

State of California
Department of Fish and Wildlife
Memorandum

Date: 24 March 2020

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

From: John Imperato, Scientific Aide;
Isaac Chellman, Environmental Scientist;
High Mountain Lakes;
North Central Region Fisheries

Cc: Region 2 Fish Files

Ec: CDFW Document Library

Subject: Native amphibian monitoring in the Blue Lakes area, Alpine County

ENVIRONMENTAL SETTING

The Blue Lakes area is in central Alpine County, 20 miles south of Lake Tahoe. Blue Lakes Road, which begins 2.5 miles west of the junction of Highways 88 and 89, provides access to the area (**Figure 1**). Easy access via Blue Lakes Road, multiple campgrounds, and recreational angling opportunities make the lakes a popular, high-traffic destination. All waterbodies discussed in this memorandum are located within the Eldorado National Forest (ENF), but Pacific Gas and Electric Company (PG&E) owns the two Blue Lakes (Upper Blue Lake, Site ID 14670; and Lower Blue Lake, Site ID 14726) and a few nearby ponds. One pond discussed in this memorandum (Site ID 50100) is located within the Mokelumne Wilderness boundary (**Figures 1 and 2**).

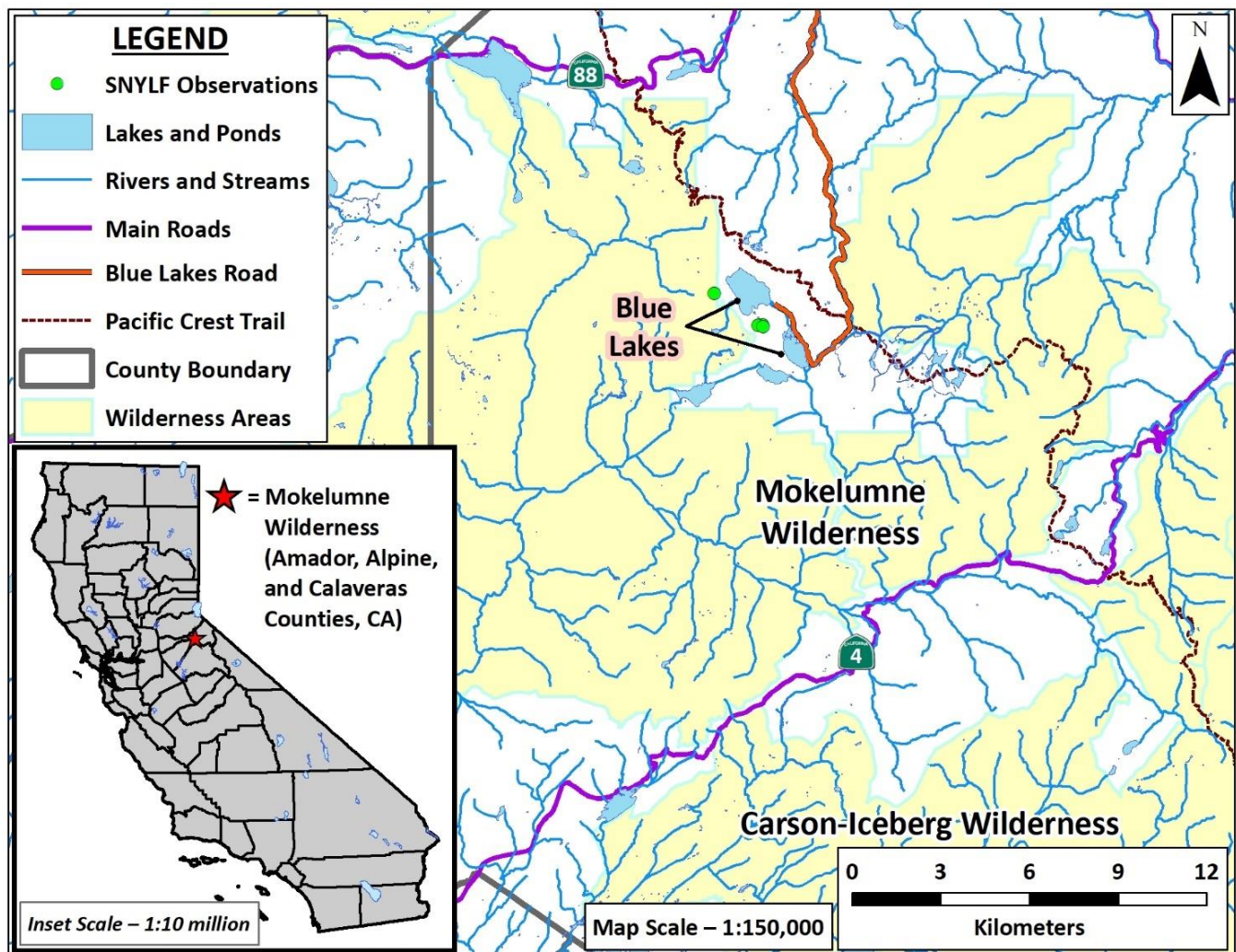


Figure 1. Mokelumne Wilderness, Alpine and Amador Counties, CA. Green dots show Sierra Nevada Yellow-legged Frog (*Rana sierrae*) detections by CDFW staff during 2019 visual encounter surveys (VES). Blue Lakes Road is displayed in orange.

INTRODUCTION

On August 21, 2019, CDFW field staff performed herpetofauna surveys to assess current distributions and relative abundance of aquatic fauna in the Blue Lakes area. Special status herpetofauna species known to occur in the area include Sierra Nevada Yellow-legged Frog (*Rana sierrae*; SNYLF) and Yosemite Toad (*Anaxyrus canorus*; ANCA; USFWS 2016). Current evidence suggests ANCA in the Blue Lakes area are hybridized with Western Toads (*Anaxyrus boreas*; ANBO; Brown et al. 2015, pg. 104). Therefore, CDFW refers to toads discussed in this memorandum as ANCA hybrids.

CDFW has been managing two ponds in the area, Site IDs 50100 and 14722, as amphibian resources, while Upper and Lower Blue Lake are stocked fisheries (CDFW 2016). The Blue Lakes area is designated as both SNYLF and ANCA critical habitat by the U.S. Fish and Wildlife Service (USFWS 2016).

THREATS

Disease

