

Riparian Woodrat
(Neotoma fuscipes riparia)

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

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

June 2012

5-YEAR REVIEW

Riparian Woodrat (*Neotoma fuscipes riparia*)

I. GENERAL INFORMATION

Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing of a species as endangered or threatened is based on the existence of threats attributable to one or more of the five threat factors described in section 4(a)(1) of the Act, and we must consider these same five factors in any subsequent consideration of reclassification or delisting of a species. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process defined in the Act that includes public review and comment.

Species Overview:

As summarized from the 1998 *Recovery Plan for Upland Species of the San Joaquin Valley* (Recovery Plan), the riparian woodrat (*Neotoma fuscipes riparia*) is a subspecies of dusky-footed woodrat, typically weighing between 200 to 400 grams, with a stocky build and a tail that is well furred and not scaled (Service 1998). The riparian woodrat is a relatively large rodent with cinnamon to gray-brown fur and a white underbelly. Dusky-footed woodrats can be distinguished from other adjacent subspecies of woodrats by a generally larger size, lighter, grayer fur coloration, hind feet with a white upper surface (instead of the dusky color associated with other subspecies), and a bicolored tail that is more distinctly darker on its dorsal surface and lighter on its ventral surface than other subspecies of *Neotoma fuscipes*. (Service 2000a). Like other woodrat species, the riparian woodrat is nocturnal and exhibits sexual dimorphism, with adult males being generally larger than adult females (Kelly et al. 2009). Kelly (pers. comm. 2011a) has noted that riparian woodrats found at the San Joaquin River National Wildlife Refuge (SJRNWR) seem to have a darker cinnamon fur color than those at Caswell Memorial State Park (CMSP). There are two known populations in the same general area of California: one within CMSP, and the other approximately five miles away within the SJRNWR (Kelly et al. 2009, Kelly et al. 2011). At both sites, the riparian woodrat prefers to occupy multi-storied riparian habitat, consisting of a shrubby understory, a midstory of willows or vines, and a well-developed overstory of valley oaks or other large trees (Gerber et al. 2003, Kelly et al. 2011).

Methodology Used to Complete This Review:

This review was prepared by a staff biologist within the Sacramento Fish and Wildlife Office following the Region 8 guidance issued in March 2008. We used information from the Recovery Plan, survey information from experts who have been monitoring various localities of this species, and the California Natural Diversity Database (CNDDDB) maintained by the California Department of Fish and Game. The Recovery Plan, personal communications with experts, and a review of literature published since 2000 were our primary sources of information used to review the species' status and threats. We received no information from the public in response to our Federal Notice initiating this 5-year review. This 5-year review contains updated information on the species' biology and threats, and an assessment of that information compared to information known at the time of listing or since the last 5-year review. We focus on current threats to the species that are attributable to the Act's five listing factors. The review synthesizes all this information to evaluate the listing status of the species and provide an indication of its progress towards recovery. Finally, based on this synthesis and the threats identified in the five-factor analysis, we recommend a prioritized list of conservation actions to be completed or initiated within the next 5 years.

Contact Information:

Lead Regional Office: Larry Rabin, Deputy Division Chief for Listing, Recovery, and Environmental Contaminants; Pacific Southwest Region, (916) 414-6464.

Lead Field Office: Josh Hull, Recovery Division Chief; Sacramento Fish and Wildlife Office, 916-414-6600

Cooperating Field Office(s): Bay-Delta Fish and Wildlife Office

Federal Register (FR) Notice Citation Announcing Initiation of This Review: A notice announcing initiation of the 5-year review of this taxon and the opening of a 60-day period to receive information from the public was published in the Federal Register on May 21, 2010 (Service 2010).

Listing History:

Original Listing

FR Notice: 65 FR 8881

Date of Final Listing Rule: February 23, 2000

Entity Listed: Riparian Woodrat, (*Neotoma fuscipes riparia*), a mammal subspecies

Classification: Endangered

State Status: Riparian Woodrat, (*Neotoma fuscipes riparia*), California Department of Fish and Game - Species of Special Concern

Associated Rulemakings: None

Review History:

No previous reviews of this species have been conducted.

Species' Recovery Priority Number at Start of 5-Year Review:

The recovery priority number for the riparian woodrat is 6C according to the Service's 2011 Recovery Data Call for the Sacramento Fish and Wildlife Office, based on a 1-18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Service 1983). This number indicates that the taxon is a subspecies that faces possible extinction from stochastic events and has a low potential for recovery. The "C" indicates conflict with construction or other development projects or other forms of economic activity.

Recovery Plan or Outline

Name of Plan or Outline: *Recovery Plan for Upland Species of the San Joaquin Valley, California*

Date Issued: September 30, 1998

While this species is mentioned in the Recovery Plan, the species was listed as a species of concern at the time this recovery plan was written and published. Although recovery criteria were not detailed in the plan, long-term conservation criteria were provided.

II. REVIEW ANALYSIS

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 (DPS) of any species of vertebrate wildlife. This definition of species under the Act limits listing as distinct population segments to species of vertebrate fish or wildlife. The 1996 Policy Regarding the Recognition of Distinct Vertebrate Population Segments under the Endangered Species act (Service 1996) clarifies the interpretation of the phrase "distinct population segment" for the purposes of listing, delisting, and reclassifying species under the Act.

