

Memorandum

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**Subject: Native aquatic resource assessment in the Black Buttes area
(Grouse Ridge Non-motorized Area, Tahoe National Forest, Nevada County)**

- **Five Lakes Basin *Rana sierrae* and fish monitoring.**
- **Site assessment to determine feasibility of non-native trout removal for *Rana sierrae* restoration**

INTRODUCTION

This memorandum (memo) encompasses surveys from three areas in the Grouse Ridge Non-Motorized Area of Tahoe National Forest, Nevada County (Figure 1), collectively referred to as the “Black Buttes Area”: Five Lakes Basin; the French Lake Ponds; and the Mont/Kaneen Lakes Area (Figure 2). California Department of Fish and Wildlife (CDFW) manages fish and wildlife resources at these locations as part of the Aquatic Biodiversity Management Plan for the South Yuba River Management Unit (ABMP; CDFW 2014).

Within the ABMP, CDFW identifies all three areas discussed in this memo as Native Species Reserves (NSR) for SNYLF, and highlights Five Lakes Basin as a priority area for non-native fish removal to help reestablish Sierra Nevada Yellow-legged Frogs (*Rana sierrae*; SNYLF) (CDFW 2014, pgs. 58–60). In early 2019, CDFW sought funding, in collaboration with Tahoe National Forest (TNF), 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 fund non-native trout removal in Five Lakes Basin to restore habitat for SNYLF. If funded, the proposed restoration work would begin in 2020.

Current visual encounter survey (VES) data suggest that very few SNYLF remain in the greater Five Lakes area. Therefore, reestablishing a SNYLF population will require translocations from a suitable donor population. In 2013, the Interagency Mountain Yellow-legged Frog Recovery Team (Recovery Team) discussed using the Mossy Pond SNYLF population as a potential source for translocations to the Five Lakes Basin area. Subsequently, the Recovery Team has finalized the Interagency Mountain Yellow-legged Frog Conservation Strategy (Strategy; USFWS 2018), which lists non-native fish removal and translocations in Five Lakes Basin as part of the species conservation action plan (USFWS 2018, pg. 57).

CDFW has completed a capture-mark-recapture (CMR) study of the Mossy Pond SNYLF population, which is located about 8 kilometers (km) to the southeast of the Black Buttes Area, and discussed in a separate memo (CDFW 2019; Figure 1). The CMR study occurred from 2014–2018 and preliminary data suggest that the Mossy Pond SNYLF population is large enough to provide adult frogs for translocation to nearby sites. Once the analyses are completed, CDFW will have more detailed knowledge of the SNYLF population structure at Mossy Pond. These results will allow the Recovery Team to estimate the number of post-metamorphic frogs to remove from the population annually for future translocation efforts in Nevada County, including Five Lakes Basin, per recommendations of the Strategy (USFWS 2018).

ENVIRONMENTAL SETTING

The Black Buttes Area is located in a region containing hundreds of small lakes and ponds, roughly bounded by Lake Spaulding, Bowman Lake, and Fordyce Lake (Figure 1). Elevations range between about 8,000 feet at the summit of Black Buttes to 6,600 feet at the south end of French Lake. Visitors may access the area via Forest Road 14 (off Bowman Lake Road), which leads to the trailhead near Grouse Ridge Campground; or from trail access to French Lake via Meadow Lake Road. Tahoe National Forest manages the surrounding land.

During baseline lake surveys in 2001 and 2002, CDFW crews detected a very small SNYLF population in the area. Between 2001 and 2004, CDFW crews also confirmed the presence of trout in Elaine Lake (site ID 12713; Figure 3), Blacks Lake (site ID 12727; Figure 4), Meyers Lake (site ID 12735; Figure 5), Pond 12742 (Figure 6), and Glacier Lake (site ID 12808; Figure 7). Based on connectivity with Glacier Lake, CDFW also suspected occasional trout presence in the small pond below Glacier Lake (site ID 12805; Figure 8). The ABMP identifies each of these waterbodies, and any connected fish-containing waters in Five Lakes Basin, for mechanical fish removal using gill nets and backpack electrofishing units (CDFW 2014).

