, height, length, substrate, surrounding habitat), deer mice and woodrats are from much larger bodied genera with different life histories than the PPM. In her testimony of February 6, 2008, before the California Coastal Commission, Shier stated that PPM "spatial patterns indicate that they are a fairly sedentary species, so the likelihood that they would actually use a single culvert, or a corridor, in the vicinity of their population is extremely

low." As a result and given the significant distances from the San Mateo North population and the proposed undercrossings and the suboptimal design considerations, we conclude that the undercrossing or culverts will be ineffective at conveying PPM under the roadway. Thus, while the proposed conservation measure of providing wildlife undercrossings likely will maintain limited connectivity across the toll road for animals such as coyotes and other medium-sized mammals, the San Mateo North population will remain isolated and confined to the west of the toll road alignment.

Reduced Potential Future Habitat Restoration

The recovery plan recommends that 2000 ha (4,940) of occupied PPM habitat be conserved, created, or restored. Today, the amount of habitat circumscribed by capture locations is 657 ha (1,620 ac). However, this figure likely overstates the current amount of occupied habitat since the 634 ha (1567 ac) circumscribed in Oscar One/Edson Range incorporates roads, developed areas, impacts from troop training activities, and intervening unsuitable habitats. The restoration lands contiguous with known occupied habitat are the best opportunity to make progress toward the goals described in the recovery plan. Under the proposed project, the western fragment would be managed for PPM consistent with the PPMRMP.

As described in the "Status and Baseline" section, San Mateo North falls on land leased by State Parks from the Base, but the Base retains the right to train troops or manage all land within its boundaries pursuant to its mission, an Integrated Natural Resource Management Plan (INRMP) adopted pursuant to the Sikes Act, and a pending consultation on ongoing and future military training and mission support activities within upland habitats. A goal of the INRMP is to "manage species and habitats in a manner that minimizes impacts to both mission and species and achieve the species specific goals established by the ESA and applicable B.O.s" (Section 4.3.2, USMC 2007b). Under the existing Crucible Course BO and anticipated commitments from the ongoing Uplands Consultation, the Base has committed to routine monitoring of PPM and implementation of appropriate management measures to facilitate recovery if any PPM population decline is observed. In this regard, the Base carried out a prescribed burn at the San Mateo North site in January 2000, and recently enlisted the U.S. Geological Survey to develop a PPM monitoring program for each of the PPM occurrences on the Base. While future restoration activities on the site may take place in the absence of the proposed project, restoration of the western fragment doubtlessly will occur sooner and with more secure and larger funding with implementation of the PPMRMP.

Within the approximately 65.8 ha (162.6 ac) of restorable land on both sides of the existing Cristianitos Road, 29.5 ha (72.9 ac) will be managed with implementation of the PPMRMP, while another 12.7 ha (31.5 ac) of potentially restorable land would be left unchanged by the project because the area is not addressed by the proposed PPM management. Within the project footprint, the construction of the toll road would preclude restoration opportunities that now exist in about 23.5 ha (58.2 ac) of the action area. Nonetheless, all known occupied PPM habitat and all contiguous restorable land adjacent to known PPM habitat will be comprehensively managed, enhanced, and/or restored for PPM within the 29.5 ha (72.9 ac) PPM Management Area.

Indirect Effects of the Roadway

Habitat Degradation

As described in the "General Effects" section, the toll road has the potential to increase invasion by non-native annual grasses and other weedy species into the San Mateo North site. While such invasions would be detrimental to PPM because invasive plants would fill in openings in the vegetation canopy and alter the structure and composition of the plant community, the existing condition as discussed above with the encroaching lemonade berry chaparral, Mexican elderberry, and other weedy species already are effecting the PPM population.

In addition, increasing the grassland habitat at this location could alter the competitive balance between PPM and other small mammal species. For example, mow strips in vehicle right of ways have also been shown to alter small mammal communities by providing habitat for grassland species and favoring species with low habitat specificity (Adams and Geis 1983). One grassland species that could be promoted along the road right-of-way is the western harvest mouse (*Reithrodontomys megalotis*). Because western harvest mice are known to be antagonistic with PPM (Meserve 1976a), suggesting they may compete for food or space, increased densities of this species adjoining the roadway could be detrimental to the PPM population. However, the PPMRMP includes the commitment to minimize potential degradation of adjacent habitat through implementation of an invasive species control program and habitat management and enhancement program.

Roadways also create an impervious surface and lead to soil compaction on the road edge, which leads to greater rates of water runoff. The non-native Argentine ant is associated with mesic habitats (Holway 2004; Holway *et al.* 2002) and is likely to benefit from increased runoff produced by the increased surface area of the toll road relative to the existing roadway in this area in addition to the creation of nest sites along road margins (*e.g.*, cracks and irregularities in the road surface) (David Holway pers. comm. 2004). The occurrence of the toll road in a coastal area where fog will accumulate and be dispersed by the roadway should, in particular, facilitate Argentine ants along the road edge (Holway 2004). As described in the "Threats and Conservation Needs" section, Argentine ants may alter the availability of seed resources and the physical structure of the plant community, thereby affecting PPM populations. However, potential adaptive management measures include an attempt to control Argentine ants, though may be difficult to control Argentine ant populations while maintaining native ant populations.

Lighting

Lighting associated with the roadway and vehicle headlights will significantly increase the level of night-time ambient light at the San Mateo North site. Light levels are thought to be an important determinant of predation risk for nocturnal small mammals (Kotler 1984; Kotler 1985; Longland and Price 1991; Price and Waser 1984), and increased light levels have been shown to improve the success and reduce the time required for owls to search for and capture deer mice (Clarke 1983; Dice 1945). The distribution of a number of nocturnal small mammals has been shown to be influenced by light level, either directly as a result of predation or indirectly as a

result of behavioral changes by the small mammals (Brown *et al.* 1988; Kotler 1984; Price and Waser 1984).

Barn owls and great horned owls are common nocturnal predators in the project vicinity. Existing housing to the west of the San Mateo North site, in addition to project features such as sound walls, fencing, and light standards, provide many perching opportunities for these species, and increased light levels associated with the proposed project should increase their foraging efficiency. If PPM individuals rely upon seed resources in open habitat and/or are unable to behaviorally compensate for increased light levels associated with the roadway, some PPM may suffer increased predation risk from owls and other visually aided predators (*e.g.*, cats, foxes) in association with the proposed project.

However, the PPMRMP proposes to use minimal lighting to reduce predation by incorporating low-light design features adjacent to the San Mateo North site unless Caltrans prohibits the use of some of these features for safety reasons. In addition, the PPMRMP will fund the installation of spikes on top of active telephone poles in the area to deter perching raptors.

Mesopredator Release

Predation rates of PPM may be increased with the increased isolation of the San Mateo North site by medium-bodied animals from adjoining habitat. Due to minimum area requirements and other factors (*e.g.*, persecution by humans), large-bodied mammalian carnivores are particularly vulnerable to extirpation in fragmented landscapes (Crooks and Soulé 1999). Loss of coyotes from habitat fragments in southern California has been shown to be a factor associated with increased numbers of smaller carnivores (*i.e.*, "mesopredators") that are principle predators of birds and other small vertebrates (Crooks and Soulé 1999). Coyote presence particularly appears to have negatively effect on domestic cat, opossum, and raccoon abundance. Ecological release of mesopredators from a loss of coyotes has been implicated as a factor that has led to higher mortality and extinction of scrub-breeding birds in southern California habitat fragments (Crooks and Soulé 1999) and may be associated with the loss of small mammals from habitat fragments as well (Clark 2002).

Because of the predation risk to PPM in the San Mateo North population posed by domestic cats and other small predators, a reduction in the number of coyotes could increase predation risk for PPM. Following completion of the toll road, the PPM population will still be connected to undeveloped habitat to the north, and undercrossings and culverts are proposed to maintain connectivity with habitat and the former agricultural fields to the west, so coyotes likely will maintain some level of activity at the San Mateo North site. However, because the project will reduce the amount of habitat west of Cristianitos Road, increase the degree of isolation of the site, and impair access to the site by coyotes, greater temporal variation in visitation and abundance of coyotes may occur at this location. Several mesopredators, including cats, foxes, and skunks, but especially cats, appear to temporally avoid habitat fragments when coyotes are present and increase their visitation rates when coyote visitation declines (Crooks and Soulé 1999). These factors suggest that the toll road could lead to increased predation pressure on PPM associated with higher mesopredator abundance or visitation rates at the San Mateo North site when coyotes are absent or distant from the PPM population.

Nonetheless, the PPMRMP includes construction of a cat exclusionary fence and trapped removal of cats within the PPM Management Area. This effort should effectively minimize predation by domestic and feral cats, although other mesopredators like foxes and skunks will remain.

Fire

As described in the "General Effects of the Action" section, the proposed project has the potential to increase the frequency of fires along the length of the toll road. The potential to increase fire frequency adjoining the roadway presents several threats to the San Mateo North PPM population. Fire can cause direct mortality of mice due to heat and/or suffocation (Howard *et al.* 1959). Fires typically raise surface soil temperatures to 95-720^{o}C (203-1,328° F) and below surface temperatures, down to 3-4 cm (1.2-1.6 in) below ground, to 50-80^{o}C (122-176°F). In an experiment to test the effects of fire on rodents above ground, Howard *et al.* (1959) reported that some rodents died due to suffocation and that all mice died when surrounding temperatures reached 59-63^{o}C (138-145°F).

Fire has the potential to kill or injure individual PPM, but some mice will likely survive fires if they are deep enough in their burrows. PELO burrows can be up to 1.0 m (3.3 ft) deep (Kenagy 1973), but PELO can select resting sites anywhere from the bottom of their burrow to as little as 1.0 cm (0.4 in) in depth (Kenagy 1973). However as discussed above, Shaffer and Laudenslayer (2006), citing work by Wirtz (1995), reported that the California pocket mouse survived fire in southern California chaparral and began to appear in burned sites 6 to 7 months post fire. Another potential effect to PPM associated with fire is the potential for firefighting activities to directly impact PPM through activities such as bulldozing firebreaks. As described in "Threats and Conservation Needs," fire has the potential to be used as a management tool to enhance PPM habitat by removing large shrubs and heavy thatch from non-native grasses that likely reduce habitat suitability for PPM. However, if fire occurs too frequently or non-native annual grasses are allowed to invade following a fire, then fire will likely have a detrimental effect.

Fencing and patrol may reduce the potential for visitors to start fires within the PPM Management Area, but fire could still start adjoining the roadway or elsewhere and burn the management area. The PPMRMP includes the commitment to develop a fire prevention/fire response strategy for the PPM Management Area, which is anticipated to reduce the potential for firefighting activities to negatively impact PPM and its habitat and will facilitate habitat restoration following a fire.

Summary of Conservation Measures

To offset impacts to PPM at the San Mateo North site, the TCA developed the PPMRMP that will be implemented within 28.2 ha (69.8 ac) of lands. The PPM Management Area, which is west of the toll road alignment, contains the entire known occupied PPM habitat and additional potentially restorable land. Though not known or shown to be occupied, the restorable areas largely consist of former cultivated fields (see Figures 13 and 14).

The PPMRMP proposes to implement specific enhancement actions within the PPM Management Area using an adaptive management approach that is consistent with the recovery goals for PPM. Measures proposed to enhance PPM habitat include removal of existing trails, concrete pads, and invasive vegetation. Measures proposed to be investigated for the potential to enhance PPM habitat include control of invasive Argentine ants, soil augmentation and manipulation in areas formerly used for agriculture, and hand thinning or use of prescribed fire to reduce vegetative cover in areas of dense sage scrub or other vegetation, which may limit the distribution of PPM.

The PPMRMP builds on the conservation measures aimed at avoiding and minimizing harm to individual PPM during construction and operation of the toll road (*i.e.*, realignment of the toll road to avoid impacts to all known occupied habitat; salvage and relocation efforts following baseline monitoring efforts, exclusionary fencing, barrier curb, and wildlife undercrossings). Intensive adaptive management of the PPM Management Area is proposed to ensure that the PPM occurrence at San Mateo North is sustained over the long term by addressing those factors that may be contributing to habitat degradation (*e.g.*, plant successional dynamics, invasion alien plants, presence of invasive ants) or otherwise impairing the viability (*e.g.*, predation pressure, low genetic variability, recurrent fire) of this occurrence.

To maximize its potential for success, the PPMRMP will be implemented prior to, during, and after construction of the toll road. The specific goals of the PPMRMP are to: "1) minimize current and potential threats (*e.g.*, predation) so that the San Mateo population is not at risk of extirpation; 2) identify specific management measures to enhance and establish new areas of suitable habitat for the PPM with the quantitative goal of achieving at least a 50 percent occupancy of the Management Area by PPM; and 3) to accommodate research within the Management Area with a focus on ecological studies of the PPM that have practical applications to the adaptive management and recovery of the San Mateo North population and other PPM populations as appropriate." (Wildlife Science International, Inc. and BonTerra Consulting. 2007).

The recovery of PPM depends on reducing imminent threats and increasing the amount of occupied habitat and overall abundance of PPM. The goals of the PPMRMP are consistent with this recovery strategy, though the proposed habitat enhancement largely remains experimental and the techniques have been unsuccessful, to date, in increasing overall PPM abundance. While the proposed toll road would preclude restoration opportunities that now exist in the action area within a 23.5-ha (58.2-ac) portion of the project footprint, proposed management actions carried out through the PPMRMP within the PPM Management Area likely will provide some immediate benefit to PPM at the San Mateo North site by implementing actions that reduce predation pressure, that eliminate or reduce habitat degradation brought about by public access to the site, and that control invasive plants. Finally, while the San Mateo North population will remain isolated and confined to the existing open lands west of the proposed toll road alignment despite the proposed wildlife undercrossings, these undercrossing will provide limited connectivity across the toll road for medium-sized mammals, like coyotes.

Summary of Effects to the Species and Recovery

The Service's PPM Recovery Plan calls for stabilizing the existing populations by protecting currently occupied habitat, in addition to establishing a total of 10 populations within its historic range (Service 1998a). The Service (1998a) also indicated in the PPM Recovery Plan that "until sufficient, additional viable populations are discovered and/or established and protected, it is imperative that existing populations be protected and expanded through active management."

Of the four extant PPM populations, three populations are unaffected by the project (*i.e.*, Dana Point Headlands, Oscar One, and San Mateo South). The northernmost Dana Point Headlands population occurs on privately conserved land. Due to topography at the site, the area that can be managed for PPM is limited to about 5.7 ha (14.0 ac). This PPM population is more isolated and distant from the other extant populations, and based on the most recent survey information, we are uncertain whether a viable population still exists at the site. These factors coupled with the threats associated with its location adjacent to residential and commercial development suggest that intensive management and possibly reintroduction of animals will be needed to conserve the Dana Point Headlands population. The two remaining populations unaffected by the project, the Oscar One and San Mateo South occurrences, are in active military training areas where permanent conservation and complete removal of threats from military training activities are unlikely due to competing national security objectives. In short, the San Mateo North occurrence of PPM is critical to the survival and recovery of the species.

Overall the proposed project footprint avoids all known occupied PPM habitat, while providing much needed management and protection described in the PPMRMP for the San Mateo North population. While the proposed toll road would preclude restoration opportunities that now exist in about 23.5 ha (58.2 ac) of the action area within the project footprint, all known occupied PPM habitat and nearly all restorable land adjacent to such habitat and west of Cristianitos Road will be managed within the 29.5-ha (72.9-ac) PPM Management Area. These potentially restorable lands represent the best opportunity to stabilize or expand known occupied PPM habitat through management actions that are not in conflict with existing military training activities.

Conclusion

After reviewing the current status of the PPM, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that construction, operation, and maintenance of the toll road is not likely to jeopardize the continued existence of the PPM. This conclusion is based on the following:

1. The proposed toll road alignment avoids all known occupied PPM habitat. Despite unsubstantiated assertions that the proposed toll road will directly impact PPM "occupied habitat" (Engel, pers. comm., 2007), the best available scientific information (*e.g.*, positive and negative PPM survey results, historic cultivation for agriculture, existing dense vegetative cover that dominates much of the PPM action area, toll road impact footprint near PPM capture locations either on or east of Cristianitos Road) argues that

PPM occupancy is currently limited to a 5.6-ha (13.8-ac) area within the PPM Management Area.

2. Like the other three PPM populations sites, the San Mateo North site remains isolated from all other extant PPM populations by existing or past anthropogenic development or activities (*e.g.*, urbanization of San Clemente, multiple realignments of Cristianitos Road, historic cultivation for agriculture). While the San Mateo North PPM population likely will remain isolated and confined to the west of the toll road alignment despite the proposed wildlife undercrossings, the connectivity of the population will not worsen with the proposed project.

3. The TCA has committed to implement conservation measures that include active management of all known occupied habitat and the potential restoration of adjacent land within the 29.5 ha (72.9 ac) PPM Management Area west of the proposed toll road. These management actions have long-term assurances of adequate funding, and the Marine Corps has agreed to allow these conservation measures to be carried out within the San Mateo North PPM Management Area. In particular, this intensive management of the San Mateo North site and all known occupied PPM habitat through the PPMRMP will address the direct and indirect impacts to PPM analyzed above such as fire, invasive species, habitat restoration, predators, public access and related disturbance, and road mortality.

4. Because some ongoing threats to the survival of the PPM population at the San Mateo North site are not currently being adequately addressed (*e.g.*, predation, invasive species, encroaching native shrubs and small trees, public access and related disturbance), intensive management of the San Mateo North population of PPM and its habitat likely will provide immediate conservation benefits to PPM. The sooner these actions are implemented by the TCA, the greater the conservation benefit to PPM.

5. The TCA will implement measures to reduce or eliminate the number of PPM potentially harmed within the construction footprint, though this area is not known to be occupied. Construction-related minimization actions include erecting temporary exclusionary fencing and a curb barrier prior to construction, and trapping animals from within the footprint for removal and release into adjoining habitat or potentially retaining them for a captive breeding program. While such salvage actions typically are recommended for projects where impacts cannot be completely avoided, such actions do not eliminate the potential for PPM mortality. Nonetheless, the number impacted individuals likely will be low due to the proposed methods of capture and expected small size of the population.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act, and Federal regulations issued pursuant to section 4(d) of the Act, prohibit take of endangered and threatened species without a special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat

modification or degradation that actually kills or injures a listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as an action that creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), such incidental taking is not considered to be a prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are non-discretionary and must be implemented by the FHWA, TCA, or Caltrans (for its routine maintenance) in order for the exemption in section 7(o)(2) to apply. The FHWA has a continuing duty to regulate the activity that is covered by this incidental take statement. If the FHWA (1) fails to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

AMOUNT OR EXTENT OF TAKE

The Service anticipates the following levels of take could occur as a result of the proposed action:

1. Tidewater goby

Gobies in the area of the dewatering activities will be captured by seining and relocated away from the construction footprint. Some gobies may be missed during pre-construction capture efforts and subsequently stranded and die in dewatered sections of San Mateo and San Onofre creeks. Gobies could also become stressed and die as a result of the capture and holding process for relocation. Due to the dynamic conditions associated with their biology, we are unable to quantify the number of gobies that will inhabit San Mateo and San Onofre creeks at the time of construction. No gobies are anticipated to be taken by toll road operation and maintenance. Take will be monitored and documented through implementation of the BRMP. Take and take thresholds are authorized as follows:

- Capture and relocation of all gobies within the dewatering areas of San Mateo and San Onofre creeks during project construction of the toll road;

- Accidental death of 1 percent of the gobies captured and held per dewatering event not to exceed 50 goby deaths for the entire toll road project.

2. Arroyo toad

The exact distribution and population size of toads is difficult to estimate due to the dynamic conditions associated with their habitat and biology. For toads, suitable habitat may change

during a given year or from year to year depending on climatic condition, flooding, or other natural or human-related events. Except during the early juvenile stage (first 4-5 weeks), toads forage at night and burrow during the day. Nocturnal activity is usually associated with rainfall and moderate temperatures and some nights of very high relative humidity. Toads may be found in upland habitats adjacent to known breeding areas. Therefore, detection of toads outside of the breeding season is very difficult, with limited opportunities for anticipating when the species may be active. Finding dead or injured toads within the action area is unlikely as the individuals may be underground.

Exclusion fencing will be erected, and toads will be captured and relocated outside of the construction footprint. Some toads may be missed and subsequently die as a result of project clearing and grading activities. Some toads may also be injured or killed as a result of the capture and relocation efforts. Once the toll road is in operation, toads may be killed by vehicle strikes along the roadway if the toad barrier fails or is not maintained. We are unable to quantify the number of toads that will be captured and relocated during the construction phase or killed by vehicle strikes once the toll road is in operation. However, take will be monitored and documented during implementation of the ATMP and during ongoing fence maintenance activities. Take and take thresholds are authorized as follows:

- Capture of up to 25 toads within the project construction footprint and release of these animals outside of the toll road alignment;

- Accidental death of up to 1 toad per year as a direct result of exclusionary fencing, capture, and release efforts;

- We cannot quantify the number of toads that will be struck by vehicles due to inadequate exclusionary fencing, but we anticipate the number to be low. Therefore, if 2 or more killed or injured toads are detected along the toll road during any 12-month period, the take threshold will be exceeded.

3. Coastal California gnatcatcher

Take and take thresholds are authorized as follows:

- Up to 4 gnatcatcher pairs in the form of harm due to the permanent removal of 19.7 ha (48.8 ac) of coastal sage scrub in the northern section of the toll road at Chiquita Canyon and up to 27 pairs in the form of harm due to the permanent removal of 88.5 ha (218.7 ac) in the southern section of the toll road at Camp Pendleton. Some, but not all, of these birds are expected to die; others may suffer a reduction in fitness and productivity. No take of gnatcatchers is anticipated in the central section of the toll road, and none is authorized. Therefore, if more than 27 pairs are harmed in the southern section of the toll road at Camp Pendleton or more than 4 pairs are harmed in the northern section of the toll road at Chiquita Canyon or any gnatcatchers are harmed in the central section of the toll road then the take threshold will be exceeded.

- We expect that brush fires will be ignited because of the construction and/or operation of the toll road leading to the death or injury of gnatcatchers. However, we cannot predict the number of gnatcatchers that would be harmed by fire resulting from the construction and/or operation of the toll road. Therefore, if 30 acres or more of coastal sage scrub is burned every 10 years from fires caused by the construction and/or operation of the toll road, then the take threshold will be exceeded.

- We anticipate that additional gnatcatchers may be killed infrequently by vehicle strikes during operation of the toll road. We cannot quantify the number of birds that will be struck by vehicles, but we anticipate the number to be low. Therefore, if 2 gnatcatchers are detected killed by vehicles during any 12-month period, then the take threshold will be exceeded.

- We do not anticipate death or injury to gnatcatchers in habitat areas to be restored and managed within the Upper Chiquita Canyon Conservation Bank and PPM habitat management areas; however, take in the form of harm may result from habitat modification actions that reduce productivity.

- No take of adults, juveniles, nestlings, or eggs during habitat clearing for toll road construction or maintenance is anticipated; therefore, none is authorized.

4. Least Bell's Vireo

Take and take thresholds are authorized as follows:

- Up to 5 vireo pairs in the form of harm due to impacts to 5.4 ha (13.3 ac) of riparian habitat in the major drainages (San Juan, San Mateo, and San Onofre creeks). None of these birds are expected to die but are anticipated to suffer a reduction in fitness and productivity. Therefore, if more than 5 pairs are documented within the 5.5 ha (13.3 ac) impact area in the major drainages, then the take threshold will be exceeded.

- No take of adults, juveniles, nestlings, or eggs during habitat clearing for toll road construction or maintenance is anticipated; therefore, none is authorized.

5. Pacific pocket mouse

PPM will be live-trapped and released away from the construction footprint. In addition, management actions will be undertaken including population surveys that require live-trapping and marking of PPM. PPM could also be stressed, injured, or die as a result of these management actions. Because of normal population fluctuations, we are unable to quantify the number of PPM that will be live-trapped and relocated during the construction phase or live-trapped and marked during the long-term management phase. Thus, take and take thresholds are authorized as follows:

- We anticipate the live-trapping of up to 2 PPM within the project footprint for holding and release into the PPM Management Area west of the toll road alignment.

- We anticipate accidental death or injury of up to 1 PPM due to live-trapping and relocation efforts during project construction.

- We anticipate accidental death or injury of up to 2 PPM per year during live-trapping and marking of PPM within the PPM Management Area during population surveys and other management actions as described in the PPMRMP.

- We anticipate accidental death or injury of up to 2 PPM per year related to habitat management activities within the PPM Management Area.

EFFECTS OF TAKE

In the accompanying biological opinion, we determined that this level of anticipated take is not likely to jeopardize the continued existence of the tidewater goby, arroyo toad, coastal California gnatcatcher, least Bell's vireo, or Pacific pocket mouse.

REASONABLE AND PRUDENT MEASURES

The FHWA shall implement the following reasonable and prudent measure:

1. Minimize impacts to tidewater goby, arroyo toad, coastal California gnatcatcher, least Bell's vireo, and Pacific pocket mouse during initial vegetation clearing/grubbing activities.

2. Minimize impacts to tidewater goby, arroyo toad, coastal California gnatcatcher, least Bell's vireo, and Pacific pocket mouse during project construction activities.

3. Minimize impacts to toad from vehicle strikes through installation and maintenance of an effective toad barrier.

4. Minimize impacts to tidewater goby, arroyo toad, coastal California gnatcatcher, least Bell's vireo, and Pacific pocket mouse during operations and maintenance activities.

TERMS AND CONDITIONS

To be exempt from the prohibitions of section 9 of the Act, FHWA, TCA, and/or Caltrans must comply with the following terms and conditions, which implements the reasonable and prudent measure described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

1a) Because it is anticipated that the toll road construction will not begin for several years and population numbers are anticipated to fluctuate, preconstruction protocol surveys for gnatcatcher and vireo will be conducted within 1-year of project vegetation

clearing/grading activities to monitor and report on the number of birds within the action area at the time of project impacts.

1b) TCA will staff a monitoring biologist(s) approved by the Agencies to ensure compliance with all avoidance/minimization measures during initial vegetation clearing/grubbing and project construction (Appendix 1; Measures WV-2, 3). The biologist(s) must be knowledgeable of the biology and ecology of the listed species addressed in this biological opinion (i.e., tidewater goby, arroyo toad, coastal California gnatcatcher, least Bell's vireo, and Pacific pocket mouse). FHWA will submit the biologist's name, address, telephone number, résumé, at least three references (i.e., the names and contact information of people who are familiar with the relevant qualifications of the proposed biologist), and work schedule on the project to the CFWO for approval at least 7 days prior to initiating work. The biological monitor(s) shall have the authority to halt/suspend all associated project activities which may be in violation of the terms and conditions of the biological opinion, or to avoid or minimize the unanticipated incidental take of listed species, for as long as necessary to resolve the situation through consultation with this office.

