

State of California
Department of Fish and Wildlife

Memorandum

Date: 16 March 2022

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North Central Region Fisheries

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

Cc: Region 2 Fish Files

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Subject: Native amphibian monitoring in Desolation Wilderness;
• *Rana sierrae* monitoring in the Clyde Lake drainage: 2021 update.



SUMMARY

Clyde Lake is a small, high mountain lake in Desolation Wilderness, El Dorado County, which forms the headwaters of the Rubicon River drainage (**Figure 1**). California Department of Fish and Wildlife (CDFW) staff removed introduced trout from 2012–2016 to benefit a small, extant population of Sierra Nevada Yellow-legged Frogs (*Rana sierrae*, SNYLF; **Figure 2**). Amphibian monitoring data from 2003–2021 suggest a persistent, small SNYLF population. CDFW will continue amphibian monitoring at least biennially to document SNYLF response to fish removal.

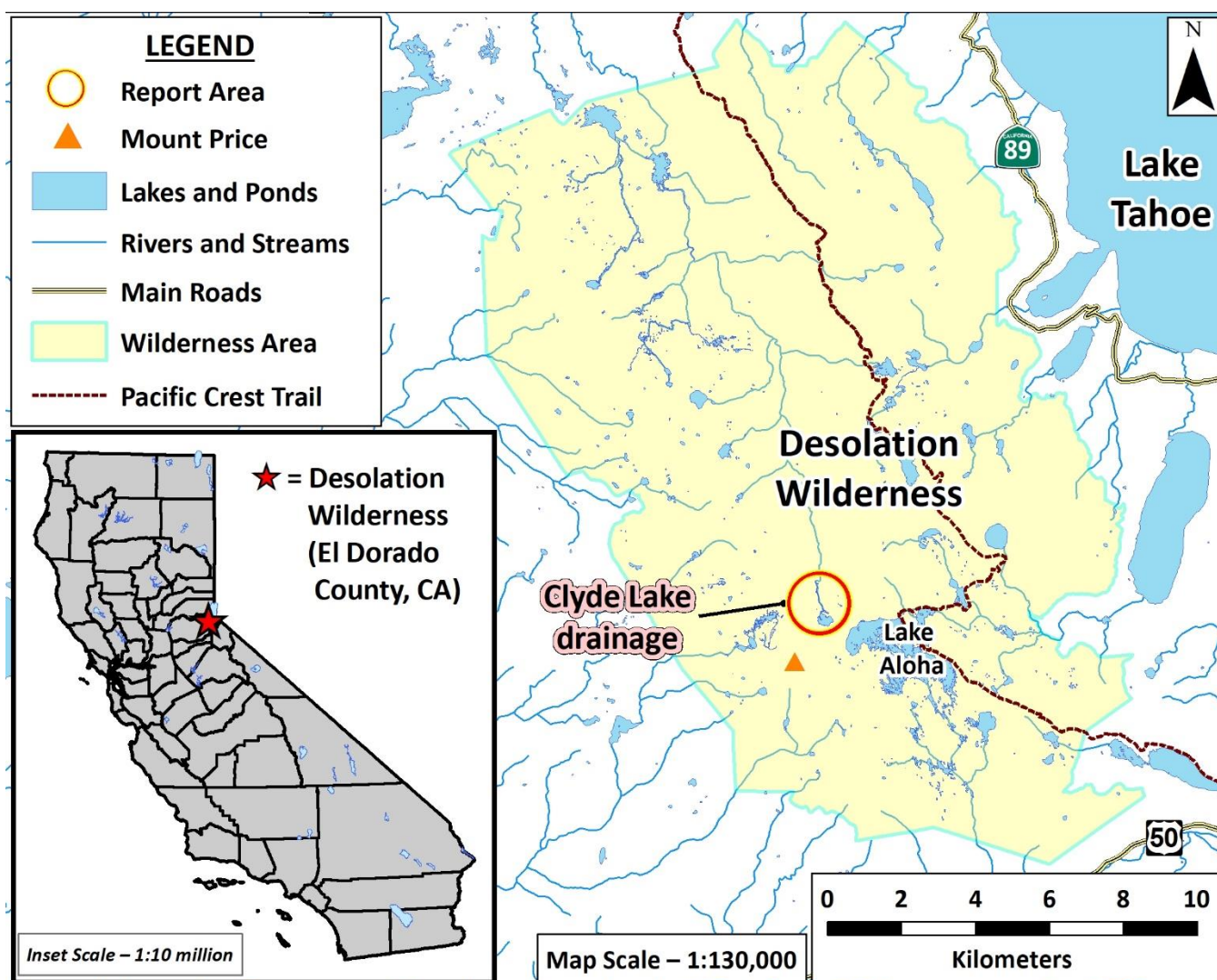


Figure 1. Desolation Wilderness, El Dorado County, CA. The area discussed in this memorandum is circled.

