State of California
Department of Fish and Wildlife

Memorandum

Date: 23 March 2021

To: Sarah Mussulman,
Senior Environmental Scientist;
Sierra District Supervisor;
North Central Region Fisheries

From: Isaac Chellman, Environmental Scientist;
High Mountain Lakes;
North Central Region Fisheries

Cc: Region 2 Fish Files

Ec: CDFW Document Library

Subject: Native amphibian monitoring in Desolation Wilderness; *Rana sierrae* monitoring at Leland Lakes and McConnell Lake.

SUMMARY

Leland Lakes and McConnell Lake are part of a large native species reserve (NSR) in the Upper Rubicon watershed of Desolation Wilderness (**Figure 1**; CDFG 2012). The NSR contains Leland Lakes, McConnell Lake, Horseshoe Lake, Lake Zitella, 4-Q Lakes, and numerous small, adjacent wetlands. This NSR is a critically important conservation area for Sierra Nevada Yellow-legged Frogs (*Rana sierrae*, SNYLF; **Figure 2**). 4-Q Lakes contains a new SNYLF population CDFW is working to establish through translocations from Highland Lake. Additionally, several smaller populations nearby, including those discussed in this memorandum, provide connectivity between 4-Q Lakes and Highland Lake, which contains one of the largest known SNYLF populations in the northern Sierra Nevada. California Department of Fish and Wildlife (CDFW) formerly stocked Leland Lakes with trout, but stocking ceased in the 1990's. The remaining trout in Leland Lakes were subsequently removed between 2000 and 2003 by CDFW and Eldorado National Forest (ENF) staff using gill nets, and subsequent overnight gill net sets in 2008 and 2010 confirmed that fish were no longer present (CDFG 2012). Since 2002, CDFW staff have been conducting occasional visual encounter surveys (VES) for SNYLF in the drainage. Survey data from 2020 suggests that the SNYLF population at Leland Lakes is small, persisting, and possibly growing. SNYLF are still present at McConnell Lake and surrounding wetlands, although the population is small and suppressed by non-native fish present in the lake and connected tributaries. CDFW will continue occasional monitoring of the Leland Lakes and McConnell Lake to keep track of the SNYLF population over time.