The SNYLF populations in the Blue Lakes area are positive for chytrid fungus, *Batrachochytrium dendrobatidis* (*Bd*). In 2008 and 2010, CDFW sampled SNYLF from Site IDs 50100 and 14722 using epithelial swabs. Partner scientists screened the swabs for presence of *Bd* DNA using real-time quantitative polymerase chain reaction (qPCR) analysis. Results from 2008 detected no *Bd* presence at Site ID 50100 and low to moderate *Bd* zoospore loads at site 14722. Results from 2010 detected light *Bd* zoospore loads at Site ID 50100. CDFW has not monitored *Bd* status among ANCA hybrid populations at Blue Lakes. When compared with SNYLF, the potential population-level effects of *Bd* are less known in Bufonid toads (Brown et al. 2015). However, Yosemite Toads, especially recent metamorphosed individuals, are susceptible to *Bd*-induced mortality (Lindauer and Voyles 2019).

Marginal Habitats

SNYLF in the Blue Lakes area are persisting in a few small ponds. Any disturbance, natural or otherwise, that threatens overwintering habitats presents a potential extirpation risk. Potential risks include severe winter conditions, extended drought, or anthropogenic habitat disturbances.

Introduced Fish

CDFW has regularly stocked trout in Lower Blue Lake since 1936 and in Upper Blue Lake since 1950. At Upper Blue Lake, CDFW exclusively planted Lahontan Cutthroat Trout (*Oncorhynchus clarki henshawi*; LCT) until 1968, after which CDFW alternately planted LCT and Rainbow Trout (*Oncorhynchus mykiss*; RT). Currently, the RT that CDFW plants into Upper and Lower Blue Lake are triploid. Triploid RT are sterile because they have an extra chromosome, which prevents the fish from producing functional gametes (CDFW 2015). The most recent plants of LCT and triploid RT at Upper Blue Lake were in 2013 and 2018, respectively. CDFW has planted Lower Blue Lake with Brown Trout (*Salmo trutta*; BN), Brook Trout (*Salvelinus fontinalis*; BK), LCT, and RT. CDFW last planted Lower Blue Lake with BN in 2000, BK in 2009, LCT in 2013, and triploid RT in 2019.

During visual encounter surveys (VES) in 2019, CDFW field staff observed young-of-the-year BK, Lahontan Redside (*Richardsonius egregius*), and Speckled Dace (*Rhinichthys osculus*) in the inlets to Upper Blue Lake (Ewing 2019a). Additionally, field staff observed salmonid fry in Middle Creek, which drains to Lower Blue Lake (Ewing 2019b). These observations indicate self-sustaining trout and cyprinid populations at Upper and Lower Blue Lake.

