United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

In Reply Refer To:
84120-2009-F-1306-2

MAY 17 2011

Mr. Marc Fugler
Senior Project Manager
California Delta Branch
U.S. Anny Corps of Engineers
1325 J Street
Sacramento, California 95814-2922

Subject: Formal Consultation for the Mariposa Energy Project (MEP), Alameda County, California

Dear Mr. Fugler:

This letter is in response to the U.S. Army Corps of Engineers (Corps) April 20, 2010, request for section 7 consultation with the U.S. Fish and Wildlife Service (Service) on the proposed MEP in unincorporated northeast Alameda County, California. The Corps letter was received in our field office on April 22, 2010. This document represents the Service's biological opinion on the effects of the action on the federally endangered longhorn fairy shrimp (*Brachinecta logiantenna*), threatened vernal pool fairy shrimp (*Brachinecta lynchi*), threatened California red-legged frog (*Rana draytonii*) and its designated critical habitat, threatened California tiger salamander (*Ambystoma californiense*), and endangered San Joaquin kit fox (Vulpes macrotis mutica). This document is issued pursuant to section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act).

The following sources of information were used to develop this biological opinion: (1) numerous revised project descriptions and effects assessments; (2) numerous meetings, letters, emails, and telephone conversations; and (3) other information available to the Service.

Consultation History

October 2009: The Service received emails from CH2M HILL and discussed the project in a phone conversation.

December 22, 2009:	The Service participated in a site visit with the California Department of Fish and Game (CDFG), California Energy Commission (CEC), Mariposa Energy, LCC, and Mariposa Energy, LCC's consultant, CH2M HILL.
April 21, 2010:	The Service received the Biological Assessment from CH2M HILL.
April 22, 2010:	The Service received a letter dated April 20, 2010, from the Corps requesting consultation for the proposed project.
May 17, 2010:	The Service and CH2M HILL exchanged emails regarding the consultation request and Biological Assessment. An additional map was emailed to the Corps with a copy to the Service.
May 19, 2010:	The Service issued a letter to the Corps requesting information required to complete consultation.
June 30, 2010:	The Service and CH2M HILL discussed the May 19, 2010 letter and information required to complete consultation.
July 2, 2010:	The Service received, via email, a technical memorandum responding to the Service's May 19, 2010 letter.
August 12, 2010:	The Service met Mariposa Energy, LCC, CH2M HILL, Souza Realty & Development, CDFG, and CEC to discuss the project.
September 2010:	The Service, CDFG, CEC and CH2M HILL exchanged emails regarding the project.
September 9, 2010:	The Service received, via email, an updated project description and supplemental information.
October 21, 2010:	CH2M HILL called the Service to discuss revisions to the project description.
October 22, 2010:	The Service received, via email, a revised project description and relocation plans for the California tiger salamander and California red-legged frog.
January 2011:	The Service exchanged emails with Mariposa Energy, LCC's consultant, Westervelt Ecological Services.
February 2011:	The Service exchanged emails with Westervelt Ecological Services.
February 3, 2011:	The Service received emails from Gibson & Skordal, LCC regarding vernal pool fairy shrimp sampling and observations.

February 25, 2011: The Service received compensation proposals from Westervelt Ecological Services.

March 1, 2011: The Service received the Draft Biological Resources Mitigation Implementation and Monitoring Plan and met with Westervelt Ecological Services, Souza Realty & Development, CH2M HILL, CEC, and CDFG to discuss the new compensation proposals.

April 6, 2011: The Service received a phone call from CH2M HILL and discussed new information regarding vernal pool fairy shrimp and project timing.

April 8, 2011: The Service received, via email, new vernal pool fairy shrimp occurrence and effects information from CH2M HILL.

April 25, 2011: The Service received an email from CH2M HILL with additional project documents.

BIOLOGICAL OPINION

Description of the Action

The proposed MEP will provide flexible energy generation to facilitate alternative energy production, helping Pacific Gas and Electric (PG&E) meet new clean energy guidelines. The facility will be located in northeastern Alameda County, California, on approximately 12.6 acres of a 158-acre parcel that consists of non-irrigated grazing land, a former wind-turbine development, and an existing cogeneration power plant. The site is approximately 7 miles northwest of Tracy, 7 miles east of Livermore, 6 miles south of Byron, and approximately 2.5 miles west of the community of Mountain House. All MEP development will occur within a 35.5-acre work area, situated near the intersection of Bruns Road and Kelso Road, in unincorporated northeastern Alameda County, California. Development within the action area will consist of the construction of a 12.6-acre power generation facility, a 0.6-acre access area, an 8.5-acre overhead transmission line, a 1.0-acre natural gas line, a 2.6-acre water supply line with associated 1-acre lay down area, and a 9.2-acre general construction lay down area.

Power Generation Facility

The proposed 12.6-acre MEP power generation facility will be a nominal 200-megawatt simple cycle generating facility consisting of four power blocks. Each power block will contain one natural gas fired combustible turbine generator (CTG). Generated power from the facility will be delivered to the grid via PG&E's Kelso Substation, located on the adjoining property, approximately 0.7 mile north of the site. The 12.6-acre footprint for the facility will include the cut and fill of approximately 2.9 acres of the surrounding hillsides to establish the new elevated footprint of the facility with the adjoining site topography and to facilitate construction access to the site. Upon completion of construction activities, this 2.9-acre area will be graded and re-seeded by Mariposa Energy, LLC.

Construction of the entire MEP facility will occur year-round and last approximately 14 months. Long term operation will be limited to activities within the fenced power generation facility and associated access road. While portions of the facility will be paved to provide internal access to buildings and structures within the site, ground surface areas surrounding power generation equipment will be limited to a gravel cover. Power will be generated by the four CTGs and stepped up using oil filled generator transformers. These transformers will be set on concrete foundations that will include secondary oil containment reservoirs to minimize potential contamination of listed species habitat in the event of accidental leaks or spills within the facility.

The MEP will be equipped with air emissions equipment and associated monitoring technology for the observation and control of air pollutants. This will require the use of a 19 percent aqueous ammonia solution and delivery system which will consist of a 10,000 gallon ammonia tank, spill containment basin, and refilling station with an additional spill containment basin and sump. Spill containment apparatuses will minimize effects to the surrounding natural grasslands and/or wetland features located adjacent to the MEP in the event of an accidental leak or spill within the facility. Air emissions will be controlled by the use of best combustion practices including the use of natural gas, which is low in sulfur, and high efficiency air inlet filtration. This will reduce particulate contamination of surrounding landscapes while limiting facility contributions to global climate change.

The MEP will also be a zero liquid discharge facility for wastewater. Site wastewater and storm water runoff from all facility equipment areas will be collected, treated, and recycled for use onsite via oil/water separators, Ph adjusters, and other similar technologies. Any oily waste collected in the oil/water separator will be transferred to 55 gallon drums and hauled offsite for disposal at an appropriate location. Sanitary wastewater from buildings within the power generation facility will be routed to an onsite holding tank and trucked offsite for treatment. Storm water runoff that is outside of the facility equipment areas but still associated with new asphalt and/or cement ground covering installed as part of the MEP will be captured and conveyed to an onsite detention basin that will be established within the power generation facility footprint. The basin will discharge via a discharge structure to one of two newly engineered grass lined swales which will convey storm water into upland grass areas surrounding the site.

Access Road

Proposed access to the site will include travel along 816 feet of existing gravel road from Bruns Road into the property as well as the development of 431 additional feet of new road which will allow access from the existing gravel roadbed to the power generation facility footprint. During construction, the 816 feet of existing road will be widened from10 feet to a 20-foot total width and paved to facilitate access by construction and ongoing maintenance vehicles. The new 431-foot portions of the road will also be developed and paved to the same dimensions. The access road will be utilized continuously for the duration of the approximate 14-month construction period as well as ongoing future MEP operation and maintenance activities. Public use of the access road will be prohibited by the maintenance of the existing property perimeter fence and associated gate which will remain locked at all times. Keys to this gate will only be made available to the current land owner, cattle grazing lessee, and pertinent MEP employees or their representatives to limit public access to the site.

Transmission Line

The MEP power generating facility will be connected to the existing PG&E Kelso Substation by a proposed 230 kilovolt overhead transmission line that will extend approximately 0.7-mile north from the site and onto the adjoining property. This power line will be supported by eight new steel monopole structures, located at appropriate intervals. A 10-foot diameter (maximum) permanent concrete foundation will support each new monopole structure. No new access or service roads will be necessary for work associated in or with the approximately 100-foot wide transmission line construction corridor. Rather, rubber tired line trucks and support vehicles will access the transmission line corridor via overland designated temporary access routes for the duration of construction activities. Establishment of the transmission line will occur over approximately three months which may span the wet and dry seasons. Vehicles will only access the transmission line corridor when onsite soils are sufficiently dry to avoid the creation of tire ruts or other unanticipated ground disturbance.

Natural Gas Pipeline

A 580-foot natural gas pipeline will connect the MEP power generation facility to an existing PG&E high pressure gas line located immediately to the east of the site. The new trenched line will be established within an approximately 75-foot wide pipeline construction corridor that will be accessed by back hoe, excavator, or other required equipment using temporary designated access routes. Natural gas within this pipeline will be monitored by a gas metering station that will be located within the power generation facility footprint. Prior to construction, vegetation and topsoil over the proposed pipeline trench footprint will be removed and salvaged for post-construction restoration of the pipeline corridor. Any excess soils not needed for this restoration will be utilized for other activities associated with construction activities or disposed of at an appropriate licensed offsite landfill. If needed, disturbed areas will be reseeded to minimize erosion and maintain onsite water quality.

Water Supply Pipeline

The MEP will include the establishment of a proposed 1.8-mile water supply pipeline within a 25-foot construction corridor that will convey water to the proposed power facility from Byron-Bethany Irrigation District's (BBID) Canal 45. The pipeline will originate at a new permanent 36-square foot concrete turnout structure and associated 250-square foot (0.006-acre) pump station at Canal 45. The first approximately 1,000 feet of the pipeline will be located within an existing agricultural road used to access an existing BBID pump house at Canal 45. Just north of the headquarters, the proposed pipeline will be established within the existing county right-of-way associated with Bruns Road. In the six locations that Bruns Road crosses a drainage, swale, or wetland feature, the water pipeline will either be tunneled underground below four intermittent features, or established via open trench methods across the two ephemeral features when these areas are dry. All pipeline activities will be limited to the Bruns Road right of way. Once the pipeline reaches the project property, the pipeline will follow the MEP main access road until its terminus at the power generation facility. All construction associated with the water pipeline will be conducted during the dry season. Activities associated with the water pipeline will also include the establishment of a 1.0-acre temporary water line lay down area. This lay down area will be located within the existing BBID maintenance yard at BBID's headquarters.

Construction Lay-Down Area

The construction and staging area for the MEP facility, gas pipeline, and transmission line will be limited to a temporary 9.2 acre worker parking and lay-down area immediately east of the power generation building footprint. The 9.2-acre lay-down area will be used for construction activities for approximately 14 months, including throughout the wet season, with an additional month anticipated for restoration activities. Portions of the 9.2 acre lay-down area will use gravel or road base with an underlayment of geotextile fabric for soil stabilization. Topsoil stripped from the lay-down area will be stockpiled onsite during initial ground disturbing activities. Upon completion of construction activities, the 9.2-acre area will be ripped to a depth of no less than two feet to reduce compaction of underlying native soils. The resulting roughed soil surface will be smoothed and covered with the stockpiled topsoil in order to facilitate the restoration of pre-construction conditions, including recolonization by fossoral mammals. Base rock and fabric underlayment will be removed from the site and disposed of at an appropriate offsite location.

In addition to the above mentioned activities, components from the previous wind farm facility within the MEP property will be removed from the site and disposed of at an appropriate licensed offsite facility in order to minimize delays during construction and to improve existing habitat for listed species within the site.

Minimization Measures

In order to minimize potential effects to listed species and their habitats during construction and operation, the MEP will implement the following minimization measures:

1. At least 15 days prior to any ground disturbing activities, the applicant will submit to the Service for review the qualifications of the proposed biological monitor(s). Upon Service approval, the biologist(s) will be given the authority to stop any work that may result in the take of listed species. If the on-site biologist(s) exercises this authority, the Service will be notified by telephone and electronic mail within one (1) working day. The on-site biologist will be the contact for any employee or contractor who might inadvertently kill or injure a California red-legged frog, San Joaquin kit fox or California tiger salamander, or anyone who finds a dead, injured, or entrapped individual of these species. The on-site biologist will possess a working cellular telephone whose number will be provided to the Service. Should take occur of a California red-legged frog, San Joaquin kit fox or

California tiger salamander individual, the Service-approved biologist will contact the Service and CDFG within 24 hours of the discovered occurrence.

2. Preconstruction surveys for the California red-legged frog, San Joaquin kit fox, and the California tiger salamander will be performed immediately prior to groundbreaking activities. Surveys will be conducted by Service-approved biologists. If at any point, activities associated with the establishment of the MEP cease for more than 15 consecutive days, additional preconstruction surveys will be conducted prior to the resumption of these actions.

3. Preconstruction surveys for San Joaquin kit fox dens will be conducted within a minimum of 200 feet of the MEP area. Any natal dens encountered will be avoided by a minimum of 100 feet for known dens and a minimum of 50 feet for potential dens. Non-natal dens will be monitored for a minimum of three days to determine their current use. If no San Joaquin kit fox activity is observed during this period, the den will be destroyed to prevent future use by San Joaquin kit fox. If San Joaquin kit fox activity is observed at the den during this period, the den will be monitored for at least five (5) consecutive days from the time of the observation to allow any resident animal to move to another den during its normal activity. Use of the den will be discouraged during this period by partially plugging its entrance(s) with soil in such a manner that any resident animal can escape easily. Only when the den is determined to be unoccupied will it be excavated under the direction of the biologist. If the animal is still present after 5 or more consecutive days of plugging and monitoring, the den will be excavated when, as determined by the biologist, it is temporarily vacant (for example, during the San Joaquin kit fox's normal foraging activity). Potential dens will be temporarily marked for avoidance by a minimum of 50 feet and further studied by the qualified biologist. Destruction of potential dens will occur only after the biologist determines that no San Joaquin kit fox are inside. To determine the presence of San Joaquin kit fox, the potential den will be fully excavated to the end by either hand or machinery. Once determined empty, the den will be filled with dirt and compacted to ensure that San Joaquin kit fox cannot enter or use the den during the construction period. If any potential den is determined to be currently or previously used by San Joaquin kit fox, the measures described above for natal and non-natal dens (as applicable) will be followed.

4. Any California tiger salamanders or California red-legged frogs observed during preconstruction surveys will be monitored by the approved biologist and allowed to passively leave the site or, if determined necessary by the Service-approved biologist, removed from the work area(s) and relocated to an appropriate location.

5. Prior to the start of groundbreaking activities, all construction personnel will receive worker education training on listed species and their habitats by a Service-approved biologist or a video recording of this biologist. The importance of these species and their habitat will be described to all employees as well as the minimization and avoidance measures that are to be implemented as part of the project. An educational brochure containing color photographs of all listed species in the work area(s) will be distributed to

all employees working within the project site(s). Workers will also be informed of appropriate measures to take should a toxic materials spill occur. A list of employees who attend the training sessions will be maintained by the applicant to be made available for review by the Service and the CDFG upon request. Contractor training will be incorporated into construction contracts and will be a component of weekly project meetings.

6. Wildlife exclusion fencing will be established around the perimeter of the MEP power generation facility, 9.2-acre laydown area, MEP main access road, and gas line work corridor. Approximately 1,000 feet of the water line, located on the Lee Property, will be included with the gas line exclusion fence, as water line and access road occur in tandem with each other. A partial wildlife exclusion fence will also be established along the eastern right-of-way of the water supply pipeline corridor to deter California tiger salamander and/or California red-legged frog from entering the disturbance area from adjacent aquatic drainages. All fencing will be, at minimum, buried six (6) inches into the ground and extend 36 inches above ground level to discourage listed animals from entering the site. Exclusion fencing will remain around the specified work areas for the duration of ground disturbing activities.

7. The monitoring biologist will be onsite at all times during initial ground-breaking activities until wildlife exclusion fencing is installed around the power generation facility, access road, laydown yard, and gas line. Upon completion of these activities, the monitoring biologist will inspect all wildlife and wetland exclusion fencing as well as construction zone fencing or flagging associated with the specified areas each week, at minimum, for the duration of MEP construction to ensure fencing integrity. During the wet season, a biological monitor will remain on site each day to record any migrating California tiger salamander or California red-legged frog individuals and to ensure appropriate avoidance and minimization measures are being implemented for these animals. During this period, the Service-approved monitor will also survey wildlife exclusion and construction perimeter fencing on a daily basis to look for tears and to ensure no California tiger salamander or California red-legged frog have become trapped along the fence line. The applicant will maintain and/or replace these barriers immediately if necessary.

8. All work areas and designated temporary travel corridors will be clearly delineated via flagging, signage or other similar methods to minimize construction disturbances beyond the work area. Vehicles will only enter temporary travel corridors when dry soil conditions exist to avoid the creation of tire ruts or other impacts to the ground surface.

9. A 25-foot minimum no-work buffer will be established around all inundated seasonal wetlands near the overland designated temporary access routes associated with the gas pipeline, transmission line or their associated work corridors. This buffer will be clearly demarcated with orange snow fencing to avoid construction access into potential branchiopod habitat. This fencing will be established prior to the start of ground breaking activities and will be checked weekly, at a minimum, by Service-approved biological

monitors throughout the course of activities within these areas. Dry seasonal drainage features located along the transmission line will be crossed via temporary metal plates that will span the entire width of these features and will be installed prior to construction activities. All metal plates will be removed upon completion of MEP construction.

10. The Service-approved biologist will monitor the construction of the water supply pipeline and transmission line on a daily basis for the duration of these activities, regardless of the season.

11. The Service-approved biological monitor and construction manager will be notified immediately if a California tiger salamander, California red-legged frog, or San Joaquin kit fox are observed anywhere within the property. If the observed animal is a California tiger salamander or California red-legged frog, the Service-approved biologist will monitor these animals and determine if they are in danger of take from construction activities, predators, or entrapment. If they are, all construction in the immediate area will cease until the animal is allowed to passively leave the site. If this is not possible, the Service-approved biological monitor will remove the California tiger salamander or California red-legged frog from the property in a cool, moist container and relocate these individuals to either the adjacent Bryon Conservation Bank or the proposed Mountain House Conservation Bank site. Upon release of these animals, the Service-approved biologist will monitor the individual until it is determined that it is in no imminent danger. If a San Joaquin kit fox is observed on the site, construction activities that will directly affect the individual will cease until the animal passively leaves the site. Field survey forms will be completed for all California tiger salamander, California red-legged frog, or San Joaquin kit fox observations. These forms will be submitted to the California Natural Diversity Data Base (CNDDB) prior to completion of construction activities.

12. To the maximum extent practicable, fossorial mammal burrows that may provide refugia habitat for California tiger salamander and California red-legged frog will be avoided during the construction and long-term operation of the MEP. Exclusion fence and/or plywood will be placed around areas with high concentrations of burrows during the course of construction activities to avoid the destruction of these features.

13. Topsoil removed from the 9.2-acre temporary laydown area, access road widening, cut-and-fill area, and gas pipeline trenching locations will be stockpiled and reserved for the duration of construction activities. Upon completion of these actions, temporarily disturbed areas will be graded and restored with reserved topsoil to facilitate the re-establishment of fossoral mammal populations and upland listed species habitats. Any surplus topsoil will be hauled off site and disposed of at an appropriate facility.

14. To the maximum extent practicable, the water pipeline will be established in existing disturbed areas. Intermittent features will be crossed by pipe ramming under the current culverts associated with Bruns Road. Water pipeline activities that do require additional disturbance to ephemeral drainage and wetland features will only occur during the dry

season once these features no longer hold water. An onsite biological monitor will be present to advise all workers to stay inside approved work areas at all times.

15. Potential effects to water quality from contaminated runoff or airborne dust will be avoided by the implementation of standard erosion and/or sedimentation control devices, fugitive dust management, avoidance, and other best management practices (BMPs) prescribed by the MEP's approved Stormwater Pollution Prevention Plan (SWPPP) and Fugitive Dust Mitigation Plan. As-needed dust control measures (e.g., wetting dry ground) will minimize airborne transmission of soil particles into aquatic habitats. Erosion and sediment control devices (such as silt fences and fiber rolls) will be implemented as necessary during the wet season and before forecasted rain events to minimize impacts to water quality and effects to branchiopods. Equipment fueling, maintenance, and repairs as well as storage of hazardous materials such as fuels and lubricants will be limited to areas 250 feet or greater from any wetlands or drainage areas. Other hazardous material BMPs, including but not limited to secondary containment and not topping off fuel tanks will be enforced to prevent soil contamination. Prior to the start of construction activities, an emergency spill plan will be developed as part of SWPPP requirements and will be readily available to all employees throughout the duration of work activities. This plan will include appropriate prevention and cleanup measures for both upland and aquatic areas.

