

# Appendix F. Endangered Species Act, Section 7 Consultation

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INFORMATION



United States Department of the Interior



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In reply refer to:  
1-1-06-F-0105

OCT 18 2006

## Memorandum

**To:** Project Leader, Stone Lakes National Wildlife Refuge, Elk Grove, California

**From:** Acting Field Supervisor, Ecological Services, Sacramento Fish and Wildlife Office, Sacramento, California *Kenneth Sank*

**Subject:** Intra-agency Programmatic Formal Section 7 Consultation on the Comprehensive Conservation Plan for Stone Lakes National Wildlife Refuge, Sacramento County, California

This is in response to your request for formal consultation with the U.S. Fish and Wildlife Service's (Service) Sacramento Fish and Wildlife Office (SFWO) on Alternative B of the Comprehensive Conservation Plan (CCP) for Stone Lakes National Wildlife Refuge (Refuge), Elk Grove, California. Your request was received in our office on March 17, 2006. This document represents the Service's biological opinion on the effects of the action on the giant garter snake (*Thamnophis gigas*) (snake), valley elderberry longhorn beetle (*Desmocercus californicus dimorphus*) (beetle), vernal pool fairy shrimp (*Branchinecta lynchi*), and vernal pool tadpole shrimp (*Lepidurus packardii*) (vernal pool crustaceans), in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act).

The Service has determined that the proposed action is not likely to adversely affect the bald eagle (*Haliaeetus leucocephalus*), the delta smelt (*Hypomesus transpacificus*), the delta green ground beetle (*Elaphrus viridis*), the California red-legged frog (*Rana aurora draytonii*), and the California tiger salamander (*Ambystoma californiense*). In addition, the proposed action will not adversely modify or destroy proposed or designated critical habitat for any federally-listed species because no critical habitat for any species has been proposed or designated on the Refuge or adjacent to the Refuge that may be affected by on-site activities.

For the bald eagle, we have made this determination because there are no documented sightings of bald eagles on the Refuge and bald eagles likely fly over the Refuge only on rare occasions. In addition, proposed riparian plantings on the Refuge will likely enhance bald eagle habitat. For

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Health Unit have not recorded the Delta smelt within Refuge waterways. Due to the presence of the Lambert Road flood control structure, the Stone Lakes Basin has an unimpeded hydrologic connection with the rest of the Delta only during major flood events. For the Delta green ground beetle we have made this determination because the species has not been documented on the refuge and no suitable habitat for this species is present (Chris Nagano, pers. comm.). For the California red-legged frog we have made this determination because this species is believed to be extirpated in this area of the Sacramento Valley floor due to a number of factors. For the California tiger salamander, we have made this determination because surveys over the last ten years on the refuge have failed to document this species. In addition, the location of the refuge in the floodplain and the soil types present on the refuge are not compatible with the presence of this species.

The National Wildlife Refuge System Improvement Act of 1997 mandated that all National Wildlife Refuges (NWRs) prepare Comprehensive Conservation Plans (CCP). The purpose of this consultation is to determine potential effects of routine Refuge projects, activities, and programs on listed or proposed species, to authorize take incidental to those actions, and to expedite review of new acquisitions, restoration projects, programs, or management plans. The Refuge and the SFWO have determined that although management and restoration of habitats on the Refuge benefit listed species in the long term, some activities may adversely affect listed species and may result in incidental take, thus requiring consultation under the Act. Projects which exceed the scope of activities described in this biological opinion may require individual biological opinions. Significant projects will be reviewed on a case by case basis to determine the need for additional consultation.

## Consultation History

The SFWO has previously reviewed the Refuge Integrated Pest Management (IMP) Proposals for mosquito abatement and for water hyacinth control, as well as reviewed other proposed actions on the Refuge, and these consultations are incorporated by reference:

March 27, 1995: The SFWO concurred with the determination that the use of the bacterium *Bacillus thuringiensis israelensis* (*Bti*) and Altocid® (methoprene) for mosquito control at the Stone Lakes NWR is not likely to adversely affect the vernal pool fairy shrimp, vernal pool tadpole shrimp, giant garter snake, valley elderberry longhorn beetle, Sacramento splittail, and delta smelt (SFWO file: 1-1-95-I-0680).

NOTE: Although Altocid (methoprene) was authorized for use on the refuge in our March 27, 1995, letter, research has shown that this pesticide can have deleterious effects on vernal pool crustaceans. The use of methoprene, a growth hormone, may result in the delay of development of adult vernal pool crustaceans which may reduce the number of resting eggs (cysts) that are formed before the pools dry (Lawrenz 1984). Because of the effects of methoprene on vernal pool crustaceans and a lack of information on how long the agent remains in the soil, we wish to clarify that methoprene will not be used within vernal pools or swales at any time, in either wet or dry conditions. A buffer of at least 300 feet would separate vernal pools and swales from areas where methoprene would be used. As of this date, methoprene has never been used at the Refuge.

May 25, 1995: The SFWO concurred with the determination that the use of Weedar 64® and Rodeo® to control water hyacinth was not likely to adversely affect the delta smelt, giant garter snake, and valley elderberry longhorn beetle, provided that mitigation measures identified in the letter were followed. These measures included: monitoring dissolved oxygen during water hyacinth die-off (for impacts to listed fish) and ceasing herbicide spray if the listed fish or giant garter snake were killed or harassed. For the valley elderberry longhorn beetle, if elderberry bushes were found in areas to be sprayed, the bushes would be flagged and avoided (SFWO file: 1-1-95-I-0903).

July 26, 1995: The SFWO issued a biological opinion which resulted in a conservation

easement agreement to preserve and construct vernal pools as mitigation for the issuance of a 404 Permit for the Elliot Ranch South Project (AKT parcel). (SFWO file number 1-1-99-F-0118).

May 21 and June 10, 1996: The SFWO concurred that aerial spraying of the herbicide Rodeo for the control of water hyacinth was not likely to adversely affect the giant garter snake, valley elderberry longhorn beetle, delta smelt, or Sacramento splittail. To minimize drift of the herbicide, aerial applications were allowed only when wind speed was between 2 and 4 miles per hour. To prevent low dissolved oxygen levels caused by decomposing water hyacinth, no more than three contiguous acres would be treated at one time and 100 foot buffer strips would be left between treated sites. (SFWO files: FWS/EC96-040 and 1-1-96-I-640).

January 9, 1997: The SFWO concurred with the determination that the use of the bacterium *Bacillus sphaericus* for mosquito control, is not likely to adversely affect the vernal pool fairy shrimp, vernal pool tadpole shrimp, giant garter snake, valley elderberry longhorn beetle, delta smelt, or Sacramento splittail at the Stone Lakes NWR (SFWO file: 1-1-96-I-0639).

July 26, 1999: The SFWO amended biological opinion 1-1-99-F-0118, to further refine required mitigation measures for the Elliot Ranch South Project (AKT parcel).

More recently, the SWFO has reviewed the following routine Refuge operations:

January 31, 2001: The SFWO concurred that pest management activities at the Refuge are not likely to jeopardize the giant garter snake, valley elderberry longhorn beetle, vernal pool tadpole shrimp, or vernal pool fairy shrimp. (SFWO file: 1-1-00-F-0162).

May 2, 2003: The SFWO concurred that the dredging of an existing channel that feeds water into permanent and seasonal wetlands on 457 acres would likely adversely affect, but would not jeopardize the giant garter snake. (SFWO file 1-1-03-F-0094).

July 16, 2003: The SFWO concurred that the mechanical shredding of water hyacinth was not likely to adversely affect the giant garter snake or the valley elderberry longhorn beetle. (SFWO file 1-1-03-I-2416).

January 3, 2005: The SFWO concurred that the Refuge waterfowl hunting program was not likely to adversely affect the giant garter snake, based on timing and monitoring efforts. (SFWO file 1-1-05-I-0323).

The Division of Endangered Species, Washington, D.C., consults annually on proposed Migratory Game Bird Hunting Regulations. The consultation addresses the effects to listed and proposed migratory birds of accidental shootings and potential lead poisoning through ingestion of lead shot. Listed migratory birds that occur on the Refuge that could be affected by Migratory Game Bird Hunting Regulations are the bald eagle.

August 24, 2005, the Service concluded that Migratory Game Bird Hunting Regulations are not likely to adversely affect the bald eagle. Because incidental take of listed migratory birds has already been addressed in the Migratory Game Bird Hunting Regulations consultation, the SFWO will only address the effects, if any, of the Refuge hunt program to other listed species.

#### Management Plans:

The National Wildlife Refuge System Improvement Act of 1997 mandates the preparation of CCPs for all wildlife refuges within 15 years, which is the purpose of this consultation.

Some projects or types of projects require more in-depth planning than the CCP process is designed

to provide. For these projects, the Refuge prepares step-down management plans. In essence, step-down management plans provide the additional planning details necessary to implement management strategies identified in a CCP. Refuge staff members have already completed a number of step-down plans. These include fire management, grazing, land protection, and the mosquito integrated pest management plans. The CCP proposes to include a volunteer and a comprehensive inventory and monitoring plan in the near future.

### **Programmatic Consultation Guidelines**

This consultation covers the Refuges' CCP which includes habitat restoration, routine management, maintenance, and operations activities carried out by the Refuge. These activities and programs are described in the project description below. Those activities outside the scope described, such as further changes in refuge management plans or new refuge programs may require further review. Upon request of the Refuge, the SFWO may agree to append additional projects or activities to this consultation.

### **Implementing Procedure**

Projects and activities covered under this opinion are those activities that are described in the CCP and include the day-to-day management of the Refuge. Such activities also include habitat manipulation and restoration, modifications of existing structures, and repair and maintenance of levees, roads, trails, utilities, etc. Projects that may require further review may include restoration plans for new acquisitions to the Refuge, significant changes in land use on refuges, or new programs proposed for implementation on the Refuge. The SFWO expects that such projects, new activities, or new programs would require review and documentation pursuant to the National Environmental Policy Act (NEPA), and believes it would be appropriate to review those projects to ensure they meet the scope of this consultation.

The following process will be used when reviewing additional proposed projects or programs for inclusion in this consultation:

1. The Refuge will submit a letter requesting that the proposed project be appended to this programmatic biological opinion and provide the SFWO with a biological assessment of the proposed action.
2. The SFWO will review the proposed project to determine: (1) the potential effects of the proposed project to listed species, (2) if it is appropriate to append the proposed project to this programmatic biological opinion, and/or (3) the proposed project should undergo a separate consultation.
3. Within 30 days, the SFWO will respond with an agreement to append the project to the programmatic consultation and/or with requests for information needed to complete a separate consultation. If additional consultation is necessary, the SFWO will initiate informal consultation upon receipt of a request from the Refuge and will contact the Refuge to request any additional information. Once the SFWO has received all the information necessary for consultation, we will initiate consultation.

## **BIOLOGICAL OPINION**

### **Description of Management Area:**

#### **Introduction**

Stone Lakes National Wildlife Refuge was established in 1994 becoming the 505<sup>th</sup> NWR. The refuge boundary encompasses 18,200 acres, including a core refuge of approximately 9,000 acres and a 9,000-acre "Cooperative Wildlife Management Area". Approximately 5,600 acres are currently managed by the Service. Stone Lakes NWR is located in the Sacramento Valley in the southwestern part of Sacramento County. The refuge lies about 10 miles south of Sacramento, straddling Interstate 5 from the town of Freeport south to Lost Slough.

#### **Climate and Physiography**

The Refuge lies between the Coast and Diablo Ranges to the west and the Sierra Nevada to the east. The Carquinez Strait provides a sea-level gap between the Coast Ranges and the Diablo Range. The Carquinez Strait is approximately 55 miles southwest of the refuge and the intervening terrain is mainly flat with rolling hills. Thus, this strait allows prevailing southerly winds from the coast to blow in. During winter, the sea breezes diminish and winds from the north occur more frequently. However, the winds from the south still predominate. Annual temperature in the area averages approximately 61.0 F degrees and annual precipitation averages approximately 17.93 inches. Tule fog is common in the winter.

#### **Soils and Representative Vegetation**

Seven general soil types are found within the Refuge: (1) Egbert clays and Valpac loams; (2) Gazwell mucky clays and Rindge muck and mucky loams; (3) Scribner clay loams, Sailboat and Cosumnes silt loams; (4) Columbia and Cosumnes sandy loams and silty loams; (5) Dierssen sandy clay loams and clay loams; (6) Clear Lake clays; and (7) San Joaquin sandy loams and silty loams.

The upland areas are dominated by introduced annual grasses interspersed with native perennial grasses and forbs. Valley oak savannah persists in well-drained alluvial soils which are not extensive within the refuge boundary. The understory typically supports annual grasses; however, moister soils support shrubs such as poison-oak and wild rose.

Riparian forests consist primarily of three types: (1) cottonwood riparian forests (2) mixed riparian forest, and (3) valley oak riparian forest. Cottonwood riparian forests occur along perennial streams where annual inundation occurs every spring, due to flooding. The forest canopy is dominated by Fremont cottonwood and Gooding's willow, typically draped with California grapevine. The understory often supports California box elder, California blackberry, white-stemmed raspberry, buttonbush, and elderberry. Mixed riparian forests occur where inundation frequency and duration are intermediate between cottonwood and valley oak riparian forests. Canopy dominants include Fremont cottonwood, valley oak, Gooding's willow, red willow, yellow willow, California black walnut, and California sycamore. Common understory dominants include California box elder, Oregon ash, poison-oak, and buttonbush. The California grape enveloping trees and shrubs often gives this forest a jungle-like appearance. The upper portion of the floodplain has less frequent inundation and supports the valley oak riparian forest. The dense forest canopy is dominated by valley oak with associated tree species of Oregon ash, California sycamore, and California black walnut. Understory vines and shrubs include California blackberry, poison-oak, and wild rose.

