

**Delta Green Ground Beetle
(*Elaphrus viridis*)**

**5-Year Review:
Summary and Evaluation**



Photo: Dr. Richard Arnold

**U.S. Fish and Wildlife Service
Sacramento Fish and Wildlife Field Office
Sacramento, California**

January 2009

5-YEAR REVIEW

Species reviewed: Delta Green Ground Beetle (*Elaphrus viridis*)

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5-YEAR REVIEW

Delta Green Ground Beetle (*Elaphrus viridis*)

I. GENERAL INFORMATION

I.A. Species Overview: The delta green ground beetle (*Elaphrus viridis*) is a member of the ground beetle family (Carabidae) in the order Coleoptera. As summarized in our Recovery Plan, the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Recovery Plan) (U.S. Fish and Wildlife Service [USFWS] 2005), the beetle was known only from a single museum specimen until the species was rediscovered in the wild in 1974, at the Jepson Prairie in Solano County, California. The beetle is about 0.25 inch long and colored in brilliant metallic green and bronze. Much about its life cycle and habitat affinities remains unknown. It is believed that adults emerge from diapause (a period of dormancy or delayed development) and females lay their eggs in early winter, and then the species disappears from view until active adults reappear the following winter. It is also believed that, as vernal pool habitats become dry, the beetle larvae crawl into cracks in the soil, and survive the hot, dry summer and fall as diapausing pupae. The beetle is typically found along the margins of vernal pools and in bare areas along trails and roadsides, where individuals often hide in cracks in the mud and under low-growing vegetation.

I.B. Methodology used to complete the review: Staff of the Sacramento Fish and Wildlife Office (SFWO) prepared this review using information from species survey and monitoring reports, the Recovery Plan (USFWS 2005), documents generated as part of section 7 and section 10 consultations, and unpublished technical reports and grant proposals. Recognized delta green ground beetle experts and land managers were interviewed for their knowledge and suggestions for future recommendations to assist the beetle's recovery within the next 5 years. Spatial analysis was performed by the Geographic Information System (GIS) staff at the Sacramento Fish and Wildlife Office. Survey data, the Recovery Plan, and personal communications with entomologists and land managers were our primary sources of information used to update the species status and threats sections of this review.

I.C. Contacts

Lead Regional Office – Diane Elam, Deputy Division Chief for Listing, Recovery, and Habitat Conservation Planning, and Jenness McBride, Fish and Wildlife Biologist, Region 8 (California and Nevada); 916-414-6464

Lead Field Office – Kirsten Tarp, Recovery Branch, Sacramento Fish and Wildlife Office, 916-414-6600

I.D. Background

I.D.1. FR Notice citation announcing initiation of this review:
71 FR 14538 14542, March 22, 2006

I.D.2. Listing history

Original Listing

FR notice: 45 FR 52807

Date listed: August 8, 1980

Entity listed: *Elaphrus viridis*, an insect species

Classification: Threatened

I.D.3. Associated rulemakings: The original proposal for listing of the delta green ground beetle was published on August 10, 1978 (43 FR 35636-43) and contained supplementary information describing critical habitat. However, the information concerning critical habitat was withdrawn by the USFWS on March 6, 1979 (44 FR 12384-84) following the 1978 amendment to the Endangered Species Act. Critical habitat was re-proposed on May 2, 1980 by the USFWS (45 FR 29371-73) to comply with newly promulgated rules regarding designation of critical habitat (45 FR 13021). The delta green ground beetle was listed as a threatened species with designated critical habitat on August 8, 1980 (45 FR 52807).

I.D.4. Review History: No previous 5-year reviews have been conducted for this species.

I.D.5. Species' Recovery Priority Number at start of review: 8 (species having a moderate level of threats and a high potential for recovery without substantial conflicts with development and economic issues). The threat level for the delta green ground beetle is somewhat moderated by the majority of known occurrences being located within preserves, conservation easements, and conservation banks.

I.D.6. Recovery Plan or Outline

Name of plan: *Vernal Pool Ecosystems of California and Southern Oregon*.

Date issued: December 2005

Dates of previous revisions: September 1985

The original recovery plan (USFWS 1985) was written for the recovery of two co-occurring species, the delta green ground beetle and the endangered Solano grass (*Tuctoria mucronata*). In 2005, both of these species were included as community members in the vernal pool ecosystem recovery plan, which revised recovery criteria and threats for each of the species.

II. REVIEW ANALYSIS

II.A. Application of the 1996 Distinct Population Segment (DPS) policy

The Endangered Species Act defines species as including any subspecies of fish or wildlife or plants and any distinct population segment of any species of vertebrate

wildlife. This definition limits listings as DPSs only to vertebrate species of fish and wildlife. Because the delta green ground beetle is an insect (an invertebrate) and the DPS policy is not applicable, the application of the DPS policy to the species listing is not addressed further in this review.

II.B. Recovery Criteria

II.B.1. Does the species have a final, approved recovery plan containing objective, measurable criteria?

Yes
 No

II.B.2. Adequacy of recovery criteria.

II.B.2.a. Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?

Yes
 No

II.B.2.b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

Yes
 No

II.B.3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information. For threats-related recovery criteria, please note which of the 5 listing factors* are addressed by that criterion. If any of the 5 listing factors are not relevant to this species, please note that here.

General recovery criteria for the delta green ground beetle and 19 other listed plants and animals are described in the 2005 Recovery Plan. This Recovery Plan uses an ecosystem-level approach because many of the listed species and species of concern addressed in the plan co-occur in the same natural ecosystem and share the same threats. The over-arching recovery strategy for species covered by the Recovery Plan is habitat protection and management. The Recovery Plan's recovery criteria address the major listing factor for the delta green ground beetle,

*A) Present or threatened destruction, modification or curtailment of its habitat or range;
B) Overutilization for commercial, recreational, scientific, or educational purposes;
C) Disease or predation;
D) Inadequacy of existing regulatory mechanisms;
E) Other natural or manmade factors affecting its continued existence.

Factor A (present or threatened destruction, modification, or curtailment of its habitat or range). Factor B, overutilization for commercial recreational, scientific, or education purposes, and Factor E, other man-made or natural factors affecting its continued existence, were not included as threats in the listing rule, but are addressed in the Recovery Plan due to information gained subsequent to listing of the species.