The presence of self-sustaining trout likely precludes any successful SNYLF recruitment and long-term occupancy at Blue Lakes (Brown et al. 2014). Additionally, fluctuating reservoir levels (e.g., from water use for hydropower and drawdowns for dam maintenance) leave the shoreline exposed and devoid of cover, which can leave SNYLF more vulnerable to predators and limit habitat for foraging (CDFG 2011). Artificial changes to the hydrologic regime can have other

negative effects on SNYLF populations, including stranding eggs and tadpoles, and overwinter mortality from artificially low water levels (Bradford 1983, CDFG 2011). Regular water fluctuations and long-term presence of fish make Upper and Lower Blue Lakes poor SNYLF habitat.

Given the absence of SNYLF observations at Upper and Lower Blue Lakes, self-sustaining trout in the lakes and tributaries, fluctuating reservoir levels, and high recreational use (including fishing, boating, camping, and swimming), CDFW will continue to manage both Upper and Lower Blue Lake as stocked fisheries (Ewing 2019a, b).

HERPETOFAUNA SURVEYS

CDFW conducted herpetofauna surveys at eight waterbodies in the Blue Lakes area on August 21, 2019. Specifically, CDFW field staff surveyed Upper Blue Lake, Lower Blue Lake, and Site IDs 14712, 14717, 14721, 14722, 14725, and 50100. CDFW conducted surveys using the High Mountain Lakes (HML) VES protocol. During 2019 surveys, CDFW staff observed SNYLF at four locations: Site IDs 14721, 14722, 14725, and 50100 (**Figures 2–6**, respectively). This was the first time that CDFW staff observed SNYLF at Site ID 14721. However, SNYLF observations at this location were probable because Site ID 14721 is adjacent to SNYLF-occupied ponds. Site IDs 14721, 14722, and 14725 connect in spring and early summer by an ephemeral stream complex and wet meadow. Given this habitat composition and SNYLF observations in 2019, CDFW will manage all sites as amphibian resources.

In total, CDFW staff observed more adult and subadult SNYLF in the Blue Lakes area during 2019 than in any other recorded survey year (**Figure 7**). Based on prior survey data, the SNYLF population in the Blue Lakes area may be growing. However, VES results can be difficult to compare due to weather conditions, time of year, and observer bias (Mazerolle et al. 2007).

Although CDFW staff observed more SNYLF larvae in 2009 when compared with other years, larval SNYLF observations have remained relatively constant between 2002 and 2019 (**Figure 8**). However, even the relative outlier of observing 73 SNYLF tadpoles in 2009 is a small number of individuals, and well within a range where variability in survey conditions and observer bias between surveys could account for differences in detection. SNYLF tadpole detections in the Blue Lakes area have always been below 100 individuals, and low tadpole detectability is common among SNYLF populations in the northern Sierra Nevada (CDFW, unpubl. data).

CDFW staff observed ANCA hybrids at three sites in 2019: Upper Blue Lake, Site ID 14712, and Site ID 14722 (**Figure 9**). Field staff detected two adults, one male and one female, at Site ID 14722 (**Figure 10**), one adult at Site ID 14712, and approximately 300 larvae on the southwest shore of Upper Blue Lake (**Figure 11**). During surveys in past years, CDFW staff have only observed ANCA hybrids on a few occasions. In 2009, CDFW crews observed ANCA hybrid adults and subadults, and one egg string, in Upper Blue Lake, and larvae at Site IDs 14722 and 50100. In 2001, CDFW observed ANCA hybrid adults and subadults in Lower Blue Lake.