ENVIRONMENTAL SETTING

Clyde Lake is located in El Dorado County, in the Desolation Wilderness, within the Lake Schmidell Planning Watershed (PWS) at approximately 8,000 feet (2,438 meters) in elevation. The outlet of Clyde Lake eventually becomes the Rubicon River, draining north from Desolation Wilderness to Hell Hole Reservoir, and ultimately to the Middle Fork American River. Eldorado National Forest (ENF) manages this section of Desolation Wilderness and the surrounding land. Clyde Lake is accessed via the Rubicon Trail, which branches off to the west from the Pacific Crest Trail at the northern end of Desolation Valley (**Figure 1**).

INTRODUCTION

The Aquatic Biodiversity Management Plan (ABMP) for the Desolation Wilderness Management Unit identifies the Clyde Lake drainage as a Native Species Reserve (NSR) for SNYLF (CDFG 2012). Additionally, the ABMP identifies the outlet of Clyde Lake and adjacent ponds for fish removal. These habitats supported a small, self-sustaining Golden Trout

(*Oncorhynchus aguabonita*; GT) population. The NSR consists of Clyde Lake (Site ID 14149; **Figure 3**), three unnamed outlet ponds (Site IDs 14142, 14143, and 66159), all of which support SNYLF (**Figure 2**), and approximately 1.5 kilometers (km) of stream habitat (Site IDs 50393, 52672, 51067, 66164 and 66165), most of which are occupied by SNYLF (**Figure 4**).

CDFW stocked Clyde Lake with trout from 1932 until 2000. In the early days of stocking, Rainbow Trout (*Oncorhynchus mykiss*) were the primary species, but CDFW planted only GT from 1962 onward. The lake contains limited spawning habitat and GT eventually died off after aerial stocking ceased in 2000. In 1936, CDFW constructed a stonemasonry streamflow maintenance dam at the outlet (CDFG 1980). The dam formed a barrier to fish moving from the outlet stream into the lake, thereby further reducing spawning potential. Gill net surveys in 2008 and 2010 indicated that GT were no longer present in Clyde Lake, but the outlet stream still supported self-sustaining trout. As a result, CDFW decided to eradicate the remaining fish in the outlet stream down to a barrier to upstream fish migration, located approximately 1.5 km below Clyde Lake, and manage the area for SNYLF (CDFG 2012).

Beginning in 2012, CDFW began removing GT from the Clyde Lake outlet stream and associated stream pools to benefit SNYLF. As of 2016, CDFW believes the Clyde Lake NSR is fishless. However, CDFW will continue to survey regularly to monitor SNYLF population status and trends. CDFW staff will also occasionally monitor the site for latent non-native trout. Those interested in learning more details about fish removal in the Clyde Lake drainage may consult the 2018 Clyde Lake survey memo (CDFW 2018). Now fishless, CDFW manages Clyde Lake, the outlet stream, and associated ponds as SNYLF breeding habitat.



Figure 2. An adult Sierra Nevada Yellow-legged Frog (*Rana sierrae*) at Clyde Lake on 6 August 2017. (CDFW)



Figure 3. Clyde Lake (center foreground), as viewed from the saddle between Clyde and Island Lakes, in summer 2020, looking east. On the far right, Lake Aloha and Heather Lake are visible in the distance. (J. Imperato)