The Recovery Plan describes the geographic distribution of vernal pool taxa according to the vernal pool regions defined by the California Department of Fish and Game (CDFG) (Keeler-Wolf et al. 1998). Vernal pool regions are discrete geographic regions identified largely on the basis of endemic species, with soils and geomorphology as secondary elements. Within the vernal pool regions, the Recovery Plan identifies core areas that support high concentrations of federally listed vernal pool species, are representative of a given species' range, and are generally where recovery actions are focused. Core areas are distinct areas that provide the features, populations, and distinct geographic and/or genetic diversity necessary to the recovery of a species. More than one federally listed vernal pool species may be found within a single core area, and the core areas encompass areas larger than just the location of any single species. Within each core area, the Recovery Plan identifies specific percentages of suitable habitat that should be protected to achieve recovery for listed species. Core areas are ranked as Zone 1, 2, or 3 in order of their overall priority for recovery, with Zone 1 reflecting the highest priority areas. Protection of the majority of suitable habitat within Zone 1 core areas, and Zone 2 and 3 core areas where appropriate, is recommended to provide corridors and dispersal habitat, support metapopulation dynamics, provide for reintroduction or introduction sites, and to protect currently undiscovered populations. Many of the species covered by the Recovery Plan can be recovered primarily through the protection of Zone 1 core areas.

Habitat Protection: The first delta green ground beetle recovery criterion in the Recovery Plan is the protection of the beetle's vernal pool habitat. This criterion addresses the continuing threat of destruction, modification or curtailment of the beetle's habitat and range (Factor A). The Recovery Plan calls for the protection of all known beetle occurrences and the protection of 95 percent of suitable beetle habitat in the Jepson Prairie core area, a Zone 1 core area in the Solano-Colusa vernal pool region. Specifically the Recovery Plan states that the remaining suitable habitat "in the greater Jepson Prairie area, particularly designated critical habitat outside of the Jepson Prairie Preserve on the Wilcox Ranch property owned by The Nature Conservancy (TNC) and Solano County," should be protected (USFWS 2005). This criterion has been partially met. Habitat for the delta green ground beetle is currently being acquired under the umbrella of conservation banks for vernal pool species in the core area. Although these acquisitions are adding protected and managed vernal pool habitat for the beetle, no net increase of habitat is realized since these land acquisitions are mitigation for lost or destroyed habitat elsewhere. Also, almost half of the beetle's known occurrences are still located on unprotected, private lands, including the private

land to the south of Hay Road east of the Burke Ranch property (see Figure 1). Many acres of suitable beetle habitat may also exist on private property around the Jepson Prairie, yet this property has not all been surveyed and remains unprotected. This property is not yet earmarked for conservation banking and includes property south of the Wilcox Ranch (see Figure 1). Additional information regarding the progress towards meeting the criterion for increased delta green ground beetle habitat protection is provided below.

The recovery plan also addresses the need to apply success criteria to reintroductions and modify techniques as necessary to achieve recovery and long term conservation of the delta green ground beetle. Reintroductions of the delta green ground beetle have not yet been conducted. The study of Dave Kavanaugh and Richard Arnold proposed to rear some beetles in captivity to study behavior and life history traits; however, due to low numbers of beetles observed during the first year of their study, this captive rearing was not started. Captive rearing will be the initial step in a reintroduction program. This aspect of the habitat protection criteria has not been met.

Adaptive Habitat Management and Monitoring: The second recovery criterion listed in the Recovery Plan is the development of habitat management and monitoring plans that facilitate maintenance of vernal pool ecosystem function and population viability (USFWS 2005). This recovery criterion addresses the continuing threat to the beetle of degradation of habitat by invasive plants (Factor A). This criterion has been partially met. Management plans for vernal pool species were to be implemented within 5 years of the Recovery Plan's finalization. For example, a management plan for the Jepson Prairie Preserve, which includes the Wilcox ranch parcel, was written and is now distributed for review prior to publishing (Witham 2006). This management plan meets the requirements of the recovery criteria in that it provides specific considerations for the beetle, particularly in addressing grazing practices, controlled burns, and hand application of herbicides to control overgrowth of invasive, non-native plants. Site-specific threats for beetle populations at the preserve and at the Wilcox Ranch are addressed (Witham 2006). Conservation banks are required to have USFWS approved management plans that address specific needs of the listed species before credits can be sold for that bank. Within the habitat area for the beetle the following conservation banks have management plans: Elsie Gridley, Burke Ranch, Muzzy Ranch, Campbell Ranch, and the North Suisun Mitigation Bank. These banks and their management plans are addressed in section II.c.2.a below.

Status Surveys: The third recovery criteria is to conduct status surveys, 5-year status surveys, and population monitoring to show where populations are viable and have been maintained for at least one multi-year period that includes above average, average, and below average local rainfall, a multi-year drought, and a minimum of 5 years of post drought monitoring. Surveys for delta green ground beetle presence and suitable habitat are ongoing, both within and outside the

Jepson Prairie core area (J. Silveira, pers. comm. 2006; C. Witham, pers. comm. 2006, Arnold and Kavanaugh 2007). The difficulty in locating the beetle, even by trained individuals, may affect the reliability of presence/absence surveys. In some cases, presence should be assumed based on proximity to known occurrences and the suitability of the habitat to support the beetle. A January 2006 survey revealed at least one previously unknown population of the beetle at the Campbell Ranch (C. Witham, pers. comm. 2006). David Kavanaugh, an entomologist at the California Academy of Sciences, and Richard Arnold, an independent entomological consultant, have conducted two surveys within the last two years, one at a proposed California Department of Transportation (CALTRANS) road improvement site along State Highway 12 between Branscombe Road and Denverton Road, and another at the Hawthorne Mill site in Fairfield. Richard Arnold also conducted a survey of the North Suisun Mitigation Bank in 2005 but did not find any delta green ground beetles (R. Arnold *in litt.* 2006). These surveys and an intensive survey of vernal pool features in and around the Jepson Prairie produced an updated distribution of the delta green ground beetle and is discussed in section II.c.1 below. This criteria has been partially met, and will be fully met if the current research by Dave Kavanaugh and Richard Arnold continues.

4. Research: The fourth criterion listed in the recovery plan calls for continuing research into many aspects of the biology and ecology of the delta green ground beetle. The Recovery Plan discusses a variety of general research topics that would help refine recovery actions and criteria, and guide overall recovery and long-term conservation efforts. The Recovery Plan recommends research on genetics, taxonomy, biology of vernal pool species, the effects of habitat management practices on vernal pool species and their habitat, and threats to vernal pool species and ecosystems (USFWS 2005). This information is necessary to develop effective conservation strategies, indicate management needs (if any), and inform the effectiveness of conservation efforts. Research topics that were promoted in the recovery plan specific to the delta green ground beetle include the following:

1. Sources and rates of mortality for adults, pupae, larvae, and eggs;
2. Productivity;
3. Dispersal;
4. Preferred habitat conditions for larvae and adults;
5. Preferred sites for oviposition;
6. Activity cycles, both daily and annual; and
7. Timing of life-cycle stages.