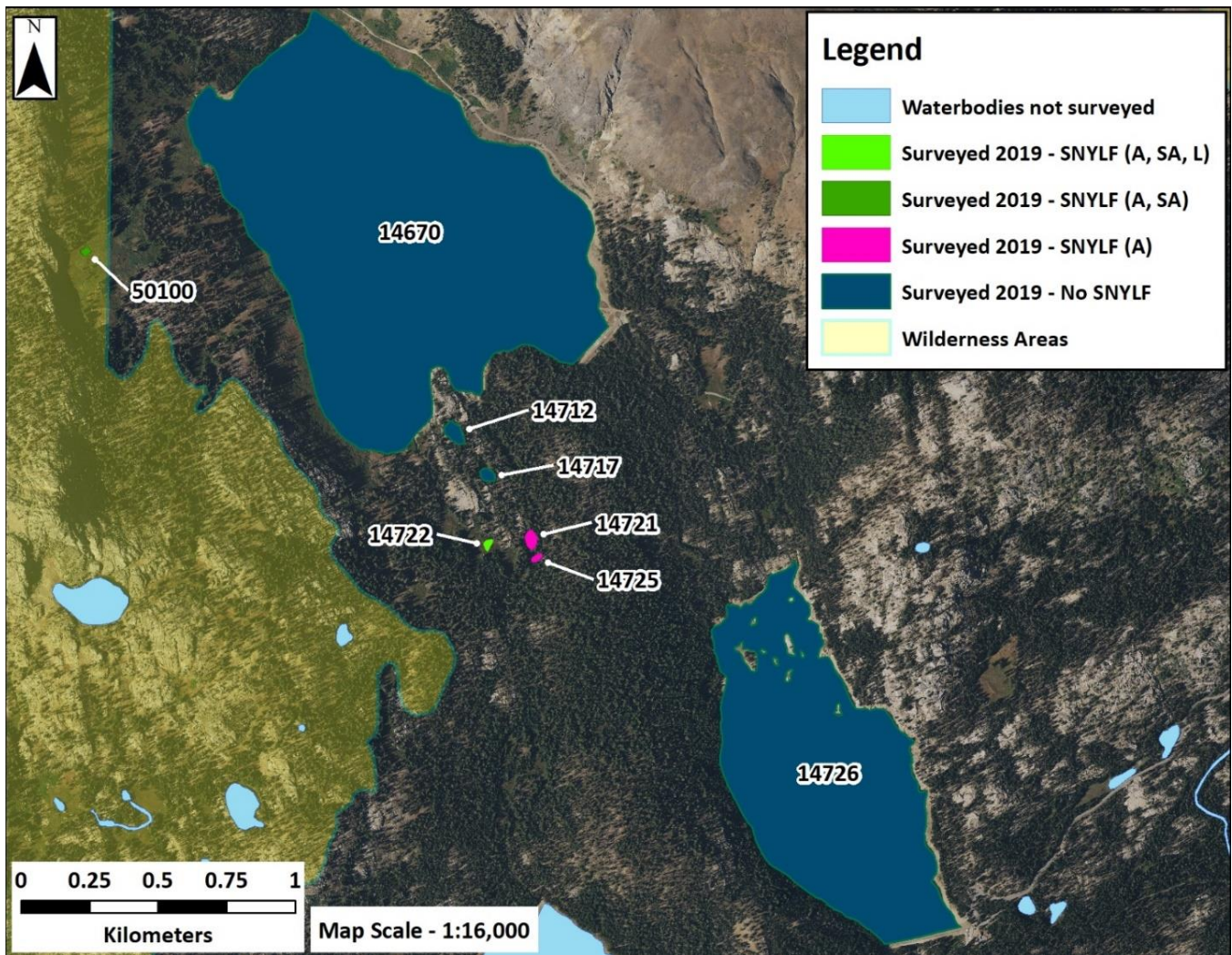


Figure 2. Sierra Nevada Yellow-legged Frog (*Rana sierrae*; SNYLF) occupancy in the Blue Lakes area, Alpine County, CA. Lakes and ponds showing SNYLF presence are from visual encounter surveys (VES) conducted in 2019; the most recent CDFW VES for each given pond. CDFW crews have observed SNYLF of all life stages in a few small ponds in the basin, but not at either of the Blue Lakes. The primary SNYLF population is located south of Upper Blue Lake (Site ID 14670), in a wetland complex that includes Site IDs 14721, 14722, and 14725. Additional SNYLF are also located in the small pond (Site ID 50100) west of Upper Blue Lake. The closest known SNYLF observation to Upper Blue Lake was an adult seen by U.S. Forest Service staff in July 2003 at Site ID 14712. CDFW is not aware of any subsequent SNYLF detections at Site ID 14712. SNYLF letter codes in the legend indicate the life stages observed during the most recent survey as follows: “A” = adults, “SA” = subadults, and “L” = larvae. All flowing waters in the Blue Lakes area drain south into Blue Creek, which flows into the North Fork Mokelumne River (not shown).