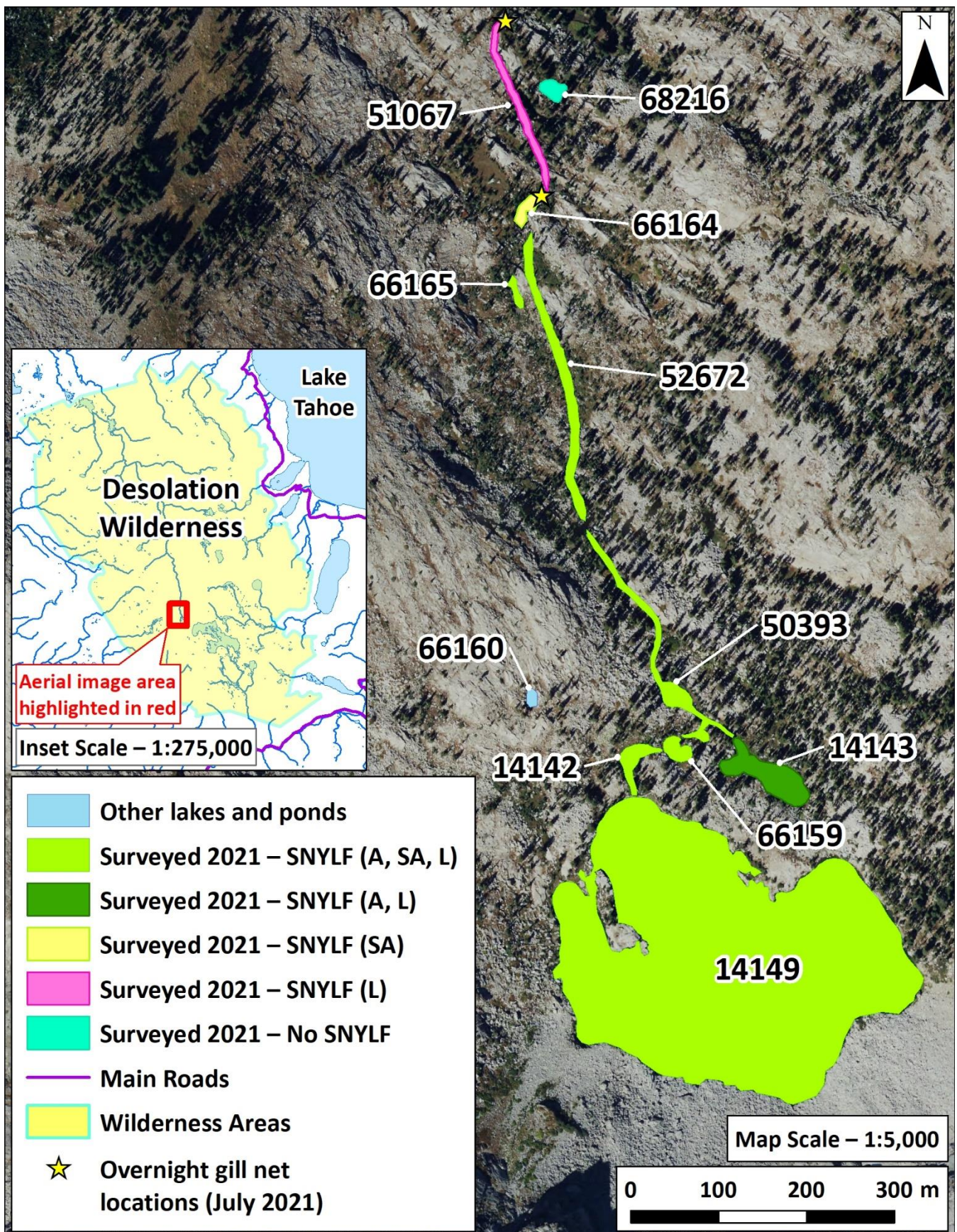


Figure 4. [See figure caption at the beginning of the next page.]

Figure 4 (continued). Clyde Lake drainage, Desolation Wilderness, CA. California Department of Fish and Wildlife (CDFW) staff have consistently observed Sierra Nevada Yellow-legged Frogs (*Rana sierrae*; SNYLF) in the main lake, outlet stream, and adjacent ponds. 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. Clyde Lake and the surrounding drainage forms the headwaters of the Rubicon River, which flows into Rubicon Reservoir (not shown).

THREATS

Introduced Fish

Trout prey on SNYLF and are a potential source of competition for food (e.g., benthic macroinvertebrates). Following fish removal efforts, trout are no longer present in the NSR. However, trout are still present immediately below the barrier that demarcates the downstream end of the NSR. Illegal movement of trout into the stream channel above the barrier, the NSR ponds, or Clyde Lake presents a potential extirpation risk for SNYLF. However, the immediate threat from trout predation has been mitigated through fish removal efforts.

