State of California
Department of Fish and Wildlife

Memorandum

Date: 25 February 2022

To: Angie Montalvo,
Senior Environmental Scientist;
Acting Sierra District Supervisor;
North Central Region Fisheries

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

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Subject: Native amphibian restoration and monitoring in Desolation Wilderness;

- ***Rana sierrae* monitoring in the Highland Lake drainage: update.**
- ***Rana sierrae* translocation from Highland Lake to 4-Q Lakes: 2018–2021 summary.**

Evening at 4-Q Lakes in June 2021, after a brief thunderstorm. (CDFW)

SUMMARY

The Highland Lake drainage is an area from which California Department of Fish and Wildlife (CDFW) staff removed Rainbow Trout (*Oncorhynchus mykiss*, RT) from 2012–2015 to benefit Sierra Nevada Yellow-legged Frogs (*Rana sierrae*, SNYLF). Amphibian monitoring data from 2003 through 2021 indicate that the Highland Lake drainage now contains one of the largest known SNYLF populations in the northern Sierra Nevada.

Since at least 2015, annual visual encounter surveys (VES) have revealed that the Highland Lake drainage contains a sufficient adult SNYLF population to provide a source for translocations to nearby suitable fishless habitats. The Interagency Conservation Strategy for Mountain Yellow-legged Frogs in the Sierra Nevada (hereafter "Strategy"; MYLF ITT 2018) highlights translocations as a principal method for SNYLF recovery. In 2016, CDFW applied for funding through the U.S. Fish and Wildlife Service (USFWS) endangered species recovery grant program (Section 6 of the U.S. Endangered Species Act of 1973) to translocate SNYLF from the Highland Lake drainage to 4-Q Lakes, a nearby fishless drainage, where VES conducted by CDFW in 2003, 2015, and 2018 suggested SNYLF were not present. The grant was awarded by the USFWS in November 2016 (Federal Grant Award #F17AP00001) and allowed staff from CDFW and Eldorado National Forest (ENF) to undertake two translocations from Highland Lake to 4-Q Lakes, one in July 2018 (60 adult frogs) and another in August 2019 (40 adult frogs).

After initial success of the first two translocations—as evidenced by many adults surviving overwinter, rapid growth of recaptured adults, and observations of early life stage SNYLF at 4-Q Lakes in June 2020—CDFW applied for another round of funding through Section 6 to conduct two additional translocations in 2021 and 2022. USFWS awarded the grant in mid-January 2021 (Federal Grant Award #F21AP00483-00). As a result, in July 2021, CDFW and ENF staff biologists translocated an additional 51 adult SNYLF. In total, CDFW and ENF staff have translocated 151 adult SNYLF (84 females and 67 males) from the Highland Lake drainage to 4-Q Lakes.

Each year from 2018–2021, CDFW field staff revisited 4-Q Lakes two times per summer to monitor the new SNYLF population. During those visits, CDFW has recaptured 64 of the 151 translocated SNYLF (42%) at least once since release at 4-Q Lakes. In 2020, CDFW observed the first signs of SNYLF breeding, including observing a recently hatched egg mass, tadpoles, and subadults. In 2021, CDFW staff observed additional subadults and five new young adults, which were unmarked with passive integrated transponder (PIT) tags and, therefore, born at 4-Q Lakes. All recaptured SNYLF had grown noticeably and appear to be in excellent body condition. CDFW plans to undertake the fourth translocation in early summer 2022. Additionally, CDFW will continue annual monitoring to document SNYLF population status at both the donor and recipient sites.

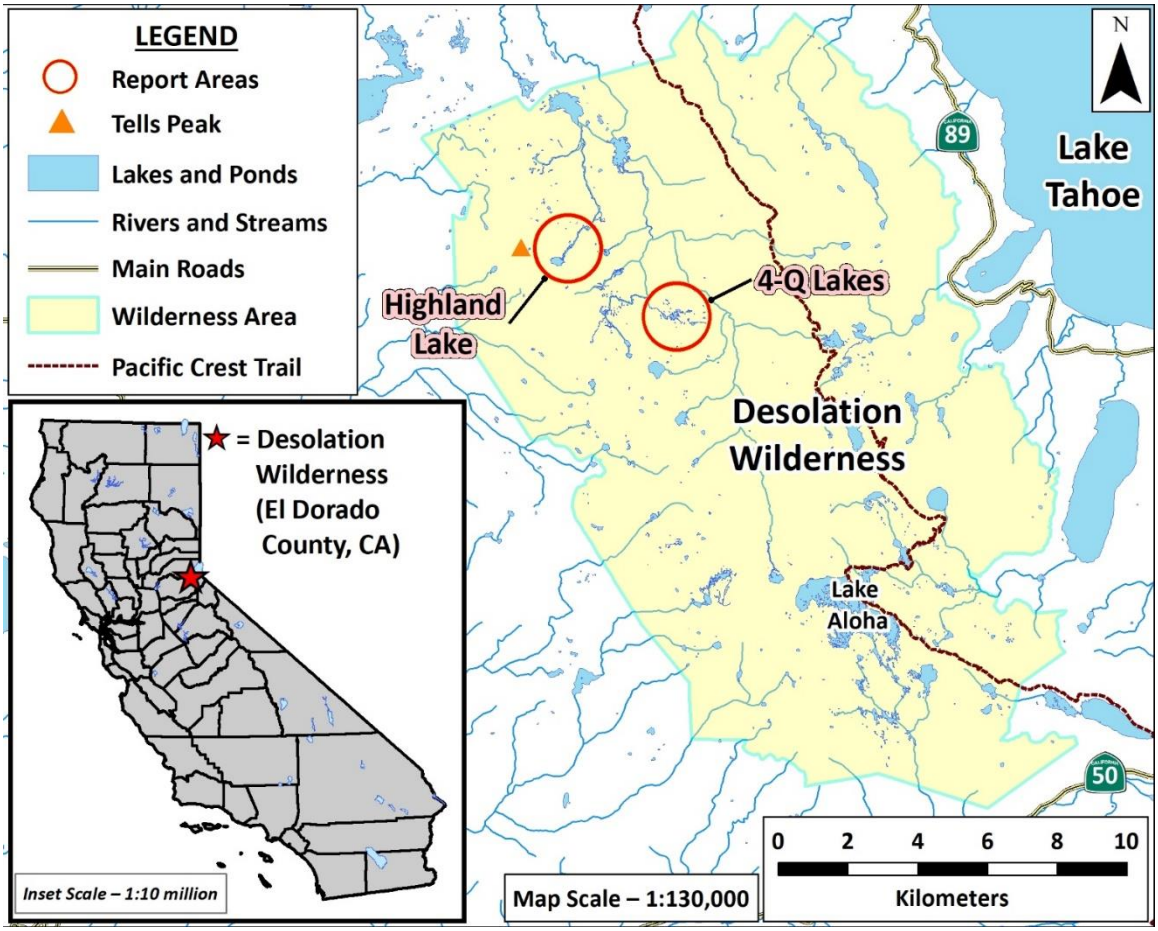


Figure 1. Desolation Wilderness, El Dorado County, CA. The areas discussed in this memorandum are circled.

ENVIRONMENTAL SETTING

Highland Lake and 4-Q Lakes are in Desolation Wilderness, northeast El Dorado County (**Figure 1**). Highland Lake sits in a granite cirque at approximately 7,800 feet in elevation and drains northeast into Rockbound Lake (**Figure 2**). No official trails access Highland Lake, but a use trail from nearby Forni Lake, which proceeds over a saddle just south of Tells Peak, indicates regular visitation by hikers. 4-Q Lakes are located approximately 3.5 km southeast of Highland Lake drainage. 4-Q Lakes sit in a granite basin at approximately 7,500 feet in elevation and drain north into Rubicon Lake. The McConnell Lake Trail provides access to the site from the Leland/McConnell/Horseshoe Lakes drainage (to the west) and Camper Flat (to the east). ENF manages this section of Desolation Wilderness and the surrounding land.

INTRODUCTION

The Aquatic Biodiversity Management Plan (ABMP) for the Desolation Wilderness Management Unit (CDFG 2012) identifies Highland Lake (Site ID 13904; **Figure 2**), approximately one kilometer (km) of outlet stream (Site IDs 52648, 52649, 52650, 52670, and 52671), and three associated ponds (Site IDs 13892, 13896, and 13903) as a Native Species Reserve (NSR) for SNYLF (**Figures 3 and 4**).

Figure 2. Highland Lake in July 2021, looking east from the saddle between Highland and Forni Lakes. (CDFW)

Figure 3. A small aggregation of Sierra Nevada Yellow-legged Frogs (*Rana sierrae*) at Highland Lake in June 2021. (CDFW)