The riparian woodrat is not listed as a DPS. Dr. Marjorie Matocq of the University of Nevada, Reno, is conducting research that may clarify the phylogenetic relationship between known riparian woodrat populations and other subspecies; however, this work is too preliminary to be used in this review. According to Kelly (pers. comm. 2011b, 2011c), Matocq's research may indicate that the CMSP and SJRNWR populations of riparian woodrats are genetically distinct from one another, and may even be allied to two different species of *Neotoma*, *Neotoma fuscipes* and *Neotoma macrotis* (Kelly et al. 2011, Matocq 2002a). This possibility is suggested by Matocq's (2002a) research on the genetics of the genus *Neotoma*. Based on mitochondrial DNA, Matocq (2002b) showed that the CMSP population of riparian woodrats was more closely related to *N. macrotis* than *N. fuscipes*, suggesting the potential need to consider this population as *Neotoma macrotis riparia* rather than *Neotoma fuscipes riparia*, if this result is substantiated

by further data (Matocq, pers. comm. 2011). This should be examined during the next 5-year review.

Information on the Species and its Status

Species Spatial and Distribution

The following information is paraphrased from the Recovery Plan:

It is thought that the riparian woodrat once ranged within riparian habitat from the type locality near Vernalis, California, to southern Merced County or northern Fresno County (Hooper 1938). Although the Recovery Plan preceded listing, conservation measures for the riparian woodrat had been described and included within it. Those conservation measures were based largely on the fact that the riparian woodrat was known only to exist as a single population within CMSP, information that was still thought to be accurate at the time of listing.

Since it was listed, an additional population has been discovered on the SJRNWR south of the confluence of the Stanislaus and San Joaquin Rivers (Kelly et al. 2009, Kelly et al. 2011, Matocq 2002a). This newly discovered population may be quite vulnerable: only 34 individuals have been captured (at different times) and no stick lodges have been observed anywhere in the refuge, although riparian woodrats are known to use downed trees, snags, or even buildings in place of constructing stick lodges (Kelly et al. 2011). Further, although the CMSP population is thought to be fairly robust, use of stick lodges appears to be relatively rare, so absence of stick lodges should not be used as an index of population size (Kelly et al. 2011). Figure 1 depicts the historic and currently extant occurrences of riparian woodrats. It is important to note that no focused surveys or studies have been conducted for riparian woodrats at the SJRNWR. There is no other new information about trends in spatial distribution.

Figure 1: Historic and unreported occurrences of riparian woodrats. Historic occurrences are compiled from documented occurrences in the California Natural Diversity Database (CNDDDB) as well as occurrences documented in the 2000 listing rule. ESRP occurrences were discovered by California State University, Stanislaus' Endangered Species Recovery Program during live trapping activity, and have not been reported to the CNDDDB. Of the historic occurrences, only those at CMSP are known to be extant. All ESRP occurrences are presumed to be extant.

Abundance

Trapping of riparian woodrats has occurred occasionally since the species was listed, but these trapping activities were not intended to estimate overall population size or density. At this time, based upon trapping success, it is thought that CMSP has both a higher population density and more individuals than the population at the SJRNWR (Kelly et al. 2009, Kelly et al. 2011). Abundance at CMSP is assumed to be similar to that when the species was listed, although fluctuations may have occurred in the population in response to fire and flood events. A wildfire event in 2004 and major flood events in 2006 and 2011 may have significantly reduced the riparian woodrat population at SJRNWR (Kelly et al. 2011).

Habitat or Ecosystem

N. fuscipes (and *N. macrotis*) prefer habitat with a large amount of overall structure, with both understory vegetation and overstory cover (Gerber et al 2003). Although no studies have been performed to determine the specific habitat needs of the species, at CMSP riparian woodrats are most often observed in areas with a valley oak overstory and a wild grape (*Vitis californica*), willow (*Salix* sp.), blackberry (*Rubus discolor* or *Rubus ursinus*), wild rose (*Rosa californica*), or coyote bush (*Baccharis pilularis*) understory (Kelly et al. 2011). In addition, the best quality habitat appears to contain a significant midstory component of vines or small trees, which the riparian woodrat is thought to utilize in order to access the canopy, where they do a substantial amount of their foraging (Kelly et al. 2011). Other important components of riparian woodrat habitat include wooded or shrub-covered upland refugia to facilitate escape from flood events while preventing predation, and downed trees and dead snags that are used in place of stick lodges (Kelly et al. 2011). While specific information on the diet of the riparian woodrat is scant, most woodrat species are generalist herbivores, eating a wide variety of foliage and possibly fungi (Service 2000a).

Approximately 95% of the riparian woodrat's habitat has been lost (Service 2000a). Causes of habitat loss include large scale land conversions to agriculture, extensive flood control projects in the form of levees, and an altered hydrology regime in the central valley due to the construction of dams and the subsequent diversion of water for agricultural and municipal uses (Service 2000a). Currently, both known populations of riparian woodrat are on protected lands. CMSP is protected by the State of California, and the SJRNWR is protected by the federal government. The riparian woodrat could benefit from a plan to extend the SJRNWR northward along the San Joaquin River, as well as southward to connect with the San Luis National Wildlife Refuge. This plan, while promising, is still in the early exploratory stages of development, and may not come to fruition. Ongoing restoration of riparian vegetation at the SJRNWR is of direct benefit to the riparian woodrat, and will provide expanded habitat for the riparian woodrat once the restoration work has matured. Currently, River Partners has restored over 1700 acres of wooded riparian habitat at the SJRNWR (SJRNWR 2011).

Changes in Taxonomic Classification or Nomenclature

There have been no changes since the time of listing. Currently available research suggests that the riparian woodrat should be classified as *Neotoma macrotis riparia* rather than *Neotoma*

fuscipes riparia. It is possible that genetic research currently being compiled by Dr. Marjorie Matocq will be available for the next 5-year review, and will clarify the species' classification.