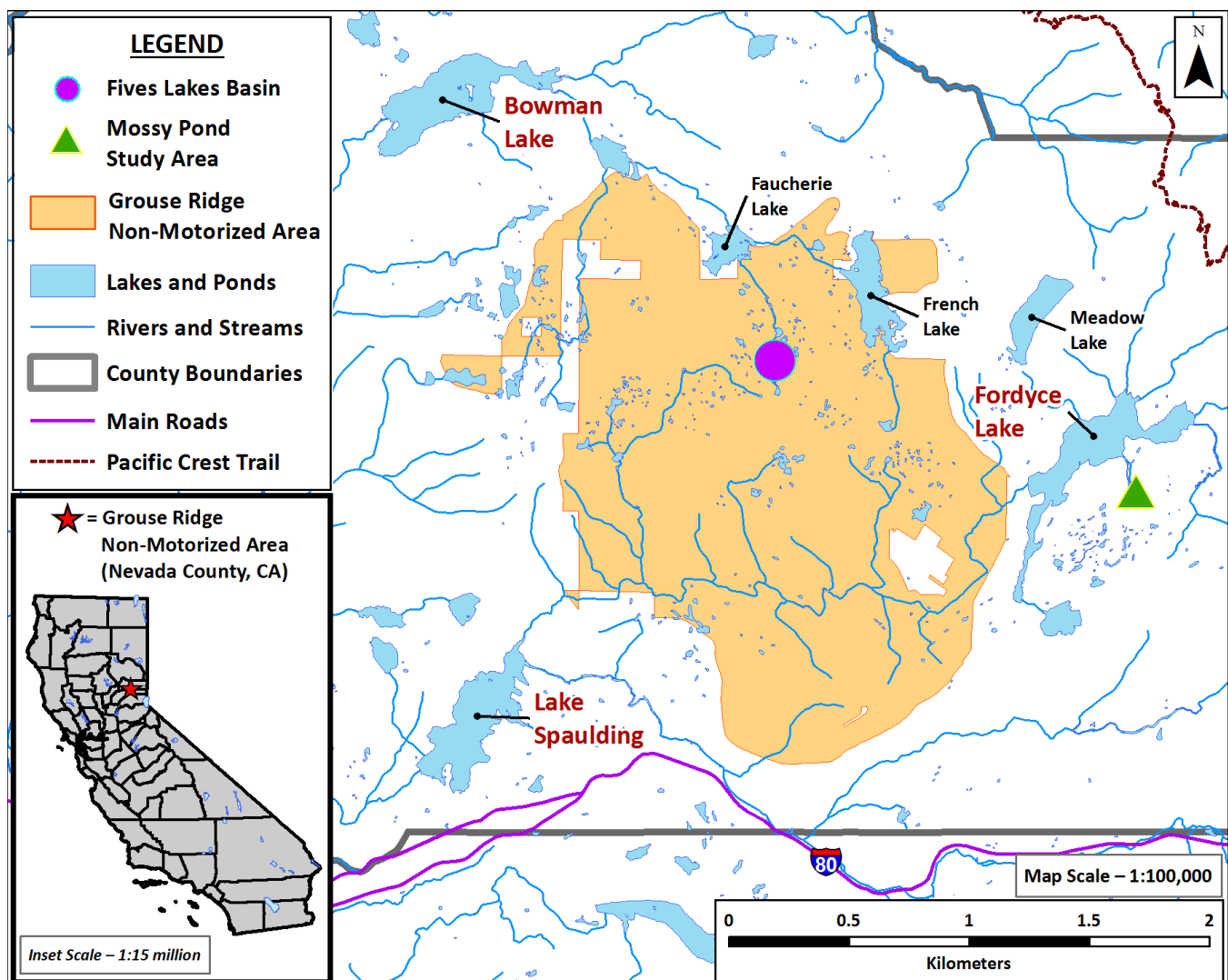


Figure 1: Grouse Ridge Non-Motorized Area, Tahoe National Forest, Nevada County, CA. The purple circle shows the location of Five Lakes Basin. The green triangle shows the location of the Mossy Pond Study Area, at which California Department of Fish and Wildlife (CDFW) biologists recently concluded a five-year capture-mark-recapture (CMR) study of Sierra Nevada Yellow-legged Frogs (*Rana sierrae*; SNYLF). The Mossy Pond population may serve as the source to reestablish a SNYLF population in Five Lakes Basin.