### **Description of the Proposed Action**

#### **Biological Surveys/Collections**

Bird surveys including ground surveys of waterbirds, mist netting, banding and marking landbirds, sandhill crane surveys, and colonial water bird rookery counts may be conducted. Annual vegetation

monitoring, such as residual dry matter measurement, growing conditions, and surveys of vegetation type, is conducted in both managed wetlands and grasslands.

Scientific research on the Refuge is allowed on a case-by-case basis via a Special Use Permit (SUP). Historical research includes studies on the western pond turtle, yellow starthistle, sunflower parasitoids, and cattle grazing. Plant collections are allowed on the refuge for educational purposes (refuge herbarium), the California Indian Basketweavers Association, and for restoration and transplant purposes. Refuge staff is working on a proposal to do additional monitoring for the giant garter snake on the Refuge with the U.S. Geological Survey, Biological Resources Division.

### **Restoration Activities**

Habitat restoration activities may include returning the land to its natural contours, installing water delivery and control structures, plantings, and removal or control of undesirable vegetation. Irrigation systems may be installed for riparian restoration. Native plant cultivation (native grasses, forbs, shrubs and trees) may be developed in refuge plant nurseries. Levee repair or levee and dike construction may be included in restoration activities. Wetland, riparian, and grassland restorations would be the most common type of restoration, although any suitable (Central Valley) natural plant community may be restored. Historical maps, aerial photographs, topography, hydrology, and soils will be assessed to determine the appropriate types of vegetation to be restored in a given area. Whenever possible, local plant strains (genotypes and phenotypes) will be used in restoration. A variety of heavy equipment (e.g., bottom scrapers, tractors, backhoes, etc.) could be used in the re-contouring of former agricultural lands, in the installation of pumps, pipelines, water control structures, and in the inundation of former agricultural land through pumping, weirs, and culverts.

### **Public Use**

The Refuge will build and maintain facilities for hunting, fishing, wildlife observation, interpretation, education, and photography. Facilities will include hiking trails, parking areas, viewing platforms, boardwalks, boat-ramps, hunting and photo blinds, and interpretive structures. Boat-fishing and non-motorized boating is also permitted. Hunting will be allowed at South Stone Lake only on Wednesdays and Saturdays, the remainder of the Refuge will be reserved as a sanctuary.

### **Water Management Activities**

Water management activities include managing the timing and duration of flood-up and drawdown for seasonal wetlands and summer irrigation to promote beneficial moist-soil vegetation. Water levels in permanent wetlands are maintained for resident wildlife and nesting bird species. Irrigation may occur to support riparian, grassland, and wetland restoration plantings.

### **Routine Maintenance**

Routine maintenance includes the repair of levees, roads, ditches, and waterways; vegetation management by mowing, disking, burning, spraying, or grazing; and the maintenance of waterways, easements and roads by clearing silt, trees, and shrubs. Heavy equipment (e.g., tractors, backhoes, excavators, etc.) use may be required for routine maintenance, repairs, enhancement, and restoration projects.

### **Prescribed Livestock Grazing**

Prescribed grazing may be used to promote native plant communities in vernal pools, seasonal wetlands, and on lakeshores, and to discourage the growth of non-native grasses, noxious weeds and other undesirable vegetation. Grazing related activities include installing and maintaining fences, gates, corrals, windmills, troughs, and irrigation systems. Pasture inspections via horse and/or ATV by the permit holder will occur on a regular basis. Grassland production estimates and residual dry matter will be assessed annually by Refuge staff to monitor grassland condition.

### **Animal Damage Control**

Live trapping and euthanasia of beaver and muskrat will be conducted in selected areas where damage

to levees, roads, water control structures, and/or native plantings has occurred.

### **Special Use Permits**

Research and other activities conducted by non-refuge personnel on the Refuge are governed by SUPs. SUPs are designed to allow appropriate activities while minimizing impacts to Refuge wildlife and habitats, with emphasis on avoidance of any sensitive areas or species. Research on listed species also requires a separate federal 10(a)(1)(A) recovery permit.

### **Herbicide/Pesticide Use**

Invasive and noxious plant control efforts on the Refuge are a major part of habitat management. Current efforts include control and treatment of non-native aquatic and terrestrial vegetation such as water hyacinth, *Egeria densa*, and other submergents, perennial pepperweed, yellow starthistle, cocklebur, thistle species, giant cane, and others. Equipment used in the treatment of invasive plants includes boats, airboats, ATVs, truck-and-trailer, and handheld apparatus. Incidental take associated with these actions has been covered through the Section 7 process and this consultation and biological opinion is incorporated by reference. Various environmental data associated with this activity are collected for monitoring and management purposes (1-1-00-F-0162).

The Refuge is using the Weed Management Information System, developed by The Nature Conservancy. This information system is used to document the location of specific weed management treatments through the use of a Global Positioning System to determine the effectiveness of treatments.

All Refuge staff applying pesticides are required to have a California Qualified Applicator certificate. Refuge staff have received training in the identification of elderberry plants, the valley elderberry longhorn beetle, and the locations of vernal pools and giant garter snake habitat. Refuge staff have attended training held by the California Department of Boating and Waterways, which included training in the protocol to use if a giant garter snake is seen when applying herbicide.

### **Mosquito Abatement**

The Refuge staff works closely with the Sacramento/Yolo Mosquito Vector Control District (SYMVCD) to reduce or eliminate mosquitoes on the Refuge. The Refuge entered into an MOU with SYMVCD in 1993. This MOU outlines an effective mosquito suppression program that includes biological and chemical controls to be used on the Refuge, wetland design and water level management recommendations, and research partnerships. The MOU is annually updated and renewed. Biological controls include the placement of mosquito fish and guppies in permanent and seasonal wetlands and the use of *Bti*, which is a very effective method for controlling mosquito larvae. All of the treatments over the past two years have been limited to biological control methods, although chemical controls are also an option if warranted. Chemicals to be used on the Refuge are approved by the Service prior to the mosquito season in early spring. These chemicals target larvae and adults and can include aerial applications, as well as ground application(s).

### **Fire Management**

Prescribed burning of wetland and grassland habitats to remove excess vegetation, control non-native species, and maintain habitat value may occur. Brush pile burning and strip fires to reduce fuel load and the threat of wildfires and to reduce threats of fire along the urban interface may occur.

### **Goals of the Proposed Action**

In addition to the management activities described above, the Refuge has identified a list of goals which are descriptive, open-ended, and often broad statements of desired future conditions that convey a purpose but do not define measurable units. Goals translate Refuge purposes into management direction. Each goal is supported by measurable, achievable objectives with specific strategies needed to accomplish them. These strategies are described in the CCP. Objectives are designed to

be accomplished within 15 years. Actual implementation, however, may vary as a result of available funding.

**Goal 1. Conserve, enhance, restore, and manage Central Valley wetland, riparian, grassland, and other native habitats to benefit their associated fish, wildlife, plants, and special status species.**

Objective 1.A. Within 15 years, plant a minimum of 65 acres of valley foothill riparian and oak woodland habitat with a canopy cover of 20-80% and a canopy height of 2-10 meters. These newly planted habitats would have a complex structure with a canopy, subcanopy, and understory shrub layer that would continue to mature after the lifetime of this CCP. An additional 40 acres of understory shrubs and herbaceous cover would be established in areas restored from 1995-1998. These restored habitats would provide breeding and migratory habitat for a variety of riparian dependent species which have been identified by the Central Valley Joint Venture as species of concern including: (1) yellow warbler, (2) song sparrow, (3) spotted towhee, (4) yellow breasted chat, (5) black headed grosbeak, and (6) common yellowthroat..

Objective 1.B: Maintain and manage on an annual basis, 425 acres of riparian and oak woodland habitat, consisting of 360 acres of existing habitat and 65 acres of restored habitat. This habitat encompasses riparian and oak woodland habitat in various successional stages comprising a complex structure with a canopy, subcanopy, and understory shrub layer (usually impenetrable). Restoration would occur through habitat manipulations, including vegetation control of invasive species and restoration of the subcanopy and understory shrub layer. These habitats provide breeding and migratory habitat for the following focal species for the Central Valley, as defined by the Central Valley Joint Venture (CVJV) (1) yellow warbler, (2) song sparrow, (3) spotted towhee, (4) yellow breasted chat, (5) black headed grosbeak, and (6) common yellowthroat. Furthermore, these riparian areas support heron and egret rookeries that vary in size from 10 to 50 nests.

Objective 1.C: Within five years, enhance and annually maintain approximately 50 acres of seasonal and permanent wetlands without water control structures on the 70-acre LIC tract of the South Stone Lake Unit by promoting the growth of wetland species such as swamp timothy, smartweeds, water grass, and associated invertebrate animals.

Objective 1.D.a: Manage on an annual basis, 529 acres as moist soil habitat, characterized by a plant composition of 50 percent or more moist soil, high-energy waterfowl plant foods (e.g. watergrass, swamp timothy, and smartweeds). Flood approximately 60 percent of the moist soil units to a depth of two to ten inches for dabbling ducks and shorebirds, and 40 percent to depths of six inches to three feet for diving ducks, grebes, pelicans, and other waterbirds.

Objective 1.D.b: Annually maintain 452 acres of seasonal wetlands with no water control structures, characterized by a plant composition of 50 percent or more of moist soil, high energy waterfowl plant foods interspersed with open water. Control undesirable vegetation such as cocklebur, pepperweed, and yellow starthistle, to benefit wintering and migratory waterfowl, as well as other wetland-dependent species.

Objective 1.D.c: Annually maintain 136 acres of vernal pool seasonal wetlands characterized by >70 percent native vernal pool vegetation.

Objective 1.E: Annually maintain 715 acres of deep-water wetlands (includes wetlands with and without water control capabilities), lakes, sloughs, and waterways, to provide breeding, foraging, and loafing habitat for waterfowl and other wetland dependent species, such as giant garter snakes and western pond turtles. Deep water wetlands are characterized by water depths of >3 feet with wetland plants species such as tules, cattails, burreed, and water primrose.

Objective 1.F: Manage and enhance approximately 1,900 acres of dry (non-irrigated) grasslands on

the North Stone Lake Unit on an annual basis, to provide a variety of grass heights and densities as measured by residual dry matter (RDM) at the end of the grazing season (Aug-Sept). The rotation of grazing pressure in the different pasture units will support a diversity of grassland dependent species including sandhill cranes, arctic nesting geese, raptors, shorebirds, and songbirds including the following species identified by the USFWS as species of conservation concern: sandhill crane, long-billed curlew.

Objective 1.G: Annually maintain 460 acres of irrigated pasture/wet meadow to provide habitat for a variety of grassland dependent species including sandhill crane, white faced ibis, long-billed curlew, and arctic nesting geese.

Objective 1.H: Restore approximately 30 acres to grassland habitat consisting of a minimum of 70 percent native grasses (*Stipa pulchra*, *Poa* spp., *Leymus* spp., *Elymus* spp., and *Mellica* spp.) on various Refuge units within ten years to promote biodiversity and improve the grassland communities on the Refuge.

Objective 1.I: Within 15 years, coordinate Refuge land conservation program to protect 75 percent of the land within the approved Refuge boundary to help achieve the CVJV regional habitat protection goals.

Objective 1.J: Coordinate Refuge habitat conservation with other private and public conservation efforts within the Sacramento-San Joaquin Delta to contribute to regional habitat conservation needs.

Objective 1.J.a: Manage Refuge floodplain lands in a manner consistent with local, State, and Federal flood management, sediment and erosion control, and water quality objectives as described in the Environmental Impact Statement associated with Refuge establishment.

Objective 1.J.b: Within 10 years of CCP approval, work toward achieving the water quality supply standard set forth by the U.S. Environmental Protection Agency, California Department of Fish and Game, and the Regional Water Quality Control Board, for wetlands and fish and wildlife resources.

**Goal 2. Conserve, enhance, and restore high quality migrating, wintering, and breeding habitat for migratory birds within the Sacramento-San Joaquin Delta of the Central Valley.**

Objective 2.A: Manage 2,950 acres of Refuge lands and work with adjacent landowners to protect agricultural lands and habitats that support a wintering population of 200-300 greater sandhill cranes and 200 lesser sandhill cranes from September through March. Shallow water will be maintained in irrigated pastures to provide roosting and foraging habitat; dry pastures, wheat, corn, and alfalfa fields will be sowed to provide foraging habitat.

Objective 2.B: Develop monitoring strategies for focal species identified in various regional bird conservation plans, to assess current and guide future habitat restoration activities. The regional plans include the following: *Central Valley Joint Venture Plan*, *Riparian Bird Conservation Plan*, *Grassland Bird Conservation Plan*, *Oak Woodland Bird Conservation Plan*, *North American Waterbird Conservation Plan*, *North American Waterfowl Management Plan*, and *North American Landbird Conservation Plan*. The Service's *Birds of Conservation Concern* are addressed within these various plans.

**Goal 3. Provide visitors with wildlife-dependent recreation, interpretation, and educational opportunities which foster an understanding of the Refuge's unique wildlife and plant communities in an urban setting.**

Objective 3.A: Recruit and maintain sufficient short and long term volunteers to accomplish habitat

restoration projects, wildlife surveys, and environmental education programs.

**Objective 3.B:** Construct adequate facilities and develop programs for the public to visit the Refuge seven days a week.

**Objective 3.C:** Within five years, develop an environmental education program with a target of providing 80 groups per year with an outdoor experience where visitors become aware of the Refuge's role in the conservation of Central Valley and Sacramento-San Joaquin Delta habitats and their fish and wildlife.

**Objective 3.D:** Within five years, develop two interpretive programs where visitors can learn of the Refuges' role in conserving the Central Valley and Sacramento-San Joaquin Delta habitats and their fish and wildlife with an emphasis on outdoor hands-on experiences.