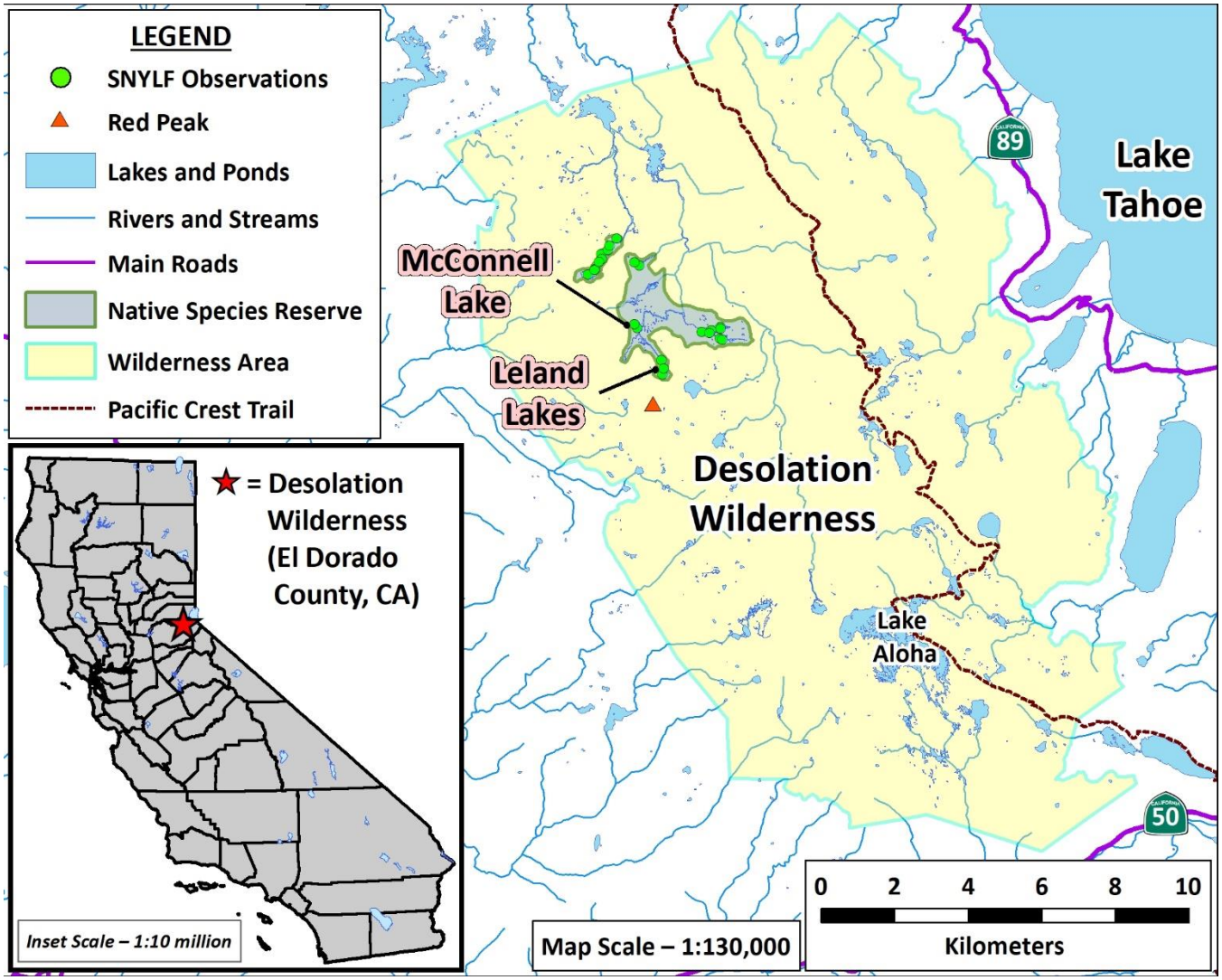


Figure 1. Desolation Wilderness, El Dorado County, CA. Green dots show *Rana sierrae* (SNYLF) sites with positive detections by CDFW staff during recent visual encounter surveys (VES).

ENVIRONMENTAL SETTING

Leland Lakes and McConnell Lake (**Figure 3–5**) are located in Desolation Wilderness, northeast El Dorado County (**Figure 1**). Leland Lakes and McConnell Lake lie in a granitic basin, between approximately 8,150 feet (ft) (2,484 meters; m) and 7,790 ft (2,374 m) in elevation, respectively. Leland Lakes drain directly into McConnell Lake, the outlet of which then flows north for 3.5 miles (mi) (5.6 kilometers; km) to Rubicon Reservoir. Many streams in this area are ephemeral and most contain multiple fish passage barriers due to the steep topography of the upper watershed.

The Upper Rubicon watershed is one of the more remote locations in Desolation Wilderness. The lower portion of the watershed can be accessed using the Rubicon Trail from Loon Lake or the Rubicon off-highway vehicle (OHV) Trail. The upper watershed is a relatively long hike from any trailhead, although the area can be accessed from the south via Wrights Lake (using the Rockbound Trail), from the east via the McConnell Loop Trail (which can be accessed from

several locations via the Rubicon Trail), and from the west via the Highland Trail. The most direct access to the upper watershed is by hiking the Red Peak Trail from the Van Vleck trailhead and then taking a cross country route from Lake #3 over a small saddle between Red and Silver Peaks.

As a result of the more difficult access, this area receives much less use than other portions of Desolation Wilderness (CDFG 2012). The NSR is an excellent area for native species management, due to the presence of multiple small SNYLF populations, relatively light recreational use, and limited fish presence. ENF manages this section of Desolation Wilderness and the surrounding land.

