State of California
Department of Fish and Wildlife

Memorandum

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Subject: Native amphibian monitoring in the Jeff Davis Creek area, Alpine County

ENVIRONMENTAL SETTING

The Jeff Davis Creek area is located in central Alpine County, approximately twenty miles south of Lake Tahoe. The area lies at the south end of Blue Lakes Road, which begins 6.2 miles (mi; 10 kilometers [km]) south of Carson Pass and 2.5 mi (4 km) west of the junction of Highways 88 and 89 (**Figure 1**). Habitat in the area consists of montane and sub-alpine coniferous forest interspersed with open granite. Elevations in the area range from approximately 7,400 feet (ft; 2,255 meters [m]) at the confluence of Paradise Valley Creek and Jeff Davis Creek, up to 10,014 ft (3,052 m) at the summit of Raymond Peak, which is located due east of the survey area (**Figure 1**). Most land discussed in this memorandum is managed by Humboldt-Toiyabe National Forest (HTNF) and the northern portion of area surveyed is located within the Mokelumne Wilderness (**Figure 2**). The national forest land supports a wide variety of recreational uses and the area is highly visited because a dirt road connects Tamarack Lake, Sunset Lakes, and Wet Meadows Reservoir with Blue Lakes Road (**Figure 2**). Therefore, with many road-accessible waters and campgrounds available, the Jeff Davis Creek area receives high visitor use. Additionally, the Pacific Crest Trail runs east-west through the PWS, providing a convenient backcountry use corridor.

