U.S. Fish & Wildlife Service

Recovery Plan for the Southern California Distinct Population Segment of the Mountain Yellow-legged Frog (*Rana muscosa*)

Photo courtesy of Adam Backlin (U.S. Geological Survey)

Recovery Plan for Southern California Distinct Population Segment of the Mountain Yellow-legged Frog (*Rana muscosa*)

Region 8
U.S. Fish and Wildlife Service
Sacramento, California

Approved: _____

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

Date: 12/20/18

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Additional copies may be obtained from:

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RECOVERY PLAN

SOUTHERN CALIFORNIA DPS OF MOUNTAIN YELLOW-LEGGED FROG

INTRODUCTION

This document presents the U.S. Fish and Wildlife Service's (Service) plan for the conservation and recovery of the southern California distinct population segment (DPS) of mountain yellow-legged frog (*Rana muscosa*)(hereafter "southern *R. muscosa*"). The goal of this recovery plan is to provide guidance on how to control or ameliorate impacts from current threats to the southern *Rana muscosa* such that the taxon no longer requires protections afforded by the Act and therefore, warrants delisting. Pursuant to section 4(f) of the Act, a recovery plan must, to the maximum extent practicable, include (1) a description of site-specific management actions as may be necessary to achieve the plan's goals for the conservation and survival of the species; (2) objective, measurable criteria which, when met, would support a determination under section 4(a)(1) that the species should be removed from the List of Endangered and Threatened Species; and (3) estimates of the time and costs required to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal. This recovery plan, therefore, provides these elements, preceded by a description of the overall recovery strategy. In developing these plan components, we recognize that continued coordination with our partners is needed to ensure long-term protections are afforded to the southern *R. muscosa* and its habitat.

The recovery plan is based on the Species Biological Report for the Southern California Distinct Population Segment of the Mountain Yellow-legged Frog (*Rana muscosa*), which describes the life history and biology of the species, the current status of the species, and the threats that impact the species. The Species Biological Report is summarized below. Those specific activities necessary for implementing this plan's proposed recovery actions are described in the Recovery Implementation Strategy. Both the Species Biological Report and the Recovery Implementation Strategy are available at https://ecos.fws.gov and will be updated as necessary.

SUMMARY OF SPECIES BIOLOGICAL REPORT

Southern *Rana muscosa*, which historically was widely distributed in at least 166 known populations across four mountain ranges in southern California, are currently considered to be extant in 10 small populations distributed disproportionately across three mountain ranges. Most populations are isolated in the headwaters of streams or tributaries due to the extensive distribution of predatory nonnative trout in historical habitat; thus, it exists in a highly fragmented environment. Such isolation and fragmentation followed by the prevention of successful recolonization increases the potential for extirpation of the remaining populations.

Each population is small and highly susceptible to stochastic events, especially wildfire, which devastated the East Fork City Creek population. Measures have been taken to reduce the impact of certain threats, including recreation, nonnative trout, and stochastic extinction. However, these threats and other threats to the habitat remain, including illegal activities (cannabis cultivation and suction dredge mining), and legal activities (recreational activities, fire suppression activities, and roadwork construction). Wildfire and climate change both have a high likelihood

of affecting southern *Rana muscosa* and its habitat; however, the timing and options available to reduce these threats are either limited or unclear. Disease is also a concern rangewide. Providing sufficient representation, resiliency, and redundancy across the historical range through the reestablishment of additional populations may be the best way to address these threats.

The small population sizes and loss of potential metapopulation dynamics are a great impetus for threat abatement. Populations have proved to be sensitive to both the presence of threats, as well as their amelioration. Two populations have responded positively with restoration efforts (through nonnative trout removal and recreational closures/management). Such efforts to minimize threats should be prioritized to prevent extirpation of small populations, expand the area available to all existing populations, and reconnect subpopulations to ultimately recreate local metapopulation dynamics. Southern *Rana muscosa* faces a high degree of threat with a high potential for recovery, therefore proactive efforts are needed to aid in the continued survival and recovery of this critically endangered species.

RECOVERY STRATEGY

Since listing, the implementation of a wide array of conservation efforts, including habitat acquisition, nonnative trout removal, recreational closures, disease research, extensive surveys and monitoring, education outreach, and captive breeding and reestablishment has created the foundation for recovery of southern *Rana muscosa*. These efforts have been conducted through the cooperative efforts of partners, including U.S. Geological Survey, California Department of Fish and Wildlife, U.S. Forest Service, California Department of Transportation, Institute for Conservation Research-San Diego Zoo, Los Angeles Zoo, and the Henry Doorly Zoo.

The cumulative effect of these actions has already provided a measurable benefit to the DPS, particularly at Little Rock Creek and Dark Canyon. In order to reverse the decline of precariously small populations, actions must be implemented immediately. The multiple Federal and State agencies and non-profit groups that have closely coordinated recovery efforts thus far continue to plan beneficial actions for the DPS. The greatest hurdle for this effort may be correctly prioritizing actions and sites for implementation in order to prevent extirpation of extant populations and encourage reestablishment of metapopulations. To this end, partners are also attempting to coordinate additional research that will inform management actions for southern *Rana muscosa*.

We envision recovery for southern *Rana muscosa* as multiple stable metapopulations in contiguous habitat free of barriers to their movement (including nonnative trout) to allow for gene flow, maximum dispersal of individuals, and natural, self-sustaining recovery following exposure to future threats. To provide sufficient representation, resiliency, and redundancy across the historical range, populations will be monitored and managed so southern *R. muscosa* will no longer require the protections of the Act. Threats impacting the species will be sufficiently understood and abated to ensure long-term conservation of southern *R. muscosa*. A rangewide monitoring and adaptive management approach will be implemented to address unforeseen events and threats.

Management Units

We have divided the range of southern *Rana muscosa* into three Management Units (MU). To have sufficient levels of resiliency, redundancy, and representation, all of the MUs are believed to be necessary for the recovery of southern *R. muscosa*. That is, we believe that to recover southern *R. muscosa*, the species must possess healthy, viable populations within each of the (1) the San Gabriel Mountains MU, (2) the San Bernardino Mountains MU, and (3) the San Jacinto Mountains/Palomar Mountain MU (Figures 1–4). The purpose of maintaining southern *R. muscosa* in each of these areas is to maintain representation by protecting the genetic diversity in each mountain range (Schoville *et al.* 2011) and providing redundancy to guard against devastating losses due to large wildfires, such as the 2009 Station Fire in the San Gabriel Mountains and the 2003 Old Fire in the San Bernardino Mountains.