Disease

The Clyde Lake SNYLF population is positive for chytrid fungus (*Batrachochytrium dendrobatidis*; *Bd*). CDFW sampled SNYLF in the Clyde Lake NCR in 2008, 2010, and 2012 using epithelial swabs and had the swabs screened for the presence of *Bd* DNA using real-time quantitative polymerase chain reaction (qPCR) analysis. In total during the three sampling years, staff collected 12 swabs, and results detected very light to moderate *Bd* infection intensity.

Loss of Genetic Diversity

Monitoring data suggest that the Clyde Lake SNYLF population was very small and only recently underwent expansion. 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 Clyde Lake population during the time-period when it was smallest is unknown. Population genetic analyses are necessary to estimate the degree of genetic bottlenecking, if any.

Marginal Habitats

With the exception of Clyde Lake and Site ID 14143 (**Figure 4**), the SNYLF population is persisting in habitats with very little water. Any disturbance, natural or otherwise, that changes the hydrology or limnology of the two deep water habitats poses a potential extirpation risk to the population. Natural deterioration of the Clyde Lake dam (potentially causing changes to streamflow in shallow habitats below), severe winter conditions, extended drought, or anthropogenic habitat disturbances are some of the potential risks.

POPULATION STATUS

Nineteen years of visual encounter survey (VES) data indicate the population is relatively small, but data collected since 2012 suggest a stable population (**Figures 5 and 6**). Observer bias, variation in survey conditions, and relatively low number of detections all make deriving trends difficult (Mazerolle et al. 2007). Large variation in the numbers of adults observed could be due to multiple factors, such as: 1) CDFW increased the number of areas surveyed in 2012, by including 1.5 km of stream habitat and three large pools; 2) the habitat is complex and difficult to survey; 3) there is true variation in the population due to various environmental and demographic influences.

Clyde Lake was fishless during CDFW gill net surveys in 2003, 2008, and 2010. In 2000, CDFW planted 5,000 GT in Clyde Lake. During the survey in 2003, CDFW crews observed 30 adult, 13 subadult (**Figure 5**), and 368 larval SNYLF (**Figure 6**) in Clyde Lake and the nearby Site ID 14143. Crews conducted additional surveys of Clyde Lake and the nearby pools in summer 2005, 2008, and 2010 (**Figures 5 and 6**). In 2012, CDFW surveyed approximately 1.5 km of Clyde Lake outlet stream for the first time, in which crews observed six SNYLF adults, 28 subadults, and four larvae.

On July 3, 2013, crews surveyed Clyde Lake, 14142, 14143, and 66159 for SNYLF (**Figures 5 and 6**), but did not survey the stream reaches. August 28–29, 2014, crews surveyed all sites in the NSR. Crews completed most surveys on the 28th during good survey conditions. However, crews surveyed Clyde Lake on the 29th during poor survey conditions, which may explain the low numbers of larvae observed (**Figure 6**). In July 2015, crews observed a large SNYLF larva in site 66164; this is the first larva observed in the lower stream since 2012. During July 27–28, 2016, CDFW crews surveyed all sites in the NSR and recorded the largest number of individuals observed in the basin since surveys began in 2003 (**Figures 5 and 6**). Forty-seven of the larvae were observed in the lower stream reaches, from which crews had recently removed fish. These observations suggest that breeding in these areas may be more successful in the absence of fish. On August 30, 2017, crews surveyed Clyde Lake and Site ID 14142. CDFW surveyed the entire NSR on August 15, 2018, and detected more SNYLF larvae than during any survey effort since baseline surveys in 2003 (**Figure 6**).

In 2021, CDFW staff surveyed the entire Clyde Lake NSR (**Figure 4**). Staff observed fewer adults and tadpoles when compared with more recent survey years (2016–2018; **Figures 5 and 6**), but staff detected a relatively high number of subadults when compared with other surveys of the drainage (**Figure 5**). The lower counts of adults and tadpoles may be due to multiple factors, such as those discussed at the beginning of this section. In addition to VES, staff set two monofilament gill nets overnight (16–17 July 2021) into large pools toward the downstream end of the Clyde Lake NSR (Site IDs 51067 and 66164; **Figure 4**, yellow stars). These overnight gill net sets resulted in zero trout captures. CDFW plans to return to the Clyde Lake drainage in summer 2022 to continue monitoring the SNYLF population.