Genetics

Matocq's (2002a) genetic study of *Neotoma fuscipes* as well as her analysis of *N. fuscipes* and *N. macrotis* (2002b) suggest that *Neotoma macrotis* be recognized as a distinct species from *N. fuscipes* (Matocq, pers. comm. 2011). Mammologists have largely accepted this new taxonomy (Kelly, pers. comm. 2011b, Matocq, pers. comm. 2011). Matocq (2002a) raised the possibility of hybridization as a possible explanation for the genetic results obtained from the CMSP population of riparian woodrats, which, based on mitochondrial DNA, were shown to be more closely related to *N. macrotis* of the Sierra Nevada foothills to the east of CMSP, contrasting with earlier assumptions that the riparian woodrat had originated from *N. fuscipes* found west of CMSP in the coast ranges (Matocq, pers. comm. 2011). Unpublished research by Matocq using both mitochondrial and nuclear genetic markers may clarify the relationship to other woodrat populations in the coast ranges and the Sierra Nevada foothills, and should be examined closely during the next 5-year review (Kelly et al. 2011, Kelly pers. comm. 2011b, Kelly pers. comm. 2011c, Matocq, pers. comm. 2011).

Species-specific Research and/or Grant-supported Activities

Research

Gerber, L.R., Seabloom, E.W., Burton, R.S., and Reichman, O.J. 2003. Translocation of an Imperilled Woodrat Population: Integrating Spatial and Habitat Patterns. *Animal Conservation* 6: 309-316.

Summary

Dr. Gerber et al. examined the habitat needs of the dusky-footed woodrat, *Neotoma fuscipes* to determine what habitat criteria are most favorable for successful translocation. Their results indicated that *Neotoma fuscipes* differentially selects den sites with high density overstory and understory. Although this research was not performed on riparian woodrats specifically, it supports other observations about the riparian woodrat's denning preferences.

Kelly, P.A., Cypher, B.L., Williams, D.F., and Sproull, K. 2009. Community Ecology of Riparian Woodrats and Black Rats at Caswell Memorial State Park: Investigating the Role of an Exotic Species in the Decline of a Native Keystone Species. California State University Stanislaus Endangered Species Recovery Program. Prepared for the U.S. Bureau of Reclamation.

Summary

The authors examined the effects of exotic black rats (*Rattus rattus*) on abundance and reproductive success of riparian woodrats. Their results suggest that woodrat reproductive success is higher in areas where black rats have been removed. They

hypothesize that a difference in reproductive success may be due to predation on woodrat nestlings by black rats.

Matocq, Marjorie D. 2002. Morphological and Molecular Analysis of a Contact Zone in the *Neotoma fuscipes* Species Complex. *Journal of Mammalogy* 83:866-883

Summary

Dr. Matocq presented evidence supporting splitting of *Neotoma fuscipes* into *N. fuscipes* and *N. macrotis*, by elevating *N. f. macrotis* from a subspecies to a species. This classification has since been largely accepted by mammalogists, according to Kelly (pers. comm. 2011b) and Matocq (pers. comm. 2011). The study has implications for the riparian woodrat because the woodrat, at least the CMSP population, may be more correctly classified as *Neotoma macrotis riparia*.

Matocq, Marjorie D. 2002. Phylogeographical Structure and Regional History of the Dusky Footed Woodrat (*Neotoma fuscipes*). *Molecular Ecology* 11 : 229-242

Summary

Dr. Matocq examined the phylogenetic relationships between all species and subspecies of *Neotoma fuscipes*. Of particular note is the possibility her results raised that the CMSP and SJRNWR populations of *Neotoma fuscipes riparia* may in fact be two different subspecies, or may actually be *Neotoma macrotis riparia*. Her results suggest that *N. f. riparia* has genetic characteristics most similar to those of an east-central foothills clade of *N. fuscipes*. Morphological characteristics of *N. f. riparia* were not examined in the study due to lack of available specimens.

Other Information

At the time of this review, Dr. Matocq is compiling a manuscript that describes the specific genetics of the riparian woodrat based on genetic data collected at the SJRNWR and CMSP. Her results were not complete enough for her to share with the Service, and the published work should be examined during the next 5-year review. Her study is tentatively titled *Genetic and Morphological Variation of the San Joaquin National Wildlife Refuge and Caswell Memorial State Park Woodrat Populations*.

Grant Supported Activities

CALFED Project #ERP-01-N08 (San Joaquin A and B Restoration Plan)

Summary

Funding awarded to restore 777 acres of riparian habitat on the west bank of the San Joaquin River in the SJRNWR, divided into two phases, Restoration Project A, and Restoration Project B. Restoration Project A was initiated in 2001, and restored 279 acres of riparian habitat. Mixed riparian forest was planted, with valley oaks at a maximum density of approximately 55 plants per acre, often mixed with Fremont cottonwoods planted at up to 64 plants per acre. Various other species were planted to benefit the riparian brush rabbit, and should benefit the riparian woodrat as well once the restoration has matured. Restoration Project B restored 551 acres similarly to Restoration

Project A, although the valley oak plantings were much more extensive. Restoration Project A was conducted from 2001 through 2004. Restoration Project B was conducted from the summer of 2002 through the spring of 2005. Active, adaptive management of both projects is ongoing (River Partners 2002a, River Partners 2002b).