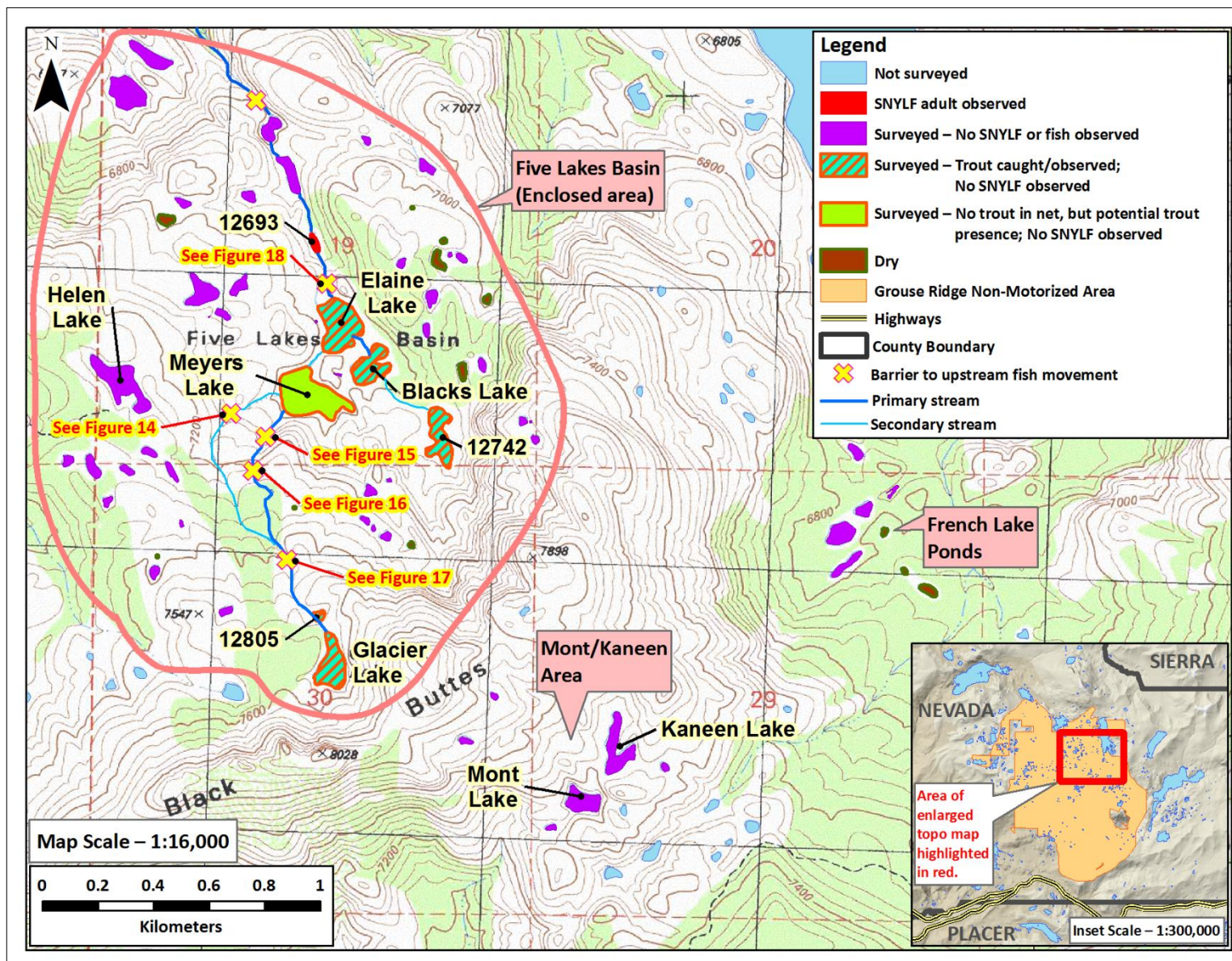


Figure 2: Summary map of results from visual encounter surveys (VES) for Sierra Nevada Yellow-legged Frogs (*Rana sierrae*; SNYLF) and gill netting surveys for trout completed by California Department of Fish and Wildlife (CDFW) staff between 30 July and 1 August 2018. For fish surveys, CDFW set one gill net for two nights in each of the following lakes: Blacks, Elaine, and Meyers. CDFW set one gill net for one night in Glacier Lake and pond 12742. With the exception of Meyers Lake, CDFW captured trout in each gill net. Given the relatively short survey duration, historic trout presence, and only a single net set, trout may still be present at low densities in Meyers Lake. On 31 July 2018, CDFW staff observed one adult SNYLF in close proximity to site 12693.