2a) For the tidewater goby, the Biological Resources Management Plan (described in Appendix 1, Measure TE3) shall include, at minimum, the following:

i. The capture, handling, and release of gobies will be done outside the goby breeding season, to the extent practicable.

ii. Capture shall be achieved through the use of minnow traps, dip nets, or seine nets with woven mesh size not smaller than 2 to 4 mm (0.08 to 0.16 in) in width. The survey methods used shall be selected to minimize potential injury or mortality to gobies and other native species; if seines are used, particular care shall be taken to avoid incidental injury or mortality to gobies and other native species that may be caught and suffocated in algal mats.

iii. Disturbance and damage to burrows, eggs, and young shall be minimized through the use of the smallest seines and lightest seine weights practicable. Dipnetting and seining shall be limited to the areas of dewatering for construction. Seining during the breeding season shall be limited to the maximum extent practicable.

iv. Handling may involve taking length and weight measurements to assess size classes of individuals, and shall require minimal exposure out of water; bagged portions of seines shall remain in the water until all gobies and native species are removed, or transferred to shallow containers of clean water that are placed in a location that will not result in exposure to extreme temperatures.

v. Any gobies or native species exhibiting signs of physiological stress shall be immediately released at the relocation area outside the dewatering footprint. All others shall be released as quickly as possible after capture. Non-native species captured shall be euthanized.

vi. The biologist shall provide a weekly report to the CFWO of the goby capture and relocation activities that includes, at minimum, the dates, times and location of capture/release activities; the area of capture (i.e., area to be dewatered); the number of gobies and other native species captured, handled, and released; the number of gobies and other native species killed or injured; and the number of non-native species captured.

vii. Activities with the potential to affect gobies will immediately cease, and CFWO will be contacted if the take limit is reached.

2b) For the arroyo toad, the Biological Resources Management Plan and the Arroyo Toad Resource Management Plan (described in Appendix 1, Measure TE10) shall include, at minimum, the following:

i. Surveys shall be conducted in accordance with the approved Service protocol.

ii. Capture methods shall follow commonly accepted techniques for amphibian field sampling, including: capture by hand, dip-netting, scooping up by container, and pit-fall trapping.

iii. Amplexing pairs of toads shall not be captured, handled, or disturbed.

iv. Toads exhibiting signs of physiological distress shall be immediately released at the relocation site.

v. Toads shall be maintained until release in a manner that optimizes their survival.

vi. Toads that are to be measured and released shall be handled in an expedient manner with minimal harm.

vii. If the take limit associated with construction is reached (i.e., if more than 25 toads are captured within the project footprint during pre-project trapping), construction-related activities with the potential to affect toads will immediately cease, and the CFWO will be contacted. If the take threshold related to capture and release or road mortality is exceeded, the CFWO will be contacted immediately to determine if additional conservation measures are required.

3a) Inspect the toad barrier at minimum twice annually with one inspection taking place prior to the typical onset of the rainy season and make any necessary repairs.

3b) Implement a monitoring program to track the take of toads from vehicle strikes along the roadway for a period of 5 years following opening of the toll road. This program shall be subject to review and approval by the Service.

4a) To minimize the potential effects of increased fire frequency associated with the toll road, the Biological Resources Management Plan will include a plan to maintain

habitat suitability following fires resulting from construction and operation of the toll road (a post-fire plan). The post-fire plan will primarily address potential effects to gnatcatcher associated with burning of coastal sage scrub, but will also address potential effects of fire on habitat for arroyo toad, least Bell's vireo, and Pacific pocket mouse. The plan will include removal of non-native invasive plant species following a fire, erosion control measures, and, if necessary, reseeding and replanting with plants of local genetic stock. The plan will be developed and implemented in close coordination with the CFWO and the property owners most likely to be affected by toll roads (MCBCP and Rancho Mission Viejo). The plan will also estimate costs and identify a funding source for post-fire habitat restoration activities.

4b) For the Pacific pocket mouse, the BRMP shall include at minimum that:

i. Except as provided in this paragraph, only 22.9- to 30.5 cm (9- or 12-in) Sherman live-traps, or traps of similar design and efficiency, shall be used to trap in potential or known pocket mouse habitat. Traps of similar design and efficiency shall be approved by the CFWO prior to their use. All trap models shall be modified to eliminate or substantially reduce the risk of injury (e.g., tail lacerations or excisions) to pocket mice and sympatric species. Trapping will be done at the appropriate time of year to facilitate capture.

ii. Traps must be checked at least twice per night, once near midnight and again at sunrise. Trapping may not be conducted if the nightly low temperature is forecast to be below 10°C (50°F) and/or if extended wind, rain, fog, or other inclement weather make (or have made) conditions unsuitable for trapping or unduly jeopardize the lives of pocket mice.

iii. No mutilation marking scheme (e.g., toe-clipping, ear-clipping) is allowed. No invasive technique (e.g., PIT-tagging) is allowed unless specifically authorized by the Service. Other marking schemes (e.g., hair clipping, ear-tagging) are permissible with prior approval by the CFWO.

iv. Plastic bags shall be used only for removing pocket mice from the traps (for extraction and processing). Trapped pocket mice shall be processed as quickly as possible to reduce stress to the animal. Pocket mice shall not be kept in plastic bags beyond 5 minutes. Trapped pocket mice that must be kept for longer periods shall be transferred into a clean, structurally sound, breathable container with adequate ventilation. At no time shall the pocket mouse be allowed to become stressed due to temperature extremes (either hot or cold).

v. Each time the traps are placed, set, and baited, the traps shall be adjusted and set by hand at a sensitivity level appropriate for capturing pocket mice. When closing traps, each trap shall be visually inspected and closed by hand.

vi. Measures to prevent inadvertently missing traps shall, at a minimum, include:

a. All trap locations shall be identified with a unique identification code.

b. While checking traps, a log sheet shall be used. Each time the trap is checked, the surveyor shall note the action on the log sheet. Periodically, the surveyor shall review the log sheet to ensure that no traps were inadvertently missed.

c. The log sheet shall be in addition to (or incorporated into) other field notes or data sheets that are used for noting trap contents. The log sheet and field notes/data sheets (collectively, the field documentation) shall be formatted to ensure the surveyor, trap (as identified by the unique identification code), and date/time checked are documented. Field documentation shall be available to Service personnel upon request (including during compliance inspections in the field).

d. In the field, all trap locations shall be marked with flagging, reflective tape, or other technique that allows the surveyor to readily locate the traps under day and nighttime conditions. To the maximum extent possible, the markings shall be visible at a distance of at least 5 m (16.3 ft).

viii. Capture activities will immediately cease and CFWO contacted if the take limit is reached.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, help implement recovery plans, or to develop information.

1. We recommend that FHWA, TCA, and Caltrans continue to explore the feasibility of alignment alternatives that are further west than the proposed project as we believe that such alignments will have less impact on federally listed species, primarily arroyo toad and gnatcatcher.

2. We recommend that FHWA, TCA, and Caltrans develop additional conservation measures to further offset impacts to federally listed species, particularly impacts to upland habitat for arroyo toad and increased fragmentation of high-quality gnatcatcher habitat. We recommend that these conservation measures take into account that much of habitat impacted by the proposed project is now conserved and/or managed for the benefit of federally listed species and other sensitive biological resources (*i.e.*, Donna O'Neill Conservancy, Rancho Mission Viejo conservation lands, and San Onofre State Beach). Potential conservation measures could include additional habitat acquisition or restoration in the vicinity of the proposed project.
3. We recommend that FHWA, TCA, and Caltrans work with the Service, Rancho Mission Viejo, Marine Corps Base Camp Pendleton, and California State Parks to implement

additional and appropriate diameter culverts and/or other wildlife crossings along the entire alignment to ensure continued movement of native predator species whose presence is important to maintaining healthy populations of federally listed species in the project area. We specifically recommend a bridge structure to span an ephemeral drainage on Camp Pendleton in the area west of Cristianitos Creek and east of the golf course/ball fields in San Clemente.

4. We recommend that FHWA and Caltrans consider alternatives to pier-supported bridges when crossing San Mateo Creek and other coastal lagoons for this project and any future plans to expand Interstate 5 to achieve less fill in the floodplain and benefit federally listed species associated with wetland habitats including the tidewater goby, arroyo toad, and least Bell's vireo.

5. To address comments by Marine Corps Base Camp Pendleton regarding effects of the toll road, we recommend the following:

    a. We recommend that FHWA and/or TCA provide funding to Caltrans to implement, in perpetuity, a Noxious Weed Management Plan. The plan should require review and concurrence by Camp Pendleton AC/S Environmental Security and the Service, and be implemented as normal roadside maintenance. Mowing weeds prior to seed-set and monitoring for new noxious weeds should be a minimum requirement in this plan. The Noxious Weed Management Plan and its implementation will also satisfy Executive Order 13112.

    b. We recommend that Camp Pendleton AC/S Environmental Security and the Service review and approve the Biological Resources Management Plan and any other plans (*e.g.*, SWPPP) pertaining to impacts on the Base and be provided any reports associated with these plans.

    c. We recommend that FHWA and/or TCA develop a restoration plan for the approximately 263 ha (650 ac) of habitat within the project footprint that will be impacted and replanted following completion of construction. We recommend the plan be submitted to Camp Pendleton AC/S Environmental Security and the Service for review and approval prior to construction. The plan should incorporate a sufficient fuel modification zone to minimize the potential for fires and appropriate native species beyond the fuel modification zone (including scrub, oak-woodland, wetland, riparian and native grass and forbs). The plan should address both short- and long-term soil stabilization of the cut and fill slopes to prevent adverse effects of erosion. The plan should have yearly success criteria including plant species diversity, plant cover, and percent allowable of weed species, using an appropriate reference site. The plan should be a separate document from the BRMP. Yearly reports should be provided to Camp Pendleton AC/S Environmental Security and the Service to document progress relative to the established success criteria.
    d. We recommend that FHWA, TCA, and/or Caltrans develop a post-fire restoration plan to restore habitat affected by fires originating from the toll road. The

restoration plan should include measures such as post-fire invasive weeding, habitat restoration, erosion control, and any species-specific measures determined to be appropriate. The post-fire restoration plan should be submitted to the Service and Camp Pendleton AC/S Environmental Security for review and approval. Any post-fire restoration activities should be coordinated with the Service and, for activities on the Base, with Camp Pendleton AC/S Environmental Security.

e. We recommend that the timing of thread-leaved brodiaea surveys be coordinated with Camp Pendleton AC/S Environmental Security Land Management Branch according to the *Brodiaea filifolia* survey protocol. This protocol can be obtained from Environmental Security. This survey protocol has been designed to ensure the validity of *Brodiaea filifolia* surveys in and around Camp Pendleton and involves the use of known reference populations as an indicator of when surveys should occur. We recommend coordination with Land Management Branch on monitoring for brodiaea including pre- and post-impact monitoring of affected populations as well as monitoring of translocated individuals. We recommend that all corms found within the impact area will be translocated except for a proportion to be held at a qualified nursery as a contingency measure in case of translocation failure.

f. We recommend that impacts to the HOLF mitigation site for arroyo toads be offset, as this site was restored to help offset impacts to arroyo toad associated with the HOLF. The Marine Corps requests that impacts to this site be offset outside the Base, whereas we support offsetting impacts on the Base to the extent practicable, then identifying offsite measures if no on-Base options are practical or appropriate.

g. That the offsetting of impacts to wetlands on Marine Corps' property be coordinated with Camp Pendleton AC/S Environmental Security and the Service.

h. That wherever appropriate, the periodic surveys conducted on Camp Pendleton be used to help fulfill monitoring requirements to minimize the likelihood of harm to species through multiple surveys during the same time period.

i. That all landscaping on the Camp Pendleton portion of the project be in accordance with the most recent version of the Camp Pendleton Base Exterior Architectural Plan (BEAP). In accordance with this plan, and Marine Corps Order P5090 2A, 11201.2A which calls for the use of native plants in landscaping, only native plants, and non-native plants found in the BEAP "acceptable plant" list (BEAP, Basewide Master Plant List, pages3-61 to 3-65), can be planted in landscaping or project revegetation efforts on base. The landscaping plan should use regionally native plants, minimize adverse effects on the natural habitat, implement water and energy efficient practices as outlined in the document "Office of the Federal Environmental Executive; Guidance for Presidential Memorandum on Environmentally and Economically Beneficial Landscape

Practices on Federal Landscaped Grounds". This directive can be found in the Federal Register, and online at: www.epa.gov/docs/fedrgstr/EPA-GENERAL/1995/August/Day-10/pr-664.html. Revegetation seed and/or adult plant stock are to originate from no more than two counties from Camp Pendleton. Any plans regarding landscaping and/or native plant palettes should be approved by Camp Pendleton AC/S Environmental Security's Land Management Branch.

j. That all of the larger construction equipment be weed free prior to entering the construction site, including the portion of the project on Camp Pendleton. Construction contractor should be responsible for treating outbreaks of noxious weeds caused by construction.

REINITIATION NOTICE

This concludes formal consultation on the proposed action. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is reached; (2) new information reveals effects of the agency action that may adversely affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is reached, any operations causing such take must cease pending reinitiation.

LITERATURE CITED

Introduction

Alberts, A. C., A. D. Richman, D. Tran, R. Sauvajot, C. McCalvin, and D. T. Bolger. 1993. Effects of habitat fragmentation on populations of native and exotic plants in southern California coastal scrub. *In* J. E. Keeley (ed.), Interface between ecology and land development in California, pp. 103-110. Southern California Academy of Science, Los Angeles, California.

Arkoosh, M., E. Casillas, E, Clemons, A. Kagley, R. Olson, P. Reno, and J. Stein. 1998. Effect of pollution on fish diseases: potential impacts on salmonid populations. Journal of Aquatic Animal Health 10:182-190.

Bailey, V. 1939. The solitary lives of two little pocket mice. Journal of Mammology 20:325-328.

Beier, P. and R. H. Barrett. 1993. The Cougar in the Santa Ana Mountain Range, California. Final Report: Orange County Cooperative Mountain Lion Study. Department of Forestry and Resource Management, University of California, Berkeley, California.

Beier, P. and R. F. Noss. 1999. Do habitat corridors provide connectivity? Conservation Biology 12:1241-1252.

Bolger, D. T., A. C. Alberts, and M. E. Soulé. 1991. Bird species occurrence patterns in habitat fragments: sampling, extinction and nested species subsets. American Naturalist 137:155-166.

Bolger, D. T., A. C. Alberts, R. M. Sauvajot, P. Potenza, C. McCalvin, D. Tran, S. Mazzoni, and M. E. Soulé. 1997a. Responses of rodents to habitat fragmentation in coastal southern California. Ecological Applications 7:552-563.

Brehme, C. 2003. Responses of small terrestrial vertebrates to roads in a coastal sage scrub ecosystem. Master's Thesis. San Diego State University, San Diego, California. 61pp.

Broom, S. W. and C. Craft. 2003. North Carolina Department of Transportation (NCDOT) Research Project 2001-12: Effects of shading from bridges on estuarine wetlands. Research Abstract NCDOT website http://www.ncdot.org/doh/preconstruct/tpb/research/2001-12.html.

Bryan, S., A. Robinson, and M. Sweetser. 2004. Behavioral responses of a small native fish to multiple introduced predators. Environmental Biology of Fishes 63:49-56.

Buchanan, B. W. 1993. Effects of enhanced lighting on the behaviour of nocturnal frogs. Animal Behaviour 45:893-899.

Crooks, D. R. and M. E. Soule. 1999. Mesopredator release and avifaunal extinctions in a fragmented system. Nature 400:563-566.

Dodd, S., P. Brylski, D. Laabs, S. Montogomery, and W. Spencer. 1998. Final report 1997 Pacific Pocket Mouse *(Perognathus longimembris pacificus)* surveys on the Dana Point Headlands, Orange County, California. Unpublished report prepared for the U. S. Fish and Wildlife Service, California Department of Fish and Game, and The Nature Reserve of Orange County. On file, U. S. Fish and Wildlife Service, Carlsbad, California.

DeBusk, W. F. 1999. Wastewater treatment wetlands: contaminant removal processes. SL 155 Fact Sheet of the Soil and Water Science Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.

Ewens, W. J., P. J. Brockwell, J. M. Gani, and S. I. Resnick. 1987. Minimum viable population size in the presence of catastrophes. *In* M. E. Soulé (ed.), Viable Populations for Conservation, pp. 59-68. Cambridge University Press, Cambridge, United Kingdom.

Fahrig, L., J. H. Pedlar, S. E. Pope, P. D. Taylor, and J. F. Wegner. 1995. Effect of road traffic on amphibian density. Biological Conservation 73:177-182.

Farmer, A. M. 1993. The effects of dust on vegetation-a review. Environmental Pollution 79:63-75.

Foothill/Eastern Transportation Corridor Agencies. 2005. Subsequent Environmental Impact Report for the South Orange County Transportation Infrastructure Improvement Project. November 2005.

Forman, R. and M. Godron. 1986. Landscape ecology. John Wiley & Sons, Inc., New York, New York.

Forman, R., and L. Alexander. 1998. Roads and their major ecological effects. Annual Review of Ecology and Systematics 29:207-231.

Forman, R. T. T. and R. D. Deblinger. 1998. The ecological road-effect zone for transportation planning and Massachusetts highway example. *In* G. L. Erink, P. Garrett, D. Ziegler, and J. Berry (eds.), Proceedings of the International Conference on Wildlife Ecology and Transportation, pp. 78-84. Publication FL-ER-69-98. Tallahassee, Florida - Department of Transportation.

Forman, R. T. T. and R. D. Deblinger. 2000. The ecological road-effect zone for transportation planning and Massachusetts (USA) suburban highway. Conservation Biology 14(1):36-46.

Forman, R. T. T., D. S. Friedman, D. Fitzhenry, J. D. Martin, A. S. Chen, and L. E. Alexander. 1997. Ecological effects of roads: toward three summary indices and an overview for

North America. *In* Canters, K., (ed.) Habitat Fragmentation and Infrastructure. pp. 40-54. Ministry of transport, Public Works and Water Management, Delft, Netherlands.

Forman, R. T., D. Sperling, J. A. Bissonette, A. P. Clevenger, C. D. Cutshall, V. H. Dale, L. Fahrig, R. France, C. R. Goldman, K. Heanue, J. A. Jones, F. J. Swanson, T. Turrnetine, and T. C. Winter. 2003. Road Ecology: Science and Solutions. Island Press, Washington, D.C.

Gilpin, M. E. 1987. Spatial structure and population vulnerability. Pp 125-140. *In* M. Soulé, (ed.) Viable Populations for Conservation. Cambridge (UK): Cambridge University Press.

Haas, C. and K. Crooks. 1999. Carnivore Abundance and Distribution throughout the Puente/Chino Hills. Final report prepared for the Mountains Recreation and Conservation Authority and the State of California, Department of Transportation. 60 pp. + figures and appendices.

Hayes, T. B., A. Collins, M. Lee, M. Mendoza, N. Noriega, A. A. Stuart, and A. Vonk. 2002. Hermaphroditic, demasculinized frogs after exposure to the herbicide atrazine at low ecologically relevant doses. PNAS 99(8):5476-5480.

Interstate Technology & Regulatory Council Wetlands Team. 2003. Technical and Regulatory Guidance Document for Constructed Wetlands. December 2003. 199 pp.

Jackson, S. D. 1996. Underpasses for amphibians. *In* G.L. Evink, P. Garrett, D. Ziegler, and J. Berry (eds.), Trends in Addressing Transportation Related Wildlife Mortality, pp. 240-244. Publication FL-ER-58-96. Tallahassee, Florida Department of Transportation.

Keeley, J.E. and C.J. Fotheringham. 2001. Historic fire regime in southern California shrublands. Conservation Biology 15:1536-1548.

Keeley, J.E., M. Keeley, C.J. Fotheringham. 2005. Alien plant dynamics following fire in Mediterranean-climate California shrublands. Ecological Applications 15:2109-2125.

Lande, R. 1988. Genetics and demography in biological conservation. Science 241:1455-1460.

Lande, R. and G. F. Barrowclough. 1987. Effective population size, genetic variation, and their use in population management, pp 87-124. *In* M. E. Soulé (ed.), Viable populations for Conservation, pp. 69-86. Cambridge University Press, Cambridge, United Kingdom.

Longcore, T. and C. Rich. 2004. A review of the ecological effects of road reconfiguration and expansion on coastal wetland ecosystems. The Urban Wildlands Group Inc., P.O. Box 24010, Los Angeles, California 90024. 12pp.

MacMillen, R. E. 1964. Population ecology, water relations and social behavior of a southern California semidesert rodent fauna. University of California Public Zoology. 71:1-66

Maehr, D. S., E. D. Land, and M. E. Roelke. 1991. Mortality patterns of panthers in Southwest Florida. Proceedings of the Annual Conference of Southeastern Association Fish and Wildlife Agencies 45:201-207.

Marchetti, M. P. and P. B. Moyle. 2001. Effects of flow regime on fish assemblages in a regulated California stream. Ecological Applications 11:530-539.

Matthiae, P. E. and F. Stearns. 1981. Mammals in forest islands in southeastern Wisconsin. *In* R. L. Burgesss and D. M. Sharpe (eds.), Forest Island Dynamics in Man Dominated Landscapes, pp. 55-66. Springer-Verlag, New York, New York.

Quinn, J. M., A. B. Cooper, M. J. Stroud, G. P. Burrell. 1997. Shade effects on stream periphyton and invertebrates: an experiment in streamside channels. New Zealand Journal of Marine and Freshwater Research 31:665-683.

Reijnen, R., R. Foppen, and G. Veenbaas. 1997. Disturbance by traffic of breeding birds: evaluation of the effect and considerations in planning and management corridors. Biodiversity and Conservation 6:567-581.

Saunders, D. A, R. J. Hobbs, and C. R. Margules, 1991. Biological consequences of ecosystem fragmentation: A review. Conservation Biology 5(1):18-32.

Shaffer, M. L. 1987. Minimum viable populations: coping with uncertainty. *In* M. E. Soulé (ed.), Viable populations for Conservation, pp. 69-86. Cambridge University Press, Cambridge, United Kingdom.

Soulé, M. E. 1986. Conservation Biology: The Science of Scarcity and Diversity. Sinauer Associates, Sunderland, Massachusetts.

Soulé, M. E. and D. Simberloff. 1986. What do genetics and ecology tell us about the design of nature reserves? Biological Conservation 35:19-40.

Soulé, M. E., D. T. Bolger, A. C. Roberts, R. Sauvajot, J. Wright, M. Sorice, and S. Hill. 1988. Reconstructed dynamics of rapid extinctions of chaparral-requiring birds in urban habitat islands. Conservation Biology 2:75-92.

Sovoda, M. A., A. B. Sargeant, and J. W. Grier. 1995. Differential effects of coyotes and red foxes on duck nest success. Journal of Wildlife Management 59:1-9.

Spellerberg, I. F. 1998. Ecological effects of roads and traffic: a literature review. Global Ecology and Biogeography Letters, 7(5):317-333.

Terborgh, J. 1988. The big things that run the world—a sequel to E. O. Wilson. Conservation Biology 2:402-403.

Trombulak, S. C., and C. A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14:18-30.

U. S. Department of Transportation and State of California Department of Transportation. 2005. Biological Assessment for SOCTIIP, South Orange County and North San Diego County Watersheds of San Mateo and San Juan Creeks, extension of the State Route 241. February 28, 2005.

Vos, C. C. and J. P. Chardon. 1998. Effects of habitat fragmentation and road density on the distribution pattern of the moor frog *Rana arvalis*. Journal of Applied Ecology 35:44-56.

Whitcomb, R., C. S. Robbins, J. Lynch, B. Whitcomb, M. Klimkiewicz, and D. Bystrak. 1981. Effects of forest fragmentation on avifauna of the eastern deciduous forest. *In* R. Burgess and D. Sharpe (eds.), Forest island dynamics in man-dominated landscapes. Springer-Verlag, New York, New York.

Wilcove, D. S., C. H. McLellan, and A. P. Dobson. 1986. Habitat fragmentation in the temperate zone. *In* M. E. Soulé (ed.), Conservation Biology: The Science of Scarcity and Diversity, pp. 237-256. Sinauer Associates, Sunderland, Massachusetts.

Willis, E. O. and E. Eisenmann. 1979. A revised list of birds in Barrow Colorado Island, Panama. Smithsonian Contributions in Zoology 291:1-31.

Thread-leaved Brodiaea

California Native Plant Society (CNPS). 2001. Inventory of Rare and Endangered Plants of California (sixth ed.). Rare Plant Scientific Advisory Committee, David P. Tibor, Convening Editor. California Native Plant Society. Sacramento, California. 388 pp.

California Department of Fish and Game (CDFG). 1995. Recovery workshop summary, thread-leaved brodiaea (*Brodiaea filifolia*). Unpublished report prepared by Sandra C. Morey.

California Natural Diversity Database (CNDDB). 2003. *Brodiaea filifolia*. Unpublished Report, Natural Heritage Division, California Department of Fish and Game, Sacramento, California.

County of Orange. 2006. Southern Subregion Orange County Draft Natural Communities Conservation Plan/Master Streambed Alteration Agreement/Habitat Conservation Plan. Plan prepared by Dudek and Associates, Inc. for the County of Orange. July 2006.

Dudek and Associates (Dudek). 1993. Biological resources report for Sierra One, Camp Pendleton, San Diego County, California. Unpublished Document.

Keator, G. 1996. *Brodiaea. In*: The Jepson Manual: Higher Plants of California. Hickman, J.C., ed., Third printing with corrections, 1996. University of California Press, Berkeley. 1400 pp.

Munz, P. 1974. A Flora of Southern California. University of California Press, Berkeley, California.

Natural Resource Consultants. 2001. Thread-leaved brodiaea restoration project at Forster Ranch, City of San Clemente, County of Orange, California, Part III: Update for October 1999-May 2000. Draft unpublished report for J. Laing Homes, San Clemente, California.

Niehaus, T. 1971. A biosystematic study of the genus *Brodiaea* (Amaryllidaceae). University of California Press, Los Angeles, California.