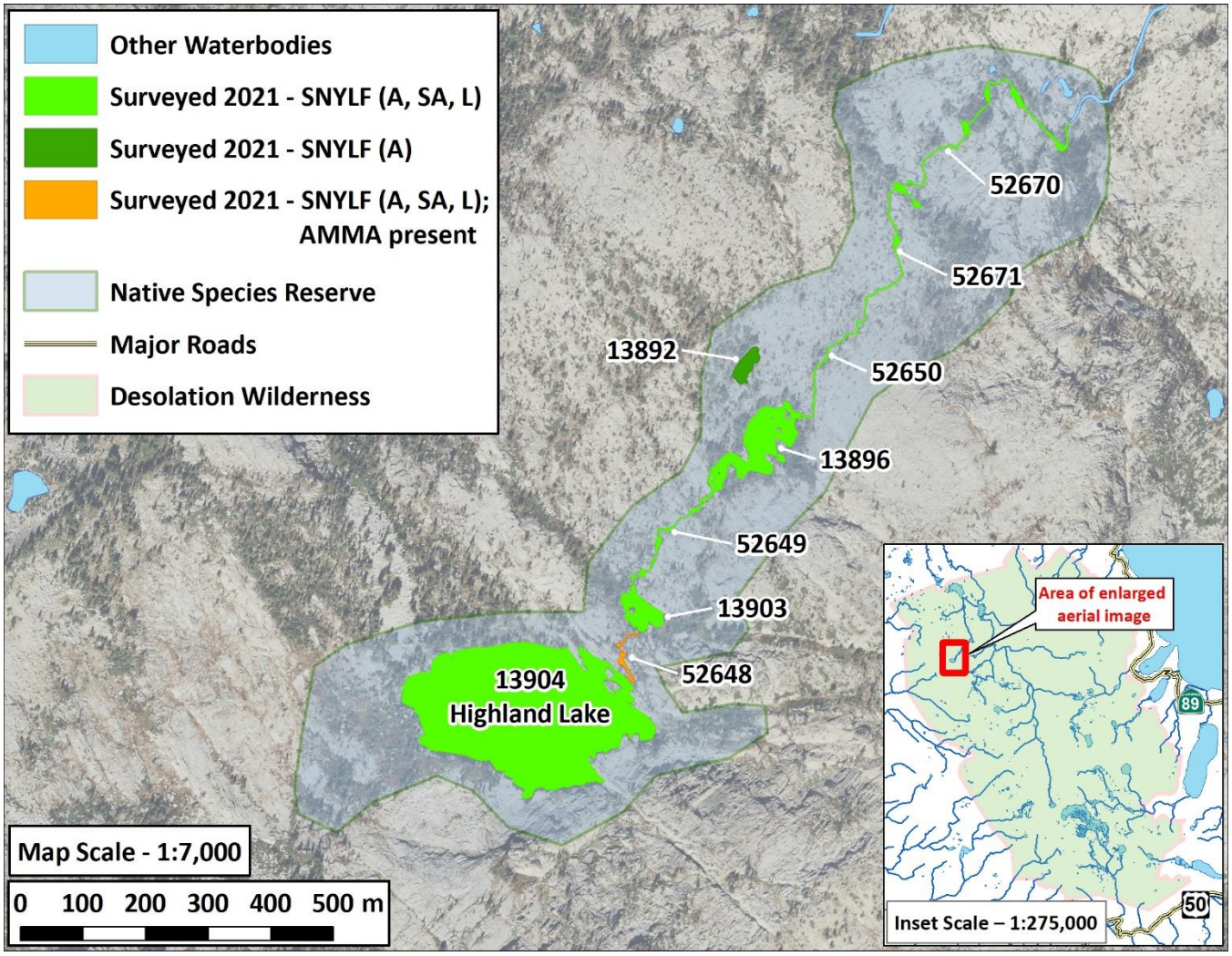


Figure 4. Highland Lake Native Species Reserve (NSR). CDFW staff have observed Sierra Nevada Yellow-legged Frogs (*Rana sierrae*; SNYLF) throughout the drainage. During VES in June 2021, staff observed SNYLF in all sites surveyed. Additionally, staff observed a late stage larval, or paedomorphic adult, Southern Long-toed Salamander (*Ambystoma macrodactylum sigillatum*; AMMA; see below), which is a California species of special concern, in the Highland Lake outlet (Site ID 52648). 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. All flowing waters drain northeast into Rockbound Lake (not shown).

The AMMA found at Site ID 52648 on 29 June 2021.

CDFW stocked Highland Lake with RT from 1935 until 2000. The lake contains limited spawning habitat and RT exhibited little natural reproduction. In 1955, CDFW constructed a stonemasonry streamflow maintenance dam at the outlet (USFS 1955, CDFG 1980). The dam forms an effective barrier to fish moving from the outlet stream into the lake, thereby further reducing spawning potential. In 1993, ENF biologists observed a very small SNYLF population in the Highland Lake outlet stream (USFS 1993). Staff also detected RT in Highland Lake and the outlet stream. Gill net surveys in 2003 and 2010 indicated that RT were persisting at low density in the absence of stocking. In the 2000's, CDFW managers, in partnership with ENF, determined that eradicating the low-density RT population using gill nets and backpack electrofishers would be feasible, and provide an opportunity to recover the SNYLF population in the Highland Lake drainage (CDFG 2012). As a result, in 2012, CDFW and ENF personnel began removing RT from Highland Lake NSR to benefit SNYLF. In 2017, CDFW and ENF determined that the NSR was fishless, following two years without any fish captures or observations. Although field staff have not seen or captured any fish since 2015, CDFW will continue monitoring the site for presence of any latent non-native trout. Those interested in learning more details about fish removal in the Highland Lake drainage may consult the 2017 Highland Lake survey memorandum (CDFW 2018).

Now that fish removal is complete in the Highland Lake drainage, the SNYLF population has grown substantially, from only a handful of post-metamorphic frog detections in the 1990's, to an average of 475 adults, 309 subadults, and 1,070 larvae observed during annual visual encounter surveys (VES) from 2014 to 2021 (**Figures 5 and 6**). The large SNYLF population allows for translocating a subset of adult frogs to establish new SNYLF populations nearby. The Desolation Wilderness ABMP identifies 4-Q Lakes (located 3.5 km to the southeast; **Figure 1**) as a site to receive SNYLF translocated from the Highland Lake drainage (CDFG 2012). 4-Q Lakes provide an interconnected, fishless aquatic basin that may provide the foundation for establishing another healthy SNYLF population in the Upper Rubicon drainage.

From at least 1931 until 2000, CDFW regularly stocked the three largest 4-Q Lakes with Brook Trout (*Salvelinus fontinalis*; BK). During overnight gill net surveys in 2003, CDFW field staff captured six BK in the basin. However, subsequent gill net surveys in 2010 (one-night net set) and 2016 (one-month net set) returned zero fish, confirming that BK were not self-sustaining and the lakes were fishless.

In addition to gill net surveys, CDFW completed VES of the entire 4-Q Lakes basin to check for potential occupancy by fish, SNYLF, or other special status herpetofauna. VES conducted by CDFW in 2003, 2015, and 2018 resulted in no SNYLF observations, although field staff did observe other amphibian and reptile species. Therefore, CDFW and ENF personnel had not observed SNYLF in 4-Q Lakes basin during any surveys prior to translocations in 2018. Given the habitat composition and relative nearness of extant populations, SNYLF likely occupied 4-Q Lakes before fish stocking began in 1931. However, CDFW is not aware of any museum or earlier survey records to confirm former SNYLF occupancy in 4-Q Lakes basin.

THREATS

Disease

All SNYLF populations in El Dorado County are positive for chytrid fungus (*Batrachochytrium dendrobatidis*; *Bd*). CDFW sampled Site IDs 13903 and 13896 in 2009 and 2010 using epithelial swabs and had the swabs screened for the presence of *Bd* DNA using real-time quantitative polymerase chain reaction (qPCR) analysis. Staff collected eight swabs and results from both years detected very light to moderate *Bd* infection intensity. In 2019, CDFW staff collected an additional 26 SNYLF epithelial swabs at Highland Lake (Site ID 13904). In fall 2020, partner scientists at the Sierra Nevada Aquatic Research Laboratory (SNARL) screened the new swabs for presence of *Bd* DNA using real-time qPCR analysis (Knapp and Lindauer 2020). The swab analyses detected either no *Bd* (n = 6), or very light (n = 8), light (n = 9), to moderate infection (n = 3). These designations of infection intensity are subjective; however, no swabs collected from SNYLF at Highland Lake in 2019 had high *Bd* loads (i.e., *Bd* loads high enough to suspect increased likelihood of mortality from severe chytridiomycosis).

Loss of Genetic Diversity

VES data suggest that the Highland Lake drainage SNYLF population was very small and only recently expanded. This potential population bottleneck may have resulted in negative genetic consequences for the population, including loss of genetic diversity, inbreeding depression, and fixation of deleterious alleles (Frankham et al. 2009). However, the true size of the Highland Lake drainage population, during the time-period when it was smallest, is unknown. Population genetic analyses are necessary to estimate the level of inbreeding and 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 Highland Lake drainage population is not completely isolated. There are a few SNYLF populations relatively close to Highland Lake (including Lake Zitella, McConnell Lake, and Leland Lakes). Lake Zitella is the only location SNYLF could conceivably immigrate from in the near term, but the other populations are close enough to allow for rare instances of gene flow. This situation contrasts SNYLF populations at the northern extent of the species' range, most of which are greatly isolated from one another.

Introduced Fish

Highland Lake, its outlet, and two small ponds along the outlet stream formerly supported a small RT population. The main lakes in 4-Q Lakes basin also formerly contained BK, although the populations were not self-sustaining. Trout prey on SNYLF and are a potential source of competition for food (e.g., benthic macroinvertebrates). Additionally, RT may have been limiting successful SNYLF breeding and recruitment in Highland Lake and the ponds below, which supply the only deep-water habitat in the basin. In the absence of stocking, RT abundance declined, but

sufficient natural reproduction was occurring in the inlet to Highland Lake and the upper segment of outlet stream to sustain a small trout population. Barriers to upstream fish movement (e.g., the Highland Lake dam and natural waterfalls) impeded or excluded trout living in stream segments and ponds from moving into Highland Lake. Trout are still present below the natural barrier that demarcates the downstream end of the NSR. Illegal movement of trout into the stream channel above the barrier, the NSR ponds, or Highland Lake presents a potential extirpation risk for SNYLF. However, CDFW has mitigated the immediate threat from trout predation through fish removal efforts.

HIGHLAND LAKE DRAINAGE SNYLF POPULATION STATUS: RESULTS

Although CDFW did not detect SNYLF in the Highland Lake drainage prior to 2008, ENF staff have been monitoring this population since 1993 (USFS 1993). VES data between 2013 and 2021 confirm that the population has increased dramatically (**Figures 5 and 6**). As the RT population declined, CDFW staff observed SNYLF moving into previously unoccupied microhabitats. Notably, as the RT population diminished, staff observed a large increase in tadpoles, particularly at Highland Lake, suggesting SNYLF had begun to successfully utilize additional breeding habitats.