**Objective 3.E:** Within five years, the Refuge will provide safe boat-only fishing with day-use parking facilities for approximately 20 boats on South Stone Lake, and approximately 10 boats on SP Cut from June through September.

**Objective 3.F:** Continue and expand the Refuge outreach program, targeting the local community and nontraditional users, by expanding partnerships for the annual "Walk on the Wildside" event. Participate in a minimum of four appropriate off-Refuge events to increase awareness of the Refuges' role in the conserving Central Valley and Sacramento-San Joaquin Delta habitats and their associated fish and wildlife.

## **Conservation Measures**

### **Giant garter snakes**

The Refuge will adhere to all guidelines listed in the Service's November 1997, *Standard Avoidance and Minimization Measures During Construction Activities in Giant Garter Snake (*Thamnophis gigas*) Habitat and Guidelines for Restoration and/or Replacement of Giant Garter Snake Habitat*.

Avoidance measures for earth moving activities:

1. Earth moving activities will be restricted to May through October, during the majority of the giant garter snakes' active period when snakes are able to escape and avoid danger. During the giant garter snakes' inactive period (November 1 through April 1) some small-scale emergency levee repair may occur, but will usually be less than 20 linear feet.
2. All earth moving activities will occur within wetlands that have been drained. Because these drained wetlands will not provide foraging habitat, it is likely that giant garter snakes will not remain for extended periods after they are drained. This reduces the chance that any earth moving activities will harm or harass snakes. Drained areas will be dry for at least two weeks prior to earth moving activities. Drained areas also will be checked for ponded areas that may concentrate prey and become an attractant to giant garter snakes. Ponded areas will be avoided and surveyed for giant garter snakes before any activity occurs within them.

Avoidance measures for canal excavation/maintenance activities (including water control structure replacement):

1. Canal excavation will be performed only from May 1 to November 1.
2. Excavation will typically occur from only one side of the canal during a given year. When possible, one side of the canal will be left undisturbed indefinitely.
3. Excavation above the high flow watermark will be avoided whenever possible to minimize disturbance to burrows and retreat sites.
4. Vegetation on the tops and sides of canals will be left as undisturbed as possible.

Avoidance measures for vegetation management:

1. Roads adjacent to giant garter snake habitat will: a) not be mowed unless necessary for regular access; b) be mowed between March 1 and October 31; c) be mowed with mowers adjusted to leave no less than six inches of standing vegetation. These measures decrease the risk of injuring snakes and minimize loss and disturbance of vegetative cover.
2. Burning will be conducted during the spring, summer, and fall months on thoroughly dried wetlands or uplands. Where possible only one bank of vegetation will be subject to prescribed burns. Vegetation along canal banks will be left undisturbed as much as possible and fire crews will not reignite bank vegetation passed over by fire. Surveys for giant garter snakes will be conducted prior to burning, and any giant garter snakes observed within prescribed burn areas will be captured and relocated or attempts will be made to flush them away from areas where fire is likely to travel.
3. Disking will only take place during the giant garter snake active period. Disking will be conducted in dried wetlands or in uplands. Disking activities will be avoided directly adjacent to waterways and summer wetlands unless they have been allowed to dry. A 200 foot buffer between disking and wetlands or open water will be adhered to.

*Habitat restoration and enhancement* – The Refuge pursues fee title acquisition and cooperative management agreements for lands within or adjacent to existing refuge boundaries. Many restoration and enhancement projects have the potential to restore summer wetlands which provide giant garter snake habitat. The Refuge evaluates restoration projects to determine whether incorporation of essential habitat components for the giant garter snake is appropriate and feasible. Restoration activities generally require the same earth moving activities required for maintenance activities and would use the same conservation measures practiced for routine maintenance.

*Maintenance and management changes* – The Refuge is using several new techniques and materials to reduce the frequency of maintenance activities in wetlands and waterways. Over the next five years, the Refuge will replace corrugated metal water control structures with polyethylene and concrete structures. The new water control structures have a longer life expectancy (>30 years versus <10 years) and require less maintenance. Use of these structures will minimize the frequency of disturbance and risk of injury to giant garter snakes. In addition, rip-rap will be used to armor many of the structures, providing additional giant garter snake habitat and further minimizing maintenance needs.

### **Valley elderberry longhorn beetle**

The Refuge will adhere to all guidelines listed in the Service's July 1999, *Conservation Guidelines for the Valley Elderberry Longhorn Beetle*.

The Refuge avoids disturbance to elderberry shrubs whenever possible, trains field crews in elderberry plant identification, and follows the July 1999, *Conservation Guidelines for the Valley Elderberry Longhorn Beetle* developed by the SFWO. When trimming elderberry shrubs that interfere with road and utility easements, trimming activities will be limited, whenever possible, to the dormant period for the beetle, November through mid February. The Refuge also actively plants elderberry plants as part of their riparian restoration activities.

### **Vernal pool species**

Habitat management activities in vernal pool areas are limited to prescribed fire and grazing. The Refuge avoids intentionally flooding these areas and avoids/restricts equipment or vehicle traffic in these areas. Vernal pool fairy shrimp and vernal pool tadpole shrimp may be harmed, harassed, injured, or killed during surveys, monitoring, and management activities of vernal pool habitat. However, adherence to the April 1996, *Interim Survey Guidelines to Permittees for Recovery Permits Under Section 10(a)(1)(A) of the Endangered Species Act for the Listed Vernal Pool Brachiopods* will minimize the effects of surveys and monitoring activities on vernal pool crustaceans.

During prescribed burns, the following measures will be implemented: 1) vehicle traffic will not occur in vernal pool basins or within 20 feet of vernal pool basin perimeters; 2) only foot traffic and wheeled vehicles will be permitted in alkali meadow and vernal pool terrain; tracked equipment such as bulldozers will not be used in these areas; 3) firebreaks will not be disked or bladed in vernal pools. Fire breaks will be constructed in managed seasonal marshes bordering vernal pool areas, or at the edge of vernal pool areas (next to buildings, parking lots, levees, roads, or canals); 4) where possible, pre-existing or natural firebreaks will be used; and 5) wet lines and/or biodegradable foam will be used to create firebreaks where edge or natural features are absent.

### **Mosquito Control**

Generally, naturally-functioning seasonal swales and vernal pools are not considered significant mosquito producing areas and should not require any chemical treatments. Furthermore, seasonal wetlands are usually dry by the onset of the primary mosquito production season (June 1). In the event mosquito control is necessary in any seasonal wetland, *Bti* would be used. The edge of man-made impoundments will be mowed and disked to discourage mosquito production. Mosquito fish are routinely introduced on the Lewis Property.

Mosquito control will follow an ordered succession, using nonchemical treatments first (i.e., water control strategies, *Bti*, etc.), resorting to chemical treatment only when necessary, as determined through standard mosquito monitoring procedures. Whenever possible, mosquito production areas will be treated with non-chemical treatments before larvicides or adulticides are applied. Wetlands that have produced large mosquito populations in the past will be flooded as quickly as possible to minimize multiple emergences that may cause a need for the use of adulticides. *Bti* will be used where it can be applied effectively. Dimilin (larvicide) would only be applied directly to water in actively-managed seasonal impoundments on the Lewis Property or the Beach Lake Mitigation Bank, not to vernal pool areas. The Sacramento-Yolo Mosquito and Vector Control District does not consider vernal pools to be mosquito production habitat because natural wetlands usually have enough natural predators (e.g., dragonfly larvae) to control mosquitoes without the use of larvicides.

If chemical treatments are necessary, adulticides will be used as a last resort after all larvicide options have been considered. The adulticide Trumpet EC will be applied by ultra-low volume (U.L.V.) cold-foggers from ground vehicles. To minimize pesticide drift when using adulticides and larvicides, dispersing vehicles will follow routes on existing roads set up to fog downwind or outside buffers of

91 meters (300 feet) from areas supporting listed or proposed special status species (vernal pool-alkali wetland habitats). All chemical applications will occur when wind speeds are between 2 and 8 mph. Specific information regarding application data for individual agents is provided in the current PUPs.

### **Habitat restoration programs**

The Refuge participates in and implements the Central Valley Joint Venture Implementation Plan of the North American Waterfowl Management Plan; components of the Central Valley Project Improvement Act (CVPIA); and the Federal Native Plant Conservation Memorandum of Understanding. The Refuge participates in development and implementation of recovery plans for listed species.

### **Status of the Species/Environmental Baseline**

#### **Giant Garter Snake**

The Service published a proposal to list the giant garter snake as an endangered species on December 27, 1991 (56 **FR** 67046). The Service reevaluated the status of the snake before adopting the final rule. The snake was listed as a threatened species on October 20, 1993 (58 **FR** 54053). A draft giant garter snake recover plan was published in 1999 (Service 1999).

The giant garter snake is one of the largest garter snake species, reaching a total length of approximately 64 inches (162 centimeters). Females tend to be slightly longer and proportionately heavier than males. The weight of adult female snakes is typically 1.1-1.5 pounds (500-700 grams). Dorsal background coloration varies from brown to olive with a cream, yellow, or orange dorsal stripe and two light colored lateral stripes. Some individuals have a checkered pattern of black spots between the dorsal and lateral stripes. Background coloration and prominence of the checkered pattern and three yellow stripes are geographically and individually variable; individuals in the northern Sacramento Valley tend to be darker with more pronounced mid-dorsal and lateral stripes (Hansen 1980; Rossman et al. 1996). Ventral coloration is variable from cream to orange to olive-brown to pale blue with or without ventral markings (Hansen 1980).

Giant garter snakes formerly occurred throughout the wetlands that were extensive and widely distributed in the Sacramento and San Joaquin Valley floors of California (Fitch 1940; Hansen and Brode 1980; Rossman and Stewart 1987). The historical range of the snake is thought to have extended from the vicinity of Chico, Butte County, southward to Buena Vista Lake, near Bakersfield, in Kern County (Fitch 1940; Fox 1948; Hansen and Brode 1980; Rossman and Stewart 1987). Early collecting localities of the giant garter snake coincide with the distribution of large flood basins, particularly riparian marsh or slough habitats and associated tributary streams (Hansen and Brode 1980).

Loss of habitat due to agricultural activities and flood control have extirpated the snake from the southern one third of its range in former wetlands associated with the historic Buena Vista, Tulare, and Kern lake beds (Hansen 1980; Hansen and Brode 1980). By 1971, so much wetland habitat had been reclaimed, that the California Department of Fish and Game (CDFG) classified the giant garter snake as a rare animal and conducted a series of field surveys. The results of these surveys indicate that snake populations were distributed in marsh wetlands, tributary streams, and portions of the rice productions zones of the Sacramento Valley in Butte, Glenn, Colusa, Sutter, Yolo, and Sacramento Counties; in the Delta region along the eastern fringes of the Sacramento-San Joaquin River Delta in Solano, Contra Costa, Sacramento, and San Joaquin Counties; and in the San Joaquin Valley in San Joaquin, Stanislaus, Merced, Mendota, and Fresno Counties (Hansen 1988; Hansen and Brode 1980).

Upon federal listing in 1993, the Service identified 13 separate populations of giant garter snakes, with each population representing a cluster of discrete locality records (Service 1993). The 13 populations

largely coincide with historical flood basins and tributary streams throughout the Central Valley: (1) Butte Basin, (2) Colusa Basin, (3) Sutter Basin, (4) American Basin, (5) Yolo Basin/Willow Slough, (6) Yolo Basin/Liberty Farms, (7) Sacramento Basin, (8) Badger Creek/Willow Creek, (9) Caldoni Marsh/White Slough, (10) East Stockton--Diverting Canal & Duck Creek, (11) North and South Grasslands, (12) Mendota, and (13) Burrel/Lanare.

A population is a group of organisms that interbreed and share a gene pool. The boundaries of a population, both in space and time, are generally not discrete and, in practice, as usually defined by the researcher (Krebs 1994). The gene pool and breeding patterns of the 13 giant garter snake populations identified in the final rule remain unstudied and unknown. What was described as “13 populations” should therefore be described more accurately as sub-populations and occurrences that note observations of individuals about which much remains unknown (Service 1999).

Surveys over the last 25 years suggest that sub-populations of giant garter snake in the northern parts of its range (*i.e.*, Butte, Colusa, and Sutter Counties) are relatively large and stable (Wylie et al. 1997; Wylie et al. 2003a, 2004a). Habitat corridors connecting sub-populations, however, are either not present or not protected, and urban encroachment increases as a serious threat (Service 1999). Sub-populations in Yolo, Sacramento, Solano, and San Joaquin Counties areas are small, fragmented, and threatened by urbanization (Hansen 2004; Service 1999). Those sub-populations in the San Joaquin Valley, however, are most vulnerable having suffered near-devastating declines and possible extirpations over the last two decades (including populations in Stanislaus, Merced, Madera and Fresno Counties) (Dickert 2002, 2003; Hansen 1988; Williams and Wunderlich 2003). The southern sub-populations are extremely small, distributed discontinuously in isolated patches, and therefore are highly vulnerable to extinction by random environmental, demographic, and genetic processes (Goodman 1987a).