Regional Environmental Consultants (RECON). 1999. Final biological survey report for rare plants at Marine Corps Base, Camp Pendleton, California. Unpublished report prepared for the Assistant Chief of Staff, Environmental Security, Marine Corps Base Camp Pendleton. RECON Number 2840F/G, September 24, 1999. 62 pp. + attachments.

Smith, N. 1997. Growing natives: Brodiaeas–Part 1. Fremontia 25:28-30.

Southwest Division Naval Facilities Engineering Command (SWDIV). 2001a. P-634 final biological assessment for the Armor/Anti-Armor Tracking Range, Marine Corps Base, Camp Pendleton, California. San Diego, California. On file (FWS-MCBCP-1789), U. S. Fish and Wildlife Service Carlsbad Fish and Wildlife Office, Carlsbad, California.

Southwest Division Naval Facilities Engineering Command (SWDIV). 2001b. Revised Figure 3-4, thread-leaved brodiaea populations within the proposed action area for P-634 final biological assessment for the Armor/Anti-Armor Tracking Range, Marine Corps Base, Camp Pendleton, California. San Diego, California. On file (FWS-MCBCP-1789), U. S. Fish and Wildlife Service Carlsbad Fish and Wildlife Office, Carlsbad, California.

U. S. Fish and Wildlife Service (Service). 1998. Determination of endangered or threatened status for four southwestern California plants from vernal wetlands and clay soils. Federal Register 63:54975-54994.

U. S. Fish and Wildlife Service (Service). 2004. Endangered and threatened wildlife and plants: Proposed designation of critical habitat for *Brodiaea filifolia* (thread-leaved brodiaea); Proposed rule. Federal Register 69:71284-71319.

U. S. Fish and Wildlife Service (Service). 2005. Endangered and threatened wildlife and plants: Designation of critical habitat for *Brodiaea filifolia* (thread-leaved brodiaea). Federal Register 70:73820-73863.

U. S. Marine Corps (Marine Corps). 1998. Camp Pendleton Wildland Fire Management Plan Update. Marine Corps Base Camp Pendleton, California. Prepared for AC/S

Environmental Security, Camp Pendleton. Contract No. N68711-95-D-7605/0020 with Southwest Division Naval Facilities Engineering Command. Prepared by Tierra Data Systems. October 1998.

U. S. Marine Corps (Marine Corps). 2001. Integrated Natural Resources Management Plan for Marine Corps Base and Marine Corps Air Station Camp Pendleton. October 2001.

Tidewater Goby

Arkoosh, M., E. Casillas, E, Clemons, A. Kagley, R. Olson, P. Reno, and J. Stein. 1998. Effect of pollution on fish diseases: potential impacts on salmonid populations. Journal of Aquatic Animal Health 10:182-190.

Bryan, S., A. Robinson, and M. Sweetser. 2004. Behavioral responses of a small native fish to multiple introduced predators. Environmental Biology of Fishes 63:49-56.

Dawson, M., K. Louie, M. Barlow, D. Jacobs, and C. Swift. 2002. Comparative phylogeography of sympatric sister species, *Clevelandia ios* and *Eucyclogobius newberryi* (Teleostei, Gobiidae), across the California Transition Zone. Molecular Ecology 11:1065-1075.

Glenn Lukos Associates. 2001. Revised shading study associated with two proposed bridges, spanning existing wetlands on the Marblehead Coastal Site, San Clemente, California. Letter report prepared for RBF Consulting, Irvine, California. December 4, 2001. 6 pp.

Holland, D., C. Swift, N. Sisk. 2001. Status, distribution and habitat use of the tidewater goby, *Eucyclogobius newberryi* (Teleostei:Gobiidae), on Marine Corps Base Camp Pendleton, California 1998-2001. Prepared for AC/S Environmental Security, Resource Management Division, Marine Corps Base Camp Pendleton. Contract #M00681-00-P-1347.

Irwin, J. and D. Soltz. 1984. The natural history of the tidewater goby, *Eucyclogobius newberryi*, in the San Antonio and Schuman Creek system, Santa Barbara County, California. U. S. Fish and Wildlife Service, Sacramento Endangered Species Office Contract No. 11310-0215-2.

Lafferty, K., C. Swift, and R. Ambrose. 1999. Postflood persistence and recolonization of endangered tidewater goby populations. Journal of Fisheries Management 19:618-622.

Merkel & Associates, Inc. 2005. Monitoring of the reintroduced tidewater goby (*Eucyclogobius newberryi*) population at San Mateo Lagoon, Year Five – 2004, Final Monitoring Report. Prepared for North County Transit District and U. S. Fish and Wildlife Service. June 14, 2005. 21pp.

Nyberg, P., E. Degerman, and B. Sers. 1996. Survival after catch in trap-nets, movements and growth of the pikeperch (*Stizostedion lucioperca*) in Lake Hjälmaren, Central Sweden. Ann. Zool. Fennici 33:569-575.

Psomas. 2003. Final South Orange County Transportation Infrastructure Improvement Project Hydrology Technical Report. Prepared for Foothill/Eastern Transportation Corridor Agency. December 2003.

Swenson, R. 1995. The reproductive behavior and ecology of the tidewater goby *Eucyclogobius newberryi* (Pisces: Gobiidae). Ph.D. Dissertation, University of California at Berkeley.

Swift, C. 2002. Survey for tidewater gobies in the lower Santa Margarita River, Marine Corps Base Camp Pendleton, California. Submitted to The Environmental Company, Inc. June 5, 2002.

Swift, C. and D. Holland. 1998. The status and distribution of the tidewater goby, *Eucyclogobious newberryi* (Pisces: Gobiidae), on Marine Corps Base Camp Pendleton, California. Prepared for AC/S Environmental Security, Resource Management Division, Marine Corps Base Camp Pendleton, Contract #MOO68196T5642. December 11, 1998. 104 pp.

Swift, C., J. Nelson, C. Maslow, and T. Stein. 1989. Biology and distribution of the tidewater goby, *Eucyclogobius newberryi* (Pisces: Gobiidae) of California. Natural History Museum of Los Angeles County, No. 404.

U. S. Fish and Wildlife Service (Service). 1994. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the Tidewater Goby; Final Rule. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 59 Federal Register 5494-5498.

U. S. Fish and Wildlife Service (Service). 1999a. Endangered and Threatened Wildlife and Plants; Proposed Rule to Remove the Northern Populations of the Tidewater Goby from the List of Endangered and Threatened Species. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 64 Federal Register 33816-33825.

U. S. Fish and Wildlife Service (Service). 1999b. Endangered and Threatened Wildlife and Plants; Proposed Designation of Critical Habitat for the Tidewater Goby. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 64 Federal Register 42250-42263.

U. S. Fish and Wildlife Service (Service). 2000. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Tidewater Goby. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 65 Federal Register 69693-69717.

U. S. Fish and Wildlife Service (Service). 2002. Endangered and Threatened Wildlife and Plants; Withdrawal of Proposed Rule To Remove the Northern Populations of the

Tidewater Goby From the List of Endangered and Threatened Wildlife. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 67 Federal Register 67803-67818.

U. S. Fish and Wildlife Service (Service). 2004. Draft Recovery Plan for the Tidewater Goby. (*Eucyclogobius newberryi*). U. S. Fish and Wildlife Service, Portland, Oregon. vi+163pp.

U. S. Fish and Wildlife Service (Service). 2005. Recovery Plan for the Tidewater Goby. (*Eucyclogobius newberryi*). U. S. Fish and Wildlife Service, Portland, Oregon. vi+199pp.

U. S. Geological Survey. 2004. Camp Pendleton Tidewater Goby Monitoring Project Report, 2004. Prepared for USMC Camp Pendleton. 17pp.

U. S. Marine Corps. 2001. Integrated Natural Resources Management Plan. Marine Corps Base Camp Pendleton. October 2001.

U. S. Marine Corps. 2006. DRAFT Integrated Natural Resources Management Plan. Marine Corps Base Camp Pendleton. September 2006.

Wang, J. 1982. Early life history and protection of the tidewater goby, *Eucyclogobius newberryi* (Girard), in the Rodeo Lagoon of the Golden Gate National Recreation Area. Cooperative National Park Research Study Unit, Technical Report 7, Institute of Ecology, University of California, Davis, CPSU/UCD 022/3.

Arroyo Toad

Barto, W. 1999. Predicting potential habitat for the arroyo toad (*Bufo microscaphus californicus*) in San Diego County using a habitat suitability model and digital terrain data. Masters Thesis for San Diego State University, San Diego. 135 pp.

Bloom, P. 2001. Arroyo toad survey report for Endangered Species Permit #TE-787376, 45-day report provided to U. S. Fish and Wildlife Service. September 10, 2001.

Brehme, C. S., S. L. Schuster, C. J. Rochester, S. A. Hathaway, and R. N. Fisher. 2006. MCBCP arroyo toad monitoring program: 3-year trend analyses for 2003-2005. U. S. Geological Survey Data Summary prepared for Marine Corps Base Camp Pendleton. 98 pp.

Cadre Environmental. 2003. Arroyo toad (*Bufo microscaphus*) radio telemetry study, San Juan Creek, Orange County, California. Prepared for Rancho Mission Viejo, LLC. October 2003. 64 pp.

DeBusk, W. F. 1999. Wastewater treatment wetlands: Applications and treatment efficiency. Fact sheet of the Soil and Water Science Department, Florida Cooperative Extension

Service, Institute of Food and Agricultural Sciences, University of Florida. 7 pp. Available at http://edis.ifas.ufl.edu/pdffiles/SS/SS29400.pdf.

Dodd, Jr., C., W. Barichivich, and L. Smith. 2004. Effectiveness of a barrier wall and culverts in reducing wildlife mortality on a heavily traveled highway in Florida. Biological Conservation 118:619-631.

Gergus, E. 1998. Systematics of the *Bufo microscaphus* complex: allozyme evidence. Herpetologica 54 (3):317-325.

Gray, M. 2005. M. Gray letter to Jim Bartel, Carlsbad Fish and Wildlife Office, California. Copy of correspondence on file at the Carlsbad Fish and Wildlife Office.

Griffin, P. C. 1999. *Bufo californicus*, arroyo toad movement patterns and habitat preferences. Masters Thesis for University of California, San Diego. 116 pp.

Griffin, P., T. Case and R. Fisher. 1999. Radio telemetry study of *Bufo californicus*, arroyo toad movement patterns and habitat preferences. Contract Report to California Department of Transportation Southern Biology Pool. 66 pp.

Holland, D. 1995. Sensitive species hydroecological evaluation – Margarita River. Unpublished report.

Holland, D. and R. Goodman. 1998a. A guide to the amphibians and reptiles of Marine Corps Base Camp Pendleton, San Diego County, California. Prepared for AC/S Environmental Security, Resource Management Division, Marine Corps Base Camp Pendleton. Contract #M00681-94-C-0039.

Holland, D. and R. Goodman. 1998b. Sensitive species of amphibians and reptiles on Marine Corps Base Camp Pendleton, San Diego County, California, with management recommendations. Prepared for AC/S Environmental Security, Resource Management Division, Marine Corps Base Camp Pendleton. Contract #M00681-94-C-0039. 48 pp.

Holland, D. and N. Sisk. 2000. Habitat use and population demographics for the arroyo toad (*Bufo californicus*) on Marine Corps Base Camp Pendleton, San Diego County, California: Final Report for 1998-1999. Prepared for AC/S Environmental Security, Resource Management Division, Marine Corps Base Camp Pendleton. Contract # M00681-97-C-0034. 29 pp. + append.

Holland, D. and N. Sisk. 2001. Habitat use and population demographics for the arroyo toad (*Bufo californicus*) on MCB Camp Pendleton, San Diego County, California 1998-2000. Prepared for AC/S Environmental Security, Resource Management Division, Marine Corps Base Camp Pendleton. Contract # M00681-97-C-0034. 32 pp. + append.

Holland, D., N. Sisk, and R. Goodman. 2001. Linear transect censusing of the arroyo toad (*Bufo californicus*) from 1996-2000 on MCB Camp Pendleton, San Diego County, California.

Prepared for AC/S Environmental Security, Resource Management Division, Marine Corps Base Camp Pendleton. Contract # M00681-98-C-3181. 29 pp. + append.

Interstate Technology & Regulatory Council. 2003. Technical and Regulatory Guidance Document for Constructed Treatment Wetlands. The Interstate Technology & Regulatory Council Wetlands Team. 128 pp. + append. Available at http://www.itrcweb.org/gd_CW.asp.

Jackson, S. and C. Griffin. 2000. A Strategy for Mitigating Highway Impacts on Wildlife. Pp. 143-159 *In*: Messmer, T. A. and B. West (eds.), Wildlife and Highways: Seeking Solutions to an Ecological and Socio-economic Dilemma. The Wildlife Society.

Jennings, M. and M. Hayes. 1994. Amphibian and reptile species of special concern in California. Final Report Submitted to the California Department of Fish and Game Inland Fisheries Division, Rancho Cordova, California.

LSA Associates. 2004. Arroyo toad survey report of findings – San Juan Creek Bridge at Ortega Highway, Orange County, California. Report provided to U. S. Fish and Wildlife Service. June 29, 2004.

National Biological Service. 1996. The arroyo toad (*Bufo microscaphus californicus*): ecology, threats, and research needs. Technical Report NBS/CSC-96-01. Prepared by the California Science Center of the National Biological Service for the U. S. Fish and Wildlife Service, Ventura Field Office. February, 1996.

Patten, M. and S. Myers. 1992. Geographic distribution. *Bufo microscaphus californicus*. Herpetological Review 23(4):124.

Stebbins, R. 1985. A field guide to western reptiles and amphibians. Second edition, revised. Houghton-Mifflin Company, Boston, Massachusetts. Xiv + 336 pp.

Sweet, S. 1989. Observations on the biology and status of the arroyo toad, *Bufo microscaphus californicus*, with a proposal for additional research. Department of Biological Sciences, University of California, Santa Barbara, California.

Sweet, S. 1992. Initial report on the ecology and status of the arroyo toad (*Bufo microscaphus californicus*) on the Los Padres National Forest of Southern California, with management recommendations. Contract report to USDA, Forest Service, Los Padres National Forest, Goleta, California. 198 pp.

Sweet, S. 1993. Second report on the biology and status of the arroyo toad (*Bufo microscaphus californicus*) on the Los Padres National Forest of southern California. Report to U S Department of Agriculture, Forest Service, Los Padres National Forest, Goleta, California. ii + 73 pp.

U. S. Fish and Wildlife Service. 1994. Endangered and threatened wildlife and plants; Determination of endangered status for the Arroyo Southwestern Toad. Federal Register 59:64859-64866.

U. S. Fish and Wildlife Service. 1999. Arroyo southwestern toad (*Bufo microscaphus californicus*) recovery plan. U. S. Fish and Wildlife Service, Portland, Oregon. vi + 119 pp.

U. S. Fish and Wildlife Service. 2001. Endangered and threatened wildlife and plants; Designation of critical habitat for the arroyo toad. Federal Register 66:9414-9474.

U. S. Fish and Wildlife Service. 2004. Endangered and threatened wildlife and plants; Proposed designation of critical habitat for the arroyo toad (*Bufo californicus*). Federal Register 69:23294-23328.

U. S. Fish and Wildlife Service. 2005. Endangered and threatened wildlife and plants; Designation of critical habitat for the arroyo toad (*Bufo californicus*). Federal Register 70:19562-19633.

U. S. Forest Service. 2005. Land Management Plan: Angeles National Forest, Cleveland National Forest, Los Padres National Forest, and San Bernardino National Forest (RS-MB-075). Plan for the U. S. Department of Agriculture, U. S. Forest Service, Pacific Southwest Region.

Coastal California Gnatcatcher

American Ornithologists' Union (AOU). 1957. Checklist of North American Birds, Fifth Edition. American Ornithologists' Union. Port City Press, Baltimore, Maryland. 691 pp.

American Ornithologists' Union (AOU). 1983. Checklist of North American Birds, Sixth Edition. American Ornithologists' Union. Allen Press, Lawrence, Kansas. 877 pp.

American Ornithologists' Union (AOU). 1989. Thirty-seventh Supplement to the American Ornithologists' Union Checklist of North American Birds. Auk 106 (3):532-538.

Atwood, J. 1980. The United States distribution of the California black-tailed gnatcatcher. Western Birds 11:65-78.

Atwood, J. 1988. Speciation and geographic variation in black-tailed gnatcatchers. *In*: D. Johnston, (ed.). Ornithological Monographs, No. 42. 74 pp.

Atwood, J. 1990. Status review of the California gnatcatcher (*Polioptila californica*). Unpublished Technical Report, Manomet Bird Observatory, Manomet, Massachusetts. 79 pp.

Atwood, J. 1991. Subspecies limits and geographic patterns of morphological variation in California gnatcatchers (*Polioptila californica*). Bulletin of the Southern California Academy of Sciences 90:118-133.

Atwood, J. and D. Bontrager. 2001. California Gnatcatcher (*Polioptila calicornica*). *In*: A. Poole and F. Gill, editors. The Birds of North America, No. 574. The Birds of North America, Inc., Philadelphia, Pennsylvania. 32 pp.

Atwood, J., C. Reynolds, and S. Grove. 1999. Distribution of California gnatcatchers on Camp Pendleton Marine Corps Base. Unpublished report, prepared for U. S. Marine Corps, Oceanside, California (Contract No. M00681-97-C-0035); Manomet Center for Conservation Sciences, Massachusetts. June 30, 1999. 29 pp.

Atwood, J., C. Reynolds, and M. Fugagli. 2000. Summary of California gnatcatcher banding and nest monitoring activities on Camp Pendleton Marine Corps Base, 1999. Unpublished report, prepared for U. S. Marine Corps, Oceanside, California (Contract No. N68711-98-LT-80045); Antioch New England Institute, New Hampshire. July 21, 2000. 31 pp.

Atwood, J., S. Tsai, C. Reynolds, and M. Fugagli. 1998a. Distribution and population size of California gnatcatchers on the Palos Verde Peninsula, 1993-1997. Western Birds 29:340-350.

Atwood, J., S. Tsai, C. Reynolds, J. Luttrell, and M. Fugagli. 1998b. Factors affecting estimates of California gnatcatcher territory size. Western Birds 29:269-279.

Axelrod, D. 1978. The Origin of Coastal Sage Vegetation, Alta and Baja California. American Journal of Botany 65 (10):1117-1131.

Bailey, E. and P. Mock. 1998. Dispersal capability of the California gnatcatcher: A landscape analysis of distribution data. Western Birds 29:351-360.

Barbour, M. and J. Major. 1977. Terrestrial vegetation of California. John Wiley and Sons, New York.

Baumgartner, J. 1989. Rancho Santa Margarita remembered. An oral history. Fithian Press, Santa Barbara, California.

Beyers, J. and W. Wirtz. 1997. Vegetative characteristics of coastal sage scrub sites used by California gnatcatchers: implications for management in a fire-prone ecosystem. Proceedings: Fire Effects on Rare and Endangered Species and Habitats Conference, Nov. 13-16, 1995. Coeur d'Alene, Idaho. Pp. 81-89.

Bontrager, D. R. 1991. Habitat requirements, home range and breeding biology of the California gnatcatcher (*Poliptila californica*) in South Orange County, California.

Prepared for Santa Margarita Company, Rancho Santa Margarita, California. April 1991. 19pp.

Bontrager, D.R., R.A. Erickson, and R.A. Hamilton. 1995. Impacts of the October 1993 Laguna fire on California gnatcatchers and cactus wrens. *In*: J.E. Keeley and T. Scott (eds.), Brushfires in California Wildlands: Ecology and Resource Management. Pp. 69-76. International Association Wildland Fire, Fairfield, Washington.

Braden, G., R. McKernan, and S. Powell. 1997a. Association of within-territory vegetation characteristics and fitness components of California gnatcatchers. The Auk 114:601-609.

Braden, G., R. McKernan, and S. Powell. 1997b. Effects of nest parasitism by the brown-headed cowbird on nesting success of the California gnatcatcher. The Condor 99:858-865.

Callaway, R. and F. Davis. 1993. Vegetation dynamics, fire, and the physical environment in coastal central California. Ecology 74:1567-1578.

Campbell, K., R. Erickson, W. Haas, and M. Patten. 1998. California gnatcatcher use of habitats other than coastal sage scrub: conservation and management implications. Western Birds 29:421-433.

Center for Natural Lands Management. 2006. Annual Report for the Fiscal Year 2005 (October 2004-September 2005) on the Coyote Hills East Preserve. Prepared for the U. S. Fish and Wildlife Service and California Department of Fish and Game. April 2006.

County of Orange. 2006. Southern Subregion Orange County Draft Natural Communities Conservation Plan/Master Streambed Alteration Agreement/Habitat Conservation Plan. Plan prepared by Dudek and Associates, Inc. for the County of Orange. July 2006.

Dudek and Associates, Inc. (Dudek). 2000. Description of Existing Reserves Western Riverside County Multiple Species Habitat Conservation Plan. April 2000.

Erickson, R. and K. Miner. 1998. Six years of synchronous California gnatcatcher population fluctuations at two locations in coastal Orange County, California. Western Birds 29:333-339.

Galvin, J. 1998. Breeding and dispersal biology of the California gnatcatcher in central Orange County. Western Birds 29:323-332.

Griffith Wildlife Biology (GWB). 1997. Survey and breeding study of the California gnatcatcher and coastal cactus wren at Marine Corps Base Camp Pendleton in 1993 and 1994. Unpublished report prepared for U. S. Marine Corps Camp Pendleton, California (Contract No. M00681-92-C-0079). September 25, 1997. 82 pp.

Griffith Wildlife Biology (GWB). 2001. The status of the least Bell's vireo at Marine Corps Base Camp Pendleton in 2001. Unpublished draft report prepared for AC/S ES, Marine Corps Base Camp Pendleton (Contract No. M00681-99-C-0003). December 15, 2001. 21 pp.

Griffith Wildlife Biology (GWB). 2004. The status of the California gnatcatcher at Marine Corps Base Camp Pendleton in 2003. Unpublished report prepared for U. S. Marine Corps Base, Camp Pendleton, AC/S Environmental Security. Contract No. M00681-02-C-0024. June 8, 2004.

Grishaver, M., P. Mock, and K. Preston. 1998. Breeding behavior of the California gnatcatcher in southwestern San Diego County, California. Western Birds 29:299-322.

Harmsworth Associates. 2000. California gnatcatcher and coastal cactus wren monitoring report for the San Joaquin Hills burn area. Unpublished report prepared for the Nature Reserve of Orange County. December 2000. 38 pp.

Harmsworth Associates. 2002. California gnatcatcher and coastal cactus wren monitoring report for the San Joaquin Hills burn area. Unpublished report prepared for the Nature Reserve of Orange County. January 2002. 40 pp.

Holland, V. and D. Keil. 1995. California Vegetation. Kendall/Hunt Publishing Company, Dubuque, IA. 516 pp.

Keeley, J.E. and C.J. Fotheringham. 2001. Historic fire regime in southern California shrublands. Conservation Biology 15:1536-1548.

Kirkpatrick, J. and C. Hutchinson. 1977. The community composition of Californian coastal sage scrub. Vegetatio 35(1):21-33.

Klopatek, J., R. Olson, C. Emerson, and J. Jones. 1979. Land Use Conflicts with Natural Vegetation in the United States. Environmental Conservation: 6:191-199.

Kus, B. 2001. Distribution, abundance and breeding activities of the southwestern willow flycatcher at Marine Corps Base Camp Pendleton, in 2000. Unpublished final report prepared for AC/S, ES, Marine Corps Base Camp Pendleton (MIPR No. M3320000MP0030). June 2001. 34 pp.

Kus, B. and P. Beck. 2001. Monitoring Avian Productivity and Survivorship (MAPS), sixth annual report. Unpublished report, prepared for U. S. Marine Corps Camp Pendleton, California. 37 pp.

Lewis, H. 1973. Patterns of Indian burning in California: ecology and ethnohistory. Ballena Press Anthropological Papers No. 1.

Malanson, G. and W. Westman. 1985. Postfire succession in Californian coastal sage scrub: the role of continual basal sprouting. The American Midland Naturalist 113:309-318.

Mensing, S., J. Michaelsen, and R. Byrne. 1999. A 560-year record of Santa Ana fires reconstructed from charcoal deposited in the Santa Barbara Basin, California. Quaternary Research 51:295-305.

Miner, K., A. Wolf, and R. Hirsch. 1998. Use of restored coastal sage scrub habitat by California gnatcatchers in a park setting. Western Birds 29:439-446.

Minnich, R. 1983. Fire mosaics in southern California and northern Baja California. Science 219:1287-1294.

Natural Resource Consultants. 2001. Results of monitoring surveys for coastal California gnatcatchers on Coyote Hills East Site, located in the City of Fullerton, Orange County, California. Report Dated June 27, 2001.

Nott, M., D. DeSante, R. Siegel, and P. Pyle. 2002. Influences of the El Niño/Southern Oscillation and the North Atlantic Oscillation on avian productivity in forests of the Pacific Northwest of North America. Global Ecology and Biogeography 11:333-342.

O'Connell, M. and R. Erickson. 1998. An example of the California gnatcatcher nesting in restored coastal sage scrub. Western Birds 29:434-438.

O'Leary, J. 1990. Californian coastal sage scrub: general characteristics and considerations for biological conservation. *In*: A. Schoenherr, (ed.), Endangered Plant Communities of Southern California. Pp. 24-41. Southern California Botanists Special Publication Number 3.

Patten, M. and J. Rotenberry. 1999. The proximate effects of rainfall on clutch size of the California gnatcatcher. The Condor 101:876-880.

Preston, K., P. Mock, M. Grishaver, E. Bailey, and D. King. 1998. California gnatcatcher territorial behavior. Western Birds 29:242-257.

Stephenson, J. and G. Calcarone. 1999. Southern California mountains and foothills assessment: habitat and species conservation issues. General Technical Report GTR-PSW-172. Albany, California: Pacific Southwest Research Station, Forest Service, U. S. Department of Agriculture.

Tutton, J. 1991. A survey of the California gnatcatcher and cactus wren on Camp Pendleton San Diego County, California. Unpublished report prepared for U. S. Marine Corps Environmental and Natural Resources Management Office, Camp Pendleton, California. 25 pp.

U. S. Fish and Wildlife Service (Service). 1993. Endangered and threatened wildlife and plants; Determination of threatened status for the Coastal California Gnatcatcher; Final Rule. Federal Register 58:16742-16757.