INTRODUCTION

Stocking records for Leland Lakes begin in 1931. CDFW stocked Leland Lakes primarily with Golden Trout (*Oncorhynchus mykiss* ssp; GT). However, CDFW briefly planted Rainbow Trout (*Oncorhynchus mykiss*; RT) from 1935–36, and Brook Trout (*Salvelinus fontinalis*; BK) once in 1937. CDFW also planted Paiute Cutthroat Trout (*Oncorhynchus clarki seleniris*; PCT) into Lower Leland Lake in 1937, but the PCT did not become established in Leland Lakes. Following SNYLF observations at Upper Leland Lake in 1993, CDFW halted fish stocking in the lake. GT, which were not self-sustaining in Upper Leland Lake, subsequently extirpated. In 1999, CDFW discontinued fish planting at Lower Leland Lake (CDFG 2012; CDFW stocking records). From 2000 to 2003, CDFW and ENF used monofilament gill nets to remove the remaining low density GT population from Lower Leland Lake.

McConnell Lake contains a small, extant GT population. CDFW does not have any stocking records for McConnell Lake, so GT most likely migrated into McConnell from the Leland Lakes outlet stream. The most recent gill net survey of McConnell Lake occurred in 2008, during which CDFW captured nine GT ranging from 113 to 240 millimeters total length. However, trout have been observed during each VES of the McConnell Lake area, including during surveys in 2020.

Following fish eradication, CDFW confirmed the continued presence of SNYLF in Leland Lakes. Beginning in 2005, CDFW staff also detected a small number of SNYLF tadpoles in McConnell Lake. During the past 19 years, VES have revealed that the Leland Lakes SNYLF population is small and may be growing (**Figure 6**). Current VES suggest that SNYLF in the McConnell Lake area may be on a trajectory toward extirpation due to the continued presence of introduced trout.

Figure 2. An adult Sierra Nevada Yellow-legged Frog (*Rana sierrae*) at Lower Leland Lake on 11 Aug 2020. (CDFW)

Figure 3. Lower Leland Lake on 11 Aug 2020, looking northwest. (CDFW)

Figure 4. Upper Leland Lake on 11 Aug 2020, looking northwest. (CDFW)

Figure 5. McConnell Lake on 13 Aug 2020, looking southeast. (CDFW)

THREATS

Introduced Fish

Although CDFW formerly stocked trout in Leland Lakes, field staff have not seen or captured any fish since eradication work was completed in the early 2000's. However, McConnell Lake and its tributaries contain a small population of GT. Low numbers of SNYLF tadpoles are regularly seen in McConnell Lake, but trout greatly limit SNYLF recruitment because GT and other salmonids prey on tadpoles and young frogs. Trout also compete with larger adult SNYLF for food (e.g., benthic macroinvertebrates). McConnell Lake is shallow and characterized by dense emergent vegetation with numerous meadow tributaries (**Figure 5**), in which GT of all sizes are often observed. This complex meadow and stream habitat around McConnell Lake may preclude mechanical fish removal. Therefore, fish eradication is not currently considered feasible at McConnell Lake (CDFG 2012). However, a fish passage barrier approximately 500 m upstream of McConnell Lake prevents trout from ascending back into Leland Lakes.

Disease

All SNYLF populations in El Dorado County are positive for chytrid fungus (*Batrachochytrium dendrobatidis*; *Bd*). CDFW collected epithelial swabs in 2010 from SNYLF at Lower Leland (n = 2) and Upper Leland (n = 1). The swabs were screened for the presence of *Bd* DNA using real-time quantitative polymerase chain reaction (qPCR) analysis. Results detected very low levels of *Bd* from one of the three swabs. However, the low sample size and presence of *Bd* in the immediately surrounding drainages (e.g., Highland Lake and Lower Leland Lake) suggests that *Bd* is likely present throughout the population, albeit at low levels.

