Appendix 3.E
Conservation Principles for the Riparian Brush Rabbit & Riparian Woodrat

CONSERVATION PRINCIPLES FOR THE RIPARIAN BRUSH RABBIT & RIPARIAN WOODRAT

Prepared for:

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INTRODUCTION

Since 2001, biologists with the CSU Stanislaus, Endangered Species Recovery Program (ESRP) have been working in partnership with the Bureau of Reclamation, the U.S. Fish and Wildlife Service, the California Department of Fish and Game, the California Department of Water Resources, the California Department of Parks and Recreation, the UC Davis School of Veterinary Medicine, private land owners and others to recover the riparian brush rabbit (*Sylvilagus bachmani riparius*; RBR) through a controlled propagation and reintroduction program (Williams et al. 2002, Williams et al. 2008). This multi-agency, cooperative project has greatly increased our knowledge of riparian brush rabbit ecology. ESRP biologists have also conducted research on the riparian woodrat (*Neotoma fuscipes riparia*; RWR) at Caswell Memorial State Park, and to a lesser extent on the San Joaquin River National Wildlife Refuge (Kelly et al. 2009).

This document provides some guiding principles and goals for the conservation of the riparian brush rabbit and riparian woodrat in the Sacramento-San Joaquin Delta and northern San Joaquin Valley.

RIPARIAN BRUSH RABBIT

Species Description

The riparian brush rabbit is a California- and federally-listed endangered species. It occupies riparian communities dominated by thickets of willows (*Salix* spp.), wild roses (*Rosa* spp.), blackberries (*Rubus* spp.) and other successional trees and shrubs; and when available seasonally, dense, tall stands of herbaceous plants adjacent to patches of riparian shrubs in the northern San Joaquin Valley (see habitat components below). Such communities in the San Joaquin Valley have been reduced to less than 2% of their historical extent (Katibah 1984), primarily by clearing natural vegetation, irrigated cultivation, impoundment of rivers, and stream channelization.

Today, the only known naturally-occurring populations of riparian brush rabbits are confined to Caswell Memorial State Park (CMSP), a 258-acre riparian oak woodland on the Stanislaus River, and to a region in the South Delta near Lathrop (Williams and Basey 1986, Williams and Hamilton 2002, Figure 1). The known distribution of the South Delta population is fragmented into isolated and semi-isolated habitat patches along the San Joaquin River, Paradise Cut, Tom Paine Slough, and railroad rights-of-way in San Joaquin County. The only protected South Delta population segment is in the Oxbow Preserve, a 30-acre riparian forest preserve owned by the Center for Natural Lands Management. Paradise Cut is located on private property and the waterway is managed primarily for flood control. Habitat patches are extremely narrow strips—most only a few meters wide—between active farmland and open water.

Both populations are under significant, proximate threats of extinction. The population at CMSP faces threats from random demographic events in small populations (e.g., inbreeding and loss of genetic diversity), wildfire, flooding, disease, and predation risk is exacerbated by high numbers of feral cats (Williams and Basey 1986, Williams 1988, 1993, U.S. Fish and Wildlife Service 1998). The South Delta population faces threats from stochastic demographic and genetic events, flooding, disease, predation, competition, habitat destruction, and urban edge effects.

During the first phase of the controlled propagation and reintroduction program (2002 to 2005), ESRP biologists translocated 404 captive-bred brush rabbits to areas of riparian habitat throughout the 3,000-acre West Unit of the San Joaquin River National Wildlife Refuge (the refuge). Telemetry and trapping data show that translocated individuals were reproducing and their offspring were dispersing into unoccupied locations (Hamilton et al. - in review).