Figure 3. Site ID 14721 on August 21, 2019, looking north-northwest. (CDFW)

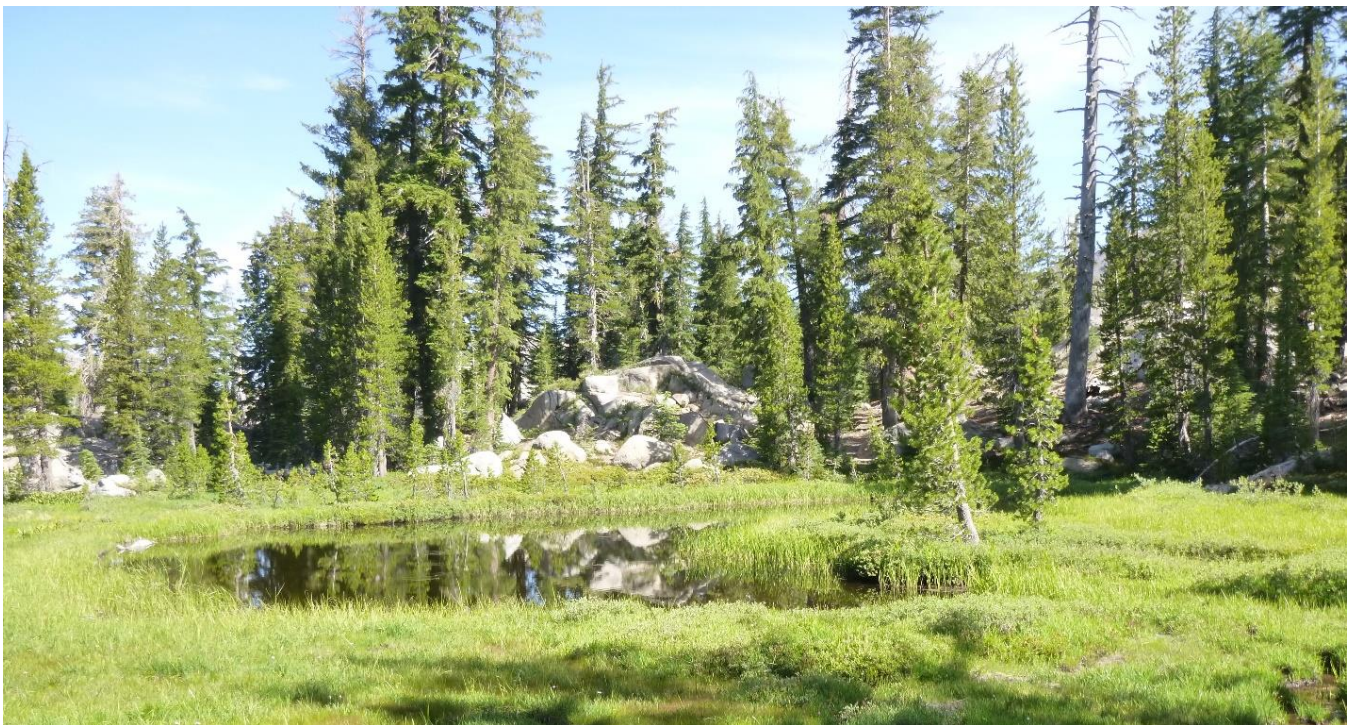


Figure 4. Site ID 14722 on August 21, 2019, looking north. (CDFW)



Figure 5. Site ID 14725 on August 21, 2019, looking southwest. (CDFW)



Figure 6. Site ID 50100 on August 21, 2019, looking northeast. The marsh on the south-southwest side of the pond (foreground) contained many interweaving flows that formed an inlet stream complex. Flows often alternated between surface and subsurface. (CDFW)

