

**FGC - 670.1 (3/94)**

**A PETITION TO THE STATE OF CALIFORNIA FISH AND GAME COMMISSION**

For action pursuant to Section 670.1, Title 14, California Code of Regulations (CCR) and Sections 2072 and 2073 of the Fish and Game Code relating to listing and delisting endangered and threatened species of plants and animals.

**I. SPECIES BEING PETITIONED:**

**Common Name: Foothill yellow-legged frog**

**Scientific Name: (*Rana boylei*)**

**II. RECOMMENDED ACTION:**

*(Check appropriate categories)*

a. List **X**    b. Change Status

As endangered

As threatened **X**

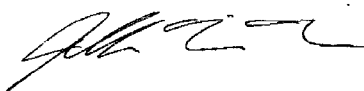
c. Or Delist

**III. AUTHOR OF PETITION:**

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*I hereby certify that, to the best of my knowledge, all statements made in this petition are true and complete.*

Signature:



Date: December 14, 2016

**BEFORE THE FISH AND GAME COMMISSION**

**Petition to List the Foothill Yellow-Legged  
Frog (*Rana boylei*) As Threatened  
Under the California Endangered Species Act**



*Photo by Todd Steiner (used with permission)*

**Submitted To:** California Fish and Game Commission  
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**Submitted By:** Center for Biological Diversity

**Date:** December 14, 2016

## EXECUTIVE SUMMARY

The Center for Biological Diversity petitions the California Fish and Game Commission to list the foothill yellow-legged frog (*Rana boylei*) as a threatened species under the California Endangered Species Act.

Adult foothill yellow-legged frogs are moderately-sized (1.5 to 3 inches) with a distinctive lemon-yellow color under their legs. They inhabit partially shaded, rocky perennial streams and rivers at low to moderate elevations in Pacific Coast drainages as well as the lower western slopes of the Sierra Nevada mountains. The foothill yellow-legged frog life cycle is synchronized with the seasonal timing of streamflow conditions. Adult frogs move throughout stream networks from winter refugia to mating habitat where eggs are laid in spring and tadpoles rear in summer. For breeding they require streams with riffles containing cobble-sized or larger rocks as substrate to be used as egg laying sites. Non-breeding habitat is characterized by perennial water where they can forage through the summer and fall months.

In California, foothill yellow-legged frogs were once found from the Oregon border to at least as far south as the Upper San Gabriel River, Los Angeles County; the species also possibly occurred historically as far south as Orange County, southwestern San Bernardino County and San Diego County. Different regions of California may contain distinct populations or subspecies of foothill yellow-legged frogs. Foothill yellow-legged frogs have now disappeared from more than half of their historically occupied locations throughout California and Oregon, resulting in a range contraction in northern and southern California.

The survival of the foothill yellow-legged frog in California is threatened by a combination of factors, including habitat alteration and destruction from: dams, water development and diversions; logging; marijuana cultivation; mining; roads and urbanization; recreation; and off-road vehicles. Frogs are also threatened by impacts from invasive species, disease, climate change, and pollution.

The foothill yellow-legged frog is now extirpated from all of southern California south of San Luis Obispo County and is nearly extirpated from the south coast region. The species is extirpated or near extirpation in many areas of the central coast and the San Francisco Bay Area, with declines in many drainages in these regions. Significant populations remain in the Diablo Range and throughout Sonoma County. There have been documented declines of frog populations in the upper Sacramento River basin although some significant and many small populations remain in the upper Sacramento River basin.

The largest foothill yellow-legged frog populations in California are in the north coast range, with healthy populations scattered throughout the region. The strongholds for the species are in the Smith River, Red Cap Creek tributary of the Klamath River, South Fork Trinity River, South Fork Eel River; Redwood Creek, coastal tributaries in Mendocino County, and Russian River tributaries. However, only 6 sites in northern California have large populations exceeding 100 breeding females per kilometer of river, with an additional 9 sites having more than 50 breeding females per km. There have been documented declines in the northern coastal California region, with frogs lost from 39 of 165 historical sites (24%) in the north coast.

Foothill yellow-legged frogs are nearly extirpated from the southern portion of the Sierra Nevada. They have disappeared from Yosemite, Sequoia and Kings Canyon National Parks, and are near extirpation in Sequoia and Sierra National Forests, with few remaining populations and limited distribution. Although populations persist in many river basins in the northern and central Sierras, including the American, Clavey, Cosumnes, Feather, Merced, Mokelumne, Stanislaus, Tuolumne, and Yuba rivers, many former populations have been lost and the majority of recent observations in Sierran national forests are of small and scattered populations, with limited evidence of successful reproduction. At least half of the known historical locations have been lost in every northern and central Sierra county except Plumas County.

The overall population trend for the foothill yellow-legged frog in California is distressing. The species had disappeared from 45 percent of its historic range in California by 1991, and frog numbers at many of the formerly large frog populations have crashed in recent years. While the number of populations is important, population size is also critical; as of 2005 only 30 of the 213 sites in California with foothill yellow-legged frogs (14%) had populations estimated to be 20 or more adult frogs.

Existing federal and state management and regulatory mechanisms - such as occurrence on federally protected lands, consideration under the National Environmental Policy Act or Clean Water Act or California Environmental Quality Act, or coverage under federal Habitat Conservation Plans and state Natural Community Conservation Plans - have proved inadequate to prevent the decline of foothill yellow-legged frogs.

Recommended management actions for foothill yellow legged frogs will vary depending on the type of river system where a given extant population remains, either with flows regulated by dams or in free-flowing systems that may be subject to other forms of human perturbation (such as illegal diversion of flows in summer for *Cannabis* cultivation or excessive sedimentation and hillslope erosion due to road building and other types of land use in the upland portions of the watersheds). In rivers with dams, avoiding aseasonal flow fluctuation which could cause the stranding and scouring of egg masses and tadpoles should be avoided. Maintaining thermal regimes conducive to larval survival and rapid development will also be important. Recovery actions for the foothill yellow-legged frog should include management of non-native bullfrogs which are predators as adults, competitors as tadpoles and reservoir hosts for parasites and disease organisms that have been shown to have negative effects on foothill yellow legged frogs. Management of non-native fish and crayfish which are predators of frogs, tadpoles, and egg masses will also be important elements of recovery. Reintroduction into stream systems with appropriate habitat should also be considered.

## **NOTICE OF PETITION**

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Petitioner Center for Biological Diversity formally requests that the California Fish and Game Commission list the Foothill yellow-legged frog (*Rana boylei*) as a threatened species under the California Endangered Species Act ("CESA"), Fish and Game Code §§ 2050 et seq. This petition sets in motion a specific administrative process as defined by Fish and Game Code §§ 2070-2079, placing mandatory response requirements on the Commission and very specific time constraints upon those responses.

Petitioner Center for Biological Diversity is a national nonprofit organization with more than 1.1 million members and online activists dedicated to the protection of endangered species and wild places, through science, policy, education, citizen activism and environmental law.

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## NATURAL HISTORY AND STATUS OF FOOTHILL YELLOW-LEGGED FROG

### A. NATURAL HISTORY

#### Description

Adult foothill yellow-legged frogs are moderate-sized (37 to 82 mm snout-urostyle length) ranid frogs with indistinct dorsolateral folds, fully webbed feet, slightly expanded toe tips, and rather thick, rough pebbly skin (Stebbins 1951, 2003; Zweifel 1955). Dorsal color is highly variable and is usually light and dark mottled gray, olive, or brown, but variable amounts of brick red are often present, and a pale triangle is often located between the eyes and the snout (Zweifel 1955; Nussbaum et al. 1983; Jones et al. 2005). The undersurfaces of the posterior abdomen and ventral surfaces of the rear legs are varying shades of yellow, which fades to white anteriorly on the belly (Stebbins 1951; Zweifel 1955). Females attain larger sizes than males (Jennings and Hayes 1994). Mature males have a dark swollen bump or nuptial pad on the dorso-medial surface of each thumb that becomes darker, slightly larger, and rougher to the touch during the breeding season (Hayes et al. 2016). Males also have proportionally larger forearm muscles and narrower waists than females (Hayes et al. 2016).

Juvenile foothill yellow-legged frogs look similar to adults except for their smaller size (14 to 36 mm snout-urostyle length), more contrasting dorsal coloration, and lack of significant yellow on their undersurfaces (Stebbins 1951; Zweifel 1955; Nussbaum et al. 1983; Jones et al. 2005). Undersurfaces of the youngest juveniles are cream or flesh colored and the yellow color makes its first appearance on the calves and thighs, expanding anteriorly and posteriorly as juveniles grow in size (Hayes et al. 2016).

Newly hatched tadpoles are dark brown to black and typically measure 7 to 8 mm in total length (Storer 1925; Zweifel 1955). As tadpoles grow, their coloration turns an olive color with coarse brown mottling dorsally. The ventral surface of the body is silvery and nearly opaque, and the coiled intestine is barely visible. The body is more flattened, and the tail fin, tallest at its mid-portion, has a relatively broad musculature (Zweifel 1955). When viewed from above, the eyes of foothill yellow-legged frog tadpoles are dorsally positioned so they are located within the outline of the head in bird's eye view (Hayes et al. 2016). Tadpoles have a large, downward-oriented, almost suction-like mouth with several rows of denticles or labial teeth, with the number of rows increasing with development (Hayes et al. 2016).

Egg masses contain from about 100 to more than 3,000 eggs, depending on the size of the female and geographic variation among populations (Kupferberg et al. 2009b). Upon deposition, the mass is compact and the jelly is highly transparent and has a hyaline blue tint. Within 6 hours, the egg mass absorbs water, loses the bluish tint, expands to a long-axis diameter of 45 to 90 mm, and resembles a cluster of grapes (Hayes et al. 2016). Each ovum is dark brown to black in appearance and surrounded by three jelly envelopes. Individual eggs range from 1.0 to 2.3 mm in diameter, and the outermost of the three jelly envelopes ranges from 3.9 to more than 6 mm in diameter (Storer 1925; Zweifel 1955).

## Taxonomy

*Rana boylei* was named after Dr. Charles Elisha Boyle, a California “49er” that collected the type specimens in 1850 (Jennings 1987). The foothill yellow-legged frog was first described as a species by Baird (1854). A half-century of taxonomic uncertainty followed with several name changes (Zweifel 1968). Since 1955, the foothill yellow-legged frog has been recognized as a distinct species in the family Ranidae (Zweifel 1955; Collins 1990). The “boylei” group of western ranids seems to have diverged from other ranids about 8 million years ago (Macey et al. 2001). Based on morphological analyses, *R. boylei* was thought to be most closely related to *R. muscosa*, the mountain yellow-legged frog (Zweifel 1955). However, a recent phylogenetic analysis allied it most closely to *R. pretiosa*, the Oregon spotted frog (Macey et al. 2001).

Several studies have detected intraspecific genetic variation (Case 1978a,b; Lind 2005; Dever 2007). Recent mitochondrial DNA analysis by Lind (2005) and Lind et al. (2011) identified significant genetic partitioning between coastal and Sierra Nevada foothill yellow-legged frog populations, two distinct more northerly groupings, and significant differentiation of a single sample in the southern Sierra Nevada from samples in the central and northern Sierra (a pattern congruent with that of other herpetofauna species widespread across the Sierra, e.g., Macey et al. 2001). Conclusions about evolutionary relationships did not involve formal taxonomic description for any of these groups in either of these studies, but Lind (2005) and Lind et al. (2011) noted that some populations may ultimately be regarded as deserving formal taxonomic recognition.

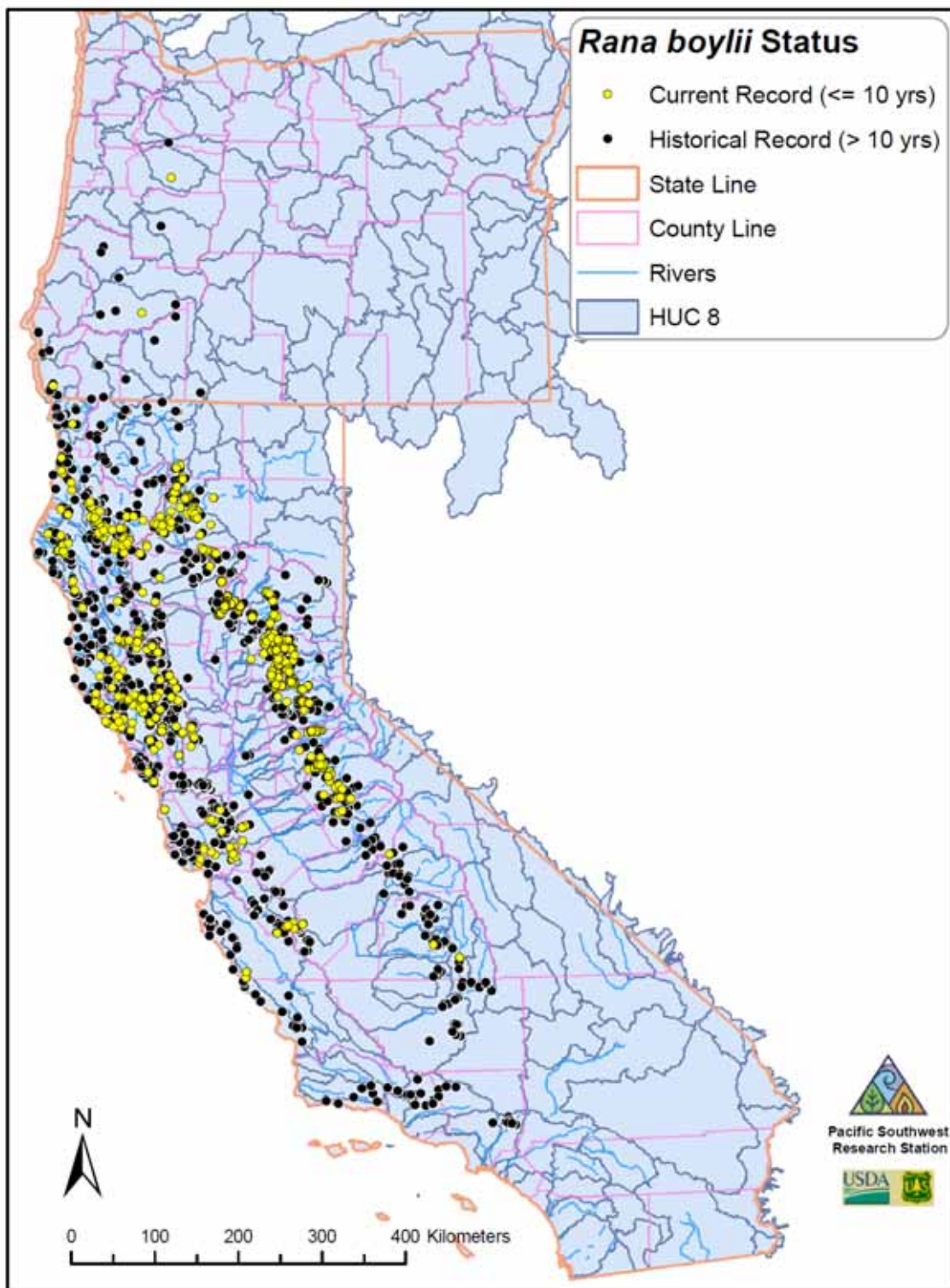
## Range in California and Documented Range Contraction

The overall range of the foothill yellow-legged frog historically included lower elevation streams draining the Pacific slope, from the upper reaches of the Willamette River system, Oregon, south to northwestern Baja California (NatureServe 2011; Hayes et al. 2016). In California, foothill yellow-legged frogs were found from the Oregon border to at least as far south as the Upper San Gabriel River, Los Angeles County; the species also possibly occurred historically as far south as Orange County, southwestern San Bernardino County and San Diego County.

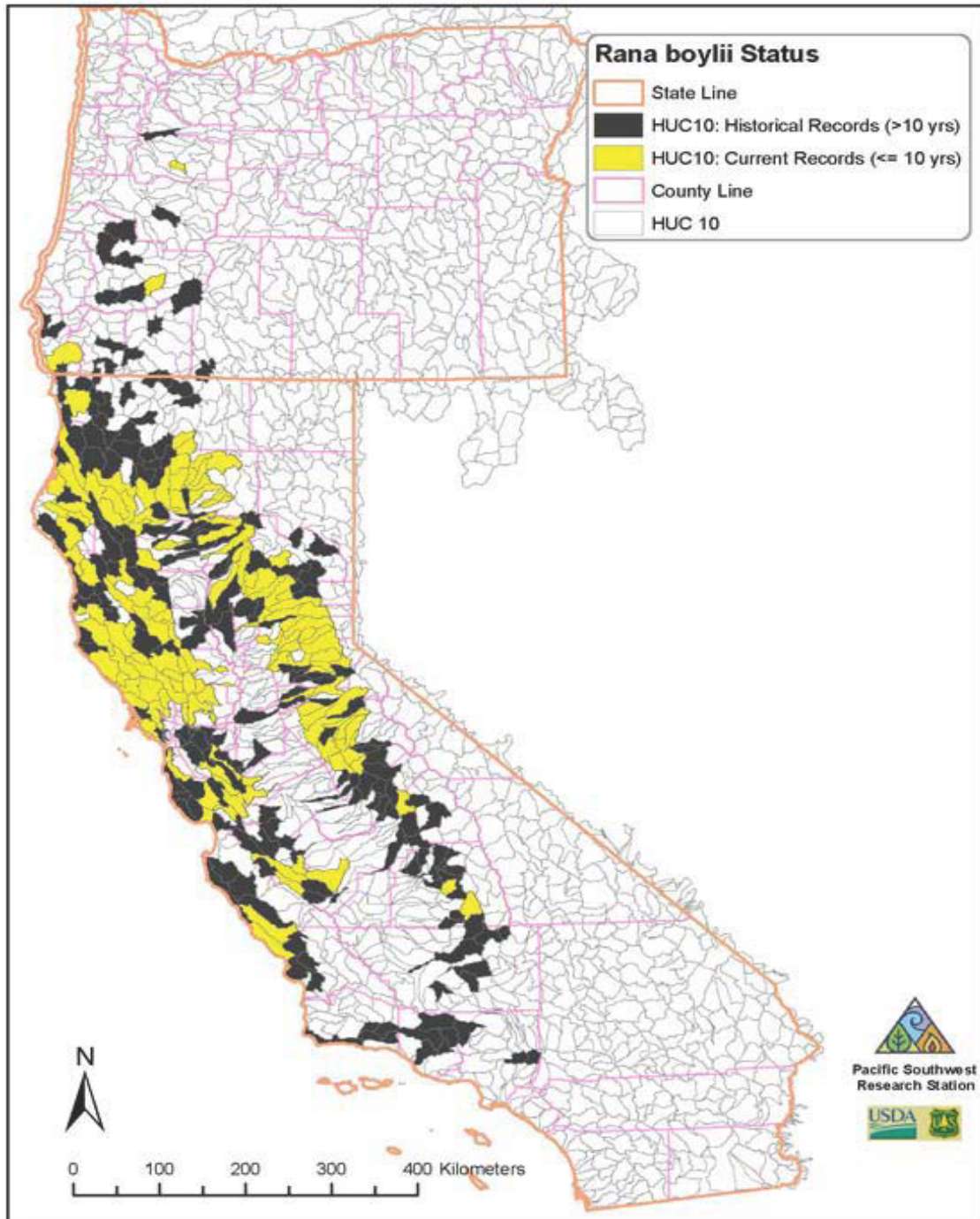
The species has now disappeared from more than half of its historically occupied locations (Lind 2005) throughout its range in California and Oregon, resulting in a range contraction at the northern and southern ends of the range. The decline is especially severe in the northern portion of the range and in southern California (see Sweet 1983; Jennings and Hayes 1994; Hayes and Jennings 1988; Jennings 1995). Maps produced by Lind (2005), Olson and Davis (2009), U.S. Forest Service (2011), Hayes et al. (2016), and Thomson et al. (2016) illustrate the range contraction (Figures 1 through 4).

Howard et al. (2015) compiled the California Freshwater Species Database from nearly 500 sources (TNC 2015), the first comprehensive geospatial database of California’s freshwater species standardized into single format, providing a single source for geodata covering the plants and animals that rely on California’s freshwater resources to survive. A description of the methods used by Howard et al. (2015) to compile the data is available in a recent study published in PLoS ONE. Mapping the *R. boylei* occurrence data from the California Freshwater Species Database would also illustrate the overall range contraction of the species.

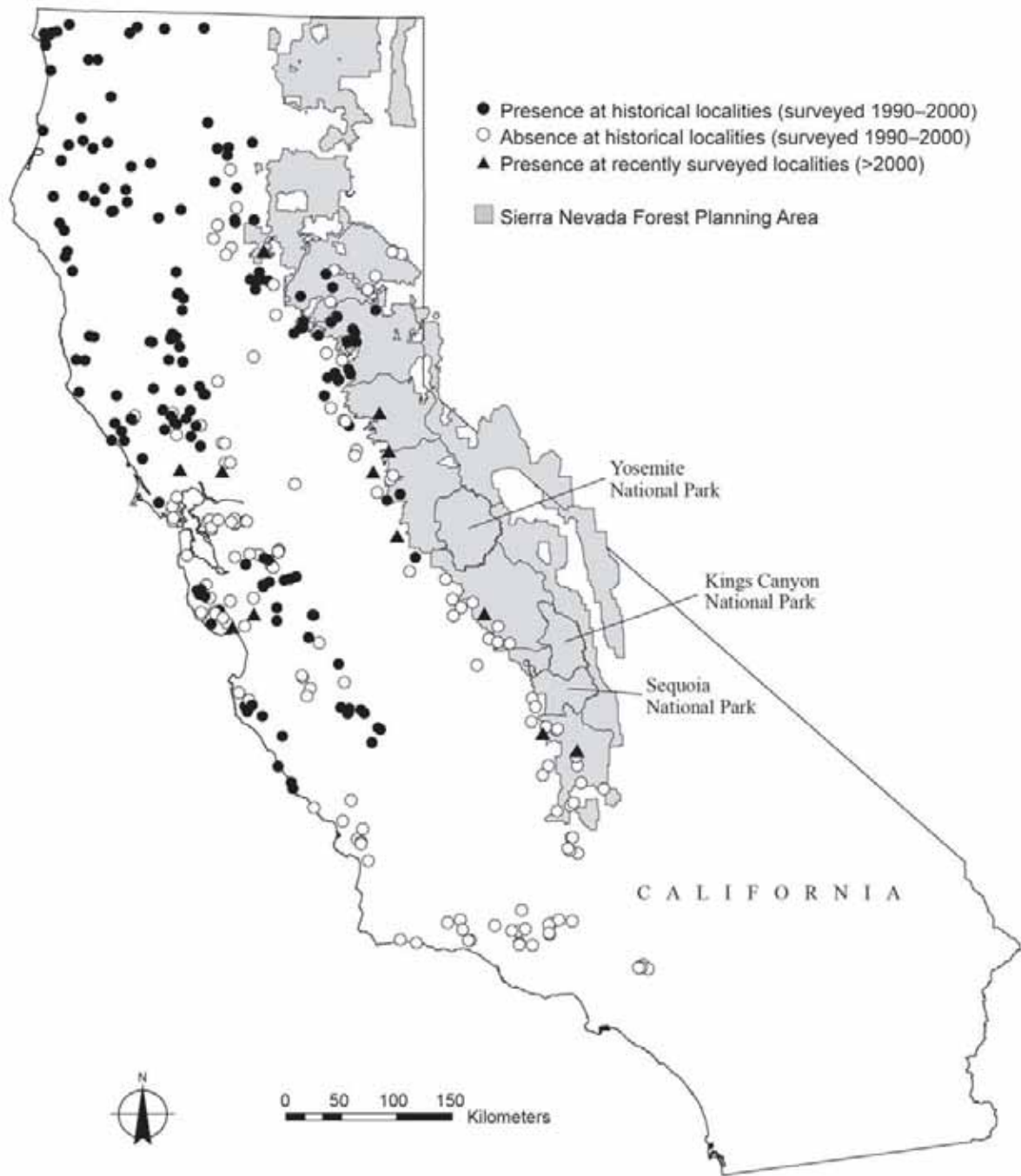




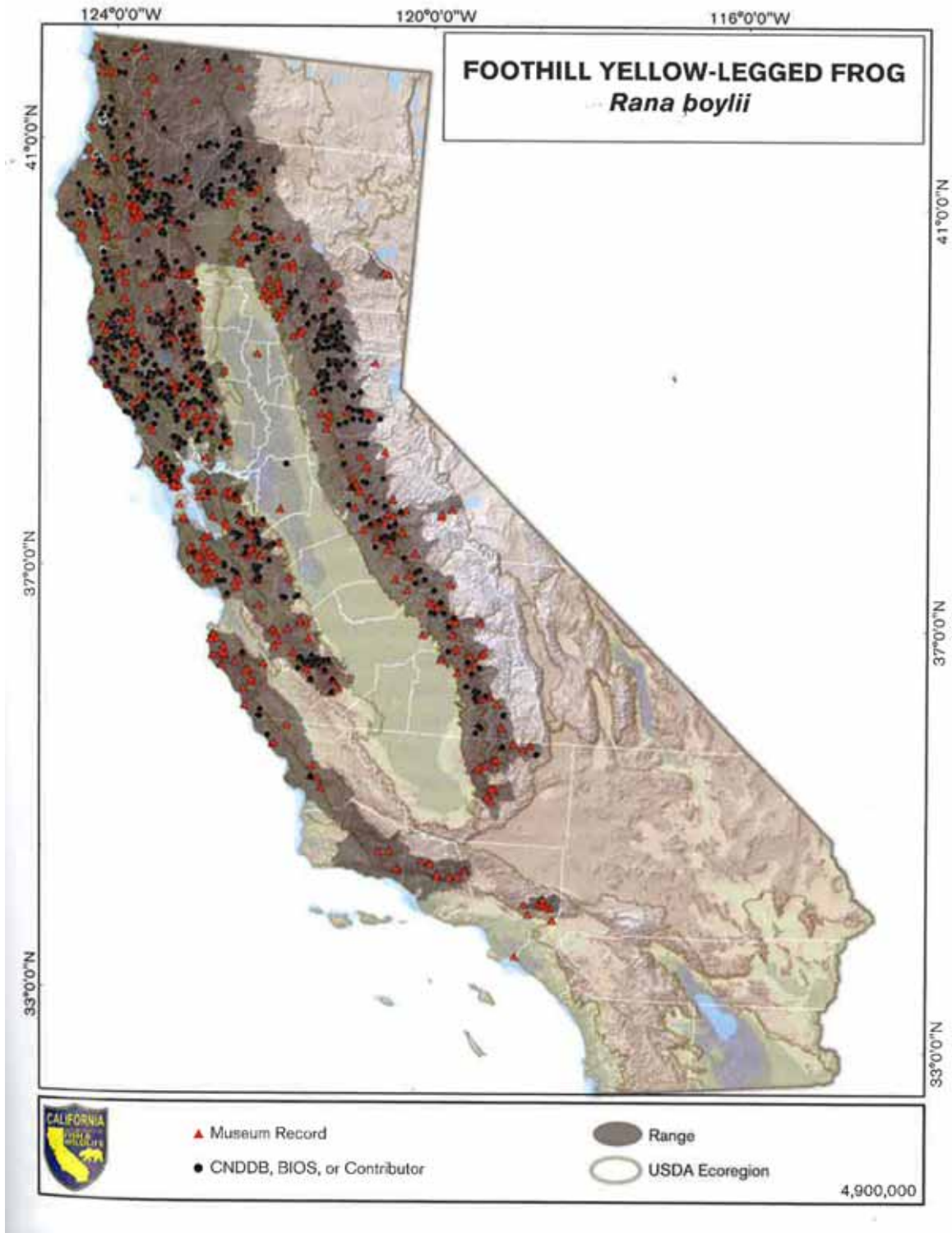
**Figure 1.** Range contraction map from USFS (2011) comparing historic ( $> 10$  yrs) and recent ( $< 10$  years) locality records. The map was developed using over 6,000 locality records from museum collections, research projects, technical reports, and government databases.



**Figure 2.** Range contraction map from USFS (2011) comparing historic (> 10 yrs) and recent (< 10 years) presence by watershed. The map was developed using over 6,000 locality records from museum collections, research projects, technical reports, and government databases.



**Figure 3.** Distribution and status map by Hayes et al. (2016) of the foothill yellow-legged frog (*Rana boylei*) in California, based on an update of Lind (2005). Lind (2005) assessed status prior to year 2000. The Hayes et al. (2016) map overlays new sightings from post-2000 localities on that previous analysis.