U. S. Fish and Wildlife Service (Service). 1993. Endangered and threatened wildlife and plants; Special rule concerning take of the threatened coastal California gnatcatcher; Final rule. Federal Register 58:65088-65096.

U. S. Fish and Wildlife Service (Service). 1996. Reinitiation of the biological opinion on implementation of the special rule for the coastal California gnatcatcher. On file, U. S. Fish and Wildlife Service Carlsbad Fish and Wildlife Office, Carlsbad, California.

U. S. Fish and Wildlife Service (Service). 1999. Reinitiation of intra-service consultation on implementation of the special rule for the coastal California gnatcatcher. On file, U. S. Fish and Wildlife Service Carlsbad Fish and Wildlife Office, Carlsbad, California.

U. S. Fish and Wildlife Service (Service). 2000. Endangered and threatened wildlife and plants; Final determination of critical habitat for the coastal California gnatcatcher; Final Rule. Federal Register 65:63680-63743.

U. S. Fish and Wildlife Service (Service). 2003. Endangered and threatened wildlife and plants; Designation of critical habitat for the coastal California gnatcatcher (*Polioptila californica californica*) and determination of distinct vertebrate population segment for the California gnatcatcher (*Polioptila californica*); Proposed Rule. Federal Register 68:20228-20312.

U. S. Fish and Wildlife Service (Service). 2004. Endangered and threatened wildlife and plants; Notice of the Availability of Draft Economic Analyses, and of a Public Hearing for the Proposed Designations of Critical Habitat for the Coastal California Gnatcatcher (*Polioptila californica californica*) and the San Diego Fairy Shrimp (*Branchinecta sandiegonensis*). Federal Register 68:18516-18518.

U. S. Fish and Wildlife Service (Service). 2007. Intra-service formal section 7 consultation/ conference for issuance of an Endangered Species Act Section 10(a)(1)(B) permit (TE144113-0, TE144140-0, and TE144105-0) for The Southern Orange Natural Community Conservation Plan/Master Streambed Alteration Agreement/Habitat Conservation Plan. On file, U. S. Fish and Wildlife Service Carlsbad Fish and Wildlife Office, Carlsbad, California.

U. S. Marine Corps (Marine Corps). 1998. Camp Pendleton Wildland Fire Management Plan Update. Marine Corps Base Camp Pendleton, California. Prepared for AC/S Environmental Security, Camp Pendleton. Contract No. N68711-95-D-7605/0020 with Southwest Division Naval Facilities Engineering Command. Prepared by Tierra Data Systems. October 1998.

U. S. Marine Corps (Marine Corps). 2000. Biological Assessment of Upland Habitats, Marine Corps Base Camp Pendleton. March 2000.

Unitt, P. 1984. The birds of San Diego County. San Diego Society of Natural History Memoir 13.

Weaver, K. L. 1998. Coastal sage scrub variations of San Diego County and their influence on the distribution of the California gnatcatcher. Western Birds 29:392-405.

Westman, W. 1981a. Diversity relations and succession in California coastal sage scrub. Ecology 62:170-184.

Westman, W. 1981b. Factors influencing the distribution of species of California coastal sage scrub. Ecology 62:439-455.

Westman, W. 1987. Implications of ecological theory for rare plant conservation in coastal sage scrub. *In*: T. Elias, (ed.), Proceedings of the conference on conservation and management of rare and endangered plants. Pp. 133-140. California Native Plant Society, Sacramento.

Wirtz, W., A. Mayer, M. Raney, and J. Beyers. 1997. Effects of fire on the ecology of the California gnatcatcher, *Polioptila californica*, in California sage scrub communities. Proceedings: Fire Effects on Rare and Endangered Species and Habitats Conference, Nov. 13-16, 1995. Coeur d'Alene, Idaho. Pp. 91-96.

Zedler, P., C. Gautier, and G. McMaster. 1983. Vegetation change in response to extreme events: the effect of a short interval between fires in California chaparral and coastal scrub. Ecology 64:809-818.

Zedler, P., S. DeSimone, J. Giessow, D. Lawson, J. Else, S. Bliss. 1997. The plant communities of Camp Pendleton Marine Corps Base, California. San Diego State University Department of Biology, Ecology Program. February 1997.

Least Bell's Vireo

American Ornithologists' Union (AOU). 1957. Check-list of North American birds, Fifth edition. Port City Press, Inc., Baltimore, Maryland. 691 pp.

Barlow, J. 1962. Natural History of the Bell Vireo, *Vireo bellii* Audubon. University of Kansas Publications Museum of Natural History 12(5):241-296.

Beck, P. 1996. Song repertoire in the least Bell's vireo, *Vireo bellii pusillus*: relationships between repertoire size and breeding ecology. M.S. Thesis, San Diego State University. viii + 94 pp.

Bell, G. P. 2003. Ecology and management of *Arundo donax* and approaches to riparian habitat restoration in southern California. *In*: J.H. Brock, M. Wade, P. Pysek, and D. Green

(eds.), Plant Invasion: Studies from North America and Europe. Pp. 104-114. Leiden, the Netherlands: Backhuys.

BonTerra Consulting. 2000. Breeding season 2000 weekly monitoring reports of least Bell's vireo and coastal California gnatcatcher for the Crown Valley Parkway Bridge project, Orange County, California. Unpublished reports prepared for the U. S. Fish and Wildlife Service.

BonTerra Consulting. 2002. Results of southwestern willow flycatcher and least Bell's vireo 2002 survey on the Prima Deshecha Landfill, Orange County, California. September 30, 2002.

BonTerra Consulting. 2003. 2003 Least Bell's vireo monitoring report for Prima Deshecha Landfill, Orange County, California. November 14, 2003.

BonTerra Consulting. 2004. 2004 Least Bell's vireo monitoring report for Prima Deshecha Landfill, Orange County, California. November 3, 2004.

BonTerra Consulting. 2005. 2005 Least Bell's vireo monitoring report for Prima Deshecha Landfill, Orange County, California. October 13, 2005.

Brown, B. 1993. Bell's Vireo. *In*: A. Poole, P. Stettenheim, and F. Gill (eds.), The Birds of North America, No. 35. Philadelphia: The Academy of Natural Sciences; Washington D.C.: The American Ornithologists' Union.

Chambers Group, Inc. 2006. Biological Assessment, Flood Control Capacity Restoration Emergency Project, San Diego Creek Channel from Macarthur Blvd. to Michaelson Drive. Prepared for Department of the Army. March 2006.

Coues, E. 1866. List of the birds of Fort Whipple, Arizona, with which are incorporated all other species ascertained to inhabit the territory. Proceedings of the Academy of Natural Science of Philadelphia, 18:76-77.

County of Orange. 2006. Southern Subregion Orange County Draft Habitat Conservation Plan. July 2006.

Dooling, R. J. and A. N. Popper. 2007. The effects of highway noise on birds. Report prepared for the California Department of Transportation. Sacramento, California. 74 pp.

Dwire, K. and J. Kauffman. 2003. Fire and riparian ecosystems in landscapes of the western USA. Forest Ecology and Management 178:61-74.

Ferree, K. 2002. Nest site selection and nest success of yellow warbler, Bell's vireo, and yellow-breasted chat in desert riparian ecosystem. M.S. Thesis, San Diego State University. viii + 57 pp.

Franzreb, K. 1989. Ecology and Conservation of the Endangered Least Bell's Vireo. Biological Report 89(1), U. S. Dept. of the Interior, USFWS, Sacramento, California.

Garrett, K. and J. Dunn. 1981. Birds of southern California: status and distribution. Los Angeles Audubon Society. 408 pp.

Goldwasser, S. 1981. Habitat requirements of the least Bell's vireo. California Department of Fish and Game Final Report, Job IV-38.1.

Gray, V. and J. Greaves. 1984. The Riparian Forest as Habitat for the Least Bell's Vireo. *In*: R. Warner and K. Hendrix (eds.), California Riparian Systems: Ecology, Conservation, and Productive Management. University of California Press, Davis, California.

Greaves, J. 1987. Least Bell's vireos at the Gibraltar Reservoir in Santa Barbara County, California in 1987. Unpublished report prepared for the Office of Endangered Species, U. S. Fish and Wildlife Service, U. S. Forest Service, and the California Department of Fish and Game.

Greaves, J. and Z. Labinger. 1997. Site tenacity and dispersal of least Bell's vireos. 1997 Transactions of the Western Section of the Wildlife Society 33:18-23.

Griffith, J. and J. Griffith. 2000. Cowbird control and the endangered least Bell's vireo: a management success story. *In*: J. Smith, T. Cook, S. Rothstein, S. Robinson, and S. Sealy (eds.), Ecology and management of cowbirds and their hosts. Pp. 342-356. University of Texas Press, Austin, Texas.

Griffith Wildlife Biology (GWB). 2001a. The status of the least Bell's vireo at Marine Corps Base Camp Pendleton in 2000. Unpublished report prepared for AC/S ES, Marine Corps Base Camp Pendleton (Contract No. M00681-99-C-0003). February 15, 2001. 43 pp.

Griffith Wildlife Biology (GWB). 2001b. The status of the least Bell's vireo at Marine Corps Base Camp Pendleton in 2001. Unpublished draft report prepared for AC/S ES, Marine Corps Base Camp Pendleton (Contract No. M00681-99-C-0003). December 15, 2001. 21 pp. + 21 figures.

Griffith Wildlife Biology (GWB). 2001c. 2001 Marine Corps Base Camp Pendleton brown-headed cowbird control program. Unpublished report prepared for AC/S ES, Marine Corps Base Camp Pendleton (Contract No. M00681-00-P-0566 P00002). 22 pp.

Grinnell, J. and A. Miller. 1944. The distribution of the birds of California. Pacific Coast Avifauna, No. 27.

Grinnell, J. and T. Storer. 1924. Animal life in the Yosemite. University of California press. Berkeley, California. Pp. 514-515.

Grishaver, M., P. Mock, and K. Preston. 1998. Breeding behavior of the California gnatcatcher in southwestern San Diego County, California. Western Birds 29:299-322.

Hamilton, T. 1962. Species relationships and adaptations for sympatry in the avian genus *Vireo*. Condor 64:40-68.

Hensley, M. 1950. Notes on the breeding behavior of the Bell's vireo. Auk 67:243-244.

Hoffman, S. and R. Zembal. 2002. Status and management of the least Bell's vireo and southwestern willow flycatcher in selected sites in the Santa Ana River watershed: San Timoteo Canyon, Hidden Valley and portions of the Santa Ana River, Temescal Canyon, and the Santa Ana Canyon. Unpublished report prepared by The Santa Ana Watershed Association for Orange County Water District and U. S. Fish and Wildlife Service. November 2002.

Hoffman, S. and R. Zembal. 2006. Status and management of the least Bell's vireo and southwestern willow flycatcher in the Santa Ana River Watershed. Unpublished report prepared by the Santa Ana Watershed Association for the Orange County Water District and the U. S. Fish and Wildlife Service. 56 pp.

Kus, B. 1999. Impacts of brown-headed cowbird parasitism on productivity of the endangered least Bell's vireo. Research and management of the brown-headed cowbird in western landscapes. Studies in Avian Biology 18:160-166.

Kus, B. 2002. Fitness consequences of nest desertion in an endangered host, the least Bell's vireo. Condor 104:795-802.

Kus, B. and P. Beck. 1998. Distribution and abundance of the least Bell's vireo (*Vireo bellii pusillus*) and the southwestern willow flycatcher (*Empidonax traillii extimus*) at selected southern California sites in 1997. Prepared for the California Department of Fish and Game. 76 pp.

Kus, B. and K. Miner. 1989. Use of non-riparian habitats by least Bell's vireos. *In*: D. Abell (ed.), California riparian systems conference: protection, management, and restoration for the 1990's; September 22-24, 1988, Davis, California. USDA Forest Service General Technical Report PSW-110. Pp. 299-303.

Kus, B. and M. Whitfield. 2005. Parasitism, productivity, and population growth: response of least Bell's vireos (*Vireo bellii pusillus*) and southwestern willow flycatchers (*Empidonax traillii extimus*) to cowbird (*Molothrus* spp.) control. Ornithological Monographs 57:16-27.

Martin, T. and J. Clobert. 1996. Nest predation and avian life-history evolution in Europe versus North America: A possible role of humans? American Naturalist 147:1028-1046.

Miner, K. 1989. Foraging ecology of the least Bell's vireo, *Vireo bellii pusillus*. M.S. Thesis, San Diego State University. vii + 87 pp.

Natural Resources Conservation Service (NRCS). 2006. California district helps watershed look like its old self again. Available at http://www.nrcs.usda.gov/news/thisweek/2004/041124/ caarundodonax.html.

Newman, J. 1992. Relationships between territory size, habitat structure, and reproductive success in the least Bell's vireo, *Vireo bellii pusillus*. M.S. Thesis, San Diego State University. vii + 85 pp.

Nolan, V. 1960. Breeding behavior of the Bell Vireo in southern Indiana. Condor 62:225-244.

Peterson, B. 2002. A multi-scale approach to nest predation of the least Bell's vireo (*Vireo bellii pusillus*). M.S. Thesis, San Diego State University. vii + 55 pp.

Peterson, B., B. Kus, and D. Deutschman. 2004. Determining nest predators of the least Bell's vireo through point counts, tracking stations, and video photography. Journal of Field Ornithology 75(1):89-95.

Pike, J. and L. Hays. 1992. The status and management of the least Bell's vireo within the Prado Basin, California, 1986-1991. Unpublished report, California State University, Long Beach Foundation and U. S. Fish and Wildlife Service, Laguna Niguel, California.

Pike, J., D. Pellegrini, L. Hays, and R. Zembal. 2005. Least Bell's vireos and southwestern willow flycatchers in Prado Basin of the Santa Ana River watershed, California. Unpublished report prepared for the Orange County Water District and U. S. Fish and Wildlife Service. 32 pp.

Pitelka, F. and E. Koestner. 1942. Breeding behavior of the Bell's Vireo in Illinois. Wilson Bulletin 54:97-106.

Riparian Habitat Joint Venture (RHJV). 2006. Website describing plans and objectives. Available at http://www.prbo.org/calpif/htmldocs/rhjv/.

Rourke, J. W. and B. E. Kus. 2006. Distribution, abundance, and breeding activities of the least Bell's vireo at Marine Corps Base Camp Pendleton, California. 2005 Annual Report. Unpublished report prepared for AC/S ES, Marine Corps Base Camp Pendleton. 50 pp.

Salata, L. 1983. Status of the least Bell's vireo on Camp Pendleton, California. Unpublished report prepared for U. S. Fish and Wildlife Service, Laguna Niguel, California. Contract No. 11100-0145-82. January 1983.

Sharp, B. 2002. Factors influencing the incidence of brood parasitism by brown-headed cowbirds (*Molothrus ater*) of least Bell's vireos (*Vireo bellii pusillus*). M.S. Thesis, San Diego State University. viii + 58 pp.

Small, M. and M. Hunter. 1988. Forest fragmentation and avian nest predation in forested landscapes. Journal of Wildlife Management 52:123-126.

Transportation Corridor Agencies (TCA). 2007. Conceptual habitat mitigation and monitoring plan for impacts to areas within the jurisdiction of the United States Army Corps of Engineers, the Regional Water Quality Control Board, the California Department of Fish, and the California Coastal Commission. South Orange County Transportation Infrastructure Improvement Project (SOCTIIP), Orange and San Diego counties, California. Unpublished conceptual plan prepared by Earthworks, Glenn Lukos Associates, and Bonterra Consulting dated August 31, 2007. iii + 69 pp.

U. S. Fish and Wildlife Service (Service). 1986. Endangered and threatened wildlife and plants; Determination of endangered status for the least Bell's vireo; Final Rule. Federal Register 51:16474-16482.

U. S. Fish and Wildlife Service (Service). 1994. Endangered and threatened wildlife and plants; Designation of critical habitat for the Least Bell's Vireo; Final Rule. Federal Register 59:4845-4867.

U. S. Fish and Wildlife Service (Service). 1998. Draft Recovery Plan for the Least Bell's Vireo. Fish and Wildlife Service, Portland, Oregon. 139 pp.

U. S. Fish and Wildlife Service (Service). 2006. Draft Least Bell's Vireo (*Vireo bellii pusillus*) 5-Year Review: Summary and Evaluation. Unpublished draft document prepared by the Carlsbad Fish and Wildlife Office. September 20, 2006.

U. S. Fish and Wildlife Service (Service). 2007. Intra-service formal section 7 consultation/ conference for issuance of an Endangered Species Act Section 10(a)(1)(B) permit (TE144113-0, TE144140-0, and TE144105-0) for The Southern Orange Natural Community Conservation Plan/Master Streambed Alteration Agreement/Habitat Conservation Plan. On file, U. S. Fish and Wildlife Service Carlsbad Fish and Wildlife Office, Carlsbad, California.

U. S. Geological Survey (USGS). 2002. Least Bell's vireo distribution and abundance in 2001: Summary. Unpublished data available from the USGS Western Ecological Research Center, San Diego Field Station, San Diego, California. Compiled November 22, 2002.

U. S. Marine Corps (Marine Corps). 1995. Programmatic groundwater/riparian habitat assessment at Marine Corps Base Camp Pendleton, California. Unpublished report prepared for Marine Corps Base Camp Pendleton, Environmental Security Office, San Diego County, California.

Whitcomb, R., C. Robbins, J. Lynch, B. Whitcomb, M. Klimkiewicz, and D. Bystrak. 1981. Effects of forest fragmentation on avifauna of the eastern deciduous forest. *In*: R. Burgess and D. Sharpe (eds.), Forest island dynamics in man-dominated landscapes. Pp. 125-205. Springer-Verlag, New York, New York.

Wilbur, S. 1980. The least Bell's vireo in Baja California, Mexico. Western Birds 11:129-133.

Yahner, R. and C. Delong. 1992. Avian predation and parasitism on artificial nests and eggs in two fragmented landscapes. Wilson Bulletin 104:162-168.

Pacific Pocket Mouse

Adams, L.W. and A.D. Geis. 1983. Effects of roads on small mammals. J. of Applied Ecology 20:403-415.

Allred, D. M. and D. E. Beck. 1963. Range of movement and dispersal of some rodents at the Nevada atomic test site. J. Mammal. 44(2):190-200.

Bailey, V. 1939. The solitary lives of two little pocket mice. J. of Mammalogy 20:325-328.

Bartholomew, G. and T. Cade. 1957. Temperature regulation, hibernation, and aestivation in the little pocket mouse, *Perognathus longimembris*. J. of Mammalogy 38:60-72.

Beatley, J. C. 1969. Dependence of desert rodents on winter annuals and precipitation. Ecology 50(4):721-724.

Boggs, J. R. 1996. Report on surveys for Pacific pocket mouse in Edson and Oscar One Ranges. Memorandum prepared by the Natural Resource Office, Southwest Division for the Wildlife Management Branch, Environmental Security, Marine Corps Base Camp Pendleton. 5 pp. + map.

Bolger, D. T., A. C. Alberts, R. M. Sauvajot, P. Potenza, C. McCalvin, D. Tran, S. Mazzoni, and M. E. Soulé. 1997a. Response of rodents to habitat fragmentation in coastal southern California. Ecological Applications 7(2):552-563.

Bolger, D. T., T. A. Scott, and J. T. Rotenberry. 1997b. Breeding bird abundance in an urbanizing landscape. Conservation Biology 11(2):406-421.

Bonterra Consulting. 2007. Analysis of the relationship between the vegetation types, soil types, topography and historical agricultural operations within and adjacent to the San Mateo North population of the Pacific pocket mouse. Unpublished letter report prepared for the Transportation Corridors Agency dated August 9, 2007.

Bornyasz, M. 2003. Pacific pocket mouse translocation receiver site soil habitat study. Incomplete draft report prepared for California Department of Fish and Game. May 15, 2003.

Bowers, M. A. 1982. Foraging behavior of heteromyids rodents: field evidence of resource partitioning. J. of Mammalogy 63(3):361-367.

Bowers, M. A. 1986. Geographic comparison of microhabitats used by three heteromyids in response to rarefraction. J. of Mammalogy 67(1):46-52.

Brehme, C. 2003. Responses of small terrestrial vertebrates to roads in a coastal sage scrub ecosystem. Master's Thesis. San Diego State University, San Diego, California. 61pp.

Brown, J. H. and B. A. Harney. 1993. Population community ecology of heteromyid rodents in temperate habitats. *In*: H. Genoways and J. Brown (eds.), Biology of the Heteromyidae. Special Publication No. 10. Pp. 618-651. The American Society of Mammalogists.

Brown, J. H. and E. J. Heske. 1990. Control of a desert-grassland transition by a keystone rodent guild. Science 250:1705-1707.

Brown, J., and G. Lieberman. 1973. Resource utilization and coexistence of seed-eating desert rodents in sand dune habitats. Ecology 54(4):788-797.

Brown, J. S., B. P. Kotler, R. J. Smith, and W. O. Wirtz. 1988. The effects of owl predation on the foraging behavior of heteromyid rodents. Oecologia 76:408-415.

Brylski, P. 1993. A focused survey for the Pacific pocket mouse (*Perognathus longimembris pacificus*) on the Dana Point Headlands, Orange County, California. Prepared for EDAW, Inc. by the Planning Center, Newport Beach, California. August 1993.

Burge, J. R. and C. D. Jorgensen. 1973. Home range of small mammals: a reliable estimate. J. of Mammalogy 54(2):483-488.

Chew, R. M. and B. B. Butterworth. 1964. Ecology of rodents in Indian Cove (Mojave Desert), Joshua Tree National Monument, California. J. of Mammalogy 45(2):203-225.

Chew, R. M., R. G. Lindberg, and P.Hayden. 1967. Temperature regulation in the little pocket mouse, *Perognathus longimembris*. Comp. Biochem. Physiol. 21:487-505.

Church, R. 1996. Unpublished memorandum from the Department of the Navy to the USFWS regarding permit reporting of trapping efforts for the Pacific pocket mouse. On file, U. S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California. 1p + map.

Clark, K. B. 2002. When abundance fails to predict persistence: species extinctions in an urban system. Unpublished masters' thesis, Arizona State University. May 2002. 35 pp.

Clarke, J. A. 1983. Moonlight's influence on predator/prey interactions between short-eared owls (*Asio flammeus*) and deermice (*Peromyscus maniculatus*). Behav. Ecol. Sociobiol. 13:205-209.

Conley, W, J. D. Nichols, and A. R. Tipton. 1977. Reproductive strategies in desert rodents. Pp 193-215 in Transaction of the Symposium on the Biological Resources of the

Chihuahuan Desert Region United States and Mexico, Sul Ross State University, Alpine Texas, 17-18 October 1974 (R. H. Wauer and D. H. Riskind, eds.). U. S. Department of the Interior.

Conrey, R. C. and L. S. Mills. 2001. Do highways fragment small mammal populations? Proceedings of the International Conference on Ecology and Transportation, Keystone, Colorado, September 24-28, 2001. Raleigh, North Carolina: Center for Transportation and the Environment, North Carolina State University (March 2002).

Cramer, K. and J. Chapman. 1990. Reproduction of three species of pocket mice (*Perognathus*) in the Bonneville Basin, Utah. Great Basin Naturalist 50(4):361-365.

Crooks, D. R. and M. E. Soulé. 1999. Mesopredator release and avifaunal extinctions in a fragmented system. Nature 400:563-566.

D'Antonio, C. M. and P. M. Vitousek. 1992. Biological invasions by exotic grasses, the grass/ fire cycle, and global change. Annual Review of Ecology and Systematics 23:63-87.

Davis, J. M. and J. A. Stamps. 2004. The effect of natal experience on habitat preferences. Trends in Ecology and Evolution 19:411-416.

DeBano, L. F., N. G. Neary, and P. F. Ffolliott. 1998. Fire's Effect on Ecosystems. Chapter 5: Physical Soil System. New York, New York: John Wiley & Sons, Inc. ISBN: 0471163562.

Dice, L. R. 1945. Minimum intensities of illumination under which owls can find dead prey by sight. American Naturalist 79:385-416.

Dodd, S. C. 2000. Trap results sheet for a trapping survey at San Mateo North PPM population site in July 2000. *In*: Montgomery, S. J. Results of monitoring surveys for the federally endangered Pacific pocket mouse, other rodents, and vegetation at the management ignited fire location, at the San Mateo North Pacific pocket mouse population site, Marine Corps Base, Camp Pendleton, California. Unpublished report prepared by S. J. Montgomery for the Marine Corps Base Camp Pendleton, Wildlife Management Branch, Environmental Security under contract N 68711-00-LT-00036. 2005. 42 pp.+ tables, figures, and appendices.

Dodd, S., P. Brylski, D. Laabs, S. Montgomery, and W. Spencer. 1998. Final report 1997 Pacific Pocket Mouse (*Perognathus longimembris pacificus*) surveys on the Dana Point Headlands, Orange County, California. Unpublished report prepared for the U. S. Fish and Wildlife Service, California Department of Fish and Game, and The Nature reserve of Orange County. On file, U. S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California.

Dodd, S., D. Laabs, and J. Greene. 1999. Final report 1998 Pacific pocket mouse (*Perognathus longimembris pacificus*) surveys on the Dana Point Headlands, Orange County,

California. Unpublished report prepared for U. S. Fish and Wildlife Service, California Department of Fish and Game, and The Nature Reserve of Orange County. March 19, 1999. 31pp. + appendices.

Dodd, S. and S. Montgomery. 1997. Draft Report: Results of an investigation of trap spacing and duration of trapping period for monitoring studies of the Pacific pocket mouse (*Perognathus longimembris* pacificus). Unpublished draft report prepared for the California Department of Fish and Game. 21 pp. + appendices.

Dodd, S. and S. Montgomery. 2000. Vegetation thinning experiment on the Dana Point Headlands, Orange County, California. Unpublished report prepared for the U. S. Fish and Wildlife Service and California Department of Fish and Game. On file, U. S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California. 21 pp.

Edmonds, V. W. and D. S. Fertig. 1972. Longevity of the pocket mouse, *Perognathus longimembris*. Southwest Naturalist 17(3):300-301.

Egoscue, H. J., J. G. Bittmenn, and J. A. Petrovich. 1970. Some fecundity and longevity records for captive small mammals. J. of Mammalogy 51(3):622-623.

Erickson, R. 1993. Pacific pocket mouse (*Perognathus longimembris pacificus*). Draft manuscript to be included *in* Endangered Rodents of the World, to be published by the Species Survival Commission of the International Union for the Conservation of Nature and Natural Resources (IUCN).