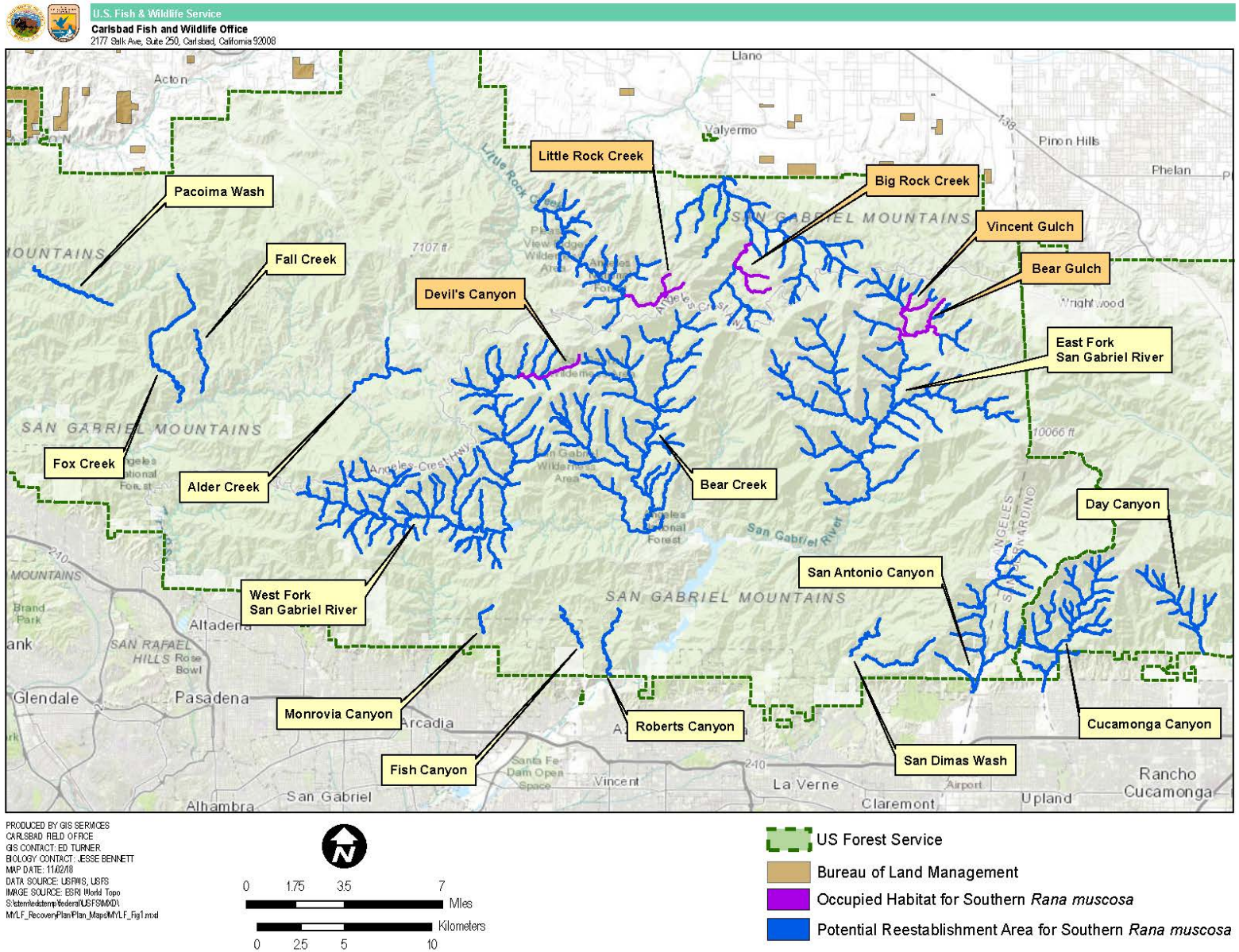

Figure 1. San Gabriel Mountains Management Unit.