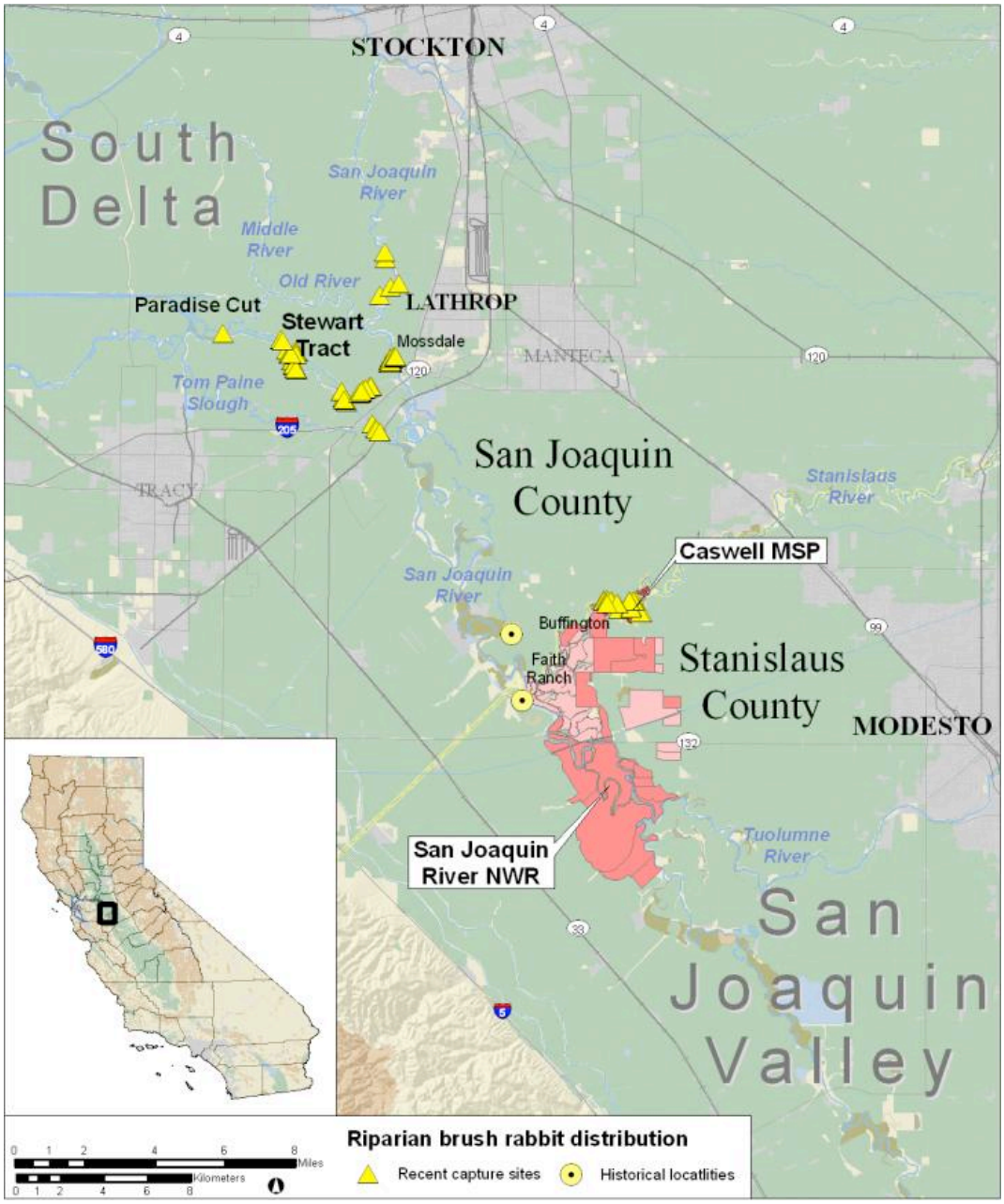

Figure 1. Riparian brush rabbit occurrence records in the northern San Joaquin Valley and South Delta regions of California.

Habitat Components

Throughout their range (Oregon to Baja California), brush rabbits are ordinarily found where their name suggests, in dense brushy habitat. At the San Joaquin River National Wildlife

Refuge, riparian brush rabbits use areas with disproportionate quantities of willows/shrubs and tall woody perennial vegetation (Hamilton et al. – in review). Shrub species—such as blackberry, California wild rose (*Rosa californica*), sandbar willow (*Salix exigua*), coyote brush (*Baccharis pilularis*), golden currant (*Ribes aureum*), and other shrubs—provide protection from predators (including during dispersal) and nesting habitat for reproduction.

Native California blackberry (*Rubus ursinus*), introduced Himalayan blackberry (*Rubus discolor*), and a hybrid of the two species can be found at sites where brush rabbits are present, and sometimes all three at the same site (e.g., CMSP), but the native species has smaller thorns and may be preferred by the rabbits. However, until more specific information on habitat use becomes available, existing patches of *R. discolor* should not necessarily be replaced with *R. ursinus* as a precondition for RBR reintroduction. We believe that removal of *R. discolor* and its replacement by *R. ursinus* can be a more-long term restoration goal.

Live-trapping programs at the refuge have documented RBR utilizing areas dominated by sandbar willow in addition to areas of dense blackberry and rose. Mature willow thickets have dense structure at ground level. This provides cover and protection from aerial and medium to large-sized terrestrial predators.

It is critical for shrubs to grow high enough above the ground so that they are not completely inundated during flood events. Blackberry and rose do not survive if completely inundated for a prolonged period of time. When some foliage stays above the high water mark, respiration in that plant can allow it to survive through flood events (River Partners 2008). Further, vertical structure provided by other shrub species and small trees provide a scaffold for blackberry and rose to grow above flood levels. For example, coyote brush forms tall stands that appear to be preferred by RBR over low-lying blackberry growth. Although coyote brush has low survival following inundation, the dead remaining structure provides ample scaffolding for blackberry growth.