California Department of Water Resources Flood Protection Corridor Program, Contract Number 4600003357 (2006)

Summary

Riparian restoration work on the Vierra Tract in the SJRNWR. Project work included the restoration of 260 acres of riparian habitat and the creation of 151 acres of wetlands. Funding was secured in 2003. Riparian woodland restoration on the Vierra Tract consisted of plantings of valley oaks at a density of 227 plants per acre on some parts of the Tract, along with Fremont cottonwoods and various understory species. This project began in the winter of 2004 and was complete at the end of 2006. Active, adaptive management is ongoing (River Partners 2006a).

State of California Wildlife Conservation Board Grant (Proposition 117 Funding), 2007

Summary

Riparian restoration work on the Hagemann Unit of the SJRNWR, directly west of restoration work done through CALFED Project ##ERP-01-N08 funding, listed above. This project restored 177 acres of agricultural field to mixed riparian woodland with the majority of the restoration consisting of understory plants to benefit the riparian brush rabbit. Work began in January of 2007 and was completed in January, 2010. Active, adaptive management is ongoing (River Partners 2007, River Partners 2008a).

CALFED Project #01-N11, July 18 2007

Summary

A grant of approximately \$2.5 million for the acquisition of land for the purpose of enlarging the SJRNWR. Buffington Tract was acquired, connecting the SJRNWR with CMSP east of the confluence of the San Joaquin and Stanislaus Rivers (River Partners 2008b).

CALFED Agreement Number F-05-ER-041, April – June 2008

Summary

\$5,465,944.00 grant awarded to River Partners, ESRP, and the SJRNWR. Some of the grant money was used by River Partners to restore riparian vegetation on Buffington Tract, a parcel acquired by the SJRNWR as a result of CALFED Project #01-N11. This also funded 53 acres of riparian restoration work on the Buffington Tract, as well as funding for ESRP's riparian brush rabbit breeding program (River Partners 2008b).

River Partners Restoration of Arambel Tract in the SJRNWR

Summary

River Partners received Central Valley Project Improvement Act funding to restore 223 acres of riparian habitat on the southernmost portion of the SJRNWR. This restoration planted over 20,000 woody trees and shrubs (River partners 2008c).

Other Non-grant, Non-research Related Activity:

ESRP's Riparian Mammals Technical Group

Summary

The Riparian Mammals Technical Group (RMTG) meets quarterly to discuss endangered mammals. Most of their discussions focus on the riparian brush rabbit, although from time to time the riparian woodrat is discussed. The RMTG input has directly influenced River Partners' restoration designs (Rentner, *in litt.* 2011).

Five-Factor Analysis

The following five-factor analysis describes and evaluates the threats attributable to one or more of the five listing factors outlined in section 4(a)(1) of the Act.

FACTOR A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

At the time of listing, the threats under factor A were a large scale destruction of riparian habitat due to urban, commercial, and agricultural development, combined with flood control and reclamation activities such as river channelization, levee construction, dam construction, water diversion, and groundwater pumping (Service 2000a). Areas surrounding levees have been entirely cleared of riparian vegetation and the topography has been leveled and planted with row crops, vineyards, and orchards, leaving no avenues for the riparian woodrat to disperse from its current occupied habitat. Levee construction and stream channelization has degraded the quality of the remaining habitat by increasing the size and duration of flood events within the levees (Service 2000a). These threats are largely the same as they were at the time of listing; however, there may be increased fire risk at CMSP because CMSP staff do not currently manage fire fuel loads within the park (Karlton pers. comm. 2011b).

A population of riparian woodrats has been discovered since it was listed. This population exists on lands protected by the federal government. River Partners, partnered with the Service, has undertaken extensive riparian habitat restoration on the SJRNWR. Restoration work ranges from wetland restoration to riparian forest restoration. According to the SJRNWR (2011) website, over 1700 acres of habitat has been restored, with over 400,000 native riparian trees planted on that 1700 acres. This restoration work has restored riparian forest habitat in areas associated with the newly discovered population of riparian woodrats. As the riparian forests mature, it can reasonably be expected that their utilization by riparian woodrats will increase, providing that the population does not become extinct in the interim. River Partners plans to perform restoration

work along the lower Tuolumne River at its confluence with the San Joaquin River. This restoration would abut the SJRNWR on its southern boundary, and would connect the restored habitat on the SJRNWR to small areas of restored habitat on the Tuolumne River (River Partners 2006b).

The Service is currently in the exploratory phase of extending the SJRNWR farther north along the San Joaquin River as well as southwards to link up with the San Luis National Wildlife Refuge System (Service 2011). The San Joaquin Council of Governments (SJCOG), the administrative entity for the San Joaquin County Multi-Species Conservation Plan (SJMSCP), has expressed interest in coordinating its mitigation obligations with the Service to augment any land the Service might acquire with adjacent preserve land to be held by SJCOG (Mayo, pers. comm. 2011). If the Service expands the SJRNWR, the combined acquisitions could be very important for the recovery of the riparian woodrat, assuming the riparian woodrat could be successfully reintroduced onto these preserve lands. Significant hurdles exist in regards to the northward expansion of the SJRNWR. The San Joaquin Board of Supervisors voted against the idea of the plan when the SJRNWR refuge manager Kim Forrest gave an outreach presentation on the topic (SJCBS 2011). Local landowners concerns raised against the idea included a notion that national wildlife refuges (NWR) lowered surrounding property values, increased federal scrutiny on private lands, that NWRs were nuisance landowners by allowing trash dumping to occur, or that the federal government would exercise eminent domain on their properties (SJCBS 2011). Refuge expansion will depend on local landowner willingness to sell land or accept conservation easements, and public outreach could help to explain the benefits of the NWRs or otherwise alleviate the concerns of the county supervisors and the general public.

FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Overutilization for commercial purposes was not known to be a factor in the final listing rule (Service 2000a). Overutilization for any purpose does not appear to be a threat at this time.

FACTOR C: Disease or Predation

Bubonic plague was listed as a possible disease threat in the 2000 listing rule. The small population size and extremely limited geographical distribution of the riparian woodrat causes it to be at heightened risk from an epidemic event (Service 2000a). There have been no reports of disease related mortality since the species was listed.

Predation from coyotes (*Canis latrans*), gray foxes (*Urocyon cinereoargenteus*), long tailed weasels (*Mustela frenata*), raccoons (*Procyon lotor*), feral domestic cats (*Felis domesticus*) and dogs (*Canis lupus familiaris*), owls (*Strigidae*), and other raptors was known to occur in the 2000 listing rule (Kelly et al. 2009, Service 2000a). Since listing, preliminary research by Kelly et al. (2009) indicates that exotic black rats (*Rattus rattus*) may compete with riparian woodrats for food resources or habitat. This research also suggests that black rat presence negatively impacts riparian woodrat reproductive success, although the mechanism for this interaction has not been explored. Nonetheless, Kelly et al. (2009) hypothesize that black rats may prey on juvenile riparian woodrats, with further research being necessary to support or reject this hypothesis.

Reproductive success could also be indirectly affected by black rat presence through reduced nourishment caused by competition for food resources, increased energy expenditure in defending stick lodges or other shelter, and reduced access to high quality habitat from competition with black rats (Kelly et al. 2009).

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

At the time of listing, regulatory mechanisms thought to have some potential to protect the riparian woodrat included: (1) section 404 of the Clean Water Act; and (2) the California Environmental Quality Act (CEQA). The 2000 listing rule provides an analysis of the level of protection that was anticipated from those regulatory mechanisms. This analysis remains valid.

Under section 404 of the Clean Water Act, the U.S. Army Corps of Engineers (Corps) regulates the discharge of fill material into waters of the United States, which include navigable and isolated waters, headwaters, and adjacent wetlands (33 U.S.C. 1344). In general, the term “wetland” refers to areas meeting the Corps’s criteria of hydric soils, hydrology (either sufficient annual flooding or water on the soil surface), and hydrophytic vegetation (plants specifically adapted for growing in wetlands). Any action with the potential to impact waters of the United States must be reviewed under the Clean Water Act, National Environmental Policy Act, and Endangered Species Act. These reviews require consideration of impacts to listed species and their habitats, and recommendations for mitigation of significant impacts.

Section 404 of the Clean Water Act does not protect against conversion of some types of riparian habitat, and does not regulate tree removal or clearing of brush. Where riparian habitat would meet the criteria of a water of the United States, section 404 of the Clean Water Act would provide some protection against the conversion of habitat, although it does not preclude it entirely.

CEQA requires review of any project that is undertaken, funded, or permitted by the State or a local governmental agency. If significant effects are identified, the lead agency has the option of requiring mitigation through changes in the project or to decide that overriding considerations make mitigation infeasible (CEQA section 21002). Protection of listed species through CEQA is, therefore, dependent upon the discretion of the lead agency involved. As such, CEQA may allow such an action to occur.

Additional protections not mentioned in the 2000 listing rule are the National Environmental Policy Act, the National Wildlife Refuge System Improvement Act of 1997, the San Joaquin County Multi-Species Conservation Plan (SJMSCP), a regional HCP, and the PG&E Operations and Management HCP (PG&E HCP), a regional HCP developed for the Pacific Gas and Electric Company.

NEPA (42 U.S.C. 4371 *et seq.*) provides some protection for listed species that may be affected by activities undertaken, authorized, or funded by Federal agencies. Prior to implementation of such projects with a Federal nexus, NEPA requires the agency to analyze the project for potential impacts to the human environment, including natural resources. In cases where that analysis reveals significant environmental effects, the Federal agency must propose mitigation

alternatives that would offset those effects (40 C.F.R. 1502.16). These mitigations usually provide some protection for listed species. However, NEPA does not require that adverse impacts be fully mitigated, only that impacts be assessed and the analysis disclosed to the public. NEPA is not triggered unless there is an action by a federal agency, and requires only that the lead federal agency disclose the environmental effects of its action; it does not require mitigation or avoidance. Still, the processes of disclosure itself, and the expense of compiling documents such as Environmental Impact Statements, are significant enough to afford some protection to the riparian woodrat.

The Endangered Species Act of 1973, as amended (ESA), is the primary Federal law providing protection for riparian woodrats. The Service's responsibilities include administering the ESA, including sections 7, 9, and 10 that address take. Since listing, the Service has analyzed the potential effects of Federal projects under section 7(a)(2), which requires Federal agencies to consult with the Service prior to authorizing, funding, or carrying out activities that may affect listed species. A jeopardy determination is made for a project that is reasonably expected, either directly or indirectly, to appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing its reproduction, numbers, or distribution (50 CFR 402.02). A non-jeopardy opinion may include reasonable and prudent measures that minimize the amount or extent of incidental take of listed species associated with a project. Incidental take refers to taking that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by a Federal agency or application (50 CFR 402.02). While projects that are likely to result in adverse effects often include minimization measures, the Service is limited to requesting minor modifications in the project description. In instances where some incidental take is unavoidable, the Service requires that additional measures be performed by the project proponents to compensate for negative impacts.

The National Wildlife Refuge System Improvement Act of 1997 establishes the protection of biodiversity as the primary purpose of the National Wildlife Refuge system. This has led to various management actions to benefit the federally listed species. Adherence to this policy has resulted in large scale riparian restoration activities on the SJRNWR that will directly benefit the riparian woodrat.

