Amargosa Vole  
(*Microtus californicus scirpensis*)

**Legal Status**

- **State:** Endangered  
- **Federal:** Endangered  
- **Critical Habitat:** Designated on November 15, 1984, when species was listed Endangered (49 FR 45160–15164)  
- **Recovery Planning:** *Recovery Plan for the Amargosa Vole* (*Microtus californicus scirpensis*) (USFWS 1997)  
- **Notes:** Most recent 5-year review on May 21, 2010, recommended no change in listing status (75 FR 28636–28642)

**Taxonomy**

The Amargosa vole (*Microtus californicus scirpensis*), is one of 17 recognized subspecies of the widespread California vole (*M. californicus*), which is found from the interior valleys of Oregon, near Eugene, to El Rosario, Baja California, Mexico (Cudworth and Koprowski 2010). The type locality for the Amargosa vole is the Amargosa River, near Shoshone and the California–Nevada border in Inyo County. Its range is small and disjunct from other populations of California vole. The Amargosa vole was once thought to be a distinct species (USFWS 1997), but is currently included as a subspecies of the California vole, and no taxonomic classification or nomenclature changes are currently proposed (USFWS 2009). However, based on an assessment of variation in mitochondrial DNA and nuclear DNA throughout the California vole’s range, Conroy and Neuwald (2008) found evidence of limited gene flow between clades (groups of a taxa sharing closer ancestry within the group than among the groups, indicating genetic distinctions between the clades). These clade differences may be correlated with ecological differences. From this evidence, Conroy and Neuwald (2008) suggest the possibility of two distinct species of California vole. If the California vole is split into two
distinct species, it is unlikely to affect the listing status of the Amargosa vole because it would still be a small, isolated population at high risk of extinction regardless of species assignment. Descriptions of Amargosa vole physical characteristics can be found in Cudworth and Koprowski (2010) and U.S. Fish and Wildlife Service (USFWS 1997).

Distribution

General

The Amargosa vole has a small, disjunct range limited to areas along the Amargosa River in the eastern Mojave Desert near the California–Nevada state line, as shown in Figure SP-M1. The entire range of the Amargosa vole is within the Desert Renewable Energy Conservation Plan (DRECP) Area.

Distribution and Occurrences within the Plan Area

Historical

The historic distribution of the Amargosa vole has been in disjunct “pockets” of marsh habitats along the Amargosa River from about Shoshone to Amargosa Canyon, Inyo County, although the full historic range of the subspecies has never been documented (USFWS 1997). The Amargosa River is largely subterranean, but supports marshy areas with perennial surface water in areas fed by tributary springs along an approximately 10-mile reach of the river (USFWS 1997).

At one time, the Amargosa vole was thought to be extinct, but was “rediscovered” in pockets of marsh habitat during trapping conducted between 1977 and 1988 (Bleich 1979; USFWS 1997). Occupied pockets ranged from about 0.5 mile north of Tecopa Hot Springs and south approximately 3.5 miles to the northern end of Amargosa Canyon.

The California Natural Diversity Database (CNDDB) includes seven “historic” occurrences for the species (i.e., pre-1990), with the most recent being 1984 (CDFG 2012). This database includes the type of specimen collected by Bailey in 1891 near Shoshone (and extirpated for a hog farm) and trapping data from 1977, 1983, and 1984.
Recent

The most recent available data for the Amargosa vole are from surveys for the subspecies conducted by McClenaghan and Montgomery in 1997 under a contract with the California Department of Fish and Game (CDFG), and more focused surveys by Neuwald in 1999 and 2000 in conjunction with a study of California vole genetics (see discussion of genetics study in the Management and Monitoring Considerations section) (McClenaghan and Montgomery 1998; USFWS 2009). (Note to reader: an extensive study was completed from September 2010 to April 2011, with preliminary findings to be submitted to CDFG by late 2011). The McClenaghan and Montgomery (1998) survey included live trapping, diagnostic sign evidence of occupation, and a habitat assessment at 48 sites, including all sites previously surveyed in the 1980s (Figure SP-M1). This study is the most detailed work to date on Amargosa vole (USFWS 2009). These more recent survey data overlap with the pre-1990 CNDDB occurrences (CDFG 2012) and should be considered the most current and complete dataset for the Amargosa vole (i.e., the older data representing extant sites are superseded by data collected in 1997 by McClenaghan and Montgomery (1998) and in 1999–2000 by Neuwald) (USFWS 2009).