Herbaceous forbs—mugwort (*Artemisia douglasiana*), stinging nettle (*Urtica dioica*), and gumplant (*Grindelia camporum*)—at the edge of dense brush appear to be important components of RBR habitat. Mugwort provides dense cover, is able to withstand flood events, and grows well in both floodplain and more upland areas, and ESRP biologists have observed RBR eating mugwort on a number of occasions (n.b., no research has been conducted to date on RBR diet). Great Valley gumplant also forms dense stands that provide cover from predators. While non-native thistles such as milk thistle (*Silybum marianum*) and bull thistle (*Cirsium vulgare*) can provide temporary cover during the wet spring season, they do not provide as much cover in the dry season. As with Himalayan blackberry, these thistles are generally undesirable in RBR habitat, but their removal can be a more-long term restoration goal.

Brush rabbits do not venture far from dense cover, usually brushy habitat. However, open fields dominated by native grasses adjacent to dense brush provide foraging opportunities for brush rabbits. Creeping wild rye (*Leymus triticoides*), which is flood-tolerant, allows for the formation of rabbit runways (tunnel-like) and it provides good cover for RBR. It is one of the only floodplain grasses native to the Central Valley that can be easily established in restoration programs. Santa Barbara sedge (*Carex barbarae*) can also be used, but it does not spread as quickly and is not as dense as creeping wild rye.

Trapping results for the refuge and the South Delta suggest that trees do not appear to be an essential feature for RBR habitat. However, a dense shrub understory can provide high

quality RBR habitat. In general, a more open tree canopy is recommended because a closed canopy can inhibit growth of a dense understory. Large trees also provide roosting and perching sites for aerial predators.

To summarize, important components of riparian brush rabbit habitat appear to be:

- Large patches of dense brush composed of riparian vegetation – blackberry, wild rose, willow – or other dense shrub species.
- Ecotonal edges of brushy species to grasses and herbaceous forbs.
- Scaffolding plants (dead or alive) for blackberry and rose to grow tall enough to withstand flood events.
- A tree overstory, if present, that is not closed.
- High ground refugia from flooding (see below).

RIPARIAN WOODRAT

Species Description

As a result of habitat loss, the range of the riparian woodrat is very restricted today. This restricted distribution, in conjunction with various threats, resulted in RWR being federally-listed as endangered in 2000 (U.S. Fish and Wildlife Service 1998, 2000). It is listed also as a California Species of Special Concern. Riparian woodrats are arboreal, primarily nocturnal, and generalist herbivores with a diet consisting of leaves, fruits, shoots, flowers, nuts and fungi. Reproduction can occur at any time of the year, especially when acorns are abundant, but the typical breeding season is between February and April.

The range of the dusky-footed woodrat (*Neotoma fuscipes*) was thought to extend from northwestern Oregon south through California to northern Baja California, Mexico (Hall 1981). However, recent research by Dr. Marjorie Matocq of the University of Nevada, Reno has shown that what was thought to be one species appears to be two species, *N. fuscipes* to the north and the big-eared woodrat (*N. macrotis*) to the south (Matocq 2002a, b). The riparian woodrat is restricted to riparian habitats in the northern San Joaquin Valley close to where the ranges of the two species come together. It may have occurred from the San Francisco East Bay region to Fresno County (Hooper 1938), but Dr. Matocq's analyses suggest that woodrat populations from CMSP, Corral Hollow (western San Joaquin Co.), and the San Joaquin River NWR comprise a distinct set of populations that harbor genetic characteristics of both *N. fuscipes* and *N. macrotis*, as well as genetic variants that are found nowhere else in the range of either species (Matocq 2007).

Only one relatively robust population is known and it is confined to CMSP, but since March 2003, 30 RWR have been captured during trapping for RBR on the San Joaquin River National Wildlife Refuge, which is only five air miles to the south of CMSP. However, there has been no systematic survey to date for RWR on refuge lands. We believe that a wildfire at the refuge in July 2004 destroyed important habitat areas, but major flooding in the spring of 2006 may have impacted the species even more significantly. Since the 2006 flood, only three woodrats have been captured on the refuge (in Jan. 2007, Nov. 2009, and August 2010).

Habitat Components

Although no research has been conducted to date on the habitat needs of riparian woodrats, at CMSP they occur in areas with an overstory dominated by valley oak (*Quercus lobata*) and a

dense shrub understory consisting of willow, wild rose, blackberry, wild grape (*Vitis californica*), coyote bush, golden currant, and other shrub species (Kelly et al. 2009). Woodrats also build nests in poison oak (*Toxicodendron diversilobum*), which can grow in shrub form or as vines into trees, but poison oak is not very common in riparian areas of the northern San Joaquin Valley.

