APPENDIX L: U.S. FISH AND WILDLIFE SERVICE CONSULTATIONS

The Endangered Species Act of 1973, as amended (16 USC 1531 et seq.), requires all federal agencies to consult with the U.S. Fish and Wildlife Service (FWS) to ensure that any action authorized, funded, or carried out by the agency does not jeopardize the continued existence of listed species or critical habitat. The National Park Service (NPS) reviewed the special-status species lists on the FWS website in 2006, 2009, 2012, and again on February 10, 2016 (see appendix F) and park biologists determine which species has the potential to be affected by the proposed project.

The NPS initiated several discussions with various FWS staff by phone, email, and in-person communications to (1) describe this project and its potential relationships to special-status species; (2) become educated on the consultation process and timeline; and (3) determine an appropriate consultation structure. The phone and email communications occurred intermittently from approximately 2011 to March 2016. In-person communications occurred during team meetings for the mountain yellow-legged frog (MYLF) Conservation Strategy, and at several research and management meetings for MYLFs and the Yosemite toad. The NPS submitted a biological assessment (BA) to evaluate the proposal to the FWS on February 24, 2016. The BA provided an analysis of the effects from the proposed project to the following listed species: the northern distinct population segment of the mountain yellow-legged frog, the Sierra Nevada yellow-legged frog, the Yosemite toad, the Little Kern golden trout, and the Sierra Nevada bighorn sheep. The BA also provided an analysis of the effects to proposed or designated critical habitat for these species.

The FWS responded to the NPS on May 25, 2016 with a Biological Opinion, included in this appendix. The FWS concurred that the Restoration Plan as proposed may affect, but is not likely to adversely affect the Sierra Nevada bighorn sheep, nor adversely affect its critical habitat. The FWS found that the proposed project is not likely to adversely affect critical habitat for the little Kern golden trout. The Service's biological opinion is that the SEKI Restoration Plan, as proposed, is not likely to jeopardize the continued existence of the Sierra Nevada yellow-legged frog, northern DPS of the mountain yellow-legged frog, Yosemite toad, and Little Kern golden trout.

It is the Service's biological opinion that the SEIKI Restoration Plan, as proposed, is not likely to destroy or adversely modify proposed critical habitat for the MYLF or Yosemite toad. The Service reached this conclusion because the project-related effects to the proposed and designated critical habitat, when added to the environmental baseline and analyzed in consideration of all potential cumulative effects, will enhance the value of the affected key components, or PCEs, to provide for the conservation of these species based on the following: (1) effects to essential physical or biological features will be temporary; (2) these actions will not destroy any essential physical or biological features of the habitat; and (3) the Restoration Plan will enhance proposed critical habitat via removing predatory fish. The effects to Sierra Nevada yellow-legged frog and northern DPS of the mountain yellow-legged frog proposed critical habitat are small and discrete, relative to the entire area designated, short in duration, and are expected over time to appreciably enhance the value of the critical habitat for the conservation of the Sierra Nevada yellow-legged frog, northern DPS of the mountain yellow-legged frog, and the Yosemite toad.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Suite W-2605
Sacramento, California 95825-1846

In Reply Refer to:
08ESMF00-2016-F-1174

JUN 0 3 2016

Memorandum

To: Park Superintendent, Sequoia and Kings Canyon National Park, Three Rivers, California

From: Field Supervisor, Sacramento Fish and Wildlife Office, Sacramento, California

Subject: Formal Consultation and Formal Conference on the Restoration of Native Species in High Elevation Aquatic Ecosystems Plan, Sequoia and Kings Canyon National Park, Three Rivers, California

This document replaces our memorandum dated May 25, 2016, same subject. This version only corrects typographical and formatting errors inadvertently over looked in the prior memorandum.

This is in response to National Park Service's (NPS) February 24, 2016, request for formal consultation with the U.S. Fish and Wildlife Service (Service). At issue are the potential effects of the Restoration of Native Species in High Elevation Aquatic Ecosystems Plan, Sequoia and Kings Canyon National Park (SEKI) on the endangered Sierra Nevada bighorn sheep (*Ovis canadensis sierrae*) and its critical habitat, endangered northern Distinct Population Segment (DPS) of the mountain yellow-legged frog *(Rana muscosa),* endangered Sierra Nevada yellow-legged frog *(Rana sierrae),* threatened Yosemite toad (*Anaxyrus canorus*) and their proposed critical habitat, and the threatened Little Kern golden trout (*Oncorhynchus mykiss whitei*) and its critical habitat. This biological opinion and biological conference is issued under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.).* (Act).

The Federal action on which we are consulting is the implementation of the preferred alternative B of the Restoration of Native Species in High Elevation Aquatic Ecosystems Plan Final Environmental Impact Statement (Restoration Plan). This alternative proposes to return strategically-located waterbodies to their naturally fishless state in locations across SEKI, and thereby restore favorable conditions for the persistence of native species and ecosystem processes in high elevation lake and stream communities.

Pursuant to 50 CFR §402.12(j), you submitted a biological assessment, along with subsequent information, for our review, and requested concurrence with your determinations on the effects on listed species. Your determinations are the proposed project may affect, likely to adversely affect the Sierra Nevada yellow-legged frog, northern DPS of the mountain yellow-legged frog, Little Kern golden trout, and the Yosemite toad; and that the proposed project may affect, not likely to adversely affect the Sierra Nevada bighorn sheep. You further made the determination that the project will not adversely affect proposed critical habitat for the Sierra Nevada yellow-legged frog, northern DPS of the mountain yellow-legged frog, Yosemite toad, and critical habitat for the Little Kern golden trout and Sierra Nevada bighorn sheep.

In considering your request, we based our evaluation on the following: (1) letter from the NPS to the Service dated February 24, 2016, and attached biological assessment (NPS 2016a); (2) Restoration of Native Species in High Elevation Aquatic Ecosystems Plan and Final Environmental Impact Statement, Appendix B (NPS 2016b) ; (3) Restoration of High Elevation Aquatic Ecosystems in Sequoia and Kings Canyon National Park s 2012 Field Season Summary (NPS 2013); (3) Mountain Yellow-legged Frog Conservation Assessment for the Sierra Nevada Mountains of California, USA (USFS 2014); (4) Administrative Draft, Interagency Conservation Strategy for Mountain Yellow-Legged Frogs in the Sierra Nevada (Service in preparation); and (5) other information available to the Service.

Many of the published peer-reviewed papers and unpublished reports on the Sierra Nevada yellow-legged frog and the mountain yellow-legged frog were issued prior to the analysis and taxonomic reclassification by Vredenburg *et al.* (2007). These two taxa have been elevated from subspecies to species, and other changes in their systematics and taxonomy; possess similar morphology, behavior, biological and ecological characteristics; and within this biological opinion when the information applies to both animals, they will be collectively referred to as "mountain yellow-legged frog."

Based on the information you provided and also available to us, we concur with your determination that the proposed project is not likely to adversely affect the endangered Sierra Nevada bighorn, nor adversely affect its critical habitat. We concur that the proposed activities will not result in harassment, injury, death, or harm because this species likely will move away from NPS staff conducting the activities of their own volition. The proposed activities will not result in loss or damage to the primary constituent elements of this species' critical habitat. We find that the proposed project is not likely to adversely affect critical habitat for the Little Kern golden trout because project activities are not proposed within the Little Kern River drainage and it is outside of aquatic features that comprise critical habitat for this species (50 CFR 17.95 – Little Kern River and all streams tributary to Little Kern River above barrier falls 1 mile below the mouth of Trout Meadows Creek). We do not concur the project will not adversely affect proposed critical habitat for the Sierra Nevada yellow-legged frog, northern DPS of the mountain yellow-legged frog, Yosemite toad.

Our evaluation of this action on the mountain yellow-legged frogs, Yosemite toad, and Little Kern golden trout; and proposed critical habitat for the Sierra Nevada yellow-legged frog, northern DPS of the mountain yellow-legged frog, and Yosemite toad; and Little Kern golden trout, is contained within this biological and conference opinion.

Consultation History

January 21, 2016 — Telephone conversation with SEKI to clarify approach towards final permitting and consultation requirements for FEIS and ROD.

February 24, 2016 — SEKI initiated formal consultation on the project in a letter dated February 24, 2016.

March 17, 2016 — The Service and SEKI met to discuss elements of the project and timeline.

April 15, 2016	Email correspondence from SEKI clarifying that the project description includes Yosemite toad monitoring; and also amending the request for May Affect, Not Likely to Adversely Affect concurrence in the biological assessment for Little Kern golden trout and Yosemite toad to May Affect, Likely to Adversely Affect to accommodate take associated with exotic fish eradication.
April 22-25, 2016	Email correspondence between SEKI and the Service clarifying incidental take of mountain yellow-legged frogs and Yosemite toad for fish eradication activities.
May 26, 2016	Electronic mail clarification for not likely to adversely affect determinations and findings.

Description of the Action

Sequoia National Park, established in 1890, and Kings Canyon National Park, established in 1940, are administered as a single unit that rises from the low western foothills at 1,370 ft to the summit of Mount Whitney at approximately 14,494 ft. SEKI protects 865,964 acres along the western slope of the Sierra Nevada mountain range in east-central California. Two wilderness areas are located within SEKI, including the Sequoia-Kings Canyon Wilderness and John Krebs Wilderness, which encompass approximately 97% of the parks. The entirety of SEKI is within Tulare and Fresno counties. Drivable access is by California State Routes 180 and 198, which within SEKI is known as the Generals Highway.

SEKI is developing a long-term, park-wide Restoration Plan/FEIS (Plan) to guide management actions to restore and conserve native species diversity and ecological function at selected high elevation aquatic ecosystems that have been adversely impacted by human activities. This project is intended to increase the amount, distribution, and connectivity of high quality habitat for the endangered mountain yellow-legged frogs. Increasing the amount, distribution and connectivity of high quality mountain yellow-legged frog habitat by eradicating non-native trout is a primary tool available for restoring ecosystems to conditions capable of supporting robust frog metapopulations. This project focuses upon non-native fish eradication and other restoration and monitoring activities. The project includes a mix of fish eradication using both physical and chemical methods (piscicides), active habitat restoration using a variety of methods to help stabilize and recover mountain yellow-legged frogs across the Park, and monitoring efforts to measure frog distribution, abundance, population, and disease status.

Since 2001, SEKI has been conducting the Preliminary Restoration of Mountain Yellow-legged Frogs project in selected high elevation basins within SEKI (NPS 2001, 2009a, 2015a). These activities are nearing completion, and were covered through prior Service formal consultation (FFOSESMF00-2014-F-0421). This action expands the areal and temporal coverage of SEKI aquatic restoration activities, and broadens the scope of the activities to include the use of rotenone(a piscicide) to complete fish eradication in those water bodies where physical eradication is infeasible.

Frog monitoring and restoration activities associated within the larger management plan include: visual encounter surveys, capture-mark-recapture surveys, translocation and reintroduction, antifungal and beneficial bacterial treatments, captive rearing, salvaging drought-threatened populations, and continued research associated with disease intervention methodologies. This plan will be implemented over a period of 25 to 35 years (2016-2051), with an internal evaluation of management effectiveness every five to ten years. SEKI is proposing to eradicate non-native trout and monitor the three listed amphibians

Project Activities

Mountain Yellow-legged Frog Restoration

The strategy incorporated into this Plan for high elevation aquatic ecosystem restoration is to both protect and rebuild extant populations of mountain yellow-legged frogs where opportunities still exist, and to reintroduce the species to many locations where populations have recently been extirpated. Non-native fish removal is a primary step in restoring mountain yellow-legged frogs as higher trophic level predators in these high elevation aquatic ecosystems, thereby restoring native community dynamics. All lake basins identified for fish eradication or known to have historic or current occupancy by the endangered amphibians are considered potential restoration sites for this species.

The proposed restoration areas within SEKI were selected for: 1) geographic and elevational representation of the historic distribution of mountain yellow-legged frogs, 2) the known genetic diversity of mountain yellow-legged frogs, 3) areas of potential high-quality habitat, and 4) known persistent mountain yellow-legged frog populations that may be important to future restoration. Mountain yellow-legged frog restoration actions will be aligned with the nearly-complete Interagency Mountain Yellow-legged Frog Conservation Strategy for the Sierra Nevada (Strategy) (Service *et al.* in preparation). Recommended actions in the Strategy include: non-native fish eradication, translocation/reintroduction, antifungal and beneficial bacteria treatment, immunization, head-starting/captive rearing, and emergency salvage.

The restoration activities will take place in a total of 55 basins. These 55 basins include up to 21 basins in which non-native fish will be eradicated from at least one waterbody, plus 34 additional basins where no fish will be eradicated, including four basins with fish eradications completed under the existing approved plan. All of the 55 restoration basins contain differing numbers of lakes, ponds, streams and associated wetlands that are already fishless. Restoring connectivity of fishless habitat between multiple waterbodies will improve dispersal between frog breeding, feeding and over-wintering habitat where occupied mountain yellow-legged frog habitat is nearby. In locations with high quality but unoccupied mountain yellow-legged frog habitat, or areas where restoration sites are geographically isolated from existing frog populations, physical reintroductions ("translocating" or transporting frogs from one site to another) will occur.

The high elevation aquatic ecosystems in the Park ranging from 6,000 to 12,000 feet targeted for physical restoration include: 21 lake basins where physical and chemical fish eradication will be applied—including 80 lakes and ponds (totaling 602 acres); five fish-containing marshes (totaling 32 acres), and approximately 31 miles of stream. Broader project related activities include continued monitoring, disease intervention, translocations/salvage/captive rearing, and related research that span a total of 55 lake basins within the Park.

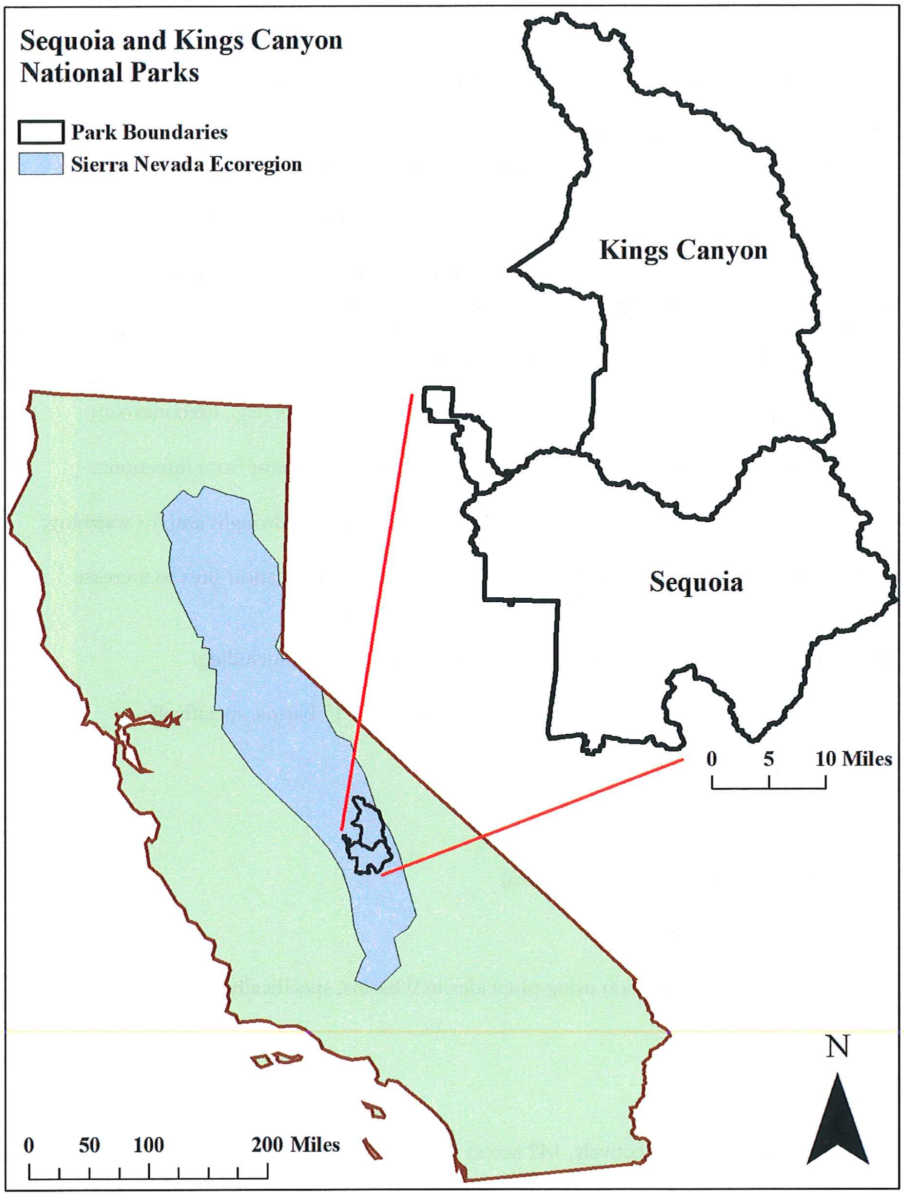


Figure 1. State perspective map of Sequoia and Kings Canyon National Parks.