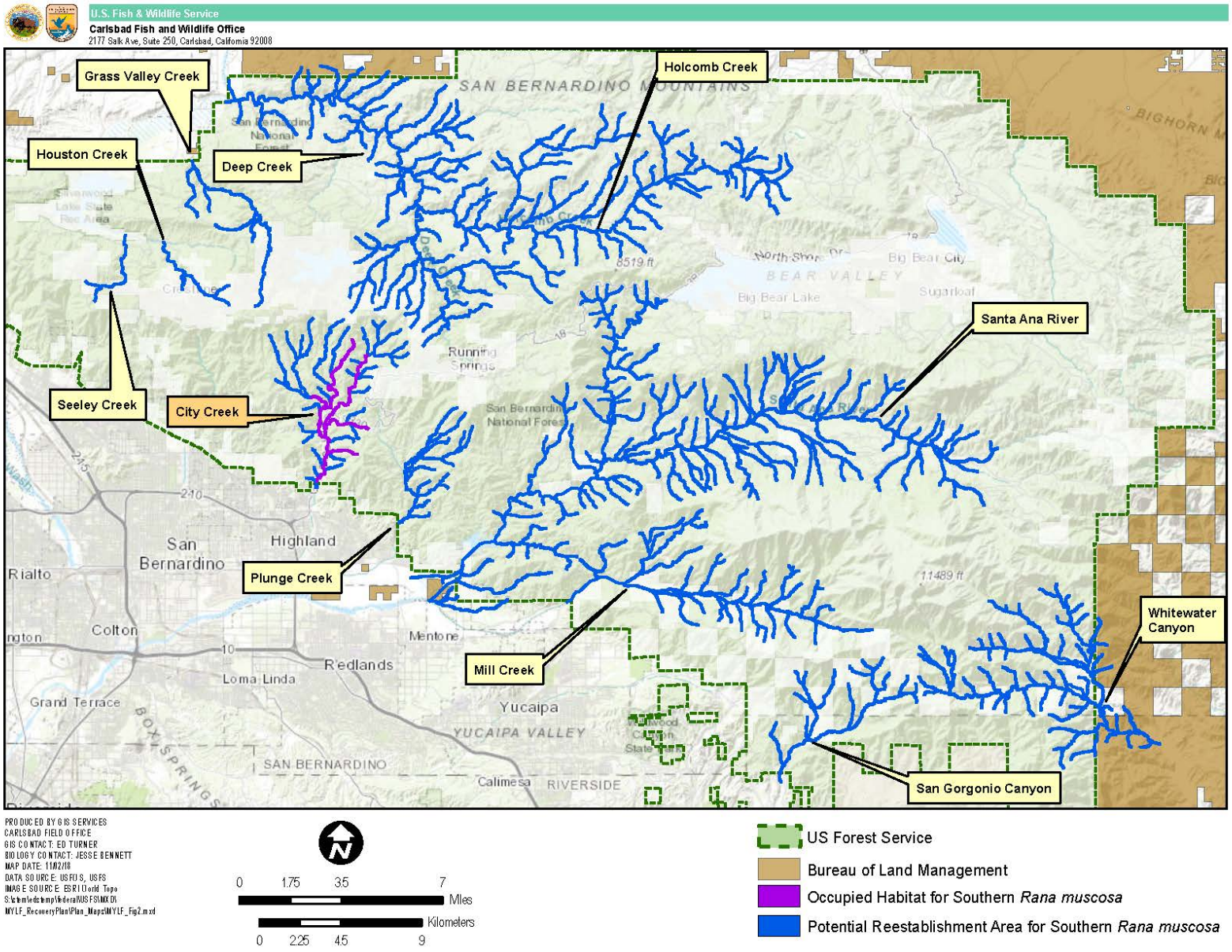

Figure 2. San Bernardino Mountains Management Unit.

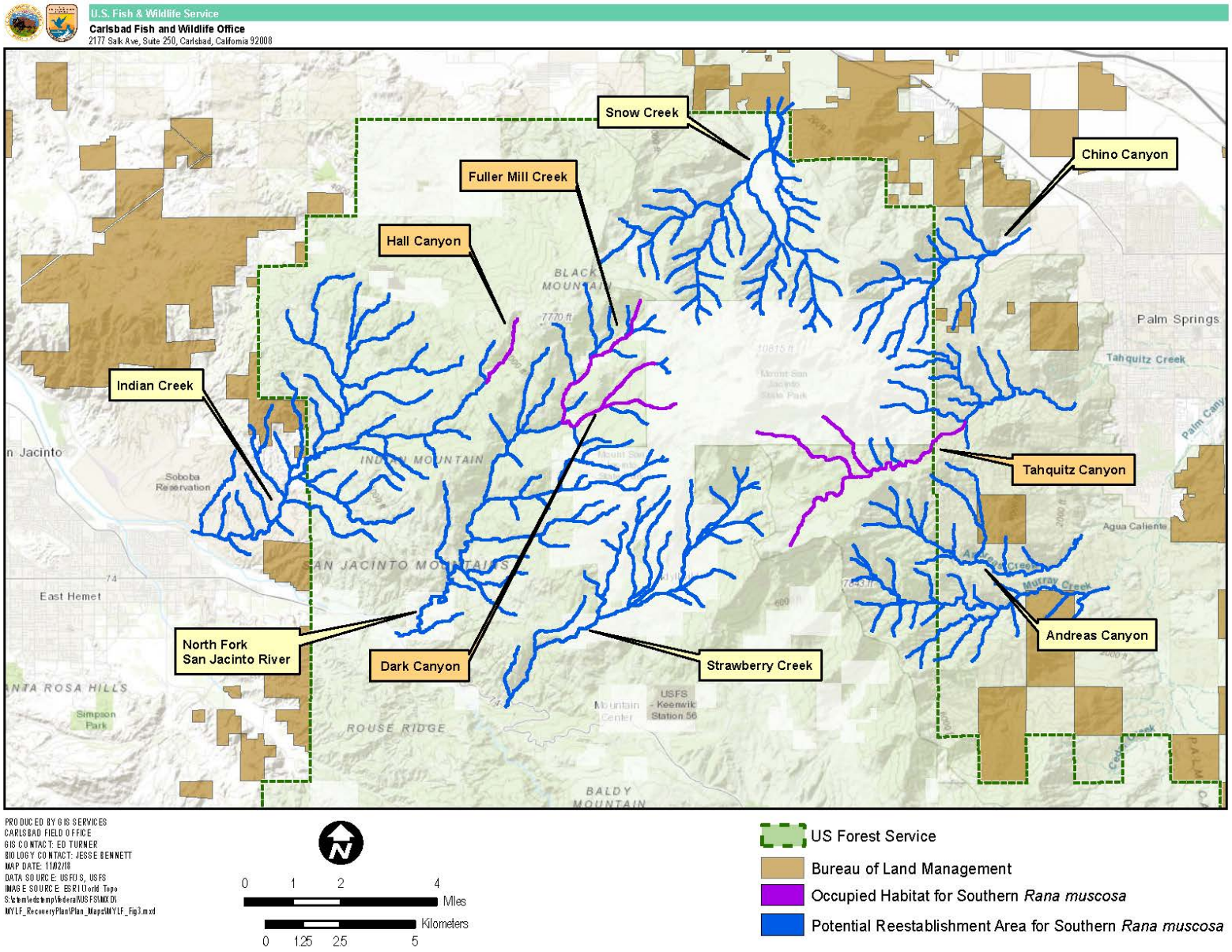

Figure 3. San Jacinto Mountain / Palomar Mountain Management Unit: San Jacinto Mountains.