In October 2014 and July 2015, CDFW staff observed SNYLF at two shallow ponds in which staff had not previously observed frogs. Coincidentally, nearby Lake Zitella (2 km southeast of the Highland Lake drainage) experienced a similar increase in SNYLF observations (CDFW 2021b). On 30 July 2015, CDFW and ENF staff surveyed all sites in the NSR. Results suggested a large increase in SNYLF abundance in the area (**Figures 5 and 6**). In 2016, CDFW field staff surveyed all sites in the NSR three times. In addition to observing another large increase in frogs, staff observed three egg masses in Highland Lake on 26 June 2016. Staff observed another single egg mass in Highland Lake in 2019. Prior to fish removal, field staff only observed egg masses in the outlet ponds, where the potential for desiccation or overwinter freezing reduced the likelihood that the larvae would recruit into the adult population.

On 29 August 2017, CDFW staff surveyed all sites along the outlet stream except Site ID 13892, an off-channel pond not directly connected to the Highland Lake outlet (**Figure 4**). Less than two weeks later (10 September 2017), CDFW staff surveyed Highland Lake. Survey conditions were adequate during all 2017 surveys. However, there was consistent wind, including occasional strong gusts, on the day staff surveyed Highland Lake. The wind resulted in poor visibility, which likely accounts for the much lower number of SNYLF available for detection when compared with previous years.

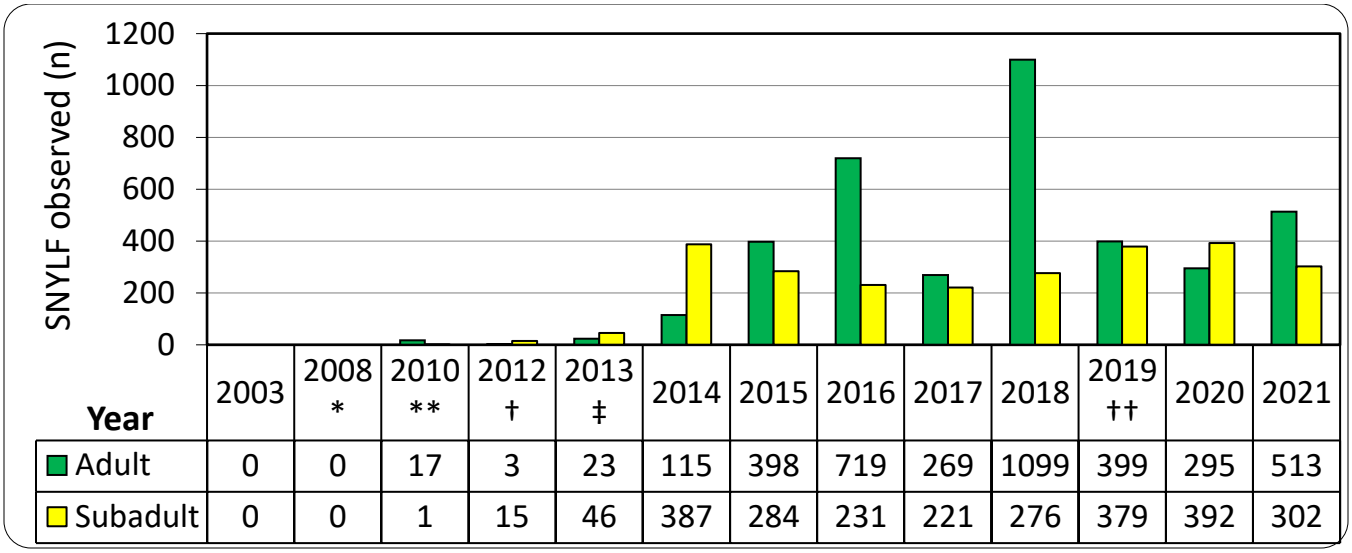
On 26 June 2018, CDFW staff surveyed the entire NSR (**Figure 4**). The goals of the VES were to determine the current population status and to estimate the number of adult SNYLF available for translocation to 4-Q Lakes the following week (CDFW 2020). Survey conditions were sunny and warm, but light wind obscured visibility into the water. Despite the wind, field staff observed hundreds of SNYLF.

On 7 August 2019, CDFW staff, with assistance from ENF staff, surveyed all waterbodies in the NSR except the two most downstream segments of the Highland outlet stream, Site IDs 52670 and 52671 (**Figure 4**). The goals were the same as surveys in 2018: determine the current population status and estimate the number of adult SNYLF available for translocation to 4-Q Lakes the following day. CDFW and ENF staff observed fewer SNYLF adults and larvae in 2019 when compared with 2018 (**Figures 5 and 6**). Despite fewer adult and larval SNYLF observations, CDFW observed more subadults in 2019 than in any prior year except 2014, during which CDFW staff observed comparable numbers of SNYLF subadults.

On 11 August 2020, CDFW staff surveyed the entire Highland Lake drainage (i.e., all waterbodies highlighted in **Figure 4**). Conditions were not ideal for VES. As often occurs in the Highland Lake drainage, consistent winds, including frequent strong gusts, were present on the survey day. These were similar circumstances to conditions experienced by CDFW staff during surveys in 2017. The wind likely played a large role in lower overall SNYLF detections when compared with the previous three years. Strong winds greatly limit visibility into the water for observing tadpoles and post-metamorphic frogs resting on the substrate. Additionally, high winds and frequent gusts appear to reduce basking behavior of post-metamorphic SNYLF, when compared with calmer conditions (I. Chellman, pers. obs.; M. Lockhart, pers. comm.). Therefore, the lower SNYLF detections in 2020 are very likely the result of environmental factors, rather than population decline.

On 28–29 June 2021, CDFW staff surveyed the entire Highland Lake drainage (**Figure 4**). Unlike the previous year, survey conditions were excellent. Winds in the basin were light and the weather was warm (an average of 26° C during surveys). The more ideal conditions may have played a role in staff observing the highest number of adult SNYLF detections since 2018 (**Figure 5**). Additionally, the light winds allowed staff to have more consistent visibility into the water during surveys. Easier visibility into the water may have factored into staff detecting the highest tadpole count since VES began in 2003 (**Figure 6**). These results provide support for CDFW's suspicion that environmental conditions in 2020 were largely responsible for lower SNYLF detections, rather than any population decline.

Monitoring should continue to assess the long-term status of the Highland Lake drainage SNYLF population. During the next several years, CDFW will monitor Highland Lake at least once per year. During translocation efforts, CDFW staff will also survey 4-Q Lakes, the translocation recipient site, multiple times each summer to monitor the status of the translocated SNYLF population. CDFW is planning another round of translocations—using the same methods implemented in 2018, 2019, and 2021—in 2022, during which CDFW field will visit 4-Q lakes at least twice annually for VES (see details in the **SNYLF TRANSLOCATION** section below).



Year	2003	2008 *	2010 **	2012 †	2013 ‡	2014	2015	2016	2017	2018	2019 ††	2020	2021
Adult	0	0	17	3	23	115	398	719	269	1099	399	295	513
Subadult	0	0	1	15	46	387	284	231	221	276	379	392	302

Figure 5. Number of adult and subadult Sierra Nevada Yellow-legged Frogs (*Rana sierrae*; SNYLF) detected during visual encounter surveys (VES) in the Highland Lake drainage between 2003 and 2021. From 2014 to 2018, and 2020–2021, surveys occurred throughout the entire drainage, including Highland Lake, the outlet stream, and the two downstream ponds.

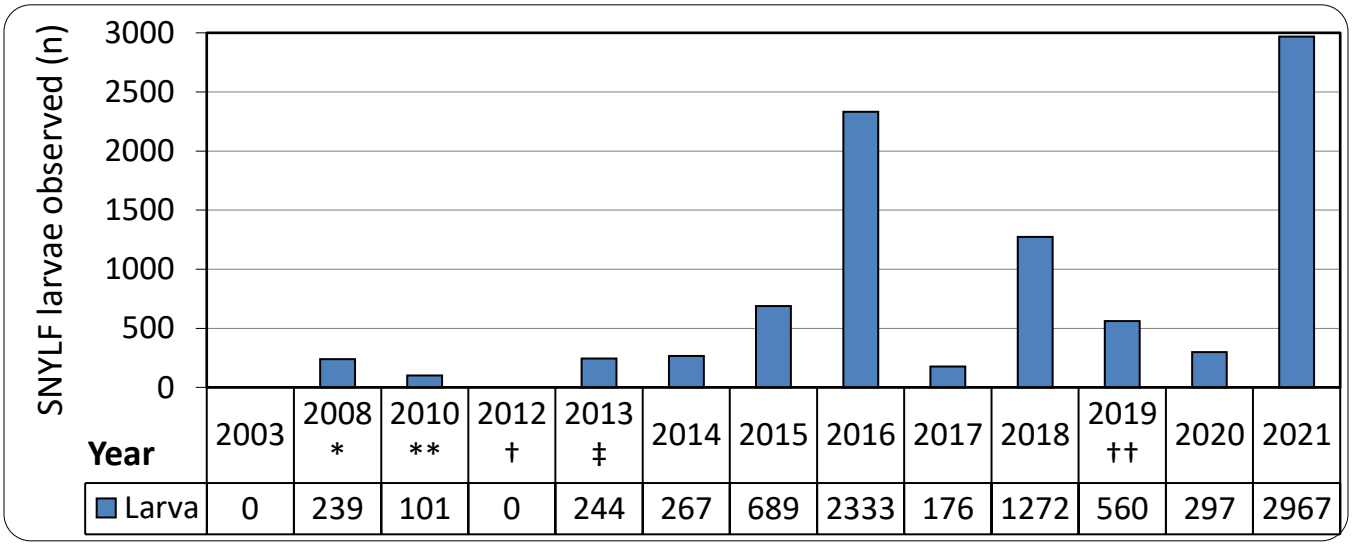
*2008 surveys only included Highland Lake and the larger downstream pond (Site ID 13896).

**Surveys in 2010 only included the two stream ponds (Site IDs 13896 and 13903).

†CDFW did not conduct formal surveys in 2012 (staff only noted anecdotal observations during gill net setting).