The SJMSCP covers many activities in San Joaquin County. Participants under the SJMSCP are required to practice complete avoidance of the riparian woodrat, and are not permitted to take any riparian woodrats. The implementing entity, the San Joaquin Council of Governments, gives strict incidental take minimization measures to any applicant who uses the plan. These incidental take minimization measures prohibit conversion of potential habitat for the riparian woodrat unless (1) a protocol level survey of the project area does not discover riparian woodrats; (2) the project is not a residential, commercial, industrial, or aggregate mining project; (3) the project will impact less than 0.25-acre of potential habitat; and (4) the project will not result in take of any riparian woodrats (Service 2000b). If these conditions are met, then the project must conform to the incidental take minimization measures for riparian habitat. The HCP limits total habitat conversion of riparian woodrat habitat to three acres for the life of the plan.

The PG&E HCP designates riparian woodrat-occupied habitat as being within two miles of a

CNDDDB occurrence polygon, and calls for any activity within designated occupied habitat to be staked and flagged to a minimum distance of 100 feet around the disturbance. In addition, PG&E is obligated to minimize the use of mechanical equipment in designated occupied riparian woodrat habitat, and must mitigate in kind for impacts within the riparian woodrat's designated occupied or potential habitat, whether they result in loss of habitat or not. To date PG&E has had no impacts in riparian woodrat habitat.

While these two HCPs provide a measure of protection for the riparian woodrat, the protection they provide is a direct result of the Endangered Species Act. The SJMSCP and PG&E HCP are 50 and 30 year plans, respectively, and while they would continue to offset effects from covered activities of these plans to the riparian woodrat if it were delisted or downlisted, this protection would be relatively short term. Since the riparian woodrat is unlikely to have significantly recovered in the next 40 years without large-scale habitat acquisition and restoration, the measures provided by these HCPs would be insufficient to ensure the riparian woodrat's survival and recovery. Furthermore, these HCPs are intended to avoid or minimize future impacts to riparian woodrats and their habitat and do not address significant habitat restoration. Since the only known populations reside on protected lands, these HCPs are not likely significantly aid in the recovery or of this species.

In summary, the Endangered Species Act is the primary Federal law that provides protection for this species since its listing as endangered in 2000. 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.

FACTOR E: Other Natural or Manmade Factors Affecting Its Continued Existence

As summarized from the listing rule, fire, flooding, inbreeding depression, genetic drift, and competition from exotic species were listed as the main natural threats to the riparian woodrat. All of these threats are magnified by the subspecies' overall small population size. Drought was correlated with a population decline as well, although a short drought could increase the carrying capacity of the woodrat's riparian habitat by reducing the number and/or duration of flood events (Service 2000a). Manmade factors included use of rodenticides in areas outside of CMSP, unknown effects from recreational vehicle and pedestrian traffic, and predation from feral cats and dogs. To date, effects from these unknown factors have not been studied, and the other manmade factors are presumed to be the same as they were in the 2000 listing.

Both populations of riparian woodrat stand at heightened risk of extinction due to random events. Both populations reside in locations prone to flooding. Riparian woodrats, due to their arboreal nature, are somewhat cushioned from experiencing direct mortality from flood events. Instead, flood events can destroy the stick lodges that are constructed by this species, and can impact the understory that is an important component of riparian woodrat habitat (Service 2000a). Minor flooding occurs approximately every two to three years in the various sloughs and channels in the SJRNWR, while major flooding occurs approximately every five years, during which most or all of the refuge is inundated (Rentner, *in litt.* 2011). Flooding at CMSP is not well documented,

but the park has not flooded in its entirety since before the year 2000 (Karlton, *in litt.* 2011d). In the winter of 2007 flooding in CMSP was significant enough to prevent travel within the park which limited access throughout the park by CMSP personnel, and CMSP personnel were unable to determine the extent of the flooding (Karlton, *in litt.* 2011d). The inability of CMSP staff to traverse the park in order to survey the extent of the flooding suggests that this flooding was extensive and a potential threat to the CMSP population of riparian woodrats.

Wildfire, while less common than flooding, has occurred at the SJRNWR. There have been two wildfire events on the SJRNWR since the species was listed. In 2004, the Pelican Fire burned over 1400 acres between July 19 and July 28. Sparked by a car fire on Highway 132, it burned much of the Christman Island area, some of which is known to be occupied by riparian woodrats (Rentner, *in litt.* 2011). More recently, in 2008, an arson-sparked fire broke out and burned the Lara and Arambel Tracts in the southern portion of the refuge. It is unknown to what extent this fire impacted the riparian woodrat because it is unknown if the woodrat occupies these areas (Rentner, *in litt.* 2011). Official records for wildfire events at CMSP are not available, although wildfire events have occurred and may have burned riparian woodrat habitat (Karlton, pers. comm. 2011a, Karlton, *in litt.* 2011c). Fuel reduction occurred at CMSP in 2001, and was performed by the California Conservation Corps. During this effort a California Conservation Corps worker disturbed a riparian woodrat nest hidden in a downed log and subsequently stepped on a juvenile riparian woodrat (Lee 2001). CMSP staff do not currently manage fuel loads within the park (Karlton, pers. comm. 2011b). Due to the lack of fuel management or recent wildfire activity, it is possible that fuel has accumulated within the park that would present an increased wildfire risk, or be subject to future fuel reduction efforts. Management of fuel loads can negatively impact riparian woodrats if large amounts of dead woody debris are removed as riparian woodrats use downed logs as shelter.