16. Plastic mono-filament netting or similar material will not be used for erosion control matting at the project site to avoid the entanglement or entrapment of California tiger salamander or California red-legged frog individuals. Acceptable substitutes include coconut coir matting, tackified hydroseeding compounds, or other similar materials.

17. Construction of the MEP will include the establishment of secondary emergency containment reservoirs for both ammonia and oil storage tanks associated with the long-term operation and maintenance of the power generation facility. This will minimize the potential leak or seepage of these materials into onsite habitats during long-term MEP operation.

18. To prevent the accidental entrapment of listed species during construction, all excavated holes or trenches deeper than six inches will be covered at the end of each work day with plywood or similar materials. Foundation trenches or larger excavations that cannot easily be covered will be ramped at the end of the work day to allow trapped animals an escape method. Prior to the filling of such holes, these areas will be thoroughly inspected for listed species by Service-approved biologists. In the event of a trapped animal is observed, construction will cease until the individual has been relocated to an appropriate location.

19. All construction pipes, culverts, or similar structures greater than 4 inches in diameter that are stored at the MEP overnight will be securely capped before storage or will be thoroughly inspected for San Joaquin kit fox and other sensitive species prior to pipe installation or capping to avoid entrapment or injury of this animal. If a San Joaquin kit fox or other sensitive species is discovered inside a pipe, that section of pipe will not be

moved until the Service and CDFG have been contacted by the Service-approved biologist to determine the appropriate course of action.

20. No discharge of pollutants from vehicle and equipment cleaning, maintenance, or repair will be allowed into storm drains, wetlands, or water courses. No discharge of sediment-laden water from project-related activities will be allowed into storm drains, wetlands, or water courses.

21. All trash and debris within the work area will be placed in containers with secure lids before the end of each work day in order reduce the likelihood of predators being attracted to the site by discarded food rappers and other rubbish that may be left on-site. Containers will be emptied as necessary to prevent trash overflow onto the site and all rubbish will be disposed of at an appropriate off-site location.

22. To the maximum extent practicable, construction will only occur between 7 a.m. and 7 p.m. to limit the need for night lighting which could attract California tiger salamanders or California red-legged frogs into the construction area and/or provide additional light for night time predators, increasing mortality of these animals. If night time work is required during certain periods, no nocturnal construction activities will occur outside of wildlife exclusion fences associated with the access road, power generation facility, laydown area, and gas pipeline corridor for the duration of the wet season.

23. All exterior lights associated with construction and long-term operation will be hooded, and directed onsite so that significant light or glare into the surrounding habitats is minimized. Low-pressure sodium lamps and other low glare fixtures will also be utilized. For areas where lighting is not required for normal operation, safety, or security, switched lighting circuits will be established, allowing these areas to remain dark to minimize attracting California tiger salamanders, California red-legged frogs, or other animals to the site.

24. All vehicles entering the work area(s) will be confined to existing roads or approved temporary routes. Speed limits within the work area(s) will be limited to 15 miles per hour. Trash dumping, firearms, and pets will be prohibited in the project area(s).

25. Construction of the power generation facility will include the installation of a permanent barrier to discourage movement of California tiger salamanders or California red-legged frogs onto the site. This barrier will be installed and maintained around the perimeter of the facility for the operational life of the project and will be comprised of tightly woven metal fencing, concrete curbing or other similar exclusionary materials. At minimum, the barrier will be buried 6 inches into the ground and extend for three vertical feet above the ground surface.

26. Upon completion of construction activities, all debris and materials associated with MEP construction will be removed and areas not needed for the long-term operation of the site will be recontoured to match adjoining grades. Post construction BMPs (as prescribed in

the SWPPP) will be implemented, including reseeding all areas as necessary to facilitate timely vegetative restoration.

27. Potential effects to listed species resulting from MEP activities will be compensated for by the preservation of 79.9 acres of upland California tiger salamanders, California red-legged frogs and San Joaquin kit fox habitats at the proposed Mountain House Mitigation Bank or other alternative Service, CDFG, and CEC -approved conservation property and 0.57-acre of preservation habitat at the Fitzgerald Ranch Conservation Bank or other alternative Service and CEC-approved conservation property for vernal pool fairy shrimp. Any conservation property utilized to offset MEP effects to listed species will be accompanied by a long-term management plan with an associated endowment, and will be placed under a permanent conservation easement. All documentation for the selected conservation property will be reviewed and approved by the Service, CDFG and CEC. Mariposa Energy, LLC will provide written verification to the Service, CDFG and CEC of the credit purchase or conservation easement within 18 months from the start of construction activities or prior to commercial operation of the power generation facility, whichever comes first. Prior to the start of construction, Mariposa Energy, LLC will provide a letter of credit to CDFG with sufficient funding to cover the higher of either the purchase of 79.9 upland acres at the Mountain House Mitigation Bank and 0.57-acre worth of preservation credits at the Fitzgerald Ranch Conservation Bank or the development and implementation of these acres at the alternative Service, CDFG, and CEC -approved conservation property.

Action Area

The action area is defined in 50 CFR § 402.02, as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." For the purposes of the effects assessment, the action area contains the MEP footprint.

<u>Analytical Framework for the Jeopardy and Adverse Modification Analyses</u>

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis in this biological opinion relies on four components: (1) the *Status of the Species*, which evaluates the longhorn fairy shrimp, vernal pool fairy shrimp, California red-legged frog, California tiger salamander, and San Joaquin kit fox's range-wide condition, the factors responsible for that condition, and their survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the two species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the these listed animals; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed federal action and the effects of any interrelated or interdependent activities on the longhorn fairy shrimp, vernal pool fairy shrimp, California red-legged frog, California tiger salamander, and San Joaquin kit fox and; (4) the *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on them.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the longhorn fairy shrimp, vernal pool fairy shrimp, California red-legged frog, California tiger salamander, and San Joaquin kit fox's current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of these five species in the wild.

The jeopardy analysis in this biological opinion places an emphasis on consideration of the range-wide survival and recovery needs of the longhorn fairy shrimp, vernal pool fairy shrimp, California red-legged frog, California tiger salamander, and San Joaquin kit fox and the role of the action area in their survival and recovery as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination

This Biological Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analysis in this Biological Opinion relies on four components: (1) the *Status of Critical Habitat*, which evaluates the rangewide condition of proposed critical habitat for the California red-legged frog in terms of primary constituent elements PCE, the factors responsible for that condition, and the intended recovery function of the critical habitat at the provincial and range-wide scale; (2) the *Environmental Baseline*, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected critical habitat units and; (4) *Cumulative Effects* which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determination, the effects of the proposed Federal action on the California red-legged frog critical habitat are evaluated in the context of the range-wide condition of the critical habitat at the provincial and range-wide scales, taking into account any cumulative effects, to determine if the critical habitat range-wide would remain functional(or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the California red-legged frog.

The analysis in this Biological Opinion places an emphasis on using the intended range-wide recovery function of California red-legged frog critical habitat and the role of the action area relative to that intended function as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

Status of the Species

California Red-Legged Frog

Listing Status: The California red-legged frog was listed as a threatened species on May 23, 1996 (Service 1996). Critical habitat was designated for this species on April 13, 2006 (Service 2006) and revisions to the critical habitat designation were published on March 17, 2010 (Service 2010). At this time, the Service recognized the taxonomic change from *Rana aurora draytonii* to *Rana draytonii* (Shaffer *et al.* 2010). A recovery plan was published for the California red-legged frog on September 12, 2002 (Service 2002).
Description: The California red-legged frog is the largest native frog in the western United States (Wright and Wright 1949), ranging from 1.5 to 5.1 inches in length (Stebbins 2003). The abdomen and hind legs of adults are largely red, while the back is characterized by small black flecks and larger irregular dark blotches with indistinct outlines on a brown, gray, olive, or reddish background color. Dorsal spots usually have light centers (Stebbins 2003), and dorsolateral folds are prominent on the back. Larvae (tadpoles) range from 0.6 to 3.1 inches in length, and the background color of the body is dark brown and yellow with darker spots (Storer 1925).

Distribution: The historic range of the California red-legged frog extended from the vicinity of Elk Creek in Mendocino County, California, along the coast inland to the vicinity of Redding in Shasta County, California, and southward to northwestern Baja California, Mexico (Fellers 2005; Jennings and Hayes 1985; Hayes and Krempels 1986). The species was historically documented in 46 counties but the taxa now remains in 238 streams or drainages within 23 counties, representing a loss of 70 percent of its former range (Service 2002). California red-legged frogs are still locally abundant within portions of the San Francisco Bay area and the Central California Coast. Isolated populations have been documented in the Sierra Nevada, northern Coast, and northern Transverse Ranges. The species is believed to be extirpated from the southern Transverse and Peninsular ranges, but is still present in Baja California, Mexico (CDFG 2010).

Status and Natural History: California red-legged frogs predominately inhabit permanent water sources such as streams, lakes, marshes, natural and manmade ponds, and ephemeral drainages in valley bottoms and foothills up to 4,921 feet in elevation (Jennings and Hayes 1994, Bulger *et al.* 2003, Stebbins 2003). However, they also inhabit ephemeral creeks, drainages and ponds with minimal riparian and emergent vegetation. California red-legged frogs breed from November to April, although earlier breeding records have been reported in southern localities. Breeding generally occurs in still or slow-moving water often associated with emergent vegetation, such as cattails, tules or overhanging willows (Storer 1925, Hayes and Jennings 1988). Female frogs deposit egg masses on emergent vegetation so that the egg mass floats on or near the surface of the water (Hayes and Miyamoto 1984).

Habitat includes nearly any area within 1-2 miles of a breeding site that stays moist and cool through the summer including vegetated areas with coyote brush, California blackberry thickets, and root masses associated with willow and California bay trees (Fellers 2005). Sheltering habitat for California red-legged frogs potentially includes all aquatic, riparian, and upland areas within the range of the species and includes any landscape feature that provide cover, such as animal burrows, boulders or rocks, organic debris such as downed trees or logs, and industrial debris. Agricultural features such as drains, watering troughs, spring boxes, abandoned sheds, or hay stacks may also be used. Incised stream channels with portions narrower and depths greater than 18 inches also may provide important summer sheltering habitat. Accessibility to sheltering habitat is essential for the survival of California red-legged frogs within a watershed, and can be a factor limiting frog population numbers and survival.

California red-legged frogs do not have a distinct breeding migration (Fellers 2005). Adults are often associated with permanent bodies of water. Some individuals remain at breeding sites year-round, while others disperse to neighboring water features. Dispersal distances are typically less than 0.5-mile, with a few individuals moving up to 1-2 miles (Fellers 2005). Movements are typically along riparian corridors, but some individuals, especially on rainy nights, move directly from one site to another through normally inhospitable habitats, such as heavily grazed pastures or oak-grassland savannas (Fellers 2005).

In a study of California red-legged frog terrestrial activity in a mesic area of the Santa Cruz Mountains, Bulger *et al.* (2003) categorized terrestrial use as migratory and non-migratory. The latter occurred from one to several days and was associated with precipitation events. Migratory movements were characterized as the movement between aquatic sites and were most often associated with breeding activities. Bulger *et al.* (2003) reported that non-migrating frogs typically stayed within 200 feet of aquatic habitat 90 percent of the time and were most often associated with dense vegetative cover, i.e., California blackberry, poison oak (*Toxicodendron diversilobum*) and coyote brush. Dispersing frogs in northern Santa Cruz County traveled distances from 0.25-mile to more than 2 miles without apparent regard to topography, vegetation type, or riparian corridors (Bulger *et al.* 2003).

In a study of California red-legged frog terrestrial activity in a xeric environment in eastern Contra Costa County, Tatarian (2008) noted that a 57 percent majority of frogs fitted with radio transmitters in the Round Valley study area stayed at their breeding pools, whereas 43 percent moved into adjacent upland habitat or to other aquatic sites. Her study reported a peak seasonal terrestrial movement occurring in the fall months associated with the first 0.2-inch of precipitation and tapering off into spring. Upland movement activities ranged from 3 to 233 feet, averaging 80 feet, and were associated with a variety of refugia including grass thatch, crevices, cow hoof prints, ground squirrel burrows at the base of trees or rocks, logs, and under man-made structures; others were associated with upland sites lacking refugia (Tatarian 2008). The majority of terrestrial movements lasted from 1 to 4 days; however, one adult female was reported to remain in upland habitat for 50 days (Tatarian 2008). Upland refugia closer to aquatic sites were used more often and were more commonly associated with areas exhibiting higher object cover, e.g., woody debris, rocks, and vegetative cover. Subterranean cover was not significantly different between occupied upland habitat and non-occupied upland habitat.

California red-legged frogs are often prolific breeders, laying their eggs during or shortly after large rainfall events in late winter and early spring (Hayes and Miyamoto 1984). Egg masses containing 2,000 to 5,000 eggs are attached to vegetation below the surface and hatch after 6 to 14 days (Storer 1925, Jennings and Hayes 1994). In coastal lagoons, the most significant mortality factor in the pre-hatching stage is water salinity (Jennings *et al.* 1992). Eggs exposed to salinity levels greater than 4.5 parts per thousand resulted in 100 percent mortality (Jennings and Hayes 1990). Increased siltation during the breeding season can cause asphyxiation of eggs and small larvae. Larvae undergo metamorphosis 3½ to 7 months following hatching and reach sexual maturity 2 to 3 years of age (Storer 1925; Wright and Wright 1949; Jennings and Hayes 1985, 1990, 1994). Of the various life stages, larvae probably experience the highest mortality rates, with less than 1 percent of eggs laid reaching metamorphosis (Jennings *et al.* 1992). California red-legged frogs may live 8 to 10 years (Jennings *et al.* 1992). Populations can fluctuate from year to year; favorable conditions allow the species to have extremely high rates of reproduction and thus produce large numbers of dispersing young and a concomitant increase in the number of occupied sites. In contrast, the animal may temporarily disappear from an area when conditions are stressful (e.g., during periods of drought, disease, etc.).

The diet of California red-legged frogs is highly variable and changes with the life history stage. The diet of the larvae is not well studied, but is likely similar to that of other ranid frogs, feeding on algae, diatoms, and detritus by grazing on the surface of rocks and vegetation (Fellers 2005; Kupferberg 1996a, 1996b, 1997). Hayes and Tennant (1985) analyzed the diets of California red-legged frogs from Cañada de la Gaviota in Santa Barbara County during the winter of 1981 and found invertebrates (comprising 42 taxa) to be the most common prey item consumed; however, they speculated that this was opportunistic and varied based on prey availability. They ascertained that larger frogs consumed larger prey and were recorded to have preyed on Pacific chorus frog, three-spined stickleback and, to a limited extent, California mice, which were abundant at the study site (Hayes and Tennant 1985, Fellers 2005). Although larger vertebrate prey was consumed less frequently, it represented over half of the prey mass eaten by larger frogs suggesting that such prey may play an energetically important role in their diets (Hayes and Tennant 1985). Juvenile and subadult/adult frogs varied in their feeding activity periods; juveniles fed for longer periods throughout the day and night, while subadult/adults fed nocturnally (Hayes and Tennant 1985). Juveniles were significantly less successful at capturing prey and all life history stages exhibited poor prey discrimination, feeding on several inanimate objects that moved through their field of view (Hayes and Tennant 1985).

Threats: Habitat loss, non-native species introduction, and urban encroachment are the primary factors that have adversely affected the California red-legged frog throughout its range. Several researchers in central California have noted the decline and eventual local disappearance of California and northern red-legged frogs in systems supporting bullfrogs (Jennings and Hayes 1990; Twedt 1993), red swamp crayfish, signal crayfish, and several species of warm water fish including sunfish, goldfish, common carp, and mosquitofish (Moyle 1976; Barry 1992; Hunt 1993; Fisher and Schaffer 1996). This has been attributed to predation, competition, and reproduction interference. Twedt (1993) documented bullfrog predation of juvenile northern red-legged frogs (*Rana aurora*), and suggested that bullfrogs could prey on subadult California red-legged frogs as well. Bullfrogs may also have a competitive advantage over California red-legged frogs. For instance, bullfrogs are larger and possess more generalized food habits (Bury and Whelan 1984). In addition, bullfrogs have an extended breeding season (Storer 1933) during which an individual female can produce as many as 20,000 eggs (Emlen 1977). Furthermore, bullfrog larvae are unpalatable to predatory fish (Kruse and Francis 1977). Bullfrogs also interfere with California red-legged frog reproduction by eating adult male California red-legged frogs. Both California and northern red-legged frogs have been observed in amplexus (mounted on) with both male and female bullfrogs (Jennings and Hayes 1990; Twedt 1993; Jennings 1993). Thus bullfrogs are able to prey upon and out-compete California red-legged frogs, especially in sub-optimal habitat.

Negative effects to wildlife populations from roads and pavement may extend some distance from the actual road. The phenomenon can result from vehicle-related mortality, habitat degradation, noise and light pollution, and invasive exotic species. Forman and Deblinger (1998) described the area affected as the "road effect" zone. One study along a 4-lane road in Massachusetts determined that this zone extended for an average of 980 feet to either side of the road for an average total zone width of approximately 1,970 feet. However, in places they detected an effect greater than 0.6-mile from the road. The road effect zone can also be subtle. Van der Zandt *et al.* (1980) reported that lapwings and black-tailed godwits feeding at 1,575 to 6,560 feet from roads were disturbed by passing vehicles. The heart rate, metabolic rate and energy expenditure of female bighorn sheep increases near roads (MacArthur *et al.* 1979). Trombulak and Frissell (2000) described another type of "road-zone" effect due to contaminants. Heavy metal concentrations from vehicle exhaust were greatest within 66 feet of roads and elevated levels of metals in soil and plants were detected at 660 feet of roads. The "road-zone" varies with habitat type and traffic volume. Based on responses by birds, Forman (2000) estimated the road-zone along primary roads of 1,000 feet in woodlands, 1,197 feet in grasslands, and 2,657 feet in natural lands near urban areas. Along secondary roads with lower traffic volumes, the effect zone was 656 feet. The road-zone with regard to California red-legged frogs has not been adequately investigated.

The necessity of moving between multiple habitats and breeding ponds means that many amphibian species, such as the California red-legged frog are especially vulnerable to roads and well-used large paved areas in the landscape. Van Gelder (1973) and Cooke (1995) have examined the effect of roads on amphibians and found that because of their activity patterns, population structure, and preferred habitats, aquatic breeding amphibians are more vulnerable to traffic mortality than some other species. High-volume highways pose a nearly impenetrable barrier to amphibians and result in mortality to individual animals as well as significantly fragmenting habitat. Hels and Buchwald (2001) found that mortality rates for anurans on high traffic roads are higher than on low traffic roads. Vos and Chardon (1998) found a significant negative effect of road density on the occupation probability of ponds by the moor frog (*Rana arvalis*) in the Netherlands. In addition, incidences of very large numbers of road-killed frogs are well documented (Asley and Robinson 1996), and studies have shown strong population level effects of traffic density (Carr and Fahrig 2001) and high traffic roads on these amphibians (Van Gelder 1973; Vos and Chardon 1998). Most studies regularly count road mortalities from slow moving vehicles (Hansen 1982; Rosen and Lowe 1994; Drews 1995; Mallick *et al.* 1998) or by foot (Munguira and Thomas 1992). These studies assume that every victim is observed, which may be true for large conspicuous mammals, but may be an incorrect assumption for small animals, such as the California red-legged frog. Amphibians appear especially vulnerable to traffic mortality because they readily attempt to cross roads, are small and slow-moving, and thus are not easily avoided by drivers (Carr and Fahrig 2001).

Recovery: The recovery plan for the California red-legged frog identifies eight recovery units (Service 2002). The establishment of these recovery units is based on the determination that various regional areas of the species' range are essential to its survival and recovery. The status of the California red-legged frog was considered within the small scale recovery units as opposed to their overall range. These recovery units are delineated by major watershed boundaries as defined by U.S. Geological Survey hydrologic units and the limits of its range. The goal of the recovery plan is to protect the long-term viability of all extant populations within each recovery unit. Within each recovery unit, core areas have been delineated and represent contiguous areas of moderate to high California red-legged frog densities that are relatively free of exotic species such as bullfrogs. The goal of designating core areas is to protect metapopulations that, combined with suitable dispersal habitat, will allow for the long term viability within existing populations. This management strategy will allow for the recolonization of habitats within and adjacent to core areas that are naturally subjected to periodic localized extinctions, thus assuring the long-term survival and recovery of California red-legged frogs.