Neotoma fuscipes/macrotis generally constructs large terrestrial stick houses, but often forages high in the tree canopy. Although woodrats readily run up and down vertical tree trunks (P. Kelly, pers. obs.), to get into the tree canopy, they generally need some level of mid-story cover. This can be in the form of smaller trees, large shrubs or vines, and it further serves to increase access to the canopy and it makes their home ranges more three-dimensional. Although CMSP has a fairly robust woodrat population, terrestrial houses appear to be relatively rare there (Kelly et al. 2009). Further, despite nine years of intensive field research—and 30 woodrat captures—we have never found any woodrat houses on the refuge (i.e., the West Unit). However, woodrats also den in dead trees (snags) and downed timber, as well as in rocks, tree cavities, arboreal nests, and manmade structures.

To summarize, important components of riparian woodrat habitat appear to be:

- A high level of structure appropriate for nesting and nest-building (see above).
- Tree canopy, especially oak (*Quercus* sp.), but also cottonwood (*Populus fremontii*), sycamore (*Platanus racemosa*), large willows, and other large trees.
- Large patches of dense brush understory—willows, blackberries, wild rose, currant, or other shrub species.
- Canopy and understory connected by a mid-story composed of vines (California wild grape), willows, or other native shrubs and trees.
- High ground refugia from flooding.

DIFFERENCES IN HABITAT NEEDS

The riparian brush rabbit and riparian woodrat have overlapping habitat needs, but they occupy different ecological niches. In general, RBR are able to use a greater variety of riparian habitat types since they are not dependent on tree cover. However, RWR generally do require a tree canopy—usually some large, mature trees (often oaks)—and a higher level of habitat structure (for nesting) than RBR. Although detailed habitat preference studies have not been conducted for either species, there are qualitative differences in their habitat needs (Table 1), differences that mandate species-specific management prescriptions.

Table 1. Differences in habitat needs for riparian brush rabbits and riparian woodrats.

	Herbaceous Edge	Dense Understory	Dense Mid-story	Tree Canopy
RBR	Essential	Essential	Not important	Not important
RWR	Not essential	Essential	Important	Important

PREDATION RISK

A wide variety of aerial and terrestrial vertebrates prey on RBR and RWR. They include but are not limited to various raptors, coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), bobcat (*Lynx rufus*), long-tailed weasel (*Mustela frenata*), mink (*Neovison vison*), raccoon (*Procyon lotor*), and also snakes, feral dogs (*Canis familiaris*), and feral cats (*Felis catus*).

In general, a robust population of RBR and RWR should be able to withstand pressure from native predators. Further, some native predators, especially coyotes and foxes, also prey on feral cats and dogs, which in turn can present a significant predation risk for RBR and RWR. This risk is exacerbated when habitat is adjacent to residential properties, along public roads or waterways, and/or is subject to human disturbance. Although not a major predator at the refuge, collection of the remains of radio-collared animals has shown that feral cats prey on RBR there (ESRP data). To the extent possible, feral cats and dogs should be prevented from entering preserved lands (e.g., with barriers), and cats and dogs found in preserves and natural areas should be removed.

The black rat (*Rattus rattus*), an exotic invasive species, may impact sensitive mammals such as RBR and RWR by preying on their offspring and competing for resources. Black rats appear to be ubiquitous in riparian habitat throughout the Central Valley and are abundant at both CMSP and the refuge. The prevalence of black rats in riparian areas is a concern because they are nest predators of birds in central California (Hammond 2008). Recent research at CMSP suggests that the reproductive success of riparian woodrats is lower in areas with high black rat densities than in areas where black rats are systematically removed (Kelly et al. 2009), but further research on woodrat and black rat ecology is urgently needed.

GUIDING PRINCIPLES & CONSIDERATIONS FOR RBR AND RWR CONSERVATION

1. **Conservation of lands –** protecting existing habitat occupied by known populations.
2. **Connectivity** – establishment of permanent corridors (with habitat components listed above) between known populations to facilitate dispersal of the species and genetic interchange between adjacent populations.
3. **Restoration** – active restoration (planting and management) of core areas and connecting lands; the authors have no faith in "passive restoration" as an effective means to restore habitat for either RBR or RWR.
4. **Range** – prioritizing lands in the South Delta near extant populations (south of highway 12 and particularly south of highway 4 within conservation zones 7 and 8).
5. **High-water Refugia** – building and restoring high-ground habitat on mounds and/or berms to provide refuge during seasonal flood events (short- and long-term) and sea level rise (due to climate change) will be essential.
6. **Invasive Species Management –** control of feral predators (cats, dogs) and invasive rodents (black rats).
7. **Additional Research –** further ecological research is sorely needed on the ecology of RBR and RWR (e.g., population and habitat management, distribution, diet, roles of predators and competitors).

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