Figure 3: Elaine Lake (Site ID 12713) in July 2018, looking southwest. (CDFW)



Figure 4: Blacks Lake (Site ID 12727) in July 2018, looking southeast. (CDFW)



Figure 5: Meyers Lake (Site ID 12735) in July 2018, looking east. (CDFW)



Figure 6: Site ID 12742 in July 2018, looking south. (CDFW)



Figure 7: Glacier Lake (Site ID 12808) in July 2018, looking north. (CDFW)



Figure 8: Site ID 12805 in July 2018, looking east. (CDFW)

THREATS

Introduced Fish – CDFW stocked Blacks Lake, Meyers Lake, and Helen Lake with Brook Trout (*Salvelinus fontinalis*; BK) from about 1938 until 2000. CDFW also stocked Blacks Lake and Meyers Lake with Lahontan Cutthroat Trout (*Oncorhynchus clarkii henshawi*; CT-L) in 1969 and 1970. CDFW stocked Elaine Lake with BK from 1941 until 1967, and subsequently stocked the lake with only Rainbow Trout (*O. mykiss*; RT) from 1968 until 2000. CDFW stocked Glacier Lake with BK until 1965 and later stocked only California Golden Trout (*Oncorhynchus mykiss aguabonita*; GT) from 1968 until 2008. CDFW stocked Helen Lake (site ID 12729) with BK until 2000. Additionally, CDFW conducted single year stocking of RT at three sites: Helen Lake in 1996, and Ponds 12704 and 12742 in 1997.

Outside of Five Lakes Basin, CDFW planted both Mont and Kaneen Lakes (site IDs 12881 and 12855, respectively) with various trout species (including BK, CT-L, GT, RT, and Lake Trout [*Salvelinus namaycush*; LT]) from 1941 until 2000. Additionally, CDFW unintentionally stocked Mont Lake with GT in 2007. However, CDFW sampled Mont Lake using four overnight gill nets in June 2013 and two overnight gill nets in May 2015. CDFW captured no trout during the two deployments, suggesting that trout in Mont Lake were also not self-sustaining. CDFW also set two gill nets in Kaneen Lake for one month in summer 2010 and captured no trout.

Overnight gill net surveys beginning in 2001, and most recently undertaken in 2018, have revealed self-sustaining trout presence in Elaine Lake (RT), Blacks Lake (BK and RT), Pond 12742 (BK and RT), and Glacier Lake (BK and GT). CDFW field staff also observed two adult BK in the small pond (site ID 12805) below Glacier Lake. Trout prey on SNYLF and are a potential source of competition for food (e.g., benthic macroinvertebrates). Additionally, the waterbodies with trout likely act as a population sink for the adult and subadult SNYLF that disperse into the larger fish-containing lakes. The continued presence of self-sustaining trout is a threat to SNYLF reintroduction. Therefore, CDFW is proposing physical trout removal prior to the proposed SNYLF reintroduction efforts.

- **Disease** – Most SNYLF populations in Nevada County sampled by CDFW have been positive for chytrid fungus (*Batrachochytrium dendrobatidis*; *Bd*). However, while SNYLF were still extant in the area, CDFW staff only collected two epithelial swabs to test for *Bd*, both from Kaneen Lake (one in 2008 and one in 2010). Partner scientists screened the swabs for presence of *Bd* DNA using real-time quantitative polymerase chain reaction (qPCR) analysis and detected none. However, the sample size was extremely low ($n = 1$ on each occasion), which is not sufficient to positively detect the presence of *Bd*, especially if the pathogen is present at low levels (Shin et al. 2014). Therefore, the true *Bd* status of this population is unknown. However, based on the nearly ubiquitous presence of *Bd* in the northern Sierra Nevada (Padgett-Flohr and Hopkins 2009, CDFG 2011), *Bd* is likely present.
- **Marginal Habitats** – Due to the long-term presence of non-native trout, habitat options for successful breeding and tadpole survival for SNYLF in Five Lakes Basin and the Mont/Kaneen area were restricted to small, shallow, fishless ponds. The smallest ponds are susceptible to seasonal drying in late summer, and periods of extended drought threaten other ponds that may retain water during average water years. Other potential risks of trout restricting SNYLF to marginal habitats include severe winter conditions and anthropogenic habitat disturbances.