Fahrig, L., J. H. Pedlar, S. E. Pope, P. D. Taylor, and J. F. Wegner. 1995. Effect of road traffic on amphibian density. Biological Conservation 73:177-182.

Flake, L. D. and C. D. Jorgensen. 1969. Invasion of a "trapped-out" southern Nevada habitat by *Perognathus longimembris*. The Great Basin Naturalist 29(3):143-149.

French, A. R. 1976. Selection of high temperatures for hibernation by the pocket mouse, *Perognathus longimembris*: ecological advantages and energetic consequences. Ecology 57:185-191.

French, A. R. 1977. Circannual rhythmicity and entrainment of surface activity in the hibernator, *Perognathus longimembris*. J. of Mammalogy 58(1):37-43.

French, N., B. Maza, and A. Aschwanden. 1967. Life spans of *Dipodomys* and *Perognathus* in the Mojave Desert. J. of Mammalogy 48(4):537-548.

French, N., B. Maza, H.O. Hill, A.P. Aschwanden, and H.W. Kaaz. 1974. A population study of irradiated desert rodents. Ecological Monographs 44:45-72.

Fritts, S. H., and L. D. Mech. 1984. Movements of translocated wolves in Minnesota. J. of Wildlife Management 48:709-721.

Garland, T. Jr. and W.G. Bradley. 1984. Effects of a highway on Mojave desert rodent populations. American Midland Naturalist 111(1):47-56.

Germano, D. J. 1997. Distribution and habitat affinities of the Pacific pocket mouse (*Perognathus longimembris pacificus*). Draft Final report prepared for the California Department of Fish and Game, contract No. FG5129WM. January 1997. 38pp.

Germano, D.J. 2001. Assessing translocation and reintroduction as mitigation tools for Tipton kangaroo rats (*Dipodomys nitratoides nitratoides*). Transactions of the Western Section of the Wildlife Society 37:71-76.

Griffith, B., J. M. Scott, J. W. Carpenter, and C. Reed. 1989. Translocation as a species conservation tool: status and strategy. Science 245:477-480.

Grinnell, J. 1933. Review of the recent mammal fauna of California. University of California Publications in Zoology 40:71-234.

Gurnell, J., and J.H.W. Gipps. 1989. Inter-trap movement and estimating rodent densities. J. Zool. Lond. 217:241-254.

Haidinger, T. L. and J. E. Keeley. 1993. Role of fire frequency in destruction of mixed chaparral. Madrono 40(3):141-147.

Hall, E. 1981. The Mammals of North America. Second ed. John Wiley and Sons, New York.

Hayden, P. and R. Lindberg. 1976. Survival of laboratory-reared pocket mice, *Perognathus longimembris*. J. Mammalogy 57(2):266-272.

Hayden, P., J. Gambino, and R. Lindberg. 1966. Laboratory breeding of the little pocket mouse, *Perognathus longimembris*. J. of Mammalogy 47(3):412-423.

Hayne, Don W. 1950. Apparent Home Range of *Microtus* in Relation to Distance between Traps. J. of Mammalogy, 31(1):26-39

Holway, D.A. 2004. Edge Effects of an invasive species across a natural ecological boundary. Biological Conservation 121:561-567.

Holway, D. A., A. V. Suarez, and T. J. Case. 2002. Role of abiotic factors in governing susceptibility to invasion: a test with Argentine ants. Ecology 83:1610-1619.

Howard, W. E., R. L. Fenner, and H. E. Childs. 1959. Wildlife survival in brush burns. J. of Range Management 12(5):230-234.

Inouye, R. S., G. S. Byers, and J. H. Brown. 1980. Effects of predation and competition on survivorship, fecundity, and community structure of desert annuals. Ecology 61(6):1344-1351.

Jones, A. L. and W. S. Longland. 1999. Effects of cattle grazing on salt desert rodent communities. American Midland Naturalist 141 (1):1-11.

Jorgensen, C. D. 1968a. Spatial relationships of *Perognathus longimembris* (Coues) in southern Nevada. Proceedings of the Utah Academy of Sciences, Arts, and Letters. 45(1):118-125.

Jorgensen, C. D. 1968b. Home range as a measure of probable interactions among populations of small mammals. J. of Mammalogy 49(1):104-112.

Keeley, J. E. 2006. South coast bioregion. *In* N. G. Sugihari, J. W. van Wangtendonk, K. E. Shaffer, J. Fites-Kaufman, and A. E. Thoede (eds), Fire in California's ecosystems. University of California Press, pp. 350-390.

Keeley, J. E., M. Baer-Keeley, and C. J. Fotheringham. 2005. Alien plant dynamics following fire in Mediterranean-climate California shrublands. Ecological Applications 15(6):2109-2125.

Kenagy, G. 1973. Daily and seasonal patterns of activity and energetics in a heteromyid rodent community. Ecology 54:1201-1219.

Kenagy, G., and G. Bartholomew. 1985. Seasonal reproductive patterns in five coexisting California desert species. Ecological Monographs 55(4):371-397.

Kleiman, D. G. 1989. Reintroduction of captive mammals for conservation. Bioscience 39:152-161.

Kotler, B. P. 1984. Risk of predation and the structure of desert rodent communities. Ecology 65(3) 689-701.

Kotler, B. P. 1985. Owl predation on desert rodents, which differ in morphology and behavior. J. of Mammalogy 66(4):824-828.

LSA. 2002. City Creek San Bernardino kangaroo rat trapping mortality notification. Letter prepared by LSA Associates Inc., Irvine, California for the U. S. Fish and Wildlife Service, Carlsbad Field Office, Carlsbad, California. August 26, 2002. 3pp.

Larsen, E. 1986. Competitive release in microhabitat use among coexisting desert rodents: a natural experiment. Oecologia 69:231-237.

Lemen, C. A. and P. W. Freeman. 1986. Interference competition in a heteromyid community in the Great Basin of Nevada, USA. Oikos 46:390-396.

Lloret, F., and P. H. Zedler. 1991. Recruitment pattern of *Rhus integrifolia* populations in periods between fire in chaparral. J. Vegetation Science 2:217-230.

Loda, J., C. Winchell, M. Pavelka, and E. King. 1999. The role of vegetation in determining suitable habitats for the Pacific pocket mouse (*Perognathus longimembris pacificus*). Unpublished report prepared by the U. S. Fish and Wildlife Service for the Marine Corps Base Camp Pendleton, Environmental Security, October 1999. 18 pp. plus appendices

Longland, W. S., and M. V. Price. 1991. Direct observations of owls and heteromyid rodents: can predation risk explain microhabitat use? Ecology 72(6):2261-2273.

MacMillen, R. E. 1964. Population ecology, water relations and social behavior of a southern California semidesert rodent fauna. Univ. of Calif. Publ. Zool. 71:1-66

Maynard Smith, J., and G. A. Parker. 1976. The logic of asymmetric contests. Animal Behaviour 24:159-175.

McDonald, W. and C. C. St Clair. 2004. Elements that promote highway crossing structure use by small mammals in Banff National Park. J. of Applied Ecology 41:82–93.

McGregor, R., D. J. Bender, and L. Fahrig. 2008. Do small mammals avoid roads because of the traffic? J. of Applied Ecology 45:117–123.

McKnight, M. L. 2005. Phylogeny of the *Perognathus longimembris* species group based on mitochondrial cytochrome-b: How many species? Journal of Mammalogy, 86:826–832.

M'Closkey, R. T. 1972. Temporal changes in populations and species diversity in a California rodent community. J. of Mammalogy 53:657-676.

Maza, B. G., N. R. French., and A. P. Aschwanden. 1973. Home range dynamics in a population of heteromyid rodents. J. of Mammalogy 54(2):405-425.

Mearns, E. 1898. Descriptions of three new forms of pocket mice from the Mexican border of the United States. Bulletin of the American Museum of Natural History 10:299-302.

Meserve, P. 1972. Resource and habitat utilization by rodents of the coastal sage scrub community. Unpublished Ph.D. dissertation, University of California, Irvine. 248 pp.

Meserve, P. 1976a. Habitat and resource utilization by rodents of a California coastal sage scrub community. J. of Animal Ecology 46:647-666.

Meserve, P. 1976b. Food relationships of a rodent fauna in a California coastal sage scrub community. J. of Mammalogy 57:300-302.

Michael Brandman Associates and LSA Associates. 1997. Results of focused surveys for the Pacific pocket mouse Foothill Transportation Corridor-South. Unpublished report prepared for Foothill/Eastern Transportation Corridor Agency, Santa Ana, California, February 1997. 26pp. + Appendices.

Michael Brandman Associates. 1999. Results of focused surveys for the Pacific pocket mouse Foothill Transportation Corridor-South. Unpublished report prepared for Foothill/Eastern Transportation Corridor Agency, Santa Ana, California, December 1999. 12pp. + appendix.

Miller, S. D., and W. B. Ballard. 1982. Homing of transplanted Alaskan brown bears. J of Wildlife Management.

Montgomery, Stephen J. 1997. Stephens' kangaroo rat relocation study for the P-143 Harm Missile storage-building project at the Fallbrook Naval Weapons Station, Fallbrook, California. Unpublished report prepared by SJM biological consultants for the Kvaas Construction Company, San Diego, California. 34pp. + figures and tables.

Montgomery, S. J. 2003. 1998-1999 Pacific pocket mouse surveys, Marine Corps Base, Camp Pendleton, California. Unpublished final report prepared for Assistant Chief of Staff, Environmental Security under contract M00681-97-C-0036. May 2003. 42 pp. + appendices

Montgomery, S. J. 2005a. Results of monitoring surveys for the federally endangered Pacific pocket mouse, other rodents, and vegetation at the management ignited fire location, at the San Mateo North Pacific pocket mouse population site, Marine Corps Base, Camp Pendleton, California. Unpublished report prepared by S. J. Montgomery for the Marine Corps Base Camp Pendleton, Wildlife Management Branch, Environmental Security under contract N 68711-00-LT-00036. 42 pp. + tables, figures, and appendices.

Montgomery, S. J. 2005b. Unpublished letter report from SJM Biological Consultants to Essex Environmental regarding trapping, holding, and relocating Pacific pocket mice (*Perognathus longimembris*) at the spur road leading to San Diego Gas and Electric Tower 322253, located in the San Mateo South PPM population area. July 25, 2005. 6 pp. + figures.

Nagel, R. J., and M. A. Pavelka. 2006. Designation of core areas and potential restoration sites for the coastal California gnatcatcher, Pacific pocket mouse and Stephens' kangaroo rat on Marine Corps Base Camp Pendleton, California. Unpublished report prepared by the U. S. Fish and Wildlife Service for the Marine Corps Base Camp Pendleton, AC/S Environmental Security under scope of work #M-00681-96-MP-00065.

Natural Resources Assessment, Inc. (NRA, Inc.) 2003. Presence/absence trapping studies for the Pacific pocket mouse on the Foothill/Eastern Transportation Corridor South. Unpublished report prepared for P&D Consultants, San Diego, California. November 7 2003. 13pp. + appendix.

Ng, S, J. Dole, R. Sauvajot, S. Riley, T. Valone. 2004. Use of highway undercrossing by wildlife in southern California. Biological Conservation 115:499-507.

O'Farrell, M. 1974. Seasonal activity patterns of rodents in a sagebrush community. J. of Mammalogy 55:809-823.

O'Farrell, M. 1992. Draft final report. Stephens' kangaroo rat translocation/habitat enhancement studies, Lake Mathews Ecological Reserve. Unpublished report prepared for the Metropolitan Water District of Southern California, Los Angeles, California.

O'Farrell, M.J. 1999. Translocation of the endangered San Bernardino kangaroo rat. Transactions of the Western Section of the Wildlife Society, 35:10-14.

O'Farrell, T. P., R. J. Olson, R. O. Gilbert, and J. D. Hedlund. 1975. A population of Great Basin pocket mice, *Perognathus parvus*, in the shrub-steppe of south-central Washington. Ecological Monographs 45:1-28.

Ogden Environmental and Energy Services Co., Inc (Ogden). 1995. Biological resources survey report for FY MCON P-577 water distribution plan, Marine Corps Base Camp Pendleton. Prepared for KEA Environmental, San Diego, September. *In*: Pacific Pocket Mouse survey, Phase III, Marine Corps Base Camp Pendleton. Ogden, 1997. Unpublished report prepared for the Marine Corps Base Camp Pendleton, AC/S Environmental Security under contract M00681-96-C-0021. November 1997. 45 pp.

Ogden Environmental and Energy Services Co., Inc (Ogden). 1997. Pacific Pocket Mouse survey, Phase III, Marine Corps Base Camp Pendleton. Unpublished report prepared for the Marine Corps Base Camp Pendleton, AC/S Environmental Security under contract M00681-96-C-0021. November 1997. 45 pp.

Oxley, D. J., M. B. Fenton, and G. R. Carmody. 1974. The effects of roads on populations of small mammals. J. of Applied Ecology 11(1):51-59.

Pearson, O. P. 1964. Carnivore-mouse predation: an example of its intensity and bioenergetics. J. of Mammalogy 45(2):177-188.

Pietruszka, R. D., J. A. Wiens, and C. J. Pietruszka. 1981. Leopard lizard predation on *perognathus.* J.of Herpetology 15(2):249-250.

Price, M. V. and J. H. Brown. 1983. Patterns of morphology and resource use in North American desert rodent communities. Great Basin Naturalist Memoirs 7:117-134.

Price, M. V., R. L. Goldingay, S. Szychowski, and N. M. Waser. 1994. Managing habitat for the endangered Stephens' kangaroo rat (*Dipodomys stephensi*): Effects of shrub removal. American Midland Naturalist 131:9-16.

Price, M. V. and N. M. Waser. 1984. On the relative abundance of species: postfire changes in a coastal sage scrub rodent community. Ecology 65(4):1161-1169.

Price, M. V., N M. Waser, and T.A. Bass. 1984. Effects of moonlight on microhabitat use by desert rodents. J. of Mammology 65(2):353-356.

Price, M. V., N. M. Waser, and S. McDonald. 2000. Seed caching by heteromyid rodents from two communities: implications for coexistence. J. of Mammalogy 81(1):97-106.

Reichman, O. J. and M. V. Price. 1993. Ecological aspects of heteromyid foraging. *In*: H. Genoways and J. Brown (eds.), Biology of the Heteromyidae. Special Publication No. 10. Pp. 539-574. The American Society of Mammalogists.

Rosenzweig, M. L. 1973. Habitat selection experiments with a pair of coexisting Heteromyid rodent species. Ecology 54(1):111-117.

Shaffer, K. E., and W. F. Laudenslayer, Jr.. 2006. Fire and animal interactions. *In* N. G. Sugihari, J. W. van Wangtendonk, K. E. Shaffer, J. Fites-Kaufman, and A. E. Thoede (eds), Fire in California's ecosystems. University of California Press, pp. 118-144.

Shier, D., and R. R. Swaisgood. 2006. Behavioral ecology and translocation of the endangered Pacific little pocket mouse, *P. longimembris pacificus*. Unpublished study proposal prepared by the San Diego Zoological Society and submitted to the Carlsbad Fish and Wildlife Office, Carlsbad, California. 21 pp.

Shier, D. 2007a. RE: PPM Data. (Personal email communication summarizing 2007 trapping results from Debra Shier to William B. Miller sent December 20, 2007, 3:15 p.m.).

Shier, D. 2007b. Behavioral ecology and translocation of the endangered Pacific little pocket mouse (*Perognathus longimembris pacificus*): Report for Phase I and Phase II for the period May 2006-December 2006. Unpublished report prepared for Conservation and Research for Endangered Species Division of Applied Animal Ecology, Zoological Society of San Diego, Escondido, California. 13 pp.

Short, J., S. D. Bradshaw, J. Giles, R. I. T. Prince, and G. R. Wilson. 1992. Reintroduction of macropods (Masupialia: Macropodoidea) in Australia – A review. Biological Conservation 62:189-204.

Smith, M.H. 1971. Food as a limiting factor in the population ecology of *Peromyscus polionotus* (Wagner). Anals Zool. Fennici. 8:109-112.

Spencer, W. D. 2005. Recovery research for the endangered Pacific pocket mouse: An overview of collaborative studies. *I*n B. E. Kus and J. L. Beyers, technical coordinators, *Planning for Biodiversity: Bringing Research and Management Together, A Symposium for the California South Coast Ecoregion*. General Technical Report PSW-GTR-195. Pacific Southwest Research Station, U.S. Department of Agriculture Albany, California. pp. 107-125.

Spencer, W. D. 2007. Pacific pocket mouse surveys in support of Biological Assessment and Environmental Assessment for Oscar roads repairs on Marine Corps Base Camp Pendleton, Draft Report. Unpublished report prepared for Ms. Adrianne Saboya, NAVFAC SW. October 2007. 10 pp. + appendix.

Spencer, W. D., C. Schaefer, S. Dodd, and S. J. Montgomery. 2000a. Pacific pocket mouse studies program, Phase I report, Final. Unpublished report prepared for Foothill/Eastern Transportation Corridor Agency and U. S. Fish and Wildlife Service. January 2000. 63pp. + appendices.

Spencer, W. D., C. Schaefer, S. Dodd, S. J. Montgomery, and C. Holland. 2000b. Pacific pocket mouse studies program, Phase II report, Final. Unpublished report prepared for Foothill/Eastern Transportation Corridor Agency and U. S. Fish and Wildlife Service. May 2000. 44pp. + appendices.

Spencer, W. D., C. Schaefer, S. Dodd, S. J. Montgomery, and C. Holland. 2001. Pacific pocket mouse studies program, Phase III report, Peer Review Draft. Unpublished report prepared for Foothill/Eastern Transportation Corridor Agency and U. S. Fish and Wildlife Service. February 2001. 36pp. + appendices.

Stamp, N. E. and R. D. Ohmart. 1978. Resource utilization by desert rodents in the lower Sonoran Desert. Ecology 59(4):700-707.

Stamps, J. A. 1988. Conspecific attraction and aggregation in territorial species. American Naturalist 131:329-347.

Stamps, J. A. and R. R. Swaisgood. 2007. Someplace like home: Experience, habitat selection and conservation biology. Applied Animal Behaviour Science 102: 392-409.

Stickel, L. F. 1954. A Comparison of Certain Methods of Measuring Ranges of Small Mammals. J. of Mammalogy, 35(1):1-15.

Suarez, A. V., D. T. Bolger, and T. J. Case. 1998. Effects of fragmentation and invasion on native ant communities in coastal southern California. Ecology 79(6):2041-2056.

Swei, A., P. Brylski, W. Spencer, S. Dodd, and J. Patton. 2003. Hierarchical genetic structure in fragmented populations of the little pocket mouse (*Perognathus longimembris*) in southern California. Conservation Genetics 4:501-514.

Swihart, R. K. and N. A. Slade. 1984. Road Crossing in *Sigmodon hispidus* and *Microtus ochrogaster*. J. of Mammalogy 65(2):357-360.

Transportation Corridors Agency (TCA). 1997. Vegetation mapping data. Electronic data provided by Paul Bopp of the Transportation Corridors Agency.

Transportation Corridors Agency (TCA) and AP Engineering & Testing, Inc. 2007. Soil Analysis *in* Analysis of the relationship between the vegetation types, soil types, topography and historical agricultural operations within and adjacent to the San Mateo North population of the Pacific pocket mouse. Unpublished letter report dated August 9, 2007, prepared by Bonterra Consulting for the Transportation Corridors Agency.

Thompson, S. D. 1982a. Microhabitat utilization and foraging behavior of bipedal and quadrapedal heteromyid rodents. Ecology 63(5) 1303-1312.

Thompson, S. D. 1982b. Structure and species composition of desert heteromyid rodent species assemblages: effects of a simple habitat manipulation. Ecology 63(5) 1313-1321.

Thompson, S. D. 1985. Bipedal hopping and seed-dispersion selection by heteromyid rodents: the role of locomotion energetics. Ecology 66(1):220-229.

URS. 2002. Dana Point Headlands Pacific pocket mouse survey, August 18-September 1, 2002. Unpublished letter from URS to USFWS regarding methods and results of PPM trapping at Dana Point Headlands. September 19, 2002. 4pp. + table and figures.

U. S. Department of Agriculture. 1993. Soil Survey Manual: U. S. Department of Agriculture Handbook No. 18. U. S. Government Printing Office, Washington D.C.

U. S. Department of Transportation. 2005. South Orange County Transportation Infrastructure Improvement Project (SOCTIP): Biological Assessment. Unpublished report prepared by U. S. Department of Transportation, Federal Highways Administration, and State of California Department of Transportation. February 28, 2005. 74pp. + appendices.

U. S. Fish and Wildlife Service (Service). 1994a. Endangered and Threatened Wildlife and Plants: Emergency Rule to List the Pacific Pocket Mouse as Endangered. Federal Register 59:5306-5310.

U. S. Fish and Wildlife Service (Service). 1994b. Endangered and Threatened Wildlife and Plants: Determination of Endangered Status for the Pacific Pocket Mouse. Federal Register 59:49752-49764.

U. S. Fish and Wildlife Service (Service). 1995. Biological and conference opinions concerning the issuance of an incidental take permit for the San Diego Gas & Electric (SDG&E) Habitat Conservation Plan in portions of San Diego County, Orange County, and Riverside County , California (1-6-96-FW-07), December 18, 1995.

U. S. Fish and Wildlife Service (Service). 1996a. Surveys and status of the Pacific pocket mouse (*Perognathus longimembris pacificus*) on Marine Corps Base Camp Pendleton, California, 1994-1995. Unpublished report prepared by the U. S. Fish and Wildlife Service for the Marine Corps Base Camp Pendleton, AC/S Environmental Security under contract M00681-94-WR-34. 42 pp. + appendices.

U. S. Fish and Wildlife Service (Service). 1996b. Formal Section 7 consultation on the Crucible Challenge Course, Marine Corps Base Camp Pendleton, San Diego County California (1-6-96-F-35). August 14, 1996.

U. S. Fish and Wildlife Service (Service). 1996c. Fieldwork on the Dana Point Headlands, 27 August – 6 September 1996 by USFWS and CDFG personnel. Unpublished memorandum, September 11, 1996. On file, U. S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California. 3pp.

U. S. Fish and Wildlife Service (Service). 1998a. Pacific Pocket Mouse (*Perognathus logimembris pacificus*) recovery plan. U. S. Fish and Wildlife Service, Portland, Oregon. 112 pp.

U. S. Fish and Wildlife Service (Service). 1998b. Unauthorized take of federally endangered Pacific pocket mouse, Oscar One, Marine Corps Base Camp Pendleton, California (1-6-99-TA-03). Unpublished letter from USFWS to Marine Corps Base Camp Pendleton. October 26, 1998.

U. S. Fish and Wildlife Service (Service). 1999a. Surveys for the Pacific pocket mouse (*Perognathus longimembris pacificus*) on Marine Corps Base Camp Pendleton, California, 1996. Unpublished report prepared by the U. S. Fish and Wildlife Service for the Marine Corps Base Camp Pendleton, AC/S Environmental Security under contract M00681-95-MP-00075. 18 pp. plus addendum.

U. S. Fish and Wildlife Service (Service). 1999b. Baseline monitoring of the Pacific pocket mouse (*Perognathus longimembris pacificus*) population in the Oscar One training Area on Marine Corps Base Camp Pendleton, California, 1996. Unpublished report prepared by the U. S. Fish and Wildlife Service for the Marine Corps Base Camp Pendleton, AC/S Environmental Security under contract M00681-95-MP-00075. 18 pp. + addendum.

U. S. Fish and Wildlife Service (Service). 1999c. Sempra Energy unauthorized Pacific Pocket Mouse grading at San Mateo South, Camp Pendleton, San Diego County, California. Unpublished memorandum. On file, U. S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California.

U. S. Fish and Wildlife Service (Service). 2000. Formal Section 7 Consultation on the Implementation of a Prescribed Burn in the San Mateo Watershed at Marine Corps Base Camp Pendleton, San Diego County, California (1-6-00-F-34). May 12, 2000.

U. S. Fish and Wildlife Service (Service). 2002a. Summary of 2001 Dana Point Headlands Temporary Pacific Pocket Mouse Preserve trapping effort, City of Dana Point, Orange County, California. Unpublished memorandum to the Pacific Pocket Mouse recovery file, June 12, 2002. On file, U. S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California.

U. S. Fish and Wildlife Service (Service). 2002b. Summary of 2002 Dana Point Headlands Temporary Pacific Pocket Mouse Preserve trapping effort, City of Dana Point, Orange County, California. Unpublished memorandum to the Pacific Pocket Mouse recovery file, December 23, 2002. On file, U. S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California.

U. S. Fish and Wildlife Service (Service). 2002c. Monitoring of the Pacific pocket mouse (*Perognathus longimembris pacificus*) population in the Oscar One training Area on Marine Corps Base Camp Pendleton, California, 1997-98. Unpublished report prepared by the U. S. Fish and Wildlife Service for the Marine Corps Base Camp Pendleton, AC/S Environmental Security under contract M00681-96-MP-00065. December 2002. 21 pp. + appendices.

U. S. Fish and Wildlife Service (Service). 2004a. Maintenance of SDG&E access roads on Marine Corps Base Camp Pendleton, San Diego County, California. Unpublished letter from USFWS to San Diego Gas and Electric Company, April 7, 2004.

U. S. Fish and Wildlife Service (Service). 2004b. Scope of incidental take coverage provided by SDG&E's section 10 permit. Unpublished letter from USFWS to San Diego Gas and Electric Company, June 4, 2004.

U. S. Fish and Wildlife Service (Service). 2004c. August PPM trapping mortalities. (Personal email communication summarizing two PPM mortalities sent by William B. Miller to Daniel Marquez on August 9, 2004 at 5:05 p.m.)

U. S. Fish and Wildlife Service (Service). 2005. Summary of fire history within areas occupied by Pacific pocket mouse (*Perognathus longimembris pacificus*, "PPM") at Marine Corps Base Camp Pendleton, California. Unpublished memorandum, August 31, 2005. On file, U. S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California.

U. S. Fish and Wildlife Service (Service). 2006. PPM Mortality, April 22, 2006. (Personal email communication summarizing trapping related mortality of Pacific pocket mouse sent by William B. Miller to Daniel Marquez on April 24, 2006 at 4:13 p.m.).

U. S. Fish and Wildlife Service (Service). 2007. April 2007 salvage trapping for Pacific pocket mouse at the Dana Point Headlands Conservation Park, City of Dana Point, CA. Unpublished memorandum, June 29, 2007. On file, U. S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California.