McClenaghan and Montgomery (1998) found the Amargosa vole at 17 of the 48 sites surveyed. Of the 17 sites, 3 were sites where the vole had not been previously documented; 8 of the sites were known to be occupied in previous surveys in the mid- to late-1980s; and the remaining 6 occupied sites were sites where the Amargosa vole’s status was previously uncertain due to either a lack of surveys or insufficient level of surveys, as noted in the species’ 5-year review (USFWS 2009). McClenaghan and Montgomery (1998) also found that 23 of the 31 unoccupied sites had suitable vole habitat, but trapping may not have been sufficient to reliably conclude presence or absence at the site (USFWS 2009). One site that was previously occupied no longer contained suitable habitat. Field work by Neuwald in 1999 and 2000 confirmed presence at seven sites occupied in 1997; presence at a site occupied in 1988, but not confirmed in 1997 by McClenaghan and Montgomery; and at a new site not previously occupied (USFWS 2009).
Most of the habitat occupied by the Amargosa vole is currently administered by the Bureau of Land Management (BLM), California State Lands Commission (CSLC), and The Nature Conservancy (TNC).

**Natural History**

**Habitat Requirements**

The Amargosa vole inhabits discontinuous pockets of marshy habitats along the Amargosa River, which is mostly subterranean (USFWS 2009). The marshy areas, which range from about 1 to 5 acres in size, are fed by perennial tributary springs along the river that maintain perennial surface water. It is estimated that suitable habitat for the Amargosa vole totals about 247 acres (USFWS 2009).

Occupied marsh habitats are closely associated with surface water and are dominated by an overstory of bulrush (*Scirpus olneyi*) in densities rated as moderate to high (USFWS 2009) (see Table 1). Occupied sites also support other overstory species, such as arrow weed (*Pluchea sericea*), seep-weed (*Suaeda torreyana*), quailbush (*Atriplex lentiformis*), and southern reed (*Phragmites australis*). Understory vegetation includes yerba mansa (*Anemopsis californica*) and saltgrass (*Distichlis spicata*) (USFWS 2009). McClenaghan and Montgomery (1998) found the highest abundance of voles at the wet or lightly flooded ecotone between bulrush and saltgrass, but also noted that one occupied site was dominated by rush (*Juncus sp.*) and marsh plants other than bulrush. The recent study by CDFG, however, provides somewhat different findings for species constituents of occupied and unoccupied habitat. In this study, and consistent with previous descriptions, occupied sites included habitat mainly supporting bulrush, and on rare occasions, voles were trapped in rush, and/or a mix of yerba mansa and seep-weed (CDFG pers. comm. 2011). However, in this study, voles were absent in arrow weed, quailbush, saltgrass, and southern reed.

As a sedentary species, the Amargosa vole likely spends its entire life in marsh-associated habitats, except possibly when dispersing between habitat patches.
Table 1. Habitat Associations for Amargosa Vole

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Land Cover Use</th>
<th>Habitat Designation</th>
<th>Habitat Parameters</th>
<th>Supporting Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetland</td>
<td>All life history phases</td>
<td>Primary</td>
<td>Dominated by bulrush, Gentle terrain (&lt; 20%)</td>
<td>USFWS 2009</td>
</tr>
</tbody>
</table>

Occupied sites tend to be on level to gently sloping terrain; trapping in the 1970s found occupied sites were on slopes less than 20% (USFWS 2009).

Burrows may be excavated by voles themselves, or voles may use the entrance of gopher burrows or overcover such as boards for refuge and nest sites.

**Foraging Requirements**

There is relatively little ecological and behavioral information for the Amargosa vole subspecies, so much of the information presented in this section and the other natural history sections that follow are for the California vole, which is simply referred to as the “vole.” Where the information is specific to the Amargosa vole, this will be indicated.