POPULATION STATUS

SNYLF populations in the Black Buttes Area are near extirpation. During surveys in 2018, CDFW field staff detected one adult SNYLF in the stream channel below Elaine Lake (Figures 2 and 9). This observation marked the first time CDFW detected any SNYLF in Five Lakes Basin in a decade. Prior to 2018, the most recent SNYLF observation by CDFW in Five Lakes Basin was a subadult seen at Elaine Lake on 13 August 2008. However, U.S. Forest Service (USFS) has a record of three adult SNYLF observed near Elaine Lake on 15 August 2009 (CNDDDB 2019). CDFW staff detected no SNYLF during surveys in subsequent years, including extensive surveys in 2013. CDFW staff have also not detected any SNYLF in the Mont/Kaneen Lakes Area or French Lake Ponds since 2010. More SNYLF may be present in lower Five Lakes Basin, and there may be small populations extant in the Mont/Kaneen Lakes Area and French Lake Ponds. Visual encounter survey methods only detect a subset of individuals present in the population (Heyer et al. 1994). However, the lack of observations from multiple survey efforts spanning nearly a decade strongly suggest that the SNYLF populations in the Black Buttes Area are very small and on the brink of extirpation.

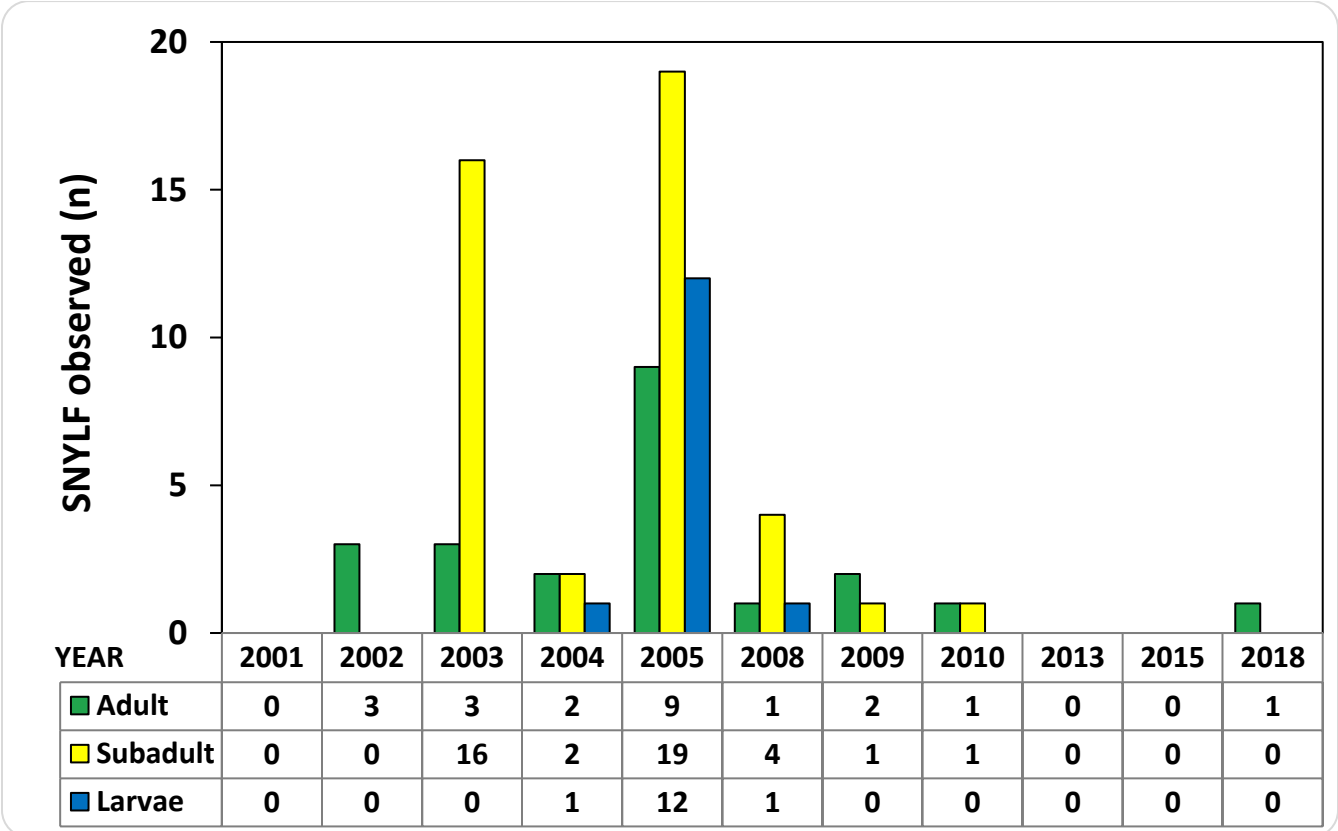


Figure 9: Number of adult, subadult, and larval Sierra Nevada Yellow-legged Frogs (*Rana sierrae*; SNYLF) detected during visual encounter surveys (VES) in the Black Buttes Area. Depending on the year, survey efforts included Five Lakes Basin, Mont/Kaneen Lakes Area, and the French Lake Ponds. The number of ponds surveyed by CDFW staff varied widely between years. The most extensive VES occurred during the following years: 2001–2002 (baseline surveys), 2004, 2008, 2010, 2013, and 2018. VES efforts in other years included a smaller subset of ponds in the area. Despite the variable survey efforts, the trend is evident: SNYLF are near extirpation in the Black Buttes Area.

FISH SAMPLING

CDFW set one gill net for two nights (30 July–1 August 2018) in each of Elaine, Blacks, and Meyers Lakes. CDFW set one gill net for one night (31 July–1 August 2018) in each of Glacier Lake and Pond 12742. Captures included 10 trout in Blacks Lake (1 BK, 9 RT; Figure 10), 13 trout in Glacier Lake (12 BK, 1 GT; Figure 11), nine trout in Pond 12742 (7 BK, 2 RT; Figure 12), and four trout in Elaine Lake (all RT; Figure 13). In addition, staff observed two adult BK in Pond 12805 while conducting a VES on 31 July 2018. Since all stocking in the Five Lakes Basin area ceased in 2008, gill net captures provide evidence of self-sustaining BK, GT, and RT populations at these sites. CDFW did not capture any fish in Meyers Lake. However, trout may still be present at low densities. Therefore, if trout removal commences as currently planned, CDFW will set gill nets in Blacks, Elaine, Meyers, Glacier, Pond 12742, and Pond 12805.



Figure 10. One Brook Trout (BK) and nine Rainbow Trout (RT) caught in Blacks Lake (site ID 12727) during a single gill net set over two



Figure 11. Twelve BK and one Golden Trout (GT) caught in Glacier Lake (site ID 12808) during a single gill net set over one night in summer 2018.



Figure 12. Seven BK and two RT caught in Pond 12742 during a single gill net set over two nights in summer 2018.



Figure 13. Four RT caught in Elaine Lake (site ID 12713) during a single gill net set over two nights in summer 2018.

SITE ASSESSMENT FOR PROPOSED NON-NATIVE FISH REMOVAL IN FIVE LAKES BASIN