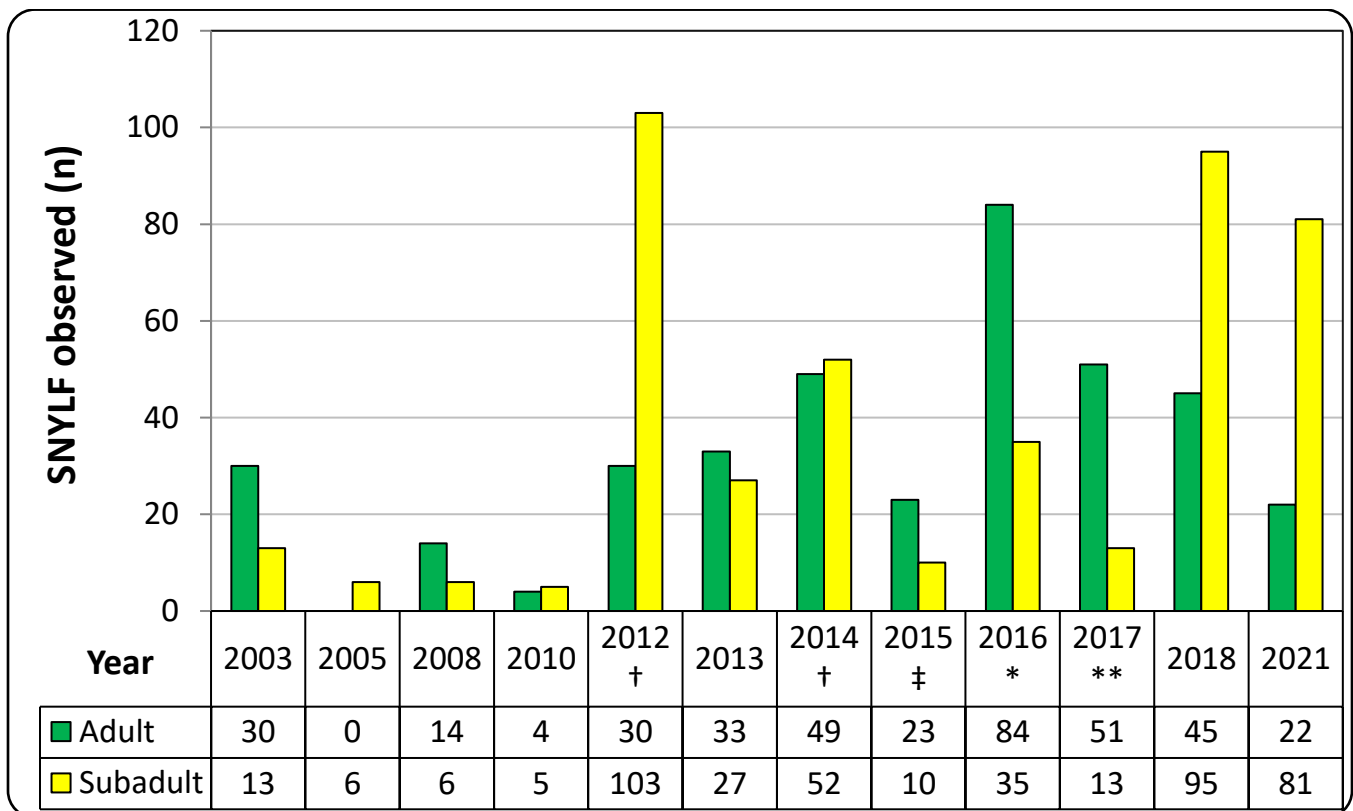


Figure 5. VES data for adult and subadult SNYLF in the Clyde Lake drainage from 2003 to 2021. CDFW surveyed Clyde Lake and Site ID 14143 each survey year from 2003–2010. Beginning in 2008, CDFW added Site ID 14142 to surveys. From 2008 onward, crews surveyed all three sites (14142, 14143, and Clyde Lake) during each VES, except for 2015 (when staff only surveyed the Clyde Lake outlet section) and 2017, when crews did not survey Site ID 14143. In 2018 and 2021, CDFW staff surveyed the entire Clyde Lake Native Species Reserve (NSR).

Symbol notations: [†]2012 and 2014 surveys also include additional surveying along Clyde Lake’s outlet and associated downstream ponds (2012: 1 adult, 23 subadults, 4 larvae; 2014: 28 adults, 19 subadults). [‡]2015 surveys only include a 1-km reach of Clyde Lake’s outlet and the associated ponds. ^{*}2016 surveys included the entire NSR, from Clyde Lake down to the barrier. ^{**}2017 surveys only included Clyde Lake and Site ID 14142. Counts were summed across all sites and the totals are displayed.