**Figure 4.** Distribution map by Thomson et al. (2016) of museum records and CNDDB/BIOS records of the foothill yellow-legged frog in California

## Habitat Requirements

Foothill yellow-legged frogs inhabit partially shaded, rocky perennial streams and rivers at low to moderate elevations, across a range of vegetation types including chaparral, oak woodland, mixed coniferous forest, riparian sycamore and cottonwood forest, and wet meadows (Nussbaum et al. 1983; Stebbins 1985; Hayes and Jennings 1988). Foothill yellow-legged frogs are primarily stream dwelling. Stebbins (1985) describes foothill yellow-legged frogs as stream or river frogs found mostly near water with rocky substrate, often found in or near riffles, and on open, sunny banks. Other authors have expanded this description, and offer variations (e.g. Storer 1925; Fitch 1938; Zweifel 1955; Hayes and Jennings 1988; Kupferberg 1996a; Lind et al. 1996; Van Wagner 1996). Jennings and Hayes (1994a) noted that suitable streams have riffles containing cobble-sized (7.5 cm diameter) or larger rocks as substrate. Habitat suitable for egg laying where flow velocities are less than those found in riffles varies among regions and size of river (Bondi et al. 2013). Within a single watershed, these frogs can occupy a wide range of stream sizes (from 1st to 7th stream order, Bury and Sisk 1997), but occupied streams are generally small to mid-sized with some shallow, flowing water (Hayes and Jennings 1988). Fuller and Lind (1992) observed subadults on partly shaded (20%) pebble/cobble river bars near riffles and pools. Less typically, occupied streams lack a rocky, cobble substrate (Fitch 1938). Other types of riparian habitats include isolated pools and vegetated backwaters (Hayes and Jennings 1988, Ashton et al. 1998). Habitat requirements vary seasonally and with life stage, but this species is absent, or occurs at low density even in suitable physical habitat if introduced aquatic predators (e.g. bullfrogs, bass) are present (Hayes and Jennings 1986, 1988; Kupferberg 1997a).

## Life History

The foothill yellow-legged frog life cycle is synchronized with the seasonal timing of streamflow conditions. Radiotelemetry studies show that adult frogs move throughout dendritic networks of streams from winter refugia, such as small tributary streams, where they can avoid mortality due to flooding (Bourque 2008; Gonsolin 2010) to mating habitat in wider and more sunlit mainstem channels where eggs are laid in spring and tadpoles graze on algae in summer (Wheeler and Welsh 2008). Non-breeding habitat is characterized by perennial water where they can forage through the summer and fall months. Springs, seeps, or other moist habitats such as woody debris and clumps of sedges occurring at high-water lines may serve as refugia during periods of high stream flow in winter (Van Wagner 1996; Rombough 2006).

Breeding is triggered by warming water temperatures, decreasing streamflows, and increasing daylength during the transition between the wet and dry season. Breeding sites are generally (but not always) located in low-gradient stream reaches at depositional features such as lateral point bars and pool tail-outs (Kupferberg 1996a; Wheeler and Welsh 2008). Breeding may commence as early as March in warm coastal locations and as late as July in snowmelt dominated rivers (Storer 1925; Zweifel 1955; Ashton et al. 1998; AmphibiaWeb 2012; Wheeler et al. 2014).

Like most ranid frogs, males probably defend areas around themselves during breeding season (Martof 1953; Emlen 1968). Foothill yellow-legged frog vocalizations are seldom heard. The voice is a guttural, grating sound on one pitch or with rising inflection, a

single croak lasting  $\frac{1}{2}$  to  $\frac{3}{4}$  of a second. Four or five croaks may be given in rapid series followed by a rattling sound, the entire sequence lasting about 2.5 seconds (Stebbins 1985). While much of the mate calling occurs underwater (MacTague and Northern 1993), males also call from above water. Above water calls are faint and are not generally heard over distances greater than 50 meters (Ashton et al. 1998). Examples of both above water, and underwater calls are documented and described on Frog and Toad Calls of the Pacific Coast (Davidson 1995).

Females often oviposit eggs in shallow water toward the margin of streams, but in some large rivers they oviposit at depths greater than 1 m and distances up to 20 meters from the water's edge (Mokelumne River, unpublished data from Garcia and Associates for PG&E). Clutches of eggs are often attached to the flow-protected lee sides of rocky substrates within a narrow range of flow velocities (Kupferberg 1996a; Bondi et al. 2013). Tadpoles disperse from egg laying sites but similarly require protection from swift currents, especially when they approach metamorphosis and are poor swimmers (Kupferberg et al. 2011). Cobble and pebble are the preferred substrate for egg mass attachment, but egg masses have been found attached to aquatic vegetation, woody debris, gravel and bedrock (Fuller and Lind 1992; Ashton et al. 1998, Bondi et al. 2013). Females lay a distinct cluster of eggs, with average clutch sizes ranging from 100 to 1,100 eggs (Storer 1925; Wright and Wright 1949) but can reach more than 3,000 eggs (Kupferberg et al. 2009c). Larger and more fecund females tend to breed first and small females oviposit clutches with fewer eggs as the breeding season progresses (Kupferberg et al. 2009c, Gonsolin 2010).

Eggs hatch in 5 to 30 days, or more (Zweifel 1955). In the mainstem Trinity River, eggs hatch in 27 to 36 days (Ashton et al. 1998). The slower development is probably due to colder temperatures from dam released water (Wheeler et al. 2015; Railsback et al. 2016). At the time of hatching, the embryos are at a Gosner stage of 20 to 22 (Ashton et al. 1998). In the absence of disturbance, the tadpoles will remain associated with the egg mass for several days after hatching then disperse to local interstices of the gravel bed, often moving downstream in areas of moderate flow (Ashton et al. 1998). Larval growth rate and survival depend on water temperature and interactions between temperature and quality of algal food resources (Catenazzi and Kupferberg 2013; Furey et al. 2015; Railsback et al. 2016). Tadpoles actively thermoregulate (Brattstrom 1962) and prefer warm temperatures at or above approximately 20C (Kupferberg et al. 2013). Larval growth rate and survival to metamorphosis are inversely proportional to flow velocity conditions (Kupferberg et al. 2011), *i.e.* growth is slower at higher velocities. Metamorphosis generally occurs in three to four months. Male foothill yellow-legged frogs can reach sexual maturity at age 1 to 2 years, at a length of about 40 mm (Zweifel 1955; Gonsolin 2010), whereas females mature at two or three years of age depending on latitude and elevation of the population (Kupferberg et al. 2009c; Gonsolin 2010), with Central Coast populations maturing at earlier ages. Some individuals may reproduce as early as 6 months after metamorphosis (Jennings 1988).

*Rana boylei* tadpoles feed on periphyton scraped from rocks or plants. They seem to grow fastest feeding on epiphytic diatoms growing on filamentous algae such as *Cladophora* sp., and have been observed to preferentially graze on this algal type (Jennings and Hayes 1994; Ashton et al. 1998; Kupferberg 1997b). Tadpoles have been observed actively congregating on dead tadpoles and dead, open bivalves (Ashton et al. 1998). Metamorphosed frogs feed primarily on terrestrial invertebrates, but also eat

some aquatic invertebrates (Fitch 1936; Zeiner et al. 1988; Hothem et al. 2009). Adult diet includes flies, moths, mosquitoes, hornets, ants, beetles, grasshoppers, water striders, and snails (Fitch 1936; Nussbaum 1983; Csuti et al. 2001). Van Wagner (1996) provided a thorough literature review and a detailed diet analysis of post-metamorphic *R. boylei*. Analysis of 63 post-metamorphic *R. boylei* found terrestrial arthropods to be the primary (~90%) prey items year round, comprised of 87.5% insects and 12.6% arachnids (Van Wagner 1996). Foothill yellow-legged frogs capture their prey by waiting along stream edges and pouncing (Airola 1980).

The foothill yellow-legged frog is primarily diurnal and may be active year-round in locations where winter temperatures permit, with peak activity in April and May (Airola 1980).

Home ranges and dispersal patterns of the foothill yellow-legged frog are poorly understood (Jennings and Hayes 1994), but a handful of mark-recapture and telemetry studies exist. Frogs have been found 50 m (Nussbaum et al. 1983; Csuti et al. 2001) to 70-80 m (C. Rombough, pers. comm., as cited in Olson and Davis 2009) from water. Metamorphs have been found in pitfall traps at greater distances upslope from the water's edge (Twitty 1967). Along streams, Van Wagner (1996) reported seasonal movements of about 450 m for this species in California, and an 800 m movement distance is known from Oregon (C. Rombough, pers. comm., as cited in Olson and Davis 2009). A telemetry study by Bourque (2008) in Tehama County, California documented movement distances to and from breeding sites of 0.65 km and as far as 7.04 km for male and female foothill yellow-legged frogs, respectively, with median travel distances of 65.7 and 70.7 meters/day. Frogs used watercourses as movement corridors and rarely moved > 12 m from the stream channel. In Coyote Creek (Santa Clara Co., CA) radio-telemetry revealed that 60% of radio-tagged frogs were found underwater and under substrate and would not have been detected without the use of a transmitter (Gonsolin 2010). Gonsolin (2010) also reported that movements were restricted seasonally to the period between Feb and May for adults as they migrated to and from breeding sites. Adult females moved an average of 744 m, adult males moved 485 m, and juveniles moved 305 m.

During breeding season and summer, foothill yellow-legged frogs are rarely encountered far from permanent water. Adults congregate around breeding pools in spring, with month varying by latitude and elevation of the river. In late summer adults were found to be scarce along the main stem of the Trinity River, indicating that they may be dispersing into the vegetation, moving up tributaries, or reducing diurnal activity (Ashton et al. 1998). Recently metamorphosed frogs show a strong tendency to migrate upstream (Twitty 1967). This may be an evolutionary mechanism to repatriate individuals washed downstream from suitable habitat during the larval stage. During the winter, frogs have been observed in abandoned rodent burrows and under logs as far as 100 m from streams (Zeiner et al. 1988; Welsh 1994).

Movements of marked animals were not noted to occur November through March in Oregon (C. Rombough, pers. comm., as cited in Olson and Davis 2009). Radio telemetry tracking of post-breeding adult females in California documented dispersal distances from 0 to 7,043 m (R. Bourque, pers. comm., as cited in Olson and Davis 2009) where, over the course of 60 days, one female traveled upstream along the main channel of a perennial stream, then up intermittent and dry tributary channels, then over a ridge eventually working her way downstream to perennial waters in an adjacent watershed

(R. Bourque, pers. comm., as cited in Olson and Davis 2009). Other ranids have capabilities of dispersing kilometers overland; however, according to Nussbaum et al. (1983) this species is likely restricted to movements along streams or stream-riparian corridors. Their likely restriction to riparian corridors needs further study because of the low detectability of frogs in uplands. Dever's (2007) genetic study suggested that a distance of 10 km may effectively isolate frog populations along a river system (i.e., frogs this distance apart on a river are not part of a single interbreeding population). In river systems altered by human activities however, when populations are separated by dams, reservoirs, and reaches where flows artificially fluctuate daily, genetic isolation becomes apparent at much shorter distances of separation (Peek 2010, 2012).

Ashton et al. (1997) summarizes additional information on the natural history of the foothill yellow-legged frog. A more recent but less detailed account is provided by Morey (2007).

### **Natural Mortality**

A number of native vertebrates (e.g. birds and snakes) and aquatic invertebrates (e.g. dragonfly nymphs) feed on foothill yellow-legged frogs, their tadpoles and eggs (Fitch 1936, 1941; Everdon 1948; Zweifel 1955; Milne and Milne 1980; Nussbaum et al. 1983; Jennings and Hayes 1994; Lind and Welsh 1994; Duellman and Trueb 1986; Jennings 1988; Moyle and Brown 1997; Ashton et al. 1998; Fellers 2005; Olson and Davis 2009). Among the documented predators of foothill yellow-legged frogs at various life stages are signal crayfish (*Pacifasticus leniusculus*) (Rombough and Hayes 2005); aquatic insects including caddisfly larvae (Limnephilidae), waterstriders (Gerridae), and veliid bugs (Veliidae) (Kupferberg 1996a; Rombough and Hayes 2005c); California tiger salamander (*Ambystoma californiense*) larva (Fidenci 2006) and the rough-skinned newt (*Taricha granulosa*, Everdon 1948); garter snakes, predominantly the aquatic garter snake (*Thamnophis atratus*) and the Sierran garter snake (*T. couchii*) (Fitch 1936, 1940, 1941; Stebbins 1951; Zweifel 1955; Nussbaum et al. 1983; Jennings and Hayes 1994; Lind and Welsh 1994); North American river otters (*Lutra canadensis*) (Hayes et al. 2016); mallard ducks (*Anas platyrhynchos*) (Rombough et al. 2005b). Foothill yellow-legged frogs are vulnerable to predation by fishes, both native and non-native including bass (*Micropterus* sp.) and Sacramento pikeminnow (*Ptychocheilus grandis*) (Brown and Moyle 1997; Corum 2003; Ashton and Nakamoto 2007; Paoletti et al. 2011). Other fish species are suspected to be predators (Hayes and Jennings 1988; Rombough and Hayes 2005c).

### **CHANGES IN DISTRIBUTION AND ABUNDANCE**

The occurrence data discussed below are derived from an exhaustive search of museum specimen collection records, published literature on the species, environmental review documents, agency survey data, and all observation records in the California Natural Diversity Database as of December 9, 2016 (CNDDDB 2016). The information is organized geographically by region, then by county (as well as by National Forest for Sierra Nevada populations), then by watershed. All known historical and recent distribution and abundance data is given or summarized, as well as a summary of the recent status for each county. Many of the "small" populations discussed below are observations of single or scattered individuals, or small numbers of frogs with no



evidence of recruitment success. Information on locations, dates and numbers of frogs can be found in the footnotes for each section.

Determining the size of *R. boylei* populations for the purposes of making comparisons among locations, detecting trends, and assessing long term viability is a problematic task. Because of their cryptic coloration and their behavior, simple counts from visual encounter surveys may not accurately reflect the abundance of frogs comprising a breeding population of *R. boylei*. Outside of the breeding season, frogs can be dispersed across a range of channel sizes throughout a dendritic stream network (Welsh et al. 2005). Telemetry studies have shown that 60% of radio-tagged foothill yellow-legged frogs were found underwater and under substrate and would not have been detected without the use of a radio-transmitter (Gonsolin 2010). Clutches of eggs on the other hand, are comparatively visible and tractable to count (Figure 5).



**Figure 5.** Photo showing cryptic nature of *Rana boylei* in the stream channel relative to an egg mass. The arrow points to a male near the bank with its head out of the water.

Since each female *R. boylei* lays one discrete clutch of eggs, it has become standard practice to use egg mass counts, standardized by the length of the river reach searched, as a proxy for population density in lieu of more labor and time-intensive methods such as mark-recapture studies. A compilation of breeding season censuses of *R. boylei*

(Kupferberg et al. 2009c), indicated that the average abundance in free-flowing rivers is approximately 32 breeding females per river kilometer while genetic evidence demonstrates that there is significant isolation by distance between individuals occurring more than 10 km away from each other (Dever 2007). Thus Kupferberg et al. (2009c) chose 320 females in a 10 km reach to represent a typical *R. boylei* population and to use this starting number as a reference for comparison in a matrix projection model of population viability. When starting population size was set at 2 females per km (the low end of extant populations in regulated rivers), the model predicted a 13 fold increase in risk of extinction over a thirty year period in the absence of other anthropogenic stressors. When small starting population sizes were combined with hydrologic stressors such as ill-timed pulsed flows which cause eggmass and tadpole mortality, risk of extinction increased 20 to 45 times above the reference model. In contrast, when starting population size was set at 107 females per river km (an observed density on the SF Eel River), risk of extinction decreased 5 fold to less than a 1% chance of occurring. Given these modeling scenarios, we evaluate the number of frogs observed in the locality accounts listed below as follows. Populations with 100's of breeding adults are considered robust while populations with densities in the single digits are considered to be at high risk of local extinction.

### **Southern California**

The foothill yellow-legged frog once occurred south of its current range, with documented historical localities in Santa Barbara, Ventura and Los Angeles counties. Based on museum specimens, the species possibly occurred as far south as Orange, southwestern San Bernardino and San Diego counties. However, foothill yellow-legged frogs are now extirpated from all of southern California south of San Luis Obispo County.

The foothill yellow-legged frog was formerly widespread and fairly common in the southern California coastal mountains, but has not been seen in or south of the Transverse Ranges since 1977 despite repeated searches (Sweet 1983; Jennings and Hayes 1994; Adams in prep.), and has completely disappeared from southern California south of Santa Barbara (Jennings 1995). High water conditions from 500-year frequency floods that occurred over much of southern California in 1969 are thought to have been one factor in the extirpation of the species from the region (Sweet 1983).

There has been some confusion regarding the species identification of historical collections of yellow-legged frogs in southern California and potential mislabeling of southern California mountain yellow-legged frogs (*Rana muscosa*) as foothill yellow-legged frogs (*R. boylei*). Historical locations of the mountain yellow-legged frog in southern California were from creeks and drainages in the San Gabriel, Big Bear, and San Jacinto Mountains of Los Angeles, San Bernardino, and Riverside Counties, as well as from an isolated population on Palomar Mountain in San Diego County (USFWS 2002). Mountain yellow-legged frogs in southern California historically inhabited a wide elevation range of localities, from 370 m (1,220 feet) to 2,290 m (7,560 feet) (USFWS 2002). The elevational range of the foothill yellow-legged frog (*R. boylei*) is from sea level to 1,830 m (6,000 feet) (Stebbins 1985; Stebbins and McGinnis 2012). *Rana boylei* and *R. muscosa* rarely co-occurred but did so at a couple of sites in the San Gabriel Mountains (Schoenherr 1976).

### San Diego County

Although San Diego County is considered outside of the known historical range for *R. boylei*, there are historical collection records of yellow-legged frogs from a few scattered locations in San Diego County from 1928 to 1963, which deserve examination. There is some debate as to whether collection specimens from San Diego County labeled *R. boylei* were mislabeled (California Herps 2015).

The U.C. Museum of Vertebrate Zoology (UCMVZ 2001) had a collection specimen originally labeled *R. boylei* from 1951 in Doane Valley, Palomar Mt. State Park, at an elevation around 6,000 feet. An isolated population of the mountain yellow-legged frog (*R. muscosa*) was known to occur historically at Palomar Mountain (Vredenburg et al. 2007), and this specimen is now apparently correctly identified as *R. muscosa* (California Herps 2015; UCMVZ 2015).

The University of Kansas Museum of Natural History (UKMNH 2001) has a collection specimen from 1928 labeled *R. boylei* from Boulder Park in Jacumba (elevation 3,000 feet or 910 m), in the southeastern part of San Diego County near the U.S./Mexico border; but this specimen is thought to be misidentified (California Herps 2015). The University of Kansas Museum of Natural History also has 3 collection specimens labeled *R. boylei* from September 1928 from an unidentified location in San Diego County; however since the location cannot be determined, it is possible these were also misidentified mountain yellow-legged frogs (UKMNH 2001). Genetic and morphological analysis of these 4 UKMNH specimens would be useful.

The California Academy of Sciences has a specimen from 1963 labeled *R. boylei* which was collected from Carroll Canyon, just north of San Diego (CAS 2001); this would have been in the Penasquitos Creek watershed, near sea level and well below the known historical elevational range for *R. muscosa*.

*Recent status:* There are no recent foothill yellow-legged frog records from San Diego County. If the species did occur in San Diego County historically, it certainly has been extirpated.

### Orange County

Although Orange County is considered outside of the known historical range for *R. boylei*, Bryant and Remington (1990) reported that foothill yellow-legged frogs were found in the 1940s (apparently as late as 1942) in the upper Newport Bay area. This would have been in the San Diego Creek/Bonita Creek watershed, near sea level and well below the known historical elevational range for *R. muscosa*.

*Recent status:* There are no known foothill yellow-legged frog records from Orange County. If the species did occur in Orange County historically, it certainly has been extirpated.

### San Bernardino County

Although San Bernardino County is considered outside of the known historical range for *R. boylei*, there are historical collection records of yellow-legged frogs from the Santa Ana River drainage, in southwestern San Bernardino County, which deserve

examination.

### Santa Ana River

The U.C. Museum of Vertebrate Zoology had specimen collection records of yellow-legged frogs originally labeled *R. boylei* (UCMVZ 2001) that were collected from the Santa Ana River drainage in San Bernardino County from 1905 to 1923; however, these specimens have more recently been identified as mountain yellow-legged frog (*R. muscosa*) (UCMVZ 2015). The University of Michigan Museum of Zoology (UMMZ 2001) has 12 frogs labeled *R. boylei* that were collected 2 miles from Santa Ana Canyon on a single day in August 1940. Santa Ana Canyon (or Santa Ana Narrows) is the water gap where the Santa Ana River passes between the Santa Ana Mountains and the Chino Hills, near the intersection of Orange, Riverside, and San Bernardino Counties, at less than 700 feet elevation. If these frogs were indeed taken in San Bernardino County, 2 miles from the Canyon, this would be the vicinity of Chino Hills State Park, in the lower Santa Ana River, below the known elevational range for *R. muscosa*.

*Recent status:* There are no recent records of foothill yellow-legged frogs from San Bernardino County. If the species did occur in San Bernardino County historically, it certainly has been extirpated.

### Los Angeles County

There are historical collection records of foothill yellow-legged frogs from 1903 to 1977 in Los Angeles County, throughout the southern foothills of the San Gabriel Mountains in the San Gabriel River drainage, in Little Rock Creek in the northern San Gabriel Mountains, in a few scattered localities in the floodplain of what is now urbanized Los Angeles, and in extreme northwestern Los Angeles County in Piru Creek and Castaic Creek, tributaries to the Santa Clara River.

The mountain yellow-legged frog (*R. muscosa*) was known to occur historically in the San Gabriel Mountains of Los Angeles County (Vredenburg et al. 2007). Museum specimens collected from the San Gabriel Mountains are currently being evaluated by the USGS and the Los Angeles County Museum herpetological curator, as to whether they were actually *R. boylei* or *R. muscosa*.

### San Gabriel River/Tujunga Creek

There are historical collection records labeled *R. boylei* from 1908-1952 in the San Gabriel Mountains, in streams draining into urbanized Los Angeles (CAS 2001; UMMZ 2001; UCMVZ 2015).<sup>1</sup> The West Fork, North Fork and East Fork of the San Gabriel River are all above San Gabriel Reservoir, which is at 1,145 ft (349 m). The U.C.

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<sup>1</sup> In the San Gabriel River drainage – an unidentified location in the San Gabriel Mountains in 1915, the East Fork in 1935, unidentified location on the San Gabriel River in 1940, San Gabriel River above the junction of the North and West Forks in 1940, Crystal Lake Park (up a tributary to the North Fork) in 1946, the West Fork in 1950 (30 frogs from N of Camp Rincon on a single day in June) and 1951, the junction of the North and West Forks in 1951, the North Fork in 1951, and unidentified location on the San Gabriel River in 1951; from the Santa Anita Wash drainage - Big Santa Anita Canyon near Sierra Madre in 1908, Little Santa Anita Canyon in 1909, near Mt. Wilson in 1913, Little Santa Anita Canyon in 1918, and 8 frogs from near Mt. Wilson in October 1944; from the Tujunga Creek drainage - Mill Creek, near Big Tujunga Creek in 1952 (CAS 2001; UMMZ 2001; UCMVZ 2015).

Museum of Vertebrate Zoology currently list 59 *R. boylei* specimens collected from the San Gabriel Mountains in Los Angeles County from 1944 through 1951 (UCMVZ 2015). All museum specimens collected from the San Gabriel Mountains should be evaluated as to whether they were actually *R. boylei* or *R. muscosa*. Dunn et al. (1988) presumed *R. boylei* persisted in the San Gabriel Mountains, but there were no recent documented occurrences.

#### Los Angeles Floodplain

There are historical collection records labeled *R. boylei* from 1907-1930 in the greater Los Angeles floodplain, at low elevation (HMCZ 2001; CAS 2001; Cornell University 2002).<sup>2</sup> The U.C. Museum of Vertebrate Zoology had a yellow-legged frog specimen originally labeled as *R. boylei*, collected from Arroyo Seco Canyon near Pasadena in 1903 (UCMVZ 2001); this specimen is now labeled as *R. muscosa* (UCMVZ 2015). However, this locale is at low elevation within the floodplain of urban Los Angeles, and well below the known elevational range for *R. muscosa* in southern California; for which the lowest known occurrence is above 1,220 feet (USFWS 2002).

#### Santa Clara River

There are historical collection records labeled *R. boylei* and reports of observations from 1967-1977 in Piru Creek in the Santa Clara River drainage (Jennings and Hayes 1994; Stephenson and Calcarone 1999; LSUMNS 2001).<sup>3</sup> The last reliable observation of *R. boylei* in this region was from Piru Creek in 1977 (Jennings and Hayes 1994).

*Recent status:* Jennings and Hayes (1994) were unable to locate the species during resurvey efforts from 1988-1991 at any of 3 historical locations in Los Angeles County. There are no records of foothill yellow-legged frogs from Los Angeles County since 1977. The species is extirpated from Los Angeles County.

### Ventura County

#### Santa Clara River

There are historical collection records of foothill yellow-legged frogs from 1914 to 1970 in Ventura County, all within the Santa Clara River drainage and its tributaries, including Piru Creek, Hopper Canyon, Sespe Creek, and Santa Paula Creek (Jennings and Hayes 1994; Stephenson and Calcarone 1999; UMMZ 2001; CAS 2001; CNDDDB 2016; UCMVZ 2015).<sup>4</sup> The species was apparently relatively common in Hopper Creek

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<sup>2</sup> Claremont in 1907; the city of Los Angeles in 1911; La Crescenta in 1915; and Monrovia in 1930 (HMCZ 2001; CAS 2001; Cornell University 2002).

<sup>3</sup> Specimens were taken from Elizabeth Lake Canyon (Stephenson and Calcarone 1999), Piru Creek south-southeast of Caswell in 1967 (LSUMNS 2001) and upstream from Piru Gorge (now flooded under Piru Lake) in 1970 (Jennings and Hayes 1994). The last reliable observation of the species in this region was 1-2 km south of Frenchman's Flat along Piru Creek in July 1977 (Jennings and Hayes 1994).

<sup>4</sup> Collections records include: 1 frog from Sespe Canyon, at the head of Sespe Creek on the Ventura/S Barbara border in 1914 (CAS #39253); 1 frog (CAS #10223) from Sespe Gorge in 1948; 1 frog (CAS #10229) in 1949 and 1 larva (CAS #11549) in 1950 from the junction of Lion Canyon and Sespe Creek; an unknown location along Sespe Creek in 1940; 5 frogs and 1 larva (CAS #10224-10228, 11550) from Piru Creek in 1949; 11 adults and juveniles (MVZ #33664-33673; 54519) from Hopper Creek in 1940; 2 juveniles

(possibly named after the species), where 11 adult/juvenile frogs were collected on a single day in May 1940, and in Piru Creek, where 5 frogs and larva were collected in May 1949 (CAS 2001; UCMVZ 2015). The last known specimens in Ventura County were collected from Piru Creek, 10 miles N of the Temescal Ranger Station, in 1970 (Jennings and Hayes 1994).

*Recent status:* Jennings and Hayes (1994) were unable to locate the species during resurvey efforts from 1988-1991 at any of 11 historical locations in Ventura County. There no reports of foothill yellow-legged frogs from Ventura County since 1970 (Jennings and Hayes 1994). The species is extirpated from Ventura County.

### Santa Barbara County

#### Santa Ynez River

There are historical collections from 1933-1966 in the upper Santa Ynez River drainage and tributaries including Big Canyon Creek, Indian Creek, Juncal Creek, and Santa Cruz Creek (Jennings and Hayes 1994; Stephenson and Calcarone 1999; SDNHM 2001; UMMZ 2001; CAS 2001; CNDDDB 2016; UCMVZ 2015).<sup>5</sup> All of the historical collections were of small numbers of frogs or individual frogs.

There are no recent records from the Santa Ynez River drainage.

#### Small coastal streams

There are historical collections records from Gaviota Creek in 1922 and Refugio Creek in 1974, small coastal streams along the southern coast of Santa Barbara County, tributary to the ocean (SBMNH 2001; UMMZ 2001; CNDDDB 2016).<sup>6</sup>

There are no recent records from southern coastal Santa Barbara County.

*Recent status:* Jennings and Hayes (1994) were unable to locate any foothill yellow-legged frogs during resurvey efforts from 1988-1991 at any of 7 historical locations in Santa Barbara County. There are no foothill yellow-legged frog records from Santa Barbara County since 1974 in the California Natural Diversity Database (CNDDDB 2016), the last record of foothill yellow-legged frog from Santa Barbara. The species is extirpated from Santa Barbara County.

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and 1 adult (CAS #50470-50472) from Sespe Creek 3 miles N of Fillmore in 1921; 1 frog (MVZ #42611) from Santa Paula Canyon, near East Fork in 1946 and 4 frogs (ASUHERPS #4431-4434) from the same location in 1962; Santa Paula Creek in 1942; and 6.4 miles NE of Ventura in 1940 (UMMZ 2001; CAS 2001; CNDDDB 2016; UCMVZ 2015).