Endemic to wetlands in the Sacramento and San Joaquin valleys, the giant garter snake inhabits marshes, sloughs, ponds, small lakes, low gradient streams, and other waterways and agricultural wetlands, such as irrigation and drainage canals, rice fields and the adjacent uplands (Service 1999). The snake feeds on small fishes, tadpoles, and frogs (Fitch 1941; Hansen 1988; Hansen and Brode 1980, 1993). Essential habitat components consist of: (1) wetlands with adequate water during the snake's active season (early-spring through mid-fall) to provide food and cover; (2) emergent, herbaceous wetland vegetation, such as cattails and bulrushes, for escape cover and foraging habitat during the active season; (3) upland habitat with grassy banks and openings in waterside vegetation for basking; and (4) higher elevation uplands for over-wintering habitat with escape cover (vegetation, burrows) and underground refugia (crevices and small mammal burrows) (Hansen 1988). Snakes are typically absent from larger rivers and other bodies of water that support introduced populations of large, predatory fish, and from wetlands with sand, gravel, or rock substrates (Hansen 1988; Hansen and Brode 1980; Rossman and Stewart 1987). Riparian woodlands do not provide suitable habitat because of excessive shade, lack of basking sites, and absence of prey populations (Hansen 1988).

Giant garter snakes are the most aquatic garter snake species and are active foragers, feeding primarily on aquatic prey such as fish and amphibians (Fitch 1941). Historically, giant garter snake prey likely consisted of Sacramento blackfish (*Orthodon microlepidots*), thick-tailed chub (*Gila crassicauda*), and red-legged frog (*Rana aurora*) (Rossman et al. 1996; Service 1999). Because these prey species are no longer available (chub extinct, red-legged frog extirpated from the Central Valley, blackfish declining) the predominant food items are now introduced species such as carp (*Cyprinus carpio*), mosquitofish (*Gambusia affinis*), larval and sub-adult bullfrogs (*Rana catesbiana*), and Pacific chorus frogs (*Pseudacris regilla*) (Fitch 1941; Hansen and Brode 1993; Rossman et al. 1996).

The giant garter snake breeding season extends through March and April, and females give birth to live young from late July through early September (Hansen and Hansen 1990). Brood size is variable, ranging from 10 to 46 individual young, with a mean of 23 individuals (Hansen and Hansen 1990). At birth, young average about 8.1 inches (20.6 centimeters) snout-to-vent length and 3 to 5 grams.

Although growth rates are variable, young typically more than double in size by one year of age, and sexual maturity averages three years in males and five years for females (Service 1993).

The giant garter snake is highly aquatic but also occupies a terrestrial niche (Service 1999; Wylie et al. 2004a). Aquatic habitat includes remnant native marshes and sloughs, restored wetlands, low gradient streams, and agricultural wetlands including rice fields and irrigation and drainage canals. Terrestrial habitat includes adjacent uplands which provide areas for basking, retreats, and over-wintering. Basking takes place in tules, cattails, saltbush, and shrubs over-hanging the water, patches of floating vegetation including waterweed, on rice checks, and on grassy banks (Service 1999). The snake typically inhabits small mammal burrows and other soil and/or rock crevices during the colder months of winter (*i.e.*, October to April) (Hansen and Brode 1993; Wylie et al. 1996; Wylie et al. 2003a). It also uses burrows as refuge from extreme heat during its active period (Wylie et al. 1997; Wylie et al. 2004a). While individuals usually remain in close proximity to wetland habitats, the Biological Resource Division of the U.S. Geological Survey (BRD) has documented snakes using burrows as much as 165 feet (50 meters) away from the marsh edge to escape extreme heat, and as far as 820 feet (250 meters) from the edge of marsh habitat for over-wintering habitat (Wylie et al. 1997). Snakes typically select burrows with sunny exposures along south and west facing slopes (Service 1993). In studies of marked snakes in the Natomas Basin, snakes moved about 0.25 to 0.5 miles (0.4 to 0.8 kilometers) per day (Hansen and Brode 1993). Home range (area of daily activity) averages about 0.1 mile<sup>2</sup> (25 hectares) in both the Natomas Basin and the Colusa National Wildlife Refuge (NWR) (Wylie 1998a; Wylie et al. 2002). Total activity, however, varies widely between individuals; individual snakes have been documented to move up to five miles (8 kilometers) over a few days in response to dewatering of habitat (Wylie et al. 1997) and to use up to eight miles (12.9 kilometers) of linear aquatic habitat over the course of a few months, and to have a home range as large as 14.5 miles<sup>2</sup> (3744 hectares) (Wylie and Martin 2004).

In agricultural areas, snakes were documented using rice fields in 19-20 percent of the observations, marsh habitat in 20-23 percent of observations, and canal and agricultural waterway habitats in 50-56 percent of the observations (Wylie 1998b). In the Natomas Basin, habitat used consisted almost entirely of irrigation ditches and established rice fields (Wylie 1998a; Wylie et al. 2004b). In the Colusa NWR, snakes were regularly found on or near edges of wetlands and ditches with vegetative cover (Wylie et al. 2003a). Telemetry studies also indicate that active snakes use uplands extensively; more than 31 percent of observations were in uplands (Wylie 1998b). Snakes observed in uplands during the active season were consistently near vegetative cover, particularly where cover exceeded 50 percent in the area within 1.6 feet (0.5 meter) of the snake (Wylie 1998b).

Snakes will move into restored habitat after two years. At the Colusa NWR, after two years, restoration area population estimates increased from 30 snakes per kilometer to 59-95 snakes per kilometer (Wylie et al. 2004a). At the Colusa Basin Drainage Canal, snakes were given three upland restoration treatments, 1) soil planted with native grasses over rock riprap, 2) soil planted with native grasses without rock, and 3) rock riprap only; snakes were most commonly found at the soil over rock riprap treatment (Wylie and Martin 2004).

Giant garter snakes are eaten by a variety of predators, including raccoons (*Procyon lotor*), striped skunks (*Mephitis mephitis*), opossums (*Didelphis virginiana*), bull frogs (*Rana catesbiana*), hawks (*Buteo* sp.), egrets (*Casmerodius albus*, *Egretta thula*), and great blue herons (*Ardea herodias*) (Dickert 2003; Service 1999; Wylie et al. 2003c). Many areas supporting snakes have been documented to have abundant predators; however, predation does not seem to be a limiting factor in areas that provide abundant cover, high concentrations of prey items, and connectivity to a permanent water source (Hansen and Brode 1993; Wylie et al. 1996).

The current distribution and abundance of the giant garter snake is much reduced from former times (Service 1999). Less than ten percent, or approximately 319,000 acres (129,000 hectares), of the historic 4.5 million acres (1.8 million hectares) of Central Valley wetlands remain (U.S. Department of

Interior 1994), of which very little provides habitat suitable for the giant garter snake. Loss of habitat due to agricultural activities and flood control have extirpated the snake from the southern one-third of its range in former wetlands associated with the historic Buena Vista, Tulare, and Kern lakebeds (Hansen 1980; Hansen and Brode 1980). These lakebeds once supported vast expanses of ideal snake habitat, consisting of cattail and bulrush dominated marshes (Service 1999). Cattail and bulrush floodplain habitat also historically typified much of the Sacramento Valley (Hinds 1952). Prior to reclamation activities beginning in the mid- to late-1800s, about 60 percent of the Sacramento Valley was subject to seasonal overflow flooding providing expansive areas of snake habitat (Hinds 1952). Valley flood wetlands are now subject to cumulative effects of upstream watershed modifications, water storage and diversion projects, as well as urban and agricultural development.

The Central Valley Project (CVP), planned by the State of California, and built and operated by the Federal Bureau of Reclamation, is the largest water management system in California. CVP and the historic water development activities that preceded it have not only resulted in the loss of all but approximately ten percent of wetlands, they have created an ecosystem altered to such an extent that remaining wetlands, like agriculture, depend on managed water (U.S. Department of Interior 1994). The historic disturbance events associated with seasonal inundation that occur naturally in dynamic riverine, riparian, and wetland ecosystems have been largely eliminated. In addition to the highly managed water regimes, implementation of the CVP has resulted in conversion of native habitats to agriculture, and has facilitated urban development through the Central Valley (Service 1999). In 1992, Congress enacted the CVPIA, the concerns of which include pricing and management of Central Valley water and attempting to mitigate for project impacts on fish, wildlife, and associated habitat. CVPIA, however, has been largely ineffective thus far, addressing primarily only the water needs of publicly-owned wetlands, which account for less than one-fourth of the wetlands in the Central Valley (Service 1999).

Residential and commercial growth with the Central Valley is consuming an estimated 15,000 acres of Central Valley farmland each year (American Farmland Trust 1999). In the future, this transformation is expected to accelerate. Rice fields have become important habitat for giant garter snakes, particularly associated canals and their banks for both spring and summer active behavior and winter hibernation (Hansen 2004). While within the rice fields, snakes forage in the shallow water for prey, utilizing rice plants and vegetated berms dividing rice checks for shelter and basking sites (Hansen and Brode 1993). The loss of rice land resulting from residential and commercial growth compounds the impact of direct habitat loss resulting from development itself.

Ongoing maintenance of aquatic habitats for flood control and agricultural purposes eliminates or prevents the establishment of habitat characteristics required by snakes (Hansen 1988). Such practices can fragment and isolate available habitat, prevent dispersal of snakes among habitat units, and adversely affect the availability of the snake's food items (Hansen 1988; Brode and Hansen 1992). For example, tilling, grading, harvesting and mowing may kill or injure giant garter snakes (Service 1999; Wylie et al. 1997). Biocides applied to control aquatic vegetation reduce cover for the snake and may harm prey species (Wylie et al. 1996). Rodent control threatens the snake's upland estivation habitat (Wylie et al. 1996; Wylie et al. 2004a). Restriction of suitable habitat to water canals bordered by roadways and levee tops renders snakes vulnerable to vehicular mortality (Wylie et al. 1997). Materials used in construction projects (e.g., erosion control netting) can entangle and kill snakes (Stuart et al. 2001). Livestock grazing along the edges of water sources degrades water quality and can contribute to the elimination and reduction of available quality snake habitat (Hansen 1988). Fluctuation in rice and agricultural production affects stability and availability of habitat (Wylie and Casazza 2001; Wylie et al. 2003b, 2004b).

Other land use practices also currently threaten the survival of the snake. Nonnative predators, including introduced predatory game fish, bullfrogs, and domestic cats, can threaten snake populations (Dickert 2003; Wylie et al. 1996; Wylie et al. 2003c). Nonnative competitors, such as the introduced water snake (*Nerodia fasciata*) in the American River and associated tributaries near Folsom, may also

threaten the giant garter snake (Stitt et al. 2005). Recreational activities, such as fishing, may disturb snakes and disrupt basking and foraging activities. While large areas of seemingly suitable snake habitat exist in the form of duck clubs and waterfowl management areas, water management of these areas typically does not provide the summer water needed by the species. Degraded water quality continues to be a threat to the species both on and off refuges.

The disappearance of giant garter snakes from much of the west side of the San Joaquin Valley was approximately contemporaneous with the expansion of subsurface drainage systems in this area, providing circumstantial evidence that the resulting contamination of ditches and sloughs with drain water constituents (principally selenium) may have contributed to the demise of giant garter snake populations. Dietary uptake is the principle route of toxic exposure to selenium in wildlife, including giant garter snakes (Beckon et al. 2003). Many open ditches in the northern San Joaquin Valley carry subsurface drainwater with elevated concentrations of selenium. Green sunfish (*Lepomis cyanellus*) in this drainwater have been found to have concentrations of selenium ranging from 12 to 23  $\mu\text{p/g}$  (Saiki 1998), within the range of concentrations associated with adverse effects on predator aquatic reptiles (Hopkins et al. 2002). Since 1996, subsurface drainwater has been discharged, via the Grassland Bypass Project into Mud Slough North, where selenium concentrations in small fish, including mosquito fish, frequently reach 10-15  $\mu\text{p/g}$  (Beckon et al. 2003).

The Central Valley contains a number of endangered ecosystems due to its fertile soils, amiable climates, easy terrains, and other factors that historically have encouraged human settlement and exploitation (Noss et al. 2003). Environmental impacts associated with urbanization include loss of biodiversity and habitat, alternation of natural fire regimes, fragmentation of habitat from road construction, and degradation due to pollutants (Service 1999). Rapidly expanding cities within the snake's range include Chico, Yuba City, the Sacramento area, Galt, Stockton, Gustine, and Los Banos. The draft recovery plan for the snake subdivided its historic range into four recovery units (Service 1999). These are: (1) the Sacramento Valley unit, extending from the vicinity of Red Bluff south to the confluence of the Sacramento and Feather Rivers; (2) the Mid-Valley unit, extending from the American and Yolo Basins south to Duck Creek near the City of Stockton; (3) the San Joaquin Valley unit, extending south from Duck Creek to the Kings River; and (4) the South Valley unit, extending south from the Kings River to the Kern River Basin. The Refuge is located in the Mid-Valley unit.

Currently, only the Sacramento Valley Recovery Unit, at the northern end of the species' range, is known to support relatively large, stable populations of the snake. This unit contains three populations: Butte Basin, Colusa Basin, and Sutter Basin, which includes the Gilsizer Slough and Robbins area subpopulations. This recovery unit includes a large amount of suitable habitat, both in protected areas on state refuges and refuges of the Sacramento NWR Complex in the Colusa and Sutter Basins, and along waterways associated with rice farming (Service 1999). While populations within the unit have some protection on refuge and other public lands, such as the Colusa NWR, Delevan NWR, and Sutter NWR, snakes are subject to flooding and mortality from predatory fish and birds, vehicular traffic, agricultural practices, and maintenance of water channels. The populations within this unit are widely distributed and mostly restricted to unnatural agricultural delivery and drainage facilities associated with rice fields, and habitat corridors connecting populations or subpopulations are not present and/or protected.