Research has shown that the annual mean temperature in North America has increased from 1955 to 2005. However, the magnitude varies spatially across the continent and is most pronounced during spring and winter months, and has affected daily minimum temperatures more than daily maximum temperatures (Field et al. 2007). Other effects of climate change include changes in types of precipitation (i.e., rain vs. snow), earlier spring run-off flow regimes, increased stream temperatures, and more generally, changes in the components of the stream hydrograph.

Climate models also predict an increase in precipitation over most of North America except for the southwestern United States (Christensen et al. 2007). In western North America, predicted increases of precipitation have a strong north-south orientation with higher precipitation expected in northern latitudes and lower precipitation in southern latitudes (Christensen et al. 2007). Due to predicted increases in warming, future precipitation events may be more likely to constitute rain than snow, especially during the spring. This may result in a reduced snowpack, earlier snowmelt, decrease spring runoff, and extension of the base flow period in the summer and fall (Hayhoe et al. 2004; Stewart et al. 2005; Knowles et al. 2006, Bates et al. 2008). An increase in rainfall may present a threat to the riparian woodrat in the form of increased flooding frequency, especially late in the rainy season.

III. RECOVERY CRITERIA

When the Recovery Plan was completed, the riparian woodrat had not yet been listed. As such, there is no recovery plan for this species, but the Recovery Plan contains several conservation measures intended to prevent extinction of the riparian woodrat. These conservation measures are as follows:

1. A survey and mapping of all riparian areas along the San Joaquin River.

To address Factor A, this conservation measure is intended to locate additional suitable habitat, as well as discover new populations of riparian woodrats. This conservation measure is both up-to-date and relevant for the conservation of the species. Implementation of this conservation measure would locate suitable habitat so that potential reintroductions of this species could occur. It could also locate previously unknown populations of riparian woodrats, which would expand the known range of the species. The discovery of new populations of riparian woodrats would broaden the gene pool for a translocation program (see conservation measure 4). While this conservation measure will not directly reduce the threat to the riparian woodrat as described in Factor A, it will do so indirectly by providing data that could be utilized for improved recovery planning. This conservation measure has not yet been implemented.

2. Develop, in collaboration with owners of riparian land and local levee-maintenance districts, an incentive program for preserving riparian vegetation.

This conservation measure addresses Factor A. This conservation measure is both up-to-date and relevant for the conservation of the species. Implementation of this measure would decrease development pressure on riparian habitat, thereby decreasing the threat of further habitat loss for the riparian woodrat. Collaboration with levee maintenance districts could lead to increased suitable habitat for the riparian woodrat by curtailing vegetation removal along levees. This conservation measure has not been implemented at this time.

3. Develop a plan for the restoration of riparian habitat, the establishment of riparian corridors, and the reintroduction, if necessary, of riparian woodrats to suitable habitat.

This conservation measure addresses Factor A and Factor E. This conservation measure is both up-to-date and relevant for the conservation of the species. Restoration work is extensive and ongoing at the SJRNWR. Establishment of riparian corridors and subsequent reintroduction of riparian woodrats would decrease the threats under Factor E by reducing the chance that a random catastrophic event could lead to the extinction of the species. Similarly, threats under Factor A would be decreased by creating newly restored habitat. Riparian corridors have been expanded only within the current boundaries of the SJRNWR. No formal plan detailing the restoration effort has been developed.

The establishment of a larger riparian corridor could be realized if the SJRNWR were to expand its boundaries northward along the San Joaquin River, as is currently being proposed by the Service.

4. Initiate a genetic study of the CMSP woodrats, and any other riparian woodrat populations that can be sampled, to determine inbreeding levels; and devise a procedure for ensuring that translocations neither reduce genetic diversity in the parent population nor unduly restrict it in the translocated population.

This conservation measure addresses Factor E. Genetic studies are necessary to determine the level of threat posed to the species by inbreeding depression. Translocation and reintroduction efforts must be performed in a manner that does not exacerbate the problem of inbreeding depression. Genetic studies of the riparian woodrat have been performed, but these were not intended to determine inbreeding levels. Instead, they were intended to better understand the genetic relationships of this subspecies to other species and subspecies within the genus *Neotoma*. As no reintroduction or translocation plan has yet been developed, there is no procedure in place for ensuring that translocations do not reduce genetic diversity in either a parent or translocated population at this time, and this conservation measure has not yet been implemented.

5. Establish conservation agreements with willing landowners that do not already have conservation easements, as appropriate and necessary, to accomplish habitat restoration, linkage, and reintroduction goals.

This conservation measure addresses Factor A. This conservation measure is both up-to-date and relevant for the conservation of the species. Establishment of conservation easements would protect the eased lands into perpetuity, providing a permanent refuge for the riparian woodrat. If planned properly, a connected system of these preserves could expand the range of the riparian woodrat, which would decrease the threat of extinction due to random events, or allow for rapid recolonization of areas impacted by random catastrophic events. Cooperation with the SJCOG could allow for the pursuit of SJCOG managed preserves situated close to riparian woodrat habitat. While a systematic effort to implement this conservation measure has not begun, the SJRNWR has acquired lands from willing landowners and expanded its boundaries significantly. Extensive restoration activity is taking place on these newly acquired lands. To what extent these restoration efforts are aiding in the recovery of the riparian woodrat is currently unknown.