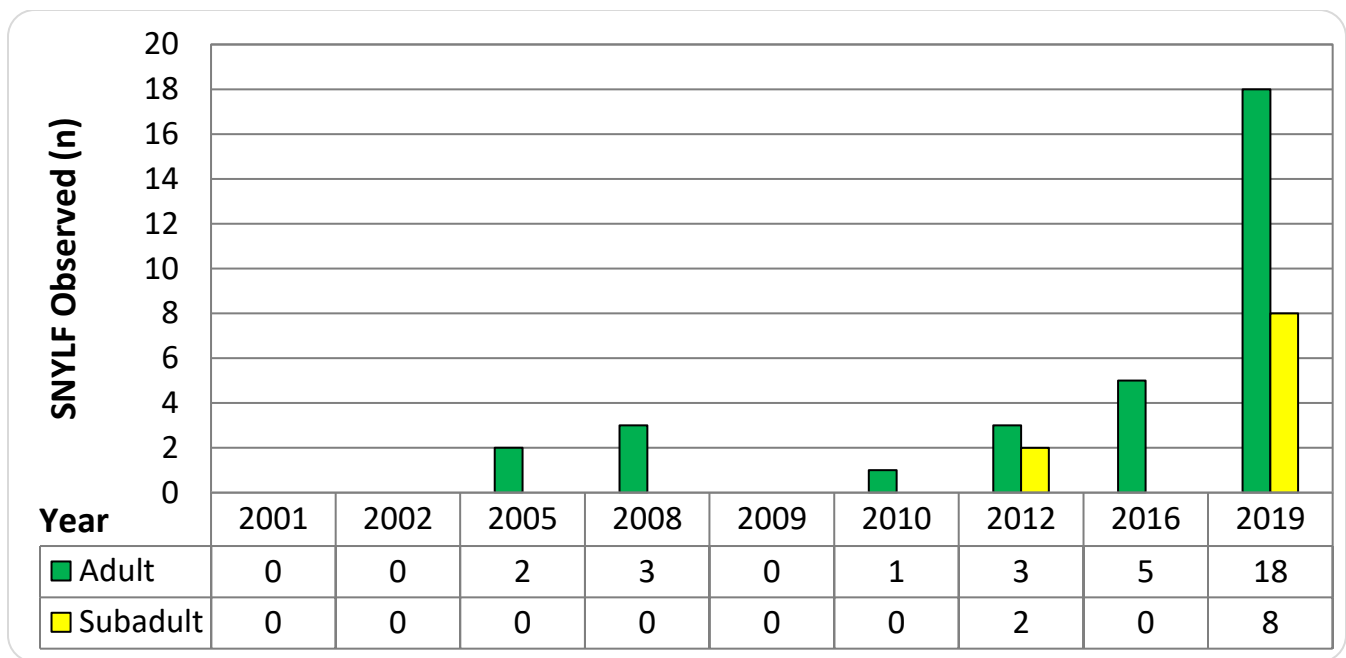


Figure 7. Number of adult and subadult Sierra Nevada Yellow-legged Frog (*Rana sierrae*; SNYLF) detected during visual encounter surveys (VES) in the Blue Lakes area. CDFW observed all post-metamorphic SNYLF at four ponds: Site IDs 14721, 14722, 14725, and 50100. The only years during which CDFW surveyed Site IDs 14721 and 14725 were 2001, 2002, 2016, and 2019. CDFW did not begin surveying Site ID 50100 until 2008.