Voles primarily feed on grasses, sedges, and forbs (Cudworth and Koprowski 2010). Food preference tests showed that grasses (e.g., *Hordeum*, *Bromus*, and *Lolium*) were the preferred food item in a captive population, which is consistent with field observations (Batzli and Pitelka 1971; Gill 1977). Seed and roots become more important in their diet during the dry summer (Cudworth and Koprowski 2010). Batzli and Pitelka (1971) found that seasonal condition is correlated with diet; as the diet changes from grass stems to grass seeds, individuals show lower growth rates, lower survival rates, and lower fat reserves. Green vegetation is necessary for reproduction (Cudworth and Koprowski 2010).
Reproduction

The vole breeding season is not sharply defined, but rather is tied to environmental conditions and trigger events. Because green vegetation is necessary for reproduction, early precipitation can offset the inhibiting effect of a short photoperiod (e.g., shorter fall and winter daylight periods may suppress reproductive conditions, such as testes size or weight in males) (Cudworth and Koprowski 2010). Although voles are capable of reproducing year-round, the main breeding period extends from about mid-September, with peak pregnancy rates in March and April (Greenwald 1956; Cudworth and Koprowski 2010; CDFG pers. comm. 2011) (see Table 2). The breeding season terminates with the lack of available green vegetation. McClenaghan and Montgomery (1998), however, found more males and females in reproductive condition in June than in November, when reduced reproductive activity may be expected, indicating potential regional seasonal variation in reproduction.

Table 2. Key Seasonal Periods for Amargosa Vole

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>March</th>
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<th>June</th>
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<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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<tbody>
<tr>
<td>Breeding</td>
<td>X</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td></td>
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<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

**Notes:** Reproduction is generally associated with production of green vegetation. Voles can reproduce year-round.  
**Sources:** Cudworth and Koprowski 2010; CDFG pers. comm. 2011).
about 6 weeks of the first major rainfall of the season (Cudworth and Koprowski 2010). Not only are adult females highly productive, juvenile females can be reproductive by 3 weeks of age and males can be reproductive by 6 weeks of age (Cudworth and Koprowski 2010). However, sexual maturation may be related to social factors and mediated by pheromones produced by the family group (Batzli et al. 1977). Batzli et al. (1977) found that California vole littermates suppress growth and sexual maturation when kept in the same cage while isolated individuals were not suppressed.

With a long breeding season, postpartum estrus, large litter sizes, and reproduction by young of the year, vole populations can expand very rapidly. However, voles also exhibit high nestling and juvenile mortality. One study estimated 35% nestling mortality and early juvenile mortality of 0% to 82% (Cudworth and Koprowski 2010). Based on mark-recapture data, McClenaghan and Montgomery (1998) estimated an 83% month-to-month survival rate and a 32% 5-month survival rate for the Amargosa vole. Generally, the lifespan of the vole is fairly short (i.e., less than 1 year), but McClenaghan and Montgomery (1998) documented one individual Amargosa vole living at least 1 year.

Not all vole species exhibit cyclical population fluctuations, and too little information is available to determine whether the Amargosa vole exhibits population irruptions (an irregular, abrupt increase in a population related to environmental factors) and crashes seen in other vole populations (USFWS 2009).

**Spatial Behavior**

California voles are sedentary and have small home ranges, but the size of home ranges vary with season and population density (Cudworth and Koprowski 2010). One study estimated home ranges of 0.02 acre (732 feet²) for females and 0.03 acre (1,109 feet²) for males (Cudworth and Koprowski 2010). A male’s home range may overlap the home ranges of several females, and voles live in family groups of one male, up to several females, and their offspring. Males tend to maintain ranges exclusive of other male ranges (Cudworth and Koprowski 2010).
The majority of a vole’s daily activity occurs within 16–17 feet of the burrow (Cudworth and Koprowski 2010). Voles may be active throughout the day, with peaks of activity typically occurring at dusk and dawn, although they may become more nocturnal during the hot summer months (Cudworth and Koprowski 2010). Males exhibit shorter distance movements than females during the non-breeding season, but longer distance movements during the breeding season, with a peak at the onset of the breeding season. Movements by females increase in July and peak in January (Cudworth and Koprowski 2010).

All age classes of voles disperse, but dispersal by the Amargosa vole may be limited by the spatial patchiness of suitable marsh habitat (USFWS 2009; Cudworth and Koprowski 2010).

**Ecological Relationships**

Where present, voles are often one of the most common members of the rodent community, and the species may negatively affect at least one other native rodent species, the western harvest mouse (*Reithrodontomys megalotis*), where they co-occur (Heske et al. 1984). In a 6-year study in Contra Costa County, California, harvest mouse populations increased on study sites when voles occurred in low densities, but declined to very low numbers or extirpation when vole populations irrupted (Heske et al. 1984). Heske et al. (1984) concluded that severe behavioral interactions occurring at high vole densities was likely responsible for the decline in the harvest mouse rather than a decline in habitat quality or an increase in predators, but whether there was interference with harvest mouse reproduction by voles could not be determined.