<sup>5</sup> Historical collection records include: single frogs collected from the Santa Ynez River at Juncal Campground in 1961 (CAS #181275) and Big Canyon Creek at Juncal Road in 1966 (CAS #181276); Indian Creek at the base of Mono Dam in 1940; 1 frog (MVZ #35222) from Indian Canyon, 2 miles southeast of Bluff Camp in 1940; 2 adults, 2 juveniles and 2 frogs of unknown age (CAS #181269-181274) from Santa Cruz Creek near Santa Cruz Guard Station in 1960; and 1 frog (SDNHM #20776) from Bear Canyon on the north slope of Santa Ynez Mountain SE of Lake Cachuma in 1933 (SDNHM 2001; UMMZ 2001; CAS 2001; CNDDDB 2016; UCMVZ 2015).

<sup>6</sup> Three yellow-legged frogs were taken from Gaviota Creek in 1922 (UMMZ 2001); and 1 frog (SBMNH #HE 243) was collected from Refugio Creek in 1974 (SBMNH 2001; CNDDDB 2016).

## South Coast

The South Coast includes coastal drainages south and west of the Santa Lucia Range in Monterey County, south to San Luis Obispo County. The foothill yellow-legged frog is now nearly extirpated from Monterey and San Luis Obispo counties and the south coast region.

### San Luis Obispo County

#### Cuyama River

There is a foothill yellow-legged frog collection record from the Alamo Creek tributary of the Cuyama River in 1940. The Cuyama River joins the Santa Maria River in southern San Luis Obispo County.

#### Arroyo Grande Creek

There are historical collection records from 1943-1963 in Arroyo Grande Creek (SBMNH 2001; CNDDDB 2016; UCMVZ 2015).<sup>7</sup>

#### San Luis Obispo Creek

There are historical collection records from 1939 and 1953 in San Luis Obispo Creek (UCMVZ 2015).<sup>8</sup>

The species was presumed to occur in Poly Canyon in the Brizzolari Creek watershed, a tributary of Stenner Creek and San Luis Obispo Creek, on land owned by Cal Poly University (Cal Poly 2001), but there were no documented records.

#### Northern coastal streams

There are historical collection records from northern coastal San Luis Obispo County streams: San Carpoforo Creek in 1940 and Santa Rosa Creek in 1948 (CAS 2001; CNDDDB 2016).<sup>9</sup>

The species persisted in several coastal drainages in very northern San Luis Obispo County in the 1990s (Jennings and Hayes 1994; Stephenson and Calcarone 1999). As discussed above, small numbers of frogs were located in San Carpoforo Creek in northern San Luis Obispo/southern Monterey Counties in 1999 (LPNF 2001), and a single adult frog (deposited at UCSB) was captured from Little Pico Creek (near Highway 1, just ESE of San Simeon) in April 1999 (CNDDDB 2016).

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<sup>7</sup> A single frog from Arroyo Grande Creek in 1943; 1 frog (MVZ #58422) from Lopez Canyon in Arroyo Grande Creek, 6 miles E of San Luis Obispo, in 1953; and 5 frogs (SBMNH #HE 136-140) from Lopez Canyon in 1963 (SBMNH 2001; CNDDDB 2016; UCMVZ 2015).

<sup>8</sup> There are collection records of single frogs from Reservoir Canyon, in San Luis Obispo Creek, 2 miles E of San Luis Obispo, in 1939 (MVZ 31615) and 1953 (MVZ 59660) (UCMVZ 2015).

<sup>9</sup> Six frogs (CAS #159503-159508, and larvae) were collected from Santa Rosa Creek near Cambria in September 1948; and single frogs in 1940 from the lagoon of San Carpoforo Creek, and 2 miles from Santa Ana Canyon (CAS 2001; CNDDDB 2016).

*Recent status:* Jennings and Hayes (1994) were able to relocate the species during resurvey efforts from 1988-1991 at only 3 of 11 historical locations (27%) in San Luis Obispo County. There have been no documented foothill yellow-legged frog observations in San Luis Obispo County since 1999. The foothill yellow-legged frog is now nearly extirpated from San Luis Obispo County.

### Monterey County

#### Malpaso Creek

Two frogs were collected from Malpaso Creek, north of Garrapata State Park, in 1915 (CAS 2001).

#### Bixby Creek

There is a historical collection record of 1 frog from the Turner Creek tributary near Devils Peak in 1939 (UCMVZ 2015).

#### Little Sur River

There are historical collection records from 1933-1948 in the Little Sur River (CAS 2001; UCMVZ 2015).<sup>10</sup>

#### Big Sur River

There are historical collection records from 1929-1946 in the Big Sur River (CAS 2001; UCMVZ 2015).<sup>11</sup>

Foothill yellow-legged frogs still occurred in the 1990s in the Big Sur River (Jennings and Hayes 1994; Stephenson and Calcarone 1999).

#### Big Creek

Frogs were not located during surveys in the 1970s of the Landels-Hill Big Creek Reserve, in the Big Creek coastal drainage (Carothers et al. 1980).

#### Willow Creek

A collection was made at the mouth of Willow Creek in 1948 (CAS 2001).

Foothill yellow-legged frogs still occurred in the 1990s in Willow Creek (Jennings and Hayes 1994; Stephenson and Calcarone 1999).

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<sup>10</sup> Two frogs from Pine Creek (at the Little Sur River) in 1933; 1 frog from Skinner Creek near Devils Peak in 1939; and 1 frog from the mouth of the Little Sur River in 1948 (CAS 2001; UCMVZ 2015).

<sup>11</sup> Collected at Idyllwild Park from 1929 to 1930; 6.5 miles above the mouth in 1937; and Big Sur State Park in 1946 (CAS 2001; UCMVZ 2015).



## Dutra Creek/San Carpoforo Creek

Small numbers of frogs were documented from 1995-1999 in Dutra Creek and San Carpoforo Creek, within Monterey County (CNDDDB 2016).<sup>12</sup> However, Kupferberg and Adams searched several reaches of San Carpoforo Creek on public lands (USFS lands in the upper watershed and BLM lands in the lower watershed), and the Dutra Creek tributary (where A. Lind had previously collected samples) in July 2014, and did not locate any foothill yellow-legged frogs (S. Kupferberg, pers. comm., 2015).

*Recent status:* Unknown, but likely near extirpation. Foothill yellow-legged frogs still occurred in the 1990s in several coastal drainages in Monterey County but there are no foothill yellow-legged frog records from coastal drainages in Monterey County south and west of the Santa Lucia Range since 1999.

## Central Coast

The species appears to be extirpated from western San Joaquin County and may be near extirpation in western Merced, Santa Cruz and San Mateo counties. The species has declined in many of the drainages in western Stanislaus, western Fresno and Monterey counties. There appear to be significant populations of foothill yellow-legged frogs remaining in the Diablo Range in San Benito County.

## Monterey County

### Salinas River

There are historical collection records from 1919-1955 in the Salinas River drainage, including Arroyo Seco, Nacimiento Creek, Reliz Canyon, Salinas River and Santa Lucia Creek (Zweifel 1955; CAS 2001; UCMVZ 2015).<sup>13</sup>

Small populations were observed in the 1990s along the Monterey/San Benito County line in Lewis Creek, tributary to San Lorenzo Creek, a northern tributary to the Salinas River, and in the Nacimiento River at Fort Hunter Liggett (CAS 2001; CNDDDB 2016).<sup>14</sup>

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<sup>12</sup> Two adult frogs were observed July 24, 1995 along Dutra Creek, 1 adult and 30 larvae were seen at this same spot on July 25, 1995 (Fellers site S-734B); a single adult was observed along San Carpoforo Creek about 0.4 mile NE of the Dutra Creek confluence on July 25, 1995; and an unknown number of tadpoles were observed and 5 tadpoles were collected (deposited in UCSB collection) on August 20 and 26, 1999 from the Dutra Creek tributary (CNDDDB 2016). The Los Padres National Forest noted that foothill yellow-legged frogs were located in San Carpoforo Creek in northern San Luis Obispo/southern Monterey Counties in 1999 (LPNF 2001).

<sup>13</sup> Frogs were collected in the Salinas River drainage from Lopez Canyon (Zweifel 1955). Frogs were collected in the Arroyo Seco tributary drainage from: Abbotts Ranch in 1919; Reliz Canyon, W of Greenfields, in 1938; W of Tassajara Springs in the Tassajara Creek tributary in 1940; and Camp Calatros, in the Santa Lucia Creek tributary, in 1951 (CAS 2001; UCMVZ 2015). There are also historical collection records from the upper Salinas River drainage within San Luis Obispo County: 1 frog (CAS #43336) from Santa Margarita in 1917; and 6 frogs from the Nacimiento Creek tributary in 1909 (CAS 2001).

<sup>14</sup> In the Lewis Creek tributary, 1 subadult frog was collected (CAS #195440) in February 1994 from Priest Valley just W of the Fresno County line; 3 adults and 7 juveniles were observed in August 2001 7 miles SW of Hernandez Reservoir; and 7 juveniles were observed on April 1, 2002 1.25 miles SE of the Yaqui Creek confluence (CAS 2001; CNDDDB 2016). These populations were subject to livestock grazing. There is one CNDDDB record from the 1990s from the Nacimiento River tributary of the Salinas River drainage: 10 adults, 10 metamorphs, and an unspecified number of tadpoles observed in August 1999 in Los Burros Creek, upstream from the confluence with Little Burros Creek, at Fort Hunter Liggett (CNDDDB 2016).

## Carmel River

There are historical collections records before 1900-1975 in the Carmel River drainage (CAS 2001; FMNH 2001; UCMVZ 2015).<sup>15</sup> The species was apparently once relatively common in San Clemente Creek, where 11 frogs were collected on a single day in August 1939 (UCMVZ 2015).

Foothill yellow-legged frogs reportedly persist at the Hastings Reserve in the Finch Creek tributary (UCNRS 2015), but there are no known documented sightings.

## Santa Lucia Range

There are historical collection records from the Santa Lucia Range in 1902, from Santa Lucia Peak and Cone Peak (UCMVZ 2015).

*Recent status:* Jennings and Hayes (1994) were able to relocate the species during resurvey efforts from 1988-1991 at only 5 of 12 (42%) historical locations in Monterey County. The species has clearly declined in the Carmel River drainage. There were small populations documented in Salinas River tributaries in the late 1990s and early 2000s. There are no foothill yellow-legged frog records from Monterey County in the California Natural Diversity Database since 2002 (CNDDDB 2016).

## San Benito County

There are numerous historical collection records for foothill yellow-legged frogs from Pinnacles National Monument in Chalone Creek and other northern tributaries to the Salinas River; from the headwaters and upper reaches of the San Benito River drainage, which flows NW to the Pajaro River; and from Panoche Creek, which flows E into the San Joaquin Valley.

## Salinas River/Pinnacles NM

There are historical collection records from Pinnacles National Monument from 1918-1938 (Banta and Morafka 1967; SDNHM 2001; CAS 2001; UCMVZ 2015).<sup>16</sup> Foothill yellow-legged frogs were apparently common historically in Pinnacles, with large numbers of specimens taken from collection sites on a single day: 14 frogs from Clear Creek in May 1960; and 11 frogs from Pinnacles in July 1938 (CAS 2001; SDNHM 2001; UCMVZ 2015). *Rana boylei* was still “abundant” in Pinnacles National Monument in 1953 (Banta and Morafka 1967) and “quite common” along streams and waterways

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<sup>15</sup> Collection localities include: Pacific Grove before 1900; Pine Valley, at the head of the Carmel River in 1902; the Carmel River about 5 miles from the mouth in 1904; San Jose Creek near Carmel in 1907; the San Clemente Creek tributary in 1939; and Carmel Valley above P.I. County Ranch, unknown date (CAS 2001; FMNH 2001; UCMVZ 2015). A tributary to Tularcitos Creek in the Carmel River Valley named Rana Creek, likely had ranid frogs in it, based on the name. Single frogs were collected from Big Creek (MVZ 134089) in 1974 and Blomquist Pond (MVZ 134090) in 1975, tributaries to Cachuga Creek (an upper tributary of the Carmel River) in the Hastings Natural History State Reserve.

<sup>16</sup> Seven frogs taken from 7 miles SW of the Cook Post Office in July 1918; one frog in August 1918; 3 frogs from Vancouver, Pinnacles in August 1918; 11 frogs taken on a single day in July 1938; and historical specimens in the Stanford University collection taken from along Chalone Creek (Banta and Morafka 1967; SDNHM 2001; CAS 2001; UCMVZ 2015).

throughout the Monument in the late 1950s (Wauer 1958). The species was present in the mid 1960s (De Foe 1963; Morafka 1965), but was not observed during sampling by Banta and Morafka (1967). By the mid 1980s *R. boylei* was considered “rare” in the Monument, found only in the vicinity of flowing streams such as Chalone Creek (Fellers 1986).

Intensive amphibian surveys by Ely (1993, 1994) during 1992-1994 covered stream reaches with suitable *R. boylei* habitat within Pinnacles National Monument, including Chalone Creek and tributaries such as West Fork Chalone Creek, Bear Creek, and Frog Canyon Creek. *Rana boylei* could not be found, even at historical locations such as Pinnacles Caves. Ely (1993, 1994) documented extensive damage to riparian vegetation, stream structure, and shorelines within the Monument by feral pigs, cited likely predation of frog larvae and eggs by introduced mosquito fish (*Gambusia affinis*) and Sacramento perch (*Archoplites interruptus*) in Chalone and Bear Creeks, and presumed that Bear Gulch Reservoir may have eliminated occupied *R. boylei* habitat in Bear Creek. *Rana boylei* is now considered extirpated from Pinnacles National Monument (Fesnock and Johnson 2002; NPS 2015).

### San Benito River

There are historical collection records from 1936-1986 in the San Benito River drainage, including Clear Creek, Laguna Creek, San Benito River and Tres Pinos Creek (CAS 2001; UCMVZ 2015).<sup>17</sup>

“Large” populations of *R. boylei* were observed on Bureau of Land Management land in the upper San Benito River watershed during surveys in 1992 (Ely 1992). The species was found in “moderate to good numbers” in every creek system surveyed upstream from Hernandez Reservoir; in several sections of the San Benito River and in tributaries such as Clear, Pacheco, San Carlos, Sawmill, and White Creeks (Ely 1992, 1993; CNDDDB 2016). Pacheco Creek had an “excellent” population, with tadpoles found in “exceptional” numbers in July 1992 (Ely 1992). *Rana boylei* were also found in the San Benito River downstream of Hernandez Reservoir to Long Canyon and a very large population with “very impressive numbers” (112 frogs seen in one visit) was noted in the Laguna Creek tributary to the reservoir. This high density of frogs was found in a gorge inaccessible to livestock. Ely (1992) thought that Laguna and Arroyo Leona Creeks had perhaps the greatest population densities of the species remaining in the entire south coast range. Ely (1992) noted impacts to frog habitat and threats to the species on these BLM lands and nearby private lands from heavy off-road vehicle use, excessive cattle grazing, and impacts from past mining. Ely (1992) noted that water releases from Hernandez Reservoir in the summer appear to have adversely impacted frog reproduction in the San Benito River downstream of the dam, and presumed the river

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<sup>17</sup> Eight frogs collected from 1 mile SE of the summit of San Benito Mt. in 1936 and 4 frogs and tadpoles in 1944; 15 frogs from 1 mile S of the summit of Santa Rita Peak in 1936; 3 frogs from Horsethief Canyon, 3.5 miles SSE of Hernandez; single frogs from Laguna Ranch, 4 miles S of Hernandez, and San Benito River, 2 miles ESE of Hernandez, in 1936; 14 frogs from Clear Creek, 15 miles SW of New Idria and 2 miles SE of Hernandez, in 1960; 1 frog from Laguna Creek at Coalinga Road in 1986; 1 frog from San Benito Road, 7.5 miles S of Bitterwater Road in 1948; 6 frogs from San Benito River, 9 miles N of Pinnacles in 1951; 6 frogs from Tres Pinos Creek, 15 miles ESE of Paicines in 1953; 3 frogs from San Benito River, 10 miles SSE of Paicines in 1953; and 6 frogs from near the San Benito River Bridge on Hwy. 25 in 1968 (CAS 2001; UCMVZ 2015).

section probably supported much larger numbers of the species before the reservoir was built.

Foothill yellow-legged frogs remained locally abundant through 2009 in some of the streams in the Clear Creek Management Area administered by the U.S. Bureau of Land Management, including San Carlos Creek, Clear Creek, and Sawmill Creek (USBLM 2009, 2013). During 13 surveys from 1996 to 2008 along Clear Creek, about 0.7 miles upstream from the San Benito River confluence, Fellers observed an annual average of 17 adults, 143 juveniles and 131 egg masses (CNDDDB 2016). Fellers documented modest numbers of adults and juveniles in San Carlos Creek in 1993, 1996-2000, and in 2009 (CNDDDB 2016).

#### Panoche Creek

Twenty-one frogs were collected from Panoche Creek (2 miles SE of Panoche) in July 1936 (CAS 2001; UCMVZ 2015).

Small to moderate populations were documented in the early 1990s in the Silver Creek drainage, which flows into Panoche Creek: in the tributaries Larious Creek, Sampson Creek, San Carlos Creek and White Creek (CAS 2001; CNDDDB 2016). There are no reports of *R. boylei* from upper Panoche Creek tributaries in the last two decades.

*Recent status:* Fellers (1994) reported healthy, reproducing populations in the Diablo Range in San Benito County. Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at only 3 of 11 historical locations (27%) in San Benito County. The species is extirpated from Pinnacles and the Salinas River drainage in San Benito County. Significant populations were documented in the early 1990s in the San Benito River and tributaries above Hernandez Reservoir, particularly in Clear Creek, Laguna Creek and Pacheco Creek; and also in the Silver Creek drainage. The species remained locally abundant through 2009 in San Benito River tributary streams in the BLM's Clear Creek Management Area.

### Santa Cruz County

#### San Lorenzo River

There are historical collection records from 1891-1967 in the San Lorenzo River drainage and tributaries Boulder Creek and Bear Creek, in the Santa Cruz Mountains (Slevin 1928; LSUMNS 2001; CAS 2001; UCMVZ 2015).<sup>18</sup>

The species was "virtually extinct" in the Santa Cruz Mountains by the 1990s, with significant impacts from logging (R. Seymour and M. Westphal, pers. comm., 1996). There are no known recent occurrences at Henry Cowell State Park, but there have not been extensive surveys for the species (G. Gray, CA State Parks, pers. comm., 2001).

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<sup>18</sup> Collection localities include: Glenwood in 1891; Boulder Creek in 1892, before 1928, and 1939; near Zayante in the early 1930s; 1 mile N of the town of Boulder Creek in 1941; 3 miles NE of Boulder Creek in 1953; Cave Gulch in 1959; Bear Creek 3 miles NE of Boulder Creek in 1966; and Bear Creek, 4.4 miles E of Boulder Creek in 1967 (Slevin 1928; LSUMNS 2001; CAS 2001; UCMVZ 2015).

## Pajaro River, Watsonville Slough

There are historical collection records from 1928 in Corralitos Creek, tributary to the Pajaro River, and 1970 in Harkins Slough, tributary of Watsonville Slough (UMMZ 2001; HMCZ 2001; UCMVZ 2015).<sup>19</sup>

## Aptos Creek

Small numbers of frogs were reported from the Aptos Creek watershed within the Forest of Nisene Marks in 1998 (CNDDDB 2016).<sup>20</sup>

## Soquel Creek

Small to moderate populations were reported from 1992-2008 in the Soquel Creek drainage (CNDDDB 2016).<sup>21</sup> There are no known recent occurrences in Big Basin Redwoods State Park, but there have not been extensive surveys for the species (G. Gray, CA State Parks, pers. comm., 2001).

## Waddell Creek

There are historical collection records from 1892-1953 in Waddell Creek (UCMVZ 2015).<sup>22</sup>

There are no known recent observations from Waddell Creek.

*Recent status:* Jennings and Hayes (1994) were able to relocate the species during resurvey efforts from 1988-1991 at 3 of 4 historical locations (75%) in Santa Cruz County. The species appears to be extirpated from much of Santa Cruz County, including the San Lorenzo River drainage, Pajaro River and Waddell Creek. Small to moderate populations appeared to persist in the Soquel Creek drainage through 2008.

## San Mateo County

### Pescadero Creek

There are historical collection records from 1937-1960 in the Pescadero Creek drainage (CAS 2001; UCMVZ 2015).<sup>23</sup>

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<sup>19</sup> One frog collected from 3 miles N of Corralitos, in Corralitos Creek, tributary to the Pajaro River, in 1928; and 1 frog (MVZ 164868) collected by S. Sweet from Harkins Slough (tributary of Watsonville Slough) on October 23, 1970 (UMMZ 2001; HMCZ 2001; UCMVZ 2015).

<sup>20</sup> Three juveniles observed in Aptos Creek 0.6 mile downstream of Five Finger Falls and 1 individual in Bridge Creek, 0.5 mile upstream of the Aptos Creek confluence, in November 1998 (CNDDDB 2016).

<sup>21</sup> Surveys of about 9 river miles of Soquel Creek upstream from Soquel and of about 1.25 miles of tributary Hinckley Creek upstream from the Soquel Creek confluence documented 1 adult in 1992; 2 adults in 1993; 20+ juveniles on 10/24/94; 2 adults, 25 juveniles and 11 egg masses on 4/27/96; 1 adult and 1 egg mass on 4/24/97; 3 adults on 10/24/97; about 20-30 adults and juveniles on 10/25/97; less than 50 frogs in October 1999; less than 50 frogs in October 2001; an unknown number of adults and juveniles in September 2002; "dozens" of frogs September-October 2003; and 3 juveniles in October 2008 (CNDDDB 2016).

<sup>22</sup> Ten frogs collected from Waddell Creek in 1892; 3 frogs taken 2 to 5 miles from Ocean Beach in 1938; 5 frogs in 1941; and 2 frogs taken 2 miles from the mouth in 1953 (UCMVZ 2015).

<sup>23</sup> Ten frogs collected from 1 mile NE of Loma Mar in 1937; 4 frogs from the upper reaches of the tributary

Other than a single record from 1999 in Pescadero Creek County Park<sup>24</sup>, there are no known recent observations from Pescadero Creek.

#### San Gregorio Creek

Historical collection records include 1 frog from La Honda in 1929 and 3 frogs from SW of La Honda in 1951 (CAS 2001; UCMVZ 2015).

There are no known recent observations from San Gregorio Creek.

*Recent status:* Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at only 4 of 9 historical locations (44%) in San Mateo County. There are no CNDDDB records from San Mateo County since 1999 (CNDDDB 2016). The species is likely close to extirpation in San Mateo County.

#### Western Fresno County

##### Los Gatos Creek

There are historical collection records from 1938-1963 in Los Gatos Creek, which flows eastward to the San Joaquin Valley, and tributary Warthan Creek (Ely 1992; CAS 2001; UMMZ 2001; UCMVZ 2015).<sup>25</sup>

No frogs were located in Warthan Creek during early 1990s surveys by Ely (1992). Small numbers of frogs were documented from 1992-1993 in Los Gatos Creek, the White Creek tributary on BLM land, and Warthan Creek (CAS 2001; CNDDDB 2016).<sup>26</sup> Threats to these frogs included legacy impacts from past heavy mining. There are no known observations in the Los Gatos Creek drainage since 1993.

##### Cantua Creek

During surveys of the east slope of the Diablo Range in the early 1990s, foothill yellow-legged frogs were found “in abundance” (more than 27 frogs) in Cantua Creek, with a “very large population” estimated at more than 88 frogs observed in the tributary Arroyo Leona Creek, in the Ciervo Hills on Bureau of Land Management and private lands (Ely 1992). A large population was documented consistently from 1992-1994 in Cantua

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Oil Creek in 1937; 3 frogs from Portola State Park in 1951, 1 frog in 1958, 1 frog in 1959, and 2 frogs in 1960; and 2 frogs taken from 8 miles E of Pescadero in 1960 (CAS 2001; UCMVZ 2015).

<sup>24</sup> A single adult frog was observed in Pescadero Creek, between Jones Gulch and Harwood Creek in Pescadero Creek County Park, in September 1999 (CNDDDB 2016).

<sup>25</sup> Single frogs from Los Gatos Creek, 10 miles N of Coalinga in 1938; 7.9 miles SE of the mouth of Bear Canyon in 1941; 2 miles W of Coalinga in 1941; and 6 frogs collected from Los Gatos Creek, 8 miles NW of Coalinga in 1963 (CAS 2001; UMMZ 2001; UCMVZ 2015). There were a few historical records from Warthan Creek, a tributary of Los Gatos Creek near Coalinga (Ely 1992).

<sup>26</sup> In the White Creek tributary, 4 miles SSE of Santa Rita Peak, 7-10 tadpoles were observed on 6/28/92, 4 adults and 2 juveniles on 3/6/93, with one adult (CAS #190766) collected, and 4 adults and larvae on 6/29/93; a single adult frog (CAS #193924) was collected from Los Gatos Creek in the Alcalde Hills in October 1993 (CAS 2001; CNDDDB 2016). A single adult frog (CAS #193923) was collected from Warthan Creek in October 1993, 1.2 road miles E of Parkfield Road (CAS 2001; CNDDDB 2016).

Creek (CAS 2001; CNDDDB 2016).<sup>27</sup> In the 2000s, there was only one report of a small population of frogs at one locality in Cantua Creek (CNDDDB 2016).<sup>28</sup>

*Recent status:* Fellers (1994) reported healthy, reproducing populations in western Fresno County. Jennings and Hayes (1994) were unable to locate the species during resurvey efforts from 1988-1991 at any of 6 historical locations in western Fresno County. Small populations were documented in Los Gatos Creek and large numbers in Cantua Creek during surveys from 1992-1993, but there has been only report since 1993 and no evidence of resurveys.

### Western Merced County

#### Los Banos Creek

There are historical collection records from 1911 and 1943 in Los Banos Creek (which flows west into the San Joaquin Valley) and tributary Romero Creek (UCMVZ 2015).<sup>29</sup> There were small populations documented from 1985-1988 in Los Banos Creek and North Fork Los Banos (CNDDDB 2016).<sup>30</sup>

There are no known recent observations from Los Banos Creek.

*Recent status:* There are no CNDDDB records from western Merced County since 1988 and the status of the species in this county is unknown.

### Western Stanislaus County

#### Del Puerto Creek

There are historical collection records from 1954-1987 in Del Puerto Creek, which flows east into the San Joaquin Valley (CAS 2001; UCMVZ 2015).<sup>31</sup>

Small to moderate populations were documented in Del Puerto Creek from 1993-1999

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<sup>27</sup> Sample observations from this drainage by Ely, Christman, and Fellers submitted to the California Natural Diversity Database and collected by the California Academy of Sciences in the early 1990s included: 115+ frogs observed on 1/25/92; 6 adults and 2 juveniles on 4/26/92; 102 frogs, juveniles and 2 egg masses/tadpoles on 4/27/92; 3 adults and "impressive" numbers of tadpoles on 6/14/92; 20 adults and 15 egg masses, with 200-300 eggs/mass on 4/15/93; 20 adults, 2 juveniles and 15 egg masses on 4/25/93; 7 adults and one egg mass on 4/26/93; and 12 adults, 47 juveniles, 3,183 larvae and 5 egg masses in April 1994 (CAS 2001; CNDDDB 2016).

<sup>28</sup> In May 2003 one location in the Cantua Creek drainage had 10 adults, 5 juveniles and 42 larvae (CNDDDB 2016).

<sup>29</sup> Single frogs collected at Sweeney's Ranch, 22 miles S of Los Banos, in 1911; and in Romero Creek in 1943 (UCMVZ 2015).

<sup>30</sup> A single adult on the North Fork Los Banos Creek, 3 miles SW of San Luis Reservoir on 8/2/85; 10 adults at the Los Banos Detention Dam on the S end of Los Banos Reservoir on 8/19/85; 2 adults in North Fork Los Banos Creek, 2 miles SSW of San Luis Reservoir on 9/20/85; several frog observations along a 1-mile section of creek approximately 7 miles ESE of San Luis Reservoir on 9/30/85; and a single adult observed in Los Banos Creek ¼ mile SSE of San Luis Reservoir on 3/21/88 (CNDDDB 2016).

<sup>31</sup> Single frogs were collected from Del Puerto Canyon, west of Patterson, in 1954, 1984 and 1986 and 7 frogs were collected in 1987 (CAS 2001; UCMVZ 2015).

