

# Memorandum

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**Subject: Native amphibian restoration and monitoring in Desolation Wilderness;  
Action: Highland Lake fish removal and *Rana sierrae* monitoring.**

## INTRODUCTION

The Aquatic Biodiversity Management Plan for the Desolation Wilderness Management Unit (CDFW 2012) identifies Highland Lake (Site ID 13904) (Figure 1), approximately 500 meters of outlet stream (Site IDs 52648, 52649 and 52650), and two associated ponds (Site IDs 13903 and 13896) as a Native Species Reserve (NSR) for the Sierra Nevada yellow-legged frog, *Rana sierrae*, (SNYLF). The habitat supports a small SNYLF population co-occurring with rainbow trout, *Onchorynchus mykiss* (Figure 2). CDFW began removing rainbow trout from Highland Lake to benefit SNYLF in 2012 with assistance from Eldorado National Forest personnel. Fish removal activities continue to be implemented and CDFW estimates the project will be complete by 2016.

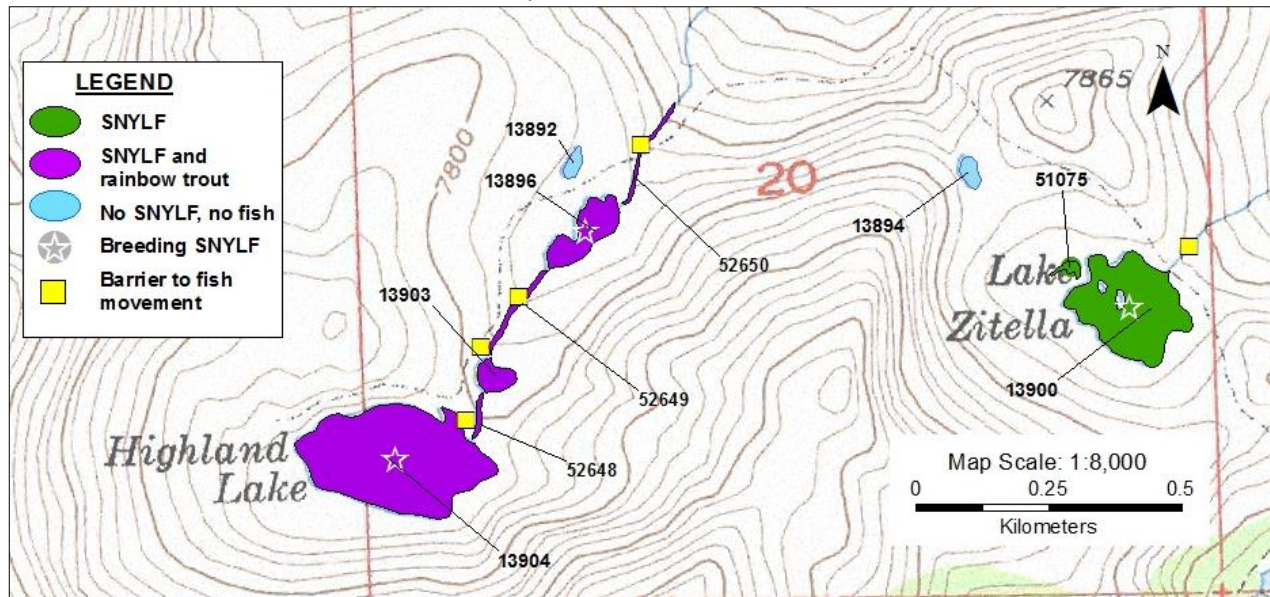
## ENVIRONMENTAL SETTING

Highland Lake is located in the Desolation Wilderness, El Dorado County at approximately 7,800' above mean sea level and is managed by the Eldorado National Forest. The lake sits within a granite cirque and drains northeast into the Rubicon River. No official trails access Highland Lake but a clearly marked user trail from nearby Forni Lake attests to regular human visitation.

Figure 1: Highland Lake looking east (CDFW 8/14/2014).



Figure 2: Highland Lake NSR: Purple and green denote waters currently occupied by SNYLF. Waters marked with stars indicate the presence of SNYLF tadpoles. Purple denotes waters currently occupied by rainbow trout. Fish barriers impeding upstream movement of fish are denoted by a yellow box. Lake Zitella and site IDs 51075 and 13894 are not part of the Highland Lake NSR but are included in this map for reference. All flowing waters drain northeast into the Rubicon River (not shown). 2015 Update: Adult SNYLF were observed at sites 13892 and 13894 on July 30, 2015.