The Mid-Valley Recovery Unit, directly to the south of the Sacramento Valley Recovery Unit, includes seven populations: American Basin, Yolo Basin-Willow Slough, Yolo Basin-Liberty Farms, Sacramento Area, Badger Creek/Willow Creek, Caldoni Marsh, and East Stockton. The status of the seven snake populations in the Mid-Valley Recovery Unit is very uncertain. The East Stockton population may be extirpated, and is not considered recoverable as a result of urban encroachment into habitat (Service 1999). Five of the remaining six populations within this recovery unit are very small, highly fragmented and isolated, and, except for the Badger Creek/Willow Creek population, are also threatened by urbanization. This latter population is within a small isolated area. Within this recovery unit, only the American Basin population supports a sizeable snake population, which is largely

dependent upon rice lands. The American Basin population, although threatened by urban development, receives protection from the approved Metro Air Park HCP and the Natomas Basin HCP, which share a regional strategy to maintain a viable snake population in the basin.

The remaining two recovery units are located to the south in the San Joaquin Valley, where the best available data indicates that the snake's status is precarious. The San Joaquin Valley Recovery Unit contains three historic snake populations: North and South Grasslands; Mendota Area; and Burrell/Lanare Area (Service 1999). This recovery unit formerly supported large snake populations, but numbers have declined severely in recent decades, and recent survey efforts indicate that numbers are very low compared to Sacramento Valley populations. No surviving snake populations are known from the fourth recovery unit, the South Valley Recovery Unit, at the southern end of the snake's historic range. This unit includes only extirpated populations, including the historic but lost habitats of Tulare Lake and Buena Vista Lake.

Since 1995, BRD has been studying life history and habitat requirements of the giant garter snake within a few of the 13 populations identified in the 1993 listing. BRD has studied snake sub-populations at the Sacramento, Delevan, and Colusa NWRs and in the Colusa Basin Drain within the Colusa Basin, at Gilsizer Slough within the Sutter Basin, at the Badger Creek area of the Cosumnes River Preserve within the Badger Creek/Willow Creek area of the Delta Basin, and in the Natomas Basin within the American Basin (Hansen 2003, 2004; Wylie 1998a, 1998b, 2003; Wylie et al. 1996; Wylie et al. 2000; Wylie et al. 2002; Wylie et al. 2003a, 2004a; Wylie et al. 2003b, 2004b). These areas contain the largest extant giant garter snake sub-populations. However, outside of protected areas, snakes are still subject to all threats identified in the final rule. The other sub-populations are distributed discontinuously in small, isolated patches, and are vulnerable to extirpation by stochastic environmental, demographic, and genetic processes (Goodman 1987a).

Until recently, there were no post-1980 sightings of giant garter snakes from Stockton southward, and surveys of historic localities conducted in 1986 did not detect any snakes (Hansen 1988). Since 1995, however, surveys conducted by CDFG in cooperation with BRD around Los Banos and the Volta Wildlife Area in the Grasslands, and Mendota Wildlife Area in the Mendota Area have detected snakes, but in numbers much lower than those found in Sacramento Valley sub-populations (Dickert 2002, 2003; Williams and Wunderlich 2003; Wylie 1998a). The estimated total population size for the Volta Wildlife Area is 45 individuals, approximately only 5.6 snakes per mile (3.5 snakes per kilometer). Such low numbers are illustrative of a tenuously small snake population. Also, one-third of the giant garter snakes found had lumps on their bodies suggestive of a parasitic nematode infection (Dickert 2003); further study is underway. However, ten of the 31 snakes found in 2003 weighed less than 40 grams, indicating that giant garter snakes have been breeding at the Volta Wildlife Area. These results demonstrate that giant garter snakes are still extant in the northern San Joaquin Valley, but probably in extremely low numbers/densities. All sub-populations are isolated from each other with no protected dispersal corridors. Few opportunities for re-colonization of small sub-populations that may become extirpated exist given the isolation from larger populations and lack of dispersal corridors between them.

The draft recovery criteria require multiple, stable sub-populations within each of the three recovery units, with sub-populations well-connected by corridors of suitable habitat. This entails that corridors of suitable habitat between existing snake sub-populations be maintained or created to enhance sub-population interchange to offset threats to the species (Service 1999). Currently, only the Northern Sacramento Valley Recovery Unit is known to support relatively large, stable giant garter snake populations. Habitat corridors connecting sub-populations, even in the Northern Sacramento Valley Recovery Unit, are either not present or not protected. Overall, the future availability of habitat in the form of canals, ditches, and flooded fields are subject to

market-driven crop choices, agricultural practices, and urban development, and are, thus, uncertain and

unpredictable.

A number of State, local, private, and unrelated Federal actions have occurred within or near the action area, affecting the environmental baseline of the giant garter snake. Some of these projects have been subject to prior section 7 consultation. These actions have resulted in both direct and indirect effects to snake habitat within the region. Ongoing agricultural activities also affect the environmental baseline for the snake, and are largely not subject to section 7 consultation. Some agriculture, such as rice farming, can provide valuable seasonal foraging and upland habitat for the snake. Although rice fields and agricultural waterways can provide habitat for the snake, agricultural activities such as waterway maintenance, weed abatement, rodent control, and discharge of contaminants into wetlands and waterways can degrade snake habitat and increase the risk of snake mortality (Service 1999). Ongoing maintenance of agricultural waterways can also eliminate or prevent establishment of snake habitat, eliminate food resources for the snake, and can fragment existing habitat and prevent dispersal of snakes (Service 1999). Flood control and maintenance activities which can result in snake mortality and degradation of habitat include levee construction, stream channelization, and the rip-rapping of streams and canals (Service 1999). Numerous development projects have been constructed in or near snake habitat in this rapidly urbanizing area. Remaining populations are vulnerable to secondary effects of urbanization, such as increased predation by house cats and increased vehicular mortality. Most documented occurrences of giant garter snakes in this area of Sacramento County have been adversely impacted by development, including freeway construction, flood control projects, and commercial development.

Giant garter snakes have been documented on or adjacent to sites that will be affected by the proposed action. The snake has been documented at Beach Lake, South Stone Lake, Snodgrass Slough, and along the Cosumnes River corridor, southwest of the refuge project boundary (California Natural Diversity Database 2005). These occurrences make up part of the Sacramento Basin subpopulation. A survey conducted by Dr. Glen Wylie, Biological Resources Division (BRD) of the U.S. Geological Survey, on SLNWR during the summer of 1997 and subsequent informal surveys by refuge staff have failed to document the presence of giant garter snake on the Refuge. However, these surveys were not conducted at a level of intensity sufficient to prove absence. Therefore, the current status of this species within the Refuge boundary and in the action area is unclear. Because the Refuge has little upland refugia, Dr. Wylie concluded that snake populations in the area may have been severely reduced by the prolonged flooding during January 1997, and that snake populations have not had sufficient time to recover. However, the Refuge contains suitable habitat to support the snake and provides the largest remaining parcel of snake habitat in this subpopulation.

### **Valley Elderberry Longhorn Beetle**

The valley elderberry longhorn beetle was federally listed as a threatened species on August 8, 1980 (Service 1980). Critical habitat for the beetle was designated on the same date. Two areas along the lower American River in the Sacramento metropolitan area have been designated as critical habitat for the beetle—one along the American River at Goethe and Ancil Hoffman parks (American River Parkway Zone) about 10 miles upstream from the river's mouth and the second is at the Sacramento Zone, an area about 2 miles upstream from the river's mouth and about 0.5-mile northeast of the river's right-bank (downstream aspect) levee. In addition, an area along Putah Creek in Solano County and an area west of Nimbus Dam along the American River Parkway, Sacramento County are designated as essential habitat in the *Valley Elderberry Longhorn Beetle Recovery Plan* (Service 1984). Each of these areas is known to support large numbers of mature elderberry shrubs with evidence of beetle use.

The beetle depends on its host plant, the elderberry shrub (*Sambucus* spp.). Elderberries are locally common components of the remaining riparian forest and savannah landscapes, and to a lesser extent the mixed chaparral-foothill woodlands, of the Central Valley. Use of elderberry shrubs plants by the beetle, a wood borer, is rarely apparent. Frequently, the only exterior evidence of the shrub's use by

the beetle is an exit hole created by the larva emerging just prior to the pupae stage. Observations of elderberry shrubs along the Cosumnes River and in the Folsom Lake area indicate that larval beetles can be found in elderberry stems with no apparent exit holes; the larvae either succumb prior to constructing an exit hole or are not developed sufficiently to construct one. Larvae appear to be distributed in stems which are one inch or greater in diameter at ground level and can occur within both living and dead stems. The *Valley Elderberry Longhorn Beetle Recovery Plan* (Service 1984) and Barr (1991) further describe the beetle's life history.

Beetle densities are probably naturally low (Service 1984); and it has been suggested, based on the spatial distribution of occupied shrubs (Barr 1991), that the beetle is a poor disperser. Low density and limited dispersal capability result in high vulnerability to the negative effects of habitat fragmentation and the resulting isolation of small sub-populations.

When the beetle was initially listed as threatened, the species was known from less than ten localities along the American and Merced rivers, and Putah Creek. By completion of the *Valley Elderberry Longhorn Beetle Recovery Plan* in 1984, additional species localities had been found along the American River and Putah Creek. The California Natural Diversity Data Base (CNDDB 2005) records 191 occurrences for this species in 23 counties throughout the Central Valley, from a location along the Sacramento River in Shasta County southward to an area along Caliente Creek in Kern County. Although the beetle continues to be threatened by long-term habitat loss and fragmentation due to extensive urbanization and land-use conversions throughout its range, there are relatively new threats as well, including destruction by non-native Argentine ants (*Linepithema humile*), mortality due to pesticide drift, competition due to exotic plant invasions, and the various adverse effects arising from livestock grazing.

Habitat loss has been ranked as the single greatest threat to biodiversity in the United States (Wilcove et al. 1998). In the 1980 final rule to list the beetle as threatened, habitat destruction was cited as the primary factor contributing to the need to federally list the species. As described in the final rule, by the time the species was listed, its habitat had largely disappeared throughout much of its former range, due to such factors as agricultural conversions, levee construction, and stream channelization. The 1984 recovery plan reiterated the primary threats to the beetle as: loss and alteration of habitat by agricultural conversions; grazing; levee construction; stream and river channelization; removal of riparian vegetation; riprapping of shorelines; and recreational, industrial and urban development (Service 1984).

Riparian forests, the primary habitat for the beetle, have been severely depleted throughout the Central Valley over the last two centuries as a result of expansive agricultural and urban development (Katibah 1984; Thompson 1961; Roberts et al. 1977). Since human colonization, these forests have been "... modified with a rapidity and completeness matched in few parts of the United States" (Thompson 1961). As of 1849, the rivers and larger streams of the Central Valley were still largely undisturbed, supporting continuous bands of riparian woodland 4-5 miles in width along some major drainages such as the lower Sacramento River and generally about two miles wide along the lesser streams (Thompson 1961). Most of the riverine floodplains supported riparian vegetation to about the 100-year flood elevation level (Katibah 1984). A large human population influx after 1849, however, resulted in Central Valley riparian habitat being rapidly converted to agriculture and used as a source of wood for fuel and construction over a wide area (Thompson 1961). By 1868, riparian woodland had already been severely impacted in the Central Valley, as evidenced by the following excerpt:

"This fine growth of timber which once graced our river (Sacramento), tempered the atmosphere, and gave protection to the adjoining plains from the sweeping winds, has entirely disappeared - the woodchopper's axe has stripped the river farms of nearly all the hard wood timber, and the owners are now obliged to rely upon the growth of willows for firewood." (Cronise 1868, *in* Thompson 1961).

The clearing of riparian forests for fuel and construction also made this land available for agriculture (Thompson 1977). Natural levees bordering the rivers, once supporting vast tracts of riparian habitat, became prime agricultural land (Thompson 1961, 1977). As agriculture expanded in the Central Valley, needs for increased water supply and flood protection spurred water development and reclamation projects. Artificial levees, river channelization, dam building, water diversion, and heavy groundwater pumping further reduced riparian habitat to small, isolated fragments (Katibah 1984). In recent decades, these riparian areas have continued in decline, as a result of ongoing agricultural conversion as well as urban development and stream channelization. As of 1989, there were over 100 dams within the Central Valley drainage basin and thousands of miles of water delivery canals and streambank flood control projects for irrigation, municipal and industrial water supplies; hydroelectric power; flood control; navigation; and recreation (Frayer et al. 1989). As a result, much of the riparian forests in the Central Valley have dwindled to discontinuous, unconnected narrow strips with widths measurable in feet compared to the former miles.

By some estimates the Sacramento Valley once supported about 775,000-800,000 acres of riparian forest as recently as 1848 (Smith 1977; Katibah 1984). No comparable estimates are available for the San Joaquin Valley. Based on early soil maps, more than 921,000 acres of riparian habitat are estimated to have been present throughout the Central Valley under pre-settlement conditions (Katibah 1984). Another source estimates that of approximately 5.0 million acres of wetlands in the Central Valley in the 1850s, about 1.6 million acres were riparian wetlands (Warner 1985; Frayer et al. 1989).

Based on a CDFG riparian vegetation distribution map, by 1979 there were about 102,000 acres of riparian vegetation remaining in the Central Valley. This represents a decline in acreage of about 89 percent as of 1979 (Katibah 1984). Significant losses were also estimated by Frayer et al. (1989), who reported that woody riparian forests in the Central Valley had declined to 34,600 acres by the mid-1980s (from 65,400 acres in 1939). These studies document the dramatic historic loss trend of riparian habitat in the Central Valley in general. Because elderberry shrubs are a key component of riparian habitat, it is a reasonable conclusion that loss of beetle habitat has been equally as dramatic.

A number of studies have focused on riparian loss along the Sacramento River, which supports some of the densest known populations of the beetle. About 98 percent of the middle Sacramento River's historic riparian vegetation is estimated to have been extirpated by 1977 (California Department of Water Resources, 1979). It has been estimated that native riparian habitat along the Sacramento River from Redding to Colusa decreased from 27,720 acres to 18,360 acres (34 percent) in just two decades from 1952 and 1972 (McGill 1975; Conrad et al. 1977). The average rate of riparian loss on the middle Sacramento River was 430 acres per year during this two-decade period and 410 acres per year from 1972 to 1977. In 1987, riparian areas as large as 180 acres were observed to have been converted to orchards along this river reach (McCarten and Patterson 1987).