(CAS 2001; CNDDDB 2016; UCMVZ 2015).<sup>32</sup> Very small populations were documented in Del Puerto Creek from 2000-2008 (CNDDDB 2016).<sup>33</sup>

#### Orestimba Creek

Small numbers of foothill yellow-legged were documented in 2004 and 2005 within Henry Coe State Park, along Robison Creek near its confluence with Orestimba Creek (CNDDDB 2016; HWCSP 2015).<sup>34</sup>

*Recent status:* Fellers (1994) reported “healthy” reproducing populations in western Stanislaus County. There appeared to be small populations remaining in Del Puerto Creek through 2008 and Orestimba Creek through 2005.

#### Western San Joaquin County

##### Corral Hollow Creek

There are historical collection records from 1911-1971 lower Corral Hollow Creek in San Joaquin County (CMNH 2001; CNDDDB 2016; UCMVZ 2015).<sup>35</sup> Lower Corral Hollow Creek apparently had a large population historically, with 17 adult specimens collected on a single day in March 1911 (UCMVZ 2015). The last known sightings in lower Corral Hollow Creek within San Joaquin County were in 1971, and the remnant population in upper Corral Hollow Creek in Alameda County may be near extirpation as well (Jones & Stokes 2000).

##### Mokelumne River/San Joaquin River

Livezey (1963) reported an isolated population of *R. boylei* on the floor of the Central Valley in San Joaquin County, approximately midway between the known distribution of the species in the coast ranges to the west and the Sierra foothills to east. Livezey collected 4 specimens (now at the California State University Sacramento) on July 30, 1958 from the Mokelumne River drainage 8 km N of Lodi. However, it has been theorized that these frogs were perhaps strays from the Sierran foothills or that waif

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<sup>32</sup> A single frog was collected from the Adobe Creek tributary at the confluence with Del Puerto Creek in June 1994 (CAS 2001; UCMVZ 2015). Fellers observed 2 adults and 800 eggs on 4/9/93 in Del Puerto Creek at Adobe Creek and returned to collect 1 adult (CAS #196026) on 6/19/94; Fellers observed 14 larvae on 5/21/96 along lower North Fork Del Puerto Creek; multiple sightings about 1 mile S of the confluence with the North Fork, with 35 adults observed on 10/19/93, 6 adults and 2 metamorphs on 7/13/98 and 9/21/98, and 3 adults, 7 metamorphs and many larvae on 7/23/99. Along Del Puerto Creek about 0.6 miles W of Arkansas Canyon, Fellers observed 9 larvae on 6/2/98, 34 adults and 11 subadults on 5/25/99 (CNDDDB 2016).

<sup>33</sup> Fellers observed 2 subadults on 6/23/00 along Del Puerto Creek, just W of Slick Rock Canyon confluence; Fellers observed 1 adult and 1 larvae on 5/28/03 in Del Puerto Creek near Frank Raines Regional Park (this is near an off-road vehicle park); along Del Puerto Creek about 0.6 miles W of Arkansas Canyon, Fellers observed 1 adult, 1 subadult and 25 larvae on 7/23/00; and 49 larvae on 5/28/08 (CNDDDB 2016).

<sup>34</sup> Within the NE portion of Henry W. Coe State Park, 3 juveniles and 2 egg masses were observed in Robinson Creek on 3/20/04; and in South Fork Orestimba Creek, 1 adult and 2 juveniles were observed on 3/21/04 and 1 adult was observed on 5/15/05 (CNDDDB 2016).

<sup>35</sup> Foothill yellow-legged frogs were collected from lower Corral Hollow Creek in San Joaquin County, near Tracy, in 1911, 1943, 1967 and 1970 (CMNH 2001; UCMVZ 2015). The last known sightings in Corral Hollow Creek were in 1971, with 1 frog (MVZ 99240) collected on 4/24/71, 23 tadpoles (MVZ 98194) collected on 5/15/71 and 7 tadpoles (MVZ 98191) collected on 5/29/71 (CNDDDB 2016).



dispersal occurred in this case (Lind et al. 1996). The species was also found in a pond near the San Joaquin River, 18 miles W of Manteca, in 1960 (UCMVZ 2015).

*Recent status:* There are no recent reports from the CNDDDB or other sources of foothill yellow-legged frogs in western San Joaquin County. The species is likely completely extirpated from lower Corral Hollow Creek and western San Joaquin County.

## **Bay Area**

The species is extirpated from western San Francisco County; and may be near extirpation in Contra Costa and San Mateo counties. The species has declined in many of the drainages in Napa, Marin, and Alameda counties; in Alameda County the largest populations have crashed recently. There appear to be significant populations of foothill yellow-legged frogs remaining in the Diablo Range in Santa Clara County and throughout Sonoma County.

### San Francisco County

The California Academy of Sciences has a single collection record of *R. boylei* from before 1938 from an unknown location in San Francisco (CAS 2001).

*Recent status:* Jennings and Hayes (1994) were unable to locate the species during resurvey efforts from 1988-1991 at the sole historical location in San Francisco County. There are no CNDDDB records and the foothill yellow-legged frog is extirpated from San Francisco County.

### San Mateo County

#### SF Bay Tributaries

Two frogs were collected from the San Mateo Creek drainage (San Andreas Lake) before 1915; and 6 frogs were taken from Redwood City (likely Redwood Creek or Atherton Creek) in 1899 (Slevin 1928; CAS 2001; USNM 2001).

There are no known recent observations from San Francisco Bay tributaries in San Mateo County.

### Santa Clara County

Historically, foothill yellow-legged frogs were probably present in virtually all of the larger perennial streams in Santa Clara County with the exceptions of the lower portions of Coyote Creek and the Guadalupe River (H.T. Harvey and Associates 1999).

#### Pajaro River

There are historical collection records in southern Santa Clara County from 1898-1965 in the Llagas Creek, Murphy Creek and Uvas Creek tributaries to the upper Pajaro River drainage (CAS 2001; UMMZ 2001; UCMVZ 2015).<sup>36</sup>

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<sup>36</sup> Single frogs collected from: Uvas Creek in 1909; Murphy Creek, tributary to Uvas Creek N of Mt. Madonna, in 1898; a tributary to Uvas Creek at Hecker Pass, 8 miles W of Gilroy in 1952; Llagas Creek in

Small populations were reported from 1998-2007 in Llagas Creek within Santa Clara County (CNDDDB 2016).<sup>37</sup>

#### Mount Hamilton/Alameda Creek headwaters

There are historical collection records from 1900-1986 in headwater tributaries of the Alameda Creek drainage around Mt. Hamilton, including the upper reaches of Arroyo Mocho and Arroyo Valle, and Isabel and Smith Creeks and their tributaries above Calaveras Reservoir (UMMZ 2001; CAS 2001; Cornell 2002; UCMVZ 2015).<sup>38</sup>

Small populations were documented from 1988-2004 in Mount Hamilton tributaries and the Alameda Creek headwaters, including upper Alameda Creek, Arroyo Hondo, Bonita Creek, Colorado Creek, Indian Creek, Smith Creek and Sulphur Creek (CNDDDB 2016).<sup>39</sup> A small population of foothill yellow-legged frogs was observed "several times" from 1997-2011 in Arroyo Hondo on the Blue Oak Ranch Reserve (CNDDDB 2016).<sup>40</sup>

#### Coyote Creek

There are historical collection records from 1904-1975 in the Coyote Creek drainage and tributaries Fisher Creek and Upper Penetencia Creek (Slevin 1928; CDFG 1975; CAS 2001; UMMZ 2001; UCMVZ 2015).<sup>41</sup> Foothill yellow-legged frogs were historically found

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1922 and 1965; and Llagas Creek just above the head of Chesbro Reservoir in 1986 (UMMZ 2001; CAS 2001; UCMVZ 2015).

<sup>37</sup> In Llagas Creek, 2 adult frogs were reported 2 miles S of Calero Reservoir on 7/13/98, and 1 adult was observed here on 3/24/07; just above Chesbro Reservoir, 2 adults were observed on 3/22/03 and single adults were seen on 3/23/03, 3/30/03 and 4/11/03 (CNDDDB 2016).

<sup>38</sup> Historical collection localities include: unknown location on Mt. Hamilton in 1900; 12 frogs from 25.4 miles SE of Livermore (likely in the headwaters of Arroyo Mocho) in 1952; 2 frogs from Arroyo Mocho, 8.5 miles N of San Antone in 1971; 2 juvenile/adult frogs from Blackbird Valley (tributary of upper Arroyo Valle) in 1986; 3 frogs from San Antonio Creek (tributary to upper Arroyo Valle), 10 miles from Mt. Hamilton, in 1939; 6 frogs from 2 miles N of the road from Lick Observatory (likely Smith Creek or Isabel Creek) in 1948; Isabel Creek near Mt. Hamilton in 1921; Smith Creek at Mt. Hamilton Road, unknown date; and Smith Creek Ranger Station, Mt. Hamilton Road, in 1950 (UMMZ 2001; CAS 2001; Cornell 2002; UCMVZ 2015).

<sup>39</sup> The species was observed in May 1990 in Upper Alameda Creek in Ohlone Regional Park, just within Santa Clara County (CNDDDB 2016). Numerous observations were made of all life stages of foothill yellow-legged frogs during surveys from March through July from 1988-91, in Smith Creek, Sulphur Creek and Indian Creek on the SW slopes of Mt. Hamilton within J.D. Grant County Park; more frogs were found upstream from Smith Creek at the confluence with Indian Creek, as well as the first 1/3 to 1/2 mile of Sulphur Creek in 1991; however in 1993 only 1 adult frog was found in this area, in Sulphur Creek (CNDDDB 2016). Single frogs were collected from Sulphur Creek, 2.5 miles upstream from the Smith Creek confluence in October 1992, and 0.2 miles upstream in May 1993 (CAS 2001). In Colorado Creek (tributary of upper Arroyo Valle), from Mines Road upstream into Blackbird Valley, Ely observed 1 adult on 4/20/93, and 17 adults and a "good number" of tadpoles upstream on 6/12/93; single adult frogs were collected from Colorado Creek by Ely on 11/3/92 (CAS #190556) and on 5/24/98 (CAS 205752) (CAS 2001; CNDDDB 2016). A single frog (CAS #195454) was collected from Indian Creek on 3/13/94 (CNDDDB 2016). The SFPUC reported 2 or more adults in Arroyo Hondo, just above Calaveras Reservoir, on 4/20/94 (CNDDDB 2016). 2 adult frogs were observed on 3/22/03 during a walking survey of a 1 mile section of Bonita Creek, a tributary of Isabel Creek (CNDDDB 2016).

<sup>40</sup> Arroyo Hondo on the Blue Oak Ranch Reserve (about 1.5 miles SSW of the Mt. Day Summit), with photos and a survey form indicating that 10 adults and 1 egg mass had been detected (CNDDDB 2016).

<sup>41</sup> Historical collection localities include: Coyote Creek from before 1928; 6.54 road miles northeast of Gilroy (likely Coyote Creek near Anderson Lake) in 1953; 15 frogs from Coyote Creek in San Jose in 1922; Berryessa, tributary to Upper Penetencia Creek in 1904; Penetencia Creek, Alum Rock Park, in 1959; and

within Henry Coe State Park in the mainstem of Coyote Creek as well as the Middle Fork, and East Forks of Coyote Creek (Christman and Long unknown date).

Small to moderate populations were documented from 1986-2004 throughout the Coyote Creek drainage including mainstem Coyote Creek from Poverty Flat downstream to Gilroy Hot Springs, Middle Fork Coyote Creek, Little Coyote Creek, Water Gulch Creek, Grizzly Gulch Creek, and Soda Springs Canyon (PRA 1997; CAS 2001; CNDDDB 2016). Gonsolin (2010) documented breeding populations of foothill yellow-legged frog from 2004-2006 in upper Coyote Creek (upstream of Coyote Reservoir, from the inundation zone to Gilroy Hot Springs) and its tributary Dexter Creek and an unnamed tributary below Sheep Ridge. 2016 surveys of a 6 mile segment of Coyote Creek, from China Hole (Middle Fork Confluence) downstream to the Coyote Gate entrance of Henry W. Coe State Park, documented 9 adults, 1,000+ tadpoles and 121 egg masses (CNDDDB 2016). Foothill yellow-legged frogs currently persist within Henry Coe State Park in Coyote Creek and some of its tributaries, including Water Gulch, though their presence on the East Fork is minimal (HWCSP 2015). The park reports the species can be seen reliably along the Middle Fork of Coyote Creek, including Soda Springs Canyon, but is not found within the park in streams such as Pacheco Creek, Mississippi Creek, Coon Creek or Red Creek (HWCSP 2015).

#### Guadalupe River

Historical collection localities in the Guadalupe River drainage include from tributary Los Gatos Creek (at Los Gatos) in 1898 and Almaden Creek in 1950 (CAS 2001).

The Santa Clara Valley Water District reported small numbers of frogs in 2000 from two locations on Guadalupe Creek and tributary Rincon Creek (CNDDDB 2016).<sup>42</sup>

#### Saratoga Creek

Foothill yellow-legged frogs were collected in the Saratoga Creek drainage from Saratoga on an unknown date before 1952; and from 2.6 miles WSW of Saratoga in 1953 (CAS 2001; UCMVZ 2015).

There are no known recent observations from Saratoga Creek.

#### Stevens Creek

Foothill yellow-legged frogs were collected in the Stevens Creek tributary in 1893 and 1939 (CAS 2001).

There are no known recent observations from Stevens Creek.

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Upper Penetencia Creek and Fisher Creek in 1975 (Slevin 1928; CDFG 1975; UMMZ 2001; CAS 2001; UCMVZ 2015).

<sup>42</sup> Two adult frogs from Guadalupe Creek downstream from Guadalupe Reservoir on 8/28/00; and 1 individual frog from Rincon Creek, upstream of the Guadalupe Creek confluence on 8/24/00 and 8/29/00 (CNDDDB 2016).

## San Francisquito Creek

San Francisquito Creek forms the border between Santa Clara and San Mateo counties. Collections and records from this watershed are discussed here, as most records are from the Santa Clara side of the creek. There are historical collections from 1897-1940 in the San Francisquito Creek drainage (Slevin 1928; CAS 2001; FMNH 2001; USNM 2001).<sup>43</sup> Foothill yellow-legged frogs were reported to be “fairly common” in the San Francisquito drainage in the 1960s (Laurer et al. 1999). Dyrkacz (1981) reported on an albinistic foothill yellow-legged frog collected from Portola Valley.

There are no known recent observations from San Francisquito Creek.

*Recent status:* Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at 8 of 14 historical locations (57%) in Santa Clara County. H.T. Harvey and Associates (1999) conducted surveys in 1999 and concluded that the species had essentially disappeared from the farmed and urbanized lowland areas in Santa Clara County, as well as many of the perennial streams below major reservoirs. H.T. Harvey and Associates (1999) determined that the species is declining throughout Santa Clara County, but was still present in the Santa Cruz Mountains and fairly abundant in the foothill and mountain ranges of eastern Santa Clara County. Small populations were documented in the Llagas Creek tributary of the Pajaro River through 2007, and in headwater tributaries of the Alameda Creek drainage around Mt. Hamilton, such as Arroyo Hondo through 2011 and the Isabel Creek drainage through 2003; small to moderate populations remain throughout the Coyote Creek drainage, particularly upper Coyote Creek and Middle Fork Coyote Creek.

## Alameda County

### Alameda Creek

There are historical collection records from 1921-1969 in the Alameda Creek watershed, including mainstem Alameda Creek in Niles Canyon, upper Alameda Creek, and the Pleasanton and Livermore tributaries Arroyo Valle and Arroyo Mocho (CAS 2001; CMNH 2001; UMMZ 2001; UCMVZ 2015).<sup>44</sup>

The largest remaining *R. boylei* population in Alameda County, and likely in the entire Bay Area, has been in upper Alameda Creek within Sunol Regional Park, from the Little Yosemite area upstream through Camp Ohlone. The CNDDDB has sightings from upper Alameda Creek from 1990, 1994, 1997, 1999, 2000 and 2001 in the reach from the Sunol Regional park staging area bridge upstream to the Calaveras Creek confluence, in and above Little Yosemite, and in the vicinity of the Alameda Diversion tunnel (CNDDDB

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<sup>43</sup> Collection records include: 1 frog from Palo Alto before 1900; single frogs from the vicinity of Stanford University in 1897 and 1907; 3 frogs from Woodside Road at Stone Circle (likely the Bear Creek tributary) in 1935; 6 frogs from Woodside Road on two occasions in 1938; and 1 frog from Corte Madera Creek (a tributary above Searsville Lake) in 1940 (Slevin 1928; CAS 2001; FMNH 2001; USNM 2001).

<sup>44</sup> Historical collection records of *Rana boylei* from Alameda Creek include between Sunol and Mission San Jose (Niles Canyon) in 1921, Niles Canyon in 1939, and Sunol Regional Park in 1967; numerous specimens were collected from the Arroyo Mocho tributary in 1937 (22 frogs), 1939 (7 frogs), 1942, 1944, 1952, 1953, 1966, 1971 (2 frogs - MVZ 95204 & 95205), 1972 (2 frogs - MVZ 125364-125365), 1973 (MVZ 136289) and 1975 (7 larvae - MVZ 136418-136424), as well as 2 frogs taken from Livermore in 1969; and there is a collection record from Arroyo del Valle in 1960 (UMMZ 2001; CAS 2001; CMNH 2001; UCMVZ 2015).

2016). During surveys from July through October 1996, 295 *R. boylei* were found at 4 locations along upper Alameda Creek within Sunol and Ohlone Regional Parks (EBRPD 1998). Extensive surveys from 1997 to 1999 by Bobzien and DiDonato (2007) located the species in the Alameda Creek watershed in upper Alameda Creek (in Ohlone Regional Wilderness and Sunol Regional Wilderness); but did not locate the species in numerous Alameda Creek tributaries, including: Indian Joe Creek, La Costa Creek, Indian Creek, Shafer Creek, San Antonio Creek, Welch Creek and Whitlock Creek (Ohlone and Sunol Regional Wilderness); Sinbad Creek (Pleasanton Ridge Regional Park); Arroyo Del Valle Creek (Del Valle Regional Park); Tassajara Creek (Morgan Territory Regional Preserve and Tassajara Creek Regional Park); Altamont Creek (Brushy Peak Regional Preserve); and Brushy Creek (Vasco Caves Regional Preserve). Bobzien and DiDonato (2007) noted a small population in a 2-mile reach of Alameda Creek in the vicinity of the Sunol Visitor Center. Bobzien and DiDonato (2007) documented a “robust” population from 2000-2006 in a 1 mile stream reach of upper Alameda Creek in Camp Ohlone, and foothill yellow-legged frogs were noted to be “abundant” in 2006 during fish surveys of the Upper Ohlone reach of Alameda Creek, upstream of the Alameda Diversion Dam (B. Sak, pers comm., 2006). However, this Camp Ohlone population has crashed since 2008 as a result of the drought; in 2015 there were only 4 clutches of eggs and no survival to metamorphosis, with all the breeding sites drying up as of early August (S. Kupferberg, pers. comm., 2015).

Foothill yellow-legged frogs in upper Alameda Creek have been particularly hard hit by the recent drought, disease and invasive species, with the “few frogs present above Little Yosemite within the Regional Park boundary and at Camp Ohlone” as of 2015, subject to predation by invasive bullfrogs and signal crayfish (Kupferberg 2015). Kupferberg and the East Bay Regional Park District documented an unprecedented chytrid fungus infection (*Batrachochytrium dendrobatidis*) in the *R. boylei* population in Little Yosemite, with confirmed mortality of frogs and Bd prevalence and loads on infected frogs an order of magnitude higher than levels leading to mortality and population decline in other well-studied amphibians (Kupferberg 2015). In the fall of 2013, foothill yellow-legged frogs in the Little Yosemite reach of Alameda Creek experienced an outbreak of Bd in which dead and dying juveniles were observed (Adams et al. in press). The SFPUC had planned to translocate frogs from this infected population to other areas of the watershed, presenting significant risk of spreading this infection to other currently uninfected *R. boylei* populations in the watershed (SFPD 2014; Kupferberg 2015). Those plans are now on hold and the project is being re-evaluated.

Small populations were documented along the Arroyo Mocho tributary SE of Livermore from 1997-2003 (CNDDDB 2016).<sup>45</sup> “Numerous” *R. boylei* were observed in 2000 during stream surveys in the Arroyo Mocho tributary along Mines Road SE of Livermore (A. Gunther, pers. comm., 2000). The species was present in the 1990s in the Arroyo Valle watershed above Del Valle Reservoir (EBRPD 1998), but this stream has not been surveyed for more than 15 years.

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<sup>45</sup> On Arroyo Mocho from the Hetch-Hetchy Pumping Station bridge access road to about 0.75 upstream (~7 miles SE of Livermore), 6 adults frogs and 2 juveniles were observed on 4/15/97, 2 male and 4 female frogs on 4/6/99, and 16 egg masses and 20 adults on 3/26/03 (CNDDDB 2016).

## Corral Hollow Creek

A foothill yellow-legged frog population was known historically from Corral Hollow Ecological Reserve (Schoenherr 1992) and prior to 1997 the species was “frequently” observed in Corral Hollow Creek within the Carnegie State Vehicle Recreation Area and downstream for several miles (Jones & Stokes 2000). A single juvenile *R. boylei* was found in April 1998 in upper Corral Hollow Creek (Jones & Stokes 2000; CNDDDB 2016); and a single adult frog was observed on Corral Hollow Creek about one half mile WSW of Tesla, within Carnegie SVRA, on April 28, 2014 (CNDDDB 2016). As discussed in the section above on San Joaquin County, foothill yellow-legged frogs were restricted to the upper half mile of Corral Hollow Creek in Alameda County by the late 1990s and near extirpation (Jones & Stokes 2000). This remnant population is jeopardized by plans to expand off-road vehicle activity and a vehicle stream crossing through the last known sighting area in the Carnegie SVRA (Jones & Stokes 2000; CNDDDB 2016).

## Western Alameda County

The species was collected from an unknown location in Oakland in 1891 and from Berkeley in Telegraph (Claremont) Canyon in 1912 (Slevin 1928; CAS 2001; UCMVZ 2015). There are no recent observations from western Alameda County.

*Recent status:* Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at only 4 of 13 historical locations (31%) in Alameda County. Bobzien and DiDonato (2007) conducted extensive surveys from 1997 to 1999 during peak breeding season for foothill yellow-legged frogs, at 100 stream stations on 42 streams within East Bay Regional Park District lands throughout Alameda and Contra Costa Counties. Except for populations in several drainages within the Alameda Creek watershed, the species was extirpated or absent from all Alameda County streams surveyed. The largest remaining populations in Alameda County (and likely in the S.F. Bay Area) were in upper Alameda Creek. These populations have now crashed and are jeopardized by multiple factors including drought, Bd infection, recreation impacts, ill-timed dam flow releases that cause direct mortality of early life stages, invasive predators that flourish under dam-altered flow conditions, and future hypolimnetic dam releases that shift water temperatures outside the thermal niche of tadpoles.

## Contra Costa County

### San Leandro Creek

There are historical records from upper San Leandro Creek and Moraga Creek (USACE 2001; CAS 2001; UCMVZ 2015).<sup>46</sup>

There is a CNDDDB report from February 1997 of 2 adult yellow-legged frogs in an intermittent tributary to Moraga Creek near the Gateway Valley; subsequent surveys of this area failed to detect any *R. boylei* (CNDDDB 2016; J. Miller, pers. comm., 2015). The species was extirpated as early as the 1950s from all East Bay Municipal Utility District

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<sup>46</sup> Collection records from upper San Leandro Creek include Redwood Peak in 1909 and the town of Canyon in 1947 (USACE 2001; CAS 2001; UCMVZ 2015). Yellow-legged frogs occurred historically in the Moraga Creek drainage near the Gateway Valley (USACE 2001).

watershed lands in the East Bay, which includes large portions of the upper San Leandro Creek watershed (EBMUD 1994).

#### San Pablo Creek

There are historical records from San Pablo Creek from 1917 to the 1950s (UCMVZ 2015).<sup>47</sup> *Rana boylei* was apparently once abundant in San Pablo Creek near Orinda, with 13 frogs collected on a single day in August 1922 (UCMVZ 2001); the creek was reportedly “full of yellow-legs” in the 1950s (G. Beeman, pers. comm., 2002).

The species was extirpated as early as the 1950s from all East Bay Municipal Utility District watershed lands in the East Bay, which includes large portions of the San Pablo Creek watershed (EBMUD 1994). Extensive surveys from 1997 to 1999 by Bobzien and DiDonato (2007) failed to locate the species in the San Pablo Creek watershed (Arroyo Del Hambre Creek and Bear Creek in Briones Regional Park).

#### Pinole Creek

The species was collected in Pinole Creek in 1939 (UCMVZ 2015).

The species was extirpated as early as the 1950s from all East Bay Municipal Utility District watershed lands in the East Bay, which includes large portions of the Pinole Creek watershed (EBMUD 1994). Extensive surveys from 1997 to 1999 by Bobzien and DiDonato (2007) failed to locate the species in the Pinole Creek watershed (Castro Creek in Sobrante Ridge Regional Preserve).

#### Walnut Creek

There are historical records from 1891-1953 in Walnut Creek and tributaries Mitchell Creek and Pine Creek (CAS 2001; UCMVZ 2015).<sup>48</sup>

*Rana boylei* was found in unknown numbers in 1996 during aquatic surveys in the Bolinger Creek drainage, within Las Trampas Regional Park (EBRPD 1998). Extensive surveys from 1997 to 1999 by Bobzien and DiDonato (2007) failed to locate the species in other streams in the Walnut Creek watershed (Bolinger Creek in Las Trampas Wilderness, Sycamore Creek in Sycamore Valley Regional Park and Pine Creek in Diablo Foothills Regional Park). Foothill yellow-legged frogs reportedly persisted in small numbers in the early 2000s in headwaters tributaries draining Mt. Diablo, such as Pine Creek and possibly Mitchell Creek (G. Beeman, pers. comm., 2002).

#### Marsh Creek

There are historical records from 1939-1976 in the Marsh Creek drainage (UCMVZ 2015; CNDDDB 2016).<sup>49</sup> Harvey et al. (1992) noted that *R. boylei* was possibly found historically in small creeks near Pittsburgh and Brentwood.

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<sup>47</sup> Historical collection records include: San Pablo Canyon in 1917; and 13 frogs from near Orinda in 1922 (UCMVZ 2015). The species was collected from Orinda in the 1950s (G. Beeman, pers. comm., 2002).

<sup>48</sup> Historical collection localities from the include: Mt. Diablo in 1891 and 1931; 9 frogs from the W side of Mt. Diablo and Pine Canyon in July 1912; Mitchell Creek in 1912; a creek at Lafayette in 1922; and Pine Creek E of Walnut Creek in 1953 (CAS 2001; UCMVZ 2015).

Extensive surveys from 1997 to 1999 by Bobzien and DiDonato (2007) failed to locate the species in the Marsh Creek watershed (Marsh Creek and Round Valley Creek in Round Valley Regional Preserve, and Marsh Creek in Morgan Territory Regional Preserve and Clayton Ranch Regional Preserve), or in streams in Black Diamond Mines Regional Preserve draining into the Delta in eastern Contra Costa County near Pittsburgh and Antioch (Kirker Creek, Sand Creek, Markley Creek, Somersville Creek, West Antioch Creek and Homestead Creek). There are no recent documented occurrences of foothill yellow-legged frogs in the eastern Contra Costa Habitat Conservation Plan inventory area, covering major portions of eastern Contra Costa County (CCC 2006).

*Recent status:* Jennings and Hayes (1994) were able to relocate the species during resurvey efforts from 1988-1991 at only 3 of 9 historical locations (33%) in Contra Costa County. Jennings and Hayes (1994) believed that 8 of 11 known historical populations in Contra Costa County were extinct, with the 3 remaining records concentrated in the Mount Diablo region. Bobzien and DiDonato (2007) conducted extensive surveys for foothill yellow-legged frogs from 1997 to 1999 during peak breeding season, at 100 stream stations on 42 streams within East Bay Regional Park District lands throughout Alameda and Contra Costa Counties. *Rana boylei* was extirpated or absent from all streams surveyed in Contra Costa County (Bobzien and DiDonato 2007). The species is likely very nearly extirpated from Contra Costa County, with the possible exception of a few locations in headwater streams around Mount Diablo.

### Solano County

Putah Creek drains to the Yolo Bypass in the Sacramento Valley. Alamo Creek and Ulatis Creek flow to Cache Slough in the San Francisco Bay Delta. Ledgewood Creek is tributary to Suisun Slough and Suisun Bay.

#### Putah Creek

Small to moderate populations of *R. boylei* were documented in tributaries to Lake Berryessa and Putah Creek in extreme northwestern Solano County: Cold Canyon Creek in 1999 and 2004, and in Wild Horse Creek in 2006 (Solano County Water Agency 2002; CNDDDB 2016).<sup>50</sup>

#### Alamo Creek, Ulatis Creek

There are historical collection records from Vacaville; and 7 frogs from 3 miles W of Vacaville in July 1912 (Slevin 1928; UCMVZ 2015).