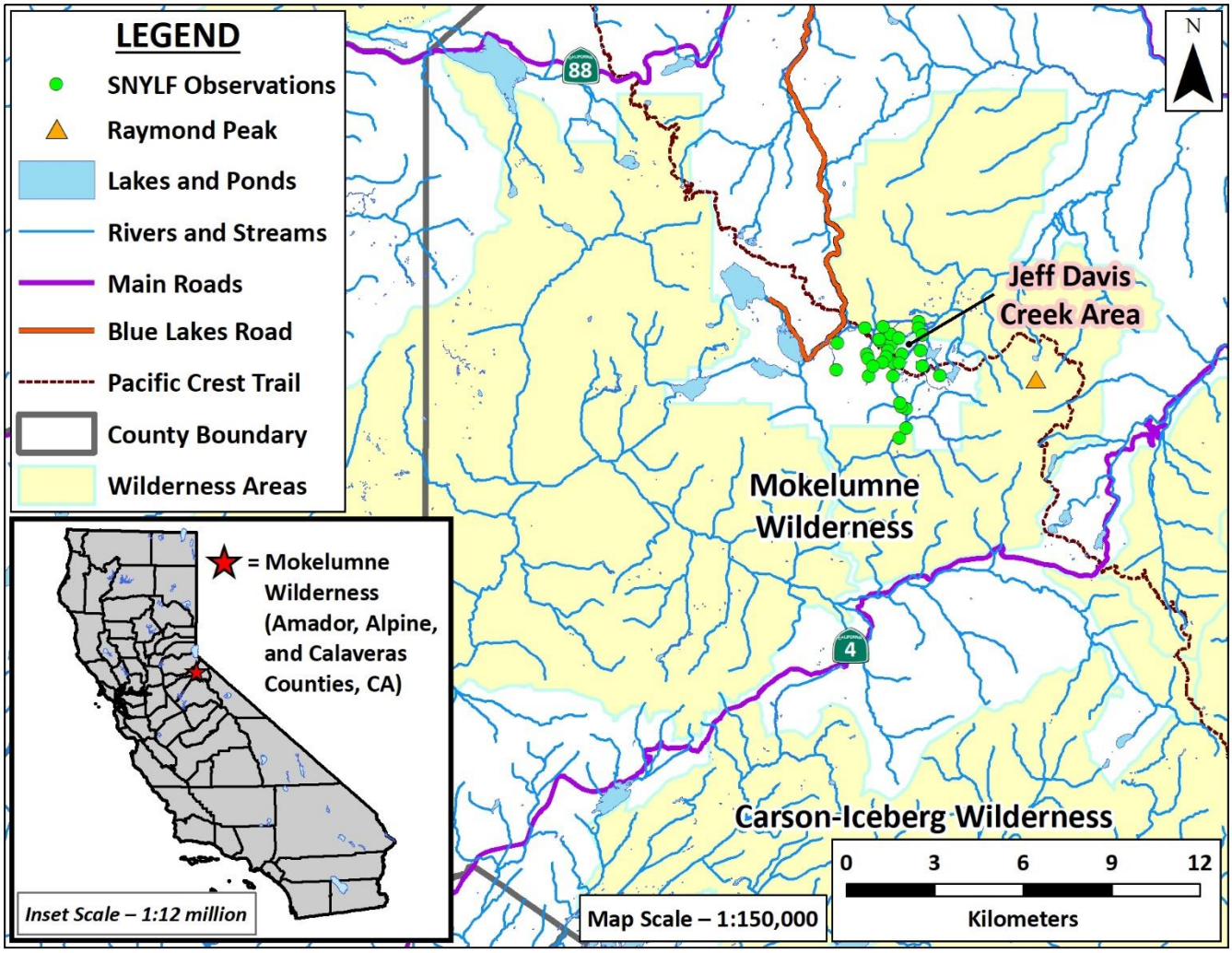


Figure 1: Mokelumne Wilderness, Amador, Alpine, and Calaveras Counties, CA. Green dots show Sierra Nevada yellow-legged frog (*Rana sierrae*; SNYLF) detections by CDFW crews during recent visual encounter surveys (VES).

INTRODUCTION

The Aquatic Biodiversity Management Plan for the Jeff Davis Creek Management Unit (CDFW 2014) identifies 37 waterbodies in the Jeff Davis Creek area as Native Species Reserve (NSR) for Sierra Nevada Yellow-legged Frogs (*Rana sierrae*; SNYLF; **Figure 2**). California Department of Fish and Wildlife (CDFW) began monitoring the NSR in 2002. Since that time, CDFW field staff have observed a seemingly stable SNYLF population (**Figure 3**).

A CDFW field crew visited the NSR on 19–20 August 2019 to perform herpetofauna surveys to assess current distributions and relative abundance of SNYLF. CDFW field staff focused 2019 survey efforts on stream segments in Jeff Davis Creek. CDFW staff conducted surveys according to the CDFW High Mountain Lakes (HML) visual encounter survey (VES) protocol.