#### THREATS

- Disease – All SNYLF populations in El Dorado County are positive for chytrid fungus, *Batrachochytrium dendrobatidis* (*Bd*). Site IDs 13903 and 13896 were sampled in 2009 and 2010 using epithelial swabs and screened for the presence of *Bd* dna using real-time qPCR analysis. Eight swabs were collected and results from both years detected very light to moderate *Bd* spore loads.
- Marginal Habitats – SNYLF are persisting in low numbers at a single large lake, two shallow ponds (Figure 3) and a small seasonal stream. Any disturbance, natural or otherwise, that results in changes to the hydrology or limnology of the deep water habitat poses a potential extirpation risk to the population. Potential risks include the natural deterioration of the Highland Lake dam, severe winter conditions, extended drought, or anthropogenic habitat disturbances.
- Introduced Fish – Highland Lake, its outlet and two small attached ponds support a small population of rainbow trout. CDFW planted Highland Lake with rainbow trout from 1935 to 2000. Trout abundance has declined in the absence of stocking but sufficient natural reproduction occurs in the inlet to Highland Lake and at Site 52649 to sustain the population. Fish barriers impede or exclude trout in the stream and ponds from moving into Highland Lake. Adult and juvenile SNYLF are regularly seen throughout the NSR and tadpoles are found in Highland Lake and site 13896. Rainbow trout predate upon tadpoles, juvenile and adult frogs and are a potential source of competition for food items for adult and juvenile frogs.

Figure 3: Site 13896 looking north east. A 1.5 meter deep pond that supports all life stages of SNYLF and low numbers of rainbow trout (CDFW 9/10/2013).



#### POPULATION STATUS

More monitoring data is required to derive population trends and quantify the SNYLF population at Highland Lake (Figure 4). However, data from 2012, 2013 and 2014 suggest the population may be increasing. Observations by CDFW biologists suggest that SNYLF abundance has increased and animals have occupied new microhabitats within the NSR as the rainbow trout population has declined. Moreover, tadpoles have been observed within additional habitats, particularly within Highland Lake, suggesting SNYLF are utilizing additional breeding habitats compared to 2008 and earlier. Although no SNYLF were detected in the watershed by CDFW crews prior to 2008, Eldorado National Forest has been monitoring this population since 1993 (CNDDDB, 2014). CDFW will continue to monitor this population annually while fish removal is occurring and biannually thereafter. Once fish removal is complete, all sites in the NSR will be managed as amphibian resources.

#### 2015 Update

All sites in the NSR were surveyed for amphibians on July 30<sup>th</sup>, 2015 by CDFW and Eldorado National Forest crews. Results continue to suggest a large increase in SNYLF abundance in the area (Figure 4, Figure 5). Numbers at Highland Lake have increased dramatically and during surveys in October 2014 and July 2015 crews observed SNYLF for the first time at two shallow ponds (13892 and 13894) (Figure 2). Nearby Lake Zitella appears to have experienced a similar large increase in SNYLF observations (CDFW 2015).

Fish planting at Highland Lake was halted in 2000 as part of a larger project to inventory fish and native amphibians throughout the Sierra Nevada (CDFW 2012). The decision to manage the watershed for native species rather than fish occurred years before active fish removal began and based on the numbers of fish captured during active removal, the fish population in the watershed likely began to decline soon after plants were halted. Therefore, the large SNYLF population increase observed in recent years is occurring in tandem with the decline of the fish population in the watershed and may partially be a factor of time passing as fish disappeared and SNYLF began to breed and forage without interference from trout. The observation of larval SNYLF in Highland Lake in 2008 – four years before active fish removal began – supports this idea. However, although SNYLF are likely benefiting from newly created fishless habitat in the watershed, an increase of this apparent magnitude in a Bd-positive SNYLF population is unexpected. Possible factors in addition to fish removal include recent short winters, increased temperatures and increased food availability due to drought conditions. Regardless of the exact reasons, fifteen years of data from this watershed suggest that SNYLF populations in the watershed are making a dramatic comeback since management in the area switched from a focus on trout to a focus on native amphibians.



Figure 4: Survey data by life stage at Highland Lake and Site IDs 13896 and 13903 from 2003 to 2014. \*Formal surveys were not done in 2012; SNYLF were incidentally observed along the shores of Highland Lake while conducting fish removal activities. \*\*Highland Lake was not surveyed in 2010 although all other habitats within the NSR were surveyed.