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<sup>49</sup> Historical collection localities in the Marsh Creek drainage include: 7 frogs from 3 miles E of the Livermore turnoff in May 1939; 10 frogs from 7 miles SE of Clayton in 1939 and 1940; 7 frogs from 4 miles E of Mt. Diablo in August 1950; 7 frogs from 6.3 miles SSE of Clayton in 1951 and 6 frogs from this location in March 1953; and 2 frogs (MVZ 55556 & 55557) collected by Zweifel from Marsh Creek 7.4 miles SE of Clayton on March 25, 1976 (UCMVZ 2015; CNDDDB 2016).

<sup>50</sup> In Cold Canyon Creek, more than 100 juvenile frogs were observed on 6/25/99 and 2 adults on 6/5/04; in Wild Horse Creek, about 1.2 miles upstream of the confluence with Cold Canyon Creek (in Stebbins Cold Canyon Reserve), more than 25 adult and subadult frogs were observed on 6/11/06 (CNDDDB 2016).



The species was reported to occur in the Vaca Mountain/Pleasants Valley/English Hills Conservation Area (Solano County Water Agency 2002). The Solano County Water Agency (2002) reported no recent observations of foothill yellow-legged frogs in drainages northwest of Vacaville, but there were subsequent observations of small numbers of frogs in Alamo Creek in 2003 and 2004, and in Ulatis Creek in 2004 (CNDDDB 2016).<sup>51</sup>

#### Sulphur Springs Creek

Foothill yellow-legged frogs are reported to have historically occurred in Sulphur Springs Creek, but were not found there during surveys in the mid-1990s (Solano County Water Agency 2002).

#### Ledgewood Creek

There is a 2002 report of 2 adult frogs from an unnamed tributary to Ledgewood Creek in the Rancho Solano area in northeastern Fairfield (Solano County Water Agency 2002; CNDDDB 2016).

*Recent status:* The Solano County Water Agency contends the scarcity of recent *R. boylei* records in the county is due to lack of survey effort for this species, as there is suitable habitat on private land in the upper reaches of streams in western Solano County such as Green Valley Creek, Suisun Creek, Wild Horse Creek, Cook Canyon Creek, Laguna Creek, Alamo Creek and its perennial tributaries, and Ulatis Creek (Solano County Water Agency 2002). There were observations in the 2000s of small to moderate populations in tributaries of Putah Creek, and small numbers of frogs in Alamo Creek, Ulatis Creek and Ledgewood Creek.

#### Napa County

Putah Creek drains to the Yolo Bypass in the Sacramento Valley. The Napa River drains to the Carquinez Straits on San Pablo Bay.

Historical collections of *R. boylei* were made from 1906-1974 from throughout the Napa River drainage (Napa River and tributaries Conn Creek, Dry Creek, North Slough, Rector Creek, Redwood Creek and Sulphur Creek), and above Lake Berryessa Reservoir (Putah Creek and tributaries Butts Creek, Capell Creek, Elicura Creek, Pope Creek, St. Helena Creek and Swartz Creek) (USNM 2001; FMNH 2001; CAS 2001; CNDDDB 2016; UCMVZ 2015). Large numbers of frogs were collected historically at some locations in Napa, for example, 38 frogs collected from Calistoga in 1915; 15 frogs from Conn Creek in March 1941; and 14 frogs from Sulphur Creek (where numerous collections were made) in May 1969 (UCMVZ 2015). E. Gerstung reported foothill yellow-legged frogs were “numerous” in April 1956 in Spanish Valley, SW of Lake Berryessa (CNDDDB 2016).

Foothill yellow-legged frogs were documented in very small numbers in the 1990s in only

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<sup>51</sup> In Alamo Creek, 6 larvae and 2 metamorphs in Gates Canyon (3 miles NW of Vacaville) on 8/7/03; and 2 adults 1.1 miles W of the junction of Lagoon Valley Road and Pleasants Valley Road on 6/5/04 (CNDDDB 2016). In Ulatis Creek, 13 adults and 10 tadpoles were observed along Mix Canyon Road (1.5 miles W of Lagoon Valley Road) on 5/30/04 (CNDDDB 2016).

a few locations in four Putah Creek tributaries (Butts Creek, Elicura Creek, Toll Canyon Creek and Zim Zim Creek) above Lake Berryessa (CNDDDB 2016). Foothill yellow-legged frogs were documented in small numbers in the 2000s in a few locations in the Napa River drainage (Bear Creek, Heath Creek, Sage Creek and at the Old La Joya Quicksilver Mine) and Putah Creek tributaries (Capell Creek, Elicura Creek and James Creek) above Lake Berryessa (CNDDDB 2016).

Surveys were done in 2007 for the proposed Walt Ranch development and small numbers of foothill yellow-legged frogs were found in Capell Creek (5 adults and 3 juveniles) and Milliken Creek (6 adults), but these surveys do not appear to have been recorded in the CNDDDB (Napa County 2016). Foothill yellow-legged frog populations in Milliken Creek in the Milliken Reservoir watershed and the upper Capell Creek drainage are threatened by the recently approved development of vineyards and associated infrastructure at Walt Ranch, including roads with numerous planned stream crossings (Napa County 2016).

*Recent status:* The species has clearly declined in Napa County and is less widely distributed in the Napa River and Putah Creek drainages, with no known significant populations remaining.

### Sonoma County

Historical collections of *R. boylei* were made from 1911-1974 from tributaries throughout the Russian River drainage (Ash Creek, Austin Creek, Dry Creek, Dutch Bill Creek, Pole Mountain Creek and Warm Springs Creek), in the Gualala River drainage (Gualala River, North Fork Gualala River, Pepperwood Creek, South Fork Gualala River and Wolf Creek), and in Salmon Creek (Freestone) and Adobe Creek in Petaluma (CAS 2001, CMNH 2001, FMNH 2001; LSUMNS 2001; UMMZ 2001; UCMVZ 2015). Large numbers of frogs were collected historically at some locations in Sonoma, for example 24 frogs collected from Austin Creek on October 12 and 13, 1940 (UCMVZ 2015).

In the 1990s, Harvey et al. (1992) reported the species as still “common” in the Sonoma Mountains east of Petaluma (Petaluma River and Sonoma Creek drainages) with sightings of “large numbers” indicating that populations were stable. Foothill yellow-legged frogs were documented in the 1990s throughout the Russian River drainage (Russian River and tributaries Burns Creek, Crocker Creek, Franz Creek, Maacama Creek, Sausal Creek and Squaw Creek), throughout the Austin Creek sub-drainage (Austin Creek and tributaries Big Austin Creek, Black Rock Creek, Blue Jay Creek, Conshea Creek, Devil Creek, East Austin Creek, Gilliam Creek, Gray Creek, Lawhead Creek, Little Sulphur Creek, Pole Mountain Creek, Sulphur Creek and Ward Creek), and in the Mark West Creek sub-drainage (Mark West Creek and tributaries Porter Creek and Weeks Creek) (CNDDDB 2016). All observations were of small populations, with notable locales being Big Austin Creek, Crocker Creek, Little Sulphur Creek and Squaw Creek.<sup>52</sup> Foothill yellow-legged frogs were also documented in small numbers in the 1990s in: tributaries to the Gualala River (Wheatfield Fork and unnamed tributary); Sonoma Creek; Santa Rosa Creek in April and May of 1991 (MacTague and Northern

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<sup>52</sup> In Big Austin Creek (1 adult and 79 juveniles captured during creek restoration construction on 10/19/98 and 10/21/98); Crocker Creek (5 adults and thousands of tadpoles on 6/9/97); Little Sulphur Creek (8 adults and thousands of tadpoles on 6/9/97); and Squaw Creek (20 adults on 8/25/98) (CNDDDB 2016).

1993); Copeland Creek, a Laguna de Santa Rosa tributary (13 adults on 8/29/96); and Adobe Creek (“lots of frogs” on 6/10/97) (CNDDDB 2016).

In the 2000s, small populations were documented throughout the Russian River drainage (Russian River and tributaries Cherry Creek, Crocker Creek, Gird Creek, Green Valley Creek, Ingalls Creek, Maacama Creek, McDonnell Creek, Miller Creek, Porter Creek, Sausal Creek and Skunk Creek), throughout the Austin Creek sub-drainage (Austin Creek and tributaries Big Austin Creek, Big Sulphur Creek, Blue Jay Creek, Kidd Creek, Schoolhouse Creek, Trestle Creek and Ward Creek), and in the Mark West Creek sub-drainage (Mark West Creek and tributary Humbug Creek) (CNDDDB 2016). All observations were of small numbers of frogs, with the exceptions of a moderate population in Cherry Creek (20+ individuals on 11/5/02) and a moderately large population in Gird Creek (about 50 adults and sub-adults on 10/17/00); other notable locales were Miller Creek, Porter Creek and Ward Creek) (CNDDDB 2016).<sup>53</sup> Foothill yellow-legged frogs were documented in small numbers in the 2000s in the South Fork Gualala River drainage, in tributaries Blue Slide Creek, Buckeye Creek (only 8 frogs documented on 5/7/08, but noted that frogs still existed in “quite large numbers”), Fuller Creek, House Creek and Patchett Creek (CNDDDB 2016). Foothill yellow-legged frogs were also documented in small numbers in the 2000s in Adobe Creek, Sonoma Creek tributaries Carriger Creek and Stuart Creek, tributaries of the Laguna de Santa Rosa (Crane Creek and Copeland Creek), and in a few small coastal drainages (Fort Ross Creek, Kolmer Gulch, East Branch Russian Gulch and Russian Gulch); with a moderate population in 2008 in Sonoma Creek (21 adults and more than 100 tadpoles on 8/7/08) (CNDDDB 2016).

The Sonoma County Water Agency (2008) compiled documented occurrences and completed habitat assessments for foothill yellow-legged frogs at 189 sites (102 unique streams) within Sonoma County, noting occurrence data for the Laguna de Santa Rosa, Petaluma River, Sonoma Creek and Russian River watersheds, as well as other scattered occurrences. SCWA (2008) concluded the species is likely distributed throughout the county in natural foothill and mountain streams with moderate gradient and permanent or semi-permanent water. SCWA (2015) reported 71 documented occurrences of foothill yellow-legged frog throughout Sonoma County.

*Recent status:* *R. boylei* is still widely distributed throughout Sonoma County in many Russian River tributaries (particularly Austin Creek and Mark West Creek), the South Fork Gualala River drainage, watersheds of the Laguna de Santa Rosa, Petaluma River, Sonoma Creek, Adobe Creek, and a few coastal streams, mostly in small populations. The most significant remaining Sonoma locales are a moderately large population documented in Gird Creek in 2000 and moderate populations in Sonoma Creek in 2008 and Russian River tributary Cherry Creek in 2002.

### Marin County

*Rana boylei* was found historically throughout Marin County, including the Lagunitas Creek drainage (Lake Lagunitas, Alpine Lake, Lagunitas Creek, San Geronimo Creek, Devil’s Gulch Creek, Nicasio Creek, Arroyo Nicasio, Arroyo Sausal, Halleck Creek, Olema Creek, Big Carson Creek, Little Carson Creek), tributaries on Mount Tamalpais

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<sup>53</sup> In Miller Creek and an unnamed tributary (about 15 adults, about 300 subadults and “many” tadpoles on 8/4/00); Porter Creek (100+ juveniles on 7/30/03); and Ward Creek (10 adults on 4/27/05).

(Cataract Creek, Rock Spring, Phoenix Gulch), Redwood Creek, tributaries to Bolinas Lagoon (Pine Gulch Creek, Pike County Gulch) and Tomales Bay (Walker Creek, Salmon Creek, Millerton Gulch), and several creeks in eastern Marin County draining to San Francisco Bay (San Anselmo Creek, Arroyo Corte Madera, Arroyo San Jose, Fairfax Creek, Big Rock Creek, Dairy Creek, Mill Creek) (USNM 2001; CMNH 2001; TMM 2001; UMMZ; LSUMNS 2001; CAS 2001; Garcia and Associates 2010b; UCMVZ 2015). There are 84 historic collection specimens from Marin County in the U.C. Museum of Vertebrate Zoology (UCMVZ 2015). Garcia and Associates (2010b) identified a total of 60 foothill yellow-legged frog localities within Marin County, based on queries to the CNDDDB, museum specimen records from HerpNet, and personal communications with biologists. Fifty-one of these localities were based upon museum specimen records collected from 1891-1972, 7 localities were based upon CNDDDB records of foothill yellow-legged frog observations from 1956-2008, and two localities were obtained via personal communications from biologists.

*Rana boylei* was historically quite abundant in Marin County, as evidenced by large specimen collections of frogs: 15 frogs from Lagunitas Creek in May 1904, 19 frogs in April 1911, 57 frogs in April 1928 and 15 frogs in 1931; 38 frogs from Mt. Tamalpais in August 1928; 8 frogs from Muir Woods (Redwood Creek) in September 1913 and 10 frogs in May 1922; 18 frogs from Pike County Gulch in March 1963; and 12 frogs from Millerton Gulch in May 1944 (UKMNH 2001; USNM 2001; CMNH 2001; CAS 2001; UCMVZ 2015).

Focused survey efforts in the 1990s failed to find any foothill yellow-legged frogs in Redwood Creek, or around Muir Woods (Ely 1993; Fong 1997). A foothill yellow-legged frog population in Cataract Creek that was considered to be abundant in the early 2000s (CDFG 2003) appears now to be extirpated (Garcia and Associates 2010b). *Rana boylei* has now been extirpated from Lagunitas Creek below Peters Dam, East Fork Lagunitas Creek, Cataract Creek and the entire Mount Tamalpais watershed above Lake Alpine and Lake Lagunitas and from west slope drainages of Mount Tamalpais.

Small populations of foothill yellow-legged frog may persist in the Tomales Bay tributaries Walker Creek and Salmon Creek; other populations may exist in Marin County, however the current population status of many historically occupied sites remains poorly understood and repeat surveys of these sites are needed (Garcia and Associates 2010b).

Only two known foothill yellow-legged frog populations remain of a once more widespread distribution within the Mount Tamalpais watershed, in Little Carson Creek and Big Carson Creek, both tributaries to Kent Lake (Garcia and Associates 2010b). Fellers documented 69 adults, 71 subadults, 1,828 larvae and 1,925 egg masses in Big Carson Creek, from 1996-2008 cumulatively (CNDDDB 2016). The Little Carson Creek population appears to be large and stable: in 2014 Garcia and Associates reported observing 96 adult males, 3 gravid females, 7 spent females and 15 egg masses at Little Carson Falls (MMWD 2014), consistent with numbers in recent years.

*Recent status:* The species has been extirpated from most former localities and watersheds in Marin County. The Little Carson Creek and Big Carson Creek tributaries to Kent Lake contain the only known significant populations in Marin County in recent years. Small populations may persist in the Tomales Bay tributaries Walker Creek and Salmon Creek.

## Upper Sacramento River

There have been documented declines in the upper Sacramento River basin, but small populations were documented in the 1990s and 2000s in Shasta County in more than three dozen tributaries in the Sacramento River drainage, with significant populations in the Sacramento River (near Dog Creek and Campbell Creek) and in Willow Creek and its tributaries. Small numbers of frogs persist in eastern Tehama County in the Battle Creek, Paynes Creek, Antelope Creek, Little Antelope Creek, Mill Creek, and Deer Creek drainages.

### Yolo County

Cache Creek drains to the Sacramento River. Putah Creek drains to the Yolo Bypass in the Sacramento Valley.

The paucity of recorded occurrences of foothill yellow-legged frogs at lower elevations suggests that the foothill yellow-legged frogs may never have been common throughout much of Yolo County (Yolo County 2013).

#### Cache Creek

Small populations were documented from 1997-2000 at a handful of locations in the Cache Creek drainage in extreme northwestern Yolo County, including Cache Creek and tributaries Bear Creek, Davis Creek and Fiske Creek (CAS 2001; Yolo County 2013; CNDDDB 2016).<sup>54</sup>

#### Putah Creek

Slevin (1928) and Harvey et al. (1992) noted a historical collection record from Putah Creek, 4 miles W of Winters.

*Recent status:* Unknown. The species may never have been common throughout much of Yolo County. Small populations were documented in Yolo County in the Cache Creek drainage through 2000.

### Colusa County

Sand Creek drains to the lower Sacramento Valley. Stony Creek is a tributary of the Sacramento River. Cache Creek drains to the Sacramento River.

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<sup>54</sup> Three adults in Davis Creek upstream from Rayhouse Road on 4/21/97; 3 adults 0.5 mile downstream from Davis Creek Reservoir on 4/21/97; 1 frog above Davis Creek Reservoir in May 1997; 2 adults and 1 juvenile in Bear Creek on 6/10/97; 1 juvenile from the oxbow adjacent to Cache Creek and Bear Creek confluence on 6/20/97; 2 adults near the confluence of Cache Creek and Bear Creek (WNW of Rumsey) on 6/24/97 and 7/8/97; 2 adults and 1 juvenile in a stock pond on Blue Ridge (1.5 miles E of Fern Spring, between Lake Berryessa and Capay Valley) during surveys from May-June 1999; and 4 adults, 13 subadults and 250 larvae along Fiske Creek (Fellers site ID# P-466; about 0.35 mile S of Cache Creek confluence), on 8/5/00 (CAS 2001; Yolo County 2013; CNDDDB 2016).

## Sand Creek

There is a historical collection record of 1 frog from Sand Creek (5 miles W of Arbuckle), in the southeastern portion of the county, on March 8, 1942 (UCMVZ 2015).

## Stony Creek

There are historical collections from 1933-1974 in the Stony Creek drainage, including Colusa Creek, Little Stony Creek, Mill Creek, South Fork Stony Creek and Stony Creek (CAS 2001; CNDDDB 2016; UCMVZ 2015).<sup>55</sup> Foothill yellow-legged frogs were apparently relatively common historically in the Stony Creek drainage, with 9 frogs collected from Stony Creek over two days in 1933, and 22 frogs collected from Mill Creek on a single day in 1973 (UCMVZ 2015).

Small populations were documented throughout the Stony Creek drainage from 1989-2000, including Little Stony Creek, Little Sullivan Creek, Mill Creek, North Fork Stony Creek, South Fork Stony Creek, Stony Creek and Sullivan Creek (CAS 2001; CNDDDB 2016; UCMVZ 2015).<sup>56</sup> Fellers (1996) observed *R. boylei* throughout the Stony Creek drainage within the Mendocino National Forest, including the tributaries Little Stony Creek, Mill Creek, and Sullivan Creek. Fellers (1996) found significant numbers of adult frogs at locations in Little Stony Creek (13 frogs) and Mill Creek (10 frogs), with notably good reproduction in Mill Creek (2,566 tadpoles). Repeat follow-up surveys by Fellers through 2008 revealed continuing significant populations in Mill Creek and Little Stony Creek (CNDDDB 2016).<sup>57</sup>

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<sup>55</sup> Collections in the Little Stony Creek tributary drainage: 1 frog from 6 miles S of Stonyford on October 10, 1963; 1 frog from Colusa Creek in 1973; and Fellers collected 22 frogs from Mill Creek (at Fouts Springs Campground) on 5/5/73, 1 frog on 5/6/73, and 2 frogs on 8/3/74 (CAS 2001; CNDDDB 2016; UCMVZ 2015). Collections in the South Fork Stony Creek drainage: 2 frogs from 1 mile S of Redbridge in November 1960 (CAS 2001). Collections in Stony Creek: 9 frogs from 3 miles W of Stonyford on October 1-2, 1933; and 1 frog from 5 miles W of Stonyford on February 10, 1968 (CAS 2001; UCMVZ 2015).

<sup>56</sup> Two frogs from a South Fork Stony Creek tributary at Davis Flat in April 1989; 1 adult frog from an unnamed tributary to South Fork Stony Creek (in the vicinity of Davis Flat) on 3/9/91; 1 frog from North Fork Campground on 2/24/97; 3 adults from Mill Creek (below Brim Road bridge) on 4/11/97; single frogs from 3 locations in South Fork Stony Creek on 9/16/99; 1 frog from Stony Creek (NE of Candy Bucket Spring) on 9/17/99; 1 frog from Mill Creek (upstream of Mill Creek Campground) in August 2000; 1 frog from an unnamed creek between Wolf Glade and Diversion Dam Campground, in August 2000; 1 frog from Little Stony Creek (upstream of Trout Creek) on 8/15/00; 1 frog from Little Stony Creek (between Sullivan Creek and Trout Creek) on 8/15/00; 1 frog from Sullivan Creek (upstream of Little Stony Creek confluence) on 8/16/00; 1 frog from Little Stony Creek on 8/17/00; and 1 frog from Little Sullivan Creek on 8/17/00 (CAS 2001; CNDDDB 2016; UCMVZ 2015).

<sup>57</sup> At Mill Creek at Fouts Springs Campground (Fellers sites Y-809A and Y-809B) a cumulative total of 99 adults, 160 subadults, 4,858 larvae and 6,532 egg masses during surveys from 1995-97, 1999-2004, and 2006-08; at South Fork Stony Creek confluence, (Fellers site Y-809B), a cumulative total of 55 adults, 96 subadults, 10,544 larvae and 36,251 egg masses during surveys from 1995-1996, 1999-2004 and 2006-2007; and in Little Stony Creek (at Digger Pine Campground, Fellers site Y-828), a cumulative total of 102 adults, 264 subadults, 8,451 larvae and 5,775 egg masses during surveys from 1995-2004 and 2006-2008 (CNDDDB 2016).

## Cache Creek

Small populations were documented in the Cache Creek tributaries Bear Creek and Sulphur Creek from 1997-1998 (CNDDDB 2016).<sup>58</sup> Fellers observed small numbers of frogs in Bear Creek from 1998-2004 (CNDDDB 2016).<sup>59</sup>

*Recent status:* Significant populations remained in Colusa County in the Stony Creek drainage in Little Stony Creek and Mill Creek through 2008, with older observations of small numbers of frogs in Stony Creek and tributaries South Fork Stony Creek, North Fork Stony Creek and Sullivan Creek through 2000. The species was present in the Cache Creek tributaries Bear Creek, Sulphur Creek and Letts Creek in the 1990s and early 2000s, but there are no reported observations since 2004.

## Glenn County

Stony Creek is a tributary of the Sacramento River. Black Butte River is a tributary of the Middle Fork Eel River.

## Stony Creek

There are historical collections from 1912-1971 in Glenn County in Stony Creek and tributaries Grindstone Creek and North Fork Stony Creek (Slevin 1928; CAS 2001; CNDDDB 2016; UCMVZ 2015).<sup>60</sup>

There were a handful of observations from 1995-2000 of small numbers of frogs in the Stony Creek drainage, including Black Diamond Creek, North Fork Stony Creek, Salt Creek and Stony Creek (CAS 2001; CNDDDB 2016).<sup>61</sup>

## Black Butte River

A single juvenile (CAS #209128) was collected from the Black Butte River drainage, in eastern Glenn County (downstream of "The Basin" and W of Bear Wallow Ridge), on 6/24/99 (CAS 2001; CNDDDB 2016).

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<sup>58</sup> Three frogs from Bear Creek downstream of the confluence with Sulphur Creek 4/11/97-4/25/97; 1 frog from Bear Creek (near Wilbur Springs Road bridge) on 4/25/97; 2 adults and 1 juvenile from Sulphur Creek (above Wilbur Springs) on 4/25/97 and 6/2/97; 1 frog from Bear Creek at Thompson Canyon on 6/10/97, with 2 additional adults observed; 5 adults from East Fork Sulphur Creek on 3/26/98; 5 adults from West Fork Sulphur Creek on 3/26/98 and 4/6/98; and 3 adults from Bear Creek on 5/5/98, with 3 additional adults observed (CNDDDB 2016).

<sup>59</sup> Three adults in Thompson Canyon (at Bear Creek confluence) on 3/20/98; 3 larvae in Bear Creek (Fellers site P-465) on 8/5/00; 2 adults in Letts Creek (Fellers site P-471) on 8/7/00; and 1 adult at confluence of Bear Creek and Sulphur Creek (vicinity of Wilbur Springs) on 3/20/04 (CNDDDB 2016).

<sup>60</sup> Five frogs from Winslow (5 miles W of Fruto) on June 18 and June 20, 1912; from Fruto before 1928; 1 frog in Grindstone Creek (4.5 miles S of Millsap) on March 21, 1954; 1 frog in North Fork Stony Creek (1 mile N of Redbridge), in November 1960; and 1 frog (MVZ 125357) from a Grindstone Creek tributary (along Hull Road N of Elk Creek) on March 29, 1971 (Slevin 1928; CAS 2001; CNDDDB 2016; UCMVZ 2015).

<sup>61</sup> One adult, 4 subadults and 2 egg masses along Salt Creek at Rattlesnake Creek (Fellers site ID#Y-813) on 5/10/95; 1 adult (CAS #202599) collected on 2/24/97 and 1 adult (CAS #202583) collected on 3/29/97 in an unnamed tributary to Stony Creek, on the Brittan Ranch; 2 small adults captured and 200-300 tadpoles observed in an unnamed tributary to Salt Creek, just E (downstream) from Sanhedrin Road, 4 miles NW of the town of Elk Creek, on 4/10/97; 3+ tadpoles observed in Black Diamond Creek, just W of the Dry Creek Confluence, on 6/5/99; and 1 collection specimen from North Fork Stony Creek on 7/24/00 (CAS 2001; CNDDDB 2016).

*Recent status:* Unknown. Small populations were documented in Glenn County in the Stony Creek drainage through 2000, and an observation in Black Butte River in 1999.

### Tehama County

#### Battle Creek

A single foothill yellow-legged frog was collected from Battle Creek on March 31, 1932 (UCMVZ 2015).

In the 2000s, small numbers of frogs were documented in the Battle Creek drainage, in tributaries South Fork Battle Creek, Soap Creek and Ripley Creek (CNDDDB 2016).<sup>62</sup>

#### Paynes Creek

Grinnell et al. (1930) collected small numbers of foothill yellow-legged frogs along Paynes Creek in 1924 (UCMVZ 2015).<sup>63</sup> In April 1928, Grinnell et al. (1930) observed “several” foothill yellow-legged frogs in the Paynes Creek drainage (9 miles NE of Red Bluff), and several more adults and several egg masses later in the month at another nearby location. A single frog was collected from Meadow Ranch (3 miles W of Paines Creek Post Office) on February 15, 1931 (UCMVZ 2015).

In the 1990s, small numbers of frogs were documented in the Paynes Creek drainage (CNDDDB 2016).<sup>64</sup>

#### Red Bank Creek

Bourque (2008) was able to find enough foothill yellow-legged frogs in the Red Bank Creek watershed during telemetry surveys from 2004-2005 to opportunistically capture 79 adult frogs.

#### Antelope Creek

*Rana boylei* was known to occur historically in the Antelope Creek watershed, below the elevation of approximately 3,200 feet (LNF and PNF 1999).

Small numbers of foothill yellow-legged frogs were found in Antelope Creek and in the Indian Creek tributary from 2001-2003 (Hayes et al. 2013). Fellers documented small populations from 1997-2003 along Antelope Creek at North Fork Antelope Creek, and at

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<sup>62</sup> One adult, 2 juveniles and 40-50 tadpoles in South Fork Battle Creek, just downstream from the PG&E South Powerhouse, S of Manton, on 6/15/00; 1 adult and 1 juvenile in Soap Creek, downstream of the diversion dam, on 6/16/00; 1 juvenile upstream of the dam on South Fork Battle Creek, on 6/26/00; 1 adult, 2 juveniles and 3 egg masses in South Fork Battle Creek, at the Manton Road crossing, on 4/25/05; and 2 adults and 16 juveniles in Ripley Creek and an associated tributary, on 4/25/05 (CNDDDB 2016).

<sup>63</sup> Four frogs from Dale’s Ranch in May 1924; 2 frogs from “Paines Creek” on May 12, 1924; 4 frogs from Elliott’s Ranch, (5 miles W of Payne’s Creek Post Office), on June 5, 1924; and 3 frogs from Lyman’s, in the Plum Creek tributary, on June 8 and June 14, 1924 (UCMVZ 2015).

<sup>64</sup> Three adults in Paynes Creek, approximately 200 feet N of Highway 36, on 4/1/93; and 1 adult observed by Fellers (site ID# L-177) at Plum Creek and an unnamed tributary confluence (about 2 miles N of Finley Butte), on 6/22/95 (CNDDDB 2016).



the Antelope Creek and Indian Creek confluence (CNDDDB 2016).<sup>65</sup> At least 10 adults and 1 egg mass were observed in Antelope Creek near Facht Place Campground on 5/25/16 (CNDDDB 2016).