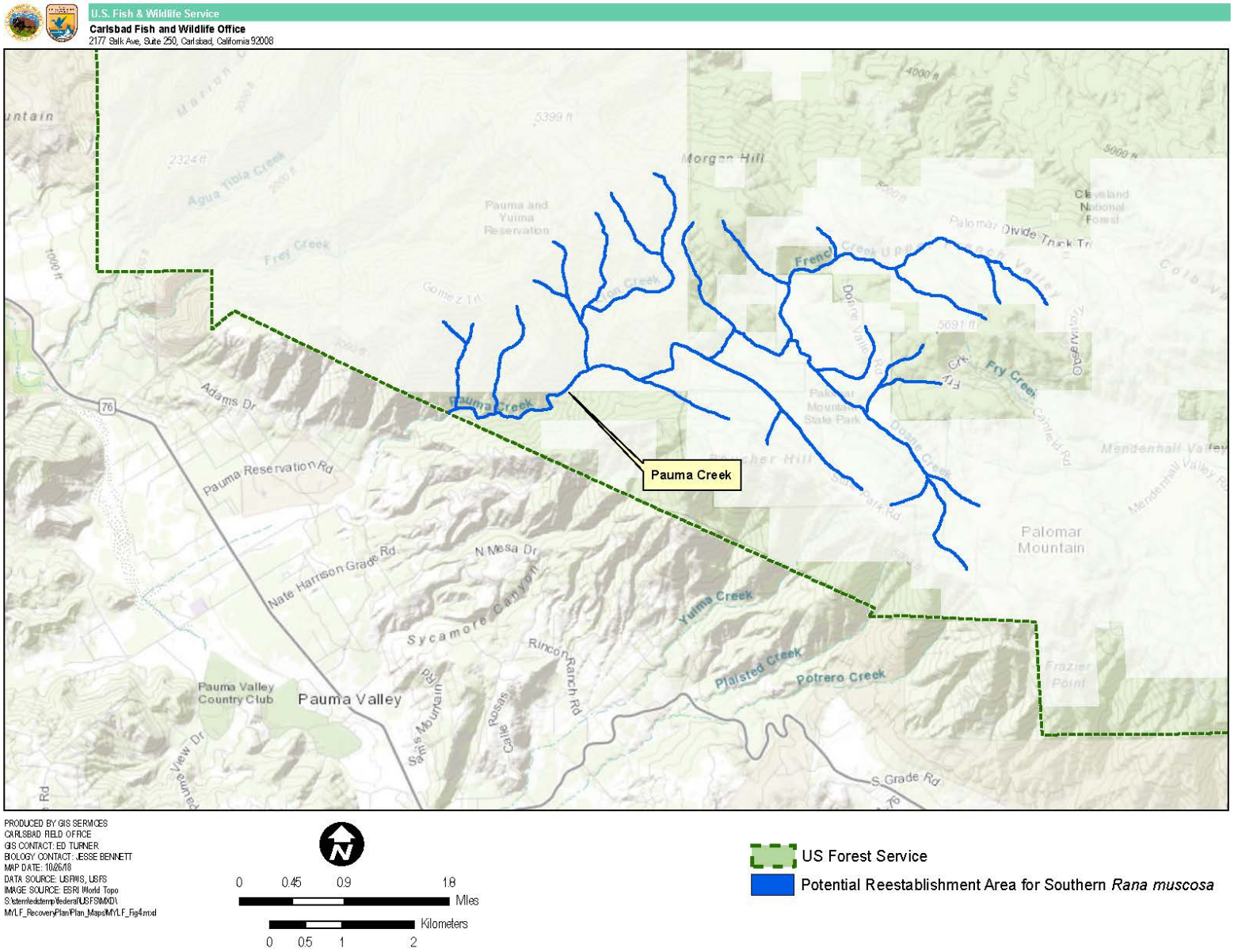

Figure 4. San Jacinto Mountain / Palomar Mountain Management Unit: Palomar Mountain.

RECOVERY CRITERIA

An endangered species is defined in the Act as a species that is in danger of extinction throughout all or a significant portion of its range. A threatened species is one that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. When we evaluate whether or not a species warrants downlisting or delisting, we consider whether the species meets either of these definitions. A recovered species is one that no longer meets the Act's definitions of threatened or endangered due to amelioration of threats. Determining whether a species should be downlisted or delisted requires consideration of the same five categories of threats which were considered when the species was listed and which are specified in section 4(a)(1) of the Act.

Recovery criteria are conditions that, when met, are likely to indicate that a species may warrant downlisting or delisting. Thus, recovery criteria are mileposts that measure progress toward recovery. Because the appropriateness of delisting is assessed by evaluating the five threat factors identified in the Act, the recovery criteria below pertain to and are organized by these factors. These recovery criteria are our best assessment at this time of what needs to be completed so that the species may be removed from the list of threatened and endangered species. Because we cannot envision the exact course that recovery may take and because our understanding of the vulnerability of a species to threats is very likely to change as more is learned about the species and its threats, it is possible that a future status review may indicate that delisting is warranted before all recovery criteria are met.

Downlisting Criteria

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

In order to downlist southern *Rana muscosa* to threatened status, threats to the species due to degraded or limited habitat must be reduced. This will have been accomplished if the following have occurred:

A.1: Impacts to southern *Rana muscosa* due to recreational activity in occupied habitat are effectively managed, avoided or minimized.

A.2: Potential impacts to southern *Rana muscosa* due to cannabis plantations are monitored and minimized.

A.3: Appropriate vegetation management projects are designed and implemented to help minimize the potential impacts of wildfire on southern Rana muscosa. Individual frogs are translocated or removed from the wild and brought into captivity to avoid severe post-fire impacts, as appropriate.

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

No known threats exist under this factor, therefore no criteria are necessary.

Factor C: Disease or Predation

C.1: Nonnative predators are absent from areas occupied by southern *Rana muscosa*. Nonnative predators are removed from downstream areas below occupied southern *Rana muscosa* occurrences as well as from re-establishment sites to allow for population expansion. An "occurrence" is defined as a location at which the species is detected. Effective barriers are established and maintained, as appropriate.

C.2: Impacts to southern *Rana muscosa* from disease are appropriately understood and managed.

Factor D: Inadequacy of Existing Regulatory Mechanisms

No known threats exist under this factor, therefore no criteria are necessary.

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

E.1: The threat of small population size is addressed. At least 20 occurrences[1] will exist with a minimum of 50 adults per occurrence or allowances for periodic translocations or movements of southern *Rana muscosa* to augment populations smaller than 50 adults (Appendix I and II). To ensure redundancy, at least five occurrences will need to be occupied in each Management Unit. Monitoring will detect these numbers for at least 5 consecutive years and document reproduction and recruitment.

Delisting Criteria

In order to delist southern *Rana muscosa* the following additional criteria must be met:

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

E.2: Genetic studies document that the mountain yellow-legged frog can sustain genetic diversity in the long-term, including consideration of minimum effective population size.

E.3: The potential effects of contaminants, ultraviolet radiation, pesticides, and acid precipitation have been considered and appropriately addressed.