U. S. Fish and Wildlife Service (Service). 2007. Habitat disturbance at the Crucible Course and status of the Pacific pocket mouse with the Oscar One Training Area, Marine Corps Base Camp Pendleton, San Diego County, California. Letter dated October 5, 2007 from Karen A. Goebel, Assistant Field Supervisor, USFWS to Mr. S. W. Norquist, Natural Resources Department Head, Marine Corps Base Camp Pendleton. 3pp.

U. S. Fish and Wildlife Service (Service). 2008a. Monitoring of the Pacific pocket mouse (*Perognathus longimembris pacificus*) population in the Oscar One Training Area on Marine Corps Base Camp Pendleton: 2003-2006. Unpublished draft report prepared by the U. S. Fish and Wildlife Service for the Marine Corps Base Camp Pendleton, AC/S Environmental Security under contract M-33200-04-MP-00054.

U. S. Fish and Wildlife Service (Service). 2008b. Marine Corps Base Camp Pendleton Pacific pocket mouse monitoring July 8-13, 2002, Oscar One Training Area, Grid D. Unpublished memorandum, January 10, 2008. On file, U. S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California.

U. S. Fish and Wildlife Service (Service). 2008c. Soil classification and percent slope at PPM capture locations. Unpublished memorandum, January 10, 2008. On file, U. S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California.

U. S. Marine Corps (USMC). 2007a. Draft biological assessment, Oscar 1 Training Area road repair, Marine Corps Base Camp Pendleton. October 2007. Prepared by Naval Facilities Engineering Command Southwest for U. S. Marine Corps Camp Pendleton, California.

U. S. Marine Corps (USMC). 2007b. Integrated Natural Resources Management Plan: Marine Corps Base Camp Pendleton, California. Approved Final April 11, 2007. Camp Pendleton, California.

U. S. Marine Corps (USMC). 2007. Habitat disturbance at the Crucible Course within Oscar-1 Training Area. Letter dated January 4, 2007 from S. W. Norquist, Natural Resources Department Head, Assistant Chief of Staff, Environmental Security to Jim Bartel, Field Supervisor, Carlsbad Fish and Wildlife Office, U. S. Fish and Wildlife Service, Carlsbad, California.

U. S. Soil Conservation Service. 1973. Soil survey of San Diego area, California. USDA, Soil Conservation Service and Forest Service. Part 1, 104 pp., Part 2, 118 pp., + maps.

U. S. Soil Conservation Service. 1978. Soil survey of Orange County and western part of Riverside County, California. USDA, Soil Conservation Service and Forest Service. 149 pp. + maps.

Vaughan, T. A. 1978. Mammalogy: Second Ed. W.B. Saunders Company, Philadelphia. 1978.

Veech, J. A. 2001. The foraging behavior of granivorous rodents and short-term apparent competition among seeds. Behavioral Ecology 12(4):467-474.

von Bloeker, J. C., Jr. 1931a. Perognathus *pacificus* from the type locality. J. of Mammalogy 12:369-372.

von Bloeker, J. C., Jr. 1931b. Extension of range of *Perognathus pacificus*. J. of Mammalogy 12:431-432.

Wildlife Science International, Inc. and Bonterra Consulting. 2007. Pacific pocket mouse resource management plan for the San Mateo North population. Unpublished document dated September 20, 2007, prepared for Transportation Corridor Agencies. 34 pp. + Tables, exhibits and an appendix.

Williams, D. 1986. Mammalian species of special concern in California. Wildlife Management Division Administrative Report 86-1. California Department of Fish and Game, Sacramento. 112 pp.

Williams, W., H. Genoways, and J. Braun. 1993. Taxonomy. *In*: H. Genoways and J. Brown (eds.), Biology of the Heteromyidae. Special Publication No. 10. Pp. 38-196. The American Society of Mammalogists.

Winchell, C. W., M. Pavelka, R. Graham, and C. Ribic. 1999. Pacific pocket mouse distribution in relation to soil type. Abstract for oral presentation at The Wildlife Society 1999 Annual Conference.

Wirtz, W. O. II. 1982. Postfire community structure of birds and rodents in southern California chaparral. *In* C.E. Conrad and W.C. Oechel, technical editors, *Proceedings of the Symposium on Dynamics and Management of Mediterranean-type Ecosystems*; General Technical Report PSW-58. Pacific Southwest Research Station, U.S. Department of Agriculture, Berkeley, California. pp. 241-246.

APPENDIX 1
CONSERVATION MEASURES
From the DEIS for the Toll Road dated April 2004
(See Project Description in the Biological Opinion for Additional Measures)

MEASURES RELATED TO WATER QUALITY

WQ-1 Preservation of Adjacent Existing Vegetation. The TCA will preserve to the extent feasible existing vegetation at areas on the construction site where either no construction activity is planned or where it will occur at a later date. The vegetation will be preserved according to the California Storm Water Best Management Practices (BMPs) Municipal Handbook (1993) as listed in the RMP.

WQ-2 Construction Site BMPs. The TCA will implement construction site BMPs as appropriate, during construction of the SOCTIIP Alternatives. These BMPs are described in the California Best Management Practice Handbooks for Construction (1993, revision pending), Caltrans, SWMP and Storm Water Quality Handbooks. BMPs categories include measures for temporary sediment control, temporary soil stabilization, scheduling, preservation of existing vegetation, conveyance controls, wind control, temporary stream crossings and waste management as well as many other measures which may be implemented during construction of a highway project. These measures are consistent with requirements set forth under the California State Water Resources Control Board (SWRCB) Order No. 99-08-DWQ, National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000002 (General Construction Permit), which governs storm water and non-storm water discharges during construction activities, as well as with those requirements set forth in the Caltrans Permit Order No. 99-06-DWQ (CAS 000003). These BMPs are directed at reducing storm runoff pollutants and eliminating non-storm water discharges.

WQ-3 Storm Water Pollution Prevention Plan (SWPPP). Prior to start of soil-disturbing activity at the project site, a Notice of Intent (NOI) and Storm Water Pollution Prevention Plan (SWPPP) will be prepared in accordance with and to partially fulfill the General Construction Permit. The SWPPP will be prepared per the SWPPP and Water Pollution Control Program (WPCP) Preparation Manual, (Storm Water Quality Handbooks, November 2003). The SWPPP will meet the applicable provisions of Sections 301 and 402 of the CWA by requiring controls of pollutant discharges that utilize best available technology (BAT) which is economically achievable and best conventional pollutant control technology (BCT) to reduce pollutants. The SWPPP will be implemented concurrently with commencement of the soil-disturbing activity. The SWPPP will need to be certified in accordance with the signatory requirements of the General Construction Permit.

WQ-4 Spill Contingency. Emergency planning for highway spills will be addressed by both operational and structural BMPs. The TCA, Caltrans will take primary responsibility for spill clean-up and contingencies during construction and operation of the project, though coordination with other agencies will be necessary.

- Operational BMPs include immediate emergency notification through 911 during a spill event. After emergency notification, the following notifications will occur:
- The local fire department and the Orange County Fire Authority will then be notified, and emergency actions (road closures, medical evacuation, cleanup of hazardous materials, etc.) will be taken; if the spill occurs on or affects MCB Camp Pendleton, these authorities will be notified.
- If the spill is above the Reportable Quantity (RQ), the State Office of Emergency Services (800.852.7550) will be contacted and a control number provided. The National Response Center (800.424.8802) will be contacted to comply with Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) requirements. The California Hazardous Material Incident Reporting System (CHMIRS) (916.427.4287) will be notified (assuming the spill volume is more than four liters (two gallons)) and appropriate forms filled out.

Measure WQ-5 Operations, Maintenance and Monitoring Plan. When an alternative is selected for implementation an Operations, Maintenance and Monitoring Plan will be developed in consultation with the appropriate agencies, *i.e.*, Caltrans. Maintenance objectives for project BMPs will be addressed and formalized in the Operation, Maintenance and Monitoring Plan. Caltrans will monitor the BMPs to ensure maintenance objectives are being met. Details of the monitoring will comply with Caltrans Storm Water Policy and requirements of the 401 Certification with Caltrans as the holder of the statewide permit for state highways.

Measure WQ-6 Monitoring of BMPs. For the corridor Alternatives, the TCA will monitor Caltrans' maintenance of the BMPs for five years to assure compliance with maintenance criteria and schedules. The TCA will provide annual reports to the Regional Water Quality Control Boards documenting the maintenance of the BMPs.

MEASURES RELATED TO WETLANDS AND WATERS OF THE UNITED STATES

Measure WW-1. Prior to construction, the TCA shall designate a Project Biologist responsible for overseeing biological monitoring, regulatory compliance, and restoration activities associated with construction of the selected alternative in accordance with the adopted mitigation measures and applicable law.

Measure WW-2. During final design of the project, the Project Biologist shall review the design plans and make recommendations for avoidance and minimization of sensitive biological resources. The TCA Environmental and Engineering Staff shall determine the implementation of those recommendations.

Measure WW-3. A Biological Resources Management Plan (BRMP) shall be prepared prior to construction. The BRMP shall provide specific design and implementation features of the biological resources mitigation measures outlined in the resource agency approval documents. Issues during construction and operation to be addressed in the BRMP shall include, but are not limited to, resource avoidance, minimization, and restoration guidelines, performance standards, maintenance criteria, and monitoring requirements. The Draft BRMP shall be submitted to the

USFWS, National Marine Fisheries Service (NMFS), CDFG, USACOE, RWQCB, FHWA, the California Coastal Commission and Caltrans for review to the extent required by permit by such agencies.

The primary goals of the BRMP are to ensure that (1) the long-term perpetuation of the existing diversity of habitats through restoration in the project area and adjacent urban interface zones and to minimize offsite or indirect effects; (2) the project is not likely to jeopardize the continued existence of any federally listed or state-listed endangered or threatened species; and (3) impacts to endangered and threatened species are minimized and mitigated to the maximum extent practicable. The BRMP shall contain at a minimum the following:

a. Identification of all Environmental Sensitive Areas (ESA). ESAs are defined as sensitive habitats including, but not limited to, areas subject to the jurisdiction of the CDFG, USACOE, and USFWS.

b. Design of protective fencing (*i.e.*, t-bar or yellow rope) around ESAs and the construction staging areas.

c. Locations of trees to be protected as wildlife habitat (roosting sites).

d. For areas that will be restored, the quality of the adjacent habitat will be characterized. This characterization shall include species composition, density, coverage, and presence of non-natives. This characterization will provide a baseline to compare the success of the restoration. The site preparation plan for each restoration site will include:

    - Sources of plant materials and methods of propagation.
    - Site preparation (clearing, grading, weed eradication, soil amendment, topsoil storage), irrigation, planting (container plantings, seeding), and maintenance (weed control, irrigation system checks, replanting) of restoration areas. Specification of parameters for maintenance and monitoring of restoration areas, including weed control measures, frequency of field checks, and monitoring reports for temporary disturbance areas within the project right-of-way.
    - Remedial measures to be taken if performance standards are not met.
    - Methods and requirements for monitoring of the restoration efforts.
    - Specification of the purpose, type, frequency, and extent of chemical use for insect and disease control operations as part of vegetative maintenance within restoration areas.

e. Specific measures for the protection of sensitive habitats to be preserved in and adjacent to the right-of-way to ensure that construction does not increase beyond the impacts identified in the EIS/SEIR. These measures will include, but are not limited to, erosion and siltation control measures, protective fencing guidelines, dust control measures, grading techniques, construction area limits, and biological monitoring requirements. Details of the erosion, siltation, and dust control mitigation measures will be provided in the Storm Water Pollution

Prevention Plan (SWPPP).

f. A summary of the type and quantification of habitats to be removed.

g. Specific construction monitoring programs for sensitive species including Coulter's saltbush, intermediate mariposa lily, southern tarplant, many-stemmed dudleya, western spadefoot toad, southwestern pond turtle, two-striped garter snake and San Diego cactus wren.

h. Specific measures for the protection of sensitive habitats to be preserved within and adjacent to the right-of-way to ensure that construction does not increase the impacts. These measures will include, but are not limited to, erosion and siltation control measures, protective fencing guidelines, dust control measures, grading techniques, construction area limits and biological monitoring requirements. Details of the erosion, siltation and dust control mitigation measures will be outlined in the Storm Water Pollution Prevention Plan (SWPPP).

i. Provisions for biological monitoring during construction activities to ensure compliance and success of each avoidance and minimization measure. The monitoring procedures will (1) identify specific locations of wildlife habitat and sensitive species to be monitored; (2) identify the frequency of monitoring and monitoring methods (for each habitat and sensitive species to be monitored); (3) list required qualifications of biological monitor(s); and (4) identify reporting requirements.

j. Or equivalent measures, *e.g.*, environmental permits.

Measure WW-4. In conjunction with the development of final plans and specifications for construction, or other activities involving vegetation/habitat removal, the Project Biologist shall review and approve the contractor's map of all sensitive habitats (Environmentally Sensitive Areas) within 152.4 meters (500 feet) of the grading limits on the grading plans. The ESA maps shall be prepared by the construction contractor's qualified biologist and approved by the TCA. All ESAs to be avoided and performance standards established by the resource agencies shall be clearly noted on the grading, construction, and landscape plans. Additionally, the landscape plans shall indicate that plant materials be local southern Orange County natives.

Measure WW-5. During grading activities and construction operations, the Project Biologist shall conduct monitoring within and adjacent to sensitive habitats including monitoring of the installation of protective devices (silt fencing, sandbags, fencing, etc.), installation and/or removal of creek crossing fill, construction of access roads, vegetation removal, column installation, falsework installation and removal, and other associated construction activities, as deemed appropriate by the Project Biologist. Biological monitoring shall be conducted to document adherence to habitat avoidance and minimization measures addressed in the project mitigation measure and as listed in the USFWS, CDFG, and USACOE permits/agreements.

Measure WW-6. Final design and construction shall restore the perennial river and stream channels and ephemeral drainages and washes to their original contours upon completion of construction where feasible, with the exclusion of areas of permanent impact.

Measure WW-7. During all construction activities, the Contractor shall ensure that construction equipment or vehicles shall not be stored in areas defined as ESAs, including areas within the jurisdiction of the USACOE and/or CDFG. There shall be no fueling, lubrication, storage, or maintenance of construction equipment within 46 meters (150 feet) of CDFG or USACOE jurisdictional areas. Construction equipment staging/storage shall be located in previously disturbed or non-native areas to the maximum extent possible.

Measure WW-8. During all construction activities, the Contractor shall ensure that no waste material shall be discharged to any CDFG or USACOE jurisdictional areas. Spoil sites shall not be located within any CDFG or USACOE jurisdictional areas, or in areas where it could be washed into any surface water body.

Measure WW-9. Prior to final design, the Contractor shall prepare the final construction Runoff Management Plan (RMP). The plan shall address the final location of facilities to route and detain corridor runoff for the purpose of maintaining peak flows and flow velocities downstream of the Alignment at existing rates and preventing project pollutants from reaching improved and unimproved downstream drainages. County of Orange Best Management Practices (BMPs) will be included in these runoff facilities of the Alternatives as determined appropriate by the Design Engineer. The final RMP will contain provisions for changes to the plan (*e.g.*, alternative mechanisms plant materials) if necessary during project design and/or construction phases to achieve the stated goals and performance standards at an equal or greater level. The RMP will address issues of detention and settlement basin design for mitigation requirements in relation to water quality. The plan shall be submitted to the Regional Water Quality Control Board (RWQCB), Caltrans, and the Orange County Environmental Management Agency (OCEMA) Environmental Planning Division for review and comment. (RMP, Psomas 2003.)

Measure WW-10. The Contractor shall locate staging areas for construction equipment outside of areas in the jurisdiction of the USACOE or CDFG to minimize impacts to sandy creek benches.

Measure WW-11. Prior to final design, the TCA shall prepare a jurisdictional delineation documenting the Waters of the U.S. and wetlands, CDFG, and CCC jurisdictional impacts for the selected alternative.

Prior to final design, the TCA shall prepare a functional assessment of the wetland mitigation plan according to the tenets of the USACOE Regulatory Guidance Letter 02-2 to assure that the functions and values have been replaced and that no net loss of waters and wetland values occur. Habitat replacement guidelines shall be developed to identify and quantify habitats that will be removed along with the locations where habitats will be restored or relocated to ensure no net loss.

MEASURES RELATED TO WILDLIFE, FISHERIES AND VEGETATION

Measure WV-1. Prior to construction, the TCA shall designate a Project Biologist responsible for overseeing biological monitoring, regulatory compliance, and restoration activities associated with construction of the selected alternative in accordance with the adopted mitigation measures

and applicable law.

Measure WV-2. During final design of the project, the TCA Project Biologist shall review the design plans and make recommendations for avoidance and minimization of sensitive biological resources. TCA Environmental and Engineering Staff shall determine the implementation of those recommendations.

Measure WV-3. A Biological Resources Management Plan (BRMP) shall be prepared prior to construction. The BRMP shall provide specific design and implementation features of the biological resources mitigation measures outlined in the resource agency approval documents. Issues to be discussed in the BRMP shall include, but are not limited to, resource avoidance, minimization, and restoration guidelines, performance standards, maintenance criteria, and monitoring requirements. The Draft BRMP shall be submitted to the USFWS, National Marine Fisheries Service (NMFS), CDFG, USACOE, RWQCB, FHWA and Caltrans for review to the extent required by permit by such agencies.

The primary goal of the BRMP will be to ensure the long-term perpetuation of the existing diversity of habitats in the project area and adjacent urban interface zones. The BRMP shall contain at a minimum the following:

a. Identification of all Environmental Sensitive Areas (ESA). ESA are defined as sensitive habitats including, but not limited to, areas subject to the jurisdiction of the CDFG, USACOE, and USFWS; areas supporting endangered, threatened or rare species; and areas supporting vegetation communities described as sensitive.

b. Design of protective fencing (*i.e.*, t-bar or yellow rope) around ESAs and the construction staging areas.

c. Specific procedures during construction for the protection of sensitive plant, amphibian, reptile, bird, and mammal species, including perimeters around drip line oak trees.

d. Locations of trees to be protected as wildlife habitat (roosting sites).

e. Procedures for topsoil preservation and erosion control.

f. A summary of the type and quantification of habitats to be removed.

g. For areas that will be restored, the quality of the adjacent habitat will be characterized. This characterization shall include species composition, density, coverage, and presence of non-natives. This characterization will provide a baseline to compare the success of the restoration. The site preparation plan for each restoration site will include:

    - Sources of plant materials and methods of propagation.
    - Site preparation (clearing, grading, weed eradication, soil amendment, topsoil storage), irrigation, planting (container plantings, seeding), and maintenance (weed control,

irrigation system checks, replanting) of restoration areas. Specification of parameters for maintenance and monitoring of restoration areas, including weed control measures, frequency of field checks, and monitoring reports for temporary disturbance areas within the project right-of-way.

- Remedial measures to be taken if performance standards are not met.
- Methods and requirements for monitoring of the restoration efforts.
- Specification of the purpose, type, frequency, and extent of chemical use for insect and disease control operations as part of vegetative maintenance within restoration areas.

h. Specific construction monitoring programs for sensitive species including Coulter's saltbush, intermediate mariposa lily, southern tarplant, many-stemmed dudleya, western spadefoot toad, southwestern pond turtle, two-striped garter snake, and San Diego cactus wren.

i. Specific measures for the protection of sensitive habitats to be preserved within and adjacent to the right-of-way to ensure that construction does not increase the impacts. These measures will include, but are not limited to, erosion and siltation control measures, protective fencing guidelines, dust control measures, grading techniques, construction area limits, and biological monitoring requirements. Details of the erosion, siltation, and dust control mitigation measures will be outlined, and performance measures provided, in the Storm Water Pollution Prevention Plan (SWPPP).

j. Provisions for biological monitoring during construction activities to ensure compliance and success of each avoidance and minimization measure. The monitoring procedures will (1) identify specific locations of wildlife habitat and sensitive species to be monitored; (2) identify the frequency of monitoring and monitoring methods (for each habitat and sensitive species to be monitored); (3) list required qualifications of biological monitor(s); and (4) identify reporting requirements.

Measure WV-4. During grading activities and/or construction operations, the Project Biologist shall conduct monitoring within and adjacent to sensitive habitats including installation of protective devices (silt fencing, sandbags, fencing, etc.), installation and/or removal of creek crossing fill, construction of access roads, vegetation removal, column installation, false work installation and removal, and other associated construction activities, as deemed appropriate by the Project Biologist.

Measure WV-5. During grading activities and construction operations, the Project Biologist shall prepare a monthly biological monitoring letter report summarizing site visits, documenting adherence or violations of required habitat avoidance measures, and listing any necessary remedial measures. The report shall be submitted to the TCA and/or other implementing resource agencies.

Measure WV-6. Prior to the commencement of grading activities or other activities involving vegetation/habitat removal, the Project Biologist shall attend preconstruction meetings with construction foremen, bridge engineers, and the TCA to confirm that all environmental

conditions are discussed. Monthly, or on an as needed basis, new construction personnel shall complete an educational program. Issues to be covered will include, but are not limited to, environmental measures for avoiding impacts to sensitive biological resources, ESAs, waste disposal, vehicle transportation routes, seasonal restrictions, fueling/maintenance restrictions, and other relevant topics.

Measure WV-7. In conjunction with final design, the Project Biologist shall work closely with the Contractor to develop native plant palettes for revegetation areas adjacent to the roadway that abut natural open space and will be implemented by the Contractor. Final landscape design plans, which will be approved by the TCA, shall reflect the following and shall be incorporated into the BRMP:

- The landscaping along the corridor in open space (non-urban) areas shall be a mix of native, non-invasive, drought tolerant plant species from the scrub, grassland, and chaparral communities. All plants used shall comply with federal, state, and county laws requiring inspection of infestation. The vendor shall provide certification of inspection from the County of Orange and/or San Diego department of agriculture. The Project Biologist shall also inspect all plants before accepting delivery.
- The landscaping community type installed shall be consistent with the plant communities that occur in the vicinity of the intended landscape area.
- Seeds, cuttings, and potted plants shall be collected from local plant material as appropriate, supplemented by material from native plant nurseries. The seed vendor shall furnish certification that the seed has been tested for purity by a certified seed laboratory and does not contain seed of any non-native, invasive species.
- Native California plant species found in the project area shall be used. Invasive, noxious weed, or non-native species identified on the State of California List of Noxious Weed Species or the California Exotic Pest Plant Council Exotic Pest Plants (CalEPPC) of Greatest Ecological Concern in California List shall not be used in landscaping along open space areas.
- All mulches used shall be free of invasive species seed.
- Landscape areas shall be subject to maintenance during plant establishment (*i.e.*, non-native species removal) that will be directed by the Project Biologist. However, the landscape areas shall not be subject to performance standards and will not be subject to mitigation in the future if construction occurs.
- Temporary low-volume irrigation systems, using reclaimed water (where available), shall be included in the final design of the selected alternative.

Portions of the landscaped areas within the Caltrans maintenance area and adjacent to the roadway may be subject to fuel modification requirements, which may preclude the use of many project-indigenous species. In these instances, plant palettes may contain both the California native plant cultivars which will be purchased and indigenous plant species found in the project area. This is due to the limited number of indigenous plant species included within the Orange County Fire Authority Fuel Modification Plant List.

Measure WV-8. In conjunction with the development of final plans and specifications for construction, or other activities involving vegetation/habitat removal, the Project Biologist shall review and approve the contractor's map of all sensitive habitats (Environmentally Sensitive Areas, or ESAs) within 152.4 meters (500 feet) of the grading limits on the grading plans. ESAs are defined as sensitive habitats including, but not limited to, scrub; native grassland; riparian communities; and areas subject to the jurisdiction of the CDFG, USACOE, and USFWS. The ESA maps shall be prepared by the construction contractor's qualified biologist and approved by the TCA. All ESAs to be avoided and performance standards established by the resource agencies shall be clearly noted on the grading, construction, and landscape plans. Additionally, the landscape plans shall indicate that plant materials shall be local southern Orange County native species.

Measure WV-9. Caltrans procedures shall be followed for the protection of ESAs. These procedures are: (1) no construction access, parking, or storage of equipment or materials will be permitted within marked ESAs or other jurisdictional areas; (2) to the maximum extent practicable, construction access points shall be limited in proximity to protected habitat; (3) waste, dirt, and trash shall not be deposited on protected habitat; (4) vehicle transportation routes shall be confined to the narrowest practicable area in areas adjacent to marked, protected habitats during construction/operations activities, (5) no construction personnel shall be permitted access to these areas except for the purpose of invasive species removal without the Project Biologist's approval, and (6) disposal of trash adjacent to ESAs shall be removed/emptied on a daily basis.

Measure WV-10. Prior to the commencement of grading activities or other activities involving vegetation/habitat removal, the Project Biologist shall field verify that protective fencing (t-bar/yellow rope and silt fencing when construction is upslope from sensitive habitat) has been installed along the disturbance limits. Additionally, the Project Biologist shall verify that all other Caltrans procedures for ESAs, identified and mapped on grading plans, have been installed by the construction contractor. These protective fencings shall be field verified by the Project Biologist on a regular basis.

Measure WV-11. To mitigate impacts, the TCA has identified additional habitat preservation and restoration activities in the Upper Chiquita Canyon Conservation Area. The Upper Chiquita Canyon Conservation Area consists of approximately 478.7 hectares (1,182 acres) created by the TCA to mitigate biological impacts resulting from construction of the FTC-N. Of these 478.7 hectares (1,182 acres), 327 credits have been set aside as a mitigation bank for future project impacts. The Conservation Area was originally under substantial threat for development and the resources within the Area have been conserved, but otherwise would have been lost or substantially degraded. In addition, the Upper Chiquita Canyon Conservation Area provides opportunities for preservation activities consisting of additional habitat for oak woodland and sensitive plant species. There are also opportunities for restoration activities on site that would include additional acres of oak woodland, non-wetland drainages, coastal sage scrub, coastal sage scrub/native perennial grassland ecotone, and native perennial grassland habitats. These opportunities for preservation and restoration activities would also serve to mitigate impacts on sensitive plants for the SOCTIIP Alternatives.

a. Impacts to scrub communities (and all sub-types thereof except floodplain sage scrub) shall be mitigated through the use of scrub mitigation credits in the Upper Chiquita Canyon Conservation Easement area and additional preservation (if necessary). The Upper Chiquita Canyon Conservation Easement area currently contains 327 mitigation credits approved by the USFWS and CDFG. The scrub areas impacted by the selected alternative will be mitigated at a credit to hectare ratio of 1:0.40 (one Upper Chiquita Canyon Conservation Easement mitigation credit for every 0.40 ha impact or one Upper Chiquita Canyon Conservation Easement mitigation credit for every 1.0 ac lost).

b. Any additional scrub areas restored within the Upper Chiquita Canyon Conservation Easement area may be added to the credit total, with the approval of the USFWS, and applied to the mitigation ratio accordingly. The TCA and the USFWS shall determine the criteria for the establishment of the new credits for the restored areas pursuant to the Upper Chiquita Canyon Conservation Bank Agreement which was entered into with the USFWS and the CDFG.

c. Any scrub areas that are impacted by the selected alignment and that have not been mitigated by the use of the Upper Chiquita Canyon Conservation Easement mitigation credits (*i.e.*, impact area exceeds mitigation credits available) shall be mitigated through preservation at a ratio of 1:1 (0.4 ha [one ac] for every 0.4 ha [one ac] lost), or other mitigation requirement that is necessary to meet the regulatory standards of an applicable state or federal regulatory program.