California Red-legged Frog Critical Habitat

The Service designated critical habitat for the California red-legged frog on April 13, 2006 (Service 2006) and a revised designation to the critical habitat was published on March 17, 2010 (Service 2010). At this time, the Service recognized the taxonomic change from *Rana aurora draytonii* to *Rana draytonii* (Shaffer *et al.* 2010). Critical habitat is defined in Section 3 of the Act as: (1) The specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (a) essential to the conservation of the species and (b) that may require special management considerations or protection and; (2) specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species. In determining which areas to designate as critical habitat, the Service considers those physical and biological features that are essential to a species' conservation and that may require special management considerations or protection (50 CFR 424.12(b)). The Service is required to list the known primary constituent elements together with the critical habitat description. Such physical and biological features include, but are not limited to, the following: (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, rearing of offspring, or dispersal and; (5) generally, habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

The primary constituent elements defined for the California red-legged frog was derived from its biological needs. The area designated as revised critical habitat provides aquatic habitat for breeding and non-breeding activities and upland habitat for shelter, foraging, predator avoidance, and dispersal across its range. The primary constituent elements and, therefore, the resulting physical and biological features essential for the conservation of the species were determined from studies of California red-legged frog ecology. Based on the above needs and our current knowledge of the life history, biology, and ecology of the species, and the habitat requirements for sustaining the essential life-history functions of the species, the Service determined that the primary constituent elements essential to the conservation of the California red-legged frog are: (1) aquatic breeding habitat defined as standing bodies of fresh water (with salinities less than 7.0 parts per thousand), including: natural and manmade (e.g., stock) ponds, slow-moving streams or pools within streams, and other ephemeral or permanent water bodies that typically become inundated during winter rains and hold water for a minimum of 20 weeks in all but the driest of years; (2) non-breeding aquatic habitat defined as freshwater and wetted riparian habitats, as described above, that may not hold water long enough for the subspecies to hatch and complete its aquatic life cycle but that do provide for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult California red-legged frogs. Other wetland habitats that would be considered to meet these elements include, but are not limited to: plunge pools within intermittent creeks; seeps; quiet water refugia during high water flows; and springs of sufficient flow to withstand the summer dry period; (3) upland habitat defined as upland areas adjacent to or surrounding breeding and non-breeding aquatic and riparian habitat up to a distance of 1 mile in most cases and comprised of various vegetational series such as grasslands, woodlands, wetland, or riparian plant species that provides the frog shelter, forage, and predator avoidance. Upland features are also essential in that they are needed to maintain the hydrologic, geographic, topographic, ecological, and edaphic features that support and surround the wetland or riparian habitat. These upland features contribute to the filling and drying of the wetland or riparian habitat and are responsible for maintaining suitable periods of pool inundation for larval frogs and their food sources, and provide breeding, non-breeding, feeding, and sheltering habitat for juvenile and adult frogs (e.g., shelter, shade, moisture, cooler temperatures, a prey base, foraging opportunities, and areas for predator avoidance). Upland habitat should include structural features such as boulders, rocks and organic debris (e.g., downed trees, logs), as well as small mammal burrows and moist leaf litter and; (4) dispersal habitat defined as accessible upland or riparian dispersal habitat within designated units and between occupied locations within a minimum of 1 mile of each other and that allows for movement between such sites. Dispersal habitat includes various natural habitats and altered habitats such as agricultural fields, which do not contain barriers (e.g., heavily traveled road without bridges or culverts) to dispersal. Dispersal habitat does not include moderate- to high-density urban or industrial developments with large expanses of asphalt or concrete, nor does it include large reservoirs over 50 acres in size, or other areas that do not contain those features identified in primary constituent elements 1, 2, or 3 as essential to the conservation of the subspecies.

With the revised designation of critical habitat, the Service intends to conserve the geographic areas containing the physical and biological features that are essential to the conservation of the species, through the identification of the appropriate quantity and spatial arrangement of the primary constituent elements sufficient to support the life-history functions of the species. Because not all life-history functions require all the primary constituent elements, not all areas designated as critical habitat will contain all the primary constituent elements. Refer to the final designation of critical habitat for California red-legged frog for additional information.

California Tiger Salamander

On May 23, 2003, the Service proposed to list the Central California Distinct Population Segment (DPS) of the California tiger salamander as threatened. At this time, the Service also proposed reclassification of the Santa Barbara County DPS and Sonoma County DPS from endangered to threatened (Service 2003). In the same notice we also proposed a special rule under section 4(d) of the Act to exempt take for routine ranching operations for the Central California DPS and, if reclassified to threatened, for the Santa Barbara and Sonoma County DPSs (Service 2003). On August 4, 2004, after determining that the listed the Central California population of the California DPS of the California tiger salamander was threatened (Service 2004b), we determined that the Santa Barbara and Sonoma County populations were threatened as well, and reclassified the California tiger salamander as threatened throughout its range, removing the Santa Barbara and Sonoma County populations as separately listed DPSs (Service 2004b). In this notice we also finalized the special rule to exempt take for routine ranching operations for the California tiger salamander throughout its range (Service 2004b).

On August 18, 2005, as a result of litigation of the August 4, 2004, final rule on the reclassification of the California tiger salamander DPSs (*Center for Biological Diversity et al.* v. *United States Fish and Wildlife Service et al.*, C 04-04324 WHA (N.D. Cal. 2005), the District Court of Northern California sustained the portion of the 2004 rule pertaining to listing the Central California tiger salamander as threatened with a special rule, vacated the 2004 rule with regard to the Santa Barbara and Sonoma DPSs, and reinstated their prior listing as endangered. The List of Endangered and Threatened Wildlife in part 17, subchapter B of Chapter I, title 50 of the Code of Federal Regulations (CFR) has not been amended to reflect the vacatures contained in this order, and continues to show the rangewide reclassification of the California tiger salamander as a threatened species with a special rule. We are currently in the process of correcting the CFR to reflect the current status of the species throughout its range.

Description: The California tiger salamander is a large, stocky, terrestrial salamander with a broad, rounded snout. Recorded adult measurements have been as much as 8.2 inches (20.8 centimeters) long (Petranka 1998; Stebbins 2003). Tiger salamanders exhibit sexual dimorphism (differences in body appearance based on gender) with males tending to be larger than females. Tiger salamander coloration generally consists of random white or yellowish markings against a black body. The markings on adults California tiger salamanders tend to be more concentrated on the lateral sides of the body, whereas other tiger salamander species tend to have brighter yellow spotting that is heaviest on the dorsal surface.

Distribution: The California tiger salamander is endemic to California and historically inhabited the low-elevation grassland and oak savanna plant communities of the Central Valley, adjacent foothills, and Inner Coast Ranges (Jennings and Hayes 1994; Storer 1925; Shaffer *et al.* 1993). The species has been recorded from near sea level to approximately 3,900 feet in the Coast Ranges and to approximately 1,600 feet in the Sierra Nevada foothills (Shaffer and

Trenham 2004). Along the Coast Ranges, the species occurred from the Santa Rosa area of Sonoma County, south to the vicinity of Buellton in Santa Barbara County. The historic distribution in the Central Valley and surrounding foothills included northern Yolo County southward to northwestern Kern County and northern Tulare County. Three distinct California tiger salamander populations are recognized and correspond to Santa Maria area within Santa Barbara County, the Santa Rosa Plain in Sonoma County, and vernal pool/grassland habitats throughout the Central Valley.

Status and Natural History: The California tiger salamander has an obligate biphasic life cycle (Shaffer *et al.* 2004). Although the larvae develop in the vernal pools and ponds in which they were born, California tiger salamanders are otherwise terrestrial and spend most of their post-metamorphic lives in widely dispersed underground retreats (Shaffer et al. 2004; Trenham *et al.* 2001). Because they spend most of their lives underground, California tiger salamanders are rarely encountered even in areas where salamanders are abundant. Subadult and adult California tiger salamanders typically spend the dry summer and fall months in the burrows of small mammals, such as California ground squirrels and Botta's pocket gopher (Storer 1925; Loredo and Van Vuren 1996; Petranka 1998; Trenham 1998a). Although ground squirrels have been known to eat California tiger salamanders, the relationship with their burrowing hosts is primarily commensal (an association that benefits one member while the other is not affected) (Loredo et al. 1996; Semonsen 1998).

California tiger salamanders may also use landscape features such as leaf litter or desiccation cracks in the soil for upland refugia. Burrows often harbor camel crickets and other invertebrates that provide likely prey for tiger salamanders. Underground refugia also provide protection from the sun and wind associated with the dry California climate that can cause excessive drying of amphibian skin. Although California tiger salamanders are members of a family of "burrowing" salamanders, they are not known to create their own burrows. This may be due to the hardness of soils in the California ecosystems in which they are found. Tiger salamanders depend on persistent small mammal activity to create, maintain, and sustain sufficient underground refugia for the species. Burrows are short lived without continued small mammal activity and typically collapse within approximately 18 months (Loredo *et al.* 1996).

Upland burrows inhabited by tiger salamanders have often been referred to as aestivation sites. However, "aestivation" implies a state of inactivity, while most evidence suggests that tiger salamanders remain active in their underground dwellings. A recent study has found that California tiger salamanders move, feed, and remain active in their burrows (Van Hattem 2004). Because California tiger salamanders arrive at breeding ponds in good condition and are heavier when entering the pond than when leaving, researchers have long inferred that tiger salamanders are feeding while underground. Recent direct observations have confirmed this (Trenham 2001; Van Hattem 2004). Thus, "upland habitat" is a more accurate description of the terrestrial areas used by California tiger salamanders.

California tiger salamanders typically emerge from their underground refugia at night during the fall or winter rainy season (November-May) to migrate to their breeding ponds (Stebbins 2003; Shaffer et al. 1993; Trenham *et al.* 2000). The breeding period is closely associated with the rainfall patterns in any given year with less adults migrating and breeding in drought years (Loredo and Van Vuren 1996; Trenham *et al.* 2000). Male salamanders are typically first to arrive and generally remain in the ponds longer than females. Results from a 7-year study in Monterey County suggested that males remained in the breeding ponds for an average of 44.7 days while females remained for an average of only 11.8 days (Trenham *et al.* 2000). Historically, breeding ponds were likely limited to vernal pools, but now include livestock stock ponds. Ideal breeding ponds are typically fishless, and seasonal or semi-permanent (Barry and Shaffer 1994; Petranka 1998).

While in the ponds, adult California tiger salamanders mate and then the females lay their eggs in the water (Twitty 1941; Shaffer *et al.* 1993; Petranka 1998). Egg laying typically reaches a peak in January (Loredo and Van Vuren 1996; Trenham *et al.* 2000). Females attach their eggs singly, or in rare circumstances, in groups of two to four, to twigs, grass stems, vegetation, or debris (Storer 1925; Twitty 1941). Eggs are often attached to objects, such as rocks and boards in ponds with no or limited vegetation (Jennings and Hayes 1994). Clutch sizes from a Monterey County study had an average of 814 eggs (Trenham *et al.* 2000). Seasonal pools may not exhibit sufficient depth, persistence, or other necessary parameters for adult breeding during times of drought (Barry and Shaffer 1994). After breeding and egg laying is complete, adults leave the pool and return to their upland refugia (Loredo *et al.* 1996; Trenham 1998a). Adult California tiger salamanders often continue to emerge nightly for approximately the next two weeks to feed in their upland habitat (Shaffer *et al.* 1993).

California tiger salamander larvae typically hatch within 10 to 24 days after eggs are laid (Storer 1925). The peak emergence of these metamorphs is typically between mid-June and mid-July (Loredo and Van Vuren 1996; Trenham *et al.* 2000). The larvae are totally aquatic and range in length from approximately 0.45 to 0.56 inches (1.14 to 1.42 centimeters) (Petranka 1998). They have yellowish gray bodies, broad fat heads, large, feathery external gills, and broad dorsal fins that extend well up their back. The larvae feed on zooplankton, small crustaceans, and aquatic insects for about six weeks after hatching, after which they switch to larger prey (J. Anderson 1968). Larger larvae have been known to consume the tadpoles of Pacific treefrogs, western spadefoot toads, and California red-legged frogs (J. Anderson 1968; P. Anderson 1968). California tiger salamander larvae are among the top aquatic predators in seasonal pool ecosystems. When not feeding, they often rest on the bottom in shallow water but are also found throughout the water column in deeper water. Young salamanders are wary and typically escape into vegetation at the bottom of the pool when approached by potential predators (Storer 1925). The California tiger salamander larval stage is typically completed in 3 to 6 months with most metamorphs entering upland habitat during the summer (Petranka 1998). In order to be successful, the aquatic phase of this species' life history must correspond with the persistence of its seasonal aquatic habitat. Most seasonal ponds and pools dry up completely during the summer. Amphibian larvae must grow to a critical minimum body size before they can metamorphose (change into a different physical form) to the terrestrial stage (Wilbur and Collins 1973).

Larval development and metamorphosis can vary and is often site-dependent. Larvae collected near Stockton in the Central Valley during April varied between 1.88 to 2.32 inches (4.78 to 5.89

centimeters) in length (Storer 1925). Feaver (1971) found that larvae metamorphosed and left breeding pools 60 to 94 days after eggs had been laid, with larvae developing faster in smaller, more rapidly drying pools. Longer ponding duration typically results in larger larvae and metamorphosed juveniles that are more likely to survive and reproduce (Pechmann et al. 1989; Semlitsch *et al.* 1988; Morey 1998; Trenham 1998b). Larvae will perish if a breeding pond dries before metamorphosis is complete (P. Anderson 1968; Feaver 1971). Pechmann *et al.* (1988) found a strong positive correlation between ponding duration and total number of metamorphosing juveniles in five salamander species. In Madera County, Feaver (1971) found that only 11 of 30 sampled pools supported larval California tiger salamanders, and 5 of these dried before metamorphosis could occur. Therefore, out of the original 30 pools, only 6 (20 percent) provided suitable conditions for successful reproduction that year. Size at metamorphosis is positively correlated with stored body fat and survival of juvenile amphibians, and negatively correlated with age at first reproduction (Semlitsch *et al.* 1988; Scott 1994; Morey 1998).

Following metamorphosis, juveniles leave their pools and enter upland habitat. This emigration can occur in both wet and dry conditions (Loredo and Van Vuren 1996; Loredo *et al.* 1996). Wet conditions are more favorable for upland travel but rare summer rain events seldom occur as metamorphosis is completed and ponds begin to dry. As a result, juveniles may be forced to leave their ponds on rainless nights. Under dry conditions, juveniles may be limited to seeking upland refugia in close proximity to their aquatic larval pool. These individuals often wait until the next winter's rains to move further into more suitable upland refugia. Although likely rare, larvae may over-summer in permanent ponds. Juveniles remain active in their upland habitat, emerging from underground refugia during rainfall events to disperse or forage (Trenham and Shaffer 2005). Depending on location and other development factors, metamorphs will not return as adults to aquatic breeding habitat for 2 to 5 years (Loredo and Van Vuren 1996; Trenham *et al.* 2000).

Lifetime reproductive success for California tiger salamander species is low. Results from one study suggest that the average female California tiger salamander bred 1.4 times and produced 8.5 young per reproductive effort that survived to metamorphosis (Trenham *et al.* 2000). This resulted in the output of roughly 11 metamorphic offspring over a breeding female's lifetime. The primary reason for low reproductive success may be that this relatively short-lived species requires two or more years to become sexually mature (Shaffer *et al.* 1993). Some individuals may not breed until they are four to six years old. While California tiger salamanders may survive for more than ten years, many breed only once, and in one study, less than 5 percent of marked juveniles survived to become breeding adults (Trenham 1998b). With such low recruitment, isolated populations are susceptible to unusual, randomly occurring natural events as well human-caused factors that reduce breeding success and individual survival. Factors that repeatedly lower breeding success in isolated pools can quickly extirpate a population.
Dispersal and migration movements made by California tiger salamanders can be grouped into two main categories: (1) breeding migration and; (2) interpond dispersal. Breeding migration is the movement of salamanders to and from a pond from the surrounding upland habitat. After metamorphosis, juveniles move away from breeding ponds into the surrounding uplands, where they live continuously for several years. At a study in Monterey County, it was found that upon

reaching sexual maturity, most individuals returned to their natal/ birth pond to breed, while 20 percent dispersed to other ponds (Trenham *et al.* 2001). After breeding, adult California tiger salamanders return to upland habitats, where they may live for one or more years before attempting to breed again (Trenham *et al.* 2000).

California tiger salamanders are known to travel large distances between breeding ponds and their upland refugia. Generally it is difficult to establish the maximum distances traveled by any species, but California tiger salamanders in Santa Barbara County have been recorded dispersing up to 1.3 miles (2.1 kilometers) from their breeding ponds (Sweet 1998). California tiger salamanders are also known to travel between breeding ponds. One study found that 20 to 25 percent of the individuals captured at one pond were recaptured later at other ponds approximately 1,900 and 2,200 feet away (Trenham *et al.* 2001). In addition to traveling long distances during juvenile dispersal and adult migration, California tiger salamanders may reside in burrows far from their associated breeding ponds.

Although previously cited information indicates that California tiger salamanders can travel long distances, they typically remain close to their associated breeding ponds. A trapping study conducted in Solano County during the winter of 2002/2003 suggested that juveniles dispersed and used upland habitats further from breeding ponds than adults (Trenham and Shaffer 2005). More juvenile salamanders were captured at traps placed at 328, 656, and 1,312 feet from a breeding pond than at 164 feet. Approximately 20 percent of the captured juveniles were found at least 1,312 feet from the nearest breeding pond. The associated distribution curve suggested that 95 percent of juvenile salamanders were within 2,099 feet of the pond, with the remaining 5 percent being found at even greater distances. Preliminary results from the 2003-04 trapping efforts at the same study site detected juvenile California tiger salamanders at even further distances, with a large proportion of the captures at 2,297 feet from the breeding pond (Trenham *et al.*, unpublished data). Surprisingly, most juveniles captured, even those at 2,100 feet, were still moving away from ponds (Ben Fitzpatrick, University of California at Davis, personal communication, 2004). In Santa Barbara County, juvenile California tiger salamanders have been trapped approximately 1,200 feet away while dispersing from their natal pond (Science Applications International Corporation, unpublished data). These data show that many California tiger salamanders travel far while still in the juvenile stage. Post-breeding movements away from breeding ponds by adults appear to be much smaller. During post-breeding emigration from aquatic habitat, radio-equipped adult California tiger salamanders were tracked to burrows between 62 to 813 feet from their breeding ponds (Trenham 2001). These reduced movements may be due to adult California tiger salamanders exiting the ponds with depleted physical reserves, or drier weather conditions typically associated with the post-breeding upland migration period.

California tiger salamanders are also known to use several successive burrows at increasing distances from an associated breeding pond. Although previously sited studies provide information regarding linear movement from breeding ponds, upland habitat features appear to have some influence on movement. Trenham (2001) found that radio-tracked adults were more abundant in grasslands with scattered large oaks, than in more densely wooded areas. Based on radio-tracked adults, there is no indication that certain habitat types are favored as terrestrial movement corridors (Trenham 2001). In addition, captures of arriving adults and dispersing new metamorphs were evenly distributed around two ponds completely encircled by drift fences and pitfall traps. Thus, it appears that dispersal into the terrestrial habitat occurs randomly with respect to direction and habitat types.

Threats: The California tiger salamander is imperiled throughout its range due to a variety of human activities (Service 2004b). Current factors associated with declining tiger salamander populations include continued habitat loss and degradation due to agriculture and urbanization; hybridization with the non-native eastern tiger salamander (*Ambystoma tigrinum*) (Fitzpatrick and Shaffer 2004; Riley *et al.* 2003); and predation by introduced species. California tiger salamander populations are likely threatened by multiple factors but continued habitat fragmentation and colonization of non-native salamanders may represent the most significant current threats. Habitat isolation and fragmentation within many watersheds have precluded dispersal between sub-populations and jeopardized the viability of metapopulations (broadly defined as multiple subpopulations that occasionally exchange individuals through dispersal, and are capable of colonizing or "rescuing" extinct habitat patches). Other threats include disease, predation, interspecific competition, urbanization and population growth, exposure to contaminants, rodent and mosquito control, road-crossing mortality, and hybridization with non-native salamanders. Currently, these various primary and secondary threats are largely not being offset by existing federal, state, or local regulatory mechanisms. The California tiger salamander is also prone to chance environmental or demographic events, to which small populations are particularly vulnerable.