During VES on 30 July–1 August 2018, CDFW field staff investigated the general habitat composition and features relevant to non-native trout removal in Five Lakes Basin. Staff collected the following information:

- 1) General stream habitat composition relevant to potential trout spawning and occupancy.
- 2) Location, size, and structure of barriers to upstream fish movement.
- 3) Current trout distribution and species composition.

Relevant details for each of these components assessed by CDFW staff:

- 1) During most years, streams in Five Lakes Basin are ephemeral. During the site assessment in summer 2018, very little water remained in any stream in the basin. A few tiny pools were located in the primary outlet stream of Glacier Lake at UTM 10S 710044 E 4364413 N. Additionally, a very small amount of flowing water was present along the outlet stream of Elaine Lake. However, staff observed no trout in the little water that remained in streams. Based on several years of survey efforts, apart from the largest water years, CDFW expects that the stream channels are normally dry by mid-summer. The ephemerality of the streams present in Five Lakes Basin likely precludes year-round trout occupancy and reduces potential for successful spawning in streams. Therefore, seasonal drying of streams simplifies eradication efforts by greatly reducing the amount of stream electrofishing necessary.
- 2) Streams in Five Lakes Basin contain several barriers to upstream fish movement (Figure 2). Glacier Lake's secondary outlet stream, which likely goes dry in early summer, has a vertical waterfall barrier located at UTM 10S 710009 E 4364678 N (Figure 14). The primary outlet of Glacier Lake contains three potential barriers, one of which is definitive, and all of which are steep drops over bedrock and/or boulders. The definitive barrier, which is the largest, is a few hundred meters above Meyers Lake at UTM 10S 710077 E 4364591 N. This barrier contains a large drop with overhanging granite bedrock (Figure 15). The next potential barrier when proceeding upstream is a tall, steep section of bedrock located at UTM 10S 710038 E 4364500 N (Figure 16). The potential barrier farthest upstream is a tall pile of vertical talus located at UTM 10S 710169 E 4364180 N (Figure 17). Any one of these barriers likely prevents upstream fish passage. In combination, and considering that all streams in Five Lakes Basin are ephemeral, no trout can access Glacier Lake or Pond 12805 from lakes lower in the basin. The final barrier that CDFW assessed is below Elaine Lake, along the stream draining lower Five Lakes Basin. This barrier is a vertical slab of bedrock, located at UTM 10S 710284 E 4365167 N, over which trout cannot pass upstream (Figure 18). This barrier, in combination with the ephemerality of the stream, prevents upstream fish passage from Faucherie Lake.
- 3) Trout are present at most larger lakes and ponds in Five Lakes Basin, including Elaine Lake, Blacks Lake, Pond 12742, Pond 12805, and Glacier Lake (Figure 2; Figures 10–13). Based on historic stocking and size, Meyers Lake and Helen Lake may contain trout. However, current data suggest both lakes are fishless. Based on gill net sampling, VES, and seasonal streamflow conditions, trout reproduction appears to be limited in Five Lakes Basin. The basin currently contains self-sustaining populations of BK, RT, and GT, although the latter appear to be uncommon and restricted to Glacier Lake.