‡Surveys in 2013 only include Highland Lake and the two downstream ponds.

†† CDFW did not survey Site IDs 52670 and 52671 in 2019.



Year	2003	2008 *	2010 **	2012 †	2013 ‡	2014	2015	2016	2017	2018	2019 ††	2020	2021
Larva	0	239	101	0	244	267	689	2333	176	1272	560	297	2967

Figure 6. Number of larval Sierra Nevada Yellow-legged Frogs (*Rana sierrae*; SNYLF) detected during visual encounter surveys (VES) in the Highland Lake drainage between 2003 and 2021. (See **Figure 5** for caveats about surveys between 2008 and 2019.) Steady winds and occasional strong gusts during the Highland Lake survey on 10 September 2017, 7 August 2019, and 11 August 2020 made visibility into the lake difficult, which may account for the low larval SNYLF observations when compared with other recent survey years.

HIGHLAND LAKE DRAINAGE SNYLF POPULATION STATUS: DISCUSSION

As part of a larger project to inventory fish and native amphibians throughout the Sierra Nevada (CDFG 2012), fish stocking at Highland Lake ceased in 2000. The decision to manage the watershed for native species, rather than fish, occurred years before active fish removal began. Based on the small number of RT captured during active removal, the fish population had declined soon after CDFW stopped aerial plants at Highland Lake. Therefore, the SNYLF population increase may be partly attributable to the decrease in fish numbers in the absence of stocking. A decline in the RT population allowed SNYLF to begin breeding and feeding with less interference from an efficient predator. The observation of larval SNYLF in Highland Lake in 2008—four years before active fish removal began—supports this idea.

SNYLF benefitted from reduced fish densities in the watershed, but the subsequent population increase in a *Bd*-positive environment was initially uncertain, given the high variability in *Bd*-positive SNYLF population dynamics (Briggs et al. 2010). However, recent SNYLF population monitoring in other areas of the Sierra Nevada suggests that *Bd*-positive SNYLF populations can rebound in the absence of other stressors, such as trout (Knapp et al. 2016). In addition to fish removal, other environmental factors may have helped the SNYLF population rebound, including short winters, increased temperatures, and increased food availability during the 2012–2015 drought. Regardless, monitoring efforts over a nineteen-year period demonstrate that the SNYLF population in the Highland Lake watershed has made a dramatic comeback since management in the area switched from a focus on non-native trout stocking to a focus on restoring habitat for native amphibians.

In 2021, CDFW observed more adult SNYLF observations than 2019 and 2020, and post-metamorphic counts (subadults and adults combined) were consistent with the average number of post-metamorphic individuals that CDFW has observed during VES from 2014 to 2021. Additionally, staff detected more SNYLF tadpoles in 2021 than during any previous survey year. These observations provide additional evidence against the possibility of SNYLF population decline suggested in 2020 (CDFW 2021a). However, in 2020, CDFW suspected that the population was not truly in decline, despite counts dropping in 2019 and 2020, compared with VES results in 2018. Survey conditions may be one of the most important factors explaining differences in SNYLF detections. In 2020, skies were clear and air temperatures were warm, but steady winds with frequent strong gusts limited visibility into the water. Steady wind, which is common at Highland Lake, makes it especially difficult to see tadpoles in deeper water, and can reduce basking of post-metamorphic frogs. Winds during VES in 2017, 2019, and 2020 were often high, and CDFW staff observed fewer SNYLF, when compared with years during which less wind occurred during CDFW surveys at Highland Lake (e.g., 2016, 2018, and 2021).

In discussing results from 2019, CDFW guessed that harsh winter conditions may have partially accounted for lower SNYLF observations in 2019 (CDFW 2020). However, this explanation is unlikely a factor for the comparatively lower observations during VES in 2020. The northern

Sierra Nevada experienced below average total precipitation (CDEC 2020a) and snow water content (CDEC 2020b) during winter 2019–2020. Poor SNYLF survivorship is known to occur during long, harsh winters (Bradford 1983). However, winter conditions cannot fully account for the between-year variability in SNYLF observations in the Highland Lake drainage. For example, if harsh winter conditions in 2016–2017 were the primary reason behind the low number of SNYLF observed in September 2017, far fewer adult SNYLF would have been available for detection during CDFW surveys in June 2018 (**Figures 5 and 6**). Although another winter with above average precipitation and snowpack in 2018–2019 correlates with lower SNYLF detections the following summer, VES results from the past several years suggest that weather conditions on the day of surveying may be the largest environmental influence on between-year differences in SNYLF detections in the Highland Lake drainage.

Overall, VES results can be difficult to compare, due to numerous factors, including weather conditions, time of year, and observer bias (Mazerolle et al. 2007). A particularly instructive example occurred in summer 2016, during which CDFW conducted three separate surveys of the Highland Lake drainage, in June, August, and September. When compared with other recent years, the June and September 2016 surveys at Highland Lake resulted in relatively few SNYLF detections (82 frogs and 13 larvae, then 130 frogs and 1 larva, respectively). These detection rates were comparable to observations at Highland Lake in September 2017 (102 frogs and 32 larvae). However, the August 2016 survey of Highland Lake resulted in dramatically higher SNYLF detections (693 frogs, 2,008 larvae). The higher SNYLF detections in August may have resulted from excellent survey conditions, coincidental timing with the height of summer SNYLF activity in the basin, more attentive surveying, or a combination of factors. These results help emphasize that VES are a helpful measure for quickly and cost-effectively determining general population status of SNYLF, but proper interpretation of the results requires consideration of the assumptions inherent with VES (Heyer et al. 1994).

In 2022, CDFW will again survey the entire Highland Lake drainage, including the lower stream segments. Additionally, if time allows, CDFW will survey further downstream of previously monitored portions of the Highland Lake outlet stream, to determine if there may be resident SNYLF occurring farther down the drainage. As with previous years, CDFW plans to attempt surveying the basin during calm conditions, particularly because the results of pre-translocation VES will dictate the number of adult SNYLF that may be collected for translocation to 4-Q Lakes in 2022.

SNYLF TRANSLOCATION

For complete details about the translocations of SNYLF from Highland Lake to 4-Q Lakes in 2018 and 2019, including background on the translocation recipient site, consult the survey memo for the 2019 Highland-4-Q Lakes VES and translocation (CDFW 2020). Described below is a summary of the previous translocation efforts.

Translocation Summary

CDFW has thus far conducted three translocations of adult SNYLF from Highland Lake to 4-Q Lakes (**Figure 7**). The first, which took place in July 2018, involved moving 60 adults (26 males and 34 females); the second, which took place in August 2019, involved moving 40 adults (18 males and 22 females); the third occurred in July 2021, and is described in detail below. During each translocation, staff intentionally collected a female-biased sample to increase the odds of successful reproduction at the recipient site.

Before each translocation, CDFW and ENF field staff conducted VES of the entire upper Highland Lake drainage to determine the current relative abundance of the SNYLF population (described in detail in the **HIGHLAND LAKE DRAINAGE SNYLF POPULATION STATUS: RESULTS** and **DISCUSSION** sections above). In general, the interagency technical team recommends removing no more than 10% of observed adults at the source population per year (MYLF ITT 2018, Attachment 3). Given high reproductive potential and the inability to detect all individuals during VES, the 10% threshold is likely conservative (MYLF ITT 2018, Attachment 3). Therefore, if field staff observed fewer than 200 adult SNYLF in the Highland Lake drainage, less than 20 adults could be collected for the translocation. Given the time, effort, and coordination needed to accomplish these actions, CDFW managers have decided that it may not be worthwhile to undertake a translocation with fewer than 20 adult SNYLF. Conversely, to allow for adequate time for capture, processing, and moving in the same day, CDFW decided to collect a maximum of 60 adult SNYLF per translocation action.

Translocation Methods

After VES on 28–29 June 2021 confirmed that the SNYLF population was robust enough to support removal of 51 adult SNYLF (**Figure 5**), CDFW and ENF staff mobilized for translocation efforts. Field crews began collecting adult SNYLF (individuals >40 millimeters SUL) the morning of 6 July 2021. Field staff collected adults via hand capture or dip nets (**Figure 8**), identified sex, implanted a passive integrated transponder (PIT) tag to provide a unique identifier for each individual, measured snout-to-urostyle (SUL) length (**Figure 9a**), and recorded weight (**Figure 9b**). In total, staff collected 51 adult SNYLF (for the translocation, staff collected individuals between 40 and 62 mm SUL, with an average length of 49 mm SUL for males and 52 mm SUL for females) from the northern shore of Highland Lake, Site ID 52648, and the southern shore of Site ID 13903 (approximately 10% of the adult population observed the previous week) (**Figure 4**). The 51 adult SNYLF were comprised of 28 females and 23 males.

Staff placed each frog into its own plastic container with multiple holes for ventilation (**Figure 10**) and stored the containers on snow in the shade to prevent frogs from overheating (**Figure 11**). Once the collection was complete, staff packed the contained frogs into hard-sided plastic bear-proof canisters. Staff then placed the canisters into backpacks, along with bagged snow and foam insulating pads, to maintain cool temperatures for the frogs during transport. Staff also placed digital temperature loggers inside of the canisters to provide constant temperature read-outs. Once securely packed, the field staff hiked the frogs for approximately 2 hours to 4-Q Lakes (**Figures 7 and 12**). Once at the site, staff released frogs at three different release points along the southern shore of the middle 4-Q Lakes (Site IDs 13922 and 13932; **Figures 13–15**). All frogs appeared healthy upon release.