Voles may have a substantial effect on their environment, which may affect population cycles. Batzli and Pitelka (1971) found that high vole population densities can severely reduce grass crop and seed production. A reduction in available food may delay the onset of reproduction, which is highly dependent on environmental cues, such as the availability of green vegetation in the fall, or result in early termination of reproduction. These periodic food shortages may affect population cycles.
As one of the most common rodents and because of their flexible daily activity patterns, voles are prey for a variety of nocturnal and diurnal predators. Avian predators include American kestrel (*Falco sparverius*), northern harrier (*Circus cyaneus*), white-tailed kite (*Elanus leucurus*), red-tailed hawk (*Buteo jamaicensis*), barn owl (*Tyto alba*), great horned owl (*Bubo virginianus*), clapper rail (*Rallus longirostris*), and herons and egrets (family Ardeidae) (Cudworth and Koprowski 2010). White-tailed kites, in particular, appear to be attracted to areas with high vole densities (Warner and Rudd 1975). Voles are also prey for various snakes and mammals such as long-tailed weasel (*Mustela frenata*), striped skunk (*Mephitis mephitis*), spotted skunk (*Spilogale gracilis*), common raccoon (*Procyon lotor*), coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), and feral and pet cats (*Felis catus*) (Pearson 1971; Cudworth and Koprowski 2010).

Because voles may be a preferred prey item, predators can exert a severe effect on vole populations (Pearson 1971). On a 35-acre study site in Tilden Park, California, Pearson (1971) determined that voles were the primary prey of feral cats, skunks, raccoons, and foxes, despite high densities of other potential prey, including rodents, rabbits, and lizards and snakes. From June 1961 until spring 1962, when reproduction began again, these carnivores preyed on 88% of the existing vole population (Pearson 1964). Pearson (1971) suggests that predation is a primary factor in controlling population cycles because as populations decline, the number of predators ultimately declines, until a new irruption of voles occurs.

### Population Status and Trends

**Global:** Critically Imperiled (*NatureServe 2010*)

**State:** Same as above

**Within Plan Area:** Same as above

As summarized in the species’ 5-year review, the data on status and trends are inconclusive because of a lack of key baseline information (*USFWS 2009*). The McClenaghan and Montgomery (1998) study provides the most complete set of currently available. (Note to reader: CDFG has completed a recent study in 2010–2011, the results of which will be incorporated into the profile when they become publicly available.) They found the Amargosa vole at the eight sites known to be
occupied in the mid- to late 1980s, and also found three new occupied sites, suggesting that the population may at least be stable, if not expanding. However, trapping at 23 of 31 sites that had suitable habitat was insufficient to reliably assess presence or absence (USFWS 2009). With regard to population trends, because only eight sites have been trapped by more than one investigator since the 1970s, an assessment of trends (which would require repeated comparable surveys over time) cannot be made (USFWS 2009). Therefore, the data collected to date are adequate only to assess presence.

**Threats and Environmental Stressors**

Historic threats to the Amargosa vole have included destruction of marsh habitat. The type locality at a spring near Shoshone was converted to a hog farm by 1918, as reported by Kellogg (CDFG 2012). Other historic impacts included livestock grazing, burning of marsh for pasture, diversion and channelization of springs in the Shoshone area, and development of mineral baths and mobile home courts in the Tecopa Hot Springs area (USFWS 2009). Construction of the Tonopah and Tidewater Railroad line, Tecopa Hot Springs Road, and the Old Spanish Trail Highway also may have altered ponding patterns and degraded habitat for the Amargosa vole (USFWS 2009).

Historic threats that are no longer considered to be a substantial threat to the Amargosa vole are cattle grazing and purposeful burning, although localized burning on private property continues to be a local threat (USFWS 2009). Large-scale wildfires are also a continuing threat.