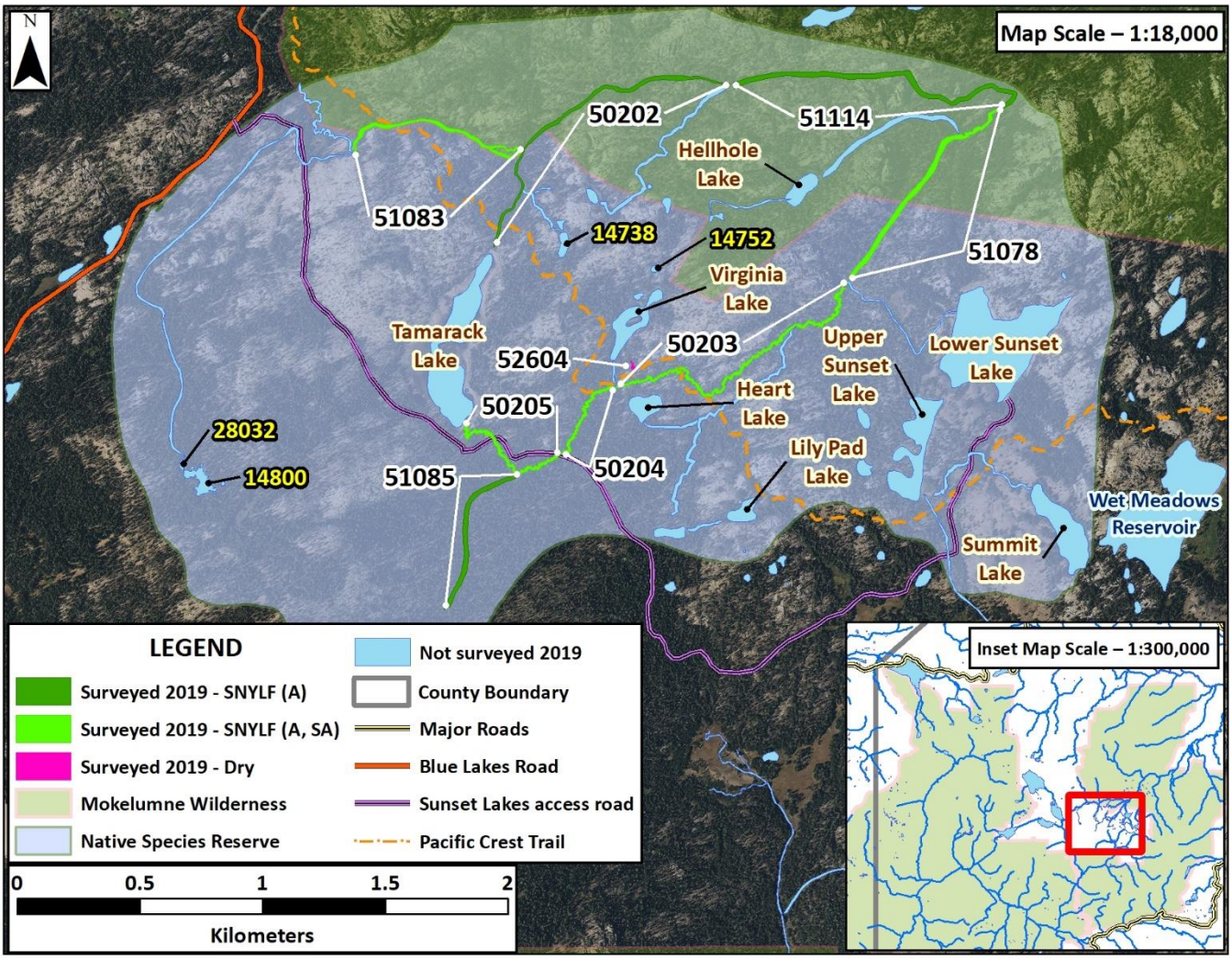


Figure 2: Sierra Nevada Yellow-legged Frog (*Rana sierrae*; SNYLF) detections in Jeff Davis Creek Native Species Reserve (NSR) by California Department of Fish and Wildlife (CDFW) field staff on 19–20 August 2019. In 2019, CDFW field staff focused visual encounter surveys (VES) in stream segments. Number labels shown are unique site identification codes that CDFW uses for data collection. Each Site ID corresponding to a stream segment surveyed in 2019 has two white leader lines, which point to the end points of the stream segment. SNYLF letter codes in the legend, which indicate the life stage(s) observed during 2019 surveys, are as follows: "A" = adults and "SA" = subadults. In prior survey years, CDFW staff have observed SNYLF in many additional ponds and stream segments of the NSR (including Tamarack, Virginia, Heart, Upper Sunset, and Summit Lakes, plus several other small ponds and stream segments shown on the map; see CDFW 2014). CDFW field staff did not observe larval SNYLF during 2019 surveys. However, in previous survey years, CDFW staff have observed larval SNYLF at Heart Lake, Virginia Lake, and Site IDs 50202, 50205, 14738, 14752, 14800, and 28032. The latter four sites are highlighted in yellow to indicate the CDFW did not survey those locations in 2019. CDFW has also observed SNYLF egg masses at Heart Lake, Virginia Lake, and Site ID 14738 in 2005, 2008–2010, and 2012. All flowing waters in the basin drain northeast into Pleasant Valley Creek, and eventually into the East Fork Carson River via Markleeville Creek.