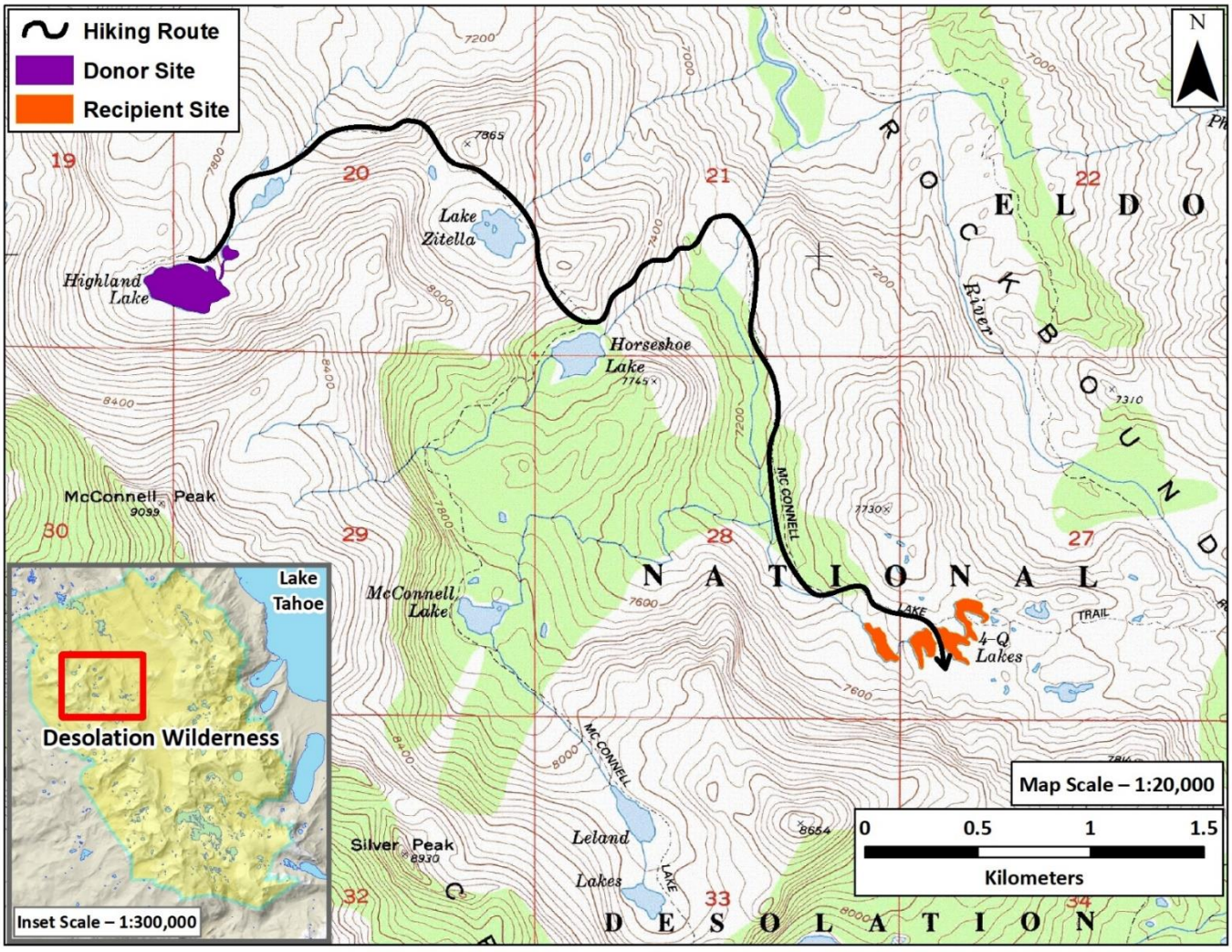


Figure 7. Path of travel for the Sierra Nevada Yellow-legged Frog (*Rana sierrae*) translocations from Highland Lake (donor site) to 4-Q Lakes (recipient site). Travel distance between the two sites via the route shown is approximately 6 kilometers (3.7 miles). The hike takes about two hours to complete.

Figure 8. A CDFW staff member, poised to capture Sierra Nevada Yellow-legged Frog (*Rana sierrae*) adults, during frog collection at Highland Lake on 6 July 2021. (CDFW)

Figure 9a. A CDFW staff member preparing to measure the snout-to-urostyle (SUL) length of an adult Sierra Nevada Yellow-legged Frog (*Rana sierrae*) at Highland Lake on 6 July 2021. (CDFW)

Figure 9b. A CDFW staff member weighing an adult Sierra Nevada Yellow-legged Frog (*Rana sierrae*) at Highland Lake on 6 July 2021. (CDFW)

Figure 10. An adult Sierra Nevada Yellow-legged Frog (*Rana sierrae*; SNYLF) inside its individual transport container. Field staff housed each adult SNYLF inside one of these containers, in which there were ventilation holes and a piece of wetted, unbleached paper towel to help retain moisture during transport. Lids with ventilation holes covered containers during storage and transport. (CDFW)

Figure 11. Adult Sierra Nevada Yellow-legged Frogs (*Rana sierrae*; SNYLF), housed inside plastic containers sitting inside hard-sided plastic bear canisters, awaiting translocation to 4-Q Lakes. Field staff kept SNYLF in the shade and on snow to remain cool during captivity. (CDFW)

Figure 12. California Department of Fish and Wildlife (CDFW) and Eldorado National Forest (ENF) field staff carrying Sierra Nevada Yellow-legged Frog (*Rana sierrae*) adults (housed individually inside bear canisters, inside backpacks) from the Highland Lake drainage to 4-Q Lakes on 3 July 2018. (CDFW)

Figure 13. California Department of Fish and Wildlife (CDFW) and Eldorado National Forest (ENF) staff releasing adult Sierra Nevada Yellow-legged Frog (*Rana sierrae*) at 4-Q lakes on 6 July 2021. (CDFW)

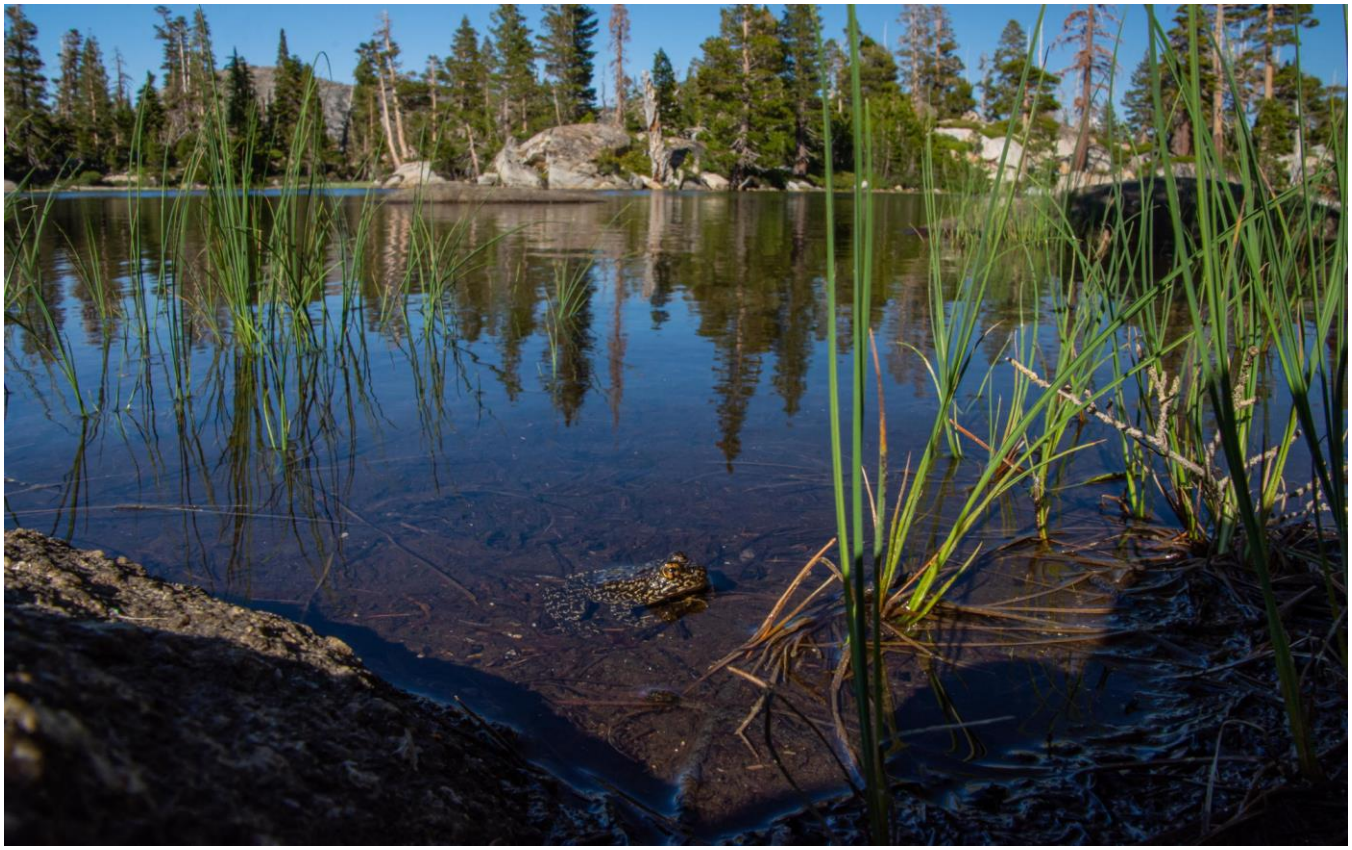


Figure 14. An adult Sierra Nevada Yellow-legged Frog (*Rana sierrae*) soon after being released at 4-Q Lakes on 6 July 2021.

Follow-up Surveys

During each summer from 2018–2021, CDFW staff conducted post-translocation surveys to assess if the frogs: 1) had moved from the original release sites, 2) appeared in good health, 3) were behaving normally, and 4) had successfully reproduced. In addition to the translocations, CDFW revisited 4-Q Lakes twice during each year, 2018–2021 (**Table 1**).