E.4: In addition to the downlisting criteria, at least one occurrence with a minimum population size of 500 adults shall occur within each of the three Management Units mentioned above, to

[1] An occurrence would be a population of southern *Rana muscosa* that is geographically separated from other southern *Rana muscosa*.

help increase resiliency of each unit and ensure the long term genetic representation of the species through protection from stochastic events such as wildfire. Monitoring will detect these numbers for at least 5 consecutive years and document reproduction and recruitment.

RECOVERY ACTIONS

Some recovery actions for southern *Rana muscosa* must begin immediately to reduce the high extinction risk of the DPS and to begin to inform management questions addressing long-term goals. Comprehensive long-term actions must also begin soon and should be flexible enough to address a number of possible changes in the future. The actions listed below may be used to guide recovery planning, minimize impacts from projects that may affect the species or its critical habitat, and plan for future restoration.

1. **Conduct research to inform management actions where appropriate throughout the range of the species.** There are numerous gaps in our understanding of mountain yellow-legged frog biology and ecology. Additional information will help us make informed management decisions throughout the range of the species, including in the planning and implementation of Recovery Actions 3 through 6 (below). Research is needed to identify optimum habitat conditions and to identify how to best minimize impacts caused by recreation, water quality, wildfire, predation, disease, and small population size.

2. **Create and implement a protocol for rangewide surveys and monitoring.** This protocol will allow for comparison of the relative status of the species within and between watersheds and would help in the development of a population viability analysis (PVA).

3. **Ameliorate Factor A threats associated with present or threatened destruction, modification, or curtailment of the habitat or range where appropriate throughout each of the three Management Units.**

4. **Ameliorate Factor C threats associated with predation and disease where appropriate in each of the three Management Units.**

5. **Ameliorate Factor E threats associated with other natural or manmade factors affecting the continued existence of southern *Rana muscosa* where appropriate in each of the three Management Units.**

6. **Use reestablishment and augmentation to increase abundance and expand distribution in the wild at those locations determined to be appropriate.**

Table 1. Recovery actions and estimated costs. Each action likely includes costs that could not be reasonably estimated at this time.

Recovery Action	Estimated Cost
1. Conduct research to inform management actions.	$800,000
2. Create and implement a protocol for rangewide surveys and monitoring.	$1,540,000
3. Ameliorate Factor A threats associated with present or threatened destruction, modification, or curtailment of the habitat or range.	TBD
4. Ameliorate Factor C threats associated with predation and disease.	$605,000
5. Ameliorate Factor E threats associated with other natural or manmade factors affecting the continued existence of southern *Rana muscosa*.	TBD
6. Ameliorate Factor E threats associated with small population size. Use reestablishment and augmentation as tools to increase abundance and expand distribution in the wild.	$3,145,000
Total estimate cost	**$6,090,000 + TBD**

ESTIMATED TIME AND COST OF RECOVERY ACTIONS

We estimate that the cost of completing the recovery actions such that the criteria have been met and the southern *Rana muscosa* may be considered for removal from the list of endangered and threatened species is $6,090,000 plus additional costs to be determined. We estimate that completion of these actions could be accomplished by 2043, assuming effective coordination and cooperation among necessary partners and stakeholders.

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Rodriguez-Prieto, I. and E. Fernandez-Juricic. 2005. Effects of direct human disturbance on the endemic Iberian frog *Rana iberica* at individual and population levels. Biological Conservation. 123:1–9.

Schoville, S.D., T.S. Tustall, V.T. Vredenburg, A.R. Backlin, E. Gallegos, D.A. Wood, R.N. Fisher. 2011. Conservation genetics of evolutionary lineages of the endangered mountain yellow-legged frog, *Rana muscosa* (Amphibia: Ranidae), in southern California. Biological Conservation 144 (2011): 2031–2040.

Personal Communication

Backlin, A. 2016. Personal communication via email from Adam Backlin of the U.S. Geological Survey. March 9, 2016.

APPENDIX I

Justification for Recovery Criteria Population Numbers for the Southern California Distinct Population Segment of the Mountain Yellow-legged Frog

Mountain yellow-legged frogs should occur in three Management Units: 1) San Gabriel Mountains, 2) San Bernardino Mountains, and 3) San Jacinto and Mountains and Palomar Mountain. The purpose of maintaining mountain yellow-legged frogs in each of these areas is to maintain representation and adaptability by protecting the genetic diversity of each currently occupied mountain range (Schoville et al. 2011). Occurrence of southern *Rana muscosa* across three mountain ranges will help to protect the distinct population segment as a whole from devastating losses due to large wildfires that could affect an entire mountain range. Mountain yellow-legged frogs are not currently known to occur on Palomar Mountain, but could be reestablished using individuals from the San Jacinto Mountains.

Demographic analysis suggests that small populations of mountain yellow-legged frogs can persist for an extended timeframe. Backlin (2016) indicates that with 20 occurrences with minimum population sizes of 20 adults, at least 5 occurrences would be expected to persist for 50 years.

However, more than five occurrences will likely be necessary to ensure long term persistence of the distinct population segment. Thus, either occurrences larger than 20 adults or more occurrences seem necessary. We propose using 20 occurrences with minimum population sizes of 50 adults to ensure long term persistence (greater than 50 years). A population size of 50 adults was selected in response to natural fluctuations of population numbers in the wild, as appropriate to provide the resiliency necessary to be able to rebound from future impacts. We are continuing to work with USGS to generate additional modeling scenarios to better understand the minimum population size needed for maintaining populations of southern *Rana muscosa* in the wild. To address uncertainty due to the limited data available for analysis, monitoring of these occurrences for a period of time prior to a change in status will help provide some assurance that they are demographically stable in the long term.

Thus, using the information provided by the demographic analysis, we propose the following downlisting criteria:

- Twenty occurrences with a minimum population size of 50 adults or allowances for periodic translocations or movements of mountain yellow-legged frogs to augment populations smaller than 50 adults.

- At least five occurrences within each of the three Management Units mentioned above.

Using these criteria, the total number of mountain yellow-legged frog adults needed for downlisting of the southern California distinct population segment would be an adult population size of 1,000 (i.e., 20 occurrences multiplied by 50 adults) and these numbers would need to be

detected for 5 years. Five years will allow for the offspring of the current generation to mature and reach reproductive age.