The necessity of moving between multiple habitats and breeding ponds means that many amphibian species, such as the California tiger salamander are especially vulnerable to roads and well-used large paved areas in the landscape. Van Gelder (1973) and Cooke (1995) have examined the effect of roads on amphibians and found that because of their activity patterns, population structure, and preferred habitats, aquatic breeding amphibians are more vulnerable to traffic mortality than some other species. Large, high-volume highways pose a nearly impenetrable barrier to amphibians and result in mortality to individual animals as well as significantly fragmenting habitat. Hels and Buchwald (2001) found that mortality rates for anurans on high traffic roads are higher than on low traffic roads (Hels and Buchwald 2001). Vos and Chardon (1998) found a significant negative effect of road density on the occupation probability of ponds by the moor frog (*Rana arvalis*) in the Netherlands. In addition, incidences of very large numbers of road-killed frogs are well documented (e.g., Asley and Robinson 1996), and studies have shown strong population level effects of traffic density (Carr and Fahrig 2001) and high traffic roads on these amphibians (Van Gelder 1973; Vos and Chardon 1998). Most studies regularly count road kills from slow moving vehicles (Hansen 1982; Rosen and Lowe 1994; Drews 1995; Mallick *et al.* 1998) or by foot (Munguira and Thomas 1992). These studies assume that every victim is observed, which may be true for large conspicuous mammals, but it certainly is not true for small animals, such as the California red-legged frog. Amphibians appear especially vulnerable to traffic mortality because they readily attempt to cross roads, are slow-moving and small, and thus cannot easily be avoided by drivers (Carr and Fahrig 2001).

The direction and type of habitat used by dispersing animals is especially important in fragmented environments (Forys and Humphrey 1996). Models of habitat patch geometry predict that individual animals will exit patches at more "permeable" areas (Buechner 1987; Stamps et al. 1987). A landscape corridor may increase the patch-edge permeability by extending patch habitat (La Polla and Barrett 1993), and allow individuals to move from one patch to another. The geometric and habitat features that constitute a "corridor" must be determined from the perspective of the animal (Forys and Humphrey 1996).

Status of the Species: 31 percent (221 of 711 records and occurrences) of all Central Valley DPS California tiger salamander records and occurrences are located in Alameda, Santa Clara, San Benito (excluding the extreme western end of the County), southwestern San Joaquin, western Stanislaus, western Merced, and southeastern San Mateo counties. Of these counties, most of the records are from eastern Alameda and Santa Clara counties (Buckingham in litt. 2003; CDFG 2011; Service 2004b). The CDFG (2011) now considers 13 of these records from the Bay Area region as extirpated or likely to be extirpated.

Of the 140 reported California tiger salamander localities where wetland habitat was identified, only 7 percent were located in vernal pools (CDFG 2011). The Bay Area is located within the Central Coast and Livermore vernal pool regions (Keeler-Wolf *et al.* 1998). Vernal pools within the Coast Range are more sporadically distributed than vernal pools in the Central Valley (Holland 2003). This rate of loss suggests that vernal pools in these counties are disappearing faster than previously reported (Holland 2003). Most of the vernal pools in the Livermore Region in Alameda County have been destroyed or degraded by urban development, agriculture, water diversions, poor water quality, and long-term overgrazing (Keeler-Wolf *et al.* 1998). During the 1980s and 1990s, vernal pools were lost at a 1.1 percent annual rate in Alameda County (Holland 1998).

Due to the extensive losses of vernal pool complexes and their limited distribution in the Bay Area region, many California tiger salamander breeding sites consist of artificial water bodies. Overall, 89 percent (124) of the identified water bodies are stock, farm, or berm ponds used by cattle grazing and/or as a temporary water source for small farm irrigation (CDFG 2011). This places the California tiger salamander at great risk of hybridization with non-native tiger salamanders, especially in Santa Clara and San Benito counties. Without long-term maintenance, the longevity of artificial breeding habitats is uncertain relative to naturally occurring vernal pools that are dependent on the continuation of seasonal weather patterns (Shaffer in litt. 2003).

Shaffer et al. (1993) found that the East Bay counties of Alameda and Contra Costa supported the greatest concentrations of California tiger salamander. California tiger salamander populations in the Livermore Valley are severely threatened by the ongoing conversion of grazing land to subdivisions and vineyards (Stebbins 2003). California tiger salamanders are under increasing pressure from habitat conversion and urbanization, development (i.e. Dublin Ranch, Fallon Village, Fallon Sports Park, Staples Ranch, Shea Center Livermore, and Livermore Toyota), and infrastructure, utility and safety improvement projects (i.e. I-580 Eastbound HOV, I-580/Isabel Avenue Interchange, and I-580/Charro Avenue Interchange). The species' low recruitment and high juvenile mortality makes it particularly susceptible to habitat loss, fragmentation, urbanization, and construction related harm and mortality. Most of the California tiger salamander natural historic habitat (vernal pool grasslands) available in this region has been lost due to urbanization and conversion to intensive agriculture (Keeler-Wolf et al. 1998). California tiger salamanders are now primarily restricted to artificial breeding ponds, such as bermed ponds or stock ponds, which are typically located at higher elevations (CDFG 2011).

San Joaquin Kit Fox

Listing Status: The San Joaquin kit fox was listed as an endangered species on March 11, 1967 (Service 1967) and it was listed by the State of California as a threatened species on June 27, 1971.

Distribution: In the San Joaquin Valley before 1930, the range of the San Joaquin kit fox extended from southern Kern County north to Tracy in San Joaquin County, on the west side, and near La Grange in Stanislaus County, on the east side (Grinnell *et al.* 1937; Service 1998). Records are currently documented north to the Antioch area of Contra Costa County.

Status and Natural History: Historically, San Joaquin kit fox occurred in several San Joaquin Valley native plant communities. In the southernmost portion of the range, these communities included valley sink scrub, valley saltbush scrub, upper Sonoran subshrub scrub, and annual grassland. The species seems to prefer more gentle terrain and decreases in abundance as terrain ruggedness increases (Grinnell *et al.* 1937; Morrell 1972; Warrick and Cypher 1999). San Joaquin kit foxes also exhibit a capacity to utilize habitats that have been altered by man and have been observed in oil fields, grazed pasturelands, and "wind farms" (Cypher 2000). Kit foxes can inhabit the margins and fallow lands near irrigated row crops, orchards, and vineyards, and may forage occasionally in these agricultural areas (Service 1998).

Adult San Joaquin kit foxes are usually solitary during late summer and fall. In September and October, adult females begin to excavate and enlarge natal dens (Morrell 1972), and adult males join the females in October or November (Morrell 1972). Typically, pups are born between February and late March (Egoscue 1962; Morrell 1972; Spiegel and Tom 1996; Service 1998). Mean litter sizes reported for San Joaquin kit foxes include 2.0 on the Carrizo Plain (White and Ralls 1993), 3.0 at Camp Roberts (Spencer *et al.* 1992), 3.7 in the Lokern area (Spiegel and Tom 1996), and 3.8 at the Naval Petroleum Reserve (Cypher *et al.* 2001). Pups appear above ground when they are approximately 3-4 weeks old, and are weaned at 6-8 weeks. Reproductive rates, the proportion of females bearing young, vary annually with environmental conditions, particularly food availability. Annual rates range from 0 to 100 percent, and reported mean rates include 61 percent at the Naval Petroleum Reserve (Cypher *et al.* 2001), 64 percent in the Lokern area (Spiegel and Tom 1996), and 32 percent at Camp Roberts (Spencer *et al.* 1992). Although some yearling female kit foxes will produce young, most do not reproduce until 2 years of age (Spencer *et al.* 1992; Spiegel and Tom 1996; Cypher *et al.* 2000). Some young of both sexes, but particularly females may delay dispersal, and may assist their parents in raising the following year's litter of pups (Spiegel and Tom 1996). The young kit foxes begin to forage for themselves at about four to five months of age (Koopman *et al.* 2000; Morell 1972). San Joaquin kit foxes may live to ten years in captivity (McGrew 1979) and 8 years in the wild (Berry *et al.* 1987), but most kit foxes do not live past 2-3 years of age.

Although most young kit foxes disperse less than 5 miles (Scrivner *et al.* 1987), dispersal distances of up to 76.3 miles have been documented for the San Joaquin kit fox (Service 1998). Dispersal can be through disturbed habitats, including agricultural fields, and across highways and aqueducts. The age at dispersal ranges from 4-32 months (Cypher 2000). Among juvenile kit foxes surviving to July 1 at the Naval Petroleum Reserve, 49 percent of the males dispersed from natal home ranges while only 24 percent of the females dispersed (Koopman *et al.* 2000). Among dispersing kit foxes, 87 percent did so during their first year of age. Some kit foxes delay dispersal and may inherit their natal home range.

San Joaquin kit foxes dens are usually located in areas with loose-textured, friable soils (Morrell 1972; O'Farrell 1983). Some studies have suggested that where hardpan layers predominate, kit foxes create their dens by enlarging the burrows of California ground squirrels or badgers (Jensen 1972; Morrell 1972; Orloff *et al.* 1986). In parts of their range, particularly in the foothills, kit foxes often use ground squirrel burrows for dens (Orloff *et al.* 1986). Kit fox dens are commonly located on flat terrain or on the lower slopes of hills with average slope at den sites reported to range from 0 to 22 degrees (CDFG 1980; O'Farrell 1983; Orloff *et al.* 1986). Natal and pupping dens are generally found in flatter terrain. Common locations for dens include washes, drainages, and roadside berms. Kit foxes also commonly den in human-made structures such as culverts and pipes (O'Farrell 1983; Spiegel *et al.* 1996).

Natal and pupping dens of the San Joaquin kit fox may include from two to 18 entrances and are usually larger than dens that are not used for reproduction (O'Farrell *et al.* 1980; O'Farrell and McCue 1981). Natal dens may be reused in subsequent years (Egoscue 1962). It has been speculated that natal dens are located in the same location as ancestral breeding sites (O'Farrell 1983). Active natal dens are generally 1.2 to 2 miles from the dens of other mated kit fox pairs (Egoscue 1962; O'Farrell and Gilbertson 1979). Natal and pupping dens usually can be identified by the presence of scat, prey remains, matted vegetation, and mounds of excavated soil (i.e. ramps) outside the dens (O'Farrell 1983). However, some active dens in areas outside the valley floor often do not show evidence of use (Orloff *et al.* 1986). During telemetry studies of kit foxes in the northern portion of their range, 70 percent of the dens that were known to be active showed no sign of use (e.g., tracks, scats, ramps, or prey remains)(Orloff *et al.* 1986). In another more recent study in the Coast Range, 79 percent of active kit fox dens lacked evidence of recent use other than signs of recent excavation (Jones and Stokes Associates 1997).

A San Joaquin kit fox can use more than 100 dens throughout its home range, although on average, an animal will use approximately 12 dens a year for shelter and escape cover (Cypher *et al.* 2001). Hall (1983) reported individual animals using up to 70 different dens. Kit foxes typically use individual dens for only brief periods, often for only one day before moving to another den (Ralls *et al.* 1990). At the Naval Petroleum Reserve, individual kit foxes used an average of 11.8 dens per year (Koopman *et al.* 1998). Den switching by the San Joaquin kit fox may be a function of predator avoidance, local food availability, or external parasite infestations (e.g., fleas) in dens (Egoscue 1956). Kit foxes tend to use dens that are located in the same general area, and clusters of dens can be surrounded by hundreds of hectares of similar habitat devoid of other dens (Egoscue 1962).

The diet of the San Joaquin kit fox varies geographically, seasonally, and annually, based on temporal and spatial variation in abundance of potential prey. Known prey species of the kit fox include white-footed mice, insects, California ground squirrels, kangaroo rats, San Joaquin antelope squirrels, black-tailed hares, and chukar (Jensen 1972; Archon 1992). Kit foxes also prey on desert cottontails, ground-nesting birds, and pocket mice.

The diets and habitats selected by coyotes and San Joaquin kit foxes living in the same areas are often quite similar. Hence, the potential for resource competition between these species may be quite high when prey resources are scarce such as during droughts, which are quite common in semi-arid, central California. Competition for resources between coyotes and kit foxes may result in kit fox mortalities. Coyote-related injuries accounted for 50-87 percent of the mortalities of radio collared kit foxes at Camp Roberts, the Carrizo Plain Natural Area, the Lokern Natural Area, and the Naval Petroleum Reserve (Cypher and Scrivner 1992; Standley *et al.* 1992).

San Joaquin kit foxes are primarily nocturnal, although individuals are occasionally observed resting or playing (mostly pups) near their dens during the day (Grinnell *et al.* 1937). Kit foxes occupy home ranges that vary in size. White and Ralls (1993) reported average home ranges of 4.47 square miles, while others have reported home ranges of up to 12 square miles (Service 1998). A mated pair of kit foxes and their current litter of pups usually occupy each home range (White and Ralls 1993, Spiegel 1996; White and Garrott 1997). Other adults, usually offspring from previous litters, also may be present (Koopman *et al.* 2000), but individuals often move independently within their home range (Cypher 2000). Individual home ranges can overlap considerably, at least outside core activity areas (Morrell 1972; Spiegel *et al.* 1996). Average distances traveled each night range from 5.8 to 9.1 miles and are greatest during the breeding season (Cypher 2000).

The territorial spacing behavior exhibited by the San Joaquin kit fox eventually limits the number of foxes that can inhabit an area owing to shortages of available space and per capita prey. Hence, as habitat is fragmented or destroyed, the carrying capacity of an area is reduced and a larger proportion of the population is forced to disperse. Increased dispersal generally leads to lower survival rates and, in turn, decreased abundance because greater than 65 percent of dispersing juvenile foxes die within 10 days of leaving their natal range (Koopman *et al.* 2000).

Estimates of kit fox density vary greatly throughout its range, and have been reported as high as 3.11 per square mile in optimal habitats in good years (Service 1998). At the Elk Hills in Kern County, density estimates varied from 0.7 animals per square kilometer (1.86 animals per square mile) in the early 1980s to 0.01 animals per square kilometer (0.03 animals per square mile) in 1991 (Service 1998).

Arid systems are characterized by unpredictable fluctuations in precipitation, which lead to high frequency, high amplitude fluctuations in the abundance of mammalian prey for kit foxes

(Goldingay *et al.* 1997; White and Garrott 1999). Because the reproductive and neonatal survival rates of kit foxes are strongly depressed at low prey densities (White and Ralls 1993; White and Garrott 1997, 1999), periods of prey scarcity owing to drought or excessive rain events can contribute to population crashes and marked instability in the abundance and distribution of kit foxes (White and Garrott 1999).

Historically, kit foxes may have existed in a metapopulation structure of core and satellite populations, some of which periodically experienced local extinctions and recolonization (Service 1998). Today's populations exist in an environment drastically different from the historic one, however, and extensive habitat fragmentation will result in geographic isolation, smaller population sizes, and reduced genetic exchange among populations; all of which increase the vulnerability of kit fox populations to extirpation. Populations of kit foxes are extremely susceptible to the risks associated with small population size and isolation because they are characterized by marked instability in population density. For example, the relative abundance of kit foxes at the Naval Petroleum Reserves, California, decreased 10-fold during 1981 to 1983, increased 7-fold during 1991 to 1994, and then decreased 2-fold during 1995 (Cypher and Scrivner 1992; Cypher and Spencer 1998).

Preliminary genetic assessments indicate that historic gene flow among populations was quite high, with effective dispersal rates of at least one to four dispersers per generation (M. Schwartz, pers. comm. to P. J. White, March 23, 2000). This level of genetic dispersal should allow for local adaptation while preventing the loss of any rare alleles. Based on these results, it is likely that northern populations of kit foxes were once panmictic (i.e., randomly mating in a genetic sense), or nearly so, with southern populations. In other words, there were no major barriers to dispersal among populations.

Current levels of gene flow also appear to be adequate, however, extensive habitat loss and fragmentation continues to form more or less geographically distinct populations of foxes, which could potentially reduce genetic exchange among them. An increase in inbreeding and the loss of genetic variation could increase the extinction risk for small, isolated populations of kit foxes by interacting with demography to reduce fecundity, juvenile survival, and lifespan (Lande 1988; Frankham and Ralls 1998; Saccheri *et al.* 1998).

Threats: Land conversions contribute to declines in kit fox abundance through direct and indirect mortalities, displacement, reduction of prey populations and denning sites, changes in the distribution and abundance of larger canids that compete with kit foxes for resources, and reductions in carrying capacity. Kit foxes may be buried in their dens during land conversion activities (C. Van Horn, Endangered Species Recovery Program, Bakersfield, personal communication to S. Jones, Fish and Wildlife Service, Sacramento, 2000), or permanently displaced from areas where structures are erected or the land is intensively irrigated (Jensen 1972; Morrell 1975). Furthermore, even moderate fragmentation or loss of habitat may significantly impact the abundance and distribution of kit foxes. Capture rates of kit foxes at the Naval Petroleum Reserve in Elk Hills were negatively associated with the extent of oil-field development after 1987 (Warrick and Cypher 1999). Likewise, the California Energy

Commission found that the relative abundance of kit foxes was lower in oil-developed habitat than in nearby undeveloped habitat on the Lokern (Spiegel *et al.* 1996).

Pesticides and rodenticides pose a threat to kit foxes through direct or secondary poisoning. Kit foxes may be killed if they ingest rodenticide in a bait application, or if they eat a rodent that has consumed the bait. Even sublethal doses of rodenticides may lead to the death of these animals by impairing their ability to escape predators or find food. Pesticides and rodenticides may also indirectly affect the survival of kit foxes by reducing the abundances of their staple prey species.

Several species prey upon San Joaquin kit foxes. Predators such as coyotes, bobcats, non-native red foxes, badgers, and golden eagles will kill kit foxes. Badgers, coyotes, and red foxes also may compete for den sites (Service 1998). The diets and habitats selected by coyotes and kit foxes living in the same areas are often quite similar (Cypher and Spencer 1998). Hence, the potential for resource competition between these species may be quite high when prey resources are scarce such as during droughts, which are quite common in semi-arid, central California. Land conversions and associated human activities have led to changes in the distribution and abundance of coyotes, which compete with kit foxes for resources.

Wildlife diseases do not appear to be a primary mortality factor that consistently limits kit fox populations throughout their range (McCue and O'Farrell 1988; Standley and McCue 1992). However, central California has a high incidence of wildlife rabies cases (Schultz and Barrett 1991), and high seroprevalences of canine distemper virus and canine parvovirus indicate that kit fox populations have been exposed to these diseases (McCue and O'Farrell 1988; Standley and McCue 1992). Hence, disease outbreaks could potentially cause substantial mortality or contribute to reduced fertility in seropositive females, as was noted in the closely-related swift fox. There are some indications that rabies virus may have contributed to a catastrophic decrease in kit fox abundance at Camp Roberts, San Luis Obispo County, California, during the early 1990's.

Status of the Species: The status (i.e., distribution, abundance) of the kit fox has decreased since its listing in 1967. This trend is reasonably certain to continue into the foreseeable future unless measures to protect, sustain, and restore suitable habitats, and alleviate other threats to their survival and recovery, are implemented.

Less than 20 percent of the habitat within the historical range of the kit fox remained when the animal was listed as federally-endangered in 1967, and there has been a substantial net loss of habitat since that time. Historically, San Joaquin kit foxes occurred throughout California's Central Valley and adjacent foothills. Extensive land conversions in the Central Valley began as early as the mid-1800s with the Arkansas Reclamation Act. By the 1930's, the range of the kit fox had been reduced to the southern and western parts of the San Joaquin Valley (Grinnell *et al.* 1937). The primary factor contributing to this restricted distribution was the conversion of native habitat to irrigated cropland, industrial uses (e.g., hydrocarbon extraction), and urbanization (Laughrin 1970; Jensen 1972; Morrell 1972, 1975). Approximately one-half of the natural communities in the San Joaquin Valley were tilled or developed by 1958 (Service 1983).

This rate of loss accelerated following the completion of the Central Valley Project and the State Water Project, which diverted and imported new water supplies for irrigated agriculture (Service 1995). Approximately 1.97 million acres of habitat were converted in the San Joaquin region between 1950 and 1980 (Service 1998). The counties specifically noted as having the highest wildland conversion rates included Kern, Tulare, Kings, and Fresno, all of which are occupied by kit foxes. From 1959 to 1969 alone, an estimated 34 percent of natural lands were lost within the then-known kit fox range (Laughrin 1970). By 1979, only approximately 370,000 acres out of a total of approximately 8.5 million acres on the San Joaquin Valley floor remained as non-developed land (Williams 1985; Service 1983). Virtually all of the documented loss of essential habitat was the result of conversion to irrigated agriculture.

The small size of the northernmost kit fox population and its isolation from other established populations make it vulnerable to extinction owing to predation and competition from coyotes and red foxes, inbreeding, catastrophic events, and disease epidemics (White *et al.* 2000). Genetic studies conducted by Schwartz et al. (2000) found that individuals in the Los Banos population near San Luis Reservoir only breed with animals in the northern population in Alameda and Contra Costa counties. Thus, projects in Alameda and Contra Costa County that significantly reduce travel corridors and population size could potentially impact the Los Banos kit fox population. The long term viability of both populations depends, at least in part, on periodic immigration and gene flow from between the populations.