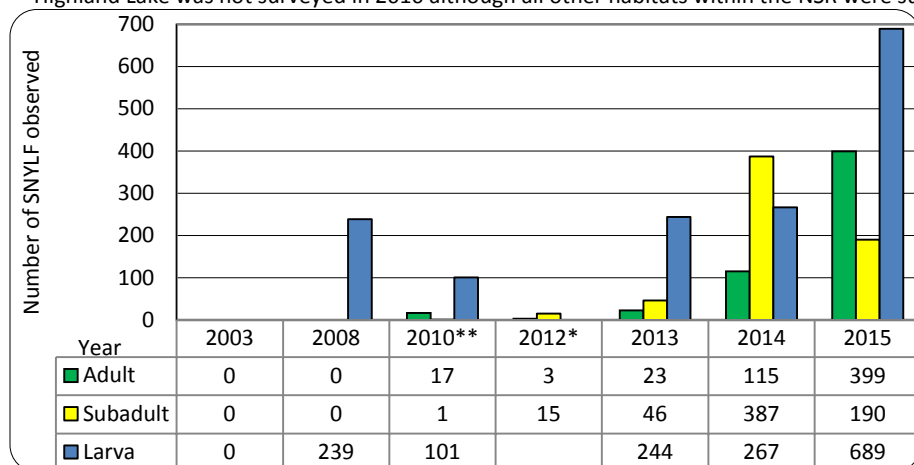
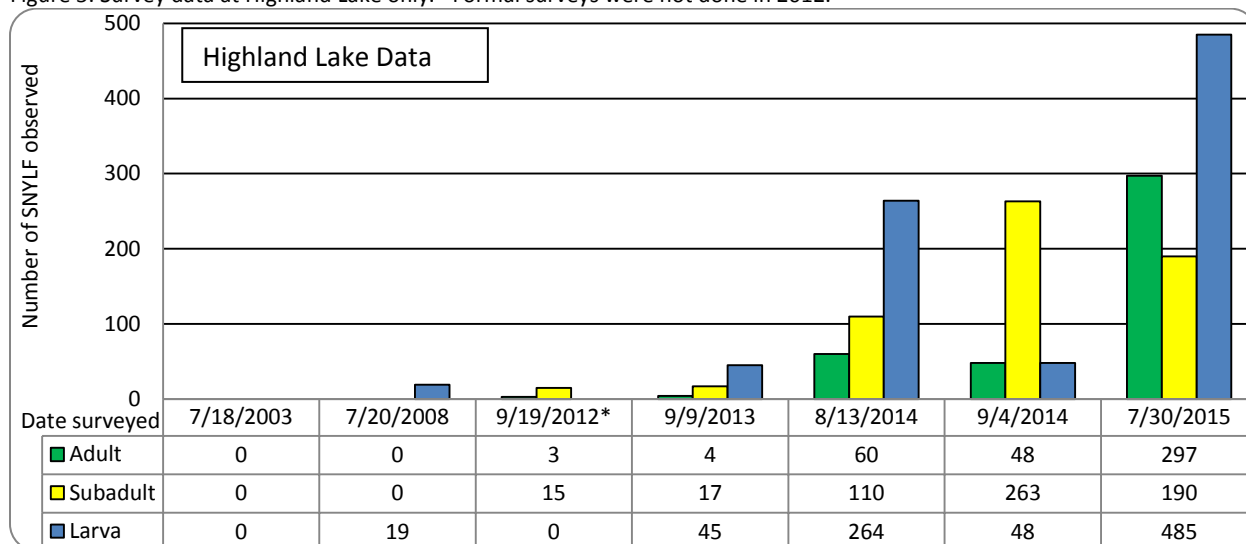


Figure 5: Survey data at Highland Lake only. \*Formal surveys were not done in 2012.



## FISH REMOVAL

Highland Lake, its outlet stream (site IDs 52648, 52649 and 52650) and associated ponds (Site IDs 13896 and 13903) are active fish removal sites.

Fish removal began at Highland Lake in 2012. Seven overwinter nets set on September 19, 2012 captured six large rainbow trout. Seven overwinter nets were re-set on September 10, 2013 and pulled in 2014. No trout have been observed or captured in Highland Lake since June of 2014. As of September 2014 two overwinter gill nets are set in Highland Lake. Due to limited spawning habitat and low numbers of fish prior to fish removal, CDFW suspects the lake is currently fishless.

Fish removal was implemented throughout the remainder of the NSR below Highland Lake in August 2014. The 2014 drought conditions created poor conditions for trout. For instance, by August the stream consisted of disconnected puddles and the ponds had drawn down to less than one meter in depth with water temps exceeding 18 C. Multiple gill nets were set in each pond and smaller gill net pieces were set in every wetted pool along the stream (Figure 5). A total of 25 rainbow trout were captured including four fry (<60mm total length) between August 12th and September 2<sup>nd</sup>. Fish removal activities continued from

September 2<sup>nd</sup> until October 17 but no additional fish were seen or captured. All nets were pulled from stream sections on October 17<sup>th</sup> and will not be reset until summer of 2015. Three overwinter nets remained in the deepest pond habitat at sites 13896 and 14903.

2015 Update: On July 28<sup>th</sup>, 2015, 22 gill nets were set at Highland Lake. No fish were captured when the nets were removed on August 21<sup>st</sup> and CDFW believes Highland Lake is fishless. No overwinter nets remain in Highland Lake due to the fact that only 6 trout were captured in the lake since restoration activities began in 2012 and no fish have been observed or captured since the initial overwinter nets were pulled in 2013. No fish were captured when four overwinter nets were removed from Highland Lake and the unnamed pond just below it on 6/4-5/2015, but a single fish was captured in an overwinter net at site 13896; therefore three overwinter nets remain fishing there. Conditions in September 2015 were considerably drier than in September 2014. The pool where fry were captured in 2014 was dry during VESs which took place on July 28<sup>th</sup>, 2015, suggesting that even if enough adult trout were present in the stream during the spring, 2015 spawning season, any fry likely did not survive the summer. Additional net sets over the summer in 13896 did not capture any fish and no fish were observed during amphibian monitoring surveys. CDFW believes the whole NSR may be fishless but will continue to monitor the lower ponds and Highland Lake outlet to confirm.

Figure 5: Gill net piece set in a small granite pool in ID 52650, the dry stream channel below site 13896.



#### LITERATURE CITED:

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