In summary, CDFW anticipates that the proposed trout removal project would be relatively simple to complete, compared to other mechanical fish removal projects implemented by CDFW. Based on current data, trout reproduction is limited. Additionally, most stream segments in Five Lakes Basin are ephemeral and only occasionally contain trout. Finally, barriers to upstream fish movement compartmentalize the basin, allowing for an easier trout removal effort. Therefore, CDFW predicts that the non-native trout populations may quickly die out once field staff begin fish removal efforts.

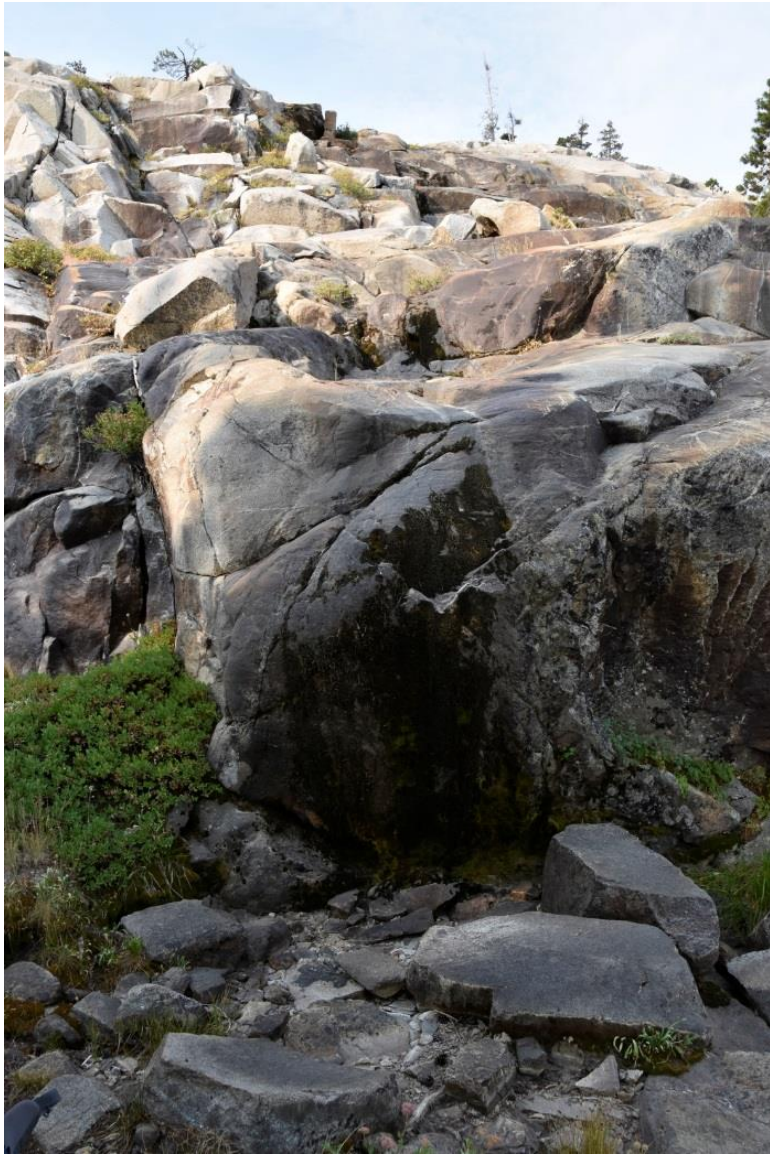


Figure 14. Three-meter slab barrier along the secondary outlet stream of Glacier Lake. There are several smaller vertical drops above this barrier that likely provide additional barriers to upstream fish movement. Barrier location is UTM 10S 710009 E 4364678 N. (CDFW)