There is no comparable information on the historic loss of beetle habitat in non-riparian situations, such as elderberry savanna and other vegetation communities where elderberry occurs (*e.g.*, oak or mixed chaparral-woodland, or grasslands, adjacent to riparian habitat). However, all natural habitats throughout the Central Valley have been heavily impacted within the last 200 years (Thompson 1961) and we can therefore assume that non-riparian beetle habitat also has suffered a widespread decline. This analysis focuses on loss of riparian habitat, because the beetle is primarily dependent upon riparian habitat. Nevertheless, adjacent upland areas are also likely to be important for the species, but this upland habitat typically consist of oak woodland or elderberry savanna bordering willow riparian habitat (Barr 1991). The riparian acreage figures given by Frayer et al. (1989) and Katibah (1984) included the oak woodlands concentrated along major drainages in the Central Valley and therefore probably included lands we would classify as upland habitat for the beetle adjacent to riparian drainages.

Between 1980 and 1995, the human population grew in the Central Valley by approximately 50 percent, while the remainder of California grew by 37 percent. The Central Valley's population totaled

4.7 million by 1999, and it is expected to more than double again by 2040. The American Farmland Trust estimates that by 2040 more than one million cultivated acres will be lost and 2.5 million more put at risk (Ritter 2000) through urbanization related to population growth. The rapidly expanding human population of the Central Valley will likely result in continued pressure on riparian habitat, related elderberry shrubs, and the beetle. As evidence, the SFWO presently receives a number of requests each month for consultation on the beetle under section 7 of the Endangered Species Act.

While habitat loss is clearly a large factor leading to the species decline, other factors may also pose significant long-term threats to the beetle's survival. Only about 20 percent of riparian sites with elderberries observed by Barr (1991) and Collinge et al. (2001) support beetle populations (Barr 1991; Collinge et al. 2001). Jones and Stokes (1988) found that only 65 percent of 4,800 riparian acres on the Sacramento River had evidence of beetle presence. The fact that a large percentage of apparently suitable habitat is unoccupied suggests that the beetle is limited by other factors such as its limited dispersal ability, habitat quality, or habitat fragmentation.

Massive destruction of riparian habitat in central California has clearly resulted in not only a loss of acreage, but severe habitat fragmentation. Fahrig (1997) indicated that habitat fragmentation becomes most important for those habitats that have suffered greater than 80 percent loss. Riparian habitat in the Central Valley, which has experienced greater than 90 percent loss by most estimates, exceeds this criterion. Existing data suggests that beetle populations are affected by such habitat fragmentation. Barr (1991) found that small, isolated habitat remnants were less likely to be occupied by beetles than larger patches, indicating that beetle sub-populations are often extirpated from small remaining habitat fragments. Moreover, Barr (1991) and Collinge et al. (2001) consistently found beetle exit holes occurring in clumps of elderberry bushes rather than isolated bushes, suggesting that isolated shrubs are less viable host habitat for this species.

Habitat fragmentation can be an important factor contributing to a species decline because: (1) it divides a large population into two or more small populations that become more vulnerable to direct loss, inbreeding depression, genetic drift, and other problems associated with small populations; (2) it limits a species potential for dispersal and colonization; and, (3) it makes habitat more vulnerable to outside influences by increasing the edge: interior ratio (Primack 1998).

Small, isolated sub-populations are susceptible to extirpation from random demographic, environmental or genetic events (Shaffer 1981, Lande 1988, Primack 1998). While a large area may support a single large population, the smaller sub-populations that result from habitat fragmentation may not be large enough to persist over the long-term. As a population becomes smaller, it tends to lose genetic variability through genetic drift, leading to inbreeding depression and a lack of adaptive flexibility. Smaller populations also become more vulnerable to random fluctuations in reproductive and mortality rates, and are more likely to be extirpated by random environmental factors.

Species that characteristically have small population sizes, such as large predators or habitat specialists, are more likely to become extinct than species that typically have large populations (Primack 1998). Also, a species with low population density (few individuals per unit area) tends to have only small populations remaining if its habitat is fragmented. Populations of species that naturally occur at lower density become extinct more rapidly than do those of more abundant species (Bolger et al. 1991). The species may be unable to persist within each fragment and thus gradually dies out across the landscape.

The beetle, a specialist on elderberry plants, tends to have small population sizes, and occurs in low densities (Barr 1991; Collinge et al. 2001). Collinge et al. (2001) compared resource use and density of exit holes between the beetle and a related subspecies, the California elderberry longhorn beetle (*Desmocerus californicus californicus*). The valley elderberry longhorn beetle tended to occur in areas with higher elderberry densities, but had lower exit hole densities than the California elderberry longhorn beetle. With extensive riparian habitat loss and fragmentation, these naturally small populations are broken into even smaller, isolated populations. Once a small population has been

extirpated from an isolated habitat patch, the species may be unable to re-colonize this patch. Insects with limited dispersal and colonization abilities may persist better in large habitat patches than small patches because small fragments may be insufficient to maintain viable populations and the insects may be unable to disperse to more suitable habitat (Collinge 1996).

Some studies suggest that the beetle is unable to recolonize drainages where the species has been extirpated, because of its limited dispersal ability (Huxel 2000; Barr 1991; Collinge et al. 2001). Huxel and Collinge (2001) used computer simulations of colonization and extinction patterns for the beetle based on differing dispersal distances and found that the short dispersal simulations best matched the 1997 census data in terms of site occupancy. This suggests that in natural-systems, dispersal recolonization is limited to nearby sites. At spatial scales greater than ten kilometers, such as across drainages, beetle occupancy appears to be strongly influenced by regional extinction and colonization processes, and colonization is constrained by limited dispersal (Collinge et al. 2001).

Except for one occasion, drainages examined by Barr (1991) that were occupied in 1991 remained occupied in 1997 (Collinge et al. 2001). The one exception was Stoney Creek, which was occupied in 1991, but not in 1997. All drainages found by Barr (1991) to be unoccupied in 1991 were also unoccupied in 1997. This data suggests that drainages unoccupied by the beetle remain unoccupied.

In addition, recent evidence indicates that the invasive Argentine ant poses a risk to the long-term survival of the beetle. Surveys along Putah Creek found beetle presence where Argentine ants were not present or had recently colonized, but the beetle was absent from otherwise suitable sites where Argentine ants had become well-established (Huxel 2000). The Argentine ant has already negatively impacted populations of other native arthropod species (Holway 1998; Ward 1987). Predation on eggs, larvae, and pupae are the most likely impacts these ants have on the beetle. In Portugal, Argentine ants have been found to be significant egg predators on the eucalyptus borer, a cerambycid similar to the beetle. Egg predation on the beetle could lead to local extirpations, as indicated by a population viability study suggesting that egg and juvenile mortality are significant factors affecting probability of extinction for the beetle (Huxel and Collinge, 2001). The Argentine ant has been expanding its range throughout California since its introduction around 1907, especially in riparian woodlands associated with perennial streams (Holway 1998; Ward 1987). Huxel (2000) concluded that, given the potential for Argentine ants to spread with the aid of human activities such as movement of plant nursery stock and agricultural products, this species may come to infest most drainages in the Central Valley along the valley floor, where the beetle is found.

Another potential harmful factor for the beetle is direct spraying with pesticides and related pesticide drift. A wide range of such spraying is done to control mosquitoes, crop diseases, and undesirable plants and insects. Although there have been no studies specifically focusing on the direct and indirect effects of pesticides on the beetle, evidence suggest that the species may be adversely affected by some pesticide applications. As of 1980, the prevalent land-use adjacent to riparian habitat in the Sacramento Valley was agriculture, even in regions where agriculture was historically not generally the most common land use (Katibah et al. 1984), therefore the species is likely vulnerable to pesticide contamination from an array of agricultural pesticide application practices. Recent studies of major rivers and streams documented that 96 percent of all fish, 100 percent of all surface water samples, and 33 percent of major aquifers contained one or more pesticides at detectable levels (Gilliom 1999). Pesticides were identified as one of the 15 leading causes of impairment for streams included on the Clean Water Act section 303(d) lists of impaired waters. Because the beetle occurs primarily in riparian habitat, the contamination of rivers and streams likely has affects on this species and its habitat. Pesticides have been identified as one of a number of potential causes of the decline of pollinator species and other insects beneficial to agriculture (Ingraham et al. 1996); therefore, it is likely that the beetle, typically occurring adjacent to agricultural lands, is adversely affected by the use of pesticides.

Also, competition from invasive exotic plants, such as giant reed (*Arundo donax*), negatively affects riparian habitat supporting the beetle. Giant reed, a native of Asia, has become a serious problem in

California riparian habitats, forming dense, homogenous stands essentially devoid of wildlife. Giant reed can grow up to 2.5 inches per day and yield 8.3 tons of oven-dry cane per acre; it also tolerates drought, floods, and extreme temperatures, and is not significantly affected by insects, disease, herbivory, fire, or mechanical disturbance. It has an extensive root system allowing it to resprout rapidly after any disturbance and it easily out-competes native riparian vegetation. Giant reed also introduces a frequent fire cycle into the riparian ecosystem, disrupting natural riparian dynamics and eventually forming homogenous climax communities. Although giant reed has become extensively distributed throughout the Central Valley and along its waterways, the extent to which it has negatively affected elderberries and the beetle is not specifically known.

Another potential factor in the decline of the beetle is the effects of adverse livestock grazing practices, which can result in the destruction of entire elderberry plants and inhibition of elderberry regeneration. Cattle, sheep, and goats readily forage on new elderberry growth, and goats will consume even decadent growth. Well-manicured stands of elderberries, which often occur due to livestock grazing, have generally been shown to have a relative absence of beetles (Service 1984). The effects on the beetle of both grazing and exotic plant invasions are likely significantly exacerbated by the problem of habitat fragmentation of elderberries. Such fragmentation increases the edge: interior ratio of habitat patches, thereby facilitating the adverse effects of these outside influences.

The beetle has been recorded adjacent to the Refuge boundary, along the Cosumnes River corridor (Tom Harvey, pers. comm.). The beetle occurs in elderberry shrubs in riparian habitats and in open savannahs with oaks and cottonwoods. Biannual surveys have been conducted on the elderberries on the Beach Lake Unit, and no exit holes have been confirmed to date. The majority of elderberries on the Refuge (95%) are less than 3 years old and are not of a sufficient size for the beetles. Elderberry shrubs have been introduced on the Refuge in two locations; on the Lewis property and near an abandoned homestead on the North Stone Lake property. To date, the beetle has not been recorded within the Refuge; however, suitable habitat exists within the boundary at the Bufferlands for the Sacramento Regional Wastewater Treatment Plant, at North and South Stone Lakes, and along Snodgrass Slough.

### **Vernal Pool Tadpole Shrimp and Vernal Pool Fairy Shrimp**

The vernal pool tadpole shrimp and vernal pool fairy shrimp were listed as endangered and threatened, respectively, on September 19, 1994 (Service 1994). The final rule to designate critical habitat for 15 vernal pool species, including two crustaceans, was published on August 6, 2003 (Service 2003), with further clarifications on critical habitat designations for listed vernal pool species published in an August 11, 2005, final rule (Service 2005). Further information on the life history and ecology of the vernal pool fairy shrimp and vernal pool tadpole shrimp may be found in the final listing rule, the final rule to designate critical habitat, Eng et al. (1990), Helm (1998), and Simovich et al. (1992), and the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Service 2005). Critical habitat for vernal pool crustaceans is not present on the Refuge.

The vernal pool tadpole shrimp has dorsal compound eyes, an approximately one-inch long large shield-like carapace that covers most of its body, and a pair of long cercopods at the end of its last abdominal segment (Linder 1952; Longhurst 1955; Pennak 1989). It is primarily a benthic animal that swims with its legs down. Vernal pool tadpole shrimp climb or scramble over objects, and plow along bottom sediments as they forage for food. Its diet consists of organic detritus and living organisms, such as fairy shrimp and other invertebrates (Pennak 1989; Fryer 1987). The females deposit their eggs on vegetation and other objects on the pool bottom. Tadpole shrimp eggs are known as cysts, and during the dry months of the year, they lie dormant in the dry pool sediments (Lanaway 1974; Ahl 1991).

The life history of the vernal pool tadpole shrimp is linked to the environmental characteristics of its vernal pool habitat. After winter rains fill the pools, its dormant cysts may hatch in as little as four days (Ahl 1991, Rogers 2001), and the animals may become sexually mature within three to four weeks

after hatching (Ahl 1991; Helm 1998; King 1996). A portion of the cysts hatch immediately and the rest remain dormant in the soil to hatch during later rainy seasons (Ahl 1991). The vernal pool tadpole shrimp is a relatively long-lived species (Ahl 1991), and will generally survive for as long as its habitat remains inundated, sometimes for six months or more (Ahl 1991; Gallagher 1996; Helm 1998). Adults are often present and reproductive until the pools dry up in the spring (Ahl 1991; Gallagher 1996; Simovich et al. 1992).