#### Little Antelope Creek

Fellers documented small populations in 1995 in Little Antelope Creek and tributary Cottonwood Creek (CNDDDB 2016).<sup>66</sup>

#### Dye Creek

Fourteen *R. boylei* were collected from Dye Creek in the Gray Davis Dye Creek Preserve (6.0 miles E and 3.5 miles N of Gerber) on April 1, 1970 (CNDDDB 2016; UCMVZ 2015).

A single frog was collected from the North Fork Dye Creek in September 1996 (CAS 2001).

#### Mill Creek

Slevin (1928) noted that *R. boylei* had been collected from Mill Creek, near Tehama. Grinnell et al. (1930) took specimens from Mill Creek at 260 feet (2 miles NE of Tehama), from June 8-13, 1912 (UCMVZ 2015). The species was known to occur historically in the Mill Creek watershed below the elevation of approximately 3,200 feet (LNF and PNF 1999).

Fellers found 3 larvae along Mill Creek (site L-050F; just W of Black Rock, about 3 miles NW of Flatiron Mountain), on 8/15/94 (CNDDDB 2016). Small numbers of frogs were found in Mill Creek from 2001-2003 (Hayes et al. 2013).

#### Deer Creek

The species was known to occur historically in the Deer Creek watershed below the elevation of approximately 3,200 feet (LNF and PNF 1999).

Fellers documented small populations from 1994-2006 in the Deer Creek drainage (CNDDDB 2016).<sup>67</sup>

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<sup>65</sup> One adult on 6/12/97 and 8 subadults on 6/18/97 at Antelope Creek at North Fork Antelope Creek (Fellers sites L-539 and L-543); and at the Antelope Creek and Indian Creek confluence (Fellers sites L-515A, L-515D, L-535), 2 adults and 38 subadults on 9/16/96; 1 adult and 51 subadults on 9/19/96; 3 adults, 19 subadults and 40 larvae on 6/10/97; 6 subadults on 6/11/97; 1 adult (CAS 226962) collected on 5/28/03; and 1 adult and 1 larva collected on 5/29/03 (CNDDDB 2016).

<sup>66</sup> Thirty larvae along Little Antelope Creek (Fellers site L-180; about 1.75 miles NE of Dewitt Peak, 1.8 miles SE of Dead Cow Flat), on 6/26/95; and 5 subadults along Cottonwood Creek (Fellers site L-179; about 1.3 air miles E of Shaw Creek Confluence, 1.4 miles NE of Dead Cow Flat), on 6/26/95 (CNDDDB 2016).

<sup>67</sup> One adult along Deer Creek near Highway 32 (site L-052B) on 7/7/94; 1 adult along Deer Creek, about 0.9 air miles ESE of Dead Horse Creek confluence (site L-052C), on 7/10/94; 2 adults along an unnamed tributary of Deer Creek (site L-058: 0.7 mile E of Little Pine Creek, 0.6 mile N of Pinnacle Peak), on 7/11/94; 1 adult along Deer Creek at Little Pine Creek (site L-061) on 7/11/94; 3 adults, 2 subadults and 90 larvae along Deer Creek at Little Pine Creek (site L-052D) on 7/12/94; 1 subadult and 5 larvae about 0.3 mile ENE of Deer Creek and a tributary confluence on 8/12/94; 6 adults in Deer Creek (site L-052B) on 8/12/94; 2 adults observed on 8/12/94 and 1 larva and 1 adult collected on 5/29/03 along Beaver Creek, at the crossing

## Thomes Creek

Fellers (1996) observed *R. boylei* in the Thomes Creek drainage within the Mendocino National Forest, including two locations in Thomes Creek and in the Bennett Creek tributary. Bennett Creek was “notably good” area for reproduction, with 8 adults, 2,200 tadpoles, and 15 egg masses observed. There are collection records of single frogs from Thomes Creek and from the Willow Creek tributary, in August 2000 (CAS 2001).

## Sacramento River

There are historical collections from 1924-1926 at the Sacramento River near Red Bluff and Tehama (UMMZ 2001; UCMVZ 2015).<sup>68</sup>

Foothill yellow-legged frogs are now extirpated from the Sacramento River area in Tehama County (Hayes et al. 2013).

*Recent status:* Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at only 3 of 7 historical locations (43%) in eastern Tehama County. No foothill yellow-legged frogs were found during amphibian surveys from 1990-1998 of potentially suitable habitat on Lassen National Forest lands in eastern Tehama County (LNF and PNF 1999). Hayes et al. (2013) noted scattered collection records and sightings since 1980 in Lassen National Forest under surveys through the Federal Energy Regulatory Commission relicensing process. Small populations were documented in the 1990s and 2000s in Tehama County in the Battle Creek, Paynes Creek, Antelope Creek, Little Antelope Creek, Mill Creek, and Deer Creek drainages. The potentially large population in Red Bank Creek warrants further investigation.

## Shasta County

Historical specimen collections were made from 1898-1981 throughout Shasta County in the upper Sacramento River drainage and in tributaries Ash Creek, Bars Creek, Cottonwood Creek, Dinner Gulch, Little Cow Creek, Low Pass Creek, McCloud River, Nosoni Creek, Pit River, Redding Creek, Salt Creek, Soda Creek, Squaw Creek and Stillwater Creek (CAS 2001; FMNH 2001; UMMZ 2001; USNM 2001; UCMVZ 2015).<sup>69</sup>

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of USFS Road 28N29 (site L-063); 1 gravid female collected from Deer Creek, 0.1 mile downstream from the Beaver Creek confluence, on 5/30/03; 1 adult collected from an unnamed tributary to Deer Creek (2.8 miles S of the USFS Road 28N29/Deer Creek junction), on 5/31/03; and 1 adult in a tributary 800' downstream from USFS Road 28N29 bridge crossing on 6/17/06 (CNDDDB 2016).

<sup>68</sup> Three frogs from 5 miles N of Tehama in the Sacramento River, on May 14, 1924 (UCMVZ 2015); 2 frogs from 8 miles N of Red Bluff and 2 frogs from 8 miles NE of Red Bluff, on April 5, 1928 (UCMVZ 2015); 1 frog from Bloody Island, along the Sacramento River, on May 28, 1926 (UCMVZ 2015); and 3 frogs from the Sacramento River below Red Bluff in August 1926 (UMMZ 2001).

<sup>69</sup> One frog from Baird (lower McCloud River, now flooded by Shasta Lake) in January 1884; 1 frog from the Sacramento River at Sims in July 1898; 3 frogs from McCloud River in June 1904; 2 frogs from Sweetbriar Camp in August 1907; 3 frogs from Redding in October 1911; 5 frogs from Middle Fork Cottonwood Creek (Divide 12 miles N of North Yolla Bolly Mt.) on May 12, 1926; 4 frogs from a tributary to the Sacramento River in August 1926; 1 frog from Redding Creek on August 16, 1941; 1 frog from a Sacramento River tributary 8 miles NW of Redding on November 13, 1945; 1 frog from Squaw Creek on October 14, 1950; 3 frogs from Bars Creek on October 15, 1950; 6 frogs from Low Pass Creek in 1950 and 1951; 3 frogs from Dinner Gulch in 1950 and 1951; 2 frogs from Ash Creek and Squaw Creek on August 11, 1951; 2 frogs from Salt Creek on June 20, 1952; 1 frog from the Pit River drainage, 8 miles NNW of Round Mountain, in April 1953; 4 frogs from Little Cow Creek (1 mile NE of Ingot) on May 3, 1953; 1 frog from Stillwater Creek (4

In the 1990s, small populations were reported in a dozen tributaries in the Sacramento River drainage, including Brandy Creek, Castle Creek, Cold Spring Gulch, Crystal Creek, Middle Fork Cottonwood Creek, Nosoni Creek, Prospect Creek, Sacramento River (near the delta of Dog Creek and Campbell Creek), Salt Creek, Squaw Creek and Sunday Gulch (CNDDDB 2016). Small populations were observed during May-September 1994 aquatic amphibian surveys of upper Sacramento River tributaries after the Cantera Bridge chemical spill, in Boulder Creek, Campbell Creek, Castle Creek, Little Slate Creek, Mears Creek, Middle Fork Castle Creek, Mosquito Creek, North Fork Salt Creek, North Fork Slate Creek, Sacramento River (S of McCardle Gulch at Sims), Shotgun Creek, Slate Creek and Whitlow Creek (Miller et al. 1994; CNDDDB 2016).

In the 2000s, small populations were reported in three dozen tributaries in the Sacramento River drainage: Backbone Creek, Baldwin Creek, Barney Gulch, Bear Gulch, Beegum Creek, Boulder Creek, Brandy Creek, Chain Gang Gulch, Cline Gulch, Clover Creek, Cornish Creek, Dry Creek, Duncan Creek, East Fork Clear Creek, East Fork Duncan Creek, Flat Creek, Flume Creek, Grizzly Creek, Hooten Gulch, Horse Creek, Madison Canyon, McCloud River, Mears Creek, Motion Creek, Nawtawaket Creek, Old Cow Creek, Ripgut Creek, Sacramento River (at Soda Creek), Salt Creek, Sawpit Gulch, Shotgun Creek, Soda Creek, South Cow Creek, Squaw Creek, Sugarpine Canyon, Susanville Canyon, Whiskey Creek and Willow Creek (CNDDDB 2016).<sup>70</sup> There were known *R. boylei* populations in the Pit River and its tributary Deep Creek (in the PG&E Pit 4 reach) and the species was expected to occur in the Pit 3 reach, between Lake Britton and Pit 4 Dam (FERC 2001).

*Recent status:* Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at only 3 of 14 historical locations (21%) in Shasta County. However, small populations were documented in more than three dozen tributaries to the Sacramento River in the 2000s, particularly in the vicinity of Dog Creek and Campbell Creek, and in Willow Creek and its tributaries Crystal Creek, Clear Creek and Mill Creek.

## Northern Coastal California

The largest foothill yellow-legged frog populations in California are in the north coast range, with healthy populations scattered throughout the region. The strongholds for the

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miles WSW of Bella Vista) on May 3, 1953; 1 frog from Low Pass Creek (15.3 miles E of Redding) in June 1953; 1 frog from Squaw Creek on August 3, 1963; 1 frog from Squaw Creek on September 2, 1966; 1 frog from Squaw Creek on May 18, 1968; 1 frog from Soda Creek (2.4 miles NE of Castle Crag Siding) on November 14, 1969; 7 frogs from Nosoni Creek at Gilman Road (tributary to McCloud arm of Shasta Lake) in September 1970; 1 frog from a tributary to McCloud arm of Shasta Lake (Gilman Road) in March 1977; and 1 frog from Pit River at Deep Creek on June 20, 1981 (CAS 2001; FMNH 2001; UMMZ 2001; USNM 2001; UCMVZ 2015).

<sup>70</sup> Significant (but small) populations were in Boulder Creek (5 adults and 25 metamorphs on 9/27/04 and 11 adults, 27 juveniles and 1 larva during 3 visits on 6/26, 8/31 and 10/5/05); Dead Horse Creek (15 adults, 5 juveniles and 15 tadpoles on 8/1/02); McCloud River near Tuna Creek crossing (frogs on 6/4/07; 5 frogs on 7/31/07; and 11 frogs on 9/11/07); and South Cow Creek (14+ frogs on 9/2/03) (CNDDDB 2016). somewhat larger populations were observed in the Sacramento River in the vicinity of the delta of Dog Creek and Campbell Creek (~50 subadults on 10/13/02 and 20-30 juveniles on 9/26/06); and in Willow Creek and tributaries Crystal Creek, Clear Creek and Mill Creek (10 adults and ~50 larvae on 5/1 and 5/5/03; 23 adults and 207 metamorphs in 9/04; 19 adults, 107 juveniles and 156 tadpoles on 6/2, 6/15, 6/28, 8/30, 8/31 and 10/4/05) (CNDDDB 2016).

species are in the Smith River; Red Cap Creek tributary of the Klamath; South Fork Trinity River; North, Middle and South Forks of the Eel River; Redwood Creek; coastal tributaries in Mendocino County; and Russian River tributaries. However, only 6 sites in northern California have large populations (estimated populations exceeding 100 adult frogs), with an additional 9 sites having moderately large (> 50 adult frogs) (Lannoo 2005). There have been documented declines in the northern coastal California region. Jennings and Hayes (1994) found that the species had been lost from 39 of 165 historical sites (24%) in the north coast of California. For the population with the longest term monitoring record on the University of California's Angelo Reserve, the population has been in decline over the last ten years (Peek and Kupferberg 2016).

### Lake County

There are historical collection records and recent documentation of *R. boylei* populations within Lake County from the Eel River, Cache Creek and Putah Creek drainages, as well as tributaries to Clear Lake. The single *R. boylei* specimen from Lake County analyzed by Lind et al. (2011) was from northern Lake County in a tributary of the Eel River, in the North Coast hydrologic region. Other drainages in Lake County (Cache Creek, Putah Creek) in the Sacramento hydrologic region may have affinity with the Upper Sacramento River population, but are discussed here.

#### Eel River

Small numbers of frogs were collected in the 1970s and 1980s from the Bear Creek, Rice Creek and Welch Creek tributaries of the Eel River (CNDDDB 2016; UCMVZ 2015).<sup>71</sup>

Small numbers of frogs were observed and collected in the 1990s in Eel River tributaries above and below Lake Pillsbury, including Bear Creek, Corbin Creek, Parramore Creek, Rice Fork and Soda Creek (CNDDDB 2016; UCMVZ 2015).<sup>72</sup> Fellers (1996) observed "relatively high numbers" of *R. boylei* in the Rice Fork of the Eel River (8-10 adults, 15 subadults and over 500 tadpoles).

Small populations of frogs were observed and collected in the 2000s in many Eel River tributaries above and below Lake Pillsbury, including Alder Creek, Asbill Creek, Benmore Creek, Copper Butte Creek, Corbin Creek, Dashiell Creek, Eel River, Horse Creek, Rice Fork, Skeleton Creek and Soda Creek; moderate populations (25-49 adults) were documented in 2004 in Berry Creek, Hummingbird Creek and Thistle Glade Creek; and a moderately large population (50-99 adults) in 2004 in Rattlesnake Creek (CNDDDB

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<sup>71</sup> Two frogs from Bear Creek Station on May 13, 1972; 4 frogs from Bear Creek Station on October 15, 1972; 2 frogs from Erickson Ridge, on Towhead Flat, on October 15, 1972; 1 frog from Upper Lake/Lake Pillsbury Road on April 21, 1973; and 9 frogs from the junction of Rice Creek and Bear Creek on August 19, 1986 (CNDDDB 2016; UCMVZ 2015).

<sup>72</sup> One subadult and 3 egg masses observed in Corbin Creek (Fellers site Y-829) on 6/6/95; 11 adults, 1 subadult, 512 larvae and 1 egg mass observed in the Rice Fork (Fellers site Y-836) on 6/20/95; 3 adults collected from the Rice Fork on 7/6/95; 1 subadult collected from "The Slides" on 5/11/96; 1 subadult collected from Soda Creek on 5/11/96; 4 adults, 20 subadults and 55 larvae observed in Rice Fork (Fellers site Y-836) on 6/9/96; 1 juvenile collected from Parramore Creek on 9/14/99; and 1 adult collected from Bear Creek on 9/14/99 (CNDDDB 2016; UCMVZ 2015).

2016).<sup>73</sup> In Soda Creek (Fellers site Y-806), Fellers noted a total of 72 adults, 117 subadults, 21,109 larvae and 18,603 egg masses observed over 13 years from 1995-2008 (surveyed every year except 2007) (CNDDDB 2016).

### Clear Lake tributaries

There are historical collection records from 1939-1967 in the Kelsey Creek and Adobe Creek drainages tributary to Clear Lake (UCMVZ 2015).<sup>74</sup> “Moderately abundant” numbers of frogs were observed in the McDowell Creek tributary in April 1956 (CNDDDB 2016).

Small numbers of frogs were observed and collected from 1997-2000 in the Clear Lake tributaries Adobe Creek, East Fork Middle Creek, Highland Creek, Kelsey Creek, Middle Creek and Panther Creek (a tributary of Scotts Creek) (CNDDDB 2016).<sup>75</sup> There are no known more recent observations from any tributaries of Clear Lake.

### Cache Creek

There are historical collection records from 1937-1972 in the Cache Creek drainage, including North Fork Cache Creek, Seigler Canyon Creek, tributaries to Indian Valley Reservoir and Kilpepper Creek (CNDDDB 2016; UCMVZ 2015).<sup>76</sup> “Moderately abundant” numbers of frogs were observed in the Seigler Canyon Creek tributary in Lower Lake in April 1956 (CNDDDB 2016).

Observations and collections of small numbers of frogs were made in the 1990s in the North Fork Cache Creek drainage, including tributaries David Creek, Grizzly Creek, Harley Gulch, Spanish Creek and Wolf Creek (CNDDDB 2016).<sup>77</sup>

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<sup>73</sup> Two adults and 17 egg masses in Rice Fork (Fellers site Y-836) on 4/9/00; 1 adult in Asbill Creek on 4/7/01; 7 frogs in Skeleton Creek on 6/15/04 and 19 frogs on 6/16/04; 1 frog in Copper Butte Creek on 6/17/04; 25 frogs in Berry Creek at Eel River on 6/17/04; 33 frogs in Hummingbird Creek on 6/18/04; 27 frogs in Thistle Glade Creek on 6/19/04; 5 frogs in the Eel River (Trout Creek to Corbin Creek) on 7/29/04; 1 frog on 7/30/04 and 14 frogs on 7/31/04; 18 frogs in Corbin Creek on 7/31/04; 29 frogs in the Eel River and Horse Creek on 7/30/04; 54 frogs in Rattlesnake Creek on 8/1/04; 7 frogs in Alder Creek at Eel River on 6/22/05; 12 frogs in Dashiell Creek at Eel River on 6/26/05; 13 frogs in Benmore Creek on 6/27/05; and 6 frogs in Soda Creek (Fellers site Y-806) on 6/27/05 (CNDDDB 2016).

<sup>74</sup> One frog from Hwy. 29 (2.6 miles S of Kelseyville) on March 22, 1939; 1 frog from Forest Lake Resort on July 29, 1945; 3 frogs from 3 miles N and 1 mile W of Cobb Mt. on April 16, 1955; 1 frog from 3 miles N and 1 mile W of Cobb Mt. on April 14, 1956; and 4 frogs from the Highland Creek tributary on May 6, 1967 (UCMVZ 2015).

<sup>75</sup> One larva collected from Middle Creek (just below Rancheria Road) on 7/8/97; 5 adults, sub-adults and larvae collected from Middle Creek (Fellers site Y-805) on 5/14/97; 4 adults collected from Highland Creek on 7/11/97; 1 juvenile collected from East Fork Middle Creek on 5/25/99; 1 adult collected from Middle Creek (Fellers site Y-805) on 5/26/99; 1 frog observed in Kelsey Creek during May-June 1999; 1 frog observed in the Mayacamas Mountains in the upper Adobe Creek drainage during May-June 1999; 1 juvenile collected from East Fork Middle Creek on 9/13/99; and 20 adults, 14 subadults and 125 larvae observed along Panther Creek (Fellers site P-460) on 8/2/00 (CNDDDB 2016).

<sup>76</sup> One frog from 3.5 miles E of Bartlett Springs on August 13, 1937; 2 frogs from State Hwy. 20 (1.5 miles W of Bridge 14-12) on September 22, 1962; 2 frogs from Complexion Spring (a tributary to Indian Valley Reservoir) on October 14, 1972; 7 frogs from Kilpepper Creek (5.2 miles W of Barkersville) on October 14, 1972; and 2 frogs from North Fork Cache Creek near the confluence with Bartlett Creek on October 14, 1972 (CNDDDB 2016; UCMVZ 2015).

<sup>77</sup> One egg mass was observed along Spanish Creek (Fellers site Y-801) on 4/25/95; 5 adults and 92 larvae were observed along North Fork Cache Creek near Bartlett Creek (Fellers site Y-850) on 7/10/95; 1 adult was collected from Harley Gulch on 3/27/97; 3 adults were collected from Harley Gulch on 4/25/97; 7 adults

Fellers documented small populations in the early 2000s in Wolf Creek and Grizzly Creek (CNDDDB 2016).<sup>78</sup> “Good” *R. boylei* populations were observed in the early 2000s in the remote, upper sections of the North Fork Cache Creek (J. Olmstead, pers. comm., 2002). Hothem (2007) and Hothem et al. (2009) documented that *R. boylei* was present in Harley Gulch.

#### Putah Creek

There are historical collection records from 1919-1974 in the Putah Creek, including tributaries Butts Creek, Dry Creek and Hunting Creek (CAS 2001; CNDDDB 2016; UCMVZ 2015).<sup>79</sup> Foothill yellow-legged frogs were reported in “sparse numbers” in Coyote Creek along state route 53 in April 1956 (CNDDDB 2016).

Observations were made in the 1990s and 2000s of small populations in the Putah Creek tributaries Big Canyon Creek, Coyote Creek, Harbin Creek and Hunting Creek (CNDDDB 2016).<sup>80</sup> The species was reported to be present in April 2001 in “low numbers” along Putah Creek near the confluence with Coyote Creek, and to occur in Coyote Creek (Lake County 2008). Foothill yellow-legged frogs were reported to be “common” within the University of California McLaughlin Reserve, in the Hunting Creek and Knoxville Creek tributaries to Putah Creek above Lake Berryessa (UC 2009).

*Recent status:* In the North Coast hydrologic region, small populations were documented in the 2000s in many Eel River tributaries, with significant populations in Berry Creek, Hummingbird Creek, Soda Creek and Thistle Glade Creek, and a moderately large population in Rattlesnake Creek. Small populations were found from 1997-2000 in a half dozen Clear Lake tributaries. In the Sacramento River hydrologic region, small populations were documented in the 1990s and early 2000s in the North Fork Cache Creek drainage and in Putah Creek tributaries.

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and several larvae were observed in Grizzly Creek (Fellers site Y-808) on 5/1/97; 3 adults were collected from Spanish Creek on 5/12/97; 15 adults and several tadpoles were observed in Grizzly Creek on 5/13/97; 1 juvenile, 1 subadult and 1 larva were collected from Quartz Canyon and Wolf Creek to Salt Lick Canyon (Fellers site P-461) on 5/14/97; 1 adult was collected from Harley Gulch on 3/11/98; 1 adult was collected from Harley Gulch on 3/16/98; 2 adults were observed in Grizzly Creek (Fellers site P-463) on 4/1/98; 3 adults were observed in David Creek on 8/4/98; 1 adult was observed in David Creek on 8/12/98; and 1 subadult and 1 juvenile were collected from Wolf Creek (Fellers site P-461) on 5/24/99 and 5/25/99 (CNDDDB 2016).

<sup>78</sup> Seven adults, 53 subadults and 350 larvae in Wolf Creek (Fellers site P-461) on 8/3/00; and 2 adults, 9 subadults and 3 larvae observed in Grizzly Creek upstream from the Cache Creek confluence (Fellers site P-463) on 8/4/00 (CNDDDB 2016).

<sup>79</sup> One frog from Castle Rock Springs in April 1919; 4 frogs from Hunting Creek (Hildebrand Ranch, Morgan Valley) on January 15, 1941; 1 frog from Dry Creek near Lower Lake on July 30, 1943; 1 frog from Hunting Creek on September 23, 1962; and 12 frogs from Butts Creek on September 29, 1974; and 1 frog from Middletown on an unknown date (CAS 2001; CNDDDB 2016; UCMVZ 2015).

<sup>80</sup> One adult collected from Big Canyon Creek on 6/21/94; 3 adults and hundreds of tadpoles observed in Harbin Creek and an unnamed tributary on 5/31/99; 1 adult and 27 metamorphs in Harbin Creek and an unnamed tributary on 9/12/99; 4 adults, 5 subadults and 6 larvae along Hunting Creek (Fellers site P-470) on 8/6/00; 1 adult in Harbin Creek on 8/20/06; and 2 tadpoles in Coyote Creek NE of Middletown on 8/24/07 (CNDDDB 2016).

## Mendocino County

### Eel River

There are historical collection records from 1911-1985 throughout the Eel River drainage in Mendocino County, including the Eel River, Elkhorn Creek, Fox Creek, Garcia Creek, Kenny Creek, Long Valley Creek, McKinley Creek, Middle Fork Eel River, North Fork Eel River, Outlet Creek, South Fork Eel River and Tenmile Creek (CAS 2001; CMNH 2001; LSUMNS 2001; SDNHM 2001; UMMZ 2001; USNM 2001; CNDDDB 2016; UCMVZ 2015). Relative abundance was indicated by collections of large numbers of frogs; for example 20 frogs taken from the Middle Fork Eel River (3 miles S of Covelo) in 1913 (UCMVZ 2015); and 38 frogs (33 collected in a single day) from the South Fork Eel River (just NW of Leggett) in 1978 (CMNH 2001).

Small populations were documented in the 1990s throughout the Eel River drainage in Mendocino County, including Bar Creek, Beaver Creek, Black Butte River, Buck Rock Creek, Burns Creek, Middle Fork Eel River, North Fork Eel River, Poor Man's Creek, Pothole Creek, Salmon Creek, Soda Creek, South Fork Bear Creek, South Fork Eel River, Trout Creek, Walters Creek, Whitney Creek and Williams Creek (Feller 1996; USDA and USDI 1996; CAS 2001; USNM 2001; CNDDDB 2016). Significant populations were documented along the South Fork Eel River (and Fox and McKinley Creeks) from 1992-1994 (1,292 egg masses cumulatively); the Middle Fork Eel River (near the Middle Fork-North Fork confluence) in 1993 (100 adults and 858 tadpoles observed during a 5-day survey); and in Burns Creek in 1998 (63 adults and hundreds of tadpoles during observations from May-Sept) (CNDDDB 2016). The species was reported to be regularly observed in the 1990s by State Department of Forestry personnel in the South Fork Eel River, East Branch North Fork Eel River, Standley Creek and Wildcat Creek (D. Matson, pers. comm., 2001).

Small numbers of frogs were documented in the 2000s at a few locations along the South Fork Eel River and Trout Creek (CNDDDB 2016; UCMVZ 2015), with a very large population documented from 2002-2008 in the South Fork Eel River at Fox and McKinley Creeks (CNDDDB 2016)<sup>81</sup> - this is part of the population whose long term trends (1992-2011) are reported in Kupferberg et al. (2012).

### Usal Creek

There was a historical collection specimen from Usal Creek in June 1897 (USNM 2001).

### Tenmile River

There are historical collection records from the Tenmile River drainage in 1899 and 1909 (USNM 2001; UCMVZ 2015).<sup>82</sup>

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<sup>81</sup> At the South Fork Eel River and Fox and McKinley Creeks, there were 29 known breeding sites along S. Kupferberg's study reach; 125 larvae were collected on 7/28/02-7/29/02; the population was approximately 600 frogs (ages not given) in 2006; 332 juveniles and 38 tadpoles were sampled in 2006; and 159 juveniles and 252 tadpoles were sampled in 2008 (CNDDDB 2016). At several sites along Trout Creek, at the Eel River, 10 frogs were observed on 6/21/05; a single adult was observed on 6/25/16. (CNDDDB 2016).

<sup>82</sup> A single frog was collected from Cahto (just W of Laytonville) in May 1889 (USNM 2001); and 13 frogs from Sherwoods in August 1909 (UCMVZ 2015).

The species was reported to be regularly observed in the Ten Mile River in the 1990s by State Department of Forestry personnel (D. Matson, pers. comm., 2001).

#### Noyo River

There are historical collection records from the Noyo River in 1927 and tributary Sixteen Gulch from 1984-1985 (CNDDDB 2016; UCMVZ 2015).<sup>83</sup>

The species was reported to be regularly observed in the Noyo River drainage in the 1990s by State Department of Forestry personnel (D. Matson, pers. comm., 2001). Foothill yellow-legged frogs were observed during the mid-1990s in the South Fork of the Noyo River, including the tributaries North Fork of the South Fork Noyo River, Parlin Creek and Brandon Gulch (DFFP 2001). A small population was documented in the 1990s in the tributary Willits Creek (CNDDDB 2016).

#### Big River

There are historical collection records from 1902-1982 in the Big River drainage, including Big River, James Creek and North Fork Big River (CAS 2001; UMMZ 2001; UCMVZ 2015).<sup>84</sup>

The species was reported to be regularly observed in the Big River drainage in the 1990s by State Department of Forestry personnel (D. Matson, pers. comm., 2001). The species was observed during the mid-1990s in the North Fork of the Big River, including the tributaries Two Log Creek, Chamberlain Creek, and James Creek (DFFP 2001; CNDDDB 2016). Foothill yellow-legged frogs were observed in the North Fork Big River in 1996 and 1997 and in Big River near Mendocino Woodlands and near James Creek in 1999 (DFFP 2001). A small population was documented in the South Fork Big River in the 2000s (CNDDDB 2016).