The following activities will be conducted at a total of 55 basins across the Park:

1. Continuing restoration and monitoring, including:

a. Handling up to 3,000 eggs or tadpoles and 2,000 (male and female) adults or post-metamorphic sub-adults per year;

b. Performing capture-mark-recapture (and release at or near point of capture);

c. Collecting and/or translocating eggs, tadpoles and adults from SEKI to captive rearing facilities (e.g., San Francisco Zoo) or directly to approved locations within SEKI;

d. Transporting live reared frogs from captive rearing facilities to SEKI;

2. Capturing adults with dip-nets and handling tadpoles, adults, and subadults (≥38 mm), weighing, measuring, and marking using passive integrated transponders (PIT tags, ≥38 mm), visual implant elastomer (VIE), radio-transmitters, toe clips (if needed for genetic material, or as a last resort for marking subadults where VIE and PIT tags are not feasible);

a. Clearing frogs of disease infection using antifungal treatments (e.g., itraconazole);

b. Performing bioaugmentation treatments on frogs to shield them from infection;

c. Conducting emergency salvage at populations threatened by drought and/or warming;

d. Conducting garter snake relocation at reintroduction/translocation sites to increase probability of population establishment.

3. A subset of 21 lake basins are identified for physical restoration, including:

a. Non-native fish eradication using physical methods in 17 basins, specifically:

i. 27 lakes

ii. 24 ponds

iii. one marsh (collectively, 492 acres)

iv. 15 miles of streams

b. Non-native fish eradication using piscicides in 9 basins, specifically:

i. four lakes

ii. 25 ponds

iii. four marshes (collectively, 142 acres)

iv. 16 miles of streams

Monitoring of the short- and long-term outcomes of restoration work will document mountain yellow-legged frog and ecosystem responses to restoration efforts. The analysis of the biological data will provide further insight regarding beneficial effects from non-native fish and restoration methods, managing genetic diversity within species populations, interactions between stressors, and discovery of issues yet unknown. The knowledge gained through monitoring will be incorporated into adaptive management activities and also will add to understanding of the continuing threats to high elevation ecosystems from non-native species, air pollution, climate change, new pathogens and other environmental stressors.

SEKI staff use visual encounter surveys (VES) to monitor the distribution, relative abundance, and age structure of mountain yellow-legged frog populations over time (Crump and Scott 1994). This technique involves one or two crew members walking around the shoreline of lakes, ponds, marshes, and streams, and sometimes through heavily-vegetated shallow aquatic habitat, and recording 1) the number of amphibian and reptile individuals detected by species and life stage; 2) the health of each individual (alive, morbid, dead); 3) presence/absence of fish and their redds, and 4) air and water temperature, wind and weather conditions; and 5) interesting observations. VES will be conducted at all mountain yellow-legged frog sites, as well as treatment (fish eradication) and control (fish-containing and historically fishless) lakes in each fish eradication basin.

VES generally do not involve handling animals unless species identification is uncertain. In very rare instances, an individual may need to be handled to confirm identification. In some surveys, up to 20 post-metamorphic frogs per waterbody may be captured using dipnets and temporarily handled to collect skin samples (sterile swabs) using standard methods (Hyatt *et al.* 2007) for assessing the presence and infection intensity of *Batrachochytrium dendrobatidis* (Bd), and to record information about the individual frog (size, sex, behavior). Disease monitoring could provide opportunities to treat animals just before and/or during a die-off to increase frog survival.

Although useful for general monitoring purposes, VESs are well-known to produce underestimates of true population size (Mazerolle *et al.* 2007). Capture-mark-recapture (CMR) surveys account for detection probability and result in larger and more accurate estimates of population size (Williams *et al.* 2002). These data can be used to more accurately determine what percentage of the population can be responsibly collected for recovery efforts. To conduct CMR surveys, surveyors capture adult and juvenile mountain yellow-legged frogs that have a snout-to-vent length greater than or equal to 1.5 inches (38 mm) from lakes using dip nets. Each individual will be sexed, weighed, and swabbed to determine amphibian Bd infection levels. To mark each frog, an 8 millimeter passive integrated transponder (PIT) tag will be inserted under the surface of the dorsal skin. To insert PIT tags, a tiny incision is made just behind the head on the dorsal surface of the mountain yellow-legged frog and the PIT tag is inserted and moved to behind the pelvic girdle (Briggs *et al.* 2010). This assures that the PIT tag remains on the dorsal surface, but cannot move above the pelvic girdle. CMR surveys depend on each animal having a unique identifying feature, and because it is difficult to distinguish individual mountain yellow-legged frogs based on color patterns or other morphological features, PIT tags are a necessary tool. Each PIT tag contains a unique alphanumeric code and can be read with hand-held readers. Every time a mountain yellow-legged frog is recaptured, the surveyor can correctly identify each individual.

In all action alternatives, fish eradication sites will be monitored to determine that complete fish eradication has been achieved. For physical fish removal methods, initial confirmation of fish eradication will be determined using the methods employed since 2001 in SEKI. This method involves conducting gill-netting and electrofishing until winter, the following summer, and a second winter with no fish captures. If no fish are captured during this period, active fish removal efforts cease. For piscicide applications, the entire treatment area will be surveyed for any live fish using visual searches, gill-netting and electrofishing in the days/months immediately following treatment and during the subsequent summer.

For all treatment methods, post fish eradication monitoring will occur from two to five years to confirm the continued absence of fish. A small number of gill nets, deployed anywhere between one day and one month, may be used along with visual surveys to confirm fish absence. If fish are discovered in a restored site, eradication crews will return for follow-up fish removal efforts. Feedback from this monitoring will inform park managers and researchers about the results of fish eradication efforts, and be incorporated into future management activities.

Use of environmental DNA (eDNA), in which water samples are collected from aquatic environments to detect species, is an emerging technique that may prove useful as an additional method for confirming fish eradication (Pilliod et al. 2013; Keskin 2014; Turner et al. 2015). This method involves amplifying small fragments of DNA from water samples using species-specific DNA primers, which allow for the detection of species from quantities of DNA present in the environment (Wilcox et al. 2013). Research into this method shows potential as a non-invasive monitoring tool (Takahara et al. 2012, Wilcox et al. 2013). Research is currently ongoing to determine the feasibility of eDNA methods for detecting low density fish populations, or confirming eradication, in high elevation aquatic ecosystems in SEKI (NPS 2016a). If eDNA methods prove useful for confirming non-native trout absence in restored waterbodies, this method may be incorporated into monitoring of fish eradication sites.

<u>Research Activities</u>

Continuing research is expected to be critically important for long-term conservation of the special-status species, especially for the mountain yellow-legged frog. In particular, solutions to mitigate the effect of amphibian chytrid fungus on this species are very much needed. Three areas of potential promise include refining methods to 1) bathe mountain yellow-legged frogs in an anti-fungal solution (e.g., itraconazole) to reduce amphibian chytrid levels on frog skin, 2) augmenting naturally occurring bacteria to frog skin (e.g., Janthobacterium lividum) to increase natural protection from amphibian chytrid fungus, and 3) re-establishing mountain yellow-legged frog populations where they historically occurred or are dwindling toward extinction due to Bd. SEKI intends to continue research activities involving chytrid disease intervention and the possible use of probiotics in addition to chemical treatments to protect dying populations during the epizootic phase of infection in currently Bd naïve lakes.

Itraconazole is an anti-fungal compound that has been used extensively to clear amphibian chytrid fungus from amphibians, typically in a laboratory setting. In recent field experiments in SEKI it was used to clear or substantially reduce amphibian chytrid fungus loads on mountain yellow-legged frogs in three populations in the parks (Knapp 2010, 2011, 2012). In each population as many mountain yellow-legged frogs as possible are captured, held in temporary enclosures, and bathed in a low-concentration solution of itraconazole for ten minutes a day for seven consecutive days.

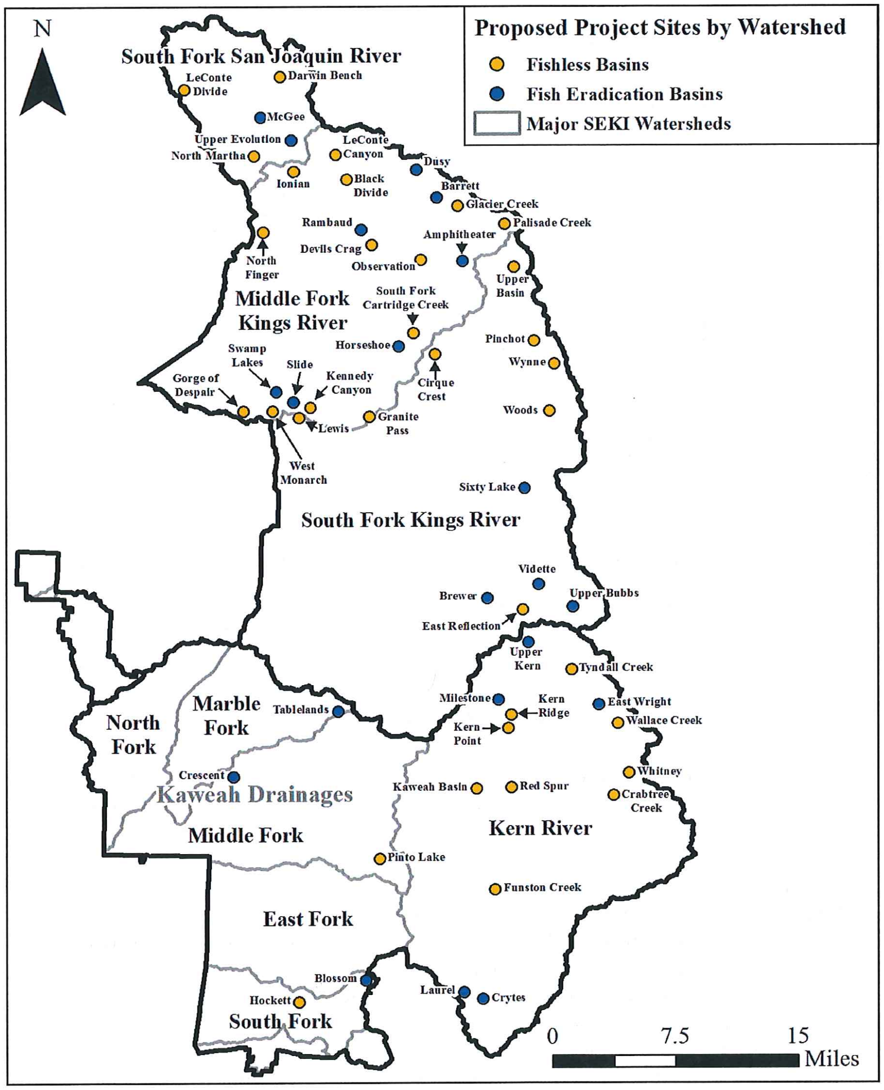


Figure 2. Locations of proposed aquatic ecosystem restoration sites. Orange dots indicate fishless conservation waterbodies, blue dots indicate proposed fish eradication waterbodies, all of which (except Crescent) also contain fishless conservation waterbodies.

San Joaquin/Kings MYLF Clade	Kings/Kern MYLF Clade	Southern Kern MYLF Clade	Unknown MYLF Clade
Physical Treatment	**Physical Treatment**	**Physical Treatment**	**Physical Treatment**
Barrett	Brewer	Crytes*	Blossom
Dusy	East Wright		Tablelands
Horseshoe*	Milestone	**Piscicide Treatment**	
McGee	Upper Bubbs*	Laurel	**Piscicide Treatment**
Rambaud	Upper Kern*		Crescent
Slide	Vidette	**Frog Restoration**	
Swamp Lakes		Funston Creek	**Frog Restoration**
Upper Evolution*	**Piscicide Treatment**		Hockett
	Sixty Lake		Pinto Lake
Piscicide Treatment			
Amphitheater	**Frog Restoration**		
	Cirque Crest		
Frog Restoration	Crabtree Creek		
Black Divide	East Lake Reflection		
Darwin Bench	Ionian		
Devils Crag	Kaweah Basin		
Glacier Creek	Kern Point		
Gorge of Despair	Kern Ridge		
Granite Pass	Lewis Lake		
Kennedy Canyon	North Finger Peak		
LeConte Canyon	North Martha		
LeConte Divide	Pinchot		
Observation	Red Spur		
Palisade Creek	Tyndall Creek		
South Fork Cartridge Creek	Upper Basin		
West Monarch	Wallace Creek		
	Whitney		
	Woods		
	Wynne		
Rana sierrae ↔	*Rana muscosa*		
* = *Basins in which fish eradication will be performed physically and with piscicides.*			

Table 1. List of 55 basins included in preferred Alternative B of the Restoration Plan/FEIS, grouped by mountain yellow-legged frog species and clade, and method of fish eradication or frog restoration

The bacterium J. lividum has strong anti-fungal properties and is found naturally on the skin of several amphibians including the mountain yellow-legged frog in the Sierra Nevada. This bacterium produces the anti- amphibian chytrid metabolite violacein and may help to protect frogs from fungal diseases including chytridiomycosis. In SEKI during 2010, a field trial was conducted in which recently infected adult mountain yellow-legged frogs were treated with J. lividum to increase the concentration of this bacterium on their skin. The treatment was conducted over one or two days by bathing frogs in a concentrated J. lividum solution for one hour each day (Knapp 2010). Subsequent monitoring showed much higher survival through the end of summer compared to individuals that were not treated.

Occupied basins will be monitored as much as possible over time, and waterbodies from which mountain yellow-legged frogs appear to have recently died out will be monitored as capacity allows, which will help assess natural recolonization rates. When a waterbody is monitored, SEKI expects to conduct one visit per year and crews will be onsite for one day during each visit. Mountain yellow-legged frogs in sites with Bd-positive populations are generally not swabbed for Bd-monitoring, whereas animals in sites with Bd-negative populations are annually swabbed in an attempt to detect the onset of expected infection and population die-offs, which will provide the opportunity to conduct antifungal and/or bacterial treatments to increase frog survival. SEKI currently has seven remaining basins in which Bd-negative mountain yellow-legged frogs occur (Dusy, Rambaud, Upper Bubbs [Center, Spur and Forester], Vidette, South Milestone, Kern Point, and Crabtree). A maximum of approximately 30 waterbodies are currently occupied by the amphibian in these seven basins. The average number of mountain yellow-legged frogs that will be captured and swabbed for Bd monitoring at these sites in one year will be ten frogs per waterbody per visit (Table 2).

Bd-monitoring will also be conducted at frog translocation/reintroduction sites, CMR study sites, and Bd treatment sites (Table 2). The maximum number of lakes at which translocations/ reintroductions may occur in one year is estimated at five lakes, and three visits swabbing an average of 20 frogs per lake could occur. The maximum number of lakes at which CMR studies may occur in one year is estimated at ten lakes (two basins, five lakes each), and three visits swabbing an average of ten frogs per lake could occur. The maximum number of lakes at which Bd treatments may occur in one year is estimated at five lakes, and two visits swabbing an average of 100 frogs per lake could occur. Swabbing may result in an annual maximum of 1900 swabs collected by SEKI staff for Bd monitoring for the duration this project (Table 2).