Although some research has been conducted, the majority of the information needs discussed in the Recovery Plan are still outstanding. D. Kavanaugh and R. Arnold have received a grant to study this species (D. Kavanaugh *in litt.* 2006). Specific research goals of their multi-year project include detailed surveys to establish updated geographical distributions of the beetle, formal descriptions of the beetle's immature stages and life history, and identification of the important features of the beetle's habitat for all of its life stages (Arnold and Kavanaugh

2007). Another important aspect of their research proposal is to captively rear individual beetles to study their life history (Arnold and Kavanaugh 2007). The recovery criteria include captive breeding and reintroduction of the beetle to suitable habitat (USFWS 2005). The knowledge gained from captive rearing individuals from this proposed study should benefit future captive breeding efforts that may be the initial steps toward reintroductions. The results of the first year of Dr. Arnold and Dr. Kavanaugh's study is included below in section II. C.1.b. This criterion has been partially met.

5. *Participation and Outreach:* The fifth criterion for the recovery of the beetle is to establish a recovery implementation team to oversee the implementation of recovery actions. The Recovery Plan discusses a variety of participation programs to achieve the goal of recovery of the listed species in the plan. An essential component of this collaborative approach is the formation of a single recovery implementation team overseeing the formation and function of multiple working groups formed at the vernal pool region level. The Service is currently in the preliminary stages of organizing both a recovery implementation team and multiple working groups. Service employees have met with various stakeholders to determine interest of stakeholders to be involved in working groups and/or the recovery implementation team. This criterion has not been met.

II.C. Updated Information and Current Species Status

II.C.1. Biology and Habitat

II.C.1.a. Abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends: There have been no coordinated systematic annual surveys or population monitoring of the delta green ground beetle to determine population and demographic trends (USFWS 2005). When the beetle was listed in 1980 the population size was not known; however, based on the species' habitat, two critical habitat units were designated (45 FR 52807). These units are located at Olcott Lake and at a smaller playa lake in what is now the Elsie Gridley multi-species conservation bank. When the original recovery plan was published in 1985, delta green ground beetles had been found around Olcott Lake and along the west side of Cook Lane within the Jepson Prairie area; however, one of the original two sites where the delta green beetle was found had been ploughed and disced under and the population was presumed to be extirpated from that site. In 2005 the revised recovery plan, which was included among other vernal pool species, reported that there were 5 extant populations, all in the Jepson Prairie area (USFWS 2005). A recent range wide survey of the delta green ground beetle was conducted in 2007 (Arnold and Kavanaugh 2007). The survey consisted of visits to 71 wetlands that were chosen for their habitat qualities and were in the area shown in Figure 1 bounded by Creed Road to the South, Hay Road to the North, Travis Air Force

Base to the West and the preserved land along Highway 113 to the East. Within the 71 wetlands, adult delta green ground beetles were found at 32 of 81 playa pools. A total of 42 adult delta green ground beetles were counted (Arnold and Kavanaugh 2007). Unfortunately, statistical estimates of population sizes were not possible due to the limited number of individual beetles found at any one location and the population size remains unknown due to the difficulty in surveying for this cryptic beetle, its little-known biology and ecology, and other abiotic and biotic factors.

II.C.1.b. Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g., corrections to the historical range, change in distribution of the species' within its historic range, etc.): The historical range of the delta green ground beetle is unknown. Population monitoring surveys to date do not provide adequate information to reveal trends in the distributions of the beetle (USFWS 2005). However, this information may be developed from the 3-5 year ongoing study by Arnold and Kavanaugh (2007).

II.C.1.c. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem): As mentioned in the Recovery Plan, Arnold (1989) conducted an analysis of habitat features associated with delta green ground beetle observations. His habitat suitability model determined that beetle occurrences are associated with the vernal lake habitat type, and found the habitat characteristics most strongly associated with the beetle's presence include *Navarretia* cover (a genus of vernal pool plants), proximity to water, *Frankenia* cover (a genus of vernal pool plants), *Downingia* cover (a genus of vernal pool plants), soil type, and cracks in the soil (Arnold 1989). Earlier, in 1985, Arnold described that 80 percent of his beetle sightings occurred "where sandy-mud substrate slopes gently into the water and there was very low growing vegetation providing cover 25 to 100 percent cover" (Arnold 1989). Upland habitat is also known to be frequented by the beetles, which have been found hundreds of meters from the nearest shoreline, but only during the wet season (Arnold 1983). Cracks in the soil are believed to be used as dry season refugia for larvae and diapausing pupae (USFWS 2005). Soil distribution analyses reveal that the beetle appears to be primarily associated with Pescadero Clay (which forms the clay base to vernal pools and lakes), the Solano-Pescadero Complex, Solano Loam, and the Pescadero Clay Loam soil types (Arnold and Kavanaugh 2007). Arnold and Kavanaugh (2007) used these habitat characteristics to prioritize wetland areas in a 35 square mile area of Solano County for conducting site assessments and delta green ground beetle surveys as part of a multi-year study. They also found that the presence of springtails (Collembola), the most important prey source for the delta green ground beetle, was another required habitat trait. These habitat qualities appeared to be valid as the delta green ground beetle was found only at those pools strongly associated with Pescadero clay soil and those pools without excessive build up of invasive plants (Arnold and Kavanaugh 2007).

II.C.1.d. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.): We are not aware of any genetic studies that were performed for this species.

II.C.1.e. Taxonomic classification or changes in nomenclature: Since listing in 1980, Dr. Henri Goulet redefined the tribe, genera, and subgenera of the taxonomic tribe Elaphrini based on characters of adults and larvae (Goulet 1983). Cladistic relationships between genera and subgenera were further defined using systematics based on adult and larval characteristics. *Elaphrus* is one of three recognized genera in the tribe Elaphrini, and *Elaphrus* is also one of three subgenera of the genus *Elaphrus*. *Elaphrus viridis* remains unchanged as one of 34 species of *Elaphrus*.