#### Navarro River

There are historical collection records from 1906-1975 throughout the Navarro River drainage, including Christine Creek, India Creek and Navarro River (CAS 2001; FMNH 2001; UCMVZ 2015).<sup>85</sup>

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<sup>83</sup> Six frogs were collected from Eagle's Nest, Noyo River, on July 20, 1927 (UCMVZ 2015); and 1 frog from Sixteen Gulch 1984-85 (CNDDDB 2016).

<sup>84</sup> Three frogs from Big River in 1902 (UCMVZ 2015); 1 frog from 7 miles SW of Willits in November 1940 (CAS 2001); 1 frog from the North Fork Big River (at junction with Big River) on April 23, 1950 (UCMVZ 2015); frogs from James Creek on March 7, 1965 (UCMVZ 2015); 5 frogs from James Creek (14 miles W of Willits) in June 1967 (UMMZ 2001); and 2 frogs from the North Fork Big River on August 28, 1982 (UCMVZ 2015).

<sup>85</sup> One frog from India Creek W of Ukiah in August 1906 (CAS 2001); 1 frog from Navarro River near Dimmick Pond in May 1931 (CAS 2001); 1 frog from Christine Creek (6 miles NW of Philo) in May 1936 (FMNH 2001); 2 frogs from Boonville-Albion Road (0.5 mile W of Navarro) in March 1939 (CAS 2001); 1 frog from Mailliard Ranch (4 miles W of Yorkville) in December 1940 (CAS 2001); 1 frog from Boonville in August 1946 (CAS 2001); 2 frogs from Dimmick Grove State Park in 1950 (UCMVZ 2015); 3 frogs from 7 miles SE of Boonville in 1950 (UCMVZ 2015); 1 frog from 0.6 mile W of Navarro in 1955 (UCMVZ 2015); 1 frog from Navarro Creek W of Navarro in 1959 (UCMVZ 2015); 3 frogs along Hwy. 128 in Dimmick State Park on March 6, 1965 (UCMVZ 2015); larvae from Fishrock Bridge (7 miles SE of Boonville) in July 1975 (USNM 2001); and 2 frogs from the Navarro River in September 1975 (UCMVZ 2015).



The species was reported to be regularly observed in the 1990s in the Indian Creek tributary of the Navarro River by State Department of Forestry personnel (D. Matson, pers. comm., 2001). Small populations were also documented in the 1990s in Flynn Creek and the North Branch of the North Fork Navarro River (CNDDDB 2016). Small populations were documented in the 2000s in Anderson Creek (CNDDDB 2016).

#### Garcia River

There are historical collection records from 1931-1971 in the Garcia River drainage (CAS 2001; UCMVZ 2015).<sup>86</sup>

The species was reported to be regularly observed in the Garcia River drainage in the 1990s by State Department of Forestry personnel (D. Matson, pers. comm., 2001). Small populations were documented in the 1990s in Garcia River and tributary Mill Creek (CNDDDB 2016).

#### Gualala River

There are historical collection records from the Gualala River in Mendocino County in 1913 and 1974 (CNDDDB 2016; UCMVZ 2015).<sup>87</sup>

The species was reported to be regularly observed in the 1990s in the Gualala River drainage by State Department of Forestry personnel (D. Matson, pers. comm., 2001). Small populations were documented in the 2000s in the North Fork Gualala River and a tributary (CNDDDB 2016).

#### Small coastal rivers

Historical collection records in small coastal rivers include: 4 frogs from 2 miles S of Westport on May 9, 1959 (UCMVZ 2015); 1 frog from 5.1 miles S of Fort Bragg on Hwy. 1 in May 1971 (UCMVZ 2015); 1 frog from Jug Handle Creek on May 29, 1971 (CNDDDB 2016); 7 frogs from the Albion River in 1897 (CAS 2001); and 3 frogs from Elk in July 1946 (LSUMNS 2001).

The species was reported to be regularly observed in the 1990s in Wages Creek, DeHaven Creek, Usal Creek and the Albion River by State Department of Forestry personnel (D. Matson, pers. comm., 2001).

#### Russian River

There are historical collection records from 1893-1981 in the Russian River drainage in Mendocino County, including Forsythe Creek, Orr Creek, Pieta Creek, Reeves Canyon, Robinson Creek and Russian River (CAS 2001; FMNH 2001; USNM 2001; UCMVZ

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<sup>86</sup> A single frog from the middle part of the Garcia River in October 1931 (CAS 2001); 1 frog from Ornbaun Springs near Yorkville in March 1939 (CAS 2001); 3 frogs from the Garcia River (10 miles SW of Point Arena) in December 1941 (CAS 2001); and 1 frog from Manchester Beach State Park in 1971 (UCMVZ 2015).

<sup>87</sup> Seven frogs from Gualala in 1913 (UCMVZ 2015); and 1 frog from the Gualala River in 1974 (CNDDDB 2016).

2015).<sup>88</sup> The species was reported to be “moderately abundant” in Pieta Creek in March-April 1956 (CNDDDB 2016).

Small populations were documented in the 1990s in Dry Creek, Edwards Creek, Jakes Creek, Pieta Creek and Salt Springs Creek (CNDDDB 2016). Small populations were documented in the 2000s in Dry Creek, Howell Creek, Parsons Creek and the Russian River; and a moderate population was documented in Hensley Creek in 2006 (CNDDDB 2016).

*Recent status:* Fellers (1996) found excellent habitat and foothill yellow-legged frogs present at 21 of 36 sites (58%) surveyed within the Mendocino National Forest in 1995.<sup>89</sup> The species was widespread in the 1990s and early 2000s throughout Mendocino County, in the Eel River, Tenmile River, Noyo River, Big River, Navarro River, Garcia River, Gualala River and Russian River drainages. Significant populations were found in the South Fork Eel River through 2008 and the Hensley Creek tributary of the Russian River in 2006.

### Humboldt County

#### Klamath River

Historical collection records from the Klamath River in Humboldt County include Tectah Creek in 1947 (CAS 2001), and the Klamath River at Aikens Creek in 1976 (UCMVZ 2015).

Small populations were documented in 1990 along the Klamath River in Hoopa Valley and in tributary Tectah Creek (CNDDDB 2016). Unknown numbers of foothill yellow-legged frogs were documented in 1994 in timber harvest areas along the Klamath River and tributary Middle Fork Roach Creek (CNDDDB 2016). There were more than 2,000 observations of foothill yellow-legged frogs during 1994-1995 fisheries surveys within the Red Cap Creek watershed, a tributary to the Klamath River south of Orleans; foothill yellow-legged frog was the most frequently seen vertebrate from Schnable Diggings to the confluence of Red Cap Creek with the Klamath River, with the majority of observations near the mouth of Red Cap Creek (Mollier and Norman 1994; Cyr and Norman 1995; USDA 1995a, 1999b). The species was also encountered at 3 of 30 non-mainstem associated sites in 30-minute time-constrained searches in the Red Cap Creek watershed.

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<sup>88</sup> Nineteen specimens (6 adults, 13 juveniles) were collected from Ukiah on a single day in October 1893 (USNM 2001); 2 frogs from Reeves Canyon (near Lake Leonard, 10 miles NW of Ukiah) in 1922 (UCMVZ 2015); 5 frogs from Forsythe Creek on June 4, 1939 (UCMVZ 2015); 1 frog from along Low Gap Road (about 3 miles W of Ukiah) in March 1951 (CAS 2001); 1 frog from Robinson Creek (5.5 miles SSW of Ukiah) on May 20, 1952 (UCMVZ 2015); 1 frog from 9.4 miles SSE of Willits in 1952 (UCMVZ 2015); 1 frog from Orr Creek (5 miles W of Ukiah) in March 1953 (FMNH 2001); 1 frog plus larvae from Forsythe Creek (Reeves Canyon) in August 1956 (CAS 2001); 2 frogs from near Hwy. 128 (3 miles WNW of McDonald) on March 19, 1965 (UCMVZ 2015); 1 juvenile from Robinson Creek in April 1979; and 1 juvenile from Robinson Creek in April 1981 (CAS 2001).

<sup>89</sup> This was a high proportion of sites occupied, given that most of the sites where frogs were not found were outside the geographical or elevational range of the species, and surveys were conducted during high water runoff, making surveying difficult and increasing the likelihood of frogs being overlooked.

## Trinity River

There are historical collection records from 1941-1977 in the Trinity River drainage (tributary to the Klamath River), including Boise Creek, Brannan Creek, Trinity River and Willow Creek (CAS 2001; UCMVZ 2015).<sup>90</sup> Small numbers of frogs were observed during 1984-1985 sampling by Welsh and Lind in the tributaries Ammon Creek, Coon Creek and Fourmile Creek (CNDDDB 2016).

In the 1990s there were “numerous” sightings of foothill yellow legged frog within the tributary Horse Linto Creek and its drainages, but no sightings in the tributaries Mill Creek or Tish Tang Creek (USDA 2000). A foothill yellow-legged frog population was studied in the lower South Fork Trinity River from 1991-1993 by Redwood Sciences Lab (USDA 1999a). Fellers documented small populations from 1994-1995 at two sites in Horse Linto Creek (CNDDDB 2016). The Six Rivers National Forest detected *R. boylei* during a 1994 stream inventory in a 1,000 m section of Grouse Creek, tributary to South Fork Trinity River (USDA 1995d). A large population was documented in the South Fork Trinity River from 1992-2007 (CNDDDB 2016).<sup>91</sup>

Small populations were documented in 2000 in the South Fork Trinity River tributaries Grapevine Creek, Grouse Creek, Madden Creek and Sims Creek (CNDDDB 2016). Welsh et al. (2010) documented relatively high numbers of foothill yellow-legged frogs from 2000–2003 in western and northern headwater tributaries of the South Fork Trinity River. A significant population was documented in Madden Creek through 2007 (CNDDDB 2016).<sup>92</sup>

## Redwood Creek

There are historical collection records from Redwood Creek in 1942 and 1955 (UMMZ 2001; UCMVZ 2015). The species was apparently abundant, as evidenced by collection of 28 specimens from Redwood Creek over three days in September 1942 (UCMVZ 2015). Adult frogs were observed in 1974 in the tributaries Cloquet Creek and Lostman Creek, within Redwood National and State Parks (RNSP 2001). Anderson (1988) found frogs believed to be *R. boylei* during intensive sampling of twelve streams in the Redwood Creek basin in 1981; frogs were found in 14 of 112 tributaries surveyed, including Captain Creek, Copper Creek, Fern Prairie Creek, Joplin Creek, Lacks Creek, Lake Prairie Creek, Miller Creek, Panther Creek, Roaring Gulch Creek, Santa Fe Creek, Simon Creek, Sweathouse Creek and Tossup Creek.

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<sup>90</sup> One frog from a small stream along Hwy. 96 in the Hoopa Reservation in July 1941 (CAS 2001); 1 frog near Boise Public Camp (1.76 miles W of Willow Creek) in 1945 (UCMVZ 2015); 1 frog from 3 miles S of Willow Creek in March 1947 (CAS 2001); single frogs from Boise Creek (about 2 miles W of Willow Creek) in February 1947 and in April 1948 (UCMVZ 2015); 2 frogs from 3 miles N of Willow Creek August 1949 (UCMVZ 2015); 1 frog from Willow Creek in August 1949 (UCMVZ 2015); 1 frog from Brannan Creek (2 miles W of Willow Creek) in September 1949 (UCMVZ 2015); 1 frog from Hwy. 96 (4.9 road miles S of Weitchpec) in March 1971 (UCMVZ 2015); and 1 juvenile from Boise Creek Camp off Hwy. 299 in March 1977 (CAS 2001).

<sup>91</sup> In the South Fork Trinity River (between Surprise Creek and Madden Creek; Fellers site R-118); 175 frogs of unknown gender found 7/92; 102 frogs of unknown gender found 9/92; unknown number of frogs found in 1993 by Welsh and Lind; 6 adults and 1 juvenile observed by Fellers on 5/30/00; during Fellers surveys over 13 survey days from 1994-2000 and 2002-200, 106 adults, 944 subadults, 28,764 larvae and 11,329 egg masses observed cumulatively (CNDDDB 2016).

<sup>92</sup> Fellers (site R-121) observed a cumulative total of 146 adults and 80 subadults in Madden Creek over 12 years: 1994-2000, 2002-2004 and 2006-2007 (CNDDDB 2105).

The amphibian populations within Redwood National and State Parks were thought to be in relatively good shape in the 1990s (G. Fellers, pers. comm., as cited in RNSP 2001), with adult *R. boylei* observed in numerous tributaries throughout the Redwood Creek drainage. Fellers documented small to moderate populations from 1993-1997 at several dozen sites along Redwood Creek and tributaries Boyes Creek, Bridge Creek, Copper Creek, Forty-four Creek and Tom McDonald Creek (CNDDDB 2016). In 1992, “numerous” frogs were documented in Redwood Creek between Slide Creek and Bridge Creek (RNSP 2001). The species was observed at various locations along Redwood Creek on at least 41 occasions from 1993 to 1997 (RNSP 1997, 2001). From 1993 to 2000, small numbers of frogs were also observed in many of the tributaries to Redwood Creek, including Bridge, Brown, Cloquet, Cole, Copper, Coyote, Devils, Elam, Emerald, Forty-four, Hayes, McArthur, Rodgers, Tom McDonald, and Tossup Creeks (RNSP 2001). On a single day in November 1998, Parks biologists located 64 yellow-legged frogs along Redwood Creek, from the Bridge Creek confluence to the Tom McDonald Creek confluence (RNSP 2001).

A Parks survey on a single day in September 2000 along Redwood Creek from Forty-four Creek confluence to Bond Creek confluence located 89 yellow-legged frogs (2001). Small populations were documented from 2004-2005 in the tributaries Bridge Creek, Garrett Creek, May Creek and Pilchuck Creek (CNDDDB 2016).

The California Department of Fish and Wildlife conducted single-pass egg mass surveys in lower Redwood Creek during breeding season for foothill yellow-legged frog in 2011 and 2012. In 2011 CDFW surveyed 5.4 km of Redwood Creek above tidal influence, and detected 19 egg masses/km; in 2012 CDFW surveyed 14.2 km of Redwood Creek above tidal influence, and detected 13 egg masses/km (M. Van Hattem, pers. comm., 2016).

#### Mad River

There are historical collection records from 1897-1985 within the Mad River drainage, including the Mad River, Maple Creek and North Fork Mad River (CAS 2001; UCMVZ 2015).<sup>93</sup> The species was apparently abundant, as evidenced by collection of 17 frogs from Maple Creek in 1942 (UCMVZ 2015).

Foothill yellow-legged frogs were known to occur in the 1990s along the Mad River and the lower portions of major tributaries to the Mad River (USDA 1999b). Small populations were documented from 1990-1991 along the Mad River and tributaries Black Dog Creek and Maple Creek; with “many” juveniles and adults reported in 1990 in the Mad River (5 miles SE of Korbel) and an unnamed tributary (6 miles SE of Korbel) (CAS 2001; CNDDDB 2016). Most of these populations were threatened by active and planned timber sales.

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<sup>93</sup> Two frogs from the Mad River in July 1897 (CAS 2001); 6 frogs from Cobbs in July 1936 (UCMVZ 2015); 17 frogs from Maple Creek (1 mile W of junction with Mad River) in September 1942 (UCMVZ 2015); 1 frog from 12 miles S of Korbel in August 1949 (UCMVZ 2015); 7 frogs from the North Fork Mad River (7.5 miles ENE of Blue Lake) in July 1955 (UMMZ 2001); and 1 frog from the junction of Butler Valley Road and Maple Creek Road in January 1985 (UCMVZ 2015).

A small population was documented in the Mad River (near Blue Slide Creek) in 2004 (CNDDDB 2016).

The California Department of Fish and Wildlife conducted single-pass egg mass surveys in the lower Mad River during breeding season for foothill yellow-legged frog in 2011, 2012, 2015 and 2016. In 2011 CDFW surveyed 13.5 km of the Mad River below the Mad River Hatchery, and detected 59 egg masses/km; in 2012 CDFW surveyed 14.7 km in the same reach and detected 13 egg masses/km (M. Van Hattem, pers. comm., 2016). The 2015 and 2016 survey results were comparable (M. Van Hattem, pers. comm., 2016).

### Eel River

There are numerous historical collection records from 1910-1989 throughout the Eel River drainage in Humboldt County, including Ascaphus Creek, Bear Creek, Cuddeback Creek, Devil's Elbow Creek, Eel River, Fish Creek, Fort Steward Creek, Redwood Creek and South Fork Eel River (Green 1986; CAS 2001; CMNH 2001; FMNH 2001; UMMZ 2001; USNM 2001; UCMVZ 2015).<sup>94</sup>

Small numbers of frogs were observed from 1994-1995 in the Eel River (at Bear Creek, Bull Creek, and W of Shively) and in the tributaries Bull Creek, Canoe Creek and Twin Creek (CNDDDB 2016), many within proposed timber harvest plan areas. The Six Rivers National Forest conducted riparian amphibian surveys in 1995 on many tributaries within the Eel River watershed; the foothill yellow-legged frog appeared to be widely-distributed in the North Fork Eel River watershed, and "present" in the Main Eel (USDA and USDI 1996). The species was not found in the Eel River Delta, the South Fork Eel River or the Middle Fork Eel River during the 1995 surveys (USDA and USDI 1996). A significant population (50-80 metamorphosed juveniles) was documented in the South Fork Eel River (between Gould Grove and Gould Bar) on 10/7/99 (CNDDDB 2016).

Small populations were documented in from 2000-2007 in Albee Creek, Bull Creek, Carson Creek, Chadd Creek, Cuneo Creek, Mill Creek, North Creek and the South Fork Eel River (at Gould Bar, and at Bull Creek) (CNDDDB 2016).

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<sup>94</sup> One frog from Cuddeback Creek in September 1910 (UCMVZ 2015); 11 frogs from Carlotta in May 1911 (CAS 2001); 7 frogs from Alton in May 1911 (CAS 2001); 2 frogs from Elinor in May 1911 (CAS 2001); 1 frog from Carlotta in July 1923 (UCMVZ 2015); 1 frog from Scotia before 1933 (USNM 2001); 6 frogs from the South Fork Eel River (3 miles S of Garberville) in October 1933 (FMNH 2001); 18 frogs from South Fork Eel River (3 miles S of Garberville) in October 1933 (18) (UCMVZ 2015); 18 frogs from 1 mile NW of Pepperwood in July 1935 (CAS 2001); 3 frogs from Fish Creek (2 miles S of Miranda) in 1936 (FMNH 2001); 1 frog from 1 mile E of Alton in March 1938 (UCMVZ 2015); 1 frog from Fort Steward Creek in June 1938 (CAS 2001); 1 frog from Charles B. Alexander Grove (Fish Creek) in March 1939 (CAS 2001); 1 frog from 10 miles S of Hartsook in November 1940 (CAS 2001); 3 frogs from Ascaphus Creek (0.5 mile N of Holmes) in November 1941 (CAS 2001); 1 frog from 4 miles N of Garberville in November 1941 (CAS 2001); 4 frogs from 2 miles S of Miranda in August 1950 (UMMZ 2001); 1 frog from 2.6 miles N of the south entrance to Richardson's Grove in March 1951 (UCMVZ 2015); single frogs from 6 miles NW of Dyerville in February 1952 and in March 1952 (UCMVZ 2015); 2 frogs from 11.1 miles SSE of Dyerville in March 1952 (UCMVZ 2015); 1 frog from 2 miles S of Miranda in 1955 (CMNH 2001); 4 frogs from 1 mile S of Pepperwood in June 1955 (UMMZ 2001); 3 frogs from Devil's Elbow Creek (4.8 miles E of Weott) in July 1961 (UCMVZ 2015); a larval specimen from the Bear Creek drainage (1.5 miles S of Pepperwood) in August 1975 (FMNH 2001); 7 frogs from the Eel River at Myer's Flat in October 1982 (UCMVZ 2015); 6 postmetamorphs from Myer's Flat (Green 1986); and larvae specimens collected from Redwood Creek (2 miles W of Garberville) in June 1989 (USNM 2001).

The California Department of Fish and Wildlife conducted single-pass egg mass surveys in 2012 in the Eel River mainstem, the South Fork Eel River and in tributary Bull Creek, during breeding season for foothill yellow-legged frog. In the Eel River mainstem CDFW surveyed 11 km and found only 1 egg mass (0.09 egg masses/km); in the South Fork Eel River CDFW surveyed 4.65 km and detected 191 egg masses/km; in the tributary Bull Creek CDFW surveyed 3.5 km and detected 101 egg masses/km (M. Van Hattem, pers. comm., 2016).

#### Van Duzen River

There are historical collection records from 1930-1967 in the Van Duzen River tributary of the Eel River (CAS 2001; SDNHM 2001; UCMVZ 2015).<sup>95</sup>

An unknown number of frogs were found in 1992 and 1993 in a timber harvest area near the mouth of the Van Duzen River (CNDDDB 2016). Fellers documented a small population in the Van Duzen River near Grizzly Creek in 1995 (CNDDDB 2016). Foothill yellow-legged frogs were present during 1995 surveys in the Van Duzen River (USDA and USDI 1996). The species was documented in the Yager Creek tributary during surveys for timber harvest plans on private lands (USDA and USDI 1998).

A small population was documented in 2007 in the tributary Flannigan Creek (CNDDDB 2016).

The California Department of Fish and Wildlife conducted a single-pass egg mass survey in the Van Duzen River during breeding season for foothill yellow-legged frog in 2011. In 2011 CDFW surveyed 2.7 km of the Van Duzen River above the Highway 101 bridge, and detected only 9 egg masses/km (M. Van Hattem, pers. comm., 2016).

#### Jacoby Creek

A single foothill yellow-legged frog was found in Jacoby Creek in 2007 (CNDDDB 2016).

#### Mattole River

There are a handful of historical collection records from 1894-1959 in the Mattole River drainage (UCMVZ 2015).<sup>96</sup>

Foothill yellow-legged frogs were reported to be regularly observed in the 1990s in the Mattole River by State Department of Forestry personnel (D. Matson, pers. comm., 2001). Significant populations were documented in 1992 within timber harvest areas in the tributaries Mill Creek and Conklin Creek (CNDDDB 2016).<sup>97</sup> Welsh and Hodgson (1997) sampled 15 tributaries of the Mattole River watershed in 1995 and 1996 and

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<sup>95</sup> Three frogs from the Van Duzen River (SE of Strong's Station) in November 1930 (UCMVZ 2015); 4 frogs from 1 mile E of Carlotta in September 1942 (UCMVZ 2015); 1 frog from the Van Duzen River (30 miles E of Alton) in September 1960 (CAS 2001); 1 frog from the Van Duzen River in May 1961 (CAS 2001); and 4 frogs from the Van Duzen River (3 miles east of Carlotta) in December 1967 (SDNHM 2001).

<sup>96</sup> Four frogs from the Mattole River in June 1894 and June 1898 (UCMVZ 2015); single frogs from 10 road miles S and 13 road miles S of Honeydew in May 1956 (UCMVZ 2015); and 1 frog from Petrolia in August 1959 (UCMVZ 2015).

<sup>97</sup> In Mill Creek (2 miles SSW of Petrolia), 36 frogs found from April-May 1992; in Conklin Creek (N of Burgess Ridge), 15 frogs trapped from April-May 1992 (CNDDDB 2016).

observed 119 adults and 347 larvae. The species was common throughout the Mattole River watershed in 1998 (Welsh and Hodgson 2011).

*Recent status:* The species was well-distributed in the 1990s throughout Humboldt County watersheds, including the Klamath River, Trinity River, Redwood Creek, Mad River, Eel River, Van Duzen River and Mattole River drainages; with notable populations in the Red Cap Creek tributary of the Klamath, the Horse Linto Creek tributary of the Trinity, Redwood Creek and numerous tributaries, both the North Fork and South Fork of the Eel River, and the Mattole watershed. There is a paucity of surveys or records from the 2000s in many of these watersheds.

## Trinity County

### Trinity River

Large numbers of *R. boylei* were collected from 1932 to 1973 from the Trinity River and many of its tributaries within Trinity County, including Bell Creek, Brown's Creek, Canyon Creek, Coffee Creek, Eagle Creek, East Fork of the North Fork Trinity River, East Fork Trinity River, East Fork Weaver Creek, Little Bidden Creek, Little Browns Creek, Mumbo Creek, New River, Panther Creek, Reddings Creek, Rush Creek, Stuart Fork Trinity River and Stetson Creek; as well as the South Fork Trinity River and its tributaries Carr Creek, Corral Creek, East Fork of the South Fork Trinity River, Hayfork Creek, Kerlin Creek, Monroe Creek, Philpot Creek, Rattlesnake Creek, Salt Creek and Wilson Creek (Slevin 1928; Bury 1969; USDA 1999b; CAS 2001; CMNH 2001; LSUMNS 2001; UMMZ 2001; CNDDDB 2016; UCMVZ 2015). The large numbers of frogs collected indicated high densities at many locations; collections of 5 to 10 adult and juvenile frogs at single locations were common (Bury 1969); and very large numbers of frogs were collected from the South Fork Trinity River in 1932; and in 1973 and 1974 from the South Fork tributaries Hayfork Creek, Philpot Creek and Salt Creek (UCMVZ 2015).

In the 1990s, Wilson et al. (1991) found foothill yellow-legged frogs in the lower reaches of the mainstem Trinity River, above the confluence with the North Fork of the Trinity River. The foothill yellow-legged frog was documented to occur in the 1990s in small clumped populations along the mainstem Trinity River (between Lewiston Dam and the North Fork Trinity River) and tributaries Bell Creek, Davis Creek and Ripple Creek (USDA 1999c; CNDDDB 2016); a significant population was found on the mainstem east of Hawkins Bar in 1994 (CNDDDB 2016).<sup>98</sup> Small populations were documented in the 1990s in the South Fork Trinity River and tributaries Big Creek, Bridge Gulch, East Fork of the South Fork, Hayfork Creek and Prospect Creek (USDA 1999c; CNDDDB 2016). Small populations were documented in the 1990s in the North Fork Trinity tributary Rattlesnake Creek (CNDDDB 2016). Foothill yellow-legged frogs were rare in Trinity River mainstem in the 12 river miles below Lewiston Dam because suitable breeding areas had been reduced 95% compared to pre-dam conditions, with most frogs clustered in the limited areas of suitable habitat (Ashton et al. 1998; USFWS et al. 1999).

In the 2000s, small populations were documented at several locales along the mainstem Trinity River and tributaries Little Bidden Creek and West Weaver Creek (CNDDDB 2016). Small populations were documented in the 2000s in the North Fork Trinity River

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<sup>98</sup> Along the mainstem Trinity River, E of Hawkins Bar (Fellers site R-120B), 13 adults and 976 subadults were observed on 9/15/94; just 5 egg masses were observed here on 6/5/95 (CNDDDB 2016).

tributaries East Twin Creek, Rattlesnake Creek, Underwood Creek and West Twin Creek (CNDDDB 2016). Small populations were documented in the 2000s in the South Fork Trinity River and numerous tributaries, including Barker Creek, Big Creek, Bridge Gulch, Butter Creek, Carrier Gulch, Chancelulla Creek, Cold Springs Creek, Ditch Gulch, Eltapom Creek, Grapevine Creek, Hayfork Creek, Hells Half Acre Creek, Jim's Creek, Monroe Creek, Olsen Creek, Orchard Gulch, Philpot Creek, Potato Creek, Salt Creek, Shiell Gulch Twenty-Two Creek and Walker Creek (CNDDDB 2016). A significant population was documented in the South Fork Trinity River (between Surprise Creek and Madden Creek) through 2007 (CNDDDB 2016).<sup>99</sup>

#### Salmon River

There is a historical collection record from 1971 in Swift Creek, in the South Fork Salmon River drainage, in Trinity County (UCMVZ 2015).

#### Mad River

There are historical collection records from 1932-1942 in the Mad River and tributary Olson's Creek, in Trinity County (UCMVZ 2015). Very large numbers of frogs were collected in 1932 in the Mad River (UCMVZ 2015).

#### Eel River

There is a historical collection record from 1913 in the North Fork of the Middle Eel River, in Trinity County (UCMVZ 2015).

Wicktor and Craven (1996) surveyed 13 streams in the North Fork of the Eel River watershed in 1995, sampling for herpetofauna in 118 reaches, 55 of which were surveyed to protocol (USDA 1995b) and 63 of which had incidental sightings. Incidental sightings were also made in the main stem of the North Fork Eel River and in Tub Creek. *Rana boylei* were found in 9 of these streams, including the North Fork Eel River, West Fork, Tub Creek, Bluff Creek, Bradburn Creek, Cottonwood Creek, Cox Creek, Kettenpom Creek and Salt Creek; 64 adult frogs were located, with the mainstem (10 adults, 262 sub-adults and 1 tadpole), West Fork (14 adults and 76 sub-adults), and Salt Creek (15 adults, 1 sub-adult, 23 tadpoles and 1 larvae) reaches containing significant populations. Fellers (1996) observed *R. boylei* at six locations in the Middle Fork Eel River drainage, including the North Fork of the Middle Fork Eel, Rattlesnake Creek, and Balm of Gilead Creek tributaries, within the Mendocino National Forest; the North Fork of the Middle Fork Eel was a notably good area for reproduction, with 286 tadpoles observed (Fellers 1996; CNDDDB 2016).