Habitat in the northern range is highly fragmented by highways, canals, and development. Interstate 580 runs southeast to northwest as it splits from Interstate 5, and turns west through the Altamont Pass area; thus it impedes both north-south and west-east movement of San Joaquin kit foxes. Although the canal system facilitates north-south migration along its length, it also impedes lateral east-west kit fox travel. Additional development in these areas will further impede the movement of kit fox and isolate the northern population from more southern populations. The protection of the remaining kit fox corridor, including grasslands west of Interstate 580, and lands between the California aqueduct and the Delta Mendota Canal, is vital to the survival of this population.

Recovery Plan: The primary goal of the recovery strategy for kit foxes identified in the *Recovery Plan for Upland Species of the San Joaquin Valley, California* (Service 1998) is to establish a complex of interconnected core and satellite populations throughout the species' range. The long-term viability of each of these core and satellite populations depends partly upon periodic dispersal and genetic flow between them. In the northern range, from the Ciervo Panoche core population in Fresno County northward, kit fox populations are small and isolated, and have exhibited significant decline. Therefore, kit fox movement corridors between these populations must be preserved and maintained.

Vernal Pool Fairy Shrimp

Listing Status: A final rule was published on September 19, 1994, listing the vernal pool fairy shrimp as threatened under the Act (Service 1994). The final rule to designate critical habitat for 15 vernal pool species, including the vernal pool fairy shrimp, was published on August 6, 2003

(Service 2003a). A final rule was published again on August 11, 2005 (Service 2005a). Further information on the life history and ecology of the vernal pool fairy shrimp may be found in the final listing rule, the final rule to designate critical habitat, the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Service 2005b), Eng *et al.* (1990), Helm (1998), Simovich *et al.* (1992), and Volmar (2002).

Description: Vernal pool fairy shrimp have delicate elongate bodies; large stalked eyes; no hard shell, and eleven pairs of swimming legs. Typically less than 1 inch long, they swim or glide upside-down by means of complex wavelike beating movements while feeding on algae, bacteria, protozoa, rotifers, and detritus. Female vernal pool fairy shrimp carry eggs in a pear-shaped, ventral brood sac until the eggs are either dropped or sink to the pool bottom with the female when she dies. Eggs which remain at the bottom of the pools after the pools dry are known as cysts. These cysts are protected by a hard outer covering, making them able to withstand heat, cold, and prolonged desiccation. When pools refill in the same or subsequent seasons, some, but not all, of the cysts hatch, resulting in a cyst bank in the soil that may include cysts from several breeding seasons (Donald 1983). Vernal pool fairy shrimp develop rapidly and may become sexually mature within two weeks after hatching under ideal conditions (Gallagher 1996; Helm 1998). Under less than perfect conditions, maturity is reached within an average of 41 days (Helm 1998). Such quick maturation permits fairy shrimp populations to persist in short-lived, shallow bodies of water (Simovich *et al.* 1992).

Distribution: All known occurrences of vernal pool fairy shrimp occur in California and southern Oregon. The geographic range of this species encompasses most of the Central Valley from Shasta County to Tulare County and the central coast range from northern Solano County to Santa Barbara County, California. Additional isolated occurrences have been identified in western Riverside County, California, and in Jackson County, Oregon near the city of Medford (Helm 1998; Eriksen and Belk 1999; Service 1994, 2003a).

Status and Natural History: Vernal pool fairy shrimp inhabit vernal pools with clear to tea-colored water, most commonly in grass or mud-bottomed swales, or basalt flow depression pools in unplowed grasslands. Vernal pool fairy shrimp have been collected from early December to early May. They can mature quickly, allowing populations to persist in short-lived shallow pools (Simovich *et al.* 1992). Fairy shrimps occupy a variety of different vernal pool habitats, from small, clear, sandstone rock pools to large, turbid, alkaline, grassland valley floor pools (Eng *et al.* 1990; Helm 1998;). The pool types where the species has been found include Northern Hardpan, Northern Claypan, Northern Volcanic Mud Flow, and Northern Basalt Flow vernal pools formed on a variety of geologic formations and soil types. Although vernal pool fairy shrimp have been collected from large vernal pools, including one exceeding 25 acres in area (Eriksen and Belk 1999), they are most frequently found in pools measuring fewer than 0.05 acre in area (Helm 1998; Gallagher 1996). Vernal pool fairy shrimp occur at elevations from 33 feet to 4,003 feet (Eng *et al.* 1990), and are typically found in pools with low to moderate amounts of salinity or total dissolved solids (Keeley 1984; Syrdahl 1993).

The primary historic dispersal method for vernal pool fairy shrimp was likely large scale flooding resulting from winter and spring rains which allowed colonization of different individual vernal pools and vernal pool complexes. This dispersal has been adversely affected by the construction of dams, levees, and other flood control measures, and widespread urbanization within significant portions of the range of this species. Waterfowl and shorebirds likely are now the primary dispersal agents for the vernal pool fairy shrimp (Simovich *et al.* 1992). The eggs of these crustaceans are either ingested (Krapu 1974; Ahl 1991) and/or adhere to the legs and feathers upon which they are transported to new habitats.

Threats: Vernal pool fairy shrimp are threatened by the same activities as other vernal pool invertebrates. These threats include the conversion of vernal pool habitat to agricultural lands and urban development, and stochastic extinction because of the small and isolated nature of remaining populations (Service 1994). The limited and disjunct distribution of vernal pools, coupled with the even more limited distribution of the vernal pool fairy shrimp, means that any reduction in vernal pool habitat quantity could adversely affect this species.

Recolonization opportunities are diminished when physical barriers, such as development or lack of vernal pool habitat, isolate populations from one another or inhibit transport of cysts. Isolated populations could be more susceptible to inbreeding depression, which can result in local extinction or reduced fitness (Gilpin and Soule 1986, Goodman 1987). However, this has never been demonstrated for branchiopod crustaceans.

Activities that alter the suitability of vernal pool habitat may impact the special status crustaceans dependent on those habitats. These activities include damaging the impermeable clay and /or hardpan layers of the habitat bottom, filling in the habitat, and altering (e.g. through contaminants) or destroying the watershed that conveys overland flow into the habitat. Additionally, introduction of non-native plants, destruction or degradation of the surrounding upland habitat, introduction of fish (such as *Gambusia* spp.) into special-status shrimp habitats, and activities that would discourage or prevent waterfowl and waders from feeding at occupied habitats and thereby restrict gene flow between populations would also significantly affect mid-valley fairy shrimp populations.

Recovery Plan: The *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* presents an ecosystem-level strategy for recovery and conservation focused on habitat protection and management. As a basis, the plan uses the 17 vernal pool regions in the State of California as defined by the California Department of Fish and Game in the California Vernal Pool Assessment Preliminary Report (Keeler-Wolf *et al.* 1998). The Livermore Vernal Pool Region includes the Altamont Hills area. The plan further designates core areas that are distinct areas in each vernal pool region that provide the features, populations, and distinct geographic and/or genetic diversity necessary for recovery of the species. In order to delist the vernal pool fairy shrimp, 80 percent of all occurrences must be protected and 85 percent of suitable species habitat must be protected rangewide and within each vernal pool region.

Longhorn Fairy Shrimp

Listing Status: A final rule was published on September 19, 1994, to list longhorn fairy shrimp as endangered under the Act (Service 1994). The final rule to designate critical habitat for 15 vernal pool species, including the vernal pool tadpole shrimp and the vernal pool fairy shrimp, was published on August 6, 2003 (Service 2003a). A final rule was published again on August 11, 2005 (Service 2005a). Further information on the life history and ecology of the longhorn fairy shrimp may be found in the final listing rule, the final rule to designate critical habitat, the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Service 2005b), and Eng *et al.* (1990).

Description: Longhorn fairy shrimp are tiny freshwater crustaceans with delicate elongate bodies, large stalked compound eyes, and 11 pairs of phyllopods (swimming legs that also function as gills). Fairy shrimp do not have a hard shell, a characteristic of the order *Anostraca* to which they belong. This species is easily distinguished from other fairy shrimp by the male's extremely long second antennae.

Distribution: The four known populations of longhorn fairy shrimp include: (1) areas within and adjacent to the Carrizo Plan National Monument; (2) areas within the San Luis National Wildlife Refuge Complex, Merced County; (3) areas within the Brushy Peak Preserve, Alameda County; and (4) areas within the Vasco Caves Preserve near the town of Byron, Contra Costa County (Service 2005b). The Brushy Peak and Vasco Caves Preserves are located within three miles of each other.

Status and Natural History: Longhorn fairy shrimp occurrences are rare and highly disjunct with specific pool characteristics largely unknown (Service 2003a). Typical habitat for listed fairy shrimp in California include vernal pools, seasonally ponded areas within vernal swales, ephemeral freshwater habitats and artificial habitats (railroad toedrains, roadside ditches, abandoned agricultural drains, ruts left by heavy construction vehicles, and depressions in firebreaks) (Eng *et al.* 1990, Service 2003a).

Habitat for longhorn fairy shrimp in the Livermore Vernal Pool Region in Contra Costa and Alameda Counties occurs primarily in small, clear, sandstone outcrop vernal pools. These sandstone pools are sometimes no larger than 3.3 feet in diameter, have a pH near neutral, and very low alkalinity and conductivity. Water temperatures in these vernal pools have been measured between 50 and 64 degrees Fahrenheit (Helm 1988). Vernal pools in other parts of California that support longhorn fairy shrimp are either loam and sandy loam or shallow, alkaline pools (Service 1994). The seasonal pool habitat is subject to seasonal variations, and it is thought that longhorn fairy shrimp are dependent on the ecological characteristics of those variations. These characteristics include duration of inundation and presence or absence of water at specific times of the year (Service 1994). The longhorn fairy shrimp is capable of living in vernal pools of relatively short duration (pond 6 to 7 weeks in winter and 3 weeks in spring) (Eriksen and Belk 1999).

Longhorn fairy shrimp are omnivorous filter-feeders (Eriksen and Belk 1999). They are a component of the planktonic crustacea within seasonal temporary pools and can occur in densities as high as 200 per liter of water (Eng *et al.* 1990). Predator consumption of fairy shrimp cysts (resting eggs) aids in distributing populations. Predators expel viable cysts in their excrement, often at locations other than where they were consumed (Wissinger *et al.* 1999). If conditions are suitable, these transported cysts may hatch at the new location and potentially establish a new population. Cysts can also be transported in mud carried on the feet of animals, including livestock that may wade through their habitat (Eriksen and Belk 1999). Beyond inundation of the habitat, the specific cues for hatching are largely unknown (Eriksen and Belk 1999), although temperature is believed to play a role. Longhorn fairy shrimp have been reported to co-occur with the vernal pool fairy shrimp throughout its range.

Threats: Longhorn fairy shrimp are threatened by the same activities as other vernal pool invertebrates. These threats include the conversion of vernal pool habitat to agricultural lands and urban development, and extinction due to the small and isolated nature of remaining populations (Service 1994).

The limited and disjunct distribution of vernal pools, coupled with the even more limited distribution of the longhorn fairy shrimp, means that any reduction in vernal pool habitat could adversely affect this species. Recolonization opportunities are diminished when physical barriers, such as development or lack of vernal pool habitat, isolate populations from one another or inhibit transport of cysts. Isolated populations could be more susceptible to inbreeding depression, which can result in local extinction or reduced fitness (Gilpin and Soule 1986, Goodman 1987). However, this has never been demonstrated for branchiopod crustaceans.

Activities that alter the suitability of vernal pool habitat could impact the special-status crustaceans that depend on them. These activities include damaging the impermeable clay and /or hardpan layers of the habitat bottom, filling in the habitat, altering (e.g. through contaminants) or destroying the watershed that conveys overland flow into the habitat. Additionally, introduction of non-native plants, destruction or degradation of the surrounding upland habitat, introduction of fish (such as *Gambusia* spp.) into special-status shrimp habitats, and activities that would discourage or prevent waterfowl and waders from feeding at occupied habitats and thereby restrict gene-flow between populations would also significantly affect longhorn fairy shrimp populations.

Recovery Plan: The *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* presents an ecosystem-level strategy for recovery and conservation focused on habitat protection and management. As a basis, the plan uses the 17 vernal pool regions in the State of California as defined by the California Department of Fish and Game in the California Vernal Pool Assessment Preliminary Report (Keeler-Wolf *et al.* 1998). The Livermore Vernal Pool Region includes the Altamont Hills area. The plan further designates core areas that are distinct areas in each vernal pool region that provide the features, populations, and distinct geographic and/or genetic diversity necessary for recovery of the species. In order to downlist the longhorn fairy shrimp, 100 percent of all occurrences must be protected and 95 percent of suitable species habitat must be protected rangewide and within each vernal pool region.

Since the time of listing, surveys for longhorn fairy shrimp throughout its range have not located additional populations of the species, although additional occurrences within the four known populations have been detected. Currently, the CNDDB database reports 11 occurrences of longhorn fairy shrimp (CDFG 2011).

Informal monitoring of known populations of fairy shrimp has occurred within the Brushy Peak Preserve. There are several vernal pools that have longhorn fairy shrimp within the 507-acre Brushy Peak Preserve, which is owned by the Livermore Area Recreation and Park District and managed by the East Bay Regional Park District (EBRPD). These pools are within rock outcrops within multiple indentations that seasonally pool water, but the exact number of vernal pools containing longhorn fairy shrimp has not been quantified.

Environmental Baseline

The MEP site is located just above the Central Valley floor in a region of low-lying foothills to the Altamont Hills. In the vicinity are farmlands of row crops and cattle grazing, interspersed with irrigation aqueducts, canals, and cattle stockponds. The project parcel is managed as a cattle grazing pasture land.

Non-native annual grassland is the predominant habitat type in the action area. The annual grasslands found in the action area support a low diversity of endemic species. The spring 2009 rare plant survey conducted by CH2M HILL biologists identified the following non-native grassland species within the action area: Italian thistle, yellow star-thistle, Great valley gumweed, black mustard, filarees, horehound, soft chess, and foxtail barley. Numerous California ground squirrels burrows were found on the site.

Four drainage features, identified as D-1, D-2, D-3, and D-4 in the 2009 wetland delineation report and shown as blue line drainages on the United States Geological Survey Clifton Court Forebay 7.5-minute quadrangle, area within the project footprint. D-1, D-3, and D-4 have an obvious bed and bank; D-2 is more swale-like. With inundation being less frequent in D-1 and D-2, ephemeral conditions support non-emergent species including saltgrass, rabbitsfoot grass, Italian ryegrass, and brass buttons.

Prolonged saturation or inundation differentiates D-3 and D-4 from the other drainages found along Bruns Road. D-3 is characterized by dense growth of cosmopolitan bulrush with scattered rabbitsfoot grass, curly dock, and cattail. The channel at ordinary high water supports three to six inches of gently flowing water. The vegetated channel flows to the north into a seasonal pond. D-4 is a well-defined channel and characterized by dense cattails growing in the center of the channel with dense saltgrass growing around the outer edges. Mexican rush and curly dock are also present in scattered locations. At ordinary high water, D-4 is relatively shallow at less than one foot, flowing east into a seasonal pond. Numerous western toad tadpoles were observed during the 2009 delineation of D-4.

Seasonal wetlands identified in the action area range from small isolated seasonal features to larger alkali sink wetlands. Alkali sink wetland is immediately north and directly abuts D-4. Within the action area, this feature is characterized by saltgrass and common rusty molly with scattered sand spurry, alkali heath, and common spikeweed. This area is completely vegetated and appears to be subject to at least seasonal inundation and most likely a prolonged seasonally shallow water table. A small shallow seasonal wetland is located along the existing access road to the Byron Power Cogeneration Plant, along the northern edge of the MEP site. A partially collapsed 18-inch-diameter culvert hydrologically connects the two distinct basins found there. Vegetation within the basins is generally sparse and includes species such as popcorn flower, coyote thistle, Italian ryegrass, gumweed, dense-flower willowherb, wooly marbles, brass buttons, and water pygmyweed. The basins were both dry during the April 2009 field delineation, but inundation and aquatic invertebrates (*Branchinecta* sp.) were noted at this site during earlier site visits in 2009. This wetland area is located nearly 500 feet south of D-1 and there is no apparent hydrological connection between this basin and the drainage.

Other aquatic features in the action area include isolated seasonal wetlands including vernal pools, swales, erosional channels, and a small section of BBID's Canal 45. The portion of Canal 45 that runs through the action area is a constructed and routinely maintained earthen channel devoid of vegetation. Cement rip rap is present along the banks of the canal. There are other seasonal wetlands and shallow ephemeral pools but were located outside the wetland delineation survey area.

A large area of alkaline meadow habitat occurs northeast of the intersection of Bruns and Kelso roads, adjacent to the proposed water supply pipeline to the east and just north of the Kelso Substation

Agricultural uses occur near the north end of the water supply pipeline route. BBID owns the agricultural area where the water supply pipeline will be installed. The adjacent field has been in agricultural production for a number of years and was recently irrigated and planted with alfalfa in 2009. BBID also owns and operates a network of irrigation canals and agricultural developments found in the project vicinity. A large-scale agricultural infrastructure associated with the Central Valley Project and State Water Project exists nearby.

Other agricultural uses exist in the project vicinity. On a parcel to the west of the project parcel is a 10-acre cattle ranching development, which includes a ranch house and stock yard. Cattle stock ponds on this property and others support known breeding habitat for California red-legged frog and California tiger salamander. In general, the grasslands occupied by these cattle developments are moderately to heavily grazed, including the project parcel and the northern portion of the proposed transmission line route.

The 6.5-megawatt Byron Power Cogeneration Plant located on the project parcel is immediately next to the MEP site. The cogeneration site is underlain with approximately one acre of asphalt and gravel and served by the existing graveled access road from Bruns Road. No landscaping exists on or next to the property. As previously noted, non-native annual grassland characterizes the surrounding landscape. At the northeast corner of Kelso Road and Bruns Road are PG&E's

Bethany Gas Compressor Station and 230-kilovolt Kelso Substation. Both facilities occupy one site totaling approximately 17 acres of gravel and asphalt.

Landscaping by ornamental Bishop pine and patches of coyote brush border the PG&E property along Kelso Road and Bruns Road. Scattered residential parcels, farm buildings, and industrial areas are also present along the water supply pipeline alignment.

Numerous existing transmission lines transect the landscape in the action area and vicinity. Wood pole lines on the project parcel service the 66.5-megawatt Byron Power Cogeneration Plant. Taller lattice high-tension 230-kilovolt and 500-kilovolt transmission line towers exist on the project parcel and in other areas of the project vicinity.

California Red-legged Frog

Threats to California red-legged frogs in the action area include habitat loss, modification, degradation, and fragmentation from development and competition and predation by introduced species and/or feral animals.

The proposed project and Conservation Area are located within the South/East San Francisco Bay Recovery Unit, which extends from the northernmost portion of Contra Costa County, includes a portion of San Joaquin County south to Santa Clara County, includes the eastern portion of San Mateo County, and all of San Francisco County. Contra Costa and Alameda Counties contain the majority of known California red-legged frog localities within the eastern San Francisco Bay area. Within this Recovery Unit, California red-legged frogs seem to have been nearly eliminated from the western lowland areas near urbanization. The species still occurs in isolated populations in the East Bay Foothills (between Interstate 580 and Interstate 680) and is abundant in several areas in eastern Alameda and Contra Costa counties. This Recovery Unit is essential to the survival and recovery of California red-legged frog, as it contains the largest number of occupied drainages in the northern portion of its range.

California red-legged frogs have been observed within the MEP property in an unnamed seasonal tributary that connects to other known occurrence locations (CDFG 2011). Seasonal drainages (D-1, D-2, D-3, and D-4) found along the water supply pipeline provide potential refugial and dispersal habitat for California red-legged frog. Stock ponds found less than one mile from the action area, northwest on the Byron Conservation Bank and west on another parcel provide known breeding sites for California red-legged frog. Numerous other observations have been recorded within a five mile radius of the project site including upstream of the site at the proposed Mountain House Conservation Bank, immediately to the west of the site, and at the Byron Conservation Bank, which adjoins the subject property to the northwest. Several seasonal wetland features that may serve as non-breeding aquatic habitat occur within the property as well as numerous small mammal burrows which provide refugial and cover habitat for dispersing California red-legged frogs. Additionally, two stock ponds on the 158-acre project parcel may support breeding for the species in certain wet years. Based on the habitat located within and adjacent to the action area, the biology and ecology of the California red-legged frog, and the records of the listed species on-site and in adjacent areas, the Service has determined this listed animal utilizes the action area for foraging, resting, dispersal, mating, and other essential behaviors.

California Red-legged Frog Critical Habitat

The project area and Conservation Area are located within the CCS-2, Mt. Diablo, California red-legged frog critical habitat unit. This unit contains the features that are essential for the conservation of the subspecies. This unit also contains aquatic habitat for breeding and non-breeding activities (PCE 1 and PCE 2) and upland habitat for foraging and dispersal activities (PCE 3 and PCE 4). CCS-2 was known to be occupied at time of listing and is currently occupied. This unit is mapped from occurrences recorded at time of listing and subsequent to the time of listing. CCS-2 is located in eastern Contra Costa County and northeastern Alameda County, north of Highway 580 and consists of 9,869 acres of State land, 4,186 acres of local government land, and 124,803 acres of private land. The unit contains permanent and ephemeral aquatic habitats suitable for breeding, upland areas for dispersal, shelter and food, and provides for connectivity between populations farther south in the interior Coast Range. Threats that may require special management in CCS-2 include removal and alteration of habitat due to urbanization, overgrazing of aquatic and riparian habitats, erosion and siltation due to flooding, and predation by non-native species.