For delisting, these numbers would need to be detected for another 5 years. In order to increase resilience of each Management Unit, each should also have a population with a size of 500 adults. A population of 500 frogs is consistent with Backlin's (2016) estimate of carrying capacity for a stretch of suitable habitat using data from Little Rock Creek, and therefore represents a good estimate of a resilient, stable population size. A PVA has been included as a recovery action to help refine these population numbers in the future when more data is available.

In addition, the Backlin (2016) analysis was a demographic study only and does not consider the genetic diversity necessary to sustain the species. For delisting, the mountain yellow-legged frog would need to have long-term genetic sustainability.

Thus, for delisting, we add the following additional criteria:

- Genetic studies document that the mountain yellow-legged frog has long-term genetic sustainability, including consideration of minimum effective population size.

- At least one occurrence with a minimum population size of 500 adults shall occur within each of the three Management Units, which will maximize the retention of genetic diversity for at least one population with each Unit.

APPENDIX II

A. PROBABILITY OF EXTINCTION[2]

Table 1: Probability of Extinction Over 20 Years

Number of Populations	Number of Adults per Population	Probability of Extirpation of All Populations	Expected Number of Populations Surviving	Probability of Less Than Two Populations Surviving
5	10	0.096	1.828	0.38
5	15	0.064	2.048	0.33
5	20	0.048	2.174	0.294
6	10	0.046	2.182	0.29
6	15	0.052	2.392	0.246
6	20	0.026	2.63	0.184
7	10	0.044	2.584	0.216
7	15	0.022	2.96	0.132
7	20	0.012	3.19	0.09
8	10	0.03	3	0.118
8	15	0.01	3.398	0.082
8	20	0.006	3.426	0.058
9	10	0.008	3.27	0.11
9	15	0.014	3.678	0.062
9	20	0	3.864	0.058
10	10	0.01	3.654	0.076
10	15	0.008	4.118	0.038
10	20	0.004	4.212	0.04
15	10	0	5.532	0.01
15	15	0	6.2	0.004
15	20	0.002	6.65	0.002
20	10	0	7.508	0
20	15	0	7.95	0
20	20	0	8.734	0
25	10	0	9.23	0
25	15	0	10.026	0
25	20	0	10.874	0
30	10	0	11.17	0
30	15	0	12.062	0
30	20	0	13.398	0
50	10	0	18.506	0
50	15	0	20.568	0

[2] From Backlin 2016.

Number of Populations	Number of Adults per Population	Probability of Extirpation of All Populations	Expected Number of Populations Surviving	Probability of Less Than Two Populations Surviving
50	20	0	21.66	0
80	10	0	29.47	0
80	15	0	32.342	0
80	20	0	35.068	0

Table 2: Probability of Extinction Over 50 Years

Number of Populations	Number of Adults per Population	Probability of Extirpation of All Populations	Expected Number of Populations Surviving	Probability of Less Than Two Populations Surviving
5	10	0.306	1.016	0.732
5	15	0.256	1.176	0.67
5	20	0.216	1.238	0.674
6	10	0.234	1.264	0.632
6	15	0.22	1.358	0.586
6	20	0.174	1.464	0.538
7	10	0.204	1.444	0.55
7	15	0.164	1.704	0.46
7	20	0.12	1.762	0.424
8	10	0.152	1.712	0.458
8	15	0.114	1.846	0.412
8	20	0.106	1.94	0.384
9	10	0.124	1.852	0.422
9	15	0.106	1.942	0.382
9	20	0.08	2.218	0.322
10	10	0.096	2.072	0.362
10	15	0.082	2.3	0.29
10	20	0.074	2.37	0.264
15	10	0.032	3.16	0.112
15	15	0.02	3.414	0.098
15	20	0.012	3.662	0.086
20	10	0.006	4.034	0.076
20	15	0.006	4.522	0.04
20	20	0.002	4.832	0.026
25	10	0	5.192	0.018
25	15	0.004	5.848	0.012
25	20	0.002	6.098	0.01
30	10	0	6.326	0.004
30	15	0	6.902	0.004
30	20	0	7.264	0.004

Number of Populations	Number of Adults per Population	Probability of Extirpation of All Populations	Expected Number of Populations Surviving	Probability of Less Than Two Populations Surviving
50	10	0	10.126	0.002
50	15	0	11.656	0
50	20	0	12.184	0
80	10	0	16.556	0
80	15	0	18.348	0
80	20	0	19.446	0

B. METHODS FOR ANALYSES

The methodology used to estimate mountain yellow-legged frogs annual growth rates and project population trajectories consisted of a series of four analyses, performed as described below.

(Methodology from: Backlin, A. 2016. Personal communication via email from Adam Backlin of the U.S. Geological Survey. May 26, 2016.)

Step 1: Estimation of annual population sizes and growth rates

We used a "closed" population mark-recapture model to estimate population size (N(t)) of adult frogs for each year t. The analysis was performed separately for each site. The model used explicitly accounted for imperfect detection of marked frogs. Because of data limitation, the probability of detection was modeled as a constant rate, for each year, each sampling occasion and across the different sites. The model was implemented in a Bayesian framework, using a MCMC algorithm implemented in program JAGS.

From the annual estimates of population size, we then derived inter-annual values of population growth rate ($\lambda(t)$).

Step 2: Estimation of temporal variability in population growth rates

The goal here was to obtain a summary of population growth rate variability, across the different populations, which will be used for population projections (see step 4 below). Using a log-normal model, we estimated a common mean (μ) and temporal variability (ε) for population growth rate, from the $\lambda(t)$ values from each population (site) obtained in step 1. To account for site-specific differences in population growth rates (due to local environmental differences, etc.), site-specific random effects were included in the model.

The model was implemented in a Bayesian framework, using a MCMC algorithm implemented in program JAGS.

Step 3: Carrying Capacity

Given the high variability of population growth rates, quantified in step 2, it was necessary to include a ceiling value of carrying capacity in population projections (step 4) to avoid projected population sizes reaching unreasonably high values. Because the studied populations of mountain yellow-legged frogs are all very small, and far from carrying capacity, estimating a relevant value K was not possible for most populations. Only one population (Little Rock Creek) had shown an exponential growth, followed by a deceleration and stabilizing phase during the 15 years of study. This allowed us to estimate K from this population, which we used as the standard carrying capacity value for the given amount of suitable habitat (stream length) present at that site. The value of K estimated from this dataset was K = 500 adult frogs for a section of 2.75 km of suitable habitat.