II.C.2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

II.C.2.a. Factor A, Present or threatened destruction, modification or curtailment of its habitat or range:

When the delta green ground beetle was listed in 1980, the following threats were identified under Factor A: The elimination of vernal pools by agricultural conversion, and specifically the plowing and leveling of land in and around the vernal pools. Since the last formal status review of the delta green ground beetle, which was the listing of the beetle in 1980, several new threats to the habitat have been identified, including the following site-specific threats:

Site-Specific Threats

The following are examples of site-specific threats that can be classified as relating to the present or threatened destruction, modification or curtailment of its range:

1. The possible expansion of the runway at Travis Air Force Base (AFB) into the western half of the Wilcox Ranch, now owned by Solano County, could negatively impact the population of the delta green ground beetle that exists around the local playa ponds. Impacts include permanently covering the beetles and their habitat with a tarmac, and by the indirect effects of the proximity of the runway to beetle populations, such as chemical runoff and fuel spills. Travis AFB still considers the expansion a possibility, but no formal planning has been drafted (C. Witham, pers. comm. 2006; J. Marty, TNC, *in litt.* 2006).
2. Maintenance and monitoring activities associated with the high powered transmission lines that cross Jepson Prairie Preserve at Olcott Lake and span critical habitat for the delta green ground beetle have an unknown impact on

the beetle. Maintenance of Pacific Gas and Electric (PG&E) natural gas pipelines and associated corridors may negatively affect the beetle. For example, repair and maintenance of a natural gas line was required and the biological opinion stated that the work would seriously affect any delta green ground beetles in the area (USFWS 2004b). Further construction of pipelines and electric transmission lines may pose a threat to the beetle and its habitat, as demonstrated by past projects. In 1997, for example, PG&E completed a gas pipeline transecting and altering known beetle habitat that was compensated for with the purchase of 142 acres of beetle habitat at Jepson Prairie Preserve as well as a management endowment (USFWS 1991). In 2001, the construction of three facilities for the generation of electrical power using natural gas turbine generators severely altered up to 4.8 acres of beetle habitat (USFWS 2001). This loss was mitigated by an endowment for the preservation and management of a 22-acre site within the Wilcox Ranch as well as the establishment of a conservation easement for the site (USFWS 2001).

3. There is a proposed rehabilitation project for widening Highway 12, which runs to the west and southwest of the Jepson Prairie Preserve. This project would adversely affect local beetle populations or their habitat. Surveys for the beetle and for suitable beetle habitat on accessible private and public land that will be affected by the widening project were required. Currently, research is ongoing to determine the effects of this project on the beetle or its habitat (USFWS 2004a).

4. Increased vehicle traffic at the Jepson Prairie Preserve increases the chances of inadvertent introduction of common and pervasive non-native animal species such as the Argentine ant (*Iridomyces humilis*) and numerous invasive plant species such as vetch (*Vicia* spp.)

5. There is one habitat conservation plan (HCP) in development within the beetle's range. HCPs are developed and implemented to minimize and mitigate the effects of activities (such as development) that impact listed species and/or their habitat, and are required for the issuance of an incidental take permit under section 10(a)(1)(B) of the Endangered Species Act. The Solano HCP planning area totals approximately 584,855 acres and includes the delta green ground beetle as a covered species. Proposed covered activities are not expected to kill or injure beetles, or destroy their habitat, with the exception of potential impacts due to preserve management activities such as vernal pool restoration. Mitigation associated with the HCP could benefit the beetle by protecting potential and occupied beetle habitat. A date for producing the draft Solano HCP has not yet been determined.

Acquisition of Habitat

Although further research is recommended in the Recovery Plan to provide a precise description of suitable habitat for the beetle, two broad requirements for suitable beetle habitat are currently known as (1) vernal pools with their surrounding vegetation and (2) the land areas that surround and drain into these pools (USFWS 2005). The extent of acquisition should provide for corridors and dispersal habitat, support metapopulation dynamics, provide reintroductions and introduction sites, and protect habitat considered suitable to support the beetle (USFWS 2005).

After the beetle was listed, approximately 1,600 acres of vernal pool habitat inhabited by the largest known population of the beetle (which amounted to 75 adult beetles seen or collected from 1974 to 1980) was purchased by TNC from the Southern Pacific Railroad. This land was set aside as the Jepson Prairie Preserve and was declared a National Natural Landmark in 1987 (USFWS 2005). The preserve has been used extensively as a study site for ongoing research being conducted at the University of California at Davis. The Solano County Farmlands and Open Space Foundation (now called the Solano Land Trust) took title to the Jepson Prairie Preserve from TNC on September 5, 1997 (Rumsey 1997) and is now partnered with the University of California's Natural Reserve System in a conservation agreement to jointly manage the preserve (Witham 2006). Figure 1 shows the extent of Jepson Prairie Preserve land holdings.

The Wilcox Ranch (2,912 acres), on which is found the second-most significant known population of the beetle, was purchased by TNC in 2001. The beetle is found in playa pools located adjacent to the wetlands in the eastern half of the property and in playa lakes located in the western half of this property (USFWS 2005). The eastern half of the Wilcox Ranch, comprising 1,342 acres, was transferred to the Solano Land Trust with a protective conservation easement in 2004. The western half comprising 1,570 acres was sold to Solano County in 2002 without a conservation easement, but with a deed restricting development except for Travis Air Force Base runway expansion (J. Marty *in litt.* 2006). Presently, the combined properties of the Jepson Prairie Preserve and the eastern portion of Wilcox Ranch are owned and managed by the Solano Land Trust. This property and two properties owned and managed by California Department of Fish and Game (CDFG) south of the preserve, the Calhoun Cut Ecological Reserve (965 acres) and the Barker Slough Management Unit (256 acres), comprise the Greater Jepson Prairie Ecosystem (Witham 2006).

The Michael Remy vernal pool preserve consists of 540 acres on two parcels. One of the parcels consists of 320 acres and lies just south of Hay Road and west of the Burke Ranch Conservation Bank (see figure 1). This preserve is managed by the Center for Natural Lands Management (CNLM) under a

contract from a private company which owns the property. The property is under a conservation easement. The preserve contains freshwater marshes and constructed wetlands in addition to some vernal pool habitat. The CNLM has a management plan and a long term protection plan for this property and manages for invasive, non-native grasses and forbs through periodic prescribed burning at the preserve (Chris Clifford, CNLM, *in litt.* 2008).

Conservation and Mitigation Banks

No mitigation or conservation banks are selling credits exclusively for the delta green ground beetle. Credits for other vernal pool species are being sold and, in many cases, these banks include suitable habitat for the beetle. Figure 1 shows the locations of the conservation and mitigation banks.