In 2021, CDFW surveyed 4-Q Lakes basin on 30 June (one week before the 2021 translocation) and 11 August (a little over one month after the 2021 translocation). During each visit, staff surveyed the main 4-Q Lakes, any nearby ponds that retained water (i.e., those within ~250 meters of the main lakes), and the outlet stream (**Figure 15**). In late June 2021, staff visited and surveyed all waterbodies shown in **Figure 15**. Additionally, staff surveyed the entire 4-Q Lakes outlet stream (heading out of frame to the west of Site ID 13928; **Figure 15**) to the confluence with the McConnell Lake outlet stream. However, by 11 August, many of the small ponds in 4-Q Lakes basin were dry, and the outlet stream was also dry. Therefore, although staff visited these locations to confirm desiccation, staff did not survey the dry locations.

CDFW staff observed 15 SNYLF individuals in late June (five males and 10 females) and 21 SNYLF individuals in August (three males and 18 females). Of the SNYLF adults observed in June, six were also captured in August. Therefore, combining both surveys, CDFW observed 30 (eight males and 22 females) SNYLF individuals in 2021. The two surveys in 2021 also marked the first time CDFW detected new adults in 4-Q Lakes. Staff captured and inserted PIT tags into two adults in June (one male, one female) and three adults in August (all females). The newly captured adults were young (one was 55 mm SUL, but the rest were 50 mm SUL or less). Subtracting the five newly marked adults, which were born at 4-Q Lakes, CDFW observed 25 of the 151 translocated SNYLF in 2021 (17%; **Table 1**). Of these 25 frogs, eight were translocated to 4-Q in 2018, 10 were translocated to 4-Q in 2019, and seven were translocated to 4-Q in 2021. When combining data for all follow-up surveys at 4-Q Lakes from 2018–2021, CDFW has observed 64 of the 151 released adult SNYLF individuals at least once (42%; **Table 1**).

In keeping with the female-skewed sex ratios for the releases, sex ratios among recaptures during follow-up surveys have been dominated by females. During post-translocation surveys from 2018–2021, CDFW has recaptured 39 of the females and 25 of the males that were translocated. These ratios among overall recaptures (1.56 females:1 male) closely correspond with the sex ratios of total released frogs (1.25 females:1 male). However, among recaptures in 2021, the sex ratios were highly female dominated, with a sex ratio of 2.6 females:1 male.

All frogs detected during follow-up surveys at 4-Q Lakes have appeared to be in good condition. Additionally, all recaptured SNYLF have grown substantially since their initial translocation, suggesting that the SNYLF are healthy and feeding well in their new habitat. Growth, in terms of increased SUL and mass, was particularly pronounced in females, which grew approximately twice as much as males (**Table 2**). These trends in growth patterns between the sexes were

consistent in individuals with data available for timespans of one-, two-, and three years between release and most recent capture (**Table 2**). On 11 August, staff recaptured six females that had been translocated on 6 July. In only 36 days, these females had increased in weight an average of 8 g and grown an average of 5 mm SUL. This average 36-day weight increase (8 g) is remarkably similar to the average one-year weight gain of eight different females for which the most recent recapture event was one year post release (9 g; **Table 2**).

SNYLF released at 4-Q Lakes have continue to disperse from their original release points and now occupy many areas in 4-Q Lakes basin (**Figure 15**). In 2021, CDFW staff observed SNYLF occupying several areas in which they had not been previously detected. These locations include a small, ephemeral pond east of Site ID 13922 (Upper 4-Q Lake); an ephemeral, marshy pond complex west Site ID 13928 (Lower 4-Q Lake); and a series of small, terraced, ephemeral ponds upslope and to the south of the main 4-Q Lakes (**Figure 15**). The frogs found at the former two locations were young, untagged adults, which suggests these individuals were likely born in one of the main 4-Q Lakes, and then dispersed to new habitats following metamorphosis. For further details on early life stage SNYLF, see the ***Reproduction*** section below.

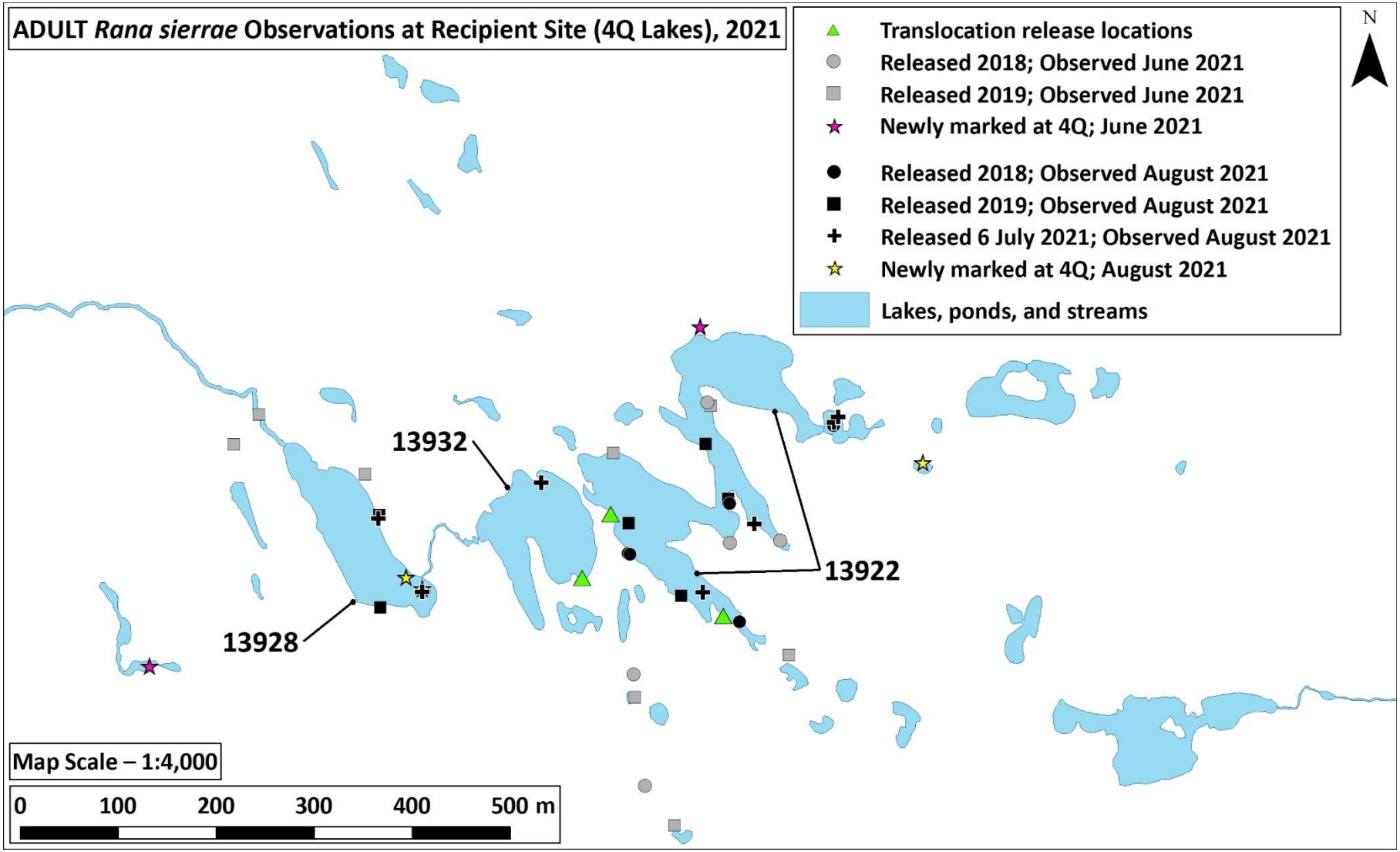


Figure 15. [See figure caption on the next page.]

Figure 15 (continued). Map showing locations of all adult Sierra Nevada Yellow-legged Frog (*Rana sierrae*; SNYLF) individuals detected by California Department of Fish and Wildlife (CDFW) field staff during visual encounter surveys (VES) in 2021. Number labels shown are unique site identification codes that CDFW uses for data collection. As of 2021, CDFW included a small, ephemeral pond into the survey area that was previously excluded (pond at southwest corner of the map). The map shows locations where adult SNYLF translocated from Highland Lake were released in 2018 (n = 60; 26 males, 34 females), 2019 (n = 40; 18 males, 22 females), and 2021 (n = 51; 23 males, 28 females) (green triangles).

During each survey at 4-Q Lakes, CDFW staff visited every pond shown in this map. Additionally, in June 2021, CDFW staff surveyed down the basin outlet stream (exiting the figure to the west), to the confluence with the outlet of McConnell Lake. In 2021, staff did not detect any SNYLF in the downstream portion of the outlet stream, so that section is excluded from the map. Most of the small ponds shown in this map dry by late summer. Summer 2021 was far drier than average, so many of the small ponds shown were completely dry during the site visit on 11 August 2021. CDFW suspects these dry conditions are the primary reason all August SNYLF detections occurred at the main lakes.

CDFW conducted surveys on 30 June 2021 (grey shapes and pink stars) and 11 August 2021 (black shapes and yellow stars). CDFW staff observed 15 SNYLF individuals in June (grey circles indicate frogs released in 2018, grey squares indicate frogs released in 2019, pink triangles indicate newly detected young adult frogs born at 4-Q) and 21 SNYLF individuals in August (black circles indicate frogs released in 2018, black squares indicate frogs released in 2019, black crosses indicate frogs released in 2021, and yellow triangles indicate newly detected young adult frogs born at 4-Q). Of the SNYLF observed in June, six were also captured in August. Five of the young adult frogs that CDFW detected in 2021 were previously unmarked and, therefore, new individuals born at 4-Q Lakes. Therefore, combining both surveys, CDFW recaptured 25 of the 151 total released adult SNYLF (17% of released frogs) in 2021.