THREATS

Introduced Fish

Historically, CDFW stocked fish into all eight named lakes in the Jeff Davis Creek NSR (**Figure 2**). The primary species CDFW stocked were Brook Trout (*Salvelinus fontinalis*; BK), Rainbow Trout (*Oncorhynchus mykiss*; RT), and Lahontan Cutthroat Trout (*Oncorhynchus clarki henshawi*; LCT). CDFW also stocked Arctic Grayling (*Thymallus arcticus*; AG) at Virginia Lake from 1969 to 1972 and Golden Trout (*Oncorhynchus mykiss aguabonita*; GT) at Hellhole Lake from 1967 to 2000. Additionally, CDFW stocked Chinook Salmon (*Oncorhynchus tshawytscha*; CHIN) at Lower Sunset Lake in 1982 and Steelhead (*Oncorhynchus mykiss irideus*; SH) at Hellhole Lake in 1930 and 1931. CDFW field staff have also observed Lahontan Redside (*Richardsonius egregious*; LRS) in Tamarack Lake, Lower Sunset Lake, and within several stream segments of the Jeff Davis Creek NSR.

In 2000, CDFW suspended aerial stocking activities in most of the Sierra Nevada, including locations in the Jeff Davis Creek NSR (CDFW 2014). After 2000, the only lake in the NSR to receive fish allotments was Tamarack Lake. However, CDFW suspended allotments to Tamarack Lake in 2008. Tamarack Lake may still contain a small number of LCT persisting from the most recent stocking period (1997–2008). However, CDFW has not used gill nets to sample Tamarack Lake since 2012, at which time staff captured seven LCT. CDFW suspects LCT cannot successfully reproduce in Tamarack Lake. Additionally, water levels in Tamarack Lake dropped drastically during periods of the 2012–2015 drought. These conditions may have caused any LCT remaining in Tamarack Lake to die out.

Based on overnight gill net surveys and VES, CDFW has determined that five of the named lakes in Jeff Davis Creek NSR (Heart Lake, Lily Pad Lake, Summit Lake, Upper Sunset Lake, and Virginia Lake) have likely become fishless in the absence of stocking. Hellhole Lake may also be fishless, but the tributaries contain abundant spawning habitat and no natural barriers to upstream fish passage (CDFW 2014).

Self-sustaining populations of LCT and LRS are present in Pleasant Valley Creek (Site ID's 51083, 50202, and 51114). CDFW has no record of planting the creek and the fish found within the NSR likely migrated downstream from Tamarack Lake. The habitat composition of Pleasant Valley Creek is complex, and any potential fish removal would likely require piscicides. Additionally, the creek is occupied by threatened LCT. Therefore, CDFW will presently manage Pleasant Valley Creek as a self-sustaining LCT fishery (CDFW 2014).

During 2019 VES, CDFW staff observed trout in Site IDs 51114 and 51078. Staff observed most trout in the most downstream end of Site ID 51114, in a wide, flat, pooled stream segment. All trout staff observed were 10–20 cm long, and, although unidentified at the time, likely LCT. The presence of trout likely prevents successful SNYLF breeding and recruitment in the areas where

the species co-occur. Trout prey on SNYLF and are a potential source of competition for food (e.g., benthic macroinvertebrates).