The North Suisun Mitigation Bank, a 609-acre parcel, is located 4 miles east of Fairfield in Solano County, bordered by Creed Road to the north and State Highway 12 to the south. The bank, which provides conservation credit for the threatened California tiger salamander (*Ambystoma californiense*) and the endangered Contra Costa goldfields (*Lasthenia conjugens*), is currently in the process of constructing 45 acres of vernal pool habitat within 1 mile of two reported sightings of the beetle at Wilcox Ranch. The project includes the conversion of formerly farmed land and land now considered suitable as an upland component of beetle habitat (USFWS 2004c). The negative effects of the conversion of this upland habitat into vernal pools are offset by the additional upland habitat that will surround the newly constructed 45 acres of vernal pool habitat (USFWS 2004c). Because of the proximity within dispersal distances of several known populations of the beetle, and the suitability of the habitat that will result from the proposed construction, delta green ground beetles are expected to colonize this new habitat (USFWS 2004c). However, they are not currently known to occur there.

The Campbell Ranch Conservation Bank site (160 acres) lies 12 miles south of Dixon, 6 miles east of Travis Air Force Base, west of, and adjacent to, Jepson Prairie Preserve and north of the Dixon Pools National Natural Landmark in Solano County. The property contains approximately 19 acres of vernal pools and additional acreage of swales that are habitat for three federally listed species: the vernal pool tadpole shrimp (*Lepidurus packardii*), the vernal pool fairy shrimp (*Branchinecta lynchi*), and the California tiger salamander. Suitable habitat for the beetle is found on this property, and recent surveys in January 2006 revealed its presence at this location, with some beetles being found in uplands that were 0.75 mile from the nearest playa pond (C. Witham, pers. comm. 2006). A management plan was included in the project agreement (Waaland 2001), but does not address specific management actions for the beetle. Other vernal pool species are addressed in the management plan and methods for invasive plant eradication and management are also presented. Controlling invasive plants in the

Campbell Ranch should ultimately improve the beetle habitat that is located there. Future revisions to the management plan should include the beetle as a resident species since at least one occurrence is reported and suitable habitat exists.

The Elsie Gridley Multi-species Conservation Bank comprises approximately 1,815 acres and is located in Solano County 12 miles south of Dixon. The southwest border of the property is contiguous with the northeast boundary of the Jepson Prairie Preserve (LSA Associates 2005). Critical habitat for the delta green ground beetle lies within the boundaries of the Gridley property and there are historical records of a beetle population occurring there (LSA Associates 2005, CNDDDB 2006). A management plan is included as part of the mitigation bank's enabling instrument (LSA Associates 2005). The management plan specifically addresses habitat maintenance through the aggressive control of invasive plants and also requires regularly scheduled surveys to monitor the beetle.

The Burke Ranch, located just north of the Jepson Prairie Preserve, was mentioned as a proposed conservation bank in the Recovery Plan, and a formal agreement establishing this conservation bank was signed in December 2007. The Burke Ranch Conservation Bank consists of 962 acres of high quality vernal pool habitat just north of the Jepson Prairie and adjacent to the Campbell Ranch Conservation Bank. The CNDDDB (2006) shows that there were historical sightings of the beetle at the Burke Ranch. Presence of the beetle was confirmed at three playa pools on the property by Dr. Richard Arnold during his 2007 survey (Westervelt Ecological Services 2007). A management plan was completed for the Burke Ranch Conservation Bank and addresses the delta green ground beetle, which includes the requirement to conduct surveys for the beetle once every five years (Westervelt Ecological Services 2007). Currently, credits specifically for the delta green ground beetle are not being sold at this bank.

A 57-acre parcel on the western side of the B&J landfill property was acquired as mitigation for B&J expansion onto delta green ground beetle habitat (USFWS 2005). Also known as the Hay Road landfill, this site is located north of the Jepson Prairie Preserve on Hay Road near the intersection with Highway 113. No beetles have been reported from this site; however, it may have small patches of suitable beetle upland habitat due to its proximity to the Burke Ranch.

A new conservation bank, The Muzzy Ranch Conservation Bank, is scheduled to be formally approved in the fall of 2008. This bank consists of 1,269 acres of high quality vernal pool habitat abutting the Wilcox Ranch to the south and the runway of Travis Air Force Base to the west (See figure 1). Credits for this bank can be sold as compensation for a variety of vernal pool associated species (LSA 2008). Currently, the conservation bank can start selling credits

for a phase 1 parcel of the ranch consisting of 735 acres, all on the eastern side of the ranch property. The remaining 534 acre western parcel will be made available to sell at an undetermined future time (LSA 2008). A draft management plan is completed for this conservation bank (LSA associates 2008) and addresses management needs for the delta green ground beetle. The management plan requires three surveys per year for the beetle during appropriate seasons.

Summary of Factor A

The latest range-wide survey for the delta green ground beetle revealed that the beetle is still found throughout the greater Jepson Prairie region. A 32 square mile area was surveyed which included 71 wetland areas with suitable habitat (playa pools) for the delta green ground beetle. Of the 71 pools that were surveyed, 29 of the pools, or 41 percent, are located on private property that is not currently protected. Currently, nearly 54 percent of available habitat is protected by preserves, conservation or mitigation banks, or by conservation easements. Threats which may lead to the loss or degradation of habitat include the possible expansion of the Travis Air Force Base runway, maintenance of electrical power lines crossing Olcutt Lake, widening highway 12, and the increased traffic into the Jepson Prairie area which may introduce undesirable invasive plant and animal species.

II.C.2.b. Factor B, Overutilization for commercial, recreational, scientific, or educational purposes:

The listing rule did not identify Factor B as a threat to the delta green ground beetle. Collecting of all species of ground beetles is popular among amateur entomologists and the unique, colorful appearance of this rare beetle and its protected status render it a highly valued addition to any entomology collection. No commercial or private trade of the delta green ground beetle is known at this time. Surreptitious, illegal collection of the beetle is a distinct possibility which would be difficult to control without constant surveillance of the Jepson Prairie Preserve by enforcement agents. However, the difficulty in locating these beetles, even by trained entomologists, may deter collectors and there is currently no evidence of any illegal collection taking place (D. Kavanaugh, pers. comm. 2006).

II.C.2.c. Factor C, Disease or predation:

The listing rule did not identify Factor C as a threat to the delta green ground beetle. No disease or vector for disease has been observed or documented for the beetle. Predation on the beetle in excessive numbers has not been observed or documented. The introduction of non-native insect species such as the Argentine ant (*I. humilis*) and the European earwig (*Forficula auricularia*), a known predator of small insects, may present the possibility of competition for the beetle's prey base of Collembola.