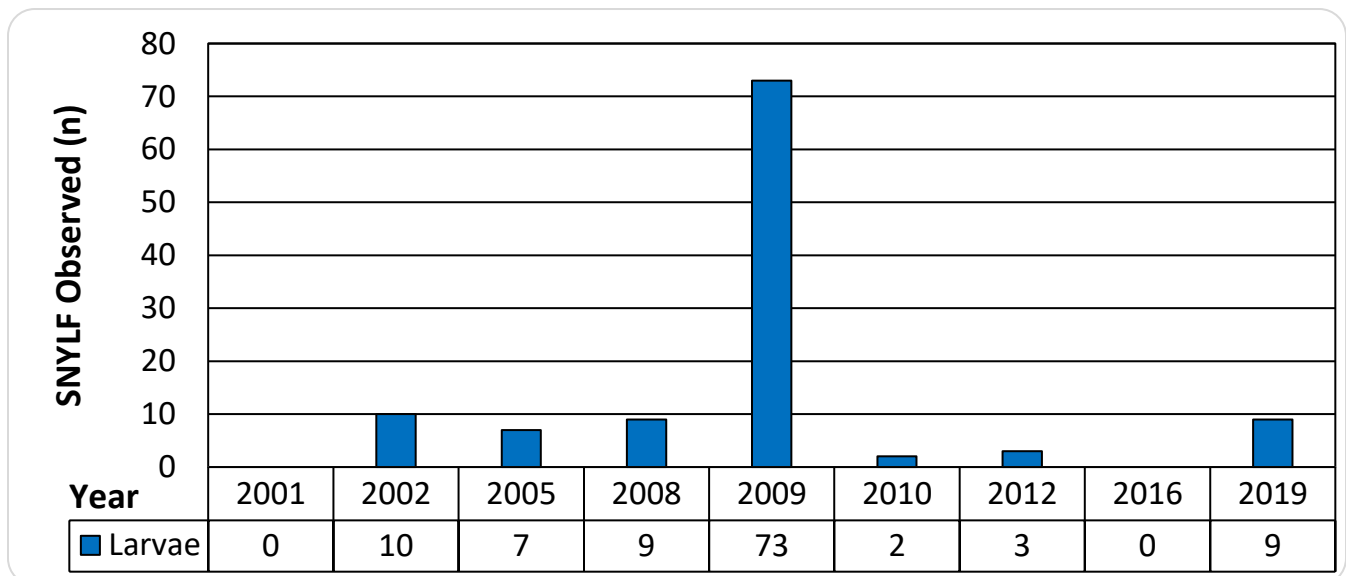


Figure 8. Number of larval Sierra Nevada Yellow-legged Frog (*Rana sierrae*; SNYLF) detected during visual encounter surveys (VES) in the Blue Lakes area. CDFW observed all SNYLF larvae at two ponds: Site IDs 14722 and 50100. CDFW did not begin surveying Site ID 50100 until 2008.