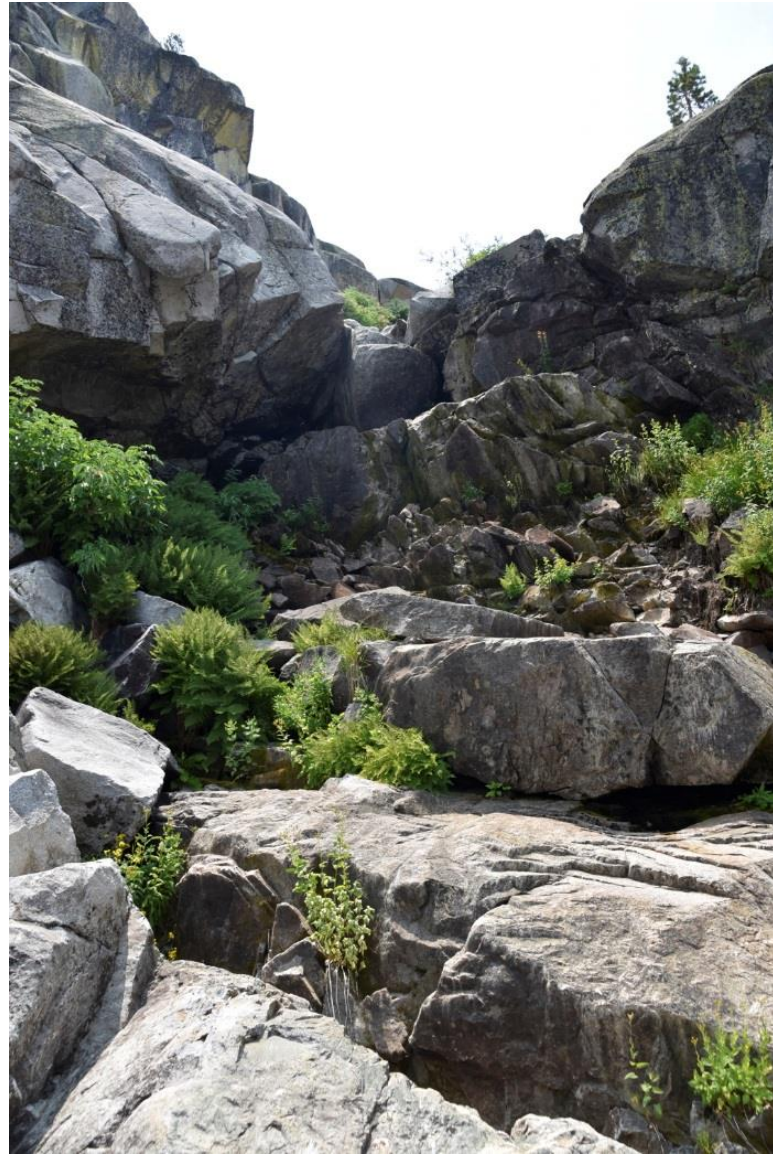


Figure 15. The largest barrier to upstream fish movement along the primary outlet stream of Glacier Lake. This barrier has an overhanging vertical drop and several smaller drops. The upper section of the notch visible in this picture is over three meters high and not passable by fish. Barrier location is UTM 10S 710077 E 4364591 N. (CDFW)



Figure 16. Nearly vertical bedrock barrier partway up the primary outlet of Glacier Lake. Barrier location is UTM 10S 710038 E 4364500 N. (CDFW)



Figure 17. Small waterfall barrier located approximately 350 stream meters below Glacier Lake. The outlet stream splits into two channels that flow down vertical, piled talus before rejoining downstream. Barrier location is UTM 10S 710169 E 4364180 N. (CDFW)



Figure 18. Vertical bedrock barrier, divided into two large steps, below Elaine Lake. The lower step is approximately one meter high and the upper step is over two meters high. Barrier location is UTM 10S 710284 E 4365167 N. (CDFW)

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