Loss of Genetic Diversity

VES data suggest that the Leland and McConnell Lakes SNYLF population is very small and may be expanding. This type of population bottleneck is common among SNYLF populations, many of which have been greatly reduced by a combination of non-native fish and *Bd.* If the SNYLF population in the Leland/McConnell drainage is expanding, there may be negative genetic consequences for the population, including loss of genetic diversity, inbreeding depression, and fixation of deleterious alleles (Frankham et al. 2009). However, the lowest actual SNYLF population size (in terms of either census or effective population size) in this drainage is unknown. Population genetic analyses would be necessary to estimate the degree of genetic bottlenecking, if any.

Isolation

Geographic isolation can limit potential for gene flow between populations and increases risk of local extirpation. Isolated populations and small populations can suffer from similar negative genetic effects. Fortunately, the Leland and McConnell Lakes population is not completely isolated. There are a few SNYLF populations nearby; including Lake Zitella and the Highland Lake drainage. Additionally, CDFW is working to establish a new self-sustaining SNYLF breeding population at 4-Q Lakes via translocation of adult frogs from Highland Lake (CDFW 2021). Once established, the 4-Q Lakes population will be the closest SNYLF population to the Leland and

McConnell Lakes population. The outlet of McConnell Lake meets with the outlet of 4-Q Lakes, and the two drainages are only separated by approximately 3 km of stream channel (the straight path between McConnell/Leland Lakes and 4-Q Lakes is approximately half that distance). The two SNYLF populations could conceivably migrate between one another in the near term, and other populations are close enough to allow for rare instances of gene flow.

Marginal Habitats

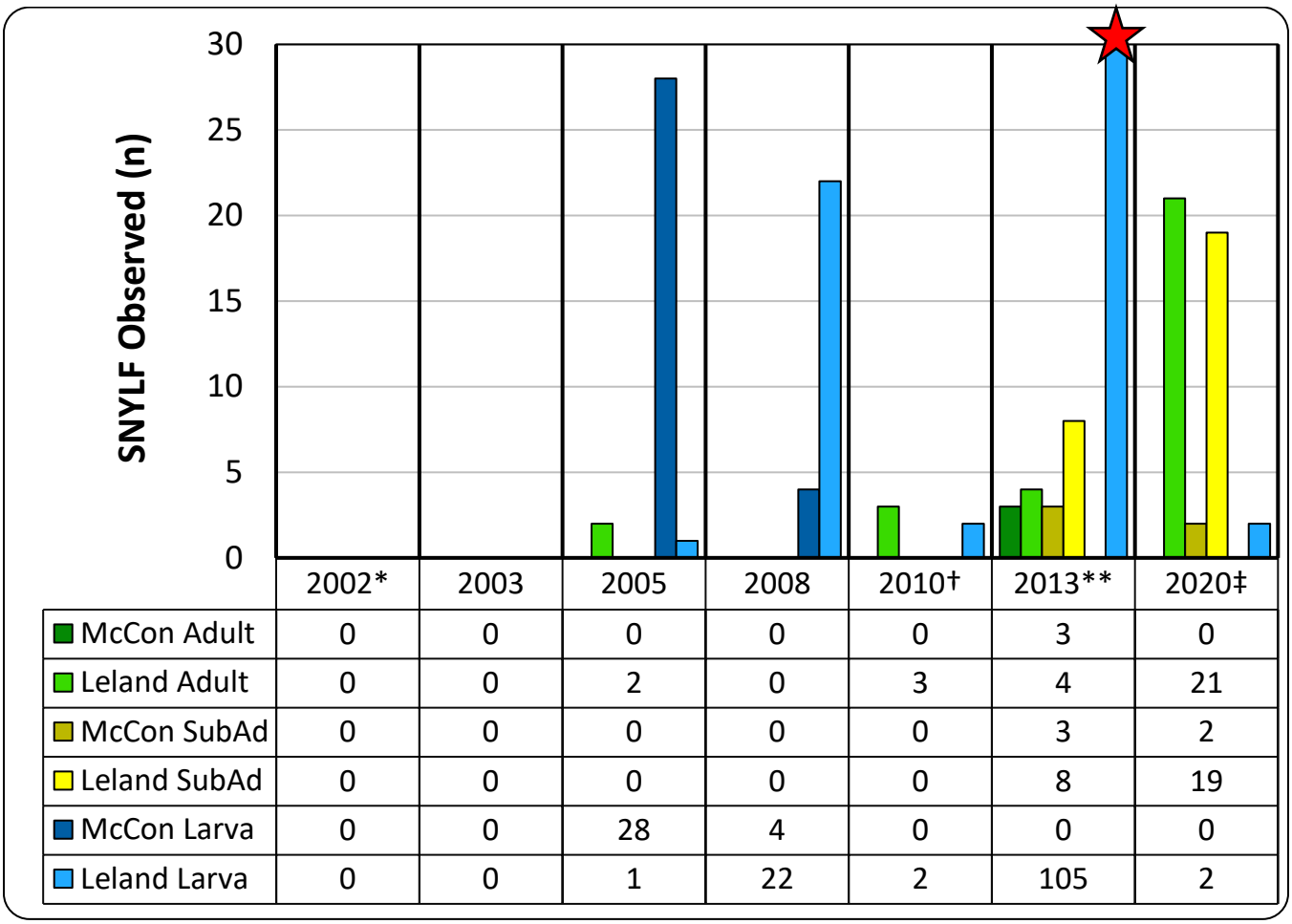
Although there were higher SNYLF detections at Leland Lakes in 2020 when compared with previous surveys, the population still appears to be very small. Any disturbance, natural or otherwise, that threatens overwintering habitats presents a potential extirpation risk. Potential risks include severe winter conditions, extended drought, or anthropogenic habitat disturbances. Additionally, populations of this size are at greater threat to extirpation due to stochastic events.