II.C.2.d. Factor D, Inadequacy of existing regulatory mechanisms:

Federal Protections

Endangered Species Act: The Endangered Species Act of 1973, as amended (Act), is the primary Federal law that provides protection for the delta green ground beetle. Since the animal's designation as a threatened species in 1980, a number of projects have undergone review under section 7 and section 10(a)(1)(B) of the Endangered Species Act. Section 7(a)(2) requires Federal agencies to consult with the Service to ensure any project they fund, authorize, or carry out does not jeopardize a listed species. To jeopardize the continued existence of a species means to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild. If we determine the proposed project will not result in jeopardy to the affected listed species, we may require the agency to implement reasonable and prudent measures, along with the terms and conditions, to minimize the amount of incidental take. Incidental take is the take of a listed species that is incidental to, but are not the purpose of, an otherwise lawful activity. If a Federal agency is not involved in the project, and federally listed species may be taken as part of the project, then the project proponent should obtain an incidental take permit pursuant to section 10(a)(1)(B) of the Act. The Service may issue such a permit upon completion of a satisfactory habitat conservation plan for the listed species that would be taken by the project.

Clean Water Act and Rivers and Harbors Act: Pursuant to section 404 of the Clean Water Act (33 U.S.C. 1344) and section 10 of the Rivers and Harbors Act, the U.S. Army Corps of Engineers (Corps) regulates the discharge of dredged or fill material into all waters of the United States, including wetlands. In general, the term "wetland" refers to areas meeting the Corps criteria of having hydric soils, hydrology (either sufficient flooding or water on the soil surface), and hydrophytic vegetation (plants specifically adapted for growing in wetlands).

Any discharge of dredged or fill material into waters of the United States, including wetlands, requires a permit from the Corps. These include individual permits which would be issued following a review of an individual application, and general permits that authorize a category or categories of activities in specific geographical locations or nationwide (33 CFR Parts 320-330). Individual permits are issued by the Corps for actions which are likely to result in greater than minimal individual or cumulative impacts to the human or aquatic environment. General permits are issued by the Corps for actions which are likely to result in minimal individual or cumulative impacts to the human or aquatic environment. It is important to note that in order to utilize any general permit, including nationwide permits, the applicant must comply with the general and specific conditions of the permit. General and

specific permit conditions may vary with individual Corps Districts and permits. However, the use of any Individual or General permit requires compliance with the Endangered Species Act. Some activities such as normal farming practices are exempt under the Clean Water Act and do not require a permit (33 U.S.C § 1344).

Section 404 of the Clean Water Act, therefore, may afford some protection to the delta green ground beetle. However, recent Supreme Court rulings have called into question the Corps' definition of "waters of the United States." On June 19, 2006, the U.S. Supreme Court vacated two district court judgments that upheld this interpretation as it applied to two cases involving "isolated" wetlands. Currently, the Corps regulatory oversight of vernal pools is in doubt because of their "isolated" nature. In response to the Supreme Court decision, the Corps and the U.S. Environmental Protection Agency (USEPA) have recently released a memorandum providing guidelines for determining jurisdiction under the Clean Water Act. The guidelines provide for a case-by-case determination of a "significant nexus" standard that may protect some, but not all, vernal pool habitat (USEPA and USACE 2007). The overall effect of the new permit guidelines on loss of vernal pool habitat is not known at this time. If the Corps loses its regulatory authority over vernal pools, unmitigated destruction of potential habitat for the delta green ground beetle may increase over the range of the species.

State and Local Protections

The beetle is not specifically protected under any State or local law. The California Endangered Species Act does not provide protection to insects (sections 2062, 2067, and 2068, California Fish and Game Code).

The California Environmental Quality Act requires full public disclosure of the potential environmental impact of proposed projects. The public agency with primary authority or jurisdiction over the project is designated as the lead agency and is responsible for conducting a review of the project and consulting with other agencies concerned with resources affected by the project. Section 15065 of the California Environmental Quality Act guidelines requires a finding of significance if a project has the potential to "reduce the number or restrict the range of a rare or endangered plant or animal" (including insects). Species that are eligible for listing as rare, threatened or endangered but are not so listed by the California Endangered Species Act, including all federally listed species, are given the same protection as those species that are officially listed with the State. Once significant impacts are identified, the lead agency has the option to require mitigation for effects through changes in the project or to decide that overriding considerations make mitigation infeasible. In the later case, projects may be approved that cause significant environmental damage, such as destruction of endangered species. Protection of listed species through

California Environmental Quality Act is, therefore, at the discretion of the lead agency. The California Environmental Quality Act provides that, when overriding social and economic considerations can be demonstrated, project proposals may go forward, even in cases where the continued existence of the species may be jeopardized, or where adverse impacts are not mitigated to the point of insignificance.

The California Porter-Cologne Act of 1969 (California Water Code section 13000 *et seq.*) is the primary law regulating water quality in California. The Porter-Cologne Act designated the State Water Resources Control Board and the nine Regional Water Quality Control Boards to serve as California's water quality planning agencies with authority over surface and groundwater quality. The State Water Resources Board develops a State Water Quality Control Plan, while the nine Regional Water Quality Control Boards develop Regional Water Quality Control Plans and issue waste discharge requirements (permits).

Summary of Factor D

In summary, the Endangered Species Act is the primary Federal law that provides protection for this species since its listing as endangered in 1980. Other Federal and State regulatory mechanisms provide discretionary protections for the species based on current management direction, but do not guarantee protection for the species absent its status under the Act. Therefore, we continue to believe other laws and regulations have limited ability to protect the species in absence of the Endangered Species Act.

II.C.2.e. Factor E, Other natural or manmade factors affecting its continued existence:

The listing rule did not identify Factor E as a threat to the delta green ground beetle. However, since listing in 1980, the following three threats have been identified:

Non-Native Plants

The listing rule did not identify Factor E as a threat to the delta green ground beetle. Since listing, the proliferation and dominance of non-native plants in the Jepson Prairie Preserve have been identified as a serious threat to the beetle. Grasses and forbs that produce a heavy build-up of thatch when they die cover preferred habitat of the beetle (L. Serpa, pers. comm. 2006; USFWS 2005; Marty 2005). This altered habitat interferes with the feeding behavior of the beetle, as well as suppresses the availability of its invertebrate prey, the springtail (Collembola) (L. Serpa, pers. comm. 2006). Serpa (1985) describes at least three practices used by the beetle to hunt its prey and all of these practices require some degree of open area interspersed with low-growing vegetation. Delta green

ground beetles were found to be associated with *Navarretia*, *Frankenia*, and *Downingia* species (Arnold 1983, USFWS 2005). Managed grazing, particularly the less destructive grazing of sheep, has been proposed as means to maintain the preferable low-growing vegetation and also to prevent the excessive accumulation of thatch along the margins of the vernal pools (Witham 2006). Other methods to control the spread of invasive plants include prescribed burns and the hand application of herbicides. Prescribed burns have not been conducted since 2003 due to liability, permit, and resource-related difficulties (Witham 2006). The regional management plan for the Greater Jepson Ecological Ecosystem (Witham 2006) contains the revised management policies for controlling invasive plants in the ecosystem, which are expected to benefit the beetle and its habitat.