While most of the suitable habitat for the Amargosa vole is now administered by BLM, CSLC, and TNC, some threats to the species are still present. Unresolved threats include groundwater pumping and development, tamarisk (*Tamarix* spp.) invasion, and water diversions and man-made barriers to natural spring flows (USFWS 2009). Groundwater pumping and development is not an issue directly within the Amargosa vole’s range, but future development of groundwater in the carbonate aquifer in the Pahrump Valley could affect habitat quality because the valley lies between the springs and the source of recharge for the aquifer (USFWS 2009). Tamarisk, which has infested several areas in Amargosa Canyon, may reduce the available surface water and displace active vegetation that provides...
Amargosa vole habitat. However, there is no current information about whether, or the extent to which, tamarisk has directly affected vole habitat (USFWS 2009).

Two non-native species associated with urban and rural development—domestic cat and house mouse (Mus musculus)—are potential threats to the Amargosa vole. Domestic and feral cats are known predators of voles and are considered to be potential predators of the Amargosa vole (Pearson 1964; USFWS 2009). The number of house mice at trapping sites was negatively correlated with the number of Amargosa voles, but whether there is direct or indirect interspecific competition (e.g., for resources) or direct behavioral exclusion is unknown (McClenaghan and Montgomery 1998; USFWS 2009).

A potential long-term threat to the Amargosa vole is habitat fragmentation and population isolation. Although the subspecies probably always existed in a naturally fragmented habitat, anthropogenic habitat loss and degradation has probably increased natural fragmentation and isolation. Based on an analysis of mitochondrial DNA and nuclear DNA, Neuwald (2010) determined that Amargosa vole exhibits significantly lower variation in both mitochondrial and nuclear DNA compared to a more broadly distributed subspecies (M. c. sanctidiegi). Heterozygosity was only 30% of that of the broadly distributed subspecies. Despite overall low genetic diversity, there were significant genetic differences among the Amargosa vole populations and no significant evidence of inbreeding.

The 5-Year Review: Summary and Evaluation also identified climate change as a potential future threat to the Amargosa vole because prolonged droughts could negatively affect marsh habitats (USFWS 2009). While broad-scale climate model predictions are for warmer temperatures in the northern hemisphere, more intense precipitation events, and increased summer continental drying, actual impacts at a smaller regional or sub-regional scale are too uncertain to make specific predictions on particular species (USFWS 2009).

(Note to reader: CDFG has completed a recent study in 2010–2011 for which a potential new threat is being analyzed. The profile will be updated when this new information becomes publicly available.)
Conservation and Management Activities

Prior to the listing of the Amargosa vole as federally endangered, BLM designated the Amargosa River and Grimshaw Lake Areas of Critical Environmental Concern (ACECs) (USFWS 2009). These ACECs encompass approximately 10,302 acres and include most of the suitable habitat for the Amargosa vole. In 2006, BLM published the Amargosa River Area of Critical Environmental Concern Implementation Plan (BLM 2006). The implementation plan sets forth management goals for the ACEC, which generally include protection, restoration, and enhancement of natural riparian and wetland systems and endangered and threatened species habitat; inventory and monitoring; and accommodation of public recreation consistent with resource protection. Based on the goals, the implementation plan identifies management actions, several of which will likely directly benefit the Amargosa vole and its habitat, including, but not limited to:

- Control tamarisk within and upstream of the ACEC
- Actively restore areas of weed control and priority damaged areas
- Prohibit ground fires in the ACEC
- Evaluate current and proposed land use authorizations for potential adverse impacts to listed species
- Eliminate bathing at native hot springs located in suitable habitat for the Amargosa vole
- Reduce house mice and free-roaming domestic and feral cats
- Reduce and modify, as necessary, the fire management plan to provide protection for listed species
- Develop a formalized agreement between BLM, CDFG, the U.S. Geological Survey, and USFWS for the implementation of actions in the Amargosa Vole Recovery Plan and encourage the establishment of an interagency Amargosa vole recovery team
- Prohibit new non-administrative, discretionary stream diversions and groundwater-disturbing activities on public lands within the ACEC
- Monitor and evaluate habitat trends and conditions specific to listed species on public lands throughout the ACEC.
In addition to the goals and implementation actions identified by BLM for the Amargosa River ACEC, the 5-Year Review: Summary and Evaluation discusses conservation and management activities that have been planned and undertaken since the species was federally listed in 1984 (USFWS 2009). These activities are briefly summarized here.