POPULATION STATUS

Leland Lakes drain into McConnell Lake via approximately 1 km of ephemeral stream. Given proximity of the two systems and an abundance of interconnected alpine wetlands, SNYLF likely move readily between Leland Lakes and McConnell Lake, and interbreed. This connectivity may be an impairment to the SNYLF population, since the fish-containing McConnell Lake area may be acting as a population sink. However, Leland Lakes may supply sufficient breeding and foraging habitat to allow the headwaters of the drainage to retain a healthy SNYLF population.

Following surveys in 2013, CDFW concluded that data from 2010 and 2013 suggested the SNYLF population in the drainage may be increasing slightly (CDFW 2015). In 2020, CDFW staff observed the highest number of post-metamorphic SNYLF at Leland Lakes since VES began in 2002 (**Figure 6**). These observations were despite field staff not surveying the Lower Leland Lake outlet stream, which likely contains dispersing SNYLF. During the survey in the late afternoon of 11 August 2020, there were occasional wind gusts that reduced visibility into the water and may have limited basking of post-metamorphic frogs. Therefore, the observations may have been an undercount when compared with VES conducted under better weather conditions. Despite conditions during the survey, the observations in 2020 are encouraging, and suggest that the Leland Lakes SNYLF population may be slowly growing, despite the presence of *Bd*.

CDFW will continue periodic monitoring at Leland Lakes and McConnell Lake to determine the relative abundance, general reproductive success, and demographic composition of the SNYLF population. During the next surveys of the area, CDFW will also survey the stream segment between Lower Leland and McConnell, the outlet stream of McConnell, and nearby ephemeral wetlands, several of which have been newly identified through high-resolution aerial imagery (**Figure 7**).