Wastewater Sludge Applications

Application of sludge from wastewater treatment plants as a soil amendment or fertilizer in grasslands in Solano County was approved by Solano County, and if applied to areas adjacent to vernal pools (for example, around Jepson Prairie Preserve) could promote the growth of vegetation (USFWS 2005). Higher and thicker vegetation within the critical habitat of the delta green ground beetle will adversely affect its feeding regime, even with the designation of 100-foot setbacks from vernal pools where the sludge is not applied. Water quality of the pools may also be affected by runoff, particularly the unintentional accumulation of additional nutrients into runoff that drains into the vernal pools. Although Solano County still allows this application around the preserve, the County does not apply sludge within the Jepson Prairie Preserve proper, so negative effects have not yet been seen (B. Wallace *in litt.* 2006). However, we believe sludge application is a potentially deleterious practice that should be monitored and evaluated.

Climate Change

An additional threat to the species noted since the listing is climate change. Impacts to the species under predicted future climate change are unclear. A trend of warming in the mountains of western North America is expected to decrease snowpack, hasten spring runoff, and reduce summer stream flows (IPCC 2007). Increased summer heat may increase the frequency and intensity of wildfires (IPCC 2007).

Climate is predicted to change in California during the 21st century (Field *et al.* 1999; Cayan *et al.* 2005). The predicted impacts on California's ecosystems projected with a high certainty include (1) higher sea level; (2) decreased suitable habitat for many terrestrial species as climate change intensifies human impacts [for example, isolated patches of vernal pools can be so poorly connected with other patches that migrations required by climate change may be difficult or impossible without human intervention (Field *et al.* 1999)]; and (3) increased competition among urban, agricultural, and natural ecosystem uses due to

decreased precipitation. Court-ordered environmental flows (water left in streams to support aquatic life) compete with agricultural or urban uses (Field *et al.* 1999), but may not be available if climate change reduces water supply for human uses. The most recent literature on climate change includes predictions of hydrological changes, higher temperatures, and expansion of drought areas, resulting in a northward and/or upward elevation shift in range for many species (IPCC 2007). Although the specific effects of climate change on the delta green ground beetle are unknown, the effects of increased winter flooding and drought conditions in the spring and summer have the potential to adversely affect this species.

II.D. Synthesis

Since the delta green ground beetle was listed as threatened in 1980 the greatest change that has occurred is the acquisition of key property around the Jepson Prairie Preserve, which holds significant vernal pool and upland habitat for the beetle and for many other listed species. The 2005 Recovery Plan identified six known occurrences at that time. Unfortunately, the population sizes and trends of the beetle populations are not currently known, owing to the difficulty in visually locating these beetles during surveys and the lack of continuous and consistent monitoring. The recovery actions for the beetle were updated in the 2005 Recovery Plan and are still considered to be sufficient to effect the beetle's recovery. The Recovery Plan sufficiently addresses all known current threats as well as those future threats to this species that can be reasonably foreseen.

Since the original Recovery Plan was drafted in 1985, an increase in protected land holdings with suitable habitat for vernal pool species, including the beetle, has been realized. Currently about 11,047 acres of beetle habitat are protected, or about 54 percent of the suitable habitat known to be available. Not only has a substantial portion of the Wilcox Ranch, which is inhabited by populations of the beetle, been secured, but several conservation banks for mitigation involving vernal pool species were opened. However, these new acquisitions need to be considered in light of two factors. First, these acquisitions were the result of the loss or degradation of vernal pool habitat at some other location, some of which may have contained suitable beetle habitat, and may not always amount to a net increase in protected habitat for this species. Second, there are still large parcels of private land that may have suitable habitat for the beetle or have recorded occurrences of the species, but remain unprotected.

The implementation of adaptive habitat management, restoration, and monitoring of preserved lands is important for the delta green ground beetle. One of the most important aspects of habitat management now is the control of invasive plants, particularly in that they adversely affect the feeding regime of the beetle. There is a draft management plan that incorporates adaptive strategies to maintain and restore the Jepson Prairie Preserve, including the Wilcox Ranch (Witham 2006). All of the local conservation banks are required to have USFWS approved management plans before they can sell credits (LSA Associates 2005).

The monitoring of population and demographic trends is absolutely vital, not only because it provides the only indication of species viability and recovery, but the surveys incidentally provide new information on life history of the beetle. Site surveys for suitable habitat and beetle presence are ongoing, primarily as part of mitigation assessments (D. Kavanaugh *in litt.* 2006, C. Witham, pers. comm. 2006), and have, in at least one case, revealed the location of a previously unknown population. However, the status of the beetle populations in their known range is not currently known, nor was it known at the time of listing, so no assessment of population trends is possible at this time. The ongoing study by Arnold and Kavanaugh (2007) should provide an updated range-wide survey for at least 5 consecutive years which may reveal the population and demographic trends of the beetle.

Additional information is needed regarding the biology and ecology of the beetle, including mortality rates, productivity, dispersal, preferred habitat, oviposition site requirements, and life-cycle stage timing. No new published or unpublished research was completed for the past ten years; however the ongoing research by Arnold and Kavanaugh (2007) on the distribution and life history of the beetle may answer many of the life history questions about it (D. Kavanaugh *in litt.* 2006). An important part of this research is to implement a captive rearing program to observe life history stages. Although captively reared colonies from this study are not anticipated to be bred for reintroduction, the lessons learned from the project should give a head start to other captive breeding programs.

At the time of listing the primary threat to the delta green ground beetle was the elimination of vernal pools by agricultural conversion. At this time the most serious threat to the beetle is habitat degradation caused by the rapid dispersal and overgrowth of invasive plants, as well as the build-up of thatch, which interfere with the beetle's feeding regime (L. Serpa, pers. comm. 2006). Another significant threat to the beetle is the continued encroachment of development projects that impact its habitat, such as: (1) maintenance activities for facilities such as electrical transmission lines located on or crossing suitable beetle habitat; (2) urban and commercial developments, including the proposed Travis AFB runway expansion and the ongoing Highway 12 expansion; and (3) the possible expansion of exploratory drilling for natural gas into the Jepson Prairie Preserve. Additionally, application of wastewater sludge and global climate change threaten the delta green ground beetle. The effects of the threat from wastewater sludge and climate change are not as immediate. Therefore, based on current, ongoing threats and the lack of information on the species' life history and population trends, we conclude that the delta green ground beetle still meets the Act's definition of threatened.