CDFW does not know if LRS affect SNYLF egg masses or tadpoles, and, therefore, influence recruitment to the adult life stage. However, there is some evidence that other cyprinids can cause reduced survival and growth in amphibians. For example, a mesocosm study found that Fathead Minnows (*Pimephales promelas*) reduced the survival and growth rates of salamander larvae through competition and inflicting injury (Pearson and Goater 2009). Other small fish species have been linked with sublethal effects on amphibians, including Mosquitofish (*Gambusia* sp.; Pyke and White 2000; studies summarized in Kats and Ferrer 2003). Experimental evidence has shown that Three-spined Sticklebacks (*Gasterosteus aculeatus*) cause limb and tail damage in larval western toads (*Anaxyrus boreas*) identical to damage observed in the field (Bowerman et al. 2010). Undoubtedly, numerous fish species can affect amphibian larvae in different ways, and many of those effects may be deleterious, if not necessarily lethal (Wells 2007 pgs. 657–659).

Disease

SNYLF populations in the Jeff Davis Creek NSR are positive for chytrid fungus, *Batrachochytrium dendrobatidis* (*Bd*). In 2008 and 2010, CDFW genetically sampled SNYLF populations in the area with epithelial swabs and partner scientists screened for the presence of *Bd* DNA using real-time quantitative polymerase chain reaction (qPCR) analysis. Individuals tested positive for *Bd*, with light to moderate zoospore loads.

Marginal Habitats

In the past, successful SNYLF breeding and recruitment was likely precluded from the large, deep lakes in the area because of negative interactions with introduced trout. Therefore, SNYLF recruitment would have been relegated to the smaller, shallower ponds that have a higher risk of freezing solid in winter, drying during drought, and may be more susceptible to anthropogenic disturbance. In the absence of stocking, evidence of successful SNYLF recruitment has been observed in Virginia Lake and in Heart Lake, but not in any of the other named lakes in the NSR.

SNYLF POPULATION STATUS

Monitoring data from 2002 to 2019 suggest that the SNYLF population in the Jeff Davis Creek NSR is stable, and possibly increasing (**Figure 3**). Prior to 2019, CDFW field staff most recently surveyed the entire NSR in 2012. During the intervening years, CDFW only surveyed two waterbodies in the area: Site ID 52604 in 2013 and Wet Meadows Reservoir (Site ID 14793), which is outside of the NSR, in 2018 (**Figure 2**). However, HTNF biologists surveyed several lentic sites in the Jeff Davis Creek NSR in 2013 and 2015, during which field staff observed SNYLF at several locations, including Heart, Lower Sunset, Tamarack, and Virginia Lakes, plus Site ID 14738. During these VESs, HTNF biologists observed 56 and 83 post-metamorphic SNYLF in 2013