Vernal pool tadpole shrimp are found only in ephemeral freshwater habitats, including alkaline pools, clay flats, vernal lakes, vernal pools, vernal swales, and other seasonal wetlands in California (Helm 1998). The vernal pool tadpole shrimp is known from 221 occurrences in the Central Valley (CNDDDB 2005), ranging from east of Redding in Shasta County south to Fresno County, and from a single vernal pool complex located in the San Francisco Bay National Wildlife Refuge in Alameda County. It inhabits vernal pools containing clear to highly turbid water, ranging in size from 54 square feet in the Mather Air Force Base area of Sacramento County, to the 89-acre Olcott Lake at Jepson Prairie in Solano County; the potential ponding depth of occupied habitat ranges from 1.5 inches to 59 inches. Although vernal pool tadpole shrimp are found on a variety of geologic formations and soil types, Helm (1998) found that over 50 percent of vernal pool tadpole shrimp occurrences were on High Terrace landforms and Redding and Corning soils. Vernal pool tadpole shrimp are uncommon even where vernal pool habitat occurs (Service 2005). The largest concentration of vernal pool tadpole shrimp occurrences are found in the Southeastern Sacramento Valley Vernal Pool Region, as defined in the Service's *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (2005). In this vernal pool region, this species occurs on a number of public and private lands in Sacramento County, and from a few locations in Yuba and Placer Counties, including Beale Air Force Base.

Vernal pool fairy shrimp have delicate elongate bodies, large stalked compound eyes, no carapace, and 11 pairs of phyllopods, or gill-like structures that also serve as legs. Typically less than one-inch long, they swim or glide gracefully upside-down by means of complex, wavelike beating movements. Fairy shrimp feed on algae, bacteria, protozoa, rotifers, and detritus. The second pair of antennae in adult male fairy shrimp are greatly enlarged and specialized for clasping the females during copulation. The females carry eggs in an oval or elongate ventral brood sac. The eggs are either dropped to the pool bottom or remain in the brood sac until the female dies and sinks. The dormant cysts are capable of withstanding heat, cold, and prolonged desiccation, and they can remain viable in the soil for decades after deposition. When the pools refill in the same or subsequent seasons, some, but not all, of the cysts may hatch. The cyst bank in the soil may therefore be comprised of cysts from several years of breeding (Donald 1983). The early stages of the fairy shrimp develop rapidly into adults and may become sexually mature within two weeks after hatching (Gallagher 1996; Helm 1998). Such quick maturation permits populations to persist in short-lived shallow bodies of water (Simovich et al. 1992). In pools that persist for several weeks to a few months, fairy shrimp may have multiple hatches during a single season (Helm 1998; Gallagher 1996).

Vernal pool fairy shrimp are found only in ephemeral freshwater habitats, including alkaline pools, ephemeral drainages, rock outcrop pools, vernal pools, and vernal swales in California and Southern Oregon (Eriksen and Belk 1999). Occupied habitats range in size from rock outcrop pools as small as 11 square feet to large vernal pools up to 12 acres; the potential ponding depth of occupied habitat ranges from 1.2 inches to 48 inches.

The vernal pool fairy shrimp is known from 372 occurrences extending from the Stillwater Plain in Shasta County through most of the length of the Central Valley to Pinnacles in San Benito County (Eng et al. 1990; Fugate 1992; Sugnet and Associates 1993; CNDDDB 2005). Five additional, disjunct populations exist: one near Soda Lake in San Luis Obispo County; one in the mountain grasslands of northern Santa Barbara County; one on the Santa Rosa Plateau in Riverside County; one near Rancho California in Riverside County; and one on the Agate Desert near Medford, Oregon (CNDDDB 2005; Helm 1998; Eriksen and Belk 1999; Service 2003). Three of these isolated populations each contain only a single pool known to be occupied by the vernal pool fairy shrimp. Although the vernal pool

fairy shrimp is distributed more widely than most other fairy shrimp species, it is generally uncommon throughout its range and rarely abundant where it does occur (Eng et al. 1990; Eriksen and Belk 1999). The greatest number occurrences of the vernal pool fairy shrimp are in the Southeastern Sacramento Vernal Pool Region (Service 2005), where it is found in scattered vernal pool habitats in Placer, Sacramento, and San Joaquin Counties, in the vicinity of Beale Air Force Base in Yuba County, and at a single location in El Dorado County.

Although the vernal pool fairy shrimp and the vernal pool tadpole shrimp are not often found in the same vernal pool at the same time, when coexistence does occur, it is generally in deeper, longer lived pools (Eng et al. 1990; Thiery 1991; Gallagher 1996). In larger pools, vernal pool crustacean species may be able to coexist by utilizing different physical portions of the vernal pool or by eating different food sources (Daborn 1978; Mura 1991; Thiery 1991), or by hatching at different temperatures or developing at different rates (Thiery 1991; Hathaway and Simovich 1996).

The primary historic large-scale dispersal method for the vernal pool tadpole shrimp and vernal pool fairy shrimp likely was large scale flooding resulting from winter and spring rains which allowed colonization of different individual vernal pools and other vernal pool complexes (King 1996). This dispersal is currently non-functional due to 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 may now be the primary dispersal agents for vernal pool tadpole shrimp and vernal pool fairy shrimp (King 1996; Simovich et al. 1992). The eggs of these branchiopods are either ingested (Krapu 1974; Swanson et al. 1974; Driver 1981; Ahl 1991) and/or adhere to the legs and feathers where they are transported to new habitats. Cysts may also be dispersed by a number of other species, such as cattle and humans (Eriksen and Belk 1999).

At the local level, vernal pool crustaceans are often dispersed from one pool to another through surface swales that connect one vernal pool to another. These dispersal events allow for genetic exchange between pools and create a population of animals that extends beyond the boundaries of a single pool. These dispersal events also allow vernal pool crustaceans to move into pools with a range of sizes and depths. In dry years, vernal pool crustaceans may only hatch in the largest and deepest pools. In wet years, vernal pool crustaceans may be present in all pools. The movement of vernal pool crustaceans into vernal pools of different sizes and depths allows these species to survive the environmental variability that is characteristic of their habitats.

The genetic characteristics of these species, as well as ecological conditions, such as watershed continuity, indicate that populations of vernal pool crustaceans are defined by pool complexes rather than by individual vernal pools (Fugate 1992). Therefore, the most accurate indication of the distribution and abundance of these species is the number of inhabited vernal pool complexes. The pools and, in some cases, pool complexes supporting these species may be small. Human-caused and unforeseen natural catastrophic events such as long-term drought, non-native predators, off-road vehicles, pollution, berming, and urban development, threaten their extirpation at some sites. Vernal pool fairy shrimp and vernal pool tadpole shrimp continue to be threatened by all of the factors which led to the original listing of this species, primarily habitat loss through agricultural conversion and urbanization (Service 2005).

The vernal pool tadpole shrimp and vernal pool fairy shrimp are imperiled by a variety of human-caused activities. Their habitats have been lost through direct destruction and modification due to filling, grading, disking, leveling, and other activities. In addition, vernal pools have been imperiled by a variety of anthropogenic modifications to upland habitats and watersheds. These activities, primarily urban development, water supply/flood control projects, land conversion for agriculture, off-road vehicle use, certain mosquito abatement measures, and pesticide/herbicide use can lead to disturbance of natural flood regimes, changes in water table depth, alterations of the timing and duration of vernal pool inundation, introduction of non-native plants and animals, and water pollution. These can result in adverse effects to vernal pool species. In addition to direct loss, the habitats of the vernal pool tadpole

shrimp and the vernal pool fairy shrimp have been and continue to be highly fragmented throughout their ranges due to conversion of natural habitat for urban and agricultural uses. Fragmentation results in smaller isolated shrimp populations. Ecological theory predicts that such populations will be highly susceptible to extirpation due to chance events, inbreeding depression, or additional environmental disturbance (Gilpin and Soulé 1988; Goodman 1987a, 1987b). If an extirpation event occurs in a population that has been fragmented, the opportunities for re-colonization would be greatly reduced due to geographic isolation from other source populations.

Historically, vernal pools and vernal pool complexes occurred extensively throughout the Sacramento Valley of California. However, conversion of vernal pools and vernal pool complexes has resulted in a 91 percent loss of vernal pool resources in California (State of California 2003d). By 1973, between 60 and 85 percent of the area within the Central Valley that once supported vernal pools had been destroyed (Holland 1978). In subsequent years, threats to this habitat type have continued and resulted in a substantial amount of vernal pool habitat being converted for human uses in spite of Federal regulations implemented to protect wetlands. The U.S. Army Corps of Engineers (Corps) Sacramento District has several thousand vernal pools under its jurisdiction (Coe 1988), which includes most of the known populations of these listed species. Between 1987 and 1992, 467 acres of wetlands within the Sacramento area were filled pursuant to the Corps' Nationwide Permit 26 (Service 1992). A majority of those wetland losses involved vernal pools, the endemic habitat of the vernal pool tadpole shrimp and the vernal pool fairy shrimp. King (1996) has estimated that approximately 15 to 33 percent of the original biodiversity of Central Valley vernal pool crustaceans has been lost since the 1800s. It is estimated that within 20 years human activities will destroy 60 to 70 percent of the remaining vernal pools (Coe 1988).

Sacramento County represents important, high quality habitat for the vernal pool tadpole shrimp and vernal pool fairy shrimp by providing large, nearly contiguous areas of relatively undisturbed vernal pool habitat. Sacramento County contains the greatest number of occurrences of vernal pool tadpole shrimp and also is one of the two counties with the greatest number of occurrences of vernal pool fairy shrimp. Sacramento County contains 60 (16 percent) out of the total of 372 reported occurrences of vernal pool fairy shrimp, and 60 (27 percent) out of the total of 221 reported occurrences of vernal pool tadpole shrimp (CNDDDB 2005). Sugnet and Associates (1993) reported that of 3,092 "discrete populations" checked, only 345 locations, or about 11 percent of all locations checked, were found to support the vernal pool tadpole shrimp. Of these 345 locations supporting the vernal pool tadpole shrimp, 219 (63 percent) were in Sacramento County. Further, of the 3,092 locations checked, 178 locations (6 percent) were found to support the vernal pool fairy shrimp. Of this total, 63 locations (35 percent) were within Sacramento County.

Throughout the Central Valley, approximately 13,000 acres of vernal pool habitats, including mitigation banks, have been set aside for the vernal pool fairy shrimp specifically as terms and conditions of section 7 consultations (Service 2005). In the Southeastern Sacramento Valley Vernal Pool Region, vernal pool fairy shrimp occurrences are protected from development at a number of private mitigation areas, compensation banks, private ranches with conservation easements, and the Beale Air Force Base in Yuba County. Very few actions have been taken specifically to benefit the vernal pool tadpole shrimp, although several Habitat Conservation Plans are developing vernal pool conservation plans in the region, including Sacramento and Placer Counties (Service 2005).

The vernal pool tadpole shrimp and vernal pool fairy shrimp are imperiled by a variety of human-caused activities. Their habitats have been lost through direct destruction and modification due to filling, grading, disking, leveling, and other activities. In addition, vernal pools have been imperiled by a variety of anthropogenic modifications to upland habitats and watersheds. These activities, primarily urban development, water supply/flood control projects, land conversion for agriculture, off-road vehicle use, certain mosquito abatement measures, and pesticide/herbicide use, can lead to disturbance of natural flood regimes, changes in water table depth, alterations of the timing and duration of vernal pool inundation, introduction of non-native plants and animals, and water pollution. These indirect

effects can result in adverse effects to vernal pool species.

The actions listed above have resulted in both direct and indirect impacts to vernal pools within the region, and have contributed to the loss of vernal pool tadpole shrimp and vernal pool fairy shrimp populations. Although a reduction of the two shrimp populations has not been quantified, the acreage of lost habitat continues to grow. On-going residential and commercial developments within the Sacramento County also affect the listed vernal pool crustaceans and their habitats. Human population growth in Sacramento County has steadily increased. For the period between 1990 and 2000, population growth in Sacramento County increased 17.5 percent, with an average annual growth rate of 17.5 percent ([State of California 2002](#)). This annual growth appears to be increasing, as demonstrated by the 2.63 percent and 2.2 percent increases in population growth in 2001 and 2002, respectively ([State of California 2003, 2003b](#)). Increased housing demand and urban development accompany the population growth in Sacramento County. Between 1990 and 2000, housing units in Sacramento County increased by 1.37 percent annually ([State of California 2000, 2003c](#)). Population growth and concomitant housing demand and subsequent vernal pool resource development are projected to continue. Population projections for Sacramento County are expected to increase above 2000 levels by 19.7 percent in 2010, by 28 percent in 2015, and by 37.5 percent in 2020 ([State of California 2001](#)).

A number of State, local, private, and unrelated Federal actions have occurred within the project area and adjacent region affecting the environmental baseline of these species. Some of these projects have been subject to prior section 7 consultation. Based on an informal review, the Service has issued approximately 177 biological opinions to Federal agencies on proposed projects in Sacramento County that have adversely affected the shrimp species since the two species were proposed to be listed in 1994. This total does not reflect the formal consultations that were withdrawn, those that were suspended, and those that have insufficient information to conclude an effects analysis, those that were amended, or ones that the Service issued a conference opinion. No State of California actions that have taken place within Sacramento County have adversely affected the species in the action area. Although these proposed projects in Sacramento County have eliminated vernal pools and vernal pool complexes, the associated conservation measures are designed to minimize the effects of proposed projects to these species. Thus, the trend for the two vernal pool crustaceans within Sacramento County is most likely downward.

Of the 136.5 acres of vernal pools that exist on Refuge managed lands, 16.5 acres, (12%) of vernal pools on the Refuge are naturally occurring pools, the rest are man-made mitigation pools (88%). The Wetland Preserve Unit, formerly known as AKT, contains 133.5 acres or 98% of vernal pools, and is managed under a conservation easement (SFWO file number 1-1-99-F-0118). This easement has periodically been surveyed (as required in the biological opinion) for vernal pool and other species for ten years, and vernal pool tadpole shrimp and vernal pool fairy shrimp have been documented within the easement area. Vernal pool fairy shrimp and vernal pool tadpole shrimp have also been documented in swales on the north Stone Lakes Unit. However, vernal pool crustaceans and other vernal pools species could potentially occur in any of the vernal pools, sloughs, or other passive seasonal wetlands managed by the Refuge.