III. RESULTS

III.A. Recommended Classification:

- Downlist to Threatened**
- Uplist to Endangered**
- Delist** (*Indicate reasons for delisting per 50 CFR 424.11*):
 - Extinction*
 - Recovery*
 - Original data for classification in error*
- No change is needed**

III.B. New Recovery Priority Number: 8 (no change)

There have not been sufficient changes in the status of the beetle to warrant changing the recovery priority number. The major threats to the beetle are moderated by the fact that most known occurrences are on preserves, conservation banks, or easements, and the recovery potential for this species remains high because there is suitable habitat for reintroductions and proper management of the habitat is in progress.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

Continue to protect and manage suitable vernal pool and upland habitat for the delta green ground beetle.

Management practices should be implemented at all locations where suitable beetle habitat exists in order to reduce the proliferation of invasive and non-native plants. The density and height of these invasive plants significantly disrupt the beetle's feeding regime. Appropriate management practices are outlined in the draft plan of the Greater Jepson Prairie Ecosystem Regional Management Plan (Witham 2006), and include grazing, and prescribed burns during the dry summer months when the beetles are not on the ground surface.

Continue to acquire property with suitable habitat for the delta green ground beetle.

Acquisitions of vernal pool habitat through mechanisms such as conservation banks and cooperative agreements will ultimately benefit the beetle. These properties should also have adequate management plans.

Start captive breeding research with programs that may lead to reintroductions of the delta green ground beetle into unoccupied suitable habitat.

Successful development of captive breeding protocols and their implementation will ensure that sufficient numbers of individuals will be available to colonize new suitable habitat. Continuing surveys for new populations and suitable habitat will locate those areas best suited for reintroductions. Monitoring existing populations will help determine trends in population sizes and distributions, and should provide guidance for efforts on reintroductions

Conduct research on life history traits of the delta green ground beetle.

Research on the life history and developmental stages of the beetle as outlined in the Recovery Plan is necessary for success in captive breeding and reintroductions, and for effectively managing existing populations. Research priorities include:

1. Sources and rates of mortality for adults, pupae, larvae, and eggs;
2. Productivity;
3. Dispersal;
4. Preferred habitat conditions for larvae and adults;
5. Preferred sites for oviposition;
6. Activity cycles, both daily and annual; and
7. Timing of life-cycle stages.

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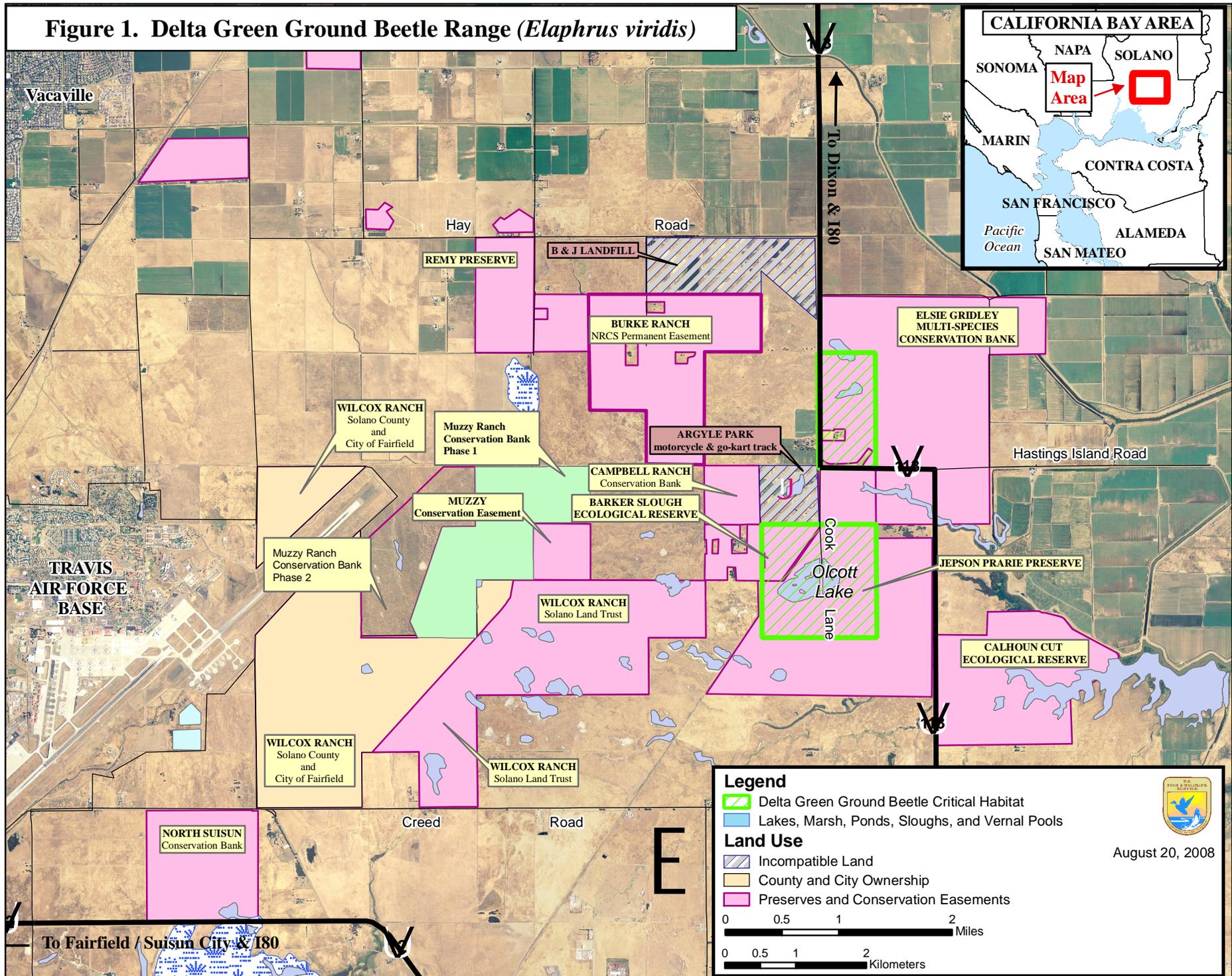
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Figure 1. Delta Green Ground Beetle Range (*Elaphrus viridis*)



**U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Elaphrus viridis***

Current Classification Threatened
Recommendation resulting from the 5-Year Review

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change is needed

Review Conducted By: Sacramento Fish and Wildlife Office Staff.

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve Susan K Moore Date 1/16/09

REGIONAL OFFICE APPROVAL:

Lead Assistant Regional Director, Fish and Wildlife Service, Region 8

Approve M. P. F. Date 2-4-09