PIT-tagging also will be conducted at Bd treatment sites, mountain yellow-legged frog translocation/reintroduction sites, and CMR study sites as part of recovery actions (Table 7). The maximum number of sites at which Bd treatments may occur in one year is estimated at five lakes, and one visit PIT-tagging an average of 100 frogs per lake could occur. The maximum number of lakes at which translocations/reintroductions may occur in one year is estimated at five lakes, and one visit PIT-tagging an average of 40 frogs per lake could occur. The maximum number of lakes at

Table 2. Mountain yellow-legged frogs that may be handled and swabbed for Bd monitoring each year by SEKI staff during this project.

Site	# Annual swab visits	Maximum # lakes	# Swabs/visit/lake	Total
7 Bd-negative basins	1	30	10	300
Translocations / reintroductions	3	5	20	300
CMR studies	3	10	10	300
Bd treatments	2	5	100	1000
Total annual maximum	3	45	100	1900

Table 3. Mountain yellow-legged frogs that may be PIT-tagged for recovery actions each year by SEKI staff during this project.

Site	# Annual Tag visits	Maximum # lakes	# Tags/visit/lake	Total
Bd treatments	1	5	100	500
Translocations / reintroductions	1	5	40	200
CMR studies	3	10	10	300
Total annual maximum	3	20	100	1000

which CMR studies may occur in one year is estimated at ten lakes (two basins, five lakes each), and three visits PIT-tagging an average of ten frogs per lake could occur. Implementation of the PIT-tagging described above will result in an annual maximum of 1000 PIT-tags that may be inserted into frogs by SEKI staff during this project (Table 3).

Translocation/Reintroduction

To restore depopulated lakes after the extensive historic losses of mountain yellow-legged frog populations, a number of individuals will be moved from extant populations to areas where populations recently died out or severely declined. Movement will involve 1) capturing a small percentage (typically <10%) of the individuals in a source population using dipnets; 2) measuring the body condition of each animal (length, weight, sex, amphibian Bd level); 3) inserting a PIT tag under the skin of each frog larger than 1.5 inches (38 mm) long from snout-to-vent (Matthews and Preisler 2010) to monitor the status of each animal following reintroductions; 4) placing them in wetted containers with air holes; 5) potentially treating frogs prior to translocation with antifungal drug (e.g., itraconazole); 6) potential bioaugmentation with naturally occurring bacteria, *Janthinobacterium lividum*; and, 7) either carrying them to nearby recipient habitat or transporting them by helicopter to distant recipient habitat.

Whether frogs are given antifungal and/or bacterial treatments will depend on: 1) if preliminary results suggesting these agents are beneficial are confirmed by further study, to be completed by 2017, and 2) a targeted population is severely affected by amphibian chytrid fungus and thus needs treatment to increase survival. "Nearby" habitat generally can be hiked to within 6 hours, posing minor risk to frog survival during transport. "Distant" habitat cannot be hiked to within 6 hours, which will pose moderate to high risk to frog survival during transport. At the recipient site, all individuals will be released into fishless habitat and monitored for the next several years.

Itraconazole (Sporonox®) is an antifungal compound that has been used to clear *Batrachochytrium dendrobatidis* (Bd, or chytrid fungus) from infected amphibians, typically in a laboratory setting. Whether antifungal treatments are conducted in the field or in a laboratory (i.e., at a zoo), the solution ratio is 0.15 milliliter (3 drops) of itraconazole to 1 liter of water. After that is mixed, the frogs (usually adults and/or juveniles) are placed in the solution for ten minutes and positioned such that they are mostly submerged in the solution but can still hold their heads above to breathe. The frogs are then moved to a holding pen so that they can be treated again, once per day, for 6 to 10 days. If mountain yellow-legged frogs were treated in the field, the treatments will likely occur at the source site. Under current methods, frogs will be held in mesh pens (2 meter × 2 meter × 0.5 meter) anchored in the lake that allow the frogs to both swim in the water and bask on the shoreline. Animals will be treated once a day by moving 20 to 50 frogs at a time into plastic tubs containing the itraconazole solution. They will be bathed in the treatment solution for ten minutes per day and then returned to the pen. After full treatment is completed, animals will be transported to the receiving lake. If deemed necessary, the animals also may be treated with *J. lividum* collected from the source population and cultured in the laboratory. At the receiving lake, frogs will be held for two days in mesh pens anchored in the lake. Up to 50 frogs at a time will each be placed in small plastic containers that contain a concentrated solution of *J. lividum* mixed with lake water. Animals will be kept in the solution for one hour per day for two days and then returned to the pens between the two treatment sessions. The frogs will be released into the receiving lake after the second day of treatment. Currently, although bioaugmentation is not frequently utilized in the parks, this form of treatment is a potentially useful tool that may be implemented more in the future (Harris *et al.* 2009). These methods and their efficacy are still in development and could change over the course of this plan.

Captive Rearing

Bd-infected mountain yellow-legged frog populations in SEKI typically have few adults that are persisting and breeding, and an abundance of tadpoles and recently metamorphosed juveniles that experience very low survival with few animals reaching adulthood. While these populations may adapt to amphibian chytrid fungus in the field, captive rearing can help increase the chance for them to persist and recover by allowing more animals to survive the high mortality phase (post-metamorphosis) by allowing animals to be immunized and "head-started." Captive rearing will generally involve collection of adults from uninfected sites, and eggs, tadpoles, and/or juveniles from infected sites, for transport to a facility such as a zoo. In uninfected sites, it is generally permissible to collect up to 10% of adults for captive rearing. In infected sites, a larger percentage of eggs, tadpoles, and/or juveniles may be permissible for collection because few, if any, of these individuals will reach adulthood without some kind of intervention (e.g., antifungal treatment and immunization). Once collected, mountain yellow-legged frogs are kept cool (i.e., to ensure they remain well below their thermal maximum temperature), and transported immediately, by foot, helicopter, and/or vehicle, to minimize stress. At the zoo, the animals are first cleared of the chytrid infection, then raised to adulthood, re-infected with amphibian chytrid fungus, and then cleared again to elicit an adaptive immune response. At this point, Bd-free but no longer naïve frogs can be returned to either their source location, or introduced to a different site depending on conservation needs.

Salvaging Drought-threatened Populations

Although small ponds are not optimal habitat for mountain yellow-legged frogs, the widespread presence of non-native fish in larger, more suitable lake habitat has increased the importance of such marginal habitats. However, the same factor that generally makes these sites incapable of sustaining fish populations, also makes them less suitable for frogs—namely small ponds tend to be shallower and more susceptible to complete drying during summer. Mountain yellow-legged frogs require two to four years of permanent water for tadpoles to complete metamorphosis and reach adulthood. Thus, the potential complete drying of these smaller ponds can cause high local mortality across multiple frog cohorts (Lacan *et al.* 2008). When combined with the severely reduced breeding and recruitment success in larger lakes that contain non-native fish, the drying of these small ponds has the potential to result in extirpation of mountain yellow-legged frog populations simply as the result of stochastic environmental events. Salvaging populations can serve as a tool against potential extirpation. In such cases, frogs at any life stage may be collected and transported to a captive location using the same protocol described above. In captivity, mountain yellow-legged frogs can be kept until habitat conditions become suitable again and then released, or can be used to establish a captive breeding program. By establishing a captive breeding program, more animals can be produced and any life stage can be released into wild sites

Garter Snake Relocation

Garter snake predation has compromised the success of at least two mountain yellow-legged frog reintroductions in SEKI and Yosemite (Knapp unpubl. data). Given the relatively small numbers of mountain yellow-legged frog individuals anticipated to be available for translocations and reintroductions, all garter snakes detected will be relocated away from these sites for one to two years following reintroduction. This will give small mountain yellow-legged frog populations a chance to successfully breed, increase in abundance and stabilize enough so that they can persist amid natural snake predation. Snakes detected during monitoring will be captured, marked, and moved by foot to a site within the same basin that does not have frogs and is at least one mile away.

Gear Transport

Field crews hike to project areas on foot, backpacking in lightweight equipment and personal supplies. The bulk of project tools, equipment and supplies require transport, including one mobilization trip per restoration basin at the beginning of each summer, and one demobilization trip per restoration basin at the end of each summer. The type of gear transport is guided by the Wilderness Act, NPS policies, and the SEKI Wilderness Stewardship Plan (NPS 2015c). This document defines the minimum tool as "the management method (tool) that causes the least amount of impact to the physical resources and experiential qualities (character) of wilderness."

Packstock are the preferred transport method used to support this project except when one or more of the following conditions applies:

1. Equipment is fragile.
2. Cargo is time-dependent or requires stable conditions
3. Cargo is bulky and does not fit well on or over panniers.
4. An individual piece of cargo weighs over 150 pounds.
5. Stock is not allowed in the area, a waiver for stock use is not authorized by the superintendent, or the area is inaccessible to stock.
6. Stock will create unacceptable environmental impacts due to wet trail conditions, and it is impractical to reschedule stock use for a less damaging time.
7. Use of stock will cause more environmental impact than a helicopter (e.g., by the creation of new trails, by off-trail travel in sensitive environments, etc.).
8. Environmental hazards to personnel or animals (e.g., snow or high water crossings) create unsafe conditions for stock use and transport of the material cannot wait until conditions improve.

When one of these conditions applies, a helicopter is defined as the minimum tool for gear transport. Light (Type 3) helicopters are utilized.

When packstock are used for gear transport, mobilization trips typically require 5-7 animals and demobilization trips typically require 3-4 animals. Packers abide by all park regulations, including those governing off-trail travel, low-impact camping, and stock grazing. In general, stock will enter a site on day one, spend the night at a suitable site enroute back to the trailhead, and reach the trailhead the following day. If the overnight location is a sensitive meadow, then supplemental feed is required to minimize grazing impacts. If the restoration site is close enough to a trailhead, the packer can go in and out on the same day without having to stay overnight.

Crews and Crew Camps

Crew camps are required for each restoration basin. Crew camps are similar in size and scale to a wilderness backpacker camp. Crew members bring individual tents and there could be one larger tent used as a work or cooking area. The primary differences are the duration of use and the placement of equipment and/or food storage lockers. Also, either a pit is dug at the camp for use as a latrine, or a portable toilet is used (depending on the location, soil conditions, and site sensitivity). Crews follow "Leave No Trace" wilderness practices to minimize impacts to wilderness character.

Crew camps are used yearly until the project work is accomplished. There typically are one to three crews working at different restoration basins from June or July through September. Timing depends on weather and snowpack conditions. Crew size is typically two to three crewmembers per restoration basin, but there could be as many as 8 crew members at a site during mobilization trips depending on the size and complexity of the site. Crews camp up to ten days per site visit and each site is visited up to 7 times per season. Camp locations are selected to prefer available granite slabs or decomposed granite substrate generally absent of vegetation, out of mountain yellow-legged frog migration routes; and at sites more than 30 meters from water.

Yosemite Toad Monitoring

The threatened Yosemite toad occurs in SEKI. The NPS intends to develop capacity to monitor this animal and hopefully to recover it in SEKI, once restoration actions are identified and recommended by the species recovery team. In the interim, general population monitoring across the toad's range is necessary to improve our understanding of population fluctuations (e.g., local extinction and recolonization processes) and provide data to proactively plan management and conservation strategies (Jennings and Hayes 1994; Brown *et al.* 2012). For 2016, SEKI has secured funding to conduct one summer of Yosemite toad (and mountain yellow-legged frog) monitoring in relation to effects from drought. Funding has also been secured for one summer of monitoring on national forests adjacent to SEKI. Joint NPS and USFS protocols are in development, but VES is likely to be utilized, and Bd swabs may be collected.

Table 4. Yosemite toads that may be swabbed for recovery actions each year by SEKI staff during this project Site

	# Annual swab visits	Maximum # meadows	# Swabs/visit/meadow	Total
SEKI wide	2 (max per meadow per summer)	35	10	700

Exotic Fish Removal

Gill Netting

Gill netting is a method of fish capture primarily used in lakes, ponds and stream pools. Repeated gill netting has been successfully used to eradicate fish from many lakes in the high Sierra (Knapp and Matthews 1998; Knapp *et al.* 2007; NPS 2015a). Gill nets are sinking nets designed to effectively capture fish of all sizes. Netting involves placing many nets in a lake, with each net stretched fromthe shoreline out toward deep water at roughly equal distances between nets. Standard nets are 36 meters long by 1.8 meters deep, and have mesh sizes ranging from 1-3.8 centimeters. Nets used to capture young fish that remain very close to shore, are 18 m long by 1.8 m deep, and have mesh sizes ranging from 1-1.7 cm. Gill nets are deployed using inflatable non-motorized float tubes.

Nets are set and pulled during daylight hours to minimize safety hazards and potential handling complications. When a new fish removal site is initiated, nets are frequently cleaned of captured fish and reset, generally every 24 to 48 hrs. By mid-season, capture rates decrease and the length of time that nets are set gradually increases. At the end of the summer field season, several nets are set in deeper water to continue catching fish under winter ice. Summer and over-winter netting continues until all nets set in a lake repeatedly capture zero fish. This method of gill netting typically results in the removal of all fish from a lake by the third or fourth summer, but could take longer depending on site conditions. Once a site is thought to be fishless, gill-netting is continued for two winters and the summer in-between. If no fish are caught during this confirmation phase, the site is considered eradicated of fish and gill-netting is terminated.

Electrofishing

Electrofishing is a physical method of fish collection primarily used in streams and occasionally in shallow water at the edges of lakes. It is a common fishery management technique that has been successfully used to collect fish for approximately 100 years (Cowx and Lamarque 1990). Electrofishing is implemented with a device called an "electrofisher," which uses two electrodes to send electric current from a battery through the water. When both electrodes are submerged in the water and the unit is activated, the water completes the circuit and a field of electricity is generated around the electrodes. Fish caught in the field of electricity are stunned, float in the water, and are then captured using dipnets.

A two to three person electrofishing crew is deployed, wearing chest waders, wading boots and rubber gloves. One person operates the electrofisher while the remaining crewmembers stand on either side of the operator and capture shocked fish using dipnets. Each stream electrofishing session begins at the downstream boundary of the targeted stream segment and proceeds in an upstream direction. This allows stunned fish to drift downstream toward dipnet crews. Fish removal by electrofishing requires repeated passes through each target stream section until fish have been eradicated.

Disruption or Covering of Fish Redds

Where redds (fish egg nests) are visible in gravel-bottom areas of streams and shallow lake shores, they are disrupted with a shovel or by foot to minimize hatching of fish eggs. Gravels in these areas are then sometimes temporarily covered with boulders to eliminate or minimize future fish spawning habitat until eradication is achieved. Redds in high Sierra streams are typically small, measuring $<0.25\ m^2$ in surface area. Although this method is described here, it is very seldom used.

Fish Traps

Fish traps (Figure 3) may be used to augment gill netting and electrofishing efforts, when necessary, to maintain fish free conditions. If fish traps are used, they will be set in lake inlets and/or outlets to catch fish as they leave the lake to spawn. During the first field season, traps will be set during ice-out and removed in the fall. Following the first field season, the effectiveness of having the traps deployed throughout the entire ice-free season will be assessed. If the traps were not effective outside of the spring spawning season, then traps will only be deployed during the spring in subsequent years. Otherwise, the traps will be deployed throughout the ice-free season until the site was restored. If the inlet or outlet stream is wider than the trap (0.5 m) than mesh arms made out of PVC pipe and aquaculture mesh will be used to construct a funnel between the trap and the stream bank.

Piscicide Treatment

A piscicide is a chemical substance toxic to fish whose intended function is to eliminate undesirable fish from a body of water (CDFW 2007). The Prentox CFT Legumine™ formulation of rotenone is currently registered in the state of California for use in aquatic environments for the purpose of fish removal (CDPR 2016) and was declared eligible for reregistration as restricted-use piscicides by the U.S. Environmental Protection Agency (EPA 2007a, 2007b). Piscicide treatments in this Plan follow guidance and standard operating procedures documented in Planning and Standard Operating Procedures for the Use of Rotenone in Fish Management (Finlayson *et al.* 2010) and project plans in NOCA (NPS 2015b) and Silver King Creek, California (Service 2010).