The model was implemented in a Bayesian framework, using a MCMC algorithm implemented in program JAGS.

Step 4: Population projections

Using estimates of the mean (μ) and variability (SD: ε) of population growth rates, from step 2, as well as the value of carrying capacity from step 3, we simulated population projections, to assess the chances of persistence of the species over 20 and 50 years. Assessments were performed for a variety of scenarios, for which we used different values of (i) the number of independent populations (S = {5,6,7,8,9,10,15,20,30,50,80}) and (ii) the initial size (number of adults) of each of these populations (N_0= {10,15,20}). A total of 36 different scenarios were assessed.

Simulated population projections were run as follows. Each population *s* (among a total S) starts in year 1 with a population of N_0 adults. At each time step (year) a value of population growth rate $\lambda(t)$ is randomly drawn, for each population, from a unique Normal distribution $N(\mu, \varepsilon)$. The site-specific value of population size for the next time step (t+1) is then obtained as: $N(t+1) = N(t) * \lambda(t)$. For instance, for year 2, we use: $N(2) = N(1) * \lambda(1)$, where $N1 = N_0$. If the value N(t+1) overshoots the carrying capacity, N(t+1) is automatically set equal to K = 500. For a single simulation and a given scenario, this procedure is repeated for each time step until reaching the set time horizon of 20 or 50 years. For each scenario, we repeated this entire procedure for a total of 500 simulations, to obtain adequate summaries and measures of uncertainty.

For each scenario, from the 500 simulations, we calculated

(1) The proportion of times that all populations S went extinct, which provides a measure of the probability of the species extinction (locally) under this scenario.
(2) The average number of population that survived, which provides a measure of the number of populations to be expected to survive under this scenario.
The proportion of times that less than 2 populations survived, which provides a measure of the probability of having less than 2 populations surviving after 20 or 50 years, under this scenario. A minimum of 2 populations surviving was considered the critical

threshold to consider that the population would not be completely doomed to extinction after 20 or 50 years.

APPENDIX III – SUMMARY OF PUBLIC, PARTNER, AND PEER REVIEW COMMENTS RECEIVED

A. Summary of Public Comments

On July 19, 2018, we published a notice in the *Federal Register* announcing the availability of the draft recovery plan for southern *Rana muscosa* for public review and comment. We received two responses total, one from an individual and the other from the Center for Biological Diversity. We received no public comments from Federal, State or local agencies, or Native American Tribes.

Public comments ranged from providing minor editorial suggestions to specific recommendations on plan content. We have considered all substantive comments and, to the extent appropriate, we have incorporated the applicable information or suggested changes into the Species Report, Recovery Plan, and Recovery Implementation Schedule. Below, we provide a summary of public comments received; however, some of the comments that we incorporated as changes into the final recovery plan did not warrant an explicit response and, thus, are not presented here.

Comment (1): Delisting criteria should include a measure of reproduction/recruitment.

Response: We revised the downlisting and delisting criteria to include reproduction.

Comment (2): The downlisting criteria are vague and lack triggers to identify when a goal is met. For example, criteria for recreation and vegetation management are too vague.

Response: We recognize that some of the qualitative criteria are vague (i.e. recreation and vegetation management). This was done to allow for management flexibility. For example, recreation and vegetation management activities will likely change in importance as population numbers change. As populations expand, they will be less vulnerable to the impacts of recreation and less restrictive measures would be appropriate. Likewise, as populations expand, they will be less vulnerable to the impacts of wildfire.

Comment (3): The benefits and risks of salvage efforts should be discussed, including the potential that recovery money is better spent on other recovery efforts.

Response: Salvage efforts have generally focused on removal of tadpoles from the wild and in small numbers. This lifestage has a high mortality rate; thus, a high proportion of those removed would likely die in the wild. Generally, we have avoided the removal of adult southern *Rana muscosa* from the wild, even after wildfires. The exception has been the removal of adults from City Creek due to their low numbers and limited recruitment in the wild over many years. This has resulted in captive breeding and reestablishment

efforts in City Creek with hundreds of juveniles that otherwise may not have been available.

Comment (4): The recovery plan should consider the possibility of future impacts from recreation if the USFS opens up areas like Little Rock Creek in the Angeles National Forest.

Response: We've added recreation as a threat to the Little Rock Creek population in the Species Biological Report. With the increase in southern *Rana muscosa* numbers in Little Rock Creek, the Angeles National Forest has been developing a plan to reopen the area to recreation, with conservation measures. However, any such proposal that may impact southern *Rana muscosa* would be subject to consultation under section 7 of the Act to ensure the distinct population segment is not jeopardized.

B. Summary of Peer and Partner Review Comments

We also solicited comment from Federal and State partners and independent peer review of the draft recovery plan from individuals who have expertise and experience with southern *Rana muscosa* or similar species. In total, we solicited comment from six peer reviewers and four partner agencies. We received comments from three peer reviewers and four partner reviewers. Peer reviewers that responded included representatives from one Federal agency (USGS) and two from a non-profit organization (ICR). Partner reviewers that responded included representatives from USGS, USFS, and CDFW. In general, the draft recovery plan was well-received by the peer and partner reviewers and garnered positive comments. Several reviewers provided additional specific information, including documents or citations; we thank the reviewers for these data and we have added the information where appropriate. Below, we provide a summary of specific comments received from peer and partner reviewers with our responses; however, we addressed many of the reviewers' specific critiques and incorporated their suggestions as changes to the final recovery plan. Such comments did not warrant an explicit response, and as such, are not addressed here. Additionally, a meeting was held on September 11, 2018, to allow for direct comments from partners working on the mountain yellow-legged frog working group. We appreciate the input from all commenters.

We considered all substantive comments and, to the extent appropriate, we incorporated the applicable information or suggested changes into the Species Report, Recovery Plan, and Recovery Implementation Schedule. Below, we provide a summary of comments received from peer reviewers and partners. Some of the comments that we incorporated as changes into the final recovery plan did not warrant an explicit response and, thus, are not presented here.

Peer Review:

Peer Review Comment (1): One of the threats to southern *Rana muscosa* is the amount of time it takes to permit recovery actions. This should be included as a Factor D threat.