Measure WV-12. Impacts to native grasslands shall be mitigated at a 1:1 ratio through either preservation or restoration in designated open space (*e.g.*, Upper Chiquita Canyon Conservation Easement). Should restoration be proposed, the restoration areas shall be located in areas deemed appropriate by the project biologist for native grassland restoration. Restoration areas shall occur within dedicated open space areas including, but not limited to, the Upper Chiquita Canyon Conservation Easement area. The restoration program for native grassland areas shall be included in the BRMP and shall include the following measures.

- Site analysis for appropriate soils.
- Site preparation specifications based on site analysis, including but not limited to grading, and weeding.
- Specifications for plant and seed material appropriate to the locality of the mitigation site and the timing of restoration activities.
- Specifications for site maintenance to establish the habitats, including but not limited to weeding and temporary irrigation.
- Restoration areas shall be considered successful at five years if the following standards are achieved:
- The site does not require substantial maintenance for at least two consecutive years during the monitoring period.

- The site must exhibit evidence of natural recruitment of native species, including plant reproduction and/or setting of seeds.
- Soil at the site exhibits a level of beneficial arbuscular mycorrhizal fungi that is comparable to an appropriate reference site, as demonstrated through soil infestivity potential.
- Absolute percent cover of native species is comparable to the absolute cover of native species at an appropriate reference site within an 80 percent confidence limit.
- An index of species diversity of the restored and/or created habitat areas is statistically comparable to an appropriate reference site within an 80 percent confidence limit.

Monitoring shall be conducted for five years (or less if site meets success criteria as designated above earlier) to ensure successful establishment of native grassland vegetation within the restored areas. If success standards are not met, remedial measures, hydroseeding, or introduction of container stock shall be implemented as directed by the Project Biologist.

Measure WV-13.

a. TCA will mitigate impacts to coast live oak and elderberry woodland communities by replacing, creating, restoring, or preserving (1) 0.4047 ha (one ac) of the identified resource for every 0.4047 ha (one ac) of the applicable resource impacted by the project, or (2) such other mitigation requirement that is necessary to meet the regulatory standards of an applicable state or federal regulatory program. Preservation and restoration areas shall occur within dedicated open space areas including, but not limited to, the Upper Chiquita Canyon Conservation Easement area as determined by the Project Biologist.

b. The restoration program shall be detailed with the BRMP. Prior to restoration of these communities, hydrological testing and monitoring of the creation site shall be conducted to determine that sufficient hydrology exists to support the community. If necessary, a temporary irrigation program shall be incorporated into the mitigation design to ensure successful establishment of the community. The RMP will address issues of detention and settlement basin design for mitigation requirements in relation to water quality.

The following performance standards shall apply for the restoration of elderberry woodland areas. Restoration shall be considered successful if:

- The site does not require substantial maintenance for at least two consecutive years during the monitoring period.
- The site must exhibit evidence of natural recruitment of native species, including plant reproduction and/or setting of seeds.
- Absolute percent cover of native upper and mid canopy species is 70 percent.
- An index of species diversity of the restored areas is statistically comparable to an appropriate reference site within an 80 percent confidence limit.

For coast live oak woodland, the following standards shall apply:

- The site does not require substantial maintenance and meets the success criteria established for this community for at least two consecutive years during the monitoring period.
- The site must exhibit evidence of natural recruitment of native species, including plant reproduction and/or setting of seeds.
- Absolute percent cover of native upper and mid canopy species is 50 percent, with 5 percent cover from oak trees.
- An index of species diversity of the restored areas is statistically comparable to an appropriate reference site within an 80 percent confidence limit.

c. Monitoring shall be conducted for 5 years (or less if success criteria are met earlier) to ensure successful establishment of the restored areas. If success standards are not met, remedial measures including introduction of additional seed and/or container stock and adjusting of irrigation shall be implemented as directed by the Project Biologist.

Measure WV-14. In conjunction with construction activity, the Contractor shall control dust accumulation on natural vegetation at the source of disturbance by standard dust control measures (Mestre Greve Associates 2003).

Measure WV-15. Prior to final design of the selected alternative, the Project Biologist shall ensure that the location of the proposed wildlife bridges and culvert identified in the NES will provide adequate travel capabilities, contain adequate vegetation cover, have adequate daylight, and have appropriate fencing to encourage animals to use these underpasses. Upon selection of and refinement to, the selected alternative, smaller culverts and bridges that will be necessary to provide drainage and/or avoid impacts to jurisdictional areas shall also be designed, at the direction of the Project Biologist, to promote local and regional wildlife movement.

Measure WV-16. Prior to or in conjunction with the permit of application and/or process, Caltrans (Environmental and Maintenance) and resource agencies are to be given an opportunity for review and approval of the design of wildlife movement bridges, undercrossings, and culverts.

The width and the height of the wildlife bridges specified in this mitigation measure are those provided by Caltrans as minimum standards. This approach is appropriate and such detail can be provided during further discussions and only for the selected project. To demonstrate the success of this approach, the TCA has monitored seven wildlife undercrossings during the fall and spring of each year since 1999. The wildlife undercrossings are along the Foothill and Eastern Transportation Corridors and consist of bridges as well as large diameter culverts. Methods used to document the presence and diversity of wildlife using the undercrossings include scent stations, spotlight surveys, general scat surveys, and direct observations. The data have shown that there is a considerable amount of wildlife within the study area using the undercrossings. The wildlife observed using the undercrossings includes mountain lions, bobcats, coyotes, gray foxes, and mule deer. This usage demonstrates the overall success of the undercrossings in allowing wildlife continued movement throughout the region. In summary, preliminary results indicate that wildlife is continuing to use the undercrossings along the Toll Roads.

Wildlife bridges and culverts shall be designed to provide approaching animals a clear view of the habitat or horizon on the opposite site of the structure. The minimum width at the base of the wildlife bridge or culvert shall be six m (20 ft). The minimum vertical clearance shall be 5.2 m (17 ft) from the floor of the bridge/culvert to the bottom of the structure. No artificial lighting shall be installed or used in or around the bridge/culvert, unless otherwise required to meet Caltrans approval. The ground surface of the wildlife bridges and culverts shall be constructed with a slope ratio of 1:1.5 (V:H).

Dirt or natural vegetation substrates, rather than concrete or other human-made material, will be placed along the bottom of the bridges or culverts as reasonably feasible.

Vegetation naturally occurring on the side slopes to the entrances to the underpass will not be removed, to the extent feasible. Where natural vegetation at underpass entrances does not occur, is minimal, or has been removed as a result of bridge or culvert construction, vegetation shall be planted along the slopes that match the closest intact native vegetation. Low-lying shrubs and/or small trees native to the area will be planted to encourage wildlife use of the underpass.

The appropriate vegetation-type and quantity will be determined by the Project Biologist during construction of the underpass and will consist, at a minimum, of appropriate large shrubs and trees that will achieve at least 1.5 m (5 ft) in height at maturity. The replanting will occur during the final stages of underpass construction or immediately following construction in the appropriate season for planting. The planting of vegetation at bridges over drainages shall be compatible with flood control requirements.

Materials such as rip-rap will not be used in or around the underpass entrances unless required by hydrology/hydraulic conditions.

Measure WV-17. Prior to operation of the corridor, chain-link, wire mesh with metal poles, or similar fencing of at least 2.1 m (7 ft) in height will be erected on both sides of the selected alternative from the underpass entrance to a distance of at least 1.0 km (0.62 mi) along the corridor to “funnel” wildlife to the underpass area and to minimize wildlife attempts to cross the roadway surface. Fence height up to 3 m (10 ft) in height will be used in areas deemed appropriate by the project biologist, TCA, USFWS, FHWA and Caltrans.

Wildlife fencing adjacent (100 m/328 ft) to wildlife movement underpasses will be inspected semiannually to identify and repair any gaps or tears in the fence caused by erosion, storm events, vandalism, burrowing animals, or other means that could allow wildlife access onto the roadway surface. TCA will be responsible for the wildlife fencing for the first 3 years of completing the corridor, with Caltrans assuming responsibility thereafter.

Measure WV-18. Prior to operation of the corridor, road signs indicating the potential for deer and mountain lion movement shall be installed where indicated by the Project Biologist, due to the potential for wildlife to circumvent the wildlife fencing.

Measure WV-19. All bridges and culverts in the final design plan will be monitored for a period of 3 years to document the effectiveness of use. Target species to be evaluated shall be

determined by the Regulatory permits, including: USFWS, ACOE and CDFG, specific to each bridge and culvert. Wildlife movement studies will be conducted at each underpass twice each year for at least 8 weeks during the periods between March and May and between September and November. The studies will begin during the first full time period (beginning with March or September) occurring after the opening of the corridor. Reports will be prepared and submitted to the TCA annually. Based on results of surveys, recommendations to enhance wildlife use of underpasses shall be provided as appropriate (*i.e.*, fencing modification, vegetation enhancement, or clearing, etc.).

Measure WV-20. In conjunction with final design, the TCA shall incorporate low-light design features, where feasible, adjacent to the following sensitive wildlife habitats: bridges or culverts within wildlife corridors, and scrub, riparian, and woodland communities. One or more of the following design options shall be used, if feasible, recognizing the constraints of roadway lighting requirements: (1) low-intensity street lamps, (2) low-elevation light poles, or (3) shielding by internal silvering of the globes or external opaque reflectors. Design features shall meet Caltrans approval.

Measure WV-21. During final design, the TCA, in coordination with the RMP, shall design, construct, and/or maintain any structure/culvert placed within a stream where sensitive fish species do/may occur such that it does not constitute a barrier to upstream or downstream movement of aquatic life, or cause an avoidance reaction by fish that impedes their upstream or downstream movement. This includes, but is not limited to, the supply of water at an appropriate depth for fish migration.

Measure WV-22. Prior to construction of the selected alternative, focused sensitive plant species surveys shall be conducted to determine the distribution of sensitive plants within the impact area of the selected alternative so appropriate avoidance (for all sensitive plant species), and seed collection and salvage measures (for Coulter's saltbush, intermediate mariposa lily, southern tarplant, and many-stemmed dudleya) can be implemented. This measure will ensure that the biologist obtains the current onsite conditions, just prior to construction, to maximize avoidance. Surveys shall be conducted during the appropriate time of year (*i.e.*, during the flowering period for each species). Locations of sensitive plant species shall be mapped and shown on construction drawings and identified as ESAs. During final design, temporary access roads will be sited with the approval of the Project Biologist so as to avoid or minimize impacts to sensitive plant populations.

Measure WV-23.

a. During the spring prior to grubbing or grading (or as determined by the Project Biologist), the limits of individual populations of Coulter's saltbush to be impacted shall be flagged and individual plants shall be marked with pin flags to facilitate the locating of individual plants after flowering. Prior to construction, seeds shall be collected from Coulter's saltbush plants from approximately June through October from ripened seed heads, for later propagation, by personnel experienced in collection of native seed and native plant propagation. This seed shall be stored by a certified seed bank. An appropriate site within the upper Chiquita Canyon Conservation Area or other area shall be identified for the seeding of this species by

the Project Biologist. The site shall have similar soils, slope, aspect, and microhabitat characteristics as the site with occupied Coulter's saltbush to support this species.

b. Prior to construction, 75 percent of the Coulter's saltbush plants within the area to be impacted shall be translocated to an appropriate site within the Upper Chiquita Canyon Conservation Area or within an appropriate open space dedication area within the region. Prior to the salvage operation, the number of Coulter's saltbush plants to be relocated shall be determined by the Project Biologist. The site can be the same or a different site than is used for the distribution of seed, but shall have similar soils, slope, aspect, and microhabitat characteristics as the site with occupied Coulter's saltbush. A bulldozer or loader shall be used to remove the top 30 cm (1 ft) of soil, including all plant material which shall be loaded on flatbed trucks and transported to the receiver site. The Project Biologist shall coordinate all salvaging and relocation efforts so that these operations occur in the appropriate season for maximum success.

c. Re-establishment of Coulter's saltbush will be monitored for 5 years. The survival of relocated plants will be recorded each year. Relocation will be considered successful when the survivorship of the relocated plants has stabilized with a 50 percent survival rate, and establishment of seedlings from the seeded material is documented.

Measure WV-24.

a. Intermediate mariposa lily seed shall be collected from populations to be impacted. Prior to grubbing or grading (or as otherwise determined by the Project Biologist), the limits of individual populations to be impacted shall be flagged and individual plants shall be marked with pin flags to facilitate locating individual plants after flowering. Seed shall be collected in late July or early August from ripened seed heads, for later propagation or hand seeding, by personnel experienced in the collection of native seed and native plant propagation.

b. Seed collection shall be conducted during two successive years and the following 3-year program shall be implemented to ensure the likelihood of success. Propagated mariposa lilies typically exhibit a germination rate of 80 percent; this percentage shall be used to determine the number of seeds to be collected to ensure production of the same number of plants as shall be impacted by construction. The propagated plants shall be grown for 2 years to allow the bulbs to reach optimal size prior to transplantation. The remaining seed not used for propagation from the first year of seed collection shall be divided in half with one-half hand broadcast during the first year and the remaining one-half hand broadcast the following year.

c. The propagated plants shall be introduced (over the 3-year program), using at least a 2:1 ratio, into appropriate habitat in open space dedication areas, or as directed by the Project Biologist. Seeding shall occur in similar areas. Site selection shall be based on the presence of suitable habitat as determined by the Project Biologist. Bulbs from the propagated plants shall be planted at the end of the second growing season. The same program shall be followed for seed collected during the second year. Planting of bulbs and hand broadcasting of seed shall be performed in September or October.

d. Re-establishment of intermediate mariposa lily will be monitored for 3 years following initial planting of the propagated plants and seeding. The survival of the plants will be recorded each year. Establishment of the population will be considered successful when the survivorship of the relocated plants has stabilized with a minimum 10 percent flowering in any one year of the monitoring period and establishment of seedlings from the seeded material is documented.

Measure WV-25.

a. Areas determined to have appropriate hydrology and soil chemistry (salinity) shall be reseeded with seed collected from populations of southern tarplant. Southern tarplant is restricted to saline, vernally mesic areas, often along the margins of estuaries or areas of high salinity. The Project Biologist shall identify candidate areas within open space areas that exhibit suitable conditions for introduction of the tarplant.

b. For 1 year prior to construction as feasible, the TCA shall have southern tarplant seed collected by personnel experienced in collection of native seeds. Seed collection shall be conducted during successive years from September through December. One-half of the first years' collected seed shall be hand broadcast at the reintroduction site with the remaining one-half stored in appropriate conditions for introduction the following year. Seed collected during the second season shall be stored for potential later use in the event that success standards are not met following the seeding during years 1 and 2.

c. Because southern tarplant is an annual species, population numbers are expected to naturally fluctuate from year to year depending upon environmental conditions. Reseeded areas shall be monitored for 3 years following the initial seeding. Establishment shall be considered successful if plant densities during any of the three years of monitoring are comparable to densities of the impacted populations based on sampling quadrants. If established populations do not achieve comparable densities of impacted populations, additional reintroduction sites shall be identified and stored seed, obtained during the collection period, shall be introduced into additional sites over a two-year period (as in the initial reintroduction program described above). The additional sites shall be monitored for 3 years and shall be considered successful if population numbers at all of the sites achieve densities of impact areas. If established populations have not reached the density threshold following the addition of supplemental sites, further remedial measures shall be implemented as determined appropriate by the Project Biologist.

Measure WV-26.

a. Many-stemmed dudleya caudexes and seed shall be collected from populations to be impacted. Prior to grubbing or grading (or as otherwise determined by the Project Biologist), the limits of individual populations to be impacted shall be flagged and groups of plants shall be marked with pin flags to facilitate the locating of individual plants after flowering. Seed shall be collected in late July or early August from ripened seed heads, for later propagation or hand seeding, by personnel experienced in the collection of native seed and native plant propagation. Twenty-five percent of the seeds collected will be stored with Rancho Santa

Ana Botanical Gardens (RSABG) by their standard agreement. The remainder of the seed will be used to establish the dudleya population as described below.

b. Caudexes shall be harvested for later planting, using appropriate screens or mesh and shall be conducted by individuals experienced in the salvage of many-stemmed dudleya. Where possible, caudexes will be salvaged by removing soil blocks containing marked dudleya. Both seed and collected caudexes shall be replanted and established at an appropriate site within an open space dedication area at the direction of the Project Biologist.

c. Monitoring of the established populations shall be conducted for 3 years. The propagated caudexes shall be introduced (over the 3-year program), using at least a 1:1 ratio. Establishment shall be considered successful if planted/seeded populations total 75 percent of the impacted populations and the population demonstrates recruitment of seedlings. If planted/seeded populations do not achieve 75 percent of the impacted populations, additional collection of seed shall be performed and additional caudexes will be propagated. If planted/seeded populations do not achieve 75 percent thresholds, further remedial measures shall be implemented as recommended by the Project Biologist.

Measure WV-27. Before entering or leaving the construction site, all construction equipment shall be inspected for evidence of invasive species and/or their seeds. Should any plants and/or seeds be detected, the equipment will be washed to ensure no invasive species and/or their seeds will be brought into or removed from the site.

Measure WV-28. Prior to construction, substantial populations of invasive plant species identified on the State of California List of Noxious Weed Species and the California Exotic Pest Plant Council Exotic Pest Plants (CalEPPC) of Greatest Ecological Concern in California List adjacent to the grading limits shall be mapped for monitoring purposes.

Measure WV-29. The Project Biologist shall prepare an invasive species management program to be incorporated into the BRMP. The program shall discuss the invasive species within landscaping and mitigation areas to be eradicated or controlled and eradication methods, which may include mowing, hand removal, or herbicide application. Removal of invasive plant species on the State of California List of Noxious Weed Species with Pest Rating A shall be required, at the direction of the Project Biologist. Eradication, containment, or control of all invasive plant species on the State of California List of Noxious Weed Species with Pest Rating B shall be at the discretion of the Project Biologist. The program shall also address invasive species identified in the California Exotic Pest Plant Council Exotic Pest Plants of Greatest Ecological Concern in California List and methods for their control. The potential for contribution of funds to such programs as the Arundo Removal Program to assist with removal of giant reed or other species from riparian habitats such as San Juan Creek shall also be addressed. The program shall also discuss monitoring of the landscaped and mitigation areas to ensure invasive species are properly controlled or eradicated. The maintenance of the mitigation sites along the corridor will be under the supervision of the Project Biologist (Executive Order 13112, Feb. 3, 1999).

Measure WV-30. Before and during construction (as appropriate), the Project Biologist shall conduct focused nocturnal and diurnal surveys within suitable habitat between February and May

(a minimum of 1 week prior to the onset of construction) to determine the presence or absence of the western spadefoot toad in the impact area. Any western spadefoot toads found within the impact area will be relocated outside the construction area by the Project Biologist. In areas where western spadefoot toads were found, fencing or screening approximately 1.5 m (5 ft) in height (with 1 m (3 ft) buried below the surface) will be installed to prevent western spadefoot toads from entering the area after the onset of construction.

Measure WV-31. Before and during construction (as appropriate), the Project Biologist shall conduct focused diurnal surveys within suitable habitat between February and May to determine the presence or absence of the southwestern pond turtle in the impact area. Southwestern pond turtles observed prior to and during construction within and adjacent to the project footprint will be relocated outside of the construction area either upstream or downstream from the selected alternative by the Project Biologist. In areas where Southwestern pond turtles are found, fencing or screening approximately 1.5 m (5 ft) in height (with 0.2 m [0.5 ft] buried below the surface) will be installed to prevent southwestern pond turtles from entering the area after the onset of construction. Fencing/screening will remain in place from June through August. "Southwestern pond turtles removed from the construction area will be relocated in such a way that the exclusion fences will not isolate any animals from the aquatic parts of their habitat."

Measure WV-32. During grading activities, two-striped garter snakes observed within and adjacent to the impact area will be relocated outside of the construction area either upstream or downstream of the selected alternative by the Project Biologist.

Measure WV-33. To minimize and offset adverse effects of the selected alternative on the San Diego cactus wren, suitable habitat for this species (as determined by the Project Biologist) shall be grubbed from the project footprint area from September to February if feasible (generally outside the breeding season for this species). The Project Biologist shall survey the suitable habitat within the areas to be grubbed 1 day prior to any vegetation disturbance to determine the location and numbers of San Diego cactus wrens. The Project Biologist will be on-site and present during all suitable habitat clearing and removal activities to minimize the potential for individual San Diego cactus wrens to be wounded or killed during the clearing of habitat.

Measure WV-34. If grubbing activities between February and August (generally within the breeding season for San Diego cactus wren) are unavoidable, the following measures will be implemented:

a. Surveys by the Project Biologist will be conducted a minimum of three times on separate days after the initiation of the nesting season to determine the presence of San Diego cactus wrens, nest building activities, egg incubation activities, or brood rearing activities. These surveys will be conducted within the week prior to the initiation of brushing, grading, or other construction activities. One survey will be conducted the day immediately prior to the initiation of work. The USFWS will be notified in writing 7 days prior to the initiation of surveys.

b. If no nest(s), nesting behavior, or brood rearing activities are detected, work may commence. Prior to and during work activities, the Project Biologist will locate any individual San Diego

cactus wrens on-site and direct operators to begin in an area away from the birds. The pattern of brushing/grubbing activities will be designed to optimize opportunities for flushed birds to be directed towards the open space areas in the vicinity of the impact area.

c. During construction, no activity will occur within approximately 150 m (500 ft) of active nests.

Measure WV-35.

a. Prior to construction activity, the Project Biologist shall survey the construction limits for the presence of occupied raptor nests and nest burrows (for burrowing owls). Occupied raptor nests/burrows shall be mapped on the construction plans by the Project Biologist. The Project Biologist will visit the nest/burrow site at the beginning of the nesting season to verify the use of the nests/burrows for that particular year.

b. If nesting activity begins at any nest site, then the active nest/burrow(s) will be protected as an ESA until nesting activity has ended to ensure compliance with Section 3503.5 of the CDFG Code. To protect any active nest/burrow sites, the following restrictions on construction are required between February and June (or until nests are no longer active as determined by the Project Biologist): (1) clearing limits will be established a minimum of approximately 150 m (500 ft) in any direction from raptor nests/burrows (or as otherwise determined by the Project Biologist); and (2) access and surveying will not be allowed within approximately 300 m (900 ft) of nests/burrows (or as otherwise determined by the Project Biologist).

Measure WV-36. Prior to construction activity, the Project Biologist shall survey the construction limits for the presence of occupied breeding coyote, bobcat, or mountain lion dens. In the event that an occupied breeding coyote, bobcat, or mountain lion den is located within the impact area, then grading and construction operations shall be redirected temporarily around the den for a distance of approximately 150 m (500 ft) or as otherwise determined by the Project Biologist. The dens shall be resurveyed by the Project Biologist within the last month of the breeding seasons of these species to verify completion of the breeding cycle. Dens shall be removed during the non-breeding season only.

Measure WV-37. During the spring and summer (May through August) prior to the habitat removal, a qualified bat biologist shall survey all potential roosting habitat proposed for removal by the proposed construction. If a roost is found, the animals will be evicted and the resource sealed or removed so the bats cannot return and would be forced to find alternative roost sites. Tree removal shall be conducted between September and November to avoid hibernating bats (December through February) and maternity season (May through August) if feasible.

Measure WV-38. Impacts to floodplain sage scrub, riparian herb, and other sub-types within the Vernal Pools, Seeps, and Wet Meadows and Marsh plant communities shall be mitigated at a 1:1 ratio or other ratio that compensates for functions and values. Mitigation shall consist of creating the above mentioned community types in the approximate proportions in which they currently exist within the impact area or as otherwise required by the resource agencies. Creation areas

shall occur within dedicated open space areas including, but not limited to, the Upper Chiquita Canyon Conservation Easement area. The creation program for the above areas shall be included in the BRMP and shall include the following measures.

- Site analysis for appropriate soils and hydrology.
- Site preparation specifications based on site analysis, including but not limited to grading, and weeding.
- Soil and plant material salvage from impact areas, as appropriate to the timing of impact and restoration as well as the location of restoration sites.
- Specifications for plant and seed material appropriate to the locality of the mitigation site.
- Specifications for site maintenance to establish the habitats, including but not limited to weeding and temporary irrigation.

Creation areas shall be considered successful if the following standards are achieved:

- The site does not require substantial maintenance for at least 2 consecutive years during the monitoring period.
- The site must exhibit evidence of natural recruitment of native species, including plant reproduction and/or setting of seeds.
- Absolute percent cover of native species is comparable to the absolute cover of native species at an appropriate reference site within an 80 percent confidence limit.
- An index of species diversity of the restored and/or created habitat areas is statistically comparable to an appropriate reference site within an 80 percent confidence limit.

Monitoring shall be conducted for 5 years (or less if success criteria are met as designated above earlier) to ensure successful establishment of hydrophytic vegetation within the restored/created areas by wetland species. If success standards are not met, remedial measures, seeding, or introduction of container stock shall be implemented as directed by the Project Biologist.

Measure WV-39. TCA will mitigate impacts to riparian scrub, woodland, and forest communities by replacing, creating, restoring, or preserving (1) 0.40 ha (1 ac) of the identified resource for every 0.40 ha (1 ac) of the applicable resource impacted by the project or other ratio that compensates for functions and values, or (2) such other mitigation requirement that is necessary to meet the regulatory standards of an applicable state or federal regulatory program. Mitigation areas shall occur within dedicated open space areas including, but not limited to, the Upper Chiquita Canyon Conservation Easement area as determined by the Project Biologist. The restoration program shall be detailed with the BRMP.