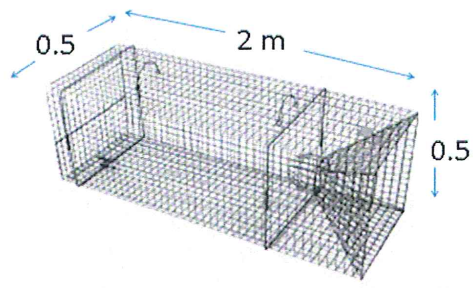
Piscicide application will be carried out in a manner that strictly adheres to practices permitted by the product labeling, including determining the maximum necessary application concentrations, and all other applicable guidelines. Experienced piscicide applicators will be directly involved in piscicicde treatments in SEKI, and all treatments will be managed by applicators certified by the state of California to apply piscicides in state waters. Applications will be conducted with an intention of eradicating all fish at treatment sites with as few treatments as possible. Fish eradication will likely be accomplished after one or two treatments at each site. Several treatments have recently been conducted in other national parks in which one application eradicated all fish. A third treatment may be necessary in the most complex areas, including Sixty Lake, Upper Kern and Laurel. Complex habitats increase the chances that rotenone concentrations will not reach levels lethal to fish in all areas (Finlayson *et al.* 2010). This rotenone SOP recommends spacing out treatments in time (usually so they occur over the course of multiple years) to allow fish eggs sufficient time to hatch and fry to be vulnerable to rotenone exposure.

The general protocol will be to treat habitat once in mid-late summer, monitor in September, and monitor again in the following early-midsummer. If live fish are found, a second treatment will be conducted. If no live fish are found, then a second treatment will not be necessary. Some of the proposed treatment areas in SEKI are small (e.g., one outlet stream of Upper Bubbs) and one treatment has a good probability of eradicating all fish in these areas. Other proposed treatment areas are larger (e.g., lower watershed of Sixty Lake), and while one treatment may eradicate all fish in these areas, additional treatment(s) may be necessary. If fish eradication is unsuccessful after three treatment years (initial year plus two reapplication years) at a particular site, then piscicide use will be abandoned at that site.

Table 5. Basins and waterbodies proposed for non-native fish eradication under Alternative B. Five associated marshes, including one in Crytes and four in Laurel are not included

Basin	# Lakes	Area (ac)	# Ponds	Area (ac)	Stream (mi)
Physical Treatment					
Barrett	3	42.07	1	0.28	0.87
Blossom	2	9.45	2	2.29	0.64
Brewer	0	0	1	1.60	0.52
Crytes	2	20.62	1	0.87	0.02
Dusy	1	10.58	2	0.60	0.69
East Wright	1	2.63	0	0	0.66
Horseshoe	4	28.96	0	0	0.40
McGee	4	75.31	4	1.19	1.20
Milestone	1	12.80	1	2.07	0.49
Rambaud	0	0	1	0.44	0.25
Slide	1	5.12	1	0.17	1.60
Swamp	0	0	1	1.85	0.28
Tablelands	0	0	1	1.48	1.65
Upper Bubbs	2	21.62	2	1.67	4.32
Upper Evolution	4	228.19	1	0.48	1.20
Upper Kern	0	0	2	2.12	0.38
Vidette	2	16.57	3	0.23	0.39
Subtotal Physical	**27**	**473.91**	**24**	**17.34**	**15.58**
Piscicide Treatment					
Amphitheater	1	58.87	2	1.34	2.16
Crescent	0	0	0	0	1.58
Crytes	0	0	0	0	1.99
Horseshoe	0	0	0	0	2.99
Laurel	0	0	1	0.22	3.09
Sixty Lake	1	13.36	14	14.87	1.00
Upper Bubbs	0	0	0	0	0.93
Upper Evolution	0	0	0	0	0.48
Upper Kern	2	18.32	8	4.17	1.47
Subtotal Piscicide	**4**	**90.56**	**25**	**20.61**	**15.69**
Grand Total	**31**	**564.46**	**49**	**37.95**	**31.27**

.Figure 3. Fish traps may be used in some lake inlets and/or outlets to catch fish as they migrate to spawning areas.



Each individual piscicide treatment will require up to ten working days (approximately 1½ weeks) including mobilization, application, neutralization, and demobilization. A crew of 8 to 15 people is needed to implement most of the piscicide treatments due to the greater size, complexity, and number of tasks compared to physical treatments. A crew of more than 15 people may be needed to implement one or more of the largest piscicide treatments, including Sixty Lake, Upper Kern and Laurel. Personnel experienced in piscicide treatments from other NPS units and/or CDFW will lead the first one to two treatments, after which SEKI personnel are expected to be sufficiently trained to lead the remaining treatments.

Anticipated take associated with fish eradication (both physical and chemical) is enumerated in Tables 5-7 for mountain yellow-legged frogs and Yosemite toad.

Table 6 Sierra Nevada yellow-legged frogs that may be incidentally taken due to fish eradication actions each year by SEKI staff during this project.

Fish Eradication Method	Adults/subadults annual average	Tadpoles annual average	Egg masses annual average	10 year total by lifestage
Physical	8	8	2	80/80/20
Piscicide	25	200	0	50/400/0[1]

Table 7 Northern DPS mountain yellow-legged frogs that may be incidentally lost to fish eradication actions each year by SEKI staff during this project.

Fish Eradication Method	Adults/subadults annual average	Tadpoles annual average	Egg masses annual average	10 year total by lifestage
Physical	8	8	2	80/80/20
Piscicide	25	200	0	75/600/0[2]

Table 8 Yosemite toads that may be incidentally lost to fish eradication actions each year by SEKI staff during this project.

Fish Eradication	Adults/subadults	Tadpoles	Egg masses	10 year total

1 Ten year cumulative incidental take figure is based on three treatment sites total, maximum two treatments first ten years.
2 Ten year cumulative incidental take figure is based on six treatment sites total, maximum three treatments first ten years.

Method	annual average	annual average	annual average	by lifestage
Physical	3	3	2	30/30/20
Piscicide	10	200	0	10/200/0[3]

Fish Disposal

Most lake systems in the high Sierra are oligotrophic, or nutrient lacking. Therefore, allowing nutrients present in fish populations to be released directly to the aquatic ecosystem through decomposition is an important step for retaining limited nutrients and will be a long-term benefit to the restoration areas. At sites where fish will be removed using physical methods, on a daily basis, crews will puncture the swim bladders of all individuals captured to prevent them from floating, and sink them in deep water to the bottom of each restoration lake. Crews will dispose of stream fish taken by electrofishing by puncturing their swim bladders and sinking them in deep water to the bottom of the nearest restoration lake. This method has been used with no observable adverse ecosystem effects in 13 project years (NPS 2015a; NPS unpubl. data). At sites where high density fish populations will be eradicated using piscicides, dead fish may float to the surface in potentially large numbers. Large fish kills resulting from piscicides will remain in larger waterbodies, or carcasses will be moved from small, shallow waterbodies to nearby larger waterbodies. In cases where myriad fish are killed in a short time period and concentrated in one area, carcasses will be distributed among nearby larger and deeper waterbodies within the same basin.

Conservation Measures

Conservation measures are designed to prevent or minimize adverse impacts or to contain impacts within acceptable limits during and after project implementation. The following conservation measures and/or best management practices will be implemented as part of this project.

1. Work Crews

    a. All crews will be instructed in and required to use minimum impact camping practices and wilderness ethics.

    b. Crew camps will be located where they have minimal impact on the natural qualities of wilderness character. Generally, naturally hardened sites will be selected. Naturally hardened sites have a natural abundance of sand, gravel, or rock and a natural lack of grasses and forbs. Wherever possible, crew camps will be located at base camps used for previous projects, with minimum potential to disrupt wildlife habitat or habits.

    c. Crews will be instructed on proper food-storage practices and camps will be inspected to make sure food is properly stored.

    d. Water for the crews both at work sites and in camp will be taken from a stream or lake that will be accessed by non-sensitive paths. The crews will be instructed to avoid sensitive areas in both the work sites and crew camp areas.

    e. Gray water will be disposed of over 100 ft (30 m) from any surface water and will be poured into a small pit through a screen to remove small food particles. Strained food particles are then removed from the area with other trash.

3 Ten year cumulative incidental take figure is based on only one treatment site with nearby toads.

f. Special containers or pit toilets will be used for toilets in all work and camp areas. The containers will be packed or flown out at the end of the field season and disposed of in a sewage treatment facility.

g. No motorized equipment will be used in camp. A propane/white gas or battery-powered lantern or headlamp will be used to light the work and cooking area inside the work tent. All other light will be from personal flashlights and headlamps.

h. All equipment, clothing, and gear will be checked for debris, cleaned of any visible plant or soil matter, and disinfected with quaternary ammonia following SEKI's disinfection protocol prior to moving to a new site.

2. Packstock

a. SEKI's packstock operations will be subject to the same minimum impact standards and grazing regulations as general parks users.

b. Packstock (fur and hooves) and equipment will be inspected and cleaned of seeds and dirt, as necessary, before leaving the front country.

c. All SEKI grazing restrictions and regulations will be adhered to. Where grazing is not allowed, only supplemental feed products that have been either heat treated or fermented so as to render any weed seeds inviable will be fed to stock.

3. Helicopter Use

a. A helicopter will be used only if determined through the minimum requirement analysis to be the minimum tool necessary for a particular project and project site.

b. If a helicopter is determined to be the minimum tool, then a temporary landing zone will be established at the project site. The landing zone should be void of trees and boulders that could pose a threat to helicopter rotors; should be on flat, level surface; minimal exposure to heavy winds; sites with ease of landing (affects load weights that can be delivered); and in proximity to base camp.

c. No whitebark or foxtail pines may be cut to accommodate a landing zone.

d. Except in the case of a medical emergency, flights will occur only between 8:00 a.m. and 5:00 p.m. and will follow flight paths to and from the project sites designed to avoid sensitive areas.

4. Restoration of mountain yellow-legged frogs

a. All personnel involved in collection and handling for CMR, translocations, reintroductions, antifungal treatments, and any other methods that involve handling mountain yellow-legged frogs will be Service-approved professional biologists with sufficient experience with proper handling of endangered amphibians; or trained, but less experienced biologists who will work under the direct supervision of Service-approved professionals.

b. All listed amphibians handling will be conducted with wet hands only and not on adults in amplexus during routine monitoring and research activities.

c. Mountain yellow-legged frog handling will be kept to the minimum time necessary for effectively completing conservation actions.

d. Expeditious and cautious handling, including proper climate control, will be used during translocations and reintroduction efforts, including transport out of the wilderness, travel time to captive rearing facilities, and transport back to wilderness following captive-rearing.

e. All captive-rearing efforts will be undertaken by professional biologists and/or zoological staff experienced with animal care and disease management techniques.

f. Collections will be limited to the minimum number of animals necessary to successfully complete recovery actions.

5. Vegetation

a. Prior to initiating work, project work areas and crew camp sites will be surveyed for the presence of plant species of concern.

b. If species of concern are present in work and camp sites, appropriate mitigation measures will be taken, which could include collecting seed or flagging areas during project work to protect the species from onsite activities.

c. Equipment and materials will be inspected for soil and plant parts. Dirty materials will be cleaned before being transported to field sites. Equipment and materials that could acquire seeds from surrounding areas will be covered during transport.

d. A list and/or map of project areas will be maintained so that sites can subsequently be surveyed for invasive non-native plants.

e. Work crews will inspect their shoes, clothing and equipment for seeds and soil before leaving the front country. Seeds and soil will be removed and placed in bagged garbage.

6. Wildlife

a. Crew camps will be located at least 100 ft. (30 m) away from aquatic habitat for mountain yellow-legged frogs, Yosemite toads, and Little Kern golden trout, and away from ridgeline habitat for bighorn sheep.

b. Stock will be kept at least 100 ft. (30 m) away from core aquatic habitat for mountain yellow-legged frogs, Yosemite toads, and Little Kern golden trout; and core terrestrial habitat for bighorn sheep.

c. Prior to any approved helicopter flight, the parks' wildlife biologist will provide a map of known bighorn sheep areas, and the helicopter will avoid flying above or landing in those areas; the final approach to the landing zone will stay below the area of the historic sightings. Flights will be suspended if sheep are observed within ½ mile (0.8 kilometers) of the project area. The landing zone for the helicopter will be located approximately 500 ft. (152 m) from any area where sheep have been observed.

d. All personnel involved in garter snake relocation will be professional biologists with years of experience with proper handling and marking of snakes, or–for trained, but less experienced biologists–work under the direct supervision of professionals.

e. Handling of garter snakes for relocations will be kept to the minimum time necessary for effectively completing each relocation action.

7. Water Quality

a. Equipment and materials will be stored at least 100 ft. (30 m) from open water to reduce the likelihood of debris or sediment entering surface water.

b. Secondary containment for hazardous materials (e.g., piscicide or white gas) will be incorporated by placing buckets under transfers of materials from one container to another. If hazardous materials were nevertheless spilled, they will be cleaned up immediately and will not be allowed to seep deep into the soil or reach open water sources. Towels will be onsite to absorb pooled hazardous materials. Shovels and bags will be onsite to gather surface soil in the spill area, which will be transported to the front country for remediation.

c. Work crews will use appropriate methods for human waste treatment, which is typically a pit toilet, or special containers for removal to the front country.

8. Gill Netting

a. Crew members will walk along the shoreline scanning for non-target animals prior to pulling nets and release animals as soon as possible to reduce mortality of non-target animals.

b. To minimize the capture of non-target animals including mountain yellow-legged frogs, the shore end of gill nets will be generally set approximately 1 to 3 m from shore to provide an area where frogs on and near the shoreline can be active with lower potential for getting caught in a net. Areas observed to periodically contain many tadpoles and frogs will generally be avoided when placing gill nets.

9. Electrofishing

a. During electrofishing, crews continually scan the area in front of their progress for non-target wildlife including mountain yellow-legged frogs. If a non-target species is observed, the electrofisher is turned off until the animal leaves the water or the shocking area. If necessary, crews capture and remove the animal downstream or to adjacent terrestrial habitat and then proceed with electrofishing.

b. Crewmembers will wear waterproof chest waders and gloves that do not conduct electricity.

c. Crewmembers will wear wading boots with felt-lined soles that provide improved stability. The output from electrofishers is engineered to specifically target fish so non-target species are much less affected by electrofishing. Felt-soled boots used for project work will only be used at project sites. Boots will remain at each project site for the summer, and will be transported out of the project area for the winter, where they will be decontaminated before their next use. This process will eliminate the potential to sustain or transport undesirable non-native species.