Response: Coordinating with landowners and land management agencies regarding potential reestablishment efforts and addressing concerns, as appropriate, is an important and necessary part of the process. We recognize that the time involved can delay or even prevent recovery efforts, but it would not be considered a Factor D threat, which involves potential lack of mechanisms and regulatory controls to prevent impacts to southern *Rana muscosa*.

Peer Review Comment (2): Freshwater ponds and lakes should be considered as a priority for reestablishment efforts.

Response: Due to the lack of lakes or lakes without nonnative predators in southern California, there are limited opportunities for using lakes for reestablishment efforts. However, we are considering use of Bluff Lake as a reestablishment site and it is within the San Bernardino Management Unit. An activity has been added to the Recovery Implementation Schedule to further investigate this potential recovery tool.

Peer Review Comment (3): Changes should be made to include a PVA with and without removal of animals for translocation.

Response: We've incorporated this suggestion into the Recovery Implementation Schedule (i.e., Recovery Activity 2.4)

Peer Review Comment (4): The distinction between Recovery Activity 1.2 and 6.2 should be clarified.

Response: We have added language to clarify that Recovery Activity 6.2 refers to management of the genetics of captive populations, while Recovery Activity 1.2 is focused on genetics associated with the wild populations.

Partner Review:

Partner Review Comment (1): Nonnative trout should be changed to predator. Mountain yellow-legged frogs are also still threatened by bullfrogs. Also make it clear that when trout removal is discussed it is referring to nonnative trout.

Response: We have changed the language regarding nonnative trout to reflect the potential for threats from other nonnative predators, including bullfrogs. We have also made it clear that we are not recommending removal of native trout.

Partner Review Comment (2): The budget is too low for nonnative trout removal.

Response: We have increased the budget, in accordance with this comment.

Partner Review Comment (3): Is reestablishing connectivity realistic? Reestablishing connectivity should only be done in areas without land management conflicts.

Response: In some cases reestablishing connectivity may be difficult or impossible. However, there are cases where we can accomplish it and will continue to look for those opportunities, especially for reestablished populations. One successful example was the nonnative trout removal that occurred between the Dark Canyon and Fuller Mill Creek occurrences to allow for those occurrences to connect.

Partner Review Comment (4): Southern *Rana muscosa* may be isolated for additional reasons beyond nonnative trout.

Response: All the remaining populations occur in areas without trout, usually separated from trout by impassable barriers, although there are occasional adult southern *Rana muscosa* that venture into areas with trout. However, it's clear that trout is a major factor in the isolation of southern *Rana muscosa*. Regardless, there may be additional factors, such as disease that have resulted in populations becoming isolated. However, the impact of disease is already addressed in the recovery plan.

Partner Review Comment (5): Southern *Rana muscosa* and native trout historically occurred in some large watersheds. In some cases, steelhead recovery efforts may conflict with southern *Rana muscosa* recovery. The partners should work together to determine how to recover southern *Rana muscosa* and steelhead in the same watersheds, perhaps by developing aquatic biodiversity management plans. Results from research on potential ability to co-occur and under what habitat conditions could inform the strategy.

Response: The Management Units represent areas where reestablishment of southern *Rana muscosa* will be considered, but some areas within those units will never be suitable for them due to the presence of steelhead, which we do not propose to remove or impact during recovery efforts. As specific sites for southern *Rana muscosa* reestablishment and nonnative trout removal are identified, we will coordinate with the relevant agencies, as appropriate, to ensure that those sites and removal efforts are not in conflict with steelhead recovery.

Partner Review Comment (6): It's not clear that recreational closures led to an increase in southern *Rana muscosa*.

Response: There is a correlation between the recreational closures and increases in southern *Rana muscosa* populations at the Little Rock and Dark Canyon populations. In addition, research indicates that recreation can impact the spatial and temporal use of resources in the Iberian frog (*Rana iberica*) (Rodriguez-Prieto and Fernandez-Juricic 2005) and southern *Rana muscosa* may respond similarly. However, recreational closures are not necessary or even appropriate at every site and situation, especially as the number of southern *Rana muscosa* increases and/or in areas where recreation is appropriately managed or there is little to no recreation.

Partner Review Comment (7): Fire suppression is the threat rather than fire management.

Response: We have changed the recovery plan to reflect this comment. Wildfire, and potential effects due to efforts to fight wildfire, is the major threat to southern *Rana muscosa*, rather than efforts to restore more of the historical fire regime.

Partner Review Comment (8): Replace the phrase nonnative trout with stocked or planted trout throughout the documents, since not all trout populations are nonnative.

Response: We recognize there are native rainbow trout populations in southern California. However, changing the phrase to stocked or planted trout may lead to confusion. Some trout occurrences are nonnative, but now reproducing in the wild.

Partner Review Comment (9): The figures in the document should be revised to identify areas where trout removal and other recovery actions will be considered.

Response: We don't have adequate information to identify such areas at this time. We will need further interaction and responses from the public and partner agencies, as necessary, as well as additional survey information to identify such areas.

Partner Review Comment (10): For the recovery criteria, identify how abundance of southern *Rana muscosa* will be determined.

Response: Currently, the unique adult southern *Rana muscosa* are being counted, which provides a minimum number of adults in the population. As populations grow in size and number, we will be considering additional practical methods to estimate abundance, in accordance with the extent of those populations.

Partner Review Comment (11): Include a recovery action that investigates the predator/prey relationship between southern *Rana muscosa* and native (and hybrid) trout and whether habitat complexity influences it as a Priority 2 action.

Response: We amended Recovery Activity 6.5.4 to address this comment.

Partner Review Comment (12): The carrying capacity should be identified for each site.

Response: Since we have identified minimum population sizes for recovery in our recovery criteria, it would be important to reestablish populations in areas that can hold that minimum number of southern *Rana muscosa*. Thus, we have added Recovery Activity 6.7 to address this issue.

Partner Review Comment (13): Some of the reestablishment sites identified in the Recovery Plan are designated as heritage or wild trout waters that are managed for fishing. Other areas will be nearly impossible to maintain trout free.

Response: We will work with our partners to evaluate sites for reestablishment to help address these concerns. Site suitability will be investigated such that selected sites do not interfere with native trout and have a high probability of remaining trout free if this is an area where nonnative trout are to be removed.