Non-breeding aquatic habitat (PCE 2) in conjunction with upland habitat for foraging and dispersal activities (PCE 3 and PCE 4) are present within both the project and conservation areas. These areas contains ponds for breeding, seasonal wetlands and swales, and upland areas for dispersal, shelter, and food. These features of the critical habitat, which are present at the site, are essential to the recovery of the species.

California Tiger Salamander

Threats to California tiger salamanders in the action area include habitat loss, modification, degradation, and fragmentation from development and competition and predation by introduced species and/or feral animals.

There are observations of California tiger salamanders less than one mile from the project area (CDFG 2011). California tiger salamander larvae have been documented in a seasonal stock pond is located less than 100 feet west of the MEP water supply pipeline route along Bruns Road, upgradient and separated by an earthen berm from the water supply pipeline work proposed at D-2. The breeding site is inside CDFG's Byron Conservation Bank property. There are no barriers to California tiger salamander dispersal from this pond to the action area. Numerous larvae observed during multiple site visits in vernal pools, associated with an upstream reach of D-1, surrounded by non-native annual grassland on the Borges Ranch mitigation property less than 600 feet west of the project area. There are no barriers to California tiger salamander dispersal from these vernal pools to the action area.

Upland areas within the proposed project site are comprised of open grasslands with seasonal wetlands interspersed throughout the area. Numerous gopher and ground squirrel burrows are present throughout the property. While no California tiger salamanders have been found within stock ponds on the 158-acre parcel, these areas may support breeding populations during certain wet years. Protocol level surveys were not conducted. Based on the habitat located within and adjacent to the action area, the biology and ecology of the California tiger salamander, and the records of the listed species on-site and in adjacent areas, the Service has determined this listed animal utilizes the action area for foraging, resting, dispersal, mating, and other essential behaviors.

San Joaquin Kit Fox

Threats to San Joaquin kit foxes within the action area include loss, degradation, and fragmentation of habitat due to suburban and agricultural development, rodenticides, competition, and predation.

The proposed project is within the known range of the San Joaquin kit fox and is within one mile of recorded observations (CDFG 2011). A single adult running west from Bruns Road along Kelso Road was observed in 1992. A 1983 record documents a single San Joaquin kit fox den located just southeast of the Bethany Reservoir. Three individuals of unknown age were observed foraging in grazed non-native grassland on a wind farm in 1998. In addition, from 1972 to 1975, numerous dens and foxes were observed. However, the reservoir and associated California Aqueduct restrict access to the action area through several road overpasses and a 1,000-foot underground section of aqueduct. Additionally, there are several occurrences within two miles of the project site including 40 dens near the Delta Mendota Canal and frequent observations along the Delta Mendota Canal.

Upland areas within the proposed construction site are comprised of open grasslands on gently sloping hillsides. Soft friable soils are present throughout the site as well as a robust burrowing rodent population, which may encourage denning and foraging activities within the area. An unnamed seasonal drainage, which exists adjacent to the site, may provide a movement corridor and fresh water source for the San Joaquin kit fox as individuals move from the surrounding undeveloped foothills to lower elevations. Based on the habitat located within and adjacent to the action area and the biology and ecology of San Joaquin kit foxes, the Service has determined it is likely this listed animal utilizes the action area for foraging, dispersal, mating, and other essential behaviors.

Vernal Pool Fairy Shrimp

Threats to vernal pool fairy shrimp include habitat loss in the form of habitat alteration and degradation as a result of development and changes to natural hydrology, invasive species, incompatible grazing regimes, including insufficient grazing for prolonged periods; recreational activities (e.g., off-highway vehicles and hiking), erosion, and contamination.

The proposed project area is within the known range of the vernal pool fairy shrimp in the Livermore Vernal Pool Region and is approximately 0.5 mile southeast of the Altamont Hills Core Area, (Service 2005b). CH2M HILL provided supplemental information in April 2011 describing a total 31 wetland features on-site. Branchiopods were identified in 23 out of the 31 features which included vernal pools, seasonal wetlands, vegetated and unvegetated depressions, a man-made stormwater ditch partially lined with riprap, and unvegetated roadside despressions. Vernal pool fairy shrimp were positively identified by Westervelt Ecological Services in one unvegetated depression. Therefore, the Service has determined it is reasonable to conclude the vernal pool fairy shrimp inhabits the action area based on the recent observations of this animal the biology and ecology of the species, and the presence of suitable habitat.

Longhorn Fairy Shrimp

Threats to longhorn fairy shrimp include habitat loss the form of habitat alteration and degradation as a result of development and changes to natural hydrology, invasive species, incompatible grazing regimes, including insufficient grazing for prolonged periods; recreational activities (e.g., off-highway vehicles and hiking), erosion, and contamination.

The proposed project area is within the known range of the vernal pool fairy shrimp and the longhorn fairy shrimp in the Livermore Vernal Pool Region (Service 2005b). CH2M HILL provided supplemental information in April 2011 describing a total 31 wetland features on-site. Branchiopods were identified in 23 out of the 31 features which included vernal pools, seasonal wetlands, vegetated and unvegetated depressions, a man-made stormwater ditch partially lined with riprap, and unvegetated roadside despressions. Only one feature was identified to species. The closest known occurrences are approximately 5 miles west of the project in the East Bay Regional Park, Brushy Peak Preserve, and Vasco Caves Nature Preserve near the town of Byron in Contra Costa County. Although longhorn fairy shrimp in the Livermore Vernal Pool Region are known from sandstone outcrop vernal pools, they do occur in different types of vernal pool habitats. Therefore, the Service has determined it is reasonable to conclude the longhorn fairy shrimp inhabits the action area based on the biology and ecology of the species, and the presence of vernal pool habitat.

Effects of the Proposed Action

Individuals and habitat may be affected throughout the MEP. Individual California red-legged frogs, California tiger salamanders, San Joaquin kit foxes, vernal pool fairy shrimp, and longhorn fairy shrimp may be directly and/or indirectly injured or killed by activities that disturb breeding, feeding, sheltering, and dispersal habitat. The proposed project will/may (1) result in the injury and death of an unknown number of these species; (2) result in development-related harm and harassment to the surviving individuals in the area; (3) impede the dispersal of these species through the area; (4) increase the likelihood of predation; and (5) fragment and reduce the amount of habitat.

The development of the MEP will occur within a 35.5-acre work area. Within this work area approximately 22.2 acres of upland habitat for the California red-legged frog, California tiger salamander, and San Joaquin kit fox will be lost permanently or for more than one construction season. Approximately 12.1 acres will be temporarily disturbed and will be restored to grassland within year from start of construction. The time for the temporarily disturbed lands to return to functional habitat for these species is unknown. An estimated 0.5 acre of vernal pool fairy shrimp and longhorn fairy shrimp habitat will be directly affected and 0.21 acre will be indirectly affected by project construction. The effects of the loss will be minimized by the protection and management of 79.9 acres of upland habitat for the California red-legged frog, California tiger salamander, and San Joaquin kit fox and 0.57 acre of habitat for vernal pool fairy shrimp and longhorn fairy shrimp.

California Red-Legged Frog and California Tiger Salamander

Construction work within the project footprint, access areas, and staging areas can result in direct mortality or injury to individual California red-legged frogs and California tiger salamanders, harassment of the animals, and entrapment. Some workers may pick up or otherwise handle individuals they encounter despite training to the contrary, and this could result in stress and injury. Mortality or injury to adults, sub-adults, and tadpoles can occur from being crushed by earth moving equipment and worker foot traffic. Individuals in burrows may be killed or injured by filling or grading activities. Work activities, including vibration, may cause California red-legged frogs and California tiger salamanders to leave the work site and surrounding areas. This disturbance and displacement may increase the potential for predation, desiccation, competition for food and shelter, or strike by vehicles on roadways. Implementation of the Minimization Measures and performing construction activities during the dry season will minimize effects to California red-legged frogs and California tiger salamanders.

Wildlife exclusion fencing (silt fence) in place for the duration of the construction project will introduce a temporary barrier to dispersing California red-legged frogs and/or California tiger salamanders from refugia to breeding sites or vice versa. Barrier fencing may also divert individuals away from their intended destination into less suitable habitats. California red-legged frogs and California tiger salamanders could congregate at the exclusion fence putting them in closer proximity to construction personnel or making them more susceptible to predation, or they may find holes or breaches in the fence and enter the active work area. However, weekly fence inspections and as-needed repairs will occur to ensure that fence is maintained sufficiently to exclude California red-legged frogs and California tiger salamanders from the work site. A full time biological monitor will be onsite daily during the wet season when these species are generally more active and moving around. The monitor will survey the fence on a daily basis and if in the opinion of the biologist any California red-legged frogs and California tiger salamanders found along the fence are in jeopardy of being killed or injured, the animal with be relocated. All wildlife exclusion fencing will be removed from the site during project completion.

Preconstruction surveys and the relocation of individual California red-legged frogs or California tiger salamanders may reduce injury or mortality. However, the capturing and handling of individuals to remove them from a work area may result in the harassment, mortality or injury of individuals. Stress, injury, and mortality may occur as a result of improper handling, containment, and transport of individuals. Death and injury of individual red-legged frogs or tiger salamanders could occur at the time of relocation or later in time subsequent to their release. Although survivorship for translocated animals has not been estimated, survivorship of translocated wildlife, in general, is lower because of intraspecific competition, lack of familiarity with the location of potential breeding, feeding, and sheltering habitats, and increased risk of predation. Improper handling, containment, or transport of individuals would be reduced or prevented by use of a Service-approved biologist, by limiting the duration of handling, and requiring the proper transport of these species. However, given the amount of habitat available and the short distance individuals would be relocated, it is expected that this effect will be negligible.

The fragmentation of upland habitat coupled with the additional vehicular traffic and human activity resulting during operations will adversely affect California red legged frogs and California tiger salamanders. Any California red legged frogs and California tiger salamanders crossing roads or incidentally entering the site during overland dispersal could be crushed by vehicles or inadvertently killed or entrapped on the facility site. A six-inch tall concrete curb will be installed along the perimeter of the MEP facility for the operationally life of the project to discourage dispersal into the facility. The combination of curb and perimeter fence may also discourage these species from entering the site. An increase in human activity or operation noise from the power plant could displace the frogs or salamanders into less suitable habitats. The site would add cumulatively to habitat loss and fragmentation experienced in the region. Fewer refugia would be available and the curbed facility would be a barrier to California red legged frog and California tiger salamander dispersal.

As these species is partially nocturnal, outdoor illumination may cause disruption of surface movement and increase rates of predator or vehicle related injury or mortality. Beier (2006), Buchanan (2006), and Wise and Buchanan (2002) reviewed the adverse effects that may result from night time illumination and concluded that artificial lighting is likely to increase predation of the California red legged frogs if it occurs during fall, winter, or spring rains, because the amphibians will lose the cover of darkness for movement. To reduce effects from offsite lighting, lighting at the MEP facility will be restricted to areas required for safety, security, and operation. Exterior lights will be hooded, and lights will be directed onsite so that significant light or glare would be minimized. Low pressure sodium lamps and fixtures of a nonglare type will be specified. For areas where lighting is not required for normal operation, safety, or security, switched lighting circuits will be provided, allowing these areas to remain dark at most times, minimizing the amount of lighting visible offsite. For these reasons, nighttime lighting effects on California red legged frogs and California tiger salamander will be minimal.

Critical Habitat for the California Red-Legged Frog

The project is within proposed Unit CCS-2. The proposed action is not expected to appreciably diminish the value of the proposed critical habitat for the red-legged frog, or prevent the proposed critical habitat from sustaining its role in the conservation and recovery of this species. PCE 2 will be directly and indirectly affected by construction and restoration. PCE 3 and 4 will be fragmented but will be offset by the preservation habitat in perpetuity within Unit CCS-2. Provided the proposed actions described in the Minimization Measures are implemented, the project will not significantly interfere with the current capability of the proposed critical habitat to satisfy essential requirements of the species. Either purchase of credits at a Service-approved conservation bank or the recordation of a Service-approved conservation easement with a fully funded endowment to implement a Service-approved management plan will provide preservation of the PCEs in perpetuity.

San Joaquin Kit Fox

The project will affect suitable foraging, dispersal, and denning habitat. San Joaquin kit foxes may enter the construction site in search of food and cover and as a result may be injured or killed by heavy equipment, or entrapped. There is also some potential for San Joaquin kit fox to be harmed during exploratory excavation of potential dens. However, implementation of the conservation measures, including preconstruction surveys and monitoring, observance of no work buffers from dens, construction monitoring, construction personnel training, and use of Service and CDFG-approved biologists during surveys and monitoring, will minimize the potential for take of San Joaquin kit fox.

The proposed project will result in both permanent and temporary effects to San Joaquin kit fox habitat. Also, project construction will destroy small mammal burrows that provide denning opportunities for the species. The temporary disturbance areas will be decompacted as needed, recontoured to match pre-existing grades, applied with salvaged top soil and/or reseeded. Fossorial mammals, including California ground squirrel, are expected to recolonize these areas, thereby providing a prey base and burrows for potential denning. Short-term temporary effects will also occur to terrestrial habitats, including non-native annual grassland, gravel surfacing including roads and road shoulders, seasonal drainages, and an agricultural road during construction of the offsite facilities. These offsite facility work corridors will be restored to pre-project conditions within one construction season and are expected to regain habitat value for San Joaquin kit fox less than one year following disturbance.

Operational activities may result in adverse effects on the San Joaquin kit fox. In addition to habitat loss, disturbance could result from noise, vibration, odors, or increased human activity. Attractants such as trash and food related debris could cause San Joaquin kit foxes to enter the fenced plant site in search of food. Operational activities may interfere with their sensory perception, which could inhibit their ability to locate prey, pups, or mates, or detect approaching predators or vehicles. Disturbance could induce stress, which may affect physiological parameters or behavior. Cumulative habitat fragmentation as a result of the facility will interfere with movement corridors potentially existing in the area.

The new facility is expected to be operated during high demand times, typically afternoon hours, to supplement base load and renewable generation capacity. However, the exact operation profile cannot be defined in detail since operation of the facility depends on the variable demand in the MEP service area. Therefore, the facility could operate at all times of the day depending on the demand for output. A security perimeter fence will keep cattle out of the property and may preclude San Joaquin kit fox access.

Vernal Pool Fairy Shrimp and Longhorn Fairy Shrimp

Direct effects to vernal pool fairy shrimp and longhorn fairy shrimp will occur from construction activities altering and/or removing habitat and individuals. Additionally, grading activities associated with the project could create short-term increases in erosion and sedimentation causing non-point source pollution within the existing wetlands. Movement of grading and excavation vehicles associated with the construction of the wetlands associated with the project could permanently or temporarily affect these crustaceans on the site and on adjacent wetlands areas. Work activities, including vibration, noise, erosion, sedimentation, or simply driving through an existing wetland, may result in harm, harassment, and/or mortality. Cysts may be crushed or transported by vehicles, construction equipment, or human foot traffic. Adverse effects may occur if stormwater laden with sediment or other deleterious material (for example, fuels or lubricants) were allowed to discharge from the action area into nearby vernal pools. However, implementation of the Minimization Measures, including construction monitoring, construction personnel training, avoidance of some habitat features, and use of qualified biologists during surveys and monitoring, should minimize these effects. Potential water quality issues related to sedimentation, erosion, or contaminants from construction materials or equipment will be minimized with the use of BMPs.

The MEP operation is not expected to result in adverse effects on listed branchiopods. Site operations personnel will stay within the established facility footprint and use the paved main access road to access the site from Bruns Road. The MEP has been designed to be a zero liquid discharge facility for wastewater and stormwater runoff that is outside of the process areas will be captured in the site stormwater drainage system and conveyed to the onsite extended detention basin located at the north end of the site.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. The Service does not anticipate any future non-Federal actions to occur in the action area.

The global average temperature has risen by approximately 0.6 degrees Celsius during the 20th Century (Intergovernmental Panel on Climate Change 2001, 2007; Adger *et al* 2007). There is an international scientific consensus that most of the warming observed has been caused by human activities (Intergovernmental Panel on Climate Change 2001, 2007; Adger *et al.* 2007), and that it is "very likely" that it is largely due to manmade emissions of carbon dioxide and other greenhouse gases (Adger *et al.* 2007). Ongoing climate change (Inkley *et al.* 2004; Kerr 2007; Adger *et al.* 2007; Kanter 2007) likely imperils these listed species and the resources necessary for their survival. Since climate change threatens to disrupt annual weather patterns, it may result in a loss of their habitat and/or prey, and/or increased numbers of their predators, parasites, and diseases. Where populations are isolated, a changing climate may result in local extinction, with range shifts precluded by lack of habitat.

Conclusion

After reviewing the current status of the California red-legged frog, California tiger salamander, San Joaquin kit fox, vernal pool fairy shrimp, and longhorn fairy shrimp, environmental baseline for the action area, the effects of the proposed action, and the cumulative effects on these species, it is the Service's biological opinion that the proposed MEP, as described herein, is not likely to jeopardize the continued existence of these species. The development project will reduce and fragment habitat for these species but will preserve habitat in perpetuity. Although designated critical habitat for the California red-legged frog will be affected, none will be destroyed or adversely modified by the project.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which 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. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including 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), taking incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act, provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are nondiscretionary and must be implemented by the Corps so they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity that is covered by this incidental take statement. If the Corps (1) fails to require the applicant 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 that incidental take of the California red-legged frog will be difficult to detect because of their life history. Specifically, when California red-legged frogs are not in their breeding ponds, they may be difficult to locate due to their cryptic appearance and behavior; they may be located a distance from the breeding ponds; and the finding of an injured or dead individual is unlikely because of their relatively small body size. Losses of these species also may be difficult to quantify due to seasonal fluctuations in their numbers, random environmental events, changes in water regime at their breeding ponds, or additional environmental disturbances. Therefore, the Service is estimating that all California red-legged frogs inhabiting the 35.5-acre work area will be subject to incidental take in the form of harm, harassment, capture, injury, and death. Upon implementation of the Reasonable and Prudent Measures, incidental take associated with the proposed MEP in the form of harm, harassment, capture, injury, and death of the California red-legged frog caused by the project will become exempt from the prohibitions described under section 9 of the Act.

The Service anticipates that incidental take of the California tiger salamander will be difficult to detect because when this amphibian is not in their breeding ponds, or foraging, migrating, or conducting other surface activity, it inhabits the burrows of ground squirrels or other rodents; the burrows may be located a distance from the breeding ponds; the migrations occur on a limited period during rainy nights in the fall, winter, or spring; and the finding of an injured or dead individual is unlikely because of their relatively small body size. Losses of this species also may be difficult to quantify due to seasonal fluctuations in their numbers, random environmental events, changes in water regime at their breeding ponds, or additional environmental disturbances. Therefore, the Service is estimating that all California tiger salamanders inhabiting the 35.5-acre work area will be subject to incidental take in the form of harm, harassment, capture, injury, and death. Upon implementation of the Reasonable and Prudent Measures, incidental take associated with the proposed MEP in the form of harm, harassment, capture, injury, and death of the California tiger salamander caused by the project will become exempt from the prohibitions described under section 9 of the Act.

The Service expects that incidental take of the San Joaquin kit fox will be difficult to detect or quantify because this mammal inhabits dens or burrows when it is not foraging, mating, or conducting other surface activity; the animal may range over a large territory; it is primarily active at night, it is a highly intelligent animal that often is extremely shy around humans, and the finding of an injured or dead individual is unlikely because of their relatively small body size. Losses of this species also may be difficult to quantify due to seasonal fluctuations in their numbers. Therefore, the Service is estimating that all of the San Joaquin kit foxes inhabiting or utilizing areas 35.5-acre work area will be subject to incidental take in the form of harm and harassment. Upon implementation of the Reasonable and Prudent Measures, incidental take associated with MEP in the form of harm and harassment of the San Joaquin kit fox caused by the project will become exempt from the prohibitions described under section 9 of the Act.

The Service anticipates that incidental take of the vernal pool fairy shrimp and longhorn fairy shrimp will be difficult to detect because when these crustaceans are not in their active adult stage, the cysts or naupuli are difficult to located in the vernal pools and seasonal wetlands, and the finding of an injured or dead individual is unlikely because of their relatively small body size. Losses of these species also may be difficult to quantify due to seasonal fluctuations in their numbers, random environmental events, changes in water regime at their breeding ponds, or additional environmental disturbances. Therefore, the Service is estimating that all vernal pool fairy shrimp and longhorn fairy shrimp inhabiting 0.71 acre of seasonal wetlands will be subject to incidental take. Upon implementation of the Reasonable and Prudent Measures, incidental take associated with MEP in the form of harm, harassment, injury, and death of the listed vernal pool crustaceans caused by indirect effects associated with the proposed project will become exempt from the prohibitions described under section 9 of the Act.