Table 1 (see next page). Dates of Sierra Nevada Yellow-legged Frog (*Rana sierrae*; SNYLF) translocations and follow-up surveys at 4-Q Lakes, Desolation Wilderness, between 2018 and 2021; and number of adult SNYLF translocated or recaptured during each event. SNYLF numbers shown in each row (females, males, and total) are the number of unique individuals recaptured during that site visit (i.e., not capture events, since some SNYLF individuals were caught more than once during each visit). The grand total row (in yellow) displays the sum of SNYLF individuals recaptured at least once since the first follow-up survey in July 2018 and all newly marked SNYLF. In total, CDFW has moved 151 adult SNYLF from the Highland Lake drainage to 4-Q Lakes between 2018 and 2021. Of those 151 translocated frogs, CDFW has recaptured 64 individuals (42% of all translocated adults) at least once during post-translocation follow-up surveys at 4-Q Lakes.

*For tallies in 2020 showing the original year of translocation (in grey), CDFW does not know the release year of two individuals because one had an unreadable passive integrated transponder (PIT) tag and another had a PIT tag number that was not originally recorded among translocated frogs. (The different PIT tag number is likely attributable to user and/or equipment error during the tagging and recording process.)

Table 1. (continued).

Year	Dates	Females	Males	Total	Notes
2018	**3 July**	**34**	**26**	**60**	**Translocation #1**
2018	17–18 July	5	7	12	
2018	21 Aug	13	2	15	
2018		***14***	***8***	***22***	***Total individuals observed in 2018***
2019	6 Aug	5	4	9	
2019	**8 Aug**	**22**	**18**	**40**	**Translocation #2**
2019	4 Sept	10	9	19	
2019	*4 Sept*	*2*	*2*	*4*	*Frogs released in 2018; all 4 also seen on 6 Aug 2019*
		8	*7*	*15*	*Frogs released in 2019*
2019		***13***	***11***	***24***	***Total individuals observed in 2019***
2020	16–17 June	14	6	20	
2020	11–12 Aug	10	6	16	
2020	*Combined*	*4*	*2*	*6*	*Frogs released in 2018*
		15	*7*	*22*	*Frogs released in 2019*
		1	*1*	*2*	*Frogs with unknown release year *(see table heading on previous page)*
2020		***20***	***10***	***30***	***Total individuals observed in 2020***
2021	30 June	10	5	15	
2021	**6 July**	**28**	**23**	**51**	**Translocation #3**
2021	11 Aug	18	3	21	
2021	*Combined*	5	3	8	*Frogs released in 2018*
		7	3	10	*Frogs released in 2019*
		6	1	7	*Frogs released in 2021*
		4	1	5	*Newly tagged*
2021		***22***	***8***	***30***	***Total individuals observed in 2021***
	2018–2021	***17***	***11***	***28***	***Frogs released in 2018***
		15	***12***	***27***	***Frogs released in 2019***
		6	***1***	***7***	***Frogs released in 2021***
		4	***1***	***5***	***Newly tagged***
		1	***1***	***2***	***Frogs with unknown release year *(see table heading on previous page)***
		43	***26***	***69***	***Grand total individuals recaptured or newly tagged at 4-Q: 2018–2021***

Table 2. Average one, two, and three-year growth summary statistics—partitioned by sex (F = female, M = male)—for adult Sierra Nevada Yellow-legged Frogs (*Rana sierrae*; SNYLF) translocated from Highland Lake to 4-Q Lakes. Measurements displayed are original ("trans." = measurement on the day of translocation) and most recent ("latest" = measurement taken during the most recent recapture event) average snout-to-urostyle length (SUL, in millimeters [mm]) and average weight (mass, in grams [g]) of unique individuals recaptured in 2020* (see note below table) and 2021 for which California Department of Fish and Wildlife (CDFW) had original measurements. Both SUL and mass have a column showing the difference between the original and most recent measurements of each row ("diff."). The first column displays the number of individual SNYLF measurements incorporated in each average value within a row. All adult SNYLF measured had grown substantially since being translocated. On average, for any given period of growth (one, two, or three years), females grew approximately twice as much as males since translocation, in both SUL and mass. The final row displays the difference in measurements for six female SNYLF translocated on 6 July 2021 and recaptured on 11 August 2021. In that one-month period, these females grew an average of 5 mm SUL and gained 8 g. Only one male translocated on 6 July 2021 was recaptured on 11 August 2021. Therefore, the table does not include an average one-month growth for males. That one male had increased 2.5 mm in SUL (within the potential margin of error for measuring bias between different observers) and was the same weight in both July and August.

sex (years of growth); sample size	SUL (trans.)	SUL (latest)	SUL (diff.)	Mass (trans.)	Mass (latest)	Mass (diff.)
F (3); n = 5	49 mm	75 mm	+26 mm	17 g	55 g	+38 g
M (3); n = 3	50 mm	63 mm	+13 mm	15 g	32 g	+17 g
F (2); n = 10	53 mm	72 mm	+19 mm	19 g	45 g	+26 g
M (2); n = 4	53 mm	61 mm	+8 mm	18 g	28 g	+10 g
F (1); n = 8	54 mm	64 mm	+10 mm	20 g	29 g	+9 g
M (1); n = 6	51 mm	58 mm	+7 mm	17 g	21 g	+4 g
F (*1 month*); n = 6	56 mm	61 mm	+5 mm	21 g	29 g	+8 g

*CDFW omitted two individuals recaptured at 4-Q Lakes in 2020 because one had an unreadable passive integrated transponder (PIT) tag and another had a PIT tag number that was not originally recorded among translocated frogs. (The unrecorded PIT tag number is likely attributable to user and/or equipment error during the tagging and recording process.)

Reproduction

Detecting SNYLF reproduction at 4-Q Lakes is one of CDFW's principal goals of this translocation project. Fortunately, in June 2020, field staff observed a recently hatched SNYLF egg mass at Site ID 13922 and one large tadpole, which evaded follow-up detection. During the second visit in August, CDFW staff observed more early life stage SNYLF, including at least five tadpoles and 14 subadults. The total number of tadpoles and subadults is not known because these life stages are unmarked. However, when totaling counts of early life stage SNYLF detections from one pass of each waterbody during the same survey day, the total is 5 larvae and 14 subadults.

Observations of early SNYLF life stages continued in 2021. During both follow-up survey visits, staff observed numerous subadults (**Figures 16a–c**). The precise number of subadults is unknown because: 1) early life stages are unmarked (i.e., unique individuals cannot be identified), 2) staff were split into two teams during surveys, and 3) teams surveyed some locations multiple times on the same day. However, based on the way surveys were allocated between teams, and based on GPS coordinates for subadult detections, CDFW can determine the minimum count of subadult individuals observed on each survey day. Therefore, staff detected at least 12 subadults in June; and at least 27 subadults in August (**Figure 17**). Staff did not detect SNYLF tadpoles in 2021. However, CDFW has found that the lack of SNYLF tadpole detections is common during VES in the northern Sierra Nevada, particularly in populations with relatively low SNYLF densities.

These early life stage observations are particularly exciting because they provide definitive evidence that the newly established SNYLF population at 4-Q Lakes is successfully reproducing. Additionally, the presence of subadults in 2020 and 2021 strongly suggests that reproduction first occurred at 4-Q Lakes in early 2019 (given that SNYLF often require at least one winter before metamorphosis), which was the first opportunity that newly translocated SNYLF would have been able to breed. The SNYLF breeding season typically occurs in late spring/early summer (depending on conditions at the site). Therefore, SNYLF translocated in summer 2018 would not have first bred until late spring 2019 at the earliest. The young subadult observations in 2021 demonstrate that additional successful breeding also occurred in 2020.

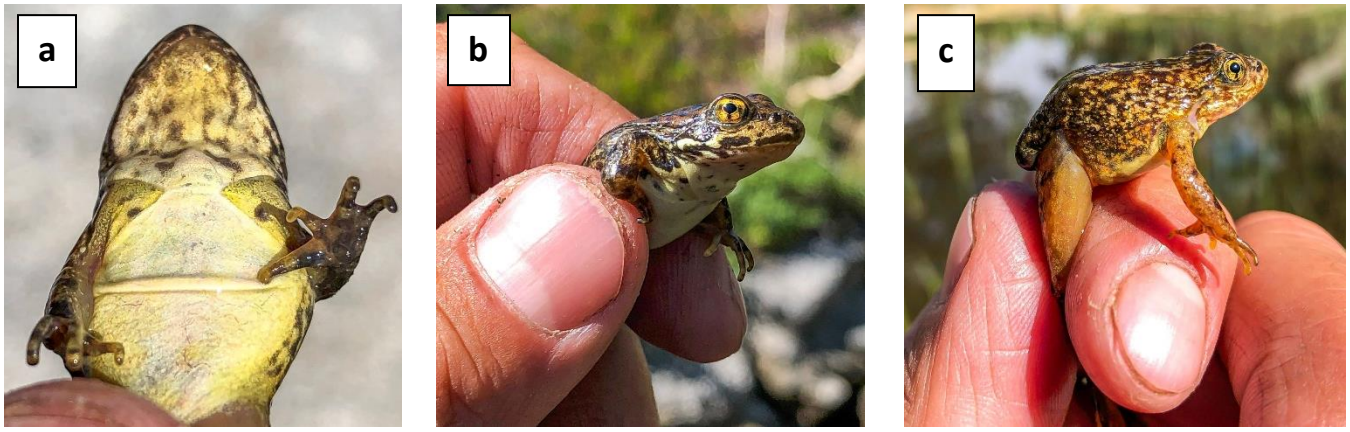


Figure 16a–c. Three subadult *Rana sierrae* observed at 4-Q Lakes on 11 August 2021. (CDFW)