6. Begin efforts to restore and link riparian habitat, and reintroduce woodrats as appropriate.

This conservation measure addresses Factors A and E. This conservation measure is both up-to-date and relevant for the conservation of the species. Satisfying this criterion will allow for a larger population of riparian woodrats, directly reversing the trend of habitat destruction thought to be most responsible for the endangerment of the species. This measure would have an added benefit of helping to insulate the species against inbreeding depression, as well as reduce the likelihood that a single random, catastrophic event could drive the species to extinction. As mentioned previously, extensive riparian restoration is ongoing at the SJRNWR, in partnership with River Partners, a nonprofit 501(c)3 organization. Efforts to expand the San Joaquin River National Refuge northward and southward along the San Joaquin River have the potential to provide an expanded, geographically linked area of suitable habitat for the riparian woodrat, especially if recovery efforts proceed as they have within the existing boundaries of the SJRNWR. Active reintroduction efforts have not occurred, but it is a reasonable assumption that

restored riparian woodland habitat will attract colonization from riparian woodrats from elsewhere in the SJRNWR once the habitat has sufficiently matured.

IV. SYNTHESIS

At the time of listing in 2000, a single population of the riparian woodrat was known to remain, a population at CMSP. In March, 2003, a second population of riparian woodrats was discovered at the SJRNWR. Between March, 2003, and November 2011, 34 individuals have been captured at the SJRNWR, which suggests a small population size. Further support for this is the fact that no stick lodges typical of the species have been observed at the SJRNWR (Kelly et al. 2011). Based on these observations, this population is believed to be vulnerable. These two populations are the only known populations of this species. Since 2000, the nonprofit River Partners has collaborated with the U.S. Fish and Wildlife Service through CALFED grant funding to restore riparian habitat on the SJRNWR. Some of this restoration will directly benefit the riparian woodrat by expanding the amount of riparian forest habitat available for the species to inhabit. Little peer-reviewed research has been conducted on the species since its listing. Research has been conducted on a conspecific to determine potential translocation and reintroduction strategies for the riparian woodrat, which may be of limited value because of the distinct needs of the species. Due to the continued small population size, as well as the relative isolation and constriction of the populations to a small geographic area, fires, floods, disease, exotic species, inbreeding depression, and genetic drift remain a significant threat to the extinction of this species. Because the threats to this species' survival are largely the same as they were when it was listed, we believe that the riparian woodrat still meets the definition of endangered, and recommend no status change at this time.

V. RESULTS

Recommended Listing Action:

- Downlist to Threatened
- Uplist to Endangered
- Delist (indicate reason for delisting according to 50 CFR 424.11):
- Extinction*
- Recovery*
- Original data for classification in error*
- No Change

New Recovery Priority Number and Brief Rationale:

3C

Due to the potential for riparian habit acquisition and restoration, coupled with the robust and ongoing restoration work performed by River Partners, the recovery potential for this species is improved. Furthermore, the isolation of the remaining populations and the propensity for their environment to experience catastrophic events place this species at high risk for extinction. Due to these factors, we recommend changing the recovery priority number to 3C to reflect its high

level of threat, improved recovery potential, and unchanged conflict with human activities, as outlined in Service 1983.

VI. RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS

1. A formal recovery plan for this species should be completed.
2. Aggressively pursue the expansion of the SJRNWR along the San Joaquin River, as is currently being examined, with emphasis on plans to connect the refuge with the San Luis NWR Complex. Restored riparian habitat within such an expansion could potentially reintroduce the riparian woodrat to much of its historical range.
3. Undertake or fund a genetic study to clarify the phylogenetic relationships of the woodrat populations at CMSP, the SJRNWR, and localities flanking the known occupied region.
4. Assess the fire fuel load at CMSP to determine the risk posed to riparian woodrats from catastrophic wildfire in the park. Fuel reduction efforts, if necessary, must take into account the relevant habitat requirements of the riparian woodrat, especially the use of downed logs and dead wood as shelter.
5. Perform population surveys of the SJRNWR, SJRNWR easement lands, and if possible, surrounding private property. Concurrently, the refuge should be examined to determine the habitat preferences of the species as the stick lodges typical of the species have not been observed. The Riparian Mammals Technical Group, and specifically C.S.U. Stanislaus' Endangered Species Recovery Program, should be approached about expanding the emphasis of their efforts to include the riparian woodrat.
6. Manage or eradicate populations of black rats (*Rattus rattus*) at CMSP and SJRNWR to reduce or eliminate competition from this exotic species. Management or eradication efforts should primarily be done using live trapping techniques, and must avoid the use of rodenticides. If possible, management or eradication efforts should be coupled with controlled experimental techniques to clarify the competitive relationships between black rats and riparian woodrats.
7. Survey the San Joaquin River and its tributaries within the known historic range of the woodrat, as well as the south Delta region, for suitable habitat for the species. If suitable habitat is located, it should be surveyed for riparian woodrats to locate additional isolated populations of the species. Unoccupied suitable habitat should be assessed for suitability for reintroduction of the species.

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

Riparian Woodrat (*Neotoma fuscipes riparia*)

Current Classification:

Recommendation Resulting from the 5-Year Review:

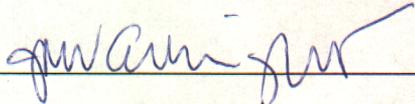
- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Review Conducted By: Joshua Emery, Sacramento Fish and Wildlife Office

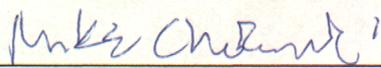
Date Submitted to Region 8: _____

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve  Date 20 June 2012

Cooperating Field Supervisor, Bay Delta Fish and Wildlife Office

Approve  Date 20 June 2012

REGIONAL OFFICE APPROVAL:

Lead Regional Director, U.S. Fish and Wildlife Service, Region 8

Approve _____ Date _____