Since the listing, TNC, in coordination with the Amargosa Conservancy, acquired approximately 2,700 acres of private land in Tecopa and the Tecopa Hot Springs area to help consolidate management in the ACECs. CDFG, TNC, USFWS, and the Desert Managers Group obtained a Section 6 grant to acquire a 40-acre parcel near Tecopa Hot Springs that contains occupied Amargosa vole habitat. CDFG also funded the 1997 survey conducted by McClenaghan and Montgomery (1998) described previously.

The 5-Year Review: Summary and Evaluation also summarizes the status of the recovery actions from the 1997 recovery plan (USFWS 1997, 2009). BLM, CDFG, TNC, and USFWS have taken steps to acquire land supporting the Amargosa vole, and BLM has prepared the management plan for the Amargosa River ACEC. However, many spring sources to the river are still in private ownership and unprotected from diversions and channelization. Some local burning of bulrush vegetation continues to affect Amargosa vole habitat. Groundwater development in the Pahrump Valley that could affect spring outflows continues to be a concern.

Along with the listing of the Amargosa vole as federally endangered, USFWS has designated approximately 4,520 acres of critical habitat (49 FR 45160–15164) (Figure SP-M1). Although the critical habitat designation does not specify specific conservation measures, it requires that evaluations of potential impacts to critical habitat be made on projects with a federal nexus (e.g., a federal permit action or funding) and may result in protection measures to avoid adverse modification or destruction of critical habitats associated with the project.

**Data Characterization**

As discussed previously, information for the Amargosa vole is inadequate to assess the overall population status and trends. Until the 1970s, the subspecies was thought to be extinct, and since that
time there have been only six reports on trapping surveys (Bleich 1979; USFWS 2009). Only eight sites have been trapped by more than one investigator, and the level of trapping in 1997 on 23 sites with apparently suitable habitat was not sufficient to determine presence or absence (USFWS 2009). However, the geographic range limits of the Amargosa vole are well understood and it is unlikely that additional surveys would significantly extend the range of the subspecies. The main uncertainty is the distribution of the Amargosa vole within its current known range in suitable marsh habitat pockets.

Management and Monitoring Considerations

Most of the occupied and otherwise suitable marsh habitat for the Amargosa vole is now protected through the efforts of BLM, CDFG, TNC, and USFWS. The main concern for now and the future is the long-term management and monitoring of the Amargosa vole and its habitat to ensure that the subspecies persists or expands within its range. Ongoing threats that require management and monitoring include localized burning of marsh habitat, tamarisk invasion, diversion of spring outflows, groundwater pumping from the carbonate aquifer, house mice and domestic and feral cats, and potential genetic impacts from small fragmented populations (USFWS 2009). As discussed previously in the Conservation and Management Activities section, the Amargosa River Area of Critical Environmental Concern Implementation Plan (BLM 2006) includes a comprehensive set of implementation actions that includes management and monitoring considerations to address these ongoing threats. With respect to genetics, maintaining ephemeral tributaries for dispersal between population clusters is critical (Neuwald 2010).

Predicted Species Distribution in Plan Area

A species habitat model was not completed at this time for the Amargosa vole because existing information is considered to be complete for depicting the subspecies’ geographic range and potential habitat areas within its range. Figure SP-M1 in Appendix C shows the wetland habitat within the potential range of the Amargosa vole, which covers 2,491 acres in the Plan Area. Figure SP-M1 shows the specific locations where the Amargosa vole was trapped by McClenaghan and
Montgomery (1998). Figure SP-M1 also shows sites that were trapped because habitat was determined to be suitable, but trapping results were negative. These sites may be considered to contain suitable habitat, but are currently not occupied. The exception is Site #40, which was previously occupied, but no longer supports suitable habitat.

In addition, based on the yet unpublished recent CDFG study, a suitable habitat model may be developed (CDFG pers. comm. 2011). This habitat model will be used if and when it becomes publicly available.

**Literature Cited**


CDFG (California Department of Fish and Game). 2011. Unpublished data in personal communication from T. Branston (CDFG) to P. Behrends (Dudek) regarding results of CDFG study.
conducted from September 2010–April 2011 and received in comment on draft species profile.


FIGURE SP-M1
Amargosa Vole Occurrences in the Plan Area (N=7)

Species Range in California
NOTE: Range is for Microtus californicus


Note: Occurrence point size graphically represents the precision level code for the data point but is not scaled geographically.