	2002*	2003	2005	2008	2010†	2013**	2020‡
McCon Adult	0	0	0	0	0	3	0
Leland Adult	0	0	2	0	3	4	21
McCon SubAd	0	0	0	0	0	3	2
Leland SubAd	0	0	0	0	0	8	19
McCon Larva	0	0	28	4	0	0	0
Leland Larva	0	0	1	22	2	105	2

Figure 6. Number of Sierra Nevada Yellow-legged Frogs (*Rana sierrae*; SNYLF) detected during visual encounter surveys (VES) in the Leland Lakes and McConnell Lake areas between 2002 and 2020. "McCon" = McConnell Lake area and "SubAd" = subadults. Totals of each life stage for Leland Lakes include the Upper and Lower Lake, plus any adjacent stream channels included during surveys. Totals for each life stage for McConnell Lake include any SNYLF detected in small ponds and stream channels adjacent to the lake. (Data caveat symbology is explained below.) Possible reasons for the recent population increase at Leland Lakes include rebounding from the former presence of non-native trout, recent mild winters (2012–2015 drought, and winters 2017–2018 and 2019–2020) potentially increasing overwinter survival (Bradford 1983), a prevalence of recent dry years reducing habitat available to trout, and adaptive resistance to the amphibian fungal pathogen *Batrachochytrium dendrobatidis* (*Bd*; Knapp et al. 2016). Additional monitoring will be needed to better determine the long-term status of the SNYLF population in the Leland and McConnell Lakes drainage.

*In 2002, CDFW only surveyed Lower Leland Lake, as part of fish eradication work.

†In 2010, CDFW staff did not survey McConnell Lake.

**In 2013, VES included many small ponds in the basin surrounding McConnell Lake. Totals include several post-metamorphic SNYLF that CDFW observed in the McConnell Lake inlet.

‡In 2020, the subadult total includes one individual observed in Site ID 63588 (a small pond adjacent to McConnell Lake).

★ [Red star] Indicates a value above the range of the Y-axis (105 larva).