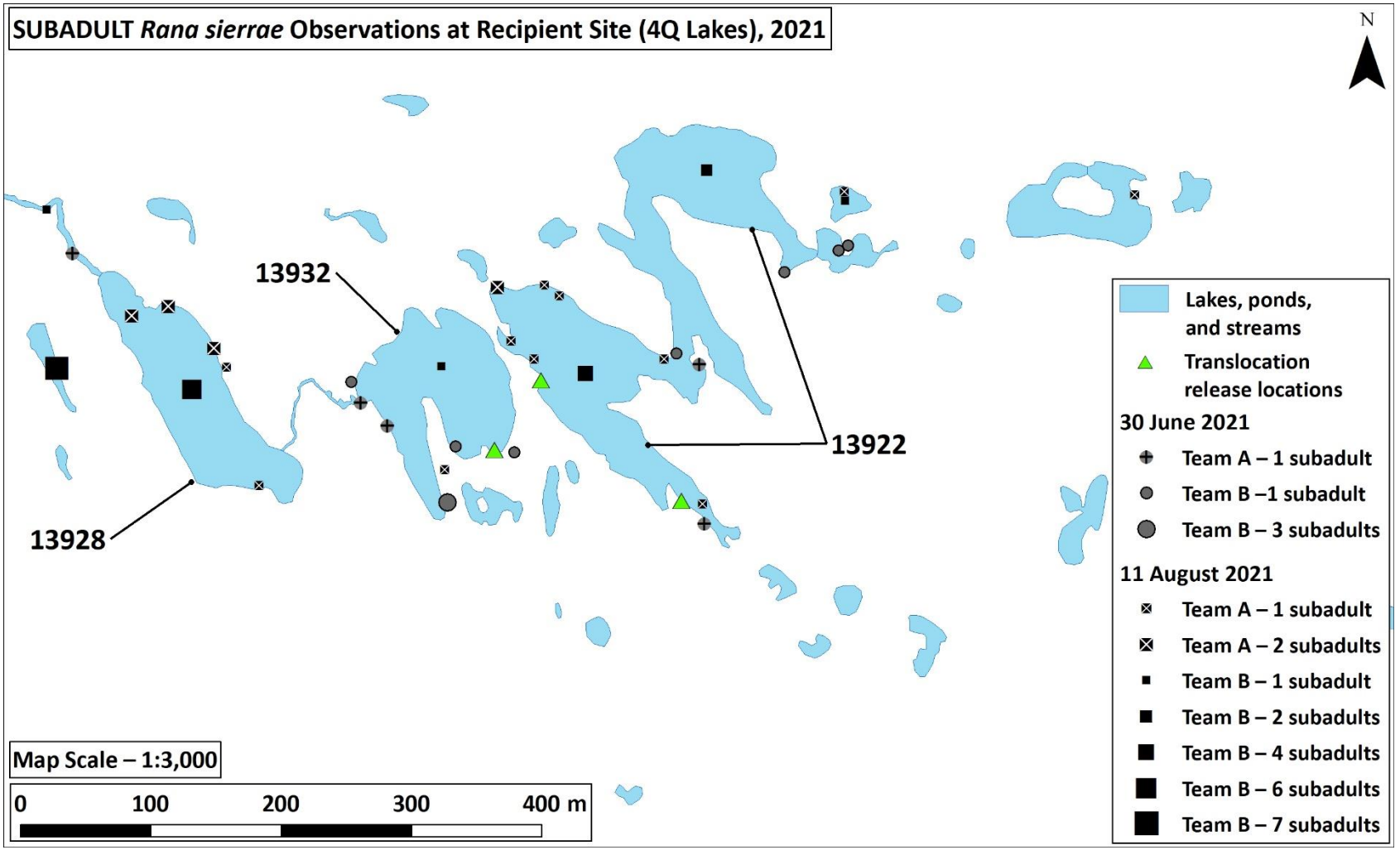


Figure 17. Locations of subadult Sierra Nevada Yellow-legged Frogs (*Rana sierrae*; SNYLF) detected by CDFW staff in summer 2021. Symbology is broken up by survey team (A or B), date of survey (30 June or 11 August), and number of subadults at each location. Symbols are sized in general proportion to the number of subadults detected at each location, where smaller symbols indicate one subadult, and larger symbols indicate more subadults, up to n = 7. In August, Team B did not record precise coordinates for all subadult detections, but instead documented the Site ID where they located subadults. Therefore, the Team B detections in August are centered in the middle of the waterbody to reflect that the precise detection location is unknown.

Looking ahead: 2022

In 2022, CDFW and ENF staff plan to visit Highland Lake in early summer to survey the drainage and obtain current information on the relative abundance of SNYLF in the basin. These surveys will determine how many adults may be available for a fourth translocation. If field staff observe at least 200 adults in the Highland Lake drainage, CDFW will undertake another translocation, using the same methods described earlier. The current Section 6 grant will also provide funding for consistent follow-up surveys annually through 2023 to maintain detailed demographic information on 4-Q Lakes populations. CDFW also has a State Wildlife Grant (SWG) application submitted, which, if selected for funding, will provide CDFW with the resources to continue monitoring at Highland and 4-Q Lakes through 2025.

For each adult captured during monitoring visits to 4-Q Lakes, staff will record PIT tag, sex, location coordinates, weight, and length measurements (staff will only record weight and length measurements once per site visit for each individual). Now that new SNYLF recruitment is occurring, CDFW will continue PIT-tagging any new adults observed at 4-Q Lakes. These data will be used for capture-mark-recapture (CMR) analysis to determine abundance and survivorship in the SNYLF population more accurately (Mazerolle et al. 2007). CDFW plans to visit 4-Q Lakes at least twice following the translocation planned for 2022. Correspondingly, if field staff unexpectedly find that the number of adult SNYLF available in the Highland Lake drainage is below the threshold needed to undertake a fourth translocation without risking harm to the source population, CDFW will still carry out monitoring surveys at 4-Q Lakes. Given the conservation importance of this population, CDFW needs current information obtained by yearly monitoring.

Other notable observations

CDFW and ENF staff documented two additional noteworthy observations during site visits to 4-Q Lakes in 2021.

First, CDFW staff detected a large adult female SNYLF (**Figure 18**) with what appeared to be a broken right femur (**Figure 19**). The cause of the injury is unknown. However, the injury appeared to be recent (i.e., both legs were robust, similar in size, and the break appeared to be clean and unhealed). This female could still hop and swim, but clearly with greater difficulty than normal. This individual is the largest SNYLF that staff have recaptured at 4-Q Lakes since the translocation effort began in 2018. This frog was originally moved to 4-Q Lakes on 3 July 2018. At the time of translocation, she was 44 mm SUL and weighed 13 g. During this recapture event on 11 August 2021, she was 75 mm SUL and weighed 76 g: a three-year growth of 31 mm SUL and 63 g. That weight gain puts this female far above the average for other females released in 2018 that were also recaptured in 2021 (**Table 2**, first row in green).

Figure 18. A very large adult female *Rana sierrae* recaptured by staff on 11 August 2021. This individual was found with a broken right femur.

Figure 19. Close up, ventral, thigh view of the female frog shown in Figure 18. Location of the break is circled in red.

Second, during late afternoon following the translocation on 6 July 2021, an ENF staff member, who assisted CDFW with the translocation, detected a Mountain Gartersnake (*Thamnophis elegans elegans*) feeding on one of the recently translocated SNYLF (**Figures 20–23**). At the time of release, CDFW staff did not have PIT tag readers available (the readers remained at the Highland Lake source site during the translocation), so staff were unable to determine the individual ID of the frog. Given this incident, during translocation in 2022, CDFW will have a PIT tag reader available at the 4-Q Lakes recipient site, in the event staff detect another predation event soon after the translocation. Following the photographs shown below, the gartersnake released the frog, likely due to disturbance by the photographer. However, the snake probably returned, and CDFW suspects the SNYLF did not survive for long after this encounter.

On a related note, during the site visit on 11 August 2021, staff observed another *T. e. elegans* preying on a female SNYLF that had been translocated the month before. On this occasion, staff were able to collect the PIT tag of the frog, which survived the initial encounter. However, staff do not know the ultimate fate of that frog, which may have succumbed to injury and/or stress from the event or been consumed upon return of the snake.

CDFW staff often observe gartersnakes, including Mountain Gartersnakes, Sierra Gartersnakes (*Thamnophis couchii*), and Valley Gartersnakes (*Thamnophis sirtalis fitchi*), during VES throughout the Sierra Nevada. Gartersnakes are known to prey on SNYLF and Sierran Chorus Frogs (*Hyliola* [*Pseudacris*] *sierra*) (Jennings et al. 1992, Matthews et al. 2002); therefore,

gartersnake predation on amphibians is a natural and expected event (CDFW staff, pers. obs.; T.C. Smith, unpubl. data). Staff have often observed gartersnakes at 4-Q Lakes: for example, one staff member observed nine gartersnakes of three different species on 11 August 2021. In another example of observed predation, CDFW staff and researchers have seen gartersnakes preying on SNYLF in Desolation Wilderness, including at another translocation site on Lake Tahoe Basin Management Unit land (I. Chellman, S. DeCurtis, J. Imperato, R. Knapp, and T.C. Smith; pers. obs.). In one notable example from that area, CDFW staff observed an adult *T. couchii* preying on a young adult SNYLF on 1 September 2020. Staff extracted the frog, which was still alive, to collect PIT tag data and morphological measurements (the frog turned out to be a San Francisco Zoo-reared frog that staff had released at the site in June 2020). Staff released the frog at the point of capture, at which time the gartersnake was no longer visible. During the next circumnavigation of the lake that same afternoon, staff observed an adult *T. e. elegans* consuming the same frog, which was by that time deceased.

Figure 20. An adult *Thamnophis elegans elegans* preying on a recently translocated *Rana sierrae* at 4-Q Lakes on 6 July 2021. (Figures 20–23 are in chronological order during the event; CDFW)

Figure 21. An adult *Thamnophis elegans elegans* preying on a recently translocated *Rana sierrae* at 4-Q Lakes on 6 July 2021. (Figures 20–23 are in chronological order during the event; CDFW)

Figure 22. An adult *Thamnophis elegans elegans* preying on a recently translocated *Rana sierrae* at 4-Q Lakes on 6 July 2021. (Figures 20–23 are in chronological order during the event; CDFW)

Figure 23. An adult *Thamnophis elegans elegans* preying on a recently translocated *Rana sierrae* at 4-Q Lakes on 6 July 2021. Soon after this photograph was taken, the gartersnake regurgitated the partially consumed frog. (Figures 20–23 are in chronological order during the event; CDFW)

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