Effect of the Take

In the accompanying biological opinion, the Service determined that the level of anticipated take is not likely to result in jeopardy to the California red-legged frog, California tiger salamander, San Joaquin kit fox, vernal pool fairy shrimp, and longhorn fairy shrimp.

Reasonable and Prudent Measures

The Service has determined that the following reasonable and prudent measure is necessary and appropriate to minimize the effects of the MEP on the California red-legged frog, California tiger salamander, San Joaquin kit fox, vernal pool fairy shrimp, and longhorn fairy shrimp:

1. All the conservation measures as described in this biological opinion shall be fully implemented and adhered to. Further, these conservation measures shall be supplemented by terms and conditions (a) through (c).

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps shall ensure the applicant complies with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

The following Terms and Conditions implement the Reasonable and Prudent Measure:

a. The applicant shall make the terms and conditions in this biological opinion a required term in all contracts for the project that are issued by them to all contractors.

b. The applicant shall provide the Resident Engineer or their designee with a copy of this biological opinion, and the Resident Engineer or their designee shall be responsible for implementing the conservation measures and Terms and Conditions of this biological opinion and shall be the point of contact for the project. The Resident Engineer or their designee shall maintain a copy of this biological opinion onsite whenever construction is taking place. Their name and telephone number shall be provided to the Service at least thirty (30) calendar days prior to groundbreaking at the project. Prior to ground breaking, the Resident Engineer must submit a letter to the Service verifying that they posses a copy of this biological opinion and have read the Terms and Conditions.

c. If requested, during or upon completion of construction activities, the on-site biologist, and/or an applicant representative shall accompany the Service and CDFG, on an onsite inspection of the site to review project effects to the listed species and their habitats.

Reporting Requirements

The Service must be notified within one (1) working day of the finding of any injured California red-legged frog, California tiger salamander, and/or San Joaquin kit fox, or any unanticipated damage to its habitat associated with the proposed project. Injured listed species must be cared for by a licensed veterinarian or other qualified person(s), such as the Service-approved biologist. Notification must include the date, time, and precise location of the individual/incident clearly indicated on a USGS 7.5 minute quadrangle and other maps at a finer scale, as requested by the Service, and any other pertinent information. Dead individuals must be sealed in a Zip-lock® plastic bag containing a paper with the date and time when the animal was found, the location where it was found, and the name of the person who found it, and the bag containing the specimen frozen in a freezer located in a secure site. The Service contact persons are the Division Chief of the Endangered Species Program at the Sacramento Fish and Wildlife Office at (916) 414-6600; and the Resident Agent-in-Charge of the Service's Division of Law Enforcement, 2800 Cottage Way, Room W-2928, Sacramento, California 95825, at (916) 414-6660. The CDFG contact is Liam Davis at (707) 944-5529.

The applicant shall submit a post-construction compliance report prepared by the Service-approved biologist to the Sacramento Fish and Wildlife Office within thirty (30) calendar days of the date of the completion of construction activity. This report shall detail (i) dates that construction occurred; (ii) pertinent information concerning the success of the project in meeting conservation measures; (iii) an explanation of failure to meet such measures, if any; (iv) known project effects on listed species, if any; (v) occurrences of incidental take of listed species, if any; (vi) documentation of employee environmental education; and (vii) other pertinent information.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Endangered Species Act directs Federal agencies to utilize their authorities to further the purposes of the Endangered Species Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities that can be implemented to further the purposes of the Act, such as preservation of endangered species habitat, implementation of recovery actions, or development of information or data bases. The Service recommends the following actions:

1. The Corps through the applicant should assist the Service in implementing recovery actions identified in the *Recovery Plan for the California Red-Legged Frog* (Service 2002).

2. The Corps through the applicant should assist the Service in developing and implementing recovery actions for the San Joaquin kit fox identified in the *Recovery Plan for Upland Species of the San Joaquin Valley, California* (Service 1998).

3. The Corps through the applicant should assist the Service in developing and implementing recovery actions identified in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Service 2005b).

4. Sightings of any listed or sensitive animal species should be reported to the CNDDB of the CDFG. A copy of the reporting form and a topographic map clearly marked with the location the animals were observed also should be provided to the Service.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the proposed MEP. As provided in 50 CFR 402.16, reinitiating 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 exceeded; (2) new information reveals effects of the agency action that may 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 that was not considered in this biological 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 exceeded, any operations causing such take must immediately cease, pending reinitiating.

If you have any questions regarding this biological opinion on the proposed MEP, please contact Kim Squires, Senior Endangered Species Biologist, or Ryan Olah, Coast Bay Branch Chief, at the letterhead address, telephone (916) 414-6600, or electronic mail at Kim_Squires@fws.gov or Ryan_Olah@fws.gov.

Sincerely,

for Susan K. Moore
Field Supervisor

cc:
Marcia Gresfrud, California Department of Fish and Game, Yountville, California
Sara Keeler, California Energy Commission, Sacramento, California
Chris Curry, Mariposa Energy, LLC, Los Angeles, California
Doug Urry, CH2M HILL, Sacramento, California

LITERATURE CITED

Adger, P., Aggarwal, S. Agrawala, J.Alcamo, A. Allali, O. Anisimov, N. Arnell, M. Boko, O.Canziani, T. Carter, G. Cassa, U. Confalonieri, R. Cruz, E.de Alba Alcaraz, W. Eastreling, C. Field, A. Fischlin, B. Fitzharris, C.G. Garcia, C. Hanson, H. Harasawa, K. Hennessy, S.Huq, R. Jones, L. K. Bogataj, D. Karoly, R. Kliein, Z. Kundzewicz, M. Lal, R. Lasco, G. Love, X. Lu, G. Magrin, L.J. Mata, R. McLean, B. Menne, G. Midgley, N. Mimura, M.Q. Mirza, J. Moreno, L. Mortsch, I. Niang-Diop, R. Nichols, B. Novaky, L. Nurse, A. Nyon, M. Oppenheimer, J. Palutikof, M. Parry, A. Patwardhan, P. R. Lankao, C. Rosenzweig, S. Schneider, S. Semenov, J. Smith, J. Stone, J van Ypersele, D. Vaughan, C. Vogel, T. Wilbanks, P.Wong, S. Wu, and G. Yohe. 2007. Working Group II Contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report. Climate Change 2007: Climate change impacts, adaptation and vulnerability. Brussels, Belgium.

Ahl, J. S. B. 1991. Factors affecting contributions of the tadpole shrimp, *Lepidurus packardi,* to its oversummering egg reserves. Hydrobiologia 2 (12): 137- 143.

Anderson, J. D. 1968. Comparison of the Food Habits of *Ambystoma macrodactylum sigillatum*, *Ambystoma macrodactylum croceum*, and *Ambystoma tigrinum californiense*. Herpetologica 24(4): 273-284.

Anderson, P. R. 1968. The Reproductive and Developmental History of the California Tiger Salamander. Masters thesis, Department of Biology, Fresno State College, Fresno, California. 82 pages.

Archon, M. 1992. Ecology of the San Joaquin kit fox in western Merced County, California. Masters thesis, California State University, Fresno California, 62 pages.

Ashley, E.P., and J.T. Robinson. 1996. Road Mortality of Amphibians, Reptiles and Other Wildlife on the Long Point Causeway, Lake Erie, Ontario. Canadian Field-Naturalist 110(3):403-412.

Barry, S. 1992. Letter to Marvin L. Plenert, Regional Director, U.S. Fish and Wildlife Service, Portland, Oregon, regarding proposed listing.

Barry, S. J. and H. B. Shaffer. 1994. The Status of the California Tiger Salamander (*Ambystoma californiense*) at Lagunita: A 50-year update. Journal of Herpetology 28(2): 159-164

Beier, P. 2006. "Effects of Artificial Night Lighting on Terrestrial Mammals." Pages 19-42 in C. Rich and T. Longcore (editors), Ecological Consequences of Artificial Night Lighting. Island Press. Washington, D.C.

Berry, W. H., J. H. Scrivner, T. P. O'Farrell, C. E. Harris, T. T. Kato, and P. M. McCue. 1987. Sources and rates of mortality of the San Joaquin kit fox, Naval Petroleum Reserve #1, Kern County, California, 1980-1986. U. S. Department of Energy Topical Report, EG&G/EM Santa Barbara Operations Report No. EGG 10282-2154. 34 pages.

Buchanan, B.C. 2006. "Observed and Potential Effects of Artificial Night Lighting on Anuran Amphibians." Pages 192-220 in C. Rich and T. Longcore (editors), Ecological Consequences of Artificial Night Lighting. Island Press. Washington, D.C.

Buechner, M. 1987. Conservation in Insular Parks: Simulation Models of Factors Affecting the Movement of Animals Across Park Boundaries. Biological Conservation 41:57-76.

Bulger, J. B., N. J. Scott Jr., and R. B. Seymour. 2003. Terrestrial activity and conservation of adult California red-legged frogs *Rana aurora draytonii* in coastal forests and grasslands. Biological Conservation 110:85-95.

Bury, R.B and J.A. Whelan. 1984. Ecology and management of the bullfrog. Fish and Wildlife Service Resource Publication 155.

California Department of Fish and Game (CDFG). 1980. At the crossroads, a report on California's endangered and rare fish and wildlife. Sacramento. 147 pp.

_____2011. RAREFIND. California Natural Diversity Data Base, Natural Heritage Division, Sacramento, California.

Carr, L.W., and L. Fahrig. 2001. Effect of road traffic on two amphibian species of differing vagility. Conservation Biology 15:1071-1078.

Caughley, G. and Gunn, A. 1995. Conservation Biology in Theory and Practice. Blackwell Science, Massachusetts.

Cooke, A.S. 1995. Comparison of survey methods for crested newts (*Triturus cristatus*) and night counts at a secure site, 1983–1993. Herpetological Journal 5: 221–228.

Cypher, B. L. 2000. Effects of roads on San Joaquin kit foxes: a review and synthesis of existing data. Endangered Species Recovery Program, California State University, Fresno, California.

Cypher, B. L., H. O. Clark, Jr., P. A. Kelly, C. Van Horn Job, G. W. Warrick, and D. F. Williams. 2001. Interspecific interactions among wild canids: implications for the conservation of endangered San Joaquin kit foxes. Endangered Species Update 18:171-174.

Cypher, B. L., and Scrivner, J. H. 1992. Coyote control to protect endangered San Joaquin kit foxes at the Naval Petroleum Reserves, California. Pages 42-47 *in* J.E. Borrecco and R. E. Marsh (editors). Proceedings of the 15th Vertebrate Pest Conference, March 1992, Newport Beach, Calif. University of California, Davis, California.

Cypher, B. L., and Spencer, K. A. 1998. Competitive interactions between coyotes and San Joaquin kit foxes. Journal of Mammalogy 79: 204-214.

Cypher, B. L., G. D. Wamck, M. R. M. Otten, T. P. O'Farrell, W. H. Berry, E. C. Harris, T. T. Kato, P. M. McCue, J. H. Scrivner, and B. W. Zoellick. 2000. Population dynamics of San Joaquin kit foxes at the Naval Petroleum Reserve in California. Wildlife Mongraphs 145.

Donald, D. B. 1983. Erratic occurrence of anostracans in a temporary pond: colonization and extinction or adaptation to variations in annual weather? Canadian Journal of Zoology 61: 1492- 1498.

Drews, C. 1995. Road kills of animals by public traffic in Mikumi National Park, Tanzania, with notes on baboon mortality. African Journal of Ecology 33: 89-100.

Egoscue, H. J. 1956. Preliminary studies of the kit fox in Utah. Journal of Mammalogy 37:351-357.

_____ 1962. Ecology and life history of the kit fox in Tooele County, Utah. Ecology 43:481-497.

Emlen, S. T. 1977. "Double Clutching" and its possible significance in the bullfrog. Copeia 1977(4):749-751.

Eng, L. L., D. Belk and C. H. Eriksen. 1990. Californian Anostraca: distribution, habitat, and status. Journal of Crustacean Biology l0 (2): 247-277.

Eriksen, C. H. and D. Belk. 1999. Fairy shrimps of California's puddles, pools, and playas. Mad River Press, Eureka, California. 196 pages.

Fahrig, L. 1997. Relative Effects of Habitat Loss and Fragmentation on Population Extinction. Journal of Wildlife Management 61:603-610.

Feaver, P. E. 1971. Breeding Pool Selection and Larval Mortality of Three California Amphibians: *Ambystoma tigrinum californiense* Gray, *Hyla regilla* Baird and Girard and *Scaphiopus hammondi hammondi* Girard. Master's thesis, Department of Biology, Fresno State College, Fresno California. 58 pages.

Fellers, G. 2005. *Rana draytonii* Baird and Girard, 1852b California red-legged frog. Pages 552-554 *in* M. Lannoo (editor). Amphibian declines the conservation status of United States species. University of California Press. Berkeley, California.

Fisher, R. N., and H. B. Schaffer. 1996. The Decline of Amphibians in California's Great Central Valley. Conservation Biology 10(5):1387-1397.

Fitzpatrick, B. M. an H. B. Shaffer. 2004. Environmental-Dependent Admixture Dynamics in a Tiger Salamander Hybrid Zone. Evolution 58(6): 1282-1293.

Forman, R.T. 2000. Estimate of the Area Affected Ecologically by the Road System in the United States. Conservation Biology 14(1): 31-35.

Forman, R. T. T., and R. D. Deblinger. 1998. The Ecological Road-Effect Zone for Transportation Planning, and a Massachusetts highway Example. Pages 78-96 *in* G. L. Evink, P. Garrett, D. Zeigler, and J. Berry, editors. Proceedings of the International Conference on Wildlife Ecology and Transportation. Publication FL-ER-69-98. Florida Department of Transportation, Tallahassee.

Forys, E.A. and S.R. Humphrey. 1996. Use of Population Viability Analysis to Evaluate Management Options for the Endangered Lower Keys Marsh Rabbit. Journal of Wildlife Management 63(1)251-260.

Frankham, R., and K. Ralls. 1998. Inbreeding leads to extinction. Nature 241:441-442.

Gallagher, S.P. 1996. Seasonal occurrence and habitat characteristics of some vernal pool Branchiopoda in northern California, U.S.A. Crustacean Biology 16 (2):323-329.

Garner, T. W. J., M. W. Perkins, P. Govindarajulu, D. Seglie, S. Walker, A. A. Cunningham, and M. C. Fisher. 2006. The Emerging Amphibian Pathogen *Batrachochytrium dendrobatidis* Globally Infects Introduced Populations of the North American Bullfrog, *Rana catesbeiana*. Biology Letters 2:455-459.

Gilpin, M.E. and M.E. Soule. 1986. Minimum Viable Populations: Processes of Species Extinction. Pages 19-34 *in:* M. E. Soule (editor), Conservation Biology: Science of Scarcity and Diversity. Sinauer, Sunderland, Masssachusetts.

Goldingay, R. L., P. A. Kelly, and D. F. Williams. 1997. The kangaroo rats of California: endemism and conservation of keystone species. Pacific Conservation Biology 3:47-60.

Goodman, D. 1987. The Demography of Chance Extinction. Pages 11-34 *in* M Soule, ed. Viable Populations for Conservation. Cambridge University Press, Cambridge, Great Britain.

Grinnell, J., J. S. Dixon, and J. M. Linsdale. 1937. Fur-bearing mammals of California. Volume 2. University of California Press. Berkeley, California.

Hall, H. M. 1983. Status of the kit fox at the Bethany wind turbine generating (WTC) project site, Alameda County, California. California Department of Fish and Game, Sacramento, California.

Hansen, L. 1982. Trafikdræbte dyr i Danmark (Road kills in Denmark, in Danish). Dansk Ornitologisk Forenings Tidsskrift 76: 97–110.

Hayes, M. P., and M. R. Jennings. 1988. Habitat Correlates of Distribution of the California Red-Legged Frog (*Rana aurora draytonii*) and the Foothill Yellow-Legged Frog (*Rana boylii*): Implications for Management. Pages 144-158 in R. Sarzo, K. E. Severson, and D. R. Patton (technical coordinators). Proceedings of the Symposium on the Management of Amphibians, Reptiles, and Small Mammals in North America. United States Department of Agriculture, Forest Service, Rocky Mountain Range and Experiment Station, Fort Collins, Colorado. General Technical Report (RM-166): 1-458.

Hayes, M. P. and D. M. Krempels. 1986. Vocal Sac Variation among Frogs of the Genus Rana from Western North America. Copeia 1986(4):927-936.

Hayes, M. P. and M. M. Miyamoto. 1984. Biochemical, Behavioral and Body Size Differences between *Rana aurora aurora* and *R. a. draytonii*. Copeia 1984(4):1018-1022.

Hayes, M. P., and M. R. Tennant. 1985. Diet and Feeding Behavior of the California Red-Legged Frog, *Rana aurora draytonii* (Ranidae). Southwestern Naturalist 30(4): 601-605.

Helm, B. P. 1998. Biogeography of eight large branchiopods endemic to California. Pages 124-139 *in*: C.W. Witham, E.T. Bauder, D. Belk, W.R. Ferren, Jr., and R. Ornduff, (editors). Ecology, conservation, and management of vernal pool ecosystems. California Native Plant Society, Sacramento, California.

Hels, T. and E. Buchwald. 2001. The Effect of Road Kills on Amphibian Populations. Biological Conservation 99: 331-340.

Holland, R. F. 2003. Distribution of vernal pool habitats in five counties of California's southern coast range. California Department of Fish and Game, Sacramento, California. 23 pp.

Hunt, L. 1993. Letter to Marvin L. Plenert, Regional Director, U.S. Fish and Wildlife Service, Portland, Oregon, regarding proposed listing.

Inkley, D. B., M. G. Anderson, A.R. Blaustein, V.R. Burkett, B. Felzer, B. Griffin, J. Price, and T.L. Root. 2004. Global climate change and wildlife in North America. Wildlife Society Technical Review 04-2.

Intergovernmental Panel on Climate Change. 2001. Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change (Houghton, J.T., Y. Ding, D.J. Griggs, M.

Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson [editors]). Cambridge University Press, Cambridge, United Kingdom and New York, New York. 881 pp. Available at http://www.ipcc.ch/.

_____ 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Alley, R., T. Berntsen, N.L. Bindoff, Z. Chen, A. Chidthaisong, P. Friedlingstein, J. Gregory, G. Hegerl, M. Heimann, B. Hewitson, B. Hoskins, F. Joos, J. Jouzel, V. Kattsov, U. Lohmann, M. Manning, T. Matsuno, M. Molina, N. Nicholls, J. Overpeck, D. Qin, G. Raga, V. Ramaswamy, J. Ren, M. Rusticucci, S. Solomon, R. Somerville, T.F. Stocker, P. Stott, R.F. Stouffer, P. Whetton, R.A. Wood, D. Wratt. 21 pages. Available at http://www.ipcc.ch/.

Jennings, M.R. 1993. Letter to Peter C. Sorensen, U.S. Fish and Wildlife Service, Sacramento, California.

Jennings, M.R. 2004. An annotated checklist of the amphibians and reptiles of California and adjacent waters. California Fish and Game 90(4):161-213.

Jennings, M. R., and M. P. Hayes. 1985. Pre-1900 overharvest of California red-legged frogs (*Rana aurora draytonii*): The inducement for bullfrog (*Rana catesbeiana*) introduction. Herpetological Review 31(1):94-103.

_____ 1990. Final report of the status of the California red-legged frog (*Rana aurora draytonii*) in the Pescadero Marsh Natural Preserve. Final report prepared for the California Department of Parks and Recreation, Sacramento, California, through Agreement (4-823-9018). Department of Herpetology, California Academy of Sciences, Golden Gate Park, San Francisco, California. 30 pages.

_____ 1994. Amphibian and reptile species of special concern in California. California Department of Fish and Game, Inland Fisheries Division, Rancho Cordova, California. 255 pages.

Jennings, M. R., M. P. Hayes, and D. C. Holland. 1992. A petition to the U.S. Fish and Wildlife Service to place the California red-legged frog (*Rana aurora draytonii*) and the western pond turtle (*Clemmys marmorata*) on the List of Endangered and Threatened Wildlife and Plants. 21 pages.

Jensen, C.C. 1972. San Joaquin Kit Fox Distribution. U.S. Fish and Wildlife Service, Sacramento, California. Unpublished Report. 18 pages.

Jones and Stokes Associates. 1997. Draft Environmental Impact Report: Vasco Road and Utility Relocation Project SCH#: 890321123. Prepared for Contra Costa Water District, Concord, California.