10. Piscicide Use

a. If adequate fishless habitat is not present at the head of streams to provide upstream source populations of invertebrates for repopulating treated areas, then a section of stream will be physically treated to remove fish and create an upstream source population. A temporary fish barrier will be installed if needed to protect a source population from fish recolonization until fish are eradicated with piscicides.

b. The state of California requires that pesticide applications be managed by trained and certified applicators. At least one member of the onsite piscicides application crew will be certified by the state of California as an applicator and all of the restoration crew working with piscicides will be trained in proper use of personal protective equipment, product safety measures, and they will operate under the direction of the certified applicator(s) and in accordance with project safety plans or job hazard analysis.

c. Application of rotenone will be carried out in a manner that strictly adheres to practices permitted by the product labeling, including use of personal protective equipment (PPE) for applicators, controlling public access during application, determining the maximum necessary application concentrations, and all other applicable guidelines.

d. Rotenone drip stations will be placed in secure and stable locations either on the stream bank or on a stand in the stream channel, and are actively monitored by project staff for the duration of the treatment. The drip nozzles of the stations will be placed very close to the water's surface to reduce the potential for piscicide drift to terrestrial environments. Rotenone applied from backpack sprayers is applied with the spray head very close to the water surface to minimize drift onto terrestrial environments.

e. Fish will be collected prior to the treatment process from the project area and placed in net baskets just upstream of drip stations to monitor the effectiveness of the piscicide treatment.

f. Although very few, if any, mountain yellow-legged frogs of any life stage are typically present in fish-containing areas, any post-metamorphic mountain yellow-legged frogs or tadpoles observed that can be captured using dip nets and/or seines will be removed from the treatment area and placed in a nearby fishless waterbody disconnected from the treatment area while piscicide concentrations dissipate.

g. Rotenone will be neutralized by the careful addition of potassium permanganate to the water at established locations. Fish baskets will also be placed downstream of the neutralization station. Mortality of these fish will alert workers to potential releases of excess chemical in the event of human or equipment error and potential downstream effects.

h. Treated fish that do not sink will have their swim bladders punctured so the carcasses will sink to the substrate.

i. During and after rotenone treatments, water quality will be monitored to assess the effects of treatment on surface waters and bottom sediments. The monitoring will determine that: 1) effective piscicide concentrations of rotenone are applied; 2) sufficient degradation of rotenone has occurred prior to the resumption of public contact; and 3) rotenone toxicity does not occur outside the project area. An analytical laboratory will analyze water samples for rotenone and rotenolone concentrations as well as for volatile organic compound and semi-volatile organic compound concentrations.

j. The parks will also develop and implement a spill contingency plan that addresses chemical transport and use guidelines, as well as spill prevention and containment that adequately protects water quality. The spill contingency plan will be maintained on site.

k. Piscicide containers will be securely locked or guarded when taken to the field for use.

l. Any piscicide that is spilled will be scooped up (including top layer of soil) with a shovel, placed in a bag designed for product disposal, and transported out of area for disposal as required on the product label.

m. Piscicide applications will be communicated to the public using 1) temporary information and warning signs posted on trails near the treatment area, 2) staff stationed on nearby trails, 3) visits to nearby campsites, 4) verbal contacts by the nearest wilderness rangers, 4) staff at local wilderness permit stations, 5) temporary postings to the parks website and 6) information attached to wilderness permits. Any area closures will be included in the annual updates to the Superintendent's compendium.

n. Most of the piscicide applications will occur in areas that generally have little visitation. Nevertheless, prior to applications and throughout treatments, public access will be restricted through the use of signs located at trailheads and other strategic places.

o. All personnel assisting in the fish removal will use hardened or durable sites for camping and will be familiar with and practice Leave-No-Trace (LNT) principles. A crew of 8 to 15 people is expected to be sufficient to implement each treatment. Trails will be used whenever possible to move from one location to another to minimize soil and vegetation disturbance and to prevent establishing new trails. Sensitive plant habitat will be avoided. Treatment activities will be coordinated with wilderness management personnel.

p. To incorporate the results of actual piscicide treatments in SEKI to future treatments, we will implement an adaptive management approach, in which intensive monitoring of the initial piscicide treatments is used to better describe the likely impacts of subsequent treatments, and if necessary, to redesign subsequent treatments to further minimize anticipated impacts.

Action Area

The action area is defined in 50 CFR § 402.02, as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." For the proposed project, the action area encompasses all SEKI lands associated with the 55 basins (Figure 2), including the restoration and monitoring lakes, creeks, wetlands, and associated uplands between the altitudes of approximately 6,000 to 12,000 feet subjected to project-related fish removal, crew camps, trails and frog population and disease monitoring. These basins are analogous to the frog conservation areas (FCAs) identified in SEKI for the mountain yellow-legged frog Conservation Strategy, and in total contain approximately 600 additional lakes, ponds, and marshes to the waterbodies in this project where mountain yellow-legged frog recovery actions may occur. Additionally, non-native fish will be eradicated using physical methods or piscicides from select waterbodies in 21 of the 55 basins, including 80 lakes and ponds (602 acres), five fish-containing marshes (32 acres), approximately 31 miles of stream, plus additional connected fish-containing habitat if necessary. These 85 waterbodies represent 15% of the SEKI's 550 waterbodies known to contain non-native fish. Appendix B in the Restoration Plan/FEIS has detailed maps of each individual fish eradication basin.

Analytical Framework for the Jeopardy Determination

The following analysis relies on four components to support the jeopardy determination for the Sierra Nevada yellow-legged frog, northern DPS of the mountain yellow-legged frog, Yosemite toad, and Little Kern golden trout: (1) the *Status of the Species*, which evaluates the species' range wide condition, the factors responsible for that condition, and their survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of these species in the action area, the factors responsible for that condition, and the role of the action area in the species' survival and recovery; (3) the *Effects of the Action*, which determines the direct and indirect effects of the proposed Federal action and the effects of any interrelated or interdependent activities on these species; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on these three species.

In accordance with the implementing regulations for Section 7 and Service policy, the jeopardy determination is made in the following manner: the effects of the proposed Federal action are evaluated in the context of the aggregate effects of all factors that have contributed to the current status of the Sierra Nevada yellow-legged frog, northern DPS of the mountain yellow-legged frog, Yosemite toad, and Little Kern golden trout.

The following analysis places an emphasis on using the range-wide survival and recovery needs of the Sierra Nevada yellow-legged frog, northern DPS of the mountain yellow-legged frog, Yosemite toad, and Little Kern golden trout, and the role of the action area in providing for those needs as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination
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Analytical Framework Adverse Modification Determination

In accordance with policy and regulation, the adverse modification analysis in this biological opinion relies on four components: (1) the *Status of Critical Habitat*, which evaluates the range-wide condition of proposed critical habitat for the Sierra Nevada yellow-legged frog, northern DPS of the mountain yellow-legged frog, and Yosemite toad; in terms of key components of the critical habitat that provide for the conservation of the listed species, the factors responsible for that condition, and the intended value of the critical habitat overall for the conservation/recovery of listed species; (2) the *Environmental Baseline*, which analyses the condition of the critical habitat in the action area, the factors responsible for that condition, and the value of the critical habitat in the action area for the conservation for the listed species; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the key components of critical habitat that provide for the conservation for the listed species of the listed species; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities that area reasonably certain to occur on the key components of critical habitat that provide for the conservation of the listed species and how those impacts are likely to influence the value of the affected critical habitat units for the conservation/recovery of the listed species.

For purposes of the adverse modification determination, the effects of the proposed Federal Action, together with any cumulative effects to determine if the value of the critical habitat rangewide for the conservation/recovery of the listed species would remain functional or would retain the current ability for the key components of the critical habitat that provide for the conservation of listed species to be functionally re-established in areas of currently unsuitable but capable habitat.

Status of the Species and Proposed Critical Habitat

Mountain Yellow-Legged Frogs and Yosemite Toad

Please refer to the Programmatic Biological Opinion on Nine Forest Programs on Nine National Forests in the Sierra Nevada of California for the Endangered Sierra Nevada Yellow-Legged Frog, Endangered Northern Distinct Population Segment of the Mountain Yellow-legged Frog, and Threatened Yosemite Toad (Service file number FFESMF04-2014-F0557) for information on the status of the mountain yellow-legged frog and Yosemite toad, and their environmental baseline (including threats).

For the Sierra Nevada ecoregion, climate models predict that mean annual temperatures will increase by 3.2 to 4.3 °F by 2070, including warmer winters with earlier spring snowmelt and higher summer temperatures. Mean annual rainfall is projected to decrease from 3.6–13.3 inches by 2070; however, projections have high uncertainty and one study predicts the opposite effect (PRBO 2011). Snowpack is, by all projections, going to decrease dramatically following the temperature rise and more precipitation falling as rain (Kadir *et al.* 2013). Higher winter streamflows, earlier runoff, and reduced spring and summer streamflows are projected, with increasing severity in the southern Sierra Nevada (PRBO 2011, Kadir *et al.* 2013). Snow-dominated elevations of 6,560–9,190 feet will be the most sensitive to temperature increases, and a warming of 9 °F is projected to shift center timing, the measure when half a stream's annual flow has passed a given point in time, to more than 45 days earlier in the year as compared to the 1961–1990 baseline (PRBO 2011). Lakes, ponds, and other standing waters fed by snowmelt or streams are likely to dry out or be more ephemeral during the non-winter months (Lacan *et al.* 2008, PRBO 2011). This pattern could influence ground water transport, and springs may be similarly depleted, leading to lower lake levels. Climate change remains a primary threat to Sierra Nevada yellow-legged frog, Northern DPS of the mountain yellow-legged frog, and the Yosemite toad.

Little Kern Golden Trout

Little Kern golden trout (*Oncorhynchus mykiss whitei*) is a subspecies of rainbow trout that is endemic to the Little Kern River drainage of Tulare County, California (Service 1978, 2011). The Little Kern River drainage occurs primarily in the Golden Trout Wilderness of Sequoia National Forest with smaller areas of the drainage in Sequoia National Park. Little Kern golden trout occur in one proposed treatment area (Crytes) included in this plan (NPS unpubl. data).

Hybridization with non-native salmonids is the most imminent threat to the Little Kern golden trout. Rainbow trout were introduced to the Little Kern basin beginning in the early 1930s or possibly earlier (Christenson 1984). Rainbow trout readily hybridized with Little Kern golden trout, producing fertile offspring (Gall *et al.* 1976). As a result of the introductions, genetic integrity of this subspecies was compromised, reducing the number of genetically pure populations and reducing the subspecies range. At the time of listing, pure populations were thought to only persist in the upper-most headwater reaches of five tributaries to the Little Kern River, and management efforts focused on piscicide eradication of introgressed (genetically compromised) populations and restocking of genetically pure Little Kern golden trout between 1975 and 1996 (Service 2011). Restoration efforts have largely been successful in removing severely introgressed populations of Little Kern golden trout and the broader influence of non-native fishes, such as brook trout. However, the hybridization with non-native rainbow trout likely still is an issue. In addition, reestablished populations are showing signs of low genetic diversity (Stephens 2007), making these populations more vulnerable to stochastic events and/or climate change (Service 2011).

Proposed Critical Habitat for the Mountain Yellow-frog Complex and Yosemite Toad

Critical habitat for the mountain yellow-frog complex and Yosemite toad was proposed on April 25, 2013 (78 FR 24515). Under the Act and its implementing regulations, we are required to identify the physical or biological features essential to the conservation of the mountain yellow-legged frog complex and Yosemite toad in areas occupied at the time of listing (in this case, areas that are currently occupied), focusing on key components of the critical habitat that provide for the conservation of the listed species. We consider these key elements, characterized as Primary Constituent Elements in this proposed critical habitat, to represent the physical or biological features that are essential to the conservation of the species.

Mountain Yellow-Legged Frog Complex

Based on our current knowledge of the physical or biological features and habitat characteristics required to sustain the species' life-history processes, we determine that the PCEs (or key elements) specific to the Sierra Nevada and northern DPS of the mountain yellow-legged frogs are:

1. *Aquatic habitat for breeding and rearing.* Habitat that consists of permanent water bodies, or those that are either hydrologically connected with, or close to, permanent water bodies, including, but not limited to, lakes, streams, rivers, tarns, perennial creeks (or permanent plunge pools within intermittent creeks), pools (such as a body of impounded water contained above a natural dam), and other forms of aquatic habitat. This habitat must:

    a. Be of sufficient depth not to freeze solid (to the bottom) during the winter (no less than 1.7 m (5.6 ft), but generally greater than 2.5 m (8.2 ft), and optimally 5 m (16.4 ft) or deeper (unless some other refuge from freezing is available)).

    b. Maintain a natural flow pattern, including periodic flooding, and have functional community dynamics in order to provide sufficient productivity and a prey base to support the growth and development of rearing tadpoles and metamorphs.

    c. Be free of fish and other introduced predators.

    d. Maintain water during the entire tadpole growth phase (a minimum of 2 years). During periods of drought, these breeding sites may not hold water long enough for individuals to complete metamorphosis, but they may still be considered essential breeding habitat if they provide sufficient habitat in most years to foster recruitment within the reproductive lifespan of individual adult frogs.

    e. Contain:

        i. Bank and pool substrates consisting of varying percentages of soil or silt, sand, gravel, cobble, rock, and boulders;

ii. Shallower lake microhabitat with solar exposure to warm lake areas and to foster primary productivity of the food web;

iii. Open gravel banks and rocks projecting above or just beneath the surface of the water for adult sunning posts;

iv. Aquatic refugia, including pools with bank overhangs, downfall logs or branches, or rocks to provide cover from predators; and

v. Sufficient food resources to provide for tadpole growth and development.

2. *Aquatic nonbreeding habitat (including overwintering habitat).* This habitat may contain the same characteristics as aquatic breeding and rearing habitat (often at the same locale), and may include lakes, ponds, tarns, streams, rivers, creeks, plunge pools within intermittent creeks, seeps, and springs that may not hold water long enough for the species to complete its aquatic life cycle. This habitat provides for shelter, foraging, predator avoidance, and aquatic dispersal of juvenile and adult mountain yellow-legged frogs. Aquatic nonbreeding habitat contains:

   a. Bank and pool substrates consisting of varying percentages of soil or silt, sand, gravel, cobble, rock, and boulders;

   b. Open gravel banks and rocks projecting above or just beneath the surface of the water for adult sunning posts;

   c. Aquatic refugia, including pools with bank overhangs, downfall logs or branches, or rocks to provide cover from predators;

   d. Sufficient food resources to provide for tadpole growth and development;

   e. Overwintering refugee, where thermal properties of the microhabitat protect hibernating life stages from winter freezing, such as crevices or holes within granite, in and near shore; and/or

   f. Streams, stream reaches, or wet meadow habitats that can function as corridors for movement between aquatic habitats used as breeding or foraging sites.

3. *Upland areas.*

   a. Upland areas adjacent to or surrounding breeding and nonbreeding aquatic habitat that provide area for feeding and movement by mountain yellow-legged frogs.

      i. For stream habitats, this area extends 25 m (82 ft) from the bank or shoreline.

      ii. In areas that contain riparian habitat and upland vegetation (for example, mixed conifer, ponderosa pine, montane hardwood conifer, and montane riparian woodlands), the canopy overstory should be sufficiently thin (generally not to exceed 85 percent) to allow sunlight to reach the aquatic habitat and thereby provide basking areas for the species.

      iii. For areas between proximate (within 300m (984 ft)) water bodies (typical of some high mountain lake habitats), the upland area extends from the bank or shoreline between such water bodies.

iv. Within mesic habitats such as lake and meadow systems, the entire area of physically contiguous or proximate habitat is suitable for dispersal and foraging.

b. Upland areas (catchments) adjacent to and surrounding both breeding and nonbreeding aquatic habitat that provide for the natural hydrologic regime (water quantity) of aquatic habitats. These upland areas should also allow for the maintenance of sufficient water quality to provide for the various life stages of the frog and its prey base.

<u>Yosemite Toad</u>

Based on our current knowledge of the physical or biological features and habitat characteristics required to sustain the species' life-history processes, we determine that the PCEs, or key elements, specific to the Yosemite toad are:

1. *Aquatic breeding habitat.* (a) This habitat consists of bodies of fresh water, including wet meadows, slow-moving streams, shallow ponds, spring systems, and shallow areas of lakes, that:

    a. Are typically (or become) inundated during snowmelt,

    b. Hold water for a minimum of 5 weeks, and

    c. Contain sufficient food for tadpole development.

    d. During periods of drought or less than average rainfall, these breeding sites may not hold water long enough for individual Yosemite toads to complete metamorphosis, but they are still considered essential breeding habitat because they provide habitat in most years.

2. *Upland areas.* (a) This habitat consists of areas adjacent to or surrounding breeding habitat up to a distance of 1.25 km (0.78 mi) in most cases (that is, depending on surrounding landscape and dispersal barriers), including seeps, springheads, and areas that provide:

    a. Sufficient cover (including rodent burrows, logs, rocks, and other surface objects) to provide summer refugia,

    b. Foraging habitat,

    c. Adequate prey resources,

    d. Physical structure for predator avoidance,

    e. Overwintering refugia for juvenile and adult Yosemite toads,

    f. Dispersal corridors between aquatic breeding habitats,

    g. Dispersal corridors between breeding habitats and areas of suitable summer and winter refugia and foraging habitat, and/or

    h. The natural hydrologic regime of aquatic habitats (the catchment).

i. These upland areas should also allow maintain sufficient water quality to provide for the various life stages of the Yosemite toad and its prey base.