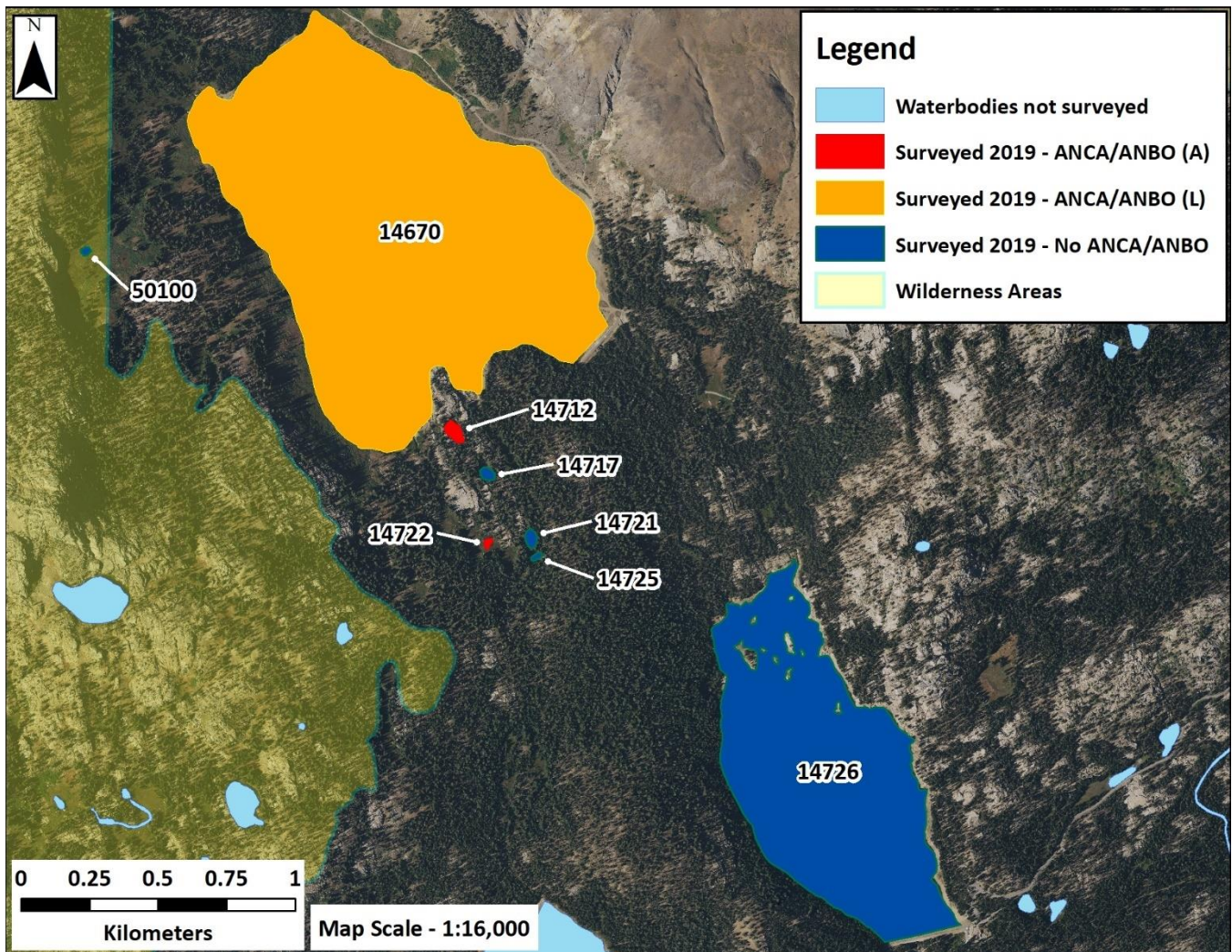


Figure 9. *Anaxyrus canorus* X *A. boreas* hybrid (*A. sp.*; ANCA hybrids) occupancy in the Blue Lakes area, Alpine County, CA. Lakes and ponds showing ANCA hybrid presence are from visual encounter surveys (VES) conducted in 2019; the most recent CDFW VES for each given pond. When combining surveys from 2009 and 2019, CDFW crews have observed ANCA hybrids of all life stages at Upper Blue Lake (Site ID 14670), which appears to be the primary ANCA hybrid habitat in the Blue Lakes area. In 2009, CDFW field staff also observed ANCA hybrid tadpoles in the small pond (Site ID 50100) west of Upper Blue Lake. ANCA letter codes in the legend indicate the life stages observed during the most recent survey as follows: “A” = adults and “L” = larvae. All flowing waters in the Blue Lakes area drain south into Blue Creek, which flows into the North Fork Mokelumne River (not shown).



Figure 10. Adult male *Anaxyrus canorus* X *A. boreas* hybrid (*A. sp.*; ANCA hybrids) at Site ID 14722 on August 21, 2019. (Nick Van Gilder, CDFW)



Figure 11. *Anaxyrus canorus* X *A. boreas* hybrid (*A. sp.*; ANCA hybrids) tadpoles on the southwestern shore of Upper Blue Lake (Site ID 14670) on August 21, 2019.

LITERATURE CITED

- Bradford, D. F. 1983. Winterkill, oxygen relations, and energy metabolism of a submerged dormant amphibian, *Rana muscosa*. Ecology 64:1171–1183.
- Brown, C., M.P. Hayes, G.A. Green, and D.C. Macfarlane. 2014. Mountain yellow-legged frog conservation assessment for the Sierra Nevada mountains of California, USA. USDA Forest Service Technical Report R5-TP-039. Available from: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3811864.pdf
- Brown, C., M.P. Hayes, G.A. Green, D.C. Macfarlane, and A.J. Lind. 2015. Yosemite toad conservation assessment. U.S. Forest Service Pacific Southwest Region Technical Publication R5-TP-040.
- California Department of Fish and Game (CDFG). 2011. Report to the Fish and Game Commission: a status review of the mountain yellow-legged frog (*Rana sierrae* and *Rana muscosa*). Available from: <http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=90162>
- California Department of Fish and Wildlife (CDFW). 2015. What is a triploid trout? 5/13/2015. Available from: <http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=94602>
- CDFW. 2016. Aquatic Biodiversity Management Plan for the Upper Mokelumne Management Unit. Available from: <https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=127574>
- Ewing, B. 2019a. Upper Blue Lake pre-stocking evaluation survey. Available from: <http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=175115>
- Ewing, B. 2019b. Lower Blue Lake pre-stocking evaluation survey. Available from: <http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=175806>
- Lindauer, A.L., and J. Voyles. 2019. Out of the frying pan, into the fire? Yosemite Toad (*Anaxyrus canorus*) susceptibility to *Batrachochytrium dendrobatidis* after development under drying conditions. Herpetological Conservation and Biology 14:185–198.
- Mazerolle, M.J., L.L. Bailey, W.L. Kendall, J.A. Royle, S.J. Converse, and J.D. Nichols. 2007. Making great leaps forward: accounting for detectability in herpetological field studies. Journal of Herpetology 41:672–689.
- United States Fish and Wildlife Service (USFWS). 2016. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Sierra Nevada Yellow Legged Frog, the Northern DPS of the Mountain Yellow-Legged Frog, and the Yosemite Toad. Federal Register 81:59046–59119