Kanter, J. 2007. Scientists detail climate changes, Poles to Tropics. New York Times. April

10, 2007.

Keeley, J.E. 1984. Photosynthetic characteristics of certain vernal pool species, Pages 218-222. In S. Jain and P. Moyle (editors). Vernal Pools and Intermittent Streams. Institute of Ecology, Publication No. 28, University of California, Davis.

Keeler-Wolf, T., D. R. Elam, K. Lewis, and S. A. Flint. 1998. California Vernal Pool Assessment Preliminary Report. State of California, Department of Fish and Game. Sacramento, California

Kerr, R. A. 2007. Global Warming in a Changing World. Science, New Series 316(5822): 188-190 (Apr. 13, 2007).

Knapp, D. K. 1978. Effects of agricultural development in Kern County, California, on the San Joaquin kit fox in 1977. California Department of Fish and Game Nongame Wildlife Investigations Report. Project E-1-1. Job-V1.21, Sacramento, California. 51 pages.

Koopman, M. E., J. H. Scrivner, and T. T. Kato. 1998. Patterns of den use by San Joaquin kit foxes. Journal of Wildlife Management 62:373-379.

Koopman, M. E., B. L. Cypher, and J. H. Scrivner. 2000. Dispersal patterns of San Joaquin kit foxes (*Vulpes macrotis mutica*). Journal of Mammalogy 81(1):213-222.

Krapu, G. L. 1974. Foods of breeding pintails in North Dakota. Journal of Wildlife Management 38(3): 408-41 7.

Kruse, K. C. and M. G. Francis. 1977. A predation deterrent in larvae of the bullfrog, *Rana catesbeiana*. Transactions of the American Fisheries Society 106(3):248-252.

Kupferberg, S. J. 1996a. Hydrologic and geomorphic factors affecting conservation of a river-breeding frog (*Rana boylii*). Ecological Applications 6: 1322-1344.

_____ 1996b. The ecology of native tadpoles (*Rana boylii* and *Hyla regilla*) and the impacts of invading bullfrogs (*Rana catesbeiana*) in a northern California river. PhD dissertation. University of California, Berkeley, California.

_____ 1997. Bullfrog (*Rana catesbeiana*) invasion of a California river: the role of larval competition. Ecology 78(6):1736-1751.

Lande, R. 1988. Genetics and Demography in Biological Conservation. Science 241:1455-1460.

La Polla, V.N. and G.W. Barrett. 1993. Effects of Corridor Width and Presence on the Population Dynamics of the Meadow Vole (*Microtus pennsylvanicus*). Landscape Ecology 8:25-37.

Laughrin, L. 1970. San Joaquin kit fox, its distribution and abundance. Wildlife Management Branch Administrative Report 70-2. California Department of Fish and Game, Sacramento, California.

Lips, K. R., F. Brem, R. Brenes, J. D. Reeve, R. A. Alford, J. Voyles, C. Carey, L. Livo, A. P. Pessier, and J. P. Collins. 2006. Emerging infectious disease and the loss of biodiversity in a neotropical amphibian community. Proceedings of the National Academy of Sciences 103(9):3165-3170.

Loredo, I., and D. Van Vuren. 1996. Reproductive Ecology of a Population of the California Tiger Salamander. Copeia 4:895-901.

Loredo, I., D. Van Vuren and M. L. Morrison. 1996. Habitat Use and Migration Behavior of the California Tiger Salamander. Journal of Herpetology 30(2): 282-285.

MacArthur, R. A., R. H. Johnston, A. Geist. 1979. Factors in influencing heart rate in free-ranging bighorn sheep: a physiological approach to the study of wildlife harassment. Canadian Journal of Zoology 57:2010-2021.

Mallick, S.A., G.J. Hocking, and M.M. Driessen. 1998. Road-kills of the eastern barred bandicoot (*Perameles gunnii*) in Tasmania: an index of abundance. Wildlife Research 25: 139-145.

Mao, J., D. E. Green, G. M. Fellers, and V. G. Chincar. 1999. Molecular characterization of iridoviruses isolated from sympatric amphibians and fish. Virus Research 6: 45-52.

McCue, P. M., and T. P. O'Farrell. 1988. Serological survey for selected diseases in the endangered San Joaquin kit fox (*Vulpes macrotis mutica*). Journal of Wildlife Diseases 24(2)274-281.

McGrew, J. C. 1979. *Vulpes macrotis*. Mammal Species 123:1-6.

Morey, S. R. 1998. Pool Duration Influences Age and Body Mass at Metamorphosis in the Western Spadefoot Toad: Implications for Vernal Pool Conservation. Pages 86-91 *in* Witham, C.W., E.T. Bauder, D. Belk, W.R. Ferren Jr., and R. Ornduff (editor). Ecology, Conservation, and Management of Vernal Pool Ecosystems - Proceedings from a 1996 Conference. California Native Plant Society. Sacramento, California. 1998.

Morrell, S. H. 1972. Life History of the San Joaquin kit fox. California Fish and Game 58:162-174.

_____ 1975. San Joaquin kit fox distribution and abundance in 1975. Wildlife Management Branch. California Department of Fish and Game, Sacramento, California. Administration Report Number 75-3, 28 pages.

Moyle, P. B. 1976. Fish introductions in California: history and impact on native fishes. Biological Conservation 9(1):101-118.

Munguira, M.L. and J.A. Thomas. 1992. Use of Road Verges by Butterfly and Moth Populations, and the Effect of Roads on Adult Dispersal and Mortality. Journal of Applied Ecology 29: 316-329.

O'Farrell, T. P. 1983. San Joaquin kit fox recovery plan. U. S. Fish and Wildlife Service, Portland, Oregon. 84 pages.

O'Farrell, T. P., and L. Gilbertson. 1979. Ecological Life History of the Desert Kit Fox in the Mojave Desert of Southern California. Final Report. U.S. Bureau of Land Management, Desert Plan Staff, Riverside, California.

O'Farrell, T. P., and P. M. McCue. 1981. Inventory of San Joaquin kit fox on USBLM lands in the western San Joaquin Valley-final report. Report No. EGG 1183-2416, EG&G Measurements, Goleta, California, 36 pages plus Appendices.

O'Farrell, T. P., P. M. McCue, and M. L. Sauls. 1980. Inventory of San Joaquin kit fox on USBLM lands in southern and southwestern San Joaquin Valley-final report. Report Number EGG 1183-2400, EG&G Measurements, Goleta, California, 74 pages plus Appendices.

Orloff, S. G., F. Hall and L. Spiegel. 1986. Distribution and habitat requirements of the San Joaquin kit fox in the northern extreme of their range. Transcripts from the Western Section of the Wildlife Society 22:60-70.

Pechmann, J. H. K., D. E. Scott, J. W. Gibbons, and R. D. Semlitsch. 1989. Influence of Wetland Hydroperiod on Diversity and Abundance of Metamorphosing Juvenile Amphibians. Wetlands Ecology and Management 1(1):3-11.

Petranka, J. W. 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, D.C.

Ralls, K, P. J. White, J. Cochran, and D. B. Siniff. 1990. Kit fox - coyote relationships in the Carrizo Plain Natural Area. Annual report to the U. S. Fish and Wildlife Service, Permit PRT 702631, Subpermit RALLK-4, October 31, 1990. 27 pages.

Riley, S. P. D., H. B. Shaffer, S. R. Voss, and B. M. Fitzpatrick. 2003. Hybridization Between a Rare, Native Tiger Salamander (*Ambystoma californiense*) and its Introduced Congener. Biological Applications 13(5): 1263-1275.

Rosen, P.C. and C.H. Lowe. 1994. Highway Mortality of Snakes in the Sonoran Desert of Southern Arizona. Biological Conservation 68:143-148.

Saccheri, I., M. Kuussaari, M. Kankare, P. Vikman, W. Fortelius, and I. Hanski. 1998. Inbreeding and extinction in a butterfly population. Nature 392:491-494.

Schwartz, M. K., K. Ralls, D. F. Williams, K. Pilgrim, and R. C. Fleischer. 2000. Genetic variation in and gene flow between San Joaquin kit fox populations. Unpublished report.

Scott, D. E. 1994. The Effect of Larval Density on Adult Demographic Traits in *Ambystoma opacum*. Ecology 75:1383-1396.

Scrivner, J. H., T. P. O'Farrell, and T. T. Kato. 1987. Dispersal of San Joaquin kit foxes, *Vulpes macrotis mutica*, on Naval Petroleum Reserve #1, Kern County, California. Report Number. EGG 10282-2190, EG&G Energy Measurements, Goleta, California, 32 pages.

Semlitsch, R. D., D. E. Scott, and J. H. K. Pechmann. 1988. Time and Size at Metamorphosis Related to Adult Fitness in *Ambystoma talpoideum*. Ecology 69: 184-192.

Semonsen, V. J. 1998. *Ambystoma californiense* (California tiger salamander) Survey Technique. Herpetological Review 29:96.

Shaffer, H. B., R. N. Fisher, and S. E. Stanley. 1993. Status Report: the California Tiger Salamander (*Ambystoma californiense*). Final report for the California Department of Fish and Game. 36 pages plus figures and tables.

Shaffer, H. B. and P. C. Trenham. 2004. *Ambystoma californiense* Gray, 1853. California tiger salamander. Pages 605 in Lannoo, M. (editor). Amphibian declines: The Conservation Status of United States Species. University of California Press, Berkeley, California. 2005.

Shaffer, H. B., G. B. Pauly, J. C. Oliver, and P. C. Trenham. 2004. The Molecular Phylogenitics of Endangerment: Cryptic Variation and Historic Phylogeography of the California Tiger Salamander, *Ambystoma californiense*. Molecular Ecology 13: 3033-3049.

Shaffer, H. B., G.M. Fellers, S. R. Voss, C. Oliver, and G.B. Pauley. 2010. Species boundaries, phylogeography, and conservation genetics of the red-legged frog (*Rana aurora/draytonii*) complex. Molecular ecology 13: 2667-2677.

Simovich, M. A., R. C. Brusca, and J. L. King. 1992. Invertebrate survey, PGT-PG&E/Bechtel Pipeline Expansion Project. University of San Diego, San Diego, California.

Spencer, K. A., W. H. Berry, W. G. Standley, and T. P. O'Farrell. 1992. Reproduction of the San Joaquin kit fox on Camp Roberts Army National Guard Training site, California. U.S. Department of Energy Topical Report EGG 10617-2154.

Spiegel, L. K. 1996. Studies of the San Joaquin kit fox in undeveloped and oil-developed areas. Studies of the San Joaquin kit fox in undeveloped and oil-developed areas. California

Energy Commission Publication Number P700-96-003. California Energy Commision Publication Unit, Sacramento, California.

Spiegel, L. K., B. L. Cypher, and T. C. Dao. 1996. Diets of San Joaquin Kit Fox at three sites in western Kern County, California. Pages 39-51 *in*: L. K. Spiegel (editor), Studies of the San Joaquin kit fox in undeveloped and oil developed areas, California Energy Commission, Environmental Protection Office, Sacramento, California.

Spiegel, L. K. and M. Disney. 1996. Mortality sources and survival rates of San Joaquin kit foxes in oil-developed and undeveloped lands of southwestern Kern County, California. Pages 71-92 *in*: L.K. Spiegel (editor), Studies of the San Joaquin kit fox in undeveloped and oil-developed areas. California Energy Commission, Sacramento, California.

Spiegel, L. K. and J. Tom. 1996. Reproduction of San Joaquin kit fox undeveloped and oil-developed habitats of Kern County, California. Pages 53-69 *in*: L.K. Spiegel (editor), Studies of the San Joaquin kit fox in undeveloped and oil-developed areas. California Energy Commission, Sacramento, California.

Syrdahl, R. L. 1993. Distribution patterns of some key macro-invertebrates in a series of vernal pools at Vina Plains Preserve in Tehama County, California. Master's thesis. California State University, Chico, California.

Stamps, J.A., M. Buechner, and V. V. Krishnan. 1987. The Effects of Edge Permeability and Habitat Geometry on Emigration from Patches of Habitat. American Naturalist 129(4):533-552.

Standley, W. G., W. H. Berry, T. P. O'Farrell, and T. T. Kato. 1992. Mortality of San Joaquin kit fox (*Vulpes velox macrotis*) at Camp Roberts Army National Guard Training Site, California. U. S. Department of Energy Topical Report No. EGG 10617-2157, EG&G/EM Santa Barbara Operations, National Technical Information Service, Springfield, Virginia.

Standley, W. G. and P. M. McCue. 1992. Blood characteristics of San Joaquin kit fox (*Vulpes velox macrotis*) at Camp Roberts Army National Guard Training Site, California. U. S. Department of Energy Topical Report, EG&G/EM Santa Barbara Operations Report No. EGG 10617-2160.

Stebbins, R. C. 1985. A field guide to western reptiles and amphibians. Houghton Mifflin Company, Boston, Massachusetts.

_______2003. A field guide to western reptiles and amphibians. Houghton Mifflin Company, Boston, Massachusetts.

Storer, T. I. 1925. A synopsis of the amphibia of California. University of California Publications in Zoology 27:1-1-342.

_____ 1933. Frogs and their commercial use. California Department of Fish and Game 19(3):203-213.

Schwartz, M. K., K. Ralls, D. F. Williams, K. Pilgrim, and R. C. Fleischer. 2000. Genetic variation in and gene flow between San Joaquin kit fox populations. Unpublished report.

Sweet, S. 1998. Letter to Dwight Harvey, U.S. Fish and Wildlife Service with a report titled "Vineyard Development Posing an Imminent Threat to *Ambystoma californiense* in Santa Barbara County, California." University of California, Santa Barbara, California.

Tatarian, P. J. 2008. Movement patterns of California red-legged frogs (*Rana draytonii*) in an inland California environment. Herpetological Conservation and Biology 3(2):155-169.

Trenham, P. 1998a. Radio Tracking Information. University of California, Davis, California.

_____ 1998b. Demography, Migration, and Metapopulation Structure of Pond Breeding Salamanders. Ph.D. dissertation. University of California, Davis, California.

_____ 2001. Terrestrial Habitat Use by Adult California Tiger Salamanders. Journal of Herpetology 35(2):343-346.

Trenham, P. C., and H. B. Shaffer. 2005. Amphibian Upland Habitat Use and its Consequences for Population Viability. Ecological Applications 15:1158–1168.

Trenham, P. C., H. B. Shaffer, W. D. Koening and M. R. Stromberg. 2000. Life History and Demographic Variation in the California Tiger Salamander (*Ambystoma californiense*). Copeia 2000(2): 365-377.

Trenham, P. C., W. D. Koenig, and H. B. Shaffer. 2001. Spatially Autocorrelated Demography and Interpond Dispersal in the Salamander *Ambystoma californiense*. Ecology 82: 3519-3530.

Trombulak, S. C., and C. A. Frissell. 2000. The Ecological Effects of Roads on Terrestrial and Aquatic Communities: a Review. Conservation Biology 14:18-30.

Twedt, B. 1993. A comparative ecology of *Rana aurora* Baird and Girard and *Rana catesbeiana* Shaw at Freshwater Lagoon, Humboldt County, California. Master of Science thesis. Humboldt State University, Arcata, California. 53 pages plus appendix.

Twitty, V. C. 1941. Data on the Life History of *Ambystoma tigrinum californiense* Gray. Copeia 1941 (1):1-4.

U. S. Fish and Wildlife Service. 1967. Native Fish and Wildlife, Endangered Species. **Federal Register** 32: 4001.

______ 1983. San Joaquin Kit Fox Recovery Plan. Portland, Oregon, 84 pages.

______ 1994. Endangered and threatened wildlife and plants; determination of endangered status for the conservancy fairy shrimp, longhorn fairy shrimp, and vernal pool tadpole shrimp; and threatened status for the vernal pool fairy shrimp. **Federal Register** 59:48136-48153.

______ 1995. Biological opinion for interim water renewal contracts, Central Valley, California, with the Bureau of Reclamation, Sacramento, California. Sacramento, California, 160 pp.

______ 1996. Endangered and threatened wildlife and plants; determination of threatened status for the California Red-Legged Frog. **Federal Register** 61:25813-25833.

______ 1998. Final Recovery Plan for upland species of the San Joaquin Valley, California. Portland, Oregon.

______ 2002. Recovery Plan for the Red-legged Frog (*Rana aurora draytonii*). Portland, Oregon. 173 pages.

______ 2003. Endangered and Threatened Wildlife and Plants: Listing of the Central California Distinct Population Segment of the California Tiger Salamander; Proposed Rule. **Federal Register** 68:28648-28670.

______ 2003a. Endangered and Threatened Wildlife and Plants: Final Designation of Critical Habitat for Four Vernal Pool Crustaceans and Eleven Vernal Pool Plants in California and Southern Oregon; Final Rule. **Federal Register** 68:46684-46762.

______ 2004b. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the California Tiger Salamander; and Special Rule Exemption for Existing Routine Ranching Activities; Final Rule. **Federal Register** 69: 47212-47248.

______ 2005a. Endangered and Threatened Wildlife and Plants; Final Designation of Critical Habitat for Four Vernal Pool Crustaceans and Eleven Vernal Pool Plants in California and Southern Oregon; Evaluation of Economic Exclusions From August 2003 Final Designation; Final Rule. **Federal Register** 70:46923-46999.

______ 2005b. Recovery plan for vernal pools ecosystems of California and Southern Oregon. Portland, Oregon. xxvi + 606 pages.

______ 2006. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the California Red-Legged Frog, and Special Rule Exemption Associated With Final Listing for Existing Routine Ranching Activities; Final Rule. **Federal Register** 71: 19244-19346.

_____ 2008. Endangered and Threatened Wildlife and Plants; Revised Critical Habitat for the California Red-Legged Frog (*Rana aurora draytonii*); Proposed Rule. **Federal Register** 53491-53540.

_____2010. Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the California Red-Legged Frog. **Federal Register** 75: 12816-12959.

Van der Zande, A.N., W.J. ter Keurs, and W.J. Van der Weijden. 1980. The Impact of Roads on the Densities of Four Bird Species in an Open Field Habitat - Evidence of a Long-Distance Effect. Biological Conservation 18: 299-321.

Van Gelder, J.J. 1973. A Quantitative Approach to the Mortality Resulting from Traffic in a Population of *Bufo bufo* L. Oecologia 13:93-95.

Van Hattem, M. G. 2004. Underground Ecology and Natural History of the California Tiger Salamander. Master of Science thesis. San Jose State University, San Jose, California.

Vollmar, J. E. 2002. Wildlife and rare plant ecology of eastern Merced County's vernal pool grasslands. Merced, California: Merced County UC Development Office.

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.

Warrick, G. D. and B. L. Cypher. 1999. Variation in the body mass of San Joaquin kit foxes. Journal of Mammalogy 80:972-979.

Weldon, C., L.H. du Preez, R. Muller, A.D. Hyatt, and R. Speare. 2004. Origin of the Amphibian Chytrid Fungus. Emerging Infectious Diseases 10:2100–2105.

White, P. J., and K. Ralls. 1993. Reproduction and spacing patterns of kit foxes relative to changing prey availability. Journal of Wildlife Management 57:861-867.

White, P. J. and R. A. Garrott. 1997. Factors regulating kit fox populations. Canadian Journal of Zoology 75:1982-1988.

_____ 1999. Population dynamics of kit foxes. Canadian Journal of Zoology 77:486-493

White, P. J., W. H. Berry, J. J. Eliason, and M. T. Hanson. 2000. Catastrophic decrease in an isolated population of kit foxes. Southwestern Naturalist 45(2):204-211.

Wilbur, H. M. and J. P. Collins. 1973. Ecological Aspects of Amphibian Metamorphosis. Science (n.s.) 182(4119): 1305-1314.

Williams, Daniel F. 1985. A review of the population status of the Tipton kangaroo rat, *(Dipodomys nitratoides.)* U.S. Fish and Wildlife Service, Sacramento Endangered Species Office, California. Final report prepared under Order No. 10181-4861 (ts) 84. 44 pages.

Wise, S.E. and B. W. Buchanan. 2006. "Influence of Artificial Illumination on the Nocturnal Behavior and Physiology of Salamanders." Pages 221-252 in C. Rich and T. Longcore (editors). Ecological Consequences of Artificial Night Lighting. Island Press. Washington, D.C.

Wissinger, S. A., A. J. Bohonak, H. H. Whiteman , and W. S. Brown. 1999. Habitat Permanence , salamander predation and invertebrate communities. In: Invertebrates in Freshwater Wetlands of North America: Ecology and Management, edited by D. P. Batzer, R. B. Bader, and S. A. Wissinger, John Wiley & Sons, Inc. New York.

Wright, A. H. and A. A. Wright. 1949. Handbook of Frogs and Toads of the United States and Canada. Comstock Publishing Company, Inc., Ithaca, New York. 640 pages.