All units and subunits proposed for designation as critical habitat are currently occupied by Sierra Nevada mountain yellow-legged frogs, the northern DPS of the mountain yellow-legged frogs, or Yosemite toads, and contain the PCEs, or key elements, sufficient to support the life-history needs of the species.

Special Management Considerations or Protection

When designating critical habitat, we assess whether the specific areas within the geographic area occupied by the species at the time of listing contain features that are essential to the conservation of the species and that may require special management considerations or protection.

The features essential to the conservation of the Sierra Nevada yellow-legged frog and northern DPS of the mountain yellow-legged frog may require special management considerations or protection to reduce the following threats: The persistence of introduced trout populations in essential habitat; the effects from water withdrawals and diversions; impacts associated with timber harvest and fuels reduction activities; impacts associated with livestock grazing; and intensive use by recreationists, including packstock camping and grazing.

Management activities that could ameliorate the threats described above include (but are not limited to) nonnative fish eradication; installation of fish barriers; modifications to fish stocking practices in certain water bodies; physical habitat restoration; and responsible management practices covering potentially incompatible activities, such as timber harvest and fuels management, water supply development and management, livestock and packstock grazing, and other recreational uses. These management practices will protect the PCEs for the mountain yellow-legged frog by reducing the stressors currently affecting population viability. Additionally, management of critical habitat lands will help maintain the underlying habitat quality, foster recovery, and sustain populations currently in decline.

The features essential to the conservation of the Yosemite toad may require special management considerations or protection to reduce the following threats: Impacts associated with timber harvest and fuels reduction activity; impacts associated with livestock grazing; the spread of pathogens; and intensive use by recreationists, including packstock camping and grazing.

Management activities that could ameliorate the threats described above include (but are not limited to) physical habitat restoration and responsible management practices covering potentially incompatible beneficial uses such as timber harvest and fuels management, water supply development and management, livestock and packstock grazing, and other recreational uses. These management activities will protect the PCEs for the Yosemite toad by reducing the stressors currently affecting population viability. Additionally, management of critical habitat lands will help maintain or enhance the necessary environmental components, foster recovery, and sustain populations currently in decline.

Environmental Baseline

Mountain Yellow-legged Frog

Survey records from 1997 to 2015 confirm that the Sierra Nevada yellow legged frog and the northern DPS of the mountain yellow-legged frog both occur within the action area (Knapp 2003; NPS 2015a; Knapp unpubl. data, NPS unpubl. data). Mountain yellow-legged frogs in SEKI are currently extant at sites from 9,200 to 12,100 ft (Knapp unpubl. data). Historic records show that they ranged down to 6,400 ft occupying montane meadows in Giant Forest and Grant Grove (Vredenburg *et al.* 2007, Vredenburg unpubl. data). It is presumed that mountain yellow-legged frogs ranged downstream to the upper limits of the natural distribution of trout prior to fish planting.

Similar to rangewide declines of mountain yellow-legged frogs, populations in SEKI have declined precipitously from their historic abundance, and they are in danger of becoming extinct (Service, 2014). Surveys by Bradford *et al.* (1994) during 1989-1990 did not detect mountain yellow-legged frogs in 48% of the sites where they were found from 1955-1979. Within the Tablelands portion of the Kaweah watershed, mountain yellow-legged frogs declined in 96% of sites between the late 1970s and 1989 (Bradford *et al.* 1994). In the 1990s, mountain yellow-legged frogs disappeared from the entire Kaweah watershed.

During the summers of 1997, 2000, 2001, and 2002, Knapp conducted mountain yellow-legged frog surveys in the majority of lentic waterbodies in SEKI (n = 3,250) and detected individuals at 567 sites (Knapp 2003). From 2009-2013, he resurveyed 492 of the 567 previously occupied sites and detected them in 187 sites (38%) (Knapp unpubl. data). Since the recent surveys visited 87% of previously occupied sites, it presents a fairly accurate picture of their current status. Mountain yellow-legged frogs have disappeared from approximately 62% of previously occupied sites in the last ten years. Further, many of the extant populations have low abundance that makes these populations vulnerable to further losses. Opportunities for restoration in particular for the northern DPS of the mountain yellow-legged frog are greatest within SEKI, and therefore the Restoration Plan is a central component of the recovery of this species.

Yosemite Toad

Recent surveys of suitable Yosemite toad habitat in Kings Canyon National Park have documented the species in approximately 42 meadows (Knapp 2003; USGS unpubl. data). Yosemite toads are known to occur near two proposed fish eradication areas (McGee and Upper Evolution) (USGS unpubl. data).

Little Kern Golden Trout

The population of Little Kern golden trout inhabiting Crytes Basin is not native to this specific area. In 1887, Little Kern golden trout were transplanted to historically fishless habitat in Crytes Basin (Ellis and Bryant 1920). Since this basin is outside of the natural range of this species, it was not designated as critical habitat (Service 1978) and the population is not part of the recovery plan (Christenson 1984). In addition, recent analysis shows that this population is not genetically-pure (Stephens *et al.* 2005; Deiner *et al.* 2010, Erickson *et al.* 2010). Although this population has Little Kern golden trout morphological characteristics, it has also acquired significant admixture with rainbow trout and California golden trout, possibly from undocumented transplant after 1887. This population also exhibits substantial genetic drift (Erickson *et al.* 2010; B. Erickson, pers. comm., April 2016). As a result of this presumed founder effect and genetic isolation, this population now represents genetic composition very different from pure Little Kern golden trout.

Proposed Critical Habitat for the Mountain Yellow-legged frog and Yosemite Toad

The action area for the project includes proposed critical habitat for the Sierra Nevada yellow-legged frog and northern DPS of the mountain yellow-legged frog.

Effects of the Action

As noted previously in the Description of the Action section, the project proponent has also proposed a set of conservation measures. The project action area includes areas in preferred alternative B of the Restoration Plan/FEIS. All of these areas are in proposed mountain yellow-legged frog critical habitat. Several of these areas are in proposed Yosemite toad critical habitat.

Little Kern golden trout occur in one proposed treatment area (Crytes; NPS unpubl. data) included in this plan. This population is not native to Crytes, it is not part of the official recovery plan for the species (Christenson 1984), and recent genetic analysis have determined this population is not genetically-pure (Deiner *et al.* 2010; Erickson *et al.* 2010).

There are anticipated effects from the SEKI Restoration Plan associated with monitoring, research, translocation, and fish eradication activities that will result in harassment and likely injury and death to individuals of the Sierra Nevada yellow-legged frog, northern DPS of the mountain yellow-legged frog, Yosemite toad, and Little Kern golden trout. Some effects such as harassment during capture, swabbing, mark and recapture, may be temporary, while seldom resulting in injury or mortality of the amphibains. There will be injury or mortality associated with fish eradication activities, as individuals that may be in the treatment areas are trapped and perish in gill nets or during piscicide treatments. Effects associated with each activity are discussed below. The fish eradication activities will eliminate this non-native hybrid population of the Little Kern golden trout.

Monitoring

Monitoring activities may result in individuals fleeing from surveyors during surveys, capture and brief handling/swabbing of some individuals, including possible PIT-tagging or elastomer marking of mountain yellow-legged frogs. This data will be used to investigate the distribution, population size, and disease status of these species. This data also will provide insight into factors that enable populations to persist to varying degrees despite on-going infection with amphibian chytrid fungus. The results will be used to prioritize sites for fish eradication and reintroductions, and to identify frog source populations. The overall risk to the majority of individuals and populations from monitoring is expected to have minimal adverse effects on the species.

Continuing Research

Research activities involving disease intervention using chemical and biological treatment will continue in SEKI. Individual mountain yellow-legged frogs that are captured for anti-fungal bathing or bacterial additions will be captured, handled, treated, and released. Research activities may result in capture and possibly injury and death. However, the treated individuals will have increased resistance to amphibian chytrid fungus and increased probability of recovery after disease intervention.

Recent chytrid treatments demonstrated no to little detectable effects on mountain yellow-legged frog survival from capture, handling, application of the medicine, and release(Knapp 2010). In these treatments, all animals that were not immediately on the verge of dying upon capture due to having already reached catastrophic levels of amphibian chytrid function survived the treatments, were fully or nearly cleared of infection, and had substantially higher survival than untreated control animals.

Although animals have little forage for up to 8 days during treatments, all treated animals appeared to have typical behavior and energy levels upon release to aid in survival. For mountain yellow-legged frogs not captured at treatment sites, and Yosemite toads that may be present, the treatment activities sometimes causes tadpole and adult individuals to exhibit a flight response, but this behavior will be temporary in nature, and any individuals that flee likely will recover and resume their prior behavior in short order.

Reintroduction/Translocation of mountain yellow-legged frogs

Two forms of population restoration for the mountain yellow-legged frog will occur in order to reestablish previously occupied habitat or augment dwindling populations: 1) natural recolonization of the restored habitat, or passive recolonization, and 2) human-assisted movement of a number of individuals from extant mountain yellow-legged frog populations to other locations, or active reintroduction. During active reintroduction, individuals may be harmed by capture, handling, transport and release into new habitat. Some animals may be transported to a captive rearing facility, by helicopter and vehicle, for "head-starting" and/or antifungal treatments. The source population of mountain yellow-legged frogs will incur a short-term loss of a small percentage of its animals, generally <10%, that likely will be replaced through reproduction and recruitment over the following several years (Knapp *et al.* 2011).

For mountain yellow-legged frogs not captured, the capture and release activities may harass individuals, which may lead to mortality or injury if animals are disoriented and at greater risk to predation or vulnerable during evasion. However, these events will be temporary in nature, and any individuals that flee will typically resume their prior behaviors within a short amount of time.

When mountain yellow-legged frogs are reintroduced to a lake site, the small population may be subject to heavy snake predation, which has negative impacts on population viability, and thus potential for reintroduction success. Translocating snakes away from reintroduction sites is expected to improve the success rates of mountain yellow-legged frog reintroductions, and will minimize or eliminate such losses. Snakes will only be relocated to areas that are not occupied by mountain yellow-legged frogs. It is anticipated that these translocation activities will be sufficient to avoid or minimize frog losses to snake predation at these reintroduction sites.

Mountain yellow-legged frog populations may be at risk of extirpation if drought causes small, occupied ponds to completely dessicate. In these cases, the entire population may be captured and relocated, or transported to a facility to establish a captive rearing program and/or head-start tadpoles until the habitat becomes suitable again for reintroduction of captured individuals and/or their progeny. Salvaging drought-threatened individuals in this way will provide a long-term benefit to the population in contrast to the potential for high mortality (Lacan *et al.* 2008) if the population is left alone.

Restoration activities may result in take due to harassment, harm and possible injury or mortality during capture and handling, swabbing and PIT-tagging of some individuals, capture and handle stress during translocation and potential for mortality to individuals during and after reintroductions. Further, there is a short-term reduction in population size of source populations following collections. However, these negative impacts are expected to be more than offset by long-term beneficial effects to mountain yellow-legged frogs resulting from successful restoration and reintroduction (extending the occupied range and range-wide resilience and abundance of frog populations). It is anticipated that the conservation measures for handling and size restrictions for tagging, and care and transport procedures will avoid and minimize take associated with these activities.

Research Activities

Research activities are expected to result in capture, and in rare cases may lead to injury or mortality during swabbing and PIT-tagging of some individuals. For individual mountain yellow-legged frogs that are captured, inserted with a PIT tag, and re-released back into the field for CMR monitoring purposes (i.e., they will not be transported to a new habitat) there will be no anticipated short-term decline of the local population. For mountain yellow-legged frogs not captured, the capture and release activities may cause a flight response, but the disturbance is anticipated to be no different than what occurs when visitors walk by these areas. These events will be temporary in nature, and any individuals that took flight will typically resume their prior behaviors within a short amount of time. Collectively, the effects from research activities are expected to be minimal in terms of the affected individuals, and short-lived, and more than offset by the benefits gained from enhanced understanding and information of population status and trend, disease status, and other gains from increasing our understanding of mountain yellow-legged frog ecology.

Garter Snake Relocation

When mountain yellow-legged frogs are reintroduced to a lake site, the small frog population is still subject to heavy garter snake predation, whereby reintroduced individuals are injured or killed. Garter snake predation has compromised the success of at least two mountain yellow-legged frog reintroductions in SEKI and YOSE (Knapp unpubl. data). Given the relatively small numbers of mountain yellow-legged frog individuals anticipated to be available for translocations and reintroductions, all garter snakes detected will be relocated away from these sites for one to two years following reintroduction. This will give small mountain yellow-legged frog populations a chance to successfully breed, increase in abundance and stabilize enough so that they can persist amid natural snake predation once snake relocations are ceased. Snakes detected during monitoring will be captured, marked, and moved by foot to a site within the same basin that does not have mountain yellow-legged frogs and is at least 1 mile away. It is expected that no more than 20 snakes will be relocated from all reintroduction sites in any given year. Over the long-term snakes are expected to return to mountain yellow-legged frog reintroduction sites, and ultimately the recovery of mountain yellow-legged frogs will positively influence the local snake populations as well. As snakes will be moved for two years to unoccupied, distant sites, effects from garter snake predation to reintroduced frog will be avoided or minimized.

Use and Support of Crew Camps

Effects on the listed species from the use of crew camps, and helicopters and stock to support the mobilization and demobilization of crew camps are expected to be insignificant or discountable because trips are infrequent (twice a season) and exposure intervals are limited (30 minutes to 2 hours). Crew camps will be located in upland areas away from aquatic habitat. Noise from helicopters landing and taking off near crew camps will be temporary and away from the core habitats are not expected to be present at most source or recipient sites. With the enumerated conservation measures, impacts from these project activities to listed species and critical habitat are expected to be fully discountable.

Fish Eradication (Physical and Chemical)

Under this Plan, non-native fish will be removed from 85 waterbodies (31 lakes, 49 ponds, five marshes) and approximately 31 miles (50 kilometers) of connected stream habitat contained in 21 basins. Non-native fish will be removed using physical methods (gill netting and electrofishing) from 52 waterbodies (27 lakes, 24 ponds, one marsh) and approximately 15 miles of stream contained in 17 basins. Non-native fish will be removed using piscicides (rotenone) from 33 waterbodies (four lakes, 25 ponds, four marshes) and approximately 16 miles of streams contained in nine basins. The following sections describe effects of fish eradication to each listed species.

Mountain Yellow-legged Frogs

Extensive research has shown that non-native trout have substantial adverse effects on mountain yellow-legged frogs, due to predation, competition and population fragmentation (Service 2014). Removing non-native trout reverses these effects and allows mountain yellow-legged frog populations in treatment areas to expand (Knapp *et al.* 2007; NPS 2012).

Removal of non-native fish from the additional 85 treatment waterbodies and 31 miles of streams contained in 21 basins included in this alternative will provide significant long-term beneficial effects on mountain yellow-legged frogs, due to: 1) expected increases in existing populations to more robust (less-vulnerable) sizes, and 2) the potential for extirpated mountain yellow-legged frog populations to be reestablished in restored habitat.

In treated areas with extant mountain yellow-legged frog populations, individuals sometimes get caught in gill nets. Depending on the length of time before staff find and release them, individuals can be killed, released with visible injury, or released with no visible injury. In SEKI between 2001-2013, 205 mountain yellow-legged frogs were captured in gill nets, including 145 that died (84 frogs, 61 tadpoles), 21 that were released injured, and 39 that were released with no visible injury (NPS 2015a). The total gill net effort was 8,313,701 net hours.

In treated areas with extant mountain yellow-legged frog populations, individuals sometimes get stunned by electrofishing. Individuals typically hop or swim away as soon as the electrofishing field is stopped; rarely individuals need from several seconds to two minutes to recover before moving away from the work area. In SEKI between 2001-2013, a total of 497 hours of electrofishing resulted in zero observed mountain yellow-legged frog mortalities (NPS 2015a).