Prior to restoration of these communities, hydrological testing and monitoring of the creation site shall be conducted to determine that sufficient hydrology exists to support the community. If necessary, a temporary irrigation program shall be incorporated into the mitigation design to ensure successful establishment of the community.

The following performance standards shall apply for the restoration of these areas (except for southern coast live oak riparian forest). Restoration shall be considered successful if:

- The site does not require substantial maintenance for at least 2 consecutive years during the monitoring period.
- The site must exhibit evidence of natural recruitment of native species, including plant reproduction and/or setting of seeds.
- Absolute percent cover of native upper and mid canopy species is 70 percent in forest scrub communities and 5 percent in woodland communities.
- An index of species diversity of the restored areas is statistically comparable to an appropriate reference site within an 80 percent confidence limit.

For southern coast live oak riparian forest, the following standards shall apply:

- The site does not require substantial maintenance and meets the success criteria established for this community for at least 2 consecutive years during the monitoring period.
- The site must exhibit evidence of natural recruitment of native species, including plant reproduction and/or setting of seeds.
- Absolute percent cover of native upper and mid canopy species is 50 percent, with 5 percent cover from oak trees.
- An index of species diversity of the restored areas is statistically comparable to an appropriate reference site within an 80 percent confidence limit.

Monitoring shall be conducted for a minimum of 5 years to ensure successful establishment of the restored areas. If success standards are not met, remedial measures including introduction of additional container stock and adjusting of irrigation shall be implemented as directed by the Project Biologist.

Measure WV-40. Impacts to open water shall be mitigated at a 1:1 ratio by the creation of wetlands and impounded features to be incorporated into the herbaceous riparian habitat restoration. The open water mitigation areas shall be located at a site determined by the Project Biologist to have hydrology sufficient to support the desired open water feature. Appropriate hydrological and soils testing shall be performed to ensure that the created open water area function properly. Creation of open water areas shall be maintained as part of the herbaceous riparian habitat restoration.

MEASURES RELATED TO THREATENED AND ENDANGERED SPECIES

Measure TE-1. Prior to construction, the TCA shall designate a Project Biologist responsible for overseeing biological monitoring, regulatory compliance, and restoration activities associated with construction of the selected alternative in accordance with the adopted mitigation measures and applicable law.

Measure TE-2. During final design of the project, the Project Biologist shall review the design plans and make recommendations for avoidance and minimization of sensitive biological resources. TCA's Environmental and Engineering Staff shall determine the implementation of those recommendations.

Measure TE-3. A Biological Resources Management Plan (BRMP) shall be prepared prior to construction. The BRMP shall provide specific design and implementation features of the biological resources mitigation measures outlined in the resource agency approval documents. Issues to be discussed in the BRMP shall include, but are not limited to, resource avoidance, minimization, and restoration guidelines, performance standards, maintenance criteria, and monitoring requirements. The Draft BRMP shall be submitted to the USFWS, NMFS, CDFG, USACOE, RWQCB, FHWA and Caltrans for review to the extent required by permit by such agencies.

The primary goals of the BRMP are to ensure that (1) the long-term perpetuation of the existing diversity of habitats in the project area and adjacent urban interface zones and minimize offsite or indirect effects; (2) the project is not likely to jeopardize the continued existence of any federally listed or state-listed endangered or threatened species; and (3) impacts to endangered and threatened species are minimized and mitigated to the maximum extent practicable. The BRMP shall contain at a minimum specific construction monitoring programs for thread-leaved brodiaea, arroyo toad, coastal California gnatcatcher, least Bell's vireo, and Pacific pocket mouse.

Measure TE-4. During grading activities and construction operations, the Project Biologist shall prepare a monthly biological monitoring letter report summarizing site visits, documenting adherence or violations of required habitat avoidance measures, and listing any necessary remedial measures. The report shall be submitted to the TCA.

Measure TE-5. Chain-link, wire mesh with metal poles, or similar fencing of at least 2.1 m (7 ft) in height will be erected on both sides of the selected alternative from the underpass entrance to a distance of at least 1.0 km (0.62 mi) along the corridor to "funnel" wildlife to the underpass area and to minimize wildlife attempts to cross the roadway surface. Fence height up to 3 m (10 ft) in height will be used in areas deemed appropriate by the Project Biologist, TCA, USFWS, FHWA and Caltrans. In addition, in areas known to support the arroyo toad, a permanent mesh fence shall be installed at the base of the chain-link fence for at least 1.0 km (0.62 mi) to keep the toads from entering onto the roadway surface.

The width and the height of the wildlife bridges specified in this mitigation measure are those provided by Caltrans as minimum standards. This approach is appropriate and such detail can be provided during further discussions and only for the selected project. To demonstrate the success of this approach, the TCA has monitored seven wildlife undercrossings during the fall and spring of each year since 1999. The wildlife undercrossings are along the Foothill and Eastern Transportation Corridors and consist of bridges as well as large diameter culverts. Methods used to document the presence and diversity of wildlife using the undercrossings include scent stations, spotlight surveys, general scat surveys, and direct observations. The data have shown that there is a considerable amount of wildlife within the study area using the

undercrossings. The wildlife observed using the undercrossings includes mountain lions, bobcats, coyotes, gray foxes, and mule deer. This usage demonstrates the overall success of the undercrossings in allowing wildlife continued movement throughout the region. In summary, preliminary results indicate that wildlife is continuing to use the undercrossings along the Toll Roads.

Measure TE-6. Prior to construction of the selected alternative, focused sensitive plant species surveys shall be conducted to determine the distribution of sensitive plants within the impact area of the selected alternative so appropriate avoidance, and seed collection and salvage measures for thread-leaved brodiaea can be implemented. This measure will ensure that the biologist obtains the current onsite conditions, just prior to construction, to maximize avoidance. Surveys shall be conducted from March through June which is the blooming period for this species. Locations of thread-leaved brodiaea species shall be mapped and shown on construction drawings and identified as ESAs. During final design, temporary access roads will be sited with the approval of the Project Biologist so as to avoid or minimize impacts to sensitive plant populations.

Measure TE-7.

a. Prior to construction (*e.g.*, clearing, grubbing or grading), focused surveys for the thread-leaved brodiaea shall be conducted during the flowering period for this species (approximately March through June). The locations of plants identified within the disturbance limits shall be recorded with a Global Positioning System (GPS) unit with sub-meter accuracy. The soils containing thread-leaved brodiaea shall be tested to determine soil texture, and organic matter, and transported to a native plant nursery for germination and propagation.

b. Prior to construction, soil containing thread-leaved brodiaea corms within the impact area shall be collected by personnel experienced in the salvage of corms. Areas of soil 0.6 m by 1 m by 0.6 m (2 ft by 3 ft by 2 ft) deep or 1 m by 1.3 m by 0.6 m (3 ft by 4 ft by 2 ft) deep shall be collected and transported for placement in an appropriate translocation site selected by the Project Biologist. The translocation site shall be located in a conservation area within an open space dedication area within the region and shall have similar soils, aspect, slope, and hydrology to the donor site (*i.e.*, the site from which thread-leaved brodiaea corns were collected).

c. Relocation success will be monitored for 5 years. The number of relocated plants that will emerge in any one year is variable and will depend on seasonal rainfall. Relocation will be considered successful when 10 percent of the relocated population emerges and sets viable seed in any monitoring year. The success criteria may vary as determined by the Project Biologist in consultation with botanists and USFWS staff with recent experience in brodiaea transplantation methodologies in the region.

Measure TE-8. To avoid impacting vernal marsh FEVM-16 and Riverside fairy shrimp from construction activities, this area shall be flagged and mapped. All construction roads and other construction related activities shall be redirected around this feature. The watershed which supplies this marsh shall also be flagged for avoidance and enclosed with silt fencing per the

direction of the Project Biologist to ensure that erosion/ground disturbance does not compromise water quality within the pool. Silt fencing shall remain intact for the duration of construction and until all disturbed soils have been stabilized. Following removal of the silt fencing, fiber rolls, or similar erosion control devices shall be placed around the pool to filter incoming runoff and reduce the potential for siltation or water turbidity until all earth moving activities have ceased and landscaping installed. See also RMP for all mitigation measures.

Measure TE-9. During final design, the TCA, as described in the RMP, shall design, construct, and/or maintain any structure/culvert placed within a stream where endangered or threatened fish do/may occur such that it does not constitute a barrier to upstream or downstream movement of aquatic life, or cause an avoidance reaction by fish that impedes their upstream or downstream movement. This includes, but is not limited to, the supply of water at an appropriate depth for fish migration.

Measure TE-10. An Arroyo Toad Resource Management Plan (ATRMP) will be prepared. The ATRMP will be incorporated into the BRMP, and action items identified in the plan will be implemented by TCA and monitored by the Project Biologist. The plan shall include measures detailing how the impact area will be surrounded with a silt fence enclosure, and how arroyo toads will be removed and relocated from the construction impact area during the breeding season (when they are detectable by vocalizations) and placed in suitable habitat either upstream or downstream of the selected alternative during construction. The ATRMP will identify areas of collection, suitable areas for temporary housing, and restoration guidelines to be in place prior to release of toads to their original location. The plan shall be submitted to the USFWS to the extent required by such agency. The locations of areas known to support arroyo toads shall be identified in the ATRMP and on the ESA maps to comply with the requirements of the biological opinion.

Measure TE-11. Prior to initiating any ground-disturbing activities in occupied/suitable habitats, or habitats proximal to suitable or occupied habitats for arroyo toad, exclusionary fencing shall be installed around the perimeter of the construction area. Fencing or screening approximately 60 cm (2 ft) in height (30 cm [1 ft] of which will be buried below the surface) shall be installed to prevent arroyo toads from entering the area after the onset of construction. The fencing will be installed at least 14 days prior to the initiation of work and must be made of a material appropriate to preclude any arroyo toads from entering the construction area. Fencing will be removed each winter during construction and at the end of project construction. Vehicle use will be restricted within areas known to support populations of the arroyo toad that are shown on the ESA maps.

Measure TE-12.

a. The Project Biologist shall conduct three focused arroyo toad surveys within the fenced construction site for arroyo toads a minimum of 14 nights prior to initiating project construction. If climatic conditions are not appropriate for arroyo toad movement during the surveys, the Project Biologist may attempt to elicit a response from the arroyo toads, during nights with temperatures of 13ºC (55ºF) or greater, by spraying the project area with water to simulate a rain event. During construction, arroyo toads surveys will be performed a

minimum of once per week and on all nights where the combination of rain/humidity and temperature would increase the movement of arroyo toads.

b. If arroyo toads are found with the construction side of the exclusionary fencing, arroyo toads will be removed by the Project Biologist and relocated from the construction impact area and placed in suitable habitat either upstream or downstream of the construction area as outlined in the Arroyo Toad Resource Management Plan.

Measure TE-13. The Contractor shall locate staging areas for construction equipment outside of areas within the jurisdiction of the USACOE or CDFG known to support arroyo toad to minimize impacts to sandy creek benches that may provide aestivating habitat for the arroyo toad to avoid taking any individuals.

Measure TE-14. When conducting construction and/or other ground-disturbing activities in arroyo toad-occupied habitats or in adjacent upland areas proximal to known arroyo toad habitats, the Contractor shall cover all grubbing spoils or other grading debris with plastic sheeting to prevent arroyo toads from opportunistically burrowing in these exposed and friable soil piles. This sheeting must be placed on the soil piles before sunset and shall remain on (during nighttime hours) for the duration of the construction/ground disturbing activities. The areas where these measures must be implemented shall be determined by the Project Biologist in coordination with the USFWS. If the sheeting does not remain in place due to unforeseen circumstances, (inclement weather or other disturbances) a biologist will monitor the soil piles for the arroyo toad. Any arroyo toads found within the soil piles will be removed and relocated as outlined in the Arroyo Toad Resource Management Plan.

Measure TE-15. The Contractor shall not drive upon construction roads or other roads/surfaces adjacent to arroyo toad occupied habitat after sunset. If the site must be accessed, a biologist permitted to handle arroyo toad must be present in the vehicle to identify any individuals on the road and the vehicle shall not exceed a speed of 16 km per hour (10 mi per hour) within these areas.

Measure TE-16. Prior to construction, the Project Biologist shall document the area of pools and gravel bars within the temporary disturbance areas of creeks occupied by the Arroyo Toad. At the conclusion of construction, the TCA shall construct artificial pools and gravel bars within these temporary disturbance areas. The artificial pools and gravel bars shall provide potential breeding and aestivating habitat for arroyo toad. These areas will be identified and established by the Project Biologist in the BRMP. The artificial pools and gravel bars shall be equal to or greater in size than those areas impacted by project implementation. Because of the natural flooding and scouring conditions of the creeks within the study area, no maintenance of these areas will be required. The construction of these features shall not preclude required Caltrans bridge maintenance. Plans shall be submitted to USFWS for review and approval, to the extent required by such agency, prior to implementation.

Measure TE-17. Prior to the arroyo toads' re-establishment to their original locations, specific activities to enhance their habitat and improve their potential for re-occupation will be implemented. These measures include the removal (up to 15 days in advance of the re-

establishment), to the extent practicable, of predatory species such as bullfrogs, western mosquito fish, yellow bullheads, bluegill, and additional predatory invertebrates, amphibians, and introduced fish species. Plans shall be submitted to USFWS for review and approval prior to implementation to determine compliance with the biological opinion.

Measure TE-18. To minimize and offset adverse effects of the selected alternative on the coastal California gnatcatcher, habitat suitable for this species (as determined by the Project Biologist) shall be grubbed from the project footprint area from September to February if feasible (generally outside the breeding season for these species). The Project Biologist shall survey the suitable habitat within the areas to be grubbed one day prior to any vegetation disturbance to determine the location and numbers of coastal California gnatcatchers. The Project Biologist will be on-site and present during all suitable habitat clearing and removal activities to minimize the potential for individual coastal California gnatcatchers to be wounded or killed during the clearing of habitat.

Measure TE-19. If grubbing activities are unavoidable during the coastal California gnatcatcher breeding season, which is between February and August, the following measures will be implemented:

Surveys by the Project Biologist will be conducted a minimum of three times on separate days after the initiation of the nesting season to determine the presence of coastal California gnatcatchers, nest building activities, egg incubation activities, or brood rearing activities. These surveys will be conducted within the week prior to the initiation of brushing, grading, or other construction activities. One survey will be conducted the day immediately prior to the initiation of work. The USFWS will be notified in writing 7 days prior to the initiation of surveys.

If no nest(s), nesting behavior, or brood rearing activities are detected, work may commence. Prior to and during work activities, the Project Biologist will locate any individual coastal California gnatcatchers on-site and direct operators to begin in an area away from the birds. The pattern of brushing/grubbing activities will be designed to optimize opportunities for flushed birds to be directed towards the open space areas in the vicinity of the impact area.

During construction, no activity will occur within approximately 150 m (500 ft) of active nests.

Measure TE-20. To minimize and offset adverse effects of the selected alternative on the least Bell's vireo, suitable habitat for this species, as determined by the Project Biologist, shall be grubbed from the impact area from 16 September to 14 March (generally outside the breeding season for this species), if feasible.

Measure TE-21. If grubbing activities between 15 March and 15 September (generally within the breeding season for the least Bell's vireo) are unavoidable, the following contingency measures will be implemented:

a. Surveys by the Project Biologist will be conducted a minimum of three times on separate days after the initiation of the nesting season to determine the presence of least Bell's vireos, nest building activities, egg incubation activities, or brood rearing activities. These surveys

will be conducted within the week prior to the initiation of brushing, grading, or other construction activities. One survey will be conducted the day immediately prior to the initiation of work. The USFWS will be notified in writing prior to the initiation of surveys.

b. If no nest(s), nesting behavior, or brood rearing activities are detected, work may commence. Prior to and during work activities, the Project Biologist will locate any individual least Bell's vireos on-site and direct operators to begin in an area away from the birds. The pattern of brushing/grubbing activities will be designed to optimize opportunities for flushed birds to be directed towards the open space areas in the vicinity of the impact area.

c. During construction, no activity will occur within approximately 150 m (500 ft) of active nests.

Measure TE-22.

a. To minimize indirect disturbance of nesting least Bell's vireos, the Contractor will not engage in any construction activities within 61 m (200 ft) of occupied least Bell's vireo habitat between the hours of 0600 and 1100 every day during the peak nesting period of 1 April to 15 July of any given calendar year if said construction activities result in noise readings greater than 60 dBA measured at the edge of the territory of the vireo in the area.

b. For construction, temporary or permanent noise barriers may be installed under the direction of the Project Biologist and USFWS to reduce noise levels. The Project Biologist shall be responsible for monitoring the noise level.

c. The Project Biologist shall be responsible for all noise monitoring reports which shall include, at a minimum, (1) baseline noise measurements at known least Bell's vireo nesting sites within riparian communities within the impacts area, prior to construction, (2) the effect construction noise has on nesting pairs in the vicinity of construction, (3) baseline noise measurements at known nesting adjacent to the alignment, prior to traffic, and (4) the effect traffic noise has on nesting pairs in the vicinity of the selected alignment. These reports will be submitted to the TCA.

Measure TE-23. During final project design, an undercrossing shall be provided in the vicinity of the San Mateo North population of the Pacific pocket mouse for any alternative selected that occurs within this area. The undercrossing shall allow for potential movement of Pacific pocket mice under the alignment. The exact placement and design of the undercrossing shall be determined by the Project Biologist, in coordination with MCB Camp Pendleton and with USFWS during the Section 7 consultation.

Measure TE-24. Prior to the initiation of construction in areas within or proximal to known sites occupied by the Pacific pocket mouse, a Pacific Pocket Mouse Resource Management Plan (PPMRMP) shall be prepared and submitted to the USFWS for review to determine compliance with the biological opinion and incorporated into the BRMP. This plan shall identify the strategies available for minimizing impacts to comply with the no jeopardy standard of Section 7(a)2 of the Federal Endangered Species Act.

The PPMRMP shall identify conservation measures. These conservation measures will be consistent with the biological opinion issued by the USFWS. Potential conservation measures may include:

a. Temporary construction measures—including temporary fencing:

- Invasive species control
- Habitat management and enhancement
- Predator control
- Control of public access
- PPM population monitoring

Implementation of these conservation measures will be completed in conjunction with USFWS and MCB Camp Pendleton.

b. Project Design Features—PPM

- Barriers along the boundary
- Minimization of roadway lighting
- Minimization of fire risk

Measure TE-25. To mitigate impacts, the TCA has identified additional habitat preservation and restoration activities in the Upper Chiquita Canyon Conservation Area. The Upper Chiquita Canyon Conservation Area consists of approximately 478.7 ha (1,182 ac) created by the TCA to mitigate biological impacts resulting from construction of the FTC-N. Of these 478.7 ha (1,182 ac), 327 credits have been set aside as a mitigation bank for future project impacts. The Conservation Area was originally under substantial threat for development and the resources within the Area have been conserved, but otherwise would have been lost or substantially degraded. In addition, the Upper Chiquita Canyon Conservation Area provides opportunities for preservation activities consisting of additional habitat for oak woodland and sensitive plant species. There are also opportunities for restoration activities on site that would include additional acres of oak woodland, non-wetland drainages, coastal sage scrub, coastal sage scrub/native perennial grassland ecotone, and native perennial grassland habitats. These opportunities for preservation and restoration activities would also serve to mitigate impacts on sensitive plants for the SOCTIIP Alternatives.

a. Impacts to scrub communities (and all sub-types thereof except floodplain sage scrub) shall be mitigated through the use of scrub mitigation credits in the Upper Chiquita Canyon Conservation Easement area and additional preservation (if necessary). The Upper Chiquita Canyon Conservation Easement area currently contains 327 mitigation credits approved by the USFWS and CDFG. The scrub areas impacted by the selected alternative will be mitigated at a credit to hectare ratio of 1:0.40 (one Upper Chiquita Canyon Conservation Easement mitigation credit for every 0.40 ha impact or one Upper Chiquita Canyon

Conservation Easement mitigation credit for every 1.0 ac lost).

b. Any additional scrub areas restored within the Upper Chiquita Canyon Conservation Easement area may be added to the credit total, with the approval of the USFWS, and applied to the mitigation ratio accordingly. The TCA and the USFWS shall determine the criteria for the establishment of the new credits for the restored areas pursuant to the Upper Chiquita Canyon Conservation Bank Agreement which was entered into with the USFWS and the CDFG.

c. Any scrub areas that are impacted by the selected alignment and that have not been mitigated by the use of the Upper Chiquita Canyon Conservation Easement mitigation credits (*i.e.*, impact area exceeds mitigation credits available) shall be mitigated through preservation at a ratio of 1:1.

Measure TE-26. Impacts to native grasslands shall be mitigated at a 1:1 ratio through either preservation or restoration in designated open space (*e.g.*, Upper Chiquita Canyon Conservation Easement). Should restoration be proposed, the restoration areas shall be located in areas deemed appropriate by the Project Biologist for native grassland restoration. Restoration areas shall occur within dedicated open space areas including, but not limited to, the Upper Chiquita Canyon Conservation Easement area. The restoration program for native grassland areas shall be included in the BRMP and shall include the following measures.

- Site analysis for appropriate soils.
- Site preparation specifications based on site analysis, including but not limited to grading and weeding.
- Specifications for plant and seed material appropriate to the locality of the mitigation site and the timing of restoration activities.
- Specifications for site maintenance to establish the habitats, including but not limited to weeding and temporary irrigation.

Restoration areas shall be considered successful at five years if the following standards are achieved:

- The site does not require substantial maintenance for at least two consecutive years during the monitoring period.
- The site must exhibit evidence of natural recruitment of native species, including plant reproduction and/or setting of seeds.
- Soil at the site exhibits a level of beneficial arbuscular mycorrhizal fungi that is comparable to an appropriate reference site, as demonstrated through soil infestivity potential.
- Absolute percent cover of native species is comparable to the absolute cover of native species at an appropriate reference site within an 80 percent confidence limit.
- An index of species diversity of the restored and/or created habitat areas is statistically comparable to an appropriate reference site within an 80 percent confidence limit.

Monitoring shall be conducted for 5 years (or less if site meets success criteria as designated above earlier) to ensure successful establishment of native grassland vegetation within the restored areas. If success standards are not met, remedial measures, hydroseeding, or introduction of container stock shall be implemented as directed by the Project Biologist.

Measure TE-27. Impacts to floodplain sage scrub, riparian herb, and other sub-types within the Vernal Pools, Seeps, and Wet Meadows and Marsh plant communities (as defined in Section 5.0 of the NES) shall be mitigated at a 1:1 ratio or other ratio that compensates for functions and values. Mitigation shall consist of creating the above mentioned community types in the approximate proportions in which they currently exist within the impact area or as otherwise required by the resource agencies. Creation areas shall occur within dedicated open space areas including, but not limited to, the Upper Chiquita Canyon Conservation Easement area. The creation program for the above areas shall be included in the BRMP and shall include the following measures.

- Site analysis for appropriate soils and hydrology.
- Site preparation specifications based on site analysis, including but not limited to grading and weeding.
- Soil and plant material salvage from impact areas, as appropriate to the timing of impact and restoration as well as the location of restoration sites.
- Specifications for plant and seed material appropriate to the locality of the mitigation site.
- Specifications for site maintenance to establish the habitats, including but not limited to weeding and temporary irrigation.
- Creation areas shall be considered successful if the following standards are achieved:
- The site does not require substantial maintenance for at least two consecutive years during the monitoring period.
- The site must exhibit evidence of natural recruitment of native species, including plant reproduction and/or setting of seeds.
- Absolute percent cover of native species is comparable to the absolute cover of native species at an appropriate reference site within an 80 percent confidence limit.
- An index of species diversity of the restored and/or created habitat areas is statistically comparable to an appropriate reference site within an 80 percent confidence limit.

Monitoring shall be conducted for five years (or less if success criteria are met as designated above earlier) to ensure successful establishment of hydrophytic vegetation within the restored/created areas by wetland species. If success standards are not met, remedial measures, seeding, or introduction of container stock shall be implemented as directed by the Project Biologist.

Measure TE-28. Impacts to riparian scrub, woodland, and forest communities (as defined in Section 5.0 of the NES) shall be mitigated by mitigation of such communities at a 1:1 ratio or other ratio that compensates for functions and values. Mitigation areas shall occur within

dedicated open space areas including, but not limited to, the Upper Chiquita Canyon Conservation Easement area as determined by the Project Biologist. The restoration program shall be detailed with the BRMP.

Prior to restoration of these communities, hydrological testing and monitoring of the creation site shall be conducted to determine that sufficient hydrology exists to support the community. If necessary, a temporary irrigation program shall be incorporated into the mitigation design to ensure successful establishment of the community.

The following performance standards shall apply for the restoration of these areas (except for southern coast live oak riparian forest). Restoration shall be considered successful if:

- The site does not require substantial maintenance for at least two consecutive years during the monitoring period.
- The site must exhibit evidence of natural recruitment of native species, including plant reproduction and/or setting of seeds.
- Absolute percent cover of native upper and mid canopy species is 70 percent.
- An index of species diversity of the restored areas is statistically comparable to an appropriate reference site within an 80 percent confidence limit.

For southern coast live oak riparian forest, the following standards shall apply:

- The site does not require substantial maintenance and meets the success criteria established for this community for at least two consecutive years during the monitoring period.
- The site must exhibit evidence of natural recruitment of native species, including plant reproduction and/or setting of seeds.
- Absolute percent cover of native upper and mid canopy species is 50 percent, with 5 percent cover from oak trees.
- An index of species diversity of the restored areas is statistically comparable to an appropriate reference site within an 80 percent confidence limit.

Monitoring shall be conducted for a minimum of 5 years to ensure successful establishment of the restored areas. If success standards are not met, remedial measures including introduction of additional container stock and adjusting of irrigation shall be implemented as directed by the Project Biologist.

Measure TE-29. Impacts to open water shall be mitigated by the creation of wetlands and/or impounded feature to be incorporated into the herbaceous riparian habitat restoration to compensate for functions and values. The open water mitigation areas shall be located at a site determined by the Project Biologist to have hydrology sufficient to support the desired open water feature. Appropriate hydrological and soils testing shall be performed to ensure that the created open water area function properly. Creation of open water areas shall be maintained as part of the herbaceous riparian habitat restoration.