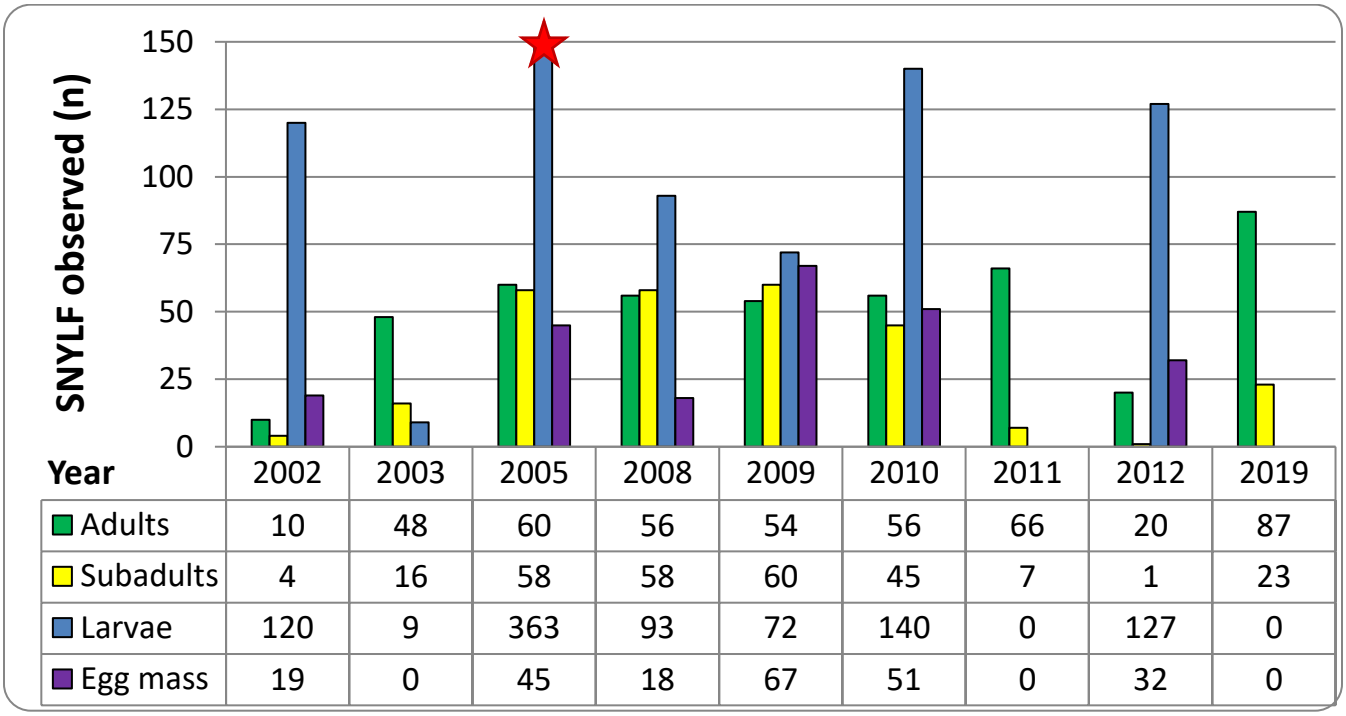
and 2015, respectively. Additionally, in 2018, HTNF collected genetic swab data from ten post-metamorphic SNYLF captured at Virginia Lake.

In 2019, CDFW field staff only surveyed stream segments. However, although field staff did not survey all waterbodies in the NSR, CDFW observed more adult SNYLF during 2019 surveys than in any other previous survey year (**Figure 3**). Half of the sites CDFW field staff surveyed in 2019 had only been surveyed once before, during baseline surveys, in 2011 (Site IDs 50183, 51114, 51078, and 51085). CDFW had most recently surveyed the remaining sites in 2010 (Site IDs 50202, 50203, 50204, and 50205). High flows, dense vegetation, and complex terrain made Pleasant Valley Creek (including Site IDs 50202 and 51114) difficult to survey (**Figures 4 and 5**). Given these challenging survey conditions, field staff likely overlooked additional frogs that may have been present during surveys. Complete overgrowth of vegetation made several small sections of Site ID 51114 impassible, which prevented staff from surveying those sections (**Figure 4**). Additionally, flows on Pleasant Valley Creek were high and fast, which provided additional cover for SNYLF. Comparatively, flows in Site ID 51083 (immediately upstream of 50202; **Figure 2**) were very low and the reach consisted of intermittent stream pools separated by little to no water in the stream channel.

In 2019, CDFW field staff observed most SNYLF at Site IDs 50203, 50204, and 50205. These segments provide wetted movement corridors for SNYLF to disperse between overwintering, breeding, and forging habitats, and encourage genetic exchange between SNYLF populations in the NSR. Based on CDFW VES surveys, SNYLF relative abundance has remained relatively high in these stream sections since 2005.

CDFW field staff did not observe any SNYLF larvae or egg masses during surveys in 2019. However, limited visibility from high flows and dense vegetation may partly explain why surveyors were unable to detect early SNYLF life stages. Additionally, the only sites CDFW surveyed in 2019 in which SNYLF larvae have been previously detected in the Jeff Davis Creek NSR are Site IDs 50202 and 50205. However, CDFW has observed very few larvae at those sites, whereas staff have previously detected most larval SNYLF in lentic sites that CDFW did not survey in 2019, including Heart Lake, Virginia Lake, and Site IDs 14738, 14752, 14800, and 28032 (**Figure 2**). During late spring/early summer surveys in previous years (in 2005, 2008–2010, and 2012), CDFW field staff have also observed SNYLF egg masses at Site IDs 14738, 14800, and Virginia Lake.