Eradicating non-native fish using gill nets and electrofishers has had an adverse effect on a small percentage of individual mountain yellow-legged frogs, these treatments have had a substantial beneficial effect at the population and species scales of mountain yellow-legged frogs. Removal of non-native fish resulted in a very large overall increase frog populations in the treatment areas (NPS 2012). Between 2001 to 2011, SEKI eradicated fish from ten lakes and nearly eradicated fish from three lakes. In nine of these lakes, in which mountain yellow-legged frogs remained disease free three years after fish removal, average density (tadpoles + frogs) increased by 13-fold, with one lake showing a 49-fold increase. Several of these restored populations are now among the largest in the ranges of mountain yellow-legged frogs. In addition, typically no or few incidental captures occur during the first year of fish removal, while these appear to increase as mountain yellow-legged frogs increasingly migrate into waterbodies approaching eradication. CDFW has reported similar results from restoration efforts adjacent to disease-free sites (CDFW 2011).
In addition, fish traps may be used to facilitate eradication in areas with extensive amounts of stream habitat containing high-densities of fish. Fish traps are expected to have no effect on mountain

yellow-legged frogs for the following reasons. First, few to no mountain yellow-legged frogs occur in habitat with high density fish populations (Knapp *et al.* 2005). Second, individuals that may be present will likely not colonize a trap containing non-native fish because they are able to sense fish presence (Vredenburg 2004) and thus will be expected to avoid them. Therefore, the potential for disturbance, injury or mortality to mountain yellow-legged frog individuals due to fish traps is expected to be low.

In piscicide treatment areas with extant mountain yellow-legged frog populations, project mitigation measures include capturing as many individuals as possible and moving them to adjacent untreated waterbodies before treatments are conducted. Most, but not all, of the frogs in the treatment areas are expected to be captured and moved out of treatment areas. Any tadpoles are not captured and moved will be harmed by piscicide treatments, because tadpoles breathe through gills (rotenone targets gill-breathing organisms) and tadpoles cannot leave the water. CFT Legumine™ application concentrations of 1 ppm (= 50 ppb rotenone) in streams and 4 ppm (= 200 ppb rotenone) in lakes exceed the 24 hr LC_{50} concentration of 5 ppb rotenone for northern leopard frog tadpoles (*Rana pipiens*) (Hamilton 1941), and 30 ppb rotenone for southern leopard frog tadpoles (*Rana sphenocephala*) (Chandler and Marking 1982). Since these species are in the same genus as mountain yellow-legged frogs, mountain yellow-legged frog tadpoles are expected to have similar rotenone LC_{50} concentrations as leopard frog tadpoles.

However, the specific response of tadpoles to rotenone depends on development stage (Hamilton 1941). Younger larvae that are dependent on gill respiration are far more sensitive than older larvae that are near metamorphosis and breathing air. Therefore, the majority of younger mountain yellow-legged frog tadpoles exposed to piscicide treatments will be expected to experience mortality, while a small percentage may be affected, but will survive. In contrast, it is expected that some older tadpoles will be killed, while some will be affected, but will survive.

Adult mountain yellow-legged frogs that are not captured and moved will not be expected to be harmed when rotenone is applied at normal concentrations (Farringer 1972; Billman *et al.* 2012), because frogs primarily breathe through skin and they can leave the water. Adult amphibian skin may be more of a barrier to rotenone than gills due to skin having a smaller relative surface area and a greater relative distance for rotenone to diffuse across (Fontenot *et al.* 1994). In addition, CFT Legumine™ application concentrations of 1 ppm (= 50 ppb rotenone) in streams and 4 ppm (= 200 ppb rotenone) in lakes do not exceed the 24 hr LC_{50} concentration of 240 to 1,580 ppb rotenone for northern leopard frog adults (Farringer 1972). As with tadpoles, mountain yellow-legged frog adults are expected to have similar rotenone LC_{50} concentrations as leopard frog adults. Therefore, piscicide treatment will not be expected to kill a significant number of adults, although this remains possible.

Amphibian eggs are thought to be less sensitive to rotenone because their rate of chemical uptake from water is much lower than tadpoles or fish (Ling 2003). In addition, piscicide treatments are expected to be conducted in August or September, after all mountain yellow-legged frog eggs will have hatched. Piscicide treatments are therefore expected to have no effect on mountain yellow-legged frog eggs.

Due to the distance between treatment sites and extant mountain yellow-legged frog populations, individuals present in untreated waterbodies adjacent to piscicide treated waterbodies are expected to be able to move into the treated areas with no adverse effects within several days after the treatment is concluded (Pope and Matthews 2001). If any mountain yellow-legged frogs arrived within one to two days after treatment, they likely will be adult or subadult frogs (not tadpoles), which do not have gills and thus will be expected to not be affected by habitat conditions.

The eradication of non-native trout from the piscicide treatment waterbodies will provide a large increase in habitat for the mountain yellow-legged frogs occupying these basins, with corresponding benefits over time of enhanced survival, growth and reproduction, including population increase above pre-treatment levels within one year (Billman *et al.* 2012). Many of the waterbodies eradicated of fish will be large, deep and/or cold waterbodies that will provide substantially enhanced habitat for remnant mountain yellow-legged frog populations currently restricted to small, shallow ponds. Treatment will create large areas of fishless habitat with high capacity to buffer drying and warming expected over time, thus allowing for the persistence of mountain yellow-legged frogs in a period of rapid and unprecedented change.

The adverse effects to individual frogs and tadpoles realized incidental to the restoration activities implemented during this project will thereby be offset substantially by the long-term beneficial effects on mountain yellow-legged frogs in the 85 additional treated waterbodies and 31 miles (50 kilometers) of streams, due to: 1) expected increases in existing mountain yellow-legged frog populations to more robust (less-vulnerable) sizes in response to non-native trout removal, and 2) the expansion of frog ranges within SEKI along with establishing more metapopulation-level resiliency as extirpated mountain yellow-legged frog populations are reestablished in restored high elevation habitat.

Given all these considerations, it is evident that the adverse effects to some individuals lost to fish eradication activities (mostly gill netting by catch) will be offset in the long term at the population level by the benefits of habitat restoration activities inherent in this project design. Although there is a temporary degradation in water quality affecting this PCE for mountain yellow legged frog in streams where chemical fish eradication is conducted, this impact is more than counterbalanced by the intended purpose and benefit from the action—the removal of predatory/resource competitor fish from frog habitat and a return to natural community dynamics under which these frogs evolved.

Proposed Critical Habitat for the Mountain yellow-legged frog complex

The proposed action specifically targets treatments of two PCE's, or key components of the proposed critical habitat that provide for the conservation of the mountain yellow-frog complex: 1) Aquatic habitat for breeding and rearing, and 2) Aquatic nonbreeding habitat (including overwintering habitat). By removing non-native fish that prevent Sierra Nevada yellow-legged frog and northern DPS of the mountain yellow-legged frog from surviving in aquatic features proposed for treatment, the proposed treatments will enable each treated water body or aquatic feature to support new populations Sierra Nevada yellow-legged frog and northern DPS of the mountain yellow-legged frog in the future. The proposed action thus will result in a substantial increase in the value of each key component to provide for the conservation of Sierra Nevada yellow-legged frog and northern DPS of the mountain yellow-legged frog because a primary stressor is being removed from the habitat.

Yosemite Toad

Yosemite toads were recently detected in two basins (McGee and Upper Evolution) proposed for treatment (USGS unpubl. data), but are not expected to be present in any of the remaining treatment basins. All of the treatment waterbodies in McGee Basin and most of the treatment waterbodies in Upper Evolution are proposed for physical fish-removal (e.g., gill netting, electrofishing, disruption or covering of redds, and fish traps). The recent detections of Yosemite toads in these areas was in habitat adjacent to the proposed treatment waterbodies in Upper Evolution, and in habitat on the edge of the proposed treatment waterbodies in McGee. Thus, there is low potential for Yosemite toads to be adversely affected by gill netting and electrofishing in McGee and Upper Evolution.

Although toad numbers are very low in these basins, and their behavior and life history do not render them particularly vulnerable to these activities, there is potential for a small number of Yosemite toads to be harassed, harmed, injured, killed, or experience significant disruption in behavior as they are caught in gill nets and/or electrofishing fields during the treatment period in these areas.

Two stream sections in Upper Evolution are proposed for fish removal using piscicides, and thus there is potential for Yosemite toads to be affected by a piscicide treatment in this treatment area. However, the treatment will be conducted in August or September, after all Yosemite toad adults will have finished breeding and likely moved from aquatic to nearby terrestrial habitat, which is their typical post-breeding behavior (Kagarise Sherman 1980). In addition, many and potentially all tadpoles will have metamorphosed into juvenile toads, which also often move from breeding ponds to adjacent terrestrial habitat. Furthermore, if any individuals are observed in treatment habitat, they will be captured and moved, which will further reduce the number Yosemite toads that will be affected by the treatment. These situations and mitigation measures make it unlikely there will be an adverse effect on this species overall, or within the action area.

Nevertheless, if Yosemite toad tadpoles are present, and they cannot be captured and moved, they will be injured or killed by the treatment. Although no rotenone toxicity data exist for toad species, Yosemite toad tadpoles are likely to have similar 24 hr LC_{50} concentrations as leopard frog tadpoles (5 to 30 ppb rotenone). Although CFT Legumine™ application concentrations (streams = 50 ppb rotenone; lakes = 200 ppb rotenone) exceed the expected 24 hr LC_{50} concentration for Yosemite toad tadpoles, tadpoles present in August or September will be older tadpoles. Therefore, if any tadpoles are still present at that time of year in the treatment site, the treatment will result in some tadpoles being killed, while some are affected but will survive.

If adult toads are present, and they are not able to be captured and moved, they will not be expected to be harmed by the treatment. Yosemite toad adults likely have similar 24 hr LC_{50} concentrations as leopard frog adults (240 to 1,580 ppb rotenone). CFT Legumine™ application concentrations (25 to 50 ppb rotenone) do not exceed the expected 24 hr LC_{50} concentration for Yosemite toad adults. Therefore, Yosemite toad adults exposed to the piscicide treatment may be affected, but most will survive.

Although conservation measures are expected to minimize any treatment effects on individuals in the two populations adjacent to the treatment waterbodies, the project has the potential to have effects on individual Yosemite toads if they are within the treatment areas during gill-netting and piscicide application.

<u>Proposed Critical Habitat for the Yosemite Toad</u>

The proposed action specifically targets treatment of PCE's, or key components of the proposed critical habitat that provide for the conservation of the Yosemite toad: 1) Aquatic habitat for breeding and rearing. By removing non-native fish that prevent the Yosemite toad from surviving in aquatic features proposed for treatment, the proposed treatments will enable each treated water body or aquatic feature to support new or increased populations of this species in the future. The proposed action thus will result in an increase in the value of each key component to provide for the conservation of Yosemite toad because a primary stressor is being removed from the habitat.

Little Kern Golden Trout

A trout population with a small fraction of Little Kern golden trout genes within its genome occurs in one of the treatment basins (Crytes). However, this population is an introduced, non-native population occupying historically fishless habitat that is not a component of the recovery plan for this species (Christenson 1984) and the site is not located within critical habitat. Recent genetic analysis (Erickson *et al.* 2010) shows this population is heavily introgressed and evidencing high levels of genetic drift, indicating it is not genetically pure, and in fact genetically very dissimilar to pure Little Kern golden trout. Therefore, the trout in Crytes Basin have no potential value for current or future restoration of Little Kern golden trout within its native range. This population's genetic content cannot be feasibly be restored to its non-introgressed state, and it is highly unlikely the Service will approve introducing these fish to their native range, as it will lead to further introgression of non-native genes into the pure Little Kern golden trout populations. The SEKI Restoration Plan will eradicate these fish from Crytes Basin using a combination of physical methods, including gill netting and electrofishing in one lake and one lake/pond complex, and piscicides, in the form of rotenone in adjacent stream and marsh areas. This fish population in the lake/pond complex will be eradicated by these activities.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. During this consultation, the Service identified global climate change and the advance of the chytrid fungus as future non-federal actions that are reasonably certain to occur in the action area of the proposed project. The actions within the SEKI Restoration Plan are designed in part to address these stressors.

Conclusion

After reviewing the current status of the Sierra Nevada yellow-legged frog, northern DPS of the mountain yellow-legged frog, Yosemite toad, and Little Kern golden trout, the environmental baseline for the action area, the effects of the proposed SEKI Restoration Plan, and the cumulative effects, it is the Service's biological opinion that the SEKI Restoration Plan, as proposed, is not likely to jeopardize the continued existence of the Sierra Nevada yellow-legged frog, northern DPS of the mountain yellow-legged frog, Yosemite toad, and Little Kern golden trout. The Service reached this conclusion because the project-related effects to the species, when added to the environmental baseline and analyzed in consideration of all potential cumulative effects, will not rise to the level of precluding recovery or reducing the likelihood of survival of the species based on the following:

1. The restoration of mountain yellow-legged frog habitat through eradication of non-native trout will result in substantial improvement in mountain yellow-legged frog habitat quality and connectivity in the treatment basins, and eventually lead to greater metapopulation abundance and resiliency.

2. The relatively short duration (1 to 4 years) of fish eradication activities in each fish eradication basin will minimize the duration and frequency of adverse effects on listed species.

3. The potential effect upon a very small percentage of each mountain yellow-legged frog population is outweighed by the potential for expansion of these populations to the restored habitat.

4. The limited areal extent of project activities within fish eradication basins represents a relatively small percentage of the number of basins with extant frogs in SEKI, and smaller percentage of the number of populations across the ranges of both species.

5. All fish eradication, frog restoration and frog-occupied waters, and nearby waters, will be monitored in this Plan to continue documenting the recovery, distribution, and population and disease status of mountain yellow-legged frog populations.

After reviewing the current status of proposed critical habitat for the Sierra Nevada yellow-legged frog, northern DPS of the mountain yellow-legged frog, and the Yosemite toad, the environmental baseline for the action area, the effects of the proposed SEKI Restoration Plan, and the cumulative effects, it is the Service's biological opinion that the SEKI Restoration Plan, as proposed, is not likely to destroy or adversely modify proposed critical habitat. The Service reached this conclusion because the project-related effects to the proposed and designated critical habitat, when added to the environmental baseline and analyzed in consideration of all potential cumulative effects, will enhance the value of the affected key components, or PCEs, to provide for the conservation of these species based on the following: (1) effects to essential physical or biological features will be temporary; (2) these actions will not destroy any essential physical or biological features of the habitat; and (3) the Restoration Plan will enhance proposed critical habitat via removing predatory fish. The effects to Sierra Nevada yellow-legged frog and northern DPS of the mountain yellow-legged frog proposed critical habitat are small and discrete, relative to the entire area designated, short in duration, and are expected over time to appreciably enhance the value of the critical habitat for the conservation of the Sierra Nevada yellow-legged frog, northern DPS of the mountain yellow-legged frog, and the Yosemite toad.

INCIDENTAL TAKE STATEMENT

Section 9(a)(1) of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened fish and wildlife species without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as actions that create the likelihood of injury to a listed species to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are non-discretionary, and must be implemented by the NPS so that they become binding conditions of any grant or permit issued by the NPS as appropriate, in order for the exemption in section 7(o)(2) to apply. The NPS has a continuing duty to regulate the activity covered by this Incidental Take Statement. If the NPS: (1) fails to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document; and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the NPS must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

Amount or Extent of Take

The Service anticipates that incidental take of the mountain yellow-legged frogs will include take which is detectable and quantifiable, along with take that will be more difficult to detect because of their life history. Mountain yellow-legged frogs can be difficult to locate due to their cryptic appearance and finding a dead or injured individual is unlikely due to their relatively small size. Losses of mountain yellow-legged frogs may also be difficult to quantify due to seasonal fluctuations in their numbers, random environmental events, changes in water regime at their breeding ponds, or additional environmental disturbances. The conservation measures described above in the project description will substantially reduce, but do not eliminate, the potential for incidental take of frogs and toads.

Monitoring, Research, and Captive Breeding

Therefore the Service anticipates that any mountain yellow-legged frogs within the action area may be subject to incidental take in the form of non-lethal harm and harassment. In addition, the Service anticipates incidental take of the northern DPS of the mountain yellow-legged frog, the Sierra Nevada yellow-legged frog, and Yosemite toad in the form of capture, harm, and harassment of eggs, tadpoles, subadults, and/or adults inhabiting or utilizing the 55 monitoring/research basins in the Plan at Sequoia and Kings Canyon National Parks. This includes harassment by capture, handling and swabbing up to 1900 individual frogs/year; and capture and PIT tagging up to 1000 frogs/year; and capture, handling and swabbing up to 700 Yosemite toads per year.