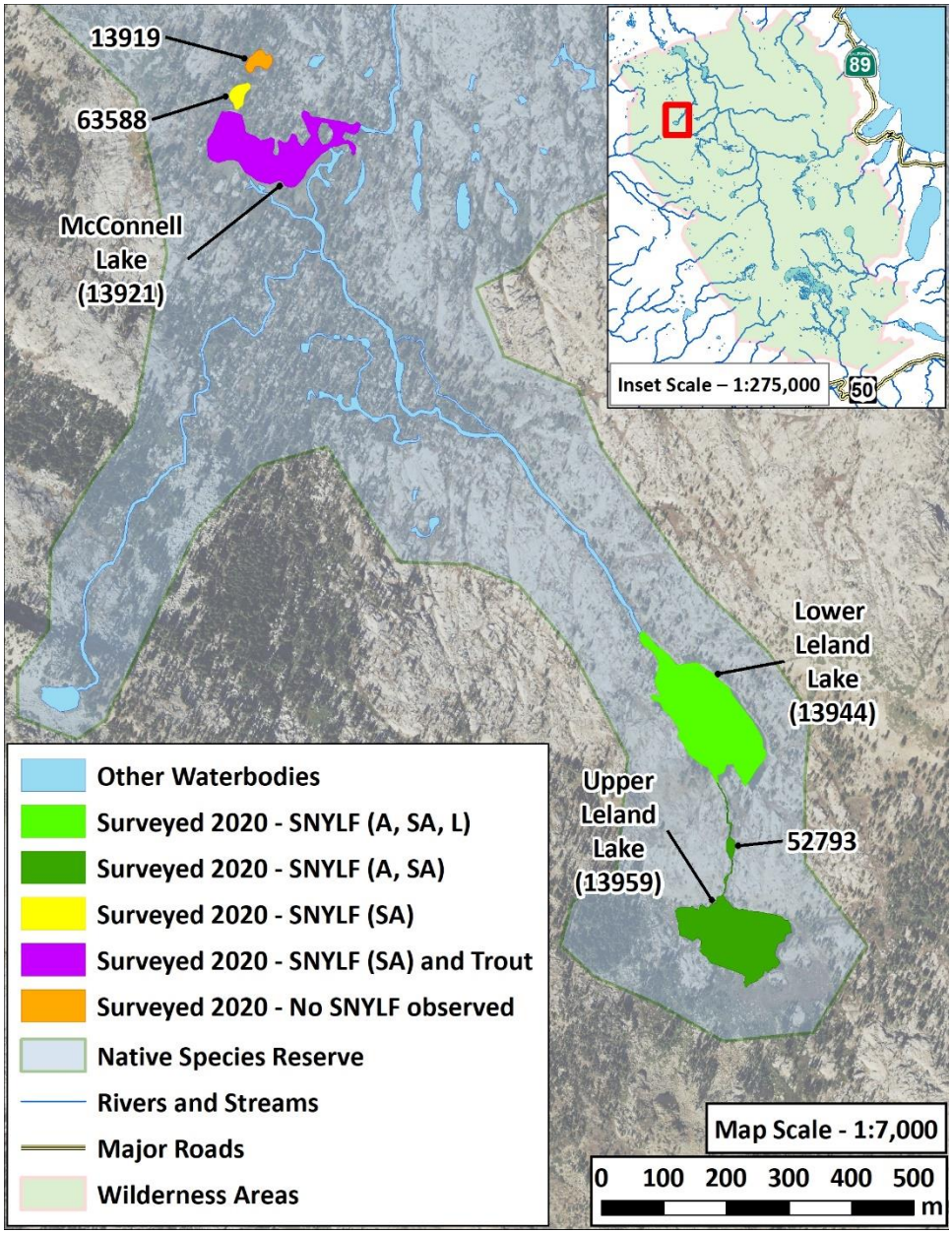


Figure 7. Sierra Nevada Yellow-legged Frog (*Rana sierrae*; SNYLF) and Golden Trout (*Oncorhynchus mykiss* spp.) observations in the Leland and McConnell Lakes areas in 2020. CDFW staff have consistently observed SNYLF in Leland Lakes and occasionally observed fewer SNYLF in the McConnell Lake area. Since results reported in 2015, CDFW updated several existing GIS polygons to more accurately reflect the composition of the depicted waterbodies. SNYLF letter codes in the legend, which indicate the life stages observed during the most recent survey, are as follows: "A" = adults, "SA" = subadults, and "L" = larvae. Number labels shown are unique site identification codes that CDFW uses for data collection. Water flowing out of McConnell Lake enters the outlet of 4-Q Lakes and then converges with the Rubicon River, which flows into Rubicon Reservoir.

LITERATURE CITED

Bradford, D.F. 1983. Winterkill, oxygen relations, and energy metabolism of a submerged dormant amphibian, *Rana muscosa*. Ecology 64:1171–1183.

California Department of Fish and Game (CDFG). 2012. Aquatic Biodiversity Management Plan for the Desolation Wilderness Management Unit. California Department of Fish and Wildlife, Rancho Cordova, CA. Available from: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=59961

California Department of Fish and Wildlife (CDFW). 2015. Sierra Nevada yellow-legged frog monitoring in Phipps Creek Planning Watershed within Desolation Wilderness. Region 2 Survey Memo. California Department of Fish and Wildlife, Rancho Cordova, CA. Available from: http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=110729

CDFW. 2021. Highland Lake and 4-Q Lakes (Desolation Wilderness) *Rana sierrae* monitoring and translocation: updates. Region 2 Survey Memo. California Department of Fish and Wildlife, Rancho Cordova, CA. Available from: http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=189169

Frankham, R., J.D. Ballou, and D.A. Briscoe. 2009. Introduction to Conservation Genetics. Cambridge University Press, New York, NY, USA.

Knapp, R.A., G.M. Fellers, P.M. Kleeman, D.A.W. Miller, V.T. Vredenburg, E.B. Rosenblum, and C.J. Briggs. 2016. Large-scale recovery of an endangered amphibian despite ongoing exposure to multiple stressors. Proceedings of the National Academy of Sciences 113:11889–11894.