During the next round of surveys in the Jeff Davis Creek NSR, CDFW will plan to survey all waterbodies, including both streams and ponds. Additionally, CDFW plans to undertake surveys in late spring or early summer to attempt detecting SNYLF egg masses, observations of which could be compared with previous survey years. CDFW will continue these occasion surveys in the Jeff Davis Creek NSR to monitor long-term SNYLF population trends.



Year	2002	2003	2005	2008	2009	2010	2011	2012	2019
Adults	10	48	60	56	54	56	66	20	87
Subadults	4	16	58	58	60	45	7	1	23
Larvae	120	9	363	93	72	140	0	127	0
Egg mass	19	0	45	18	67	51	0	32	0

Figure 3: Number of Sierra Nevada Yellow-legged Frogs (*Rana* sierrae; SNYLF) detected during visual encounter surveys (VES) in the Jeff Davis Creek NSR between 2002 and 2019. Survey efforts varied between years. Baseline surveys occurred in 2002 and 2003. Subsequent survey efforts, in 2005 and 2008–2010, were similar between years, during which CDFW field staff surveyed between 12 and 16 waterbodies each year. In 2011, CDFW did not conduct VES in previously surveyed locations, but instead surveyed approximately 15 new sites, most of which were stream segments. Additionally, CDFW conducted 2011 VES later in the summer. Survey timing and habitat type were likely reasons that CDFW did not detect early life stage SNYLF in 2011. In 2012, CDFW conducted widespread surveys, including approximately 30 sites in Jeff Davis Creek NSR. In 2019, CDFW only surveyed stream segments, which did not include the three primary locations in which CDFW has detected early life stage SNYLF. For consistency, SNYLF larvae and egg mass counts only include the total from three waterbodies: Site IDs 14738, 14800, and Virginia Lake). These three sites account for >95% of all SNYLF larvae and egg mass detections in the Jeff Davis Creek NSR since 2002. ★ [red star] indicates an outlier value (n = 363) beyond the range shown in the figure.

Figure 4: Site ID 51114, a section of Pleasant Valley Creek, looking downstream. Photo taken on August 19, 2019. Most of this reach was heavily vegetated. (CDFW)

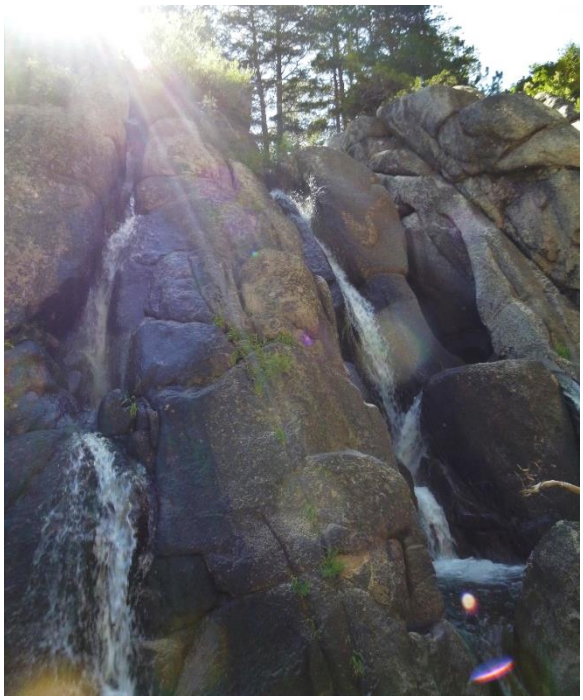


Figure 5: A large cascade, approximately eight meters high, toward the downstream end of Site ID 51114. Photo taken on August 19, 2019. This photo illustrates the habitat complexity in Pleasant Valley Creek. (CDFW)

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