Fish Eradication and Piscicide

The Service anticipates quantifiable incidental take in the form of harm, as injury or death, of two (2), not to exceed four (4) egg masses in a given year; eight (8), not to exceed twenty (20) tadpoles in a given year; and eight (8), not to exceed sixteen (16) subadults/adults in a given year for the duration of the project for either mountain yellow-legged frog species from physical fish eradication activities.

The Service anticipates incidental take in the form of harm, as injury or death of forty (40), not to exceed eighty (80) tadpoles in a given year; and five (5), not to exceed ten (10) subadults/adults in a given year for the duration of the project for Sierra Nevada yellow-legged frog from fish eradication activities via piscicide.

The Service anticipates incidental take in the form of harm, as injury or death of sixty (60), not to exceed ninety (90) tadpoles in a given year; and eight (8), not to exceed twelve (12) subadults/adults in a given year for the duration of the project for northern DPS of the mountain yellow-legged frog from fish eradication activities via piscicide.

The Service anticipates incidental take in the form of harm as injury or death of two (2), not to exceed four (4) egg masses in a given year; three (3), not to exceed ten (10) tadpoles in a given year, and three (3), not to exceed six (6) subadults/adults in a given year for the duration of the project for Yosemite toad from physical fish eradication activities.

The Service anticipates incidental take in the form of harm as injury or death of twenty (20), not to exceed forty (40) tadpoles in a given year, and one (1) not to exceed three (3) subadults/adults in a given year for the duration of the project for /Yosemite toad from fish eradication activities via piscicide.

The Service anticipates incidental take in the form of harm as death for all individuals of the hybrid Little Kern golden trout in Crytes basin.

At the end of the first season, the Service and the Park Service will reevaluate the level of incidental take to assess whether anticipated levels of incidental take align with the actual amount of incidental take and whether there is a need for modification or clarification of the conservation measures or authorized incidental take.

Upon implementation of the following *Reasonable and Prudent Measures*, all such take will become exempt from the prohibitions described under section 9 of the Act. Therefore, reinitiation will be triggered if the amount of incidental take is exceeded by the NPS.

Effect of the Take

The Service has determined that the level of anticipated take is not likely to result in jeopardy to the Northern Distinct Population Segment of the mountain yellow-legged frog, the Sierra Nevada yellow-legged frog, the Yosemite toad, and the Little Kern golden trout. Effects to proposed critical habitat of the Sierra Nevada yellow-legged frog and northern DPS of the mountain yellow-legged frog will be temporary, and will not destroy any essential features of the habitat but rather the action will enhance the value of the treated aquatic features for conservation and recovery of all three listed amphibians species via removing predatory fish.

Although effects to individual frogs and toads will occur, at a metapopulation level, these will be insignificant. This is because the vast majority of mountain yellow-legged frogs in treatment areas will not be affected by fish eradication activities, and also because the risk is reduced by the conservation measures that will be implemented as part of the project in the immediate and near-term. There is a very low likelihood that incidental take will occur for Yosemite toad during physical and chemical fish eradication. The incidental take that will occur as a result of this project on the Little Kern golden trout at Crytes is not detrimental to the species recovery potential, as this population is genetically distinct from pure Little Kern golden trout, currently exists outside the native range of this species, and restoration of its native genetic heritage of the affected population to a natural state is infeasible. In the long-term, the positive impacts from habitat restoration in these high elevation basins indicate this project will have cumulative net benefits to the mountain yellow-legged frog. Overall, the actions are expected to substantially benefit these two species through the eradication of non-native trout, and implementation of the suite of active frog restoration methods recommended in the mountain yellow-legged frog Conservation Strategy (Service in preparation).

Reasonable and Prudent Measures

All necessary and appropriate measures to avoid or minimize effects on the Sierra Nevada yellow-legged frog, northern DPS of the mountain yellow-legged frog, Yosemite toad, and Little Kern golden trout resulting from implementation of this project have been incorporated into the project's proposed conservation measures. Therefore, the Service believes the following reasonable and prudent measure is necessary and appropriate to minimize incidental take of the Sierra Nevada yellow-legged frog, northern DPS of the mountain yellow-legged frog, Yosemite toad, and Little Kern golden trout:

> All conservation measures, as described in the biological assessment and restated here in the Project Description section of this biological opinion, shall be fully implemented and adhered to. Further, this reasonable and prudent measure shall be supplemented by the terms and conditions below.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the NPS must ensure compliance with the following terms and conditions, which implement the reasonable and prudent measure described above. These terms and conditions are nondiscretionary.

1. The NPS shall implement the Conservation Measures as described in this biological opinion.

2. Mountain yellow-legged frog surveys, including capture and handling for measurements and examining for infections, shall follow the guidelines found in Knapp and Matthews (2000) as revised during the life of this project, or other guidelines as authorized by the Service.

3. The use of PIT-tagging and the injection of colored elastomers are authorized to mark individual mountain yellow-legged frogs, and shall be implemented in the following manner:

   a. No mountain yellow-legged frogs less than 4 centimeters snout-vent length (SVL) shall be PIT-tagged. PIT tags of appropriate size shall be used (8-12 mm).

   b. Crews shall note any physical or behavioral changes to individual mountain yellow-legged frogs that could possibly be attributed to the insertion of PIT tags or injection of colored elastomer, such as swelling, bleeding, infection, or changes in swimming ability. This information shall be included in the annual reports.

   c Tissue samples for genetic research may be collected from tadpoles or adult mountain yellow-legged frogs. Tissue samples may be collected from swabbing the skin surface. Alternatively, for genetic research that may require a larger individual sample, clipping of a single toe from post-metamorphs to obtain tissue samples shall be allowed with the use of surgical scissors only.

4. Collection of individual mountain yellow-legged frogs for examination and treatment of infectious disease.

   a. All captured individual mountain yellow-legged frogs may be examined, swabbed for determining the presence of infectious disease, and treated if a known or experimental treatment is available. Dead or moribund individual mountain yellow-legged frogs should also be swabbed, if practical, to determine cause of death.

   b. If individual mountain yellow-legged frogs are found to have signs of infection or determined to be infected by chytrid fungus (chytridiomycosis), they may be treated using itraconazole. Individuals may be retained in specially designed cages at the collection site for up to two weeks while being treated. Treatment method may vary; however, the field crew must have suitable experience conducting the treatment method.

5. For the captive rearing and translocation program:

   a. All collection, transport, captive care, and release activities will follow the associated methods and protocols specified in the translocation plan as described in Knapp *et al.* (2011) and the Conservation Strategy (Knapp, Appendix A *in* Service in preparation). Any deviation from these methods and protocols requires prior approval from the Service.

   b. The NPS, and all captive rearing facilities, shall assure to the maximum extent practicable that all individuals removed will not contract a disease, unless that is part of the immunization procedure for disease treatment. Potential threats to the mountain yellow-legged frog regarding the introduction and/or spread of disease shall be closely monitored.

   c. Only individuals removed from the wild for captive rearing that are sick, injured, or have no reasonable prospect of being reintroduced to the wild may be euthanized for scientific research and vouchering of specimens, or if deemed fit enough, used for display or public outreach by the holding facility.

   d. The San Francisco Zoo, Oakland Zoo, or other facility authorized by the Service may receive mountain yellow-legged frogs for captive rearing and husbandry pursuant to this Biological Opinion. The following measures shall be implemented by the facility(ies).

      i. All proposed captive rearing activities for the upcoming season will be submitted in writing for review and approval by the Service and the California Department of Fish and Wildlife. The Service will be notified via email within 24 (24) hours following delivery of individual mountain yellow-legged frogs to the captive facility(ies). Notification will include numbers and lifestages of individuals delivered, condition and status of individuals, and collection location. In emergency situations, injured individuals shall be delivered first to a qualified veterinarian or Service approved biologist.

      ii. The number of individual frogs taken into captivity annually will not exceed the capacity of the facility(ies) to provide adequate care and husbandry as determined by the Service.

      iii. Individuals will be transferred to the captive facilities and returned to the wild using appropriate methods to avoid and minimize harassment, death and injury to the animals. Carrier containers shall keep the individual individuals cool, adequately hydrated, and free from injury or death due to contact with protruding or sharp objects within the interior.

      iv. Incoming individuals displaying signs of any infectious pathogens shall be immediately separated upon observation and kept physically isolated (quarantined) from any living amphibians residing in the facility(ies), including mountain yellow-legged frogs from other locations. Infected individuals will be treated by a veterinarian, or by a qualified technician under instruction of a veterinarian, until the individual is evaluated as free of the infection.

      v. Individuals will be held in an American Zoological Association-approved tank or natural display.

      vi. Once in captivity, individual frogs will not, under any circumstances, be bred in captivity without the written permission of the Service.

vii. All handling shall be done in an expedient manner with minimal harassment and injury to the individuals being handled. The hands and arms of all workers handling frogs shall be free of lotions, creams, sunscreen, oils, ointment, insect repellent, or any other material that may harm frogs.

6. For emergency salvage of mountain yellow-legged frogs:

   a. Only pools that have been determined to be unable to continue supporting eggs or tadpoles until the wet season shall be considered for salvage actions. These pools shall be monitored by SEKI field crews to determine drying rates and assess predation pressures. The NPS will have discretion on the timeline for further action.

Monitoring:

In order to monitor whether the amount or extent of incidental take anticipated from implementation of the project is approached or exceeded, the NPS shall adhere to the following reporting requirements. Should this anticipated amount or extent of incidental take be exceeded, the NPS must immediately reinitiate formal consultation as per 50 CFR 402.16.

1. For those components of the action that will result in habitat degradation or modification whereby incidental take in the form of harm is anticipated (i.e., fish removal by piscicides), the NPS will coordinate with the Service before each annual piscicide fish eradication action is anticipated. Once a piscicide eradication is initiated, it may be followed through to completion, per the project description in this biological opinion, unless the take limit is exceeded during that action, indicating the need for immediate coordination with the Service, and reinitiation. Updates shall also include any information about changes in project implementation that result in habitat disturbance not described in the Project Description and not analyzed in this Biological Opinion.

2. For those components of the action that result in direct encounters between listed species and project workers and their equipment, whereby take in the form of harassment, harm, injury, or death occurs that has not been analyzed in this Biological Opinion, the NPS shall immediately contact the Chief Endangered Species Forest Division, at the Service's Sacramento Fish and Wildlife Office at (916) 414-6600 and via email to report the encounter. If encounter occurs after normal working hours, the NPS shall contact the Service at the earliest possible opportunity the next working day.

3. The NPS will provide the Service an annual report of incidental take associated with project activities covered by this biological opinion, which shall include: summary of project activities, total numbers of animals captured/swabbed/tagged/sampled, and the total numbers of individuals accidentally killed or injured. The annual report is due by February 28 of the succeeding calendar year for which the prior field season's activity is being reported.

4. The NPS will provide either: 1) interim documents every five (5) calendar years from the date this project is approved that will include: (a) summary discussions of significant research results; (b) maps and descriptions of completed and ongoing actions; (c) results of restoration efforts, including estimates of population sizes, if appropriate; (d) other pertinent observations regarding the status or ecology of the species; *or* 2) regularly disseminate the required information as part of (ongoing) annual Conservation Strategy meeting updates with the Service and other agencies per the adaptive management process established in that document.

5. Should incidental take averages indicate higher than anticipated levels of incidental take trending above the authorized ten year incidental take estimates, the NPS will coordinate during the off season with the Service to evaluate trends, adjust activities, or reinitiate consultation to ensure compliance under the Act.

6. The NPS will provide, no later than ten (10) calendar years following the first complete year of implementation of project activities, information to the Service indicating project performance, including beneficial impacts in terms of areas of habitat restored, and any population level benefits observed, trends and study findings from monitoring and research, in order to evaluate the beneficial effects to frog populations from overall project activities in the context of incidental take. This project summary report will also include: (a) summary discussions of significant research results; (b) maps and descriptions of completed and ongoing actions; (c) results of restoration efforts, including estimates of population sizes, if appropriate; and (d) other pertinent observations regarding the status or ecology of the species. Presuming SEKI begins this project his season, the calendar date of the first interim project report will be February 28, 2026.

7. The Service must be notified as soon as possible if large numbers of the northern DPS of the mountain yellow-legged frog, and/or Sierra Nevada yellow-legged frog are found injured, sick or dead (e.g., due to illness, chemicals, or other factors), foul play is suspected, or unauthorized take of any listed species is observed or suspected. For such incidents, notification should be made by a NPS biologist, NPS law enforcement ranger, or other qualified NPS personnel. We recognize that the activities in this project will occur in the back country a substantial distance from roads, telephones, and cellphone service for long periods of time, so the notification should be made as soon as practicable. The report of the incident should include the date(s), location(s), habitat description, photographs, maps, preserved specimens (if possible), and any other pertinent information. The Service contact is the Chief of the Endangered Species Division (Forest) at the Sacramento Fish and Wildlife Office at (916) 414-6621.

Deviations from these terms and conditions may be authorized in writing by the Service as an appendage to this biological opinion.

The reasonable and prudent measure, with its implementing terms and conditions, is designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take described for each species in the Amount or Extent of Take section is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The NPS must provide an explanation of the causes of the taking as soon as possible and review with the Service the need for possible modification of the reasonable and prudent measure.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities that can be implemented to further the purposes of the Act, such as preservation of endangered species habitat, implementation of recovery actions, or development of information and databases. The Service has the following recommendations:

1. The NPS should continue to assist the Service in implementing the Conservation Strategy and, where applicable, recovery plans for the Northern Distinct Population Segment of the mountain yellow-legged frog, Sierra Nevada yellow-legged frog, Yosemite toad, Little Kern golden trout, and the Sierra Nevada bighorn sheep.

For the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, we request notification of the implementation of any of the conservation recommendations.

REINITIATION – CLOSING NOTICE

This concludes formal consultation on the Restoration of Native Species in High Elevation Aquatic Ecosystems Plan and Final Environmental Impact Statement in Sequoia and Kings Canyon National Parks for the endangered northern Distinct Population Segment of the mountain yellow-legged frog, the endangered Sierra Nevada yellow-legged frog, the threatened Yosemite toad, the threatened Little Kern golden trout, and the endangered Sierra Nevada bighorn sheep. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

This concludes formal conference on the effects of the Restoration of Native Species in High Elevation Aquatic Ecosystems Plan and Final Environmental Impact Statement in Sequoia and Kings Canyon National Parks for the proposed critical habitat for the mountain yellow-legged frog Pursuant to 50 CFR § 402.10.10(d), you may ask the Service to adopt this conference report as a biological opinion issued through formal consultation if the proposed critical habitat is designated as critical habitat. The request must be in writing. If the Service reviews the Restoration of Native Species in High Elevation Aquatic Ecosystems Plan and finds that there have been no significant changes in the action as analyzed, the Service will adopt the conference report as the biological opinion for the critical habitat.

If you have any questions about this biological opinion and conference opinion on the Restoration of Native Species in High Elevation Aquatic Ecosystems Plan, please contact Steven Detwiler, Senior Scientist, Forest/Foothill Division at the letterhead address, via email (steven_detwiler@fws.gov), or at telephone (916) 414-6569; or Chris Nagano, Chief, Endangered Species Division (Forest) via email (chris_nagano@fws.gov), or at telephone (916) 414-6621.

cc:
Daniel Boiano, Sequoia and Kings Canyon National Park, Three Rivers CA
Nancy Hendricks, Sequoia and Kings Canyon National Park, Three Rivers CA
Carolyn Swed, U.S. Fish and Wildlife Service, Reno NV
Laura Patterson, California Department of Fish and Wildlife, Sacramento CA
Marguerite Gordus, California Department of Fish and Wildlife, Fresno, CA
Rob Grasso, Yosemite National Park, Yosemite, CA

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Personal Communications

Erickson, P.B. 2016. Personal communication with S. Detwiler (April 12, 2016).