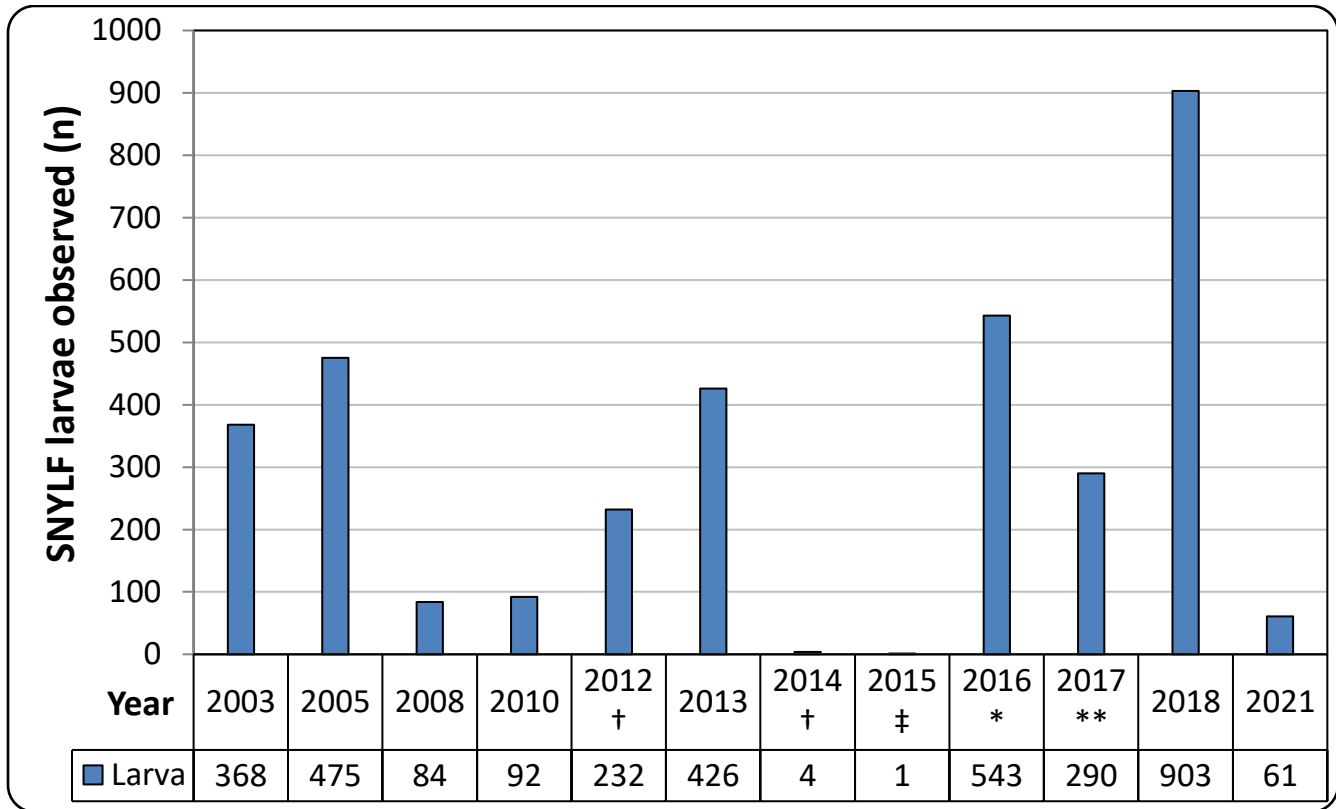


Figure 6. VES data for larval SNYLF in the Clyde Lake drainage from 2003 to 2021. CDFW surveyed Clyde Lake and Site ID 14143 each survey year from 2003–2010. Beginning in 2008, CDFW added Site ID 14142 to surveys. From 2008 onward, crews surveyed all three sites (14142, 14143, and Clyde Lake) during each VES, except for 2015 (when staff only surveyed the Clyde Lake outlet section) and 2017, when crews did not survey Site ID 14143. In 2018 and 2021, CDFW staff surveyed the entire Clyde Lake Native Species Reserve (NSR).

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