## **Effects of the Proposed Action**

### **Giant garter snake**

Refuge activities, particularly construction activities (e.g., facilities construction and maintenance, habitat restoration), occurring in giant garter snake habitat may disturb, harass, injure, or kill giant garter snakes. Construction activities may remove vegetative cover and basking sites, fill or crush burrows, and decrease the prey base. Temporary dewatering of portions of canals or fields may temporarily remove giant garter snake habitat and may obstruct movement. Snakes may be killed or

injured by construction equipment or other vehicles accessing the construction site. Disturbance from construction activities may also cause snakes to temporarily move into areas of unsuitable habitat where they may be more prone to higher rates of mortality from predation. Snakes may also be killed or injured by refuge, research, and visitor vehicles. Although operations and maintenance activities have the potential to harm individual giant garter snakes and cause short-term habitat alteration, there are long-term benefits to giant garter snakes due to increasing wetland acreage and riparian habitat and maintaining canals and wetlands.

Recreational activities, such as fishing and hunting, may disturb snakes and disrupt basking and foraging activities. Increased vehicle use in giant garter snake habitat may harass, injure, or kill giant garter snakes. Vehicles will be used primarily on existing roads; therefore, harassment, injury, or mortality from vehicle use would occur only if snakes are in the roadway. Regarding the effects of the proposed use of pesticides, a Service-sponsored study indicated that the short-term effects of adulticides approved for mosquito control on the Refuge did not significantly reduce abundance or biomass of the snake's prey items, macro-invertebrates and fish, in treated wetlands (Lawler *et al.* 1997). However, no information is available on the toxicity of pesticides directly to the giant garter snake. Without further information, it must be assumed that exposure of giant garter snakes to these chemicals could result in direct impacts, such as lethal or sub lethal effects to individual animals.

### **Valley elderberry longhorn beetle**

The beetle has not been documented on the Refuge; however, it has been found adjacent to the refuge boundary along the Cosumnes River corridor and may be present in elderberry shrubs within the refuge boundary. The beetle and its habitat, the elderberry shrubs, may be affected by the proposed herbicides or pesticides if the chemicals come in contact with elderberry shrubs either by direct or indirect (drift, treated water inundation) contact.

Though there are no documented occurrences of the beetle on the Refuge, however elderberry bushes are present. All existing elderberry shrubs are mapped and avoided during application of herbicides intended to control invasive weeds. The number of elderberry shrubs on the Refuge is small and relatively easy to avoid during the proposed pest management activities. The Refuge has planted and/or maintained over 75 blue elderberries that may provide habitat for the Valley elderberry longhorn beetle. Plans for the Headquarters Unit include approximately 50 additional elderberry plants.

Management and restoration of riparian areas on the Refuge are expected to benefit the valley elderberry longhorn beetle. The SFWO expects that Refuge staff may remove or transplant a small number of shrubs. However, the Refuge has proposed to implement all guidelines listed in the Service's July 1999, *Conservation Guidelines for the Valley Elderberry Longhorn Beetle*, therefore, potential adverse effects to the beetle and elderberry shrubs will be minimized. Trimming of elderberry shrubs that interfere with road and utility easements will be limited to the dormant period for the beetle whenever possible, thus minimizing the potential for take of the beetle.

### **Vernal pool fairy shrimp and vernal pool tadpole shrimp**

Vernal pool fairy shrimp and vernal pool tadpole shrimp may be harmed, harassed, injured, or killed during surveys, monitoring, and management activities of vernal pool habitat. However, adherence to survey guidelines for vernal pool crustaceans will minimize the effects of surveys and monitoring activities on vernal pool crustaceans. The Refuge expects that information on presence and distribution of vernal pool crustaceans will assist the Refuge in improving management of vernal pool habitats.

Management of vernal pools using prescribed fire and grazing is expected to benefit vernal pool

habitat by controlling proliferation of exotic plants. However, the effect of fire and grazing on vernal pool crustaceans is poorly known. It is expected that the use of fire and grazing may result in some disturbance and loss of cysts while benefiting and improving the long-term viability of vernal pool communities.

### **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. Our agency is aware of other projects currently under review by State, county, and local authorities where biological surveys have documented the occurrence of several listed species covered by this opinion. Projects under review include such actions as urban expansion, road improvement projects, water transfers that may not have a Federal nexus, and continued agricultural development. The cumulative effects of these known actions could pose a threat to the eventual recovery of the giant garter snake, valley elderberry longhorn beetle, and the vernal pool crustaceans.

An undetermined number of future land use conversions and routine agricultural practices are not subject to Federal permitting processes and may alter habitat or increase incidental take of giant garter snakes, valley elderberry longhorn beetles, vernal pool fairy shrimp, and vernal pool tadpole shrimp. These additional cumulative effects include 1) fluctuations in acres of aquatic habitat due to water management or acres of rice lands in production, 2) levee repairs, 3) dredging and clearing vegetation from irrigation canals, 4) mowing and clearing vegetation adjacent to canals and streams, 5) increased vehicular traffic on roads and levees, and 6) use of burrow fumigants.

The vernal pool habitat for the vernal pool tadpole shrimp and vernal pool fairy shrimp also has been and continues to be increasingly fragmented throughout their ranges by conversion of natural habitat to urban, industrial, commercial, and agricultural uses. For all of these species, fragmentation results in small isolated populations. Ecological theory predicts that such populations will be highly susceptible to extirpation due to chance events, inbreeding depression, or additional environmental disturbance (Gilpin and Soule 1988, Goodman 1987a, b). Should an extirpation event occur in a population that has been fragmented, the opportunities for recolonization would be greatly reduced due to physical (geographical) isolation from other (source) populations.

### **Conclusion**

After reviewing the current status of the following species; giant garter snake, valley elderberry longhorn beetle, vernal pool fairy shrimp, and vernal pool tadpole shrimp; the environmental baseline for the action area; the effects of Refuge management activities; and the cumulative effects, it is the Service's biological opinion that Refuge management activities, as proposed, are not likely to jeopardize the continued existence of the above species. Critical habitat for the valley elderberry longhorn beetle has been designated in two areas in Sacramento County, California; however, this action does not affect those areas and, therefore, no destruction or adverse modification of its critical habitat is anticipated. Critical habitat for vernal pool fairy shrimp and vernal pool tadpole shrimp has been designated, but does not include the Refuge. No critical habitat has been designated for the remaining species; therefore, none will be affected.

### **INCIDENTAL TAKE STATEMENT**

Section 9(a)(1) of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened fish and wildlife 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 that is 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 non-discretionary, and must be implemented by the agency so that they become binding conditions of any grant or permit issued to an applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The Refuge has a continuing duty to regulate activities covered by this incidental take statement. If the Refuge (1) fails to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to any contract, agreement, or special use permit granted by the Refuge, 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**

#### **Giant garter snake**

The SFWO anticipates incidental take of giant garter snakes will be difficult to detect or quantify for the following reasons: giant garter snakes are cryptically colored, secretive, and known to be sensitive to human activities. Snakes may avoid detection by retreating to burrows, soil crevices, vegetation, and other cover. Individual snakes are difficult to detect unless they are observed, undisturbed, at a distance. Most close-range observations represent chance encounters that are difficult to predict. It is not possible to make an accurate estimate of the number of snakes that would be harassed or harmed by Refuge operational activities described in the CCP. In instances when take is difficult to detect, the Service may estimate take in numbers of species per acre of habitat lost or degraded as a result of the action. Considering all permanent water sources (water that persists through summer) with a buffer of 200 feet, the result is 2,069 acres of potential habitat. Permanent water sources include, lakes, sloughs, perennial marsh, managed permanent wetlands. Therefore, the Service anticipates that all snakes within the 2,069 acre area may be subject to harassment and harm as a result of implementation of the CCP. The SFWO anticipates that, while some take of giant garter snake may occur, the long-term results of the proposed management and restoration activities will benefit the snake and its habitat.

#### **Valley elderberry longhorn beetle**

The SFWO is unable to quantify incidental take of the beetle, because the potential number of beetle larvae contained within each elderberry bush is unknown. Because it is not known how many larvae each stem can support, the SFWO must quantify the amount of incidental take of the beetle in terms of the number of plants and stems that would be lost. The SFWO anticipates that the amount of take for the beetle would be small due to the small number of elderberry shrubs on the Refuge and the proposed conservation measures for the species. Therefore, the SFWO anticipates that all beetles inhabiting not more than one elderberry plant with at least one stem measuring 1.0 inch or greater in diameter at ground level will be taken annually through harm, harassment, or killing. The SFWO also anticipates that, while some take of the beetle may occur, the long-term results of the proposed management and restoration activities will benefit the beetle and its habitat, including the planting of over 50 elderberry shrubs during riparian restoration projects.

#### **Vernal pool crustaceans**

The SFWO expects that incidental take of the vernal pool tadpole shrimp and vernal pool fairy shrimp will be difficult to detect or quantify for the following reasons: the aquatic nature of the organisms and their very small body size make the finding of a dead specimen unlikely; losses may be masked by seasonal fluctuations in numbers or other causes; and the species occur in habitat that makes them difficult to detect. Due to the difficulty in quantifying the number of vernal pool crustaceans that will be taken as a result of implementation of the CCP, the SFWO is quantifying take incidental to the project as the number of acres of habitat that will be impacted as a result of the action. The SFWO anticipates that during the fifteen year life span of the management plan, take of vernal pool crustaceans may result from Refuge activities on a maximum of two acres of vernal pools and seasonal swales on the North Stone Lake property. However, due to the relatively minimal impacts of the proposed activities and the implementation of proposed conservation measures, the SFWO anticipates that relatively few vernal pool crustaceans and their cysts within these two acres will be killed, harmed, or disturbed by the proposed actions. The SFWO also anticipates that, while some take of vernal pool crustaceans will occur, the long-term results of the proposed management and restoration activities will benefit vernal pool crustaceans and their habitat.

### **Effect of the Take**

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the listed wildlife species or destruction or adverse modification of critical habitat.

### **Reasonable and Prudent Measures**

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the impact of take on listed species:

1. Assess over time the effects of management, operations, and maintenance on listed species.
2. Design/ incorporate/ follow measures that reduce or eliminate impacts to listed species.

### **Terms and Conditions**

To be exempt from the prohibitions of section 9 of the Act, the Refuge must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

1. The following term and condition implements reasonable and prudent measure number one (Assess the effects of the proposed action on the listed species):

Develop baseline information for the listed species addressed in this opinion. Information shall include, but is not limited to, acreage of occupied and potential habitat for each listed species occurring on the Refuge, distribution of habitat, and current status of the species. Update the baseline for each listed species when changes occur.

2. The following term and condition implements reasonable and prudent measure number two (Design/ incorporate/ follow measures that reduce or eliminate impacts to listed species):

The Refuge shall implement all conservation measures described on pages 13 through 16 of this biological opinion.

### **Review Requirements**

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize incidental take that might otherwise result from the proposed action. With implementation

of these measures, the Service believes that incidental take will not exceed for each covered species the amount discussed in the previous section - Amount or Extent of Take. If, during the course of the action, this minimized level of incidental take is exceeded, such incidental take would represent new information requiring review of the reasonable and prudent measures provided. The Refuge must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

### **Reporting Requirements**

Refuge staff shall forward copies of all research, surveys, or monitoring results on the refuge for listed species addressed by this consultation to the SFWO.

The Sacramento Fish and Wildlife Office is to be notified within three working days of the finding of any dead listed wildlife species or any unanticipated harm to the species addressed in this biological opinion. The Service contact person for this is the Chief, Endangered Species Division at (916) 414-6600.

### **CONSERVATION RECOMMENDATIONS**

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities 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 and data bases.

1. Controlled grazing by goats (*Capra hircus*) may be used as a method to control the target species and thatch on SLNWR particularly within the buffer zones for vernal pools and swales.
2. As recommended in the preliminary draft recovery plan for the giant garter snake, conservation measures that could be undertaken by the Refuge include: (1) incorporate giant garter snake considerations into Refuge management guidelines, (2) build refugia for giant garter snakes that is protected from flooding, (3) expand giant garter snake habitat on the Refuge (Giant Garter Snake Recovery Plan, Recovery Task 1.3.5), and (4) conducting periodic surveys on the Refuge for the giant garter snake.
3. As recommended in the recovery plan for the valley elderberry longhorn beetle, conservation measures that could be undertaken by the Refuge include: (1) conducting periodic surveys within the Refuge for the beetle (Recovery Task 2), and (2) removal of exotic trees or shrubs such as Chinese tree-of-heaven (*Ailanthus altissima*), black locust (*Robinia pseudoacacia*), and scotch broom (*Cytisus scoparius*) that may compete with elderberry (Recovery Task 113). Currently tree-of-heaven and scotch broom are not known to occur on the Refuge, however; any plants that are discovered in the future should be removed. Other invasive species which may be a problem for the beetle and its habitat and should be removed when they are found include scarlet wisteria (*Sesbania punicea*), giant reed (*Arundo donax*), and pampas grass (*Cortaderia selloana*).
4. For vernal pool crustaceans, restoration of vernal pool habitat within the Refuge is encouraged to benefit the vernal pool fairy shrimp and vernal pool tadpole shrimp.

The SFWO requests notification of the implementation of any conservation recommendations.

## REINITIATION--CLOSING STATEMENT

This concludes formal consultation on the action(s) outlined in your request. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (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 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 cease pending reinitiation.

Please contact Mary Hammer or Holly Herod of this office at (916) 414-6645 if you have any questions. If you have any questions regarding environmental contaminants, contact Tom Maurer at (916) 414-6590.

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