#### Cottonwood Creek

There is a historical collection record from 1946 in Harrison Gulch, an upper tributary to the Middle Fork of Cottonwood Creek, which drains east to the Sacramento Valley (UCMVZ 2015).

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<sup>99</sup> In the South Fork Trinity River (between Surprise Creek and Madden Creek; Fellers site R-118), Fellers observed a cumulative total of 106 adults, 944 subadults, 28,764 larvae and 11,329 egg masses over 13 survey days from 1994-2000 and 2002-2007 (CNDDDB 2016).



*Recent status:* The species was common in the 1990s in the North Fork Eel River and Middle Fork Eel River drainages; the status in the 2000s is unknown. Despite declines in the Trinity River mainstem below Lewiston Dam, foothill yellow-legged frogs continued to be widespread throughout the Trinity River basin through the 2000s, particularly in the South Fork Trinity River and numerous of its tributaries.

### Siskiyou County

#### Klamath River

There are historical collection records from 1935-1972 in the Klamath River drainage in Siskiyou County, including Beaver Creek, Clear Creek, Dillon Creek, Ditch Creek, Grant Creek, Grider Creek, Klamath River, Little Bogus Creek, Little Shasta River, O'Farrell Gulch, Salmon River, Seiad Creek and Swillup Creek (CAS 2001; LSUMNS 2001; UMMZ 2001; CNDDDB 2016; UCMVZ 2015).<sup>100</sup>

Foothill yellow-legged frogs were reported to be "fairly common" in the 1990s along the banks of the Klamath River, including the vicinity of the mouth of Rogers Creek, north of Somes Bar (KNF 1999).

#### Sacramento River

There are historical collection records from 1953 in the Sacramento River near the Mt. Shasta Fish Hatchery in Siskiyou County (UMMZ 2001; UCMVZ 2015).<sup>101</sup>

A small number of frogs were reported from 1994-2003 in tributaries to the Sacramento River in Siskiyou County, including Big Spring Creek, Little Castle Creek, Ney Springs Creek, North Fork Sacramento River and South Fork Sacramento River (CNDDDB 2016).<sup>102</sup>

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<sup>100</sup> Two frogs from Little Shasta River (10 miles E of Montague) on May 21-22, 1935 (UCMVZ 2015); 5 frogs from Clear Creek (3 miles W of Klamath River) on June 23-25, 1935 (UCMVZ 2015); 1 frog from Klamath River (1.5 miles S of Clear Creek) on June 27, 1935 (UCMVZ 2015); 2 frogs from Little Bogus Creek (4 miles NE of Ager) on November 4, 1951 (UCMVZ 2015); 1 frog from the Salmon River (4.5 miles NW of Forks of Salmon) in July 1955 (UMMZ 2001); 1 frog from Swillup Campground in October 1959 (CAS 2001); 4 frogs from the Salmon River (at junction near Klamath River) on September 1, 1961 (UCMVZ 2015); 1 frog from Ditch Creek at Cottonwood Creek (1 mile north of Hornbrook) in June 1963 (LSUMNS 2001); 1 frog from Dillon Creek (on Highway 98 between Willow Creek and Happy Camp) in August 1968 (UMMZ 2001); 2 frogs from Beaver Creek (about 0.25 mile E of Klamath River) on November 15, 1969 (UCMVZ 2015); 1 frog from Klamath River (2.5 miles N of Ti Bar, Hwy. 96) on November 16, 1969 (UCMVZ 2015); 1 egg mass from Beaver Creek (USFS Camp, N of Hwy. 96) on April 26, 1970 (UCMVZ 2015); 2 larvae from Grider Road (2.9 miles E of Grider Creek) on April 15, 1970 (UCMVZ 2015); 1 frog from Seiad Creek Road (5.7 road miles N of Seiad Valley) on March 23, 1971 (UCMVZ 2015); 1 frog from Hwy. 5 at Hilt on March 23, 1971 (UCMVZ 2015); 3 frogs from Salmon River (Hwy. 93, 3.9 miles SE of Somes Bar Bridge) on March 24, 1971 (UCMVZ 2015); 1 frog from Hwy. 93 and Grant Creek (about 8.1 miles NW of Forks of Salmon) on March 24, 1971 (UCMVZ 2015); 1 frog from junction of O'Farrell Gulch and Hwy. 93 (4.5 road miles SE of Forks of Salmon) on March 24, 1971 (UCMVZ 2015); and 1 frog from 1 mile SE of Hilt (off Hwy. 5) on March 19, 1972 (UCMVZ 2015).

<sup>101</sup> Thirteen frogs collected from 2 miles S of the Mt. Shasta Fish Hatchery in May 1953 (UMMZ 2001); and 1 frog from 2 miles S of Mt. Shasta Fish Hatchery on June 7, 1953 (UCMVZ 2015).

<sup>102</sup> During a 1994 stream survey for the Cantara Spill Recovery and Restoration Program, 2 adults observed in Ney Springs Creek (SE of Lake Siskiyou) and 1 adult observed in Little Castle Creek (SW of Dunsmuir). One adult observed at the confluence of the North and South Forks of the Sacramento River on 6/12/96; 3 adults along the South Fork Sacramento River (0.9 mile SW of confluence of South and North Forks of Sacramento River) on 7/29/96; 1 adult just S of Little Castle Creek (at Railroad Park pond, 2 miles SSW of

*Recent status:* Unknown. Other than reports of small numbers of frogs from 1994-2003 in tributaries to the Sacramento River, there are no known recent data for Siskiyou County.

### Del Norte County

#### Rogue River

There is a historical collection record from the East Fork Illinois River, in Del Norte County just south of the Oregon State Line, in 1935 (UCMVZ 2015).<sup>103</sup>

Welsh and Lind found a single frog in Bybee Gulch, a tributary of the East Fork Illinois River in Del Norte County just south of the Oregon State Line, during sampling in 1984-1985 (CNDDDB 2016).<sup>104</sup>

#### Smith River

There are historical collection records from 1940-1986 in the Smith River drainage, including Mill Creek, Patrick's Creek, Smith River and South Fork Smith River (CAS 2001; CMNH 2001; FMNH 2001; RNSP 2001; SDMNH 2001; UMMZ 2001; UTA 2001; UCMVZ 2015).<sup>105</sup>

The foothill yellow-legged frog was considered common in the 1990s across the Six Rivers National Forest (which encompasses portions of Del Norte, Humboldt, Trinity, and Siskiyou counties); the species was found in most tributaries to the Smith River and was "very abundant" in the Middle Fork Smith River (USDA 1999b, 1995c). However, the Six Rivers National Forest sampled 10 creeks in the Smith River basin from 1990-1992 and *R. boylei* was located in only 3 tributaries; Muzzleloader Creek and Hurdygurdy

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Dunsmuir) on 5/23/01; 2 adults along South Fork Sacramento River (1.5 miles W of Lake Siskiyou) on 6/9/01 and 1 adult in August 2001; 1 adult along the South Fork Sacramento River (about 1.7 miles W of Lake Siskiyou) in August 2001; 1 frog in Big Spring Creek (near Mount Shasta State Fish Hatchery) on 9/4/01; and 1 adult along the South Fork Sacramento River (about 1.7 miles W of Lake Siskiyou) on 5/30/03 (CNDDDB 2016).

<sup>103</sup> Three frogs were collected from the East Fork Illinois River, 0.25 mile south of the Oregon State Line, on July 15, 1935 (UCMVZ 2015).

<sup>104</sup> One frog found by Welsh and Lind in Bybee Gulch (4 Miles N of Chicago Peak) during time-constrained sampling of a 1 mile reach during in 1984-85 (CNDDDB 2016).

<sup>105</sup> One frog from 8 miles NE of Crescent City (Smith River) in November 1940 (CAS 2001); 3 frogs from Mill Creek Park (Mill Creek) in February 1942 (CAS 2001); 1 frog from a small stream near Siskiyou Mountain Camp along Hwy. 199 (Smith River drainage) in September 1949 (FMNH 2001); 18 frogs from the Smith River (8 miles NE of Crescent City) in August 1950 (UMMZ 2001); 2 frogs from 2.25 miles N and 6.5 miles E of Crescent City on February 5, 1952 (UCMVZ 2015); 2 frogs from Mill Creek, 5 miles ENE of Crescent City, on July 22, 1952 (UCMVZ 2015); 3 frogs from Jedediah Smith State Park along the Smith River, in September 1953 (FMNH 2001); 2 frogs from the Smith River on an unknown date before 1955 (CAS 2001); 5 frogs from Patrick's Creek along the Smith River in 1955 (CMNH 2001); 2 juveniles and 2 juvenile/adult frogs from 12 miles NE of Crescent City, 2 miles W of Gasquet school, in June 1956 (CAS 2001); 1 frog from Jedediah Smith State Park in November 1961 (UCMVZ 2015); 3 frogs from the Smith River (2 miles W of Gasquet) in August 1975 (FMNH 2001); 2 frogs from the South Fork Smith River (South Fork Road milepost 3.05 and milepost 9.35, 3.6 road miles NW of Steven Memorial Bridge) on January 9, 1985 (UCMVZ 2015); 2 frogs from Panther Flat Campground in the Six Rivers National Forest (Smith River) in July 1985 (UTA 2001); and 2 frogs from Hiouchi and 2 frogs from Patrick in August 1986 (SDNHM 2001). A single frog was observed in Mill Creek at the confluence with the Smith River, within Redwood National and State Parks, in 1973 (RNSP 2001).

Creek West in the South Fork tributary, and Patrick Creek in the Middle Fork tributary (USDA 1995c, 1999b).

Small populations were documented from 1991-1995 in the Smith River drainage, including Hurdygurdy Creek, Hutsinpillar Creek, Mill Creek, Muzzleloader Creek and Patrick Creek, as well as along the Smith River at Cedar Creek, Clarks Creek and near Hiouchi Bridge (CAS 2001; RNSP 2001; CNDDDB 2016).<sup>106</sup> Fellers had continued observations of unspecified numbers of *R. boylei* in Hurdygurdy Creek during surveys from 1986-1993 and 2002-2007 (CNDDDB 2016).

Wheeler et al. (2006) documented a heavily used *R. boylei* breeding site in the lower 2 km of Hurdygurdy Creek from 2002-2005; with 129 male and 34 female frogs observed from 2002-2005 and 36 oviposition sites in 2003 and nine oviposition sites in 2004.

### Klamath River

There were observations in 1990 of three frogs at two localities near Omegaar Creek, a tributary of the lower Klamath River in Del Norte County (CNDDDB 2016).<sup>107</sup>

*Recent status:* Unknown. The species was abundant in the Middle Fork Smith River and there were observations of small populations throughout the Smith River drainage in the 1990s; other than the apparently significant population documented in Hurdygurdy Creek from 2002-2005, there are no known recent data.

### Southern Sierra Nevada

The southern Sierra Nevada includes drainages of the Sierra foothills in Mariposa, Madera, Fresno, Tulare and Kern counties. There are no known *R. boylei* records from Kings County or eastern Merced County, which are considered to be outside the historic range for this species (Jennings 1996).

There has been confusion over identification of a few yellow-legged frog specimens collected from the southern Sierra Nevada. While the foothill yellow-legged frog (*R. boylei*) inhabits low to moderate elevation streams, from sea level to 1,830 m (6,000 feet)

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<sup>106</sup> In Hurdygurdy Creek and Hurdygurdy Creek tributaries near Horse Flat, 1 adult female was collected on 4/24/91 (CAS 2001), and 1 frog was observed in May or June 1991 near Horse Flat; in Muzzleloader Creek (W of Ship Mountain), 1 frog was found during surveys from 7/29/91-8/7/91, and 1 male and 3 females were found during surveys from 7/14/92-7/23/92; in Patrick Creek, 2 frogs were found between 8/19/91 and 9/9/91; in the Smith River and Hutsinpillar Creek (North Bank Road and Highway 101) "several" frogs were found in 1994; in Mill Creek at the Smith River (Fellers site R-102B; Stout Grove, Jedediah Smith Redwoods State Park), Fellers observed 13 adults, 2 subadults and 35 larvae on 8/3/94, and observed 1 adult and 1 subadult on 5/31/95; along the Smith River at Cedar Creek (Fellers site R-109A; between Stout Grove and Hiouchi), Fellers observed 1 adult, 1 subadult and 100 larvae on 8/4/94; at three sites in Clarks Creek and along the Smith River (about 1.8 miles NE of the NE edge of Crescent City), Fellers observed 1 adult and 7 subadults on 7/5/94 at site R-110, 1 adult and 3 subadults on 7/5/94 at site R-111, 7 adults, 15 subadults and 4 larvae on 7/5/94, and 7 subadults on 5/31/95 at site R-109B; and along the Smith River (Fellers site R-109C; about 0.25 mile SW of Hiouchi Bridge and 0.5 mile N of Jedediah Smith Campground), 9 adults, 3 subadults and 2 larvae were observed on 8/26/94 (CNDDDB 2016). Two *Rana boylei* were observed along a creek tributary to the Smith River, within Redwood National and State Parks (RNSP 2001).

<sup>107</sup> One frog observed about 1.5 air miles S of Omegaar Creek at Klamath River (about 3.3 miles WNW of Blue Creek Campground); and 2 frogs observed in Hoopa Valley (about 1.5 miles SSE of Klamath River at Omegaar Creek, about 2.7 miles NW of Blue Creek Campground), on an unspecified date in 1990 (CNDDDB 2016).

in California (Stebbins 1985; Stebbins and McGinnis 2012), the mountain yellow-legged frog (*Rana muscosa*) occurs in the southern Sierra at elevations mostly above 1,820 meters (6,000 feet), with the lowest documented occurrence of this species in the Sierra foothills at 1,044 m (3,425 feet) (Jennings and Hayes 1994; USFS 2000). Historically, the ranges of *R. muscosa* and *R. boylei* abutted each other at mid-elevations in the southern Sierra Nevada, and the two species were sometimes found in close proximity to each other in the same drainages (Zweifel 1955). Though the two species can appear morphologically similar, genetic analysis can differentiate between the species (e.g. Lind et al. 2011; Poorten et al. 2013).

Between 1911 and 1920, Grinnell and Storer (1924) surveyed terrestrial vertebrates at 41 sites along a transect that stretched from the western foothills of the Sierra Nevada through Yosemite National Park. Grinnell and Storer (1924) found foothill yellow-legged frogs at 7 sites throughout the western foothill portion of their transect. Grinnell and Storer (1924) described the foothill yellow-legged frog as widespread and “fairly common” along Smith Creek, occurring in “moderate numbers” along Blacks Creek, and observed “several” along Piney Creek (Storer field notes, 1915, 1916, as cited in Drost and Fellers 1994).

Moyle (1973) found *R. boylei* at only 30 of 95 sites (32%) sampled in the southern and central Sierra Nevada foothills (from the Yosemite area south) in 1970, and believed the species was declining at that time. Intensive surveys by David Graber in the 1980s of 15 different stream reaches throughout the southern Sierra Nevada foothills did not locate any surviving populations of *R. boylei* (D. Graber, Sequoia National Park, pers. comm., as cited in Drost and Fellers 1994, 1996).

Surveys of the southern Sierra foothills in 1993 by Fellers (1994) found only one subadult foothill yellow-legged frog south of Calaveras County, in spite of surveying 310 sites within the frog’s known range. Drost and Fellers (1994) re-surveyed 38 of 40 Grinnell and Storer collecting sites in the Yosemite section, and were unable to locate foothill yellow-legged frogs at any of the historical sites, despite careful searches. Drost and Fellers (1994, 1996) also searched 10 additional sites at other streams that offered suitable habitat within the elevational range where Grinnell and Storer found the species, without finding foothill yellow-legged frogs, even though these sites included a number of areas where *R. boylei* had been recorded in the past, including sites within Yosemite National Park and in tributaries of the Merced River below El Portal. Drost and Fellers (1996) concluded that *R. boylei* had been essentially extirpated from the southern Sierra Nevada. Additional surveys in the 1990s found no foothill yellow-legged frogs in Yosemite National Park, while searching suitable habitat in Yosemite Valley, Foresta, Wawona, and El Portal (Fellers and Freel 1995; Fellers 1997).

Moritz (2007) conducted a resurvey from 2003 through 2005 of amphibians at 7 sites within Yosemite National Park that were originally surveyed from 1911-1920 by Grinnell; the Moritz surveys also detected no foothill yellow-legged frogs.

Hayes et al. (2013) summarized the evidence that *R. boylei* is extirpated from Yosemite, Sequoia and Kings Canyon National Parks, and near extirpation in Sequoia and Sierra National Forests, with few remaining populations and limited distribution. The species is now nearly extirpated from the southern portion of its Sierra range. The few known remaining localities in the southern Sierra Nevada are small populations in Mariposa County (Merced River through 2009 and tributaries above Lake McClure: Bull Creek

through 2007 and Sherlock Creek through 2009) and eastern Fresno County (a tributary of the San Joaquin River, Jose Creek, through 2007); and two moderate populations in Tulare County (in tributaries of the North Fork Kern River and upper Kern River).

### Southern Sierra National Forests and National Parks

Hayes et al. (2013) comprehensively reviewed the foothill yellow-legged frog's historical (prior to 1980) and recent (1980 to 2001) status across the two National Forests (Sierra and Sequoia) and three National Parks (Yosemite, Sequoia and Kings Canyon) that overlap with the southern Sierra Nevada *R. boylei* population. Although historical records imply that *R. boylei* populations were robust in this region until the 1960s and 1970s, Hayes et al. (2013) found fewer than 10 recent records from the Cosumnes River south, indicating the species is near extirpation in the southern portion of its Sierra range. A summary of the findings of Hayes et al. (2013), evaluated by National Forest and National Park:

#### Sequoia National Forest

Hayes et al. (2013) noted historical records from 1891-1970 in Sequoia National Forest and adjacent private lands, primarily in the Kern, Kings and Tule river systems, including from Angel Creek, Caliente Creek, Canebrake Creek, Cedar Creek, Clear Creek, Cottonwood Creek, Cowflat Creek, Deer Creek, Fay Creek, Kern River, Kings River, Middle Fork Tule River, North Fork Kern River, North Fork of the Middle Fork Tule River, Pechacho Creek, Salmon Creek, South Fork Kern River, Tehachapi Creek, Tejon Creek and White River. By the end of the 1970s, 17 foothill yellow-legged frog localities had been documented from the Sequoia National Forest, and 23 additional foothill yellow-legged frog localities were documented from drainages downstream or outside of Sequoia National Forest lands. An indication of declines was evident by the late 1970s.

Hayes et al. (2013) noted that no collections and very few sightings of foothill yellow-legged frogs exist for the Sequoia National Forest and vicinity from 1980 to the present. Lind et al. (2003b) indicated that none of 6 historical localities resurveyed on the Sequoia National Forest had foothill yellow-legged frogs. The two most recently occupied localities in the Sequoia National Forest consisted of tributaries of the North Fork Kern River, Ash and Jywood Creeks, which were surveyed multiple times from 1998-2003. Foothill yellow-legged frogs now have likely been extirpated from Ash Creek. Hayes et al. (2013) noted that foothill yellow-legged frogs in the Sequoia National Forest appear to be very few and limited in distribution, and may be near extirpation in the region.

#### Sierra National Forest

Hayes et al. (2013) noted historical records from 1916-1970 in Sierra National Forest and adjacent private lands in the Merced, San Joaquin and Kings river systems, including from Big Creek, Feliciano Creek, Kings River, Merced River, Middle Fork Kings River, Mill Creek and North Fork Kings River. By the end of the 1970s, 6 foothill yellow-legged frog localities had been documented from the Sierra National Forest, and 14 additional foothill yellow-legged frog localities were documented from drainages downstream or outside of Sierra National Forest lands. Indication of declines was evident by the late 1970s.

Hayes et al. (2013) noted that no collections and very few sightings of foothill yellow-legged frogs exist for the Sierra National Forest and vicinity from 1980 to the present. Lind et al. (2003b) indicated that none of the 6 historical localities on the Sierra National Forest had foothill yellow-legged frogs. The only drainage recently confirmed to have foothill yellow-legged frogs in the Sierra National Forest is Jose Creek, a tributary of the San Joaquin River that is isolated by the presence of upper Redinger Lake at its mouth. Hayes et al. (2013) noted that foothill yellow-legged frogs in the Sierra National Forest appear to be rare and limited in distribution, and may be near extirpation in the region.

#### Sequoia and Kings Canyon National Park

Hayes et al. (2013) noted 3 historical records of foothill yellow-legged frogs from Sequoia National Park from the 1930s, from the North Fork of the Kaweah River and Alder Creek. There were no existing historical records from Kings Canyon National Park.

Hayes et al. (2013) noted that there have been no collections or sightings of foothill yellow-legged frogs from Sequoia National Park from 1980 to present. The foothill yellow-legged frog has not been recorded in or near Sequoia or Kings Canyon National Parks for more than 30 years despite substantial searching, and is considered locally extinct (SKCNP 2001).

#### Yosemite National Park

Hayes et al. (2013) noted few historical records exist for foothill yellow-legged frogs in Yosemite National Park, and that Grinnell and Storer's (1924) transect was outside National Park boundaries and did not document the species within Yosemite National Park. Hayes et al. (2013) noted 1 historical record within Yosemite National Park, in 1948 along the Merced River (see the Mariposa County section below for additional historical records).

Hayes et al. (2013) noted that systematic surveys of the amphibian fauna of Yosemite National Park (Drost and Fellers 1994, 1996) and surveys conducted by National Park personnel through 2006 have also failed to find the species within Yosemite National Park. Hayes et al. (2013) concluded that foothill yellow-legged frogs are likely to be extirpated from Yosemite National Park.

### Kern County

#### Kern River

There are historical collection records from 1891-1954 in the Kern River drainage, including the Kern River, South Fork Kern River and tributaries Canebrake Creek, Cowflat Creek and Fay Creek (UMMZ 2001; LSUMNS 2001; CAS 2001; USNM 2001; CNDDB 2016; UCMVZ 2015).<sup>108</sup>

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<sup>108</sup> Historical collection records include: 2 frogs (USNM #18951 and 18952) from Kern River at Old Kernville in June 1891 (now inundated by Isabella Lake); 1 adult (USNM #18950) collected from Canebrake Creek at Walker Pass Campground (elevation 5,000 feet) on July 4, 1891; 5 frogs from the Kern River 12 miles below Bodfish in June 1911; 30 frogs from the Kern River near Bodfish in June 1911; Fay Creek, 6 miles N of Weldon, in July 1911; 1 frog from Miracle Hot Springs on the Kern River in November 1938; 1 frog from Kern River at Kernville in April 1940; 1 frog from Kern Canyon E of Bakersfield in August 1940; 4 frogs and 32 tadpoles from 4-5 miles S of Glennville in August 1940; 2 frogs from 5 miles E of Onyx along South Fork

There are no known observations from the Kern River drainage in Kern County since 1954.

#### Tehachapi Creek

There are historical collection records from 1947-1963 in Tehachapi Creek (UCMVZ 2015).<sup>109</sup>

There are no known observations from Tehachapi Creek since 1963.

#### Caliente Creek

There are historical collection records from 1952-1967 in Caliente Creek (UCMVZ 2015).<sup>110</sup>

There are no known observations from Caliente Creek since 1967.

#### Tejon Creek

There is a historical collection record of 8 frogs from the Tejon Creek drainage in 1875.

There are no known observations from Tejon Creek.

*Recent status:* Jennings and Hayes (1994) were unable to locate the species during resurvey efforts from 1988-1991 at any of 15 historical locations in Kern County. There are no recent records from Kern County. The foothill yellow-legged frog is extirpated from Kern County.

### Tulare County

#### Kern River

There are historical records from 1891 and 1953 in the Kern River (USNM 2001; UCMVZ 2015).<sup>111</sup>

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Kern River in August 1940; 2 frogs from 2 miles E of Onyx, in August 1949; 5 frogs from Cowflat Creek, Kern River Canyon, in April 1952; 1 frog from Miracle Hot Springs in April 1952; and 8 frogs from Canebrake Creek, and 1 frog from 9 miles ENE of Onyx in February 1954 (UMMZ 2001; LSUMNS 2001; CAS 2001; USNM 2001; CNDDDB 2016; UCMVZ 2015).

<sup>109</sup> Historical collection records include: 2 frogs from Tehachapi Creek in May 1947; 2 frogs from Tehachapi Creek, 6 miles NW of Tehachapi, in May 1952; 1 frog from Keene, along Tehachapi Creek, in June 1963; and 1 frog from the Keene Fire sub-station along Hwy. 58 in March 1970 (UCMVZ 2015).

<sup>110</sup> Historical collection records include: 7 frogs from Caliente Creek 6 miles ESE of Caliente in May 1952; 5 frogs from Caliente Creek 8 miles E of Caliente in July 1952; 2 frogs from Caliente Creek 3 miles W of Paris-Lorraine in June 1967; and 4 frogs from 4.5 miles W of Paris-Lorraine in June 1967 (UCMVZ 2015).

<sup>111</sup> The U.S. National Museum of Natural History has 8 *Rana boylei* specimens collected from the upper Kern River, 25 miles above Kernville in July 1891 (USNM 2001). The U.C. Museum of Vertebrate Zoology has 7 *Rana boylei* specimens collected from Salmon Creek, in the Kern River Canyon, 2.5 miles SE of Fairview (elevation ~3200' feet) in April 1953 (UCMVZ 2015).

Fellers documented one moderate and one small population from 1998 through 2008 along the Rincon Trail in the Sequoia National Forest, in unnamed tributaries of the upper Kern River (CNDDDB 2016).<sup>112</sup>

#### Kaweah River

There are historical records from 1907-1970 in the Kaweah River drainage, including Alder Creek Reservoir, Cottonwood Creek, East Fork Kaweah River, Kaweah River, Little Deer Creek, North Fork Kaweah River and South Fork Kaweah River (Moyle 1972, 1973; CAS 2001; HMCZ 2001; CNDDDB 2016; UCMVZ 2015).<sup>113</sup>

There are no known observations in the Kaweah River drainage since 1970. Sequoia and Kings Canyon National Park noted that the species had not been recorded in or near Sequoia National Park for more than 30 years despite substantial searching, and was considered locally extinct (SKCNP 2001).

#### Deer Creek/White River

There are historical collection records from 1940 and 1970 in Deer Creek and tributary Tyler Creek, in Moore Creek, in Yokohl Creek and in the White River (Moyle 1972, 1973; UMMZ 2001; CNDDDB 2016).<sup>114</sup>

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<sup>112</sup> The first population (Fellers site ID #s S-849 & S-849B) is about 3.6 miles W of Sherman Peak and about 4.5 miles ENE of Ida Lake, where Fellers observed 3 adults on 9/12/98; 11 adults on 6/4/99; 3 adults on 6/6/00; 1 adult on 5/31/03; 1 adult and 1 subadult on 6/28/05; 1 adult and 1 subadult on 6/29/05; 3 adults and 5 subadults on 5/15/06; 35 adults and 2 subadults on 5/25/07; and 6 adults and 12 subadults on 5/31/08 (CNDDDB 2016). The second population (Fellers site ID #s S-840) is about 2.7 miles SSE of Durwood Camp and about 4.7 miles ENE of Ida Lake, where Fellers observed 2 adults and 3 subadults on 8/20/98; 4 adults on 6/6/99; 1 adult, 1 subadult and 5,000 larvae on 6/6/00; 4 adults, 1 subadult and 30 larvae on 7/5/01; 5 adults and 2 subadults on 6/1/02; 24 adults and 22 subadults on 5/31/03; 6 adults and 2 subadults on 6/28/05; 3 adults and 1 larvae on 5/25/07; and 1 subadult on 5/31/08 (CNDDDB 2016).

<sup>113</sup> Cornell University has a specimen collected from Giant Forest from 1907 (CU 2002). The California Academy of Sciences has specimens collected from the Kaweah River, Potwisha Camp, and Sequoia National Park in August 1941 (CAS 2001). The Harvard Museum of Comparative Zoology has 8 specimens collected from Giant Forest in Sequoia National Park (Little Deer Creek tributary to the Marble Fork Kaweah River) in August 1960 (HMCZ 2001). The U.C. Museum of Vertebrate Zoology has historical collection specimens from the Kaweah River drainage: 6 frogs from the North Fork Kaweah River (elevation ~2,000 feet) in July and August 1935; 1 frog from Alder Creek Reservoir (elevation ~1,700 feet) in August 1935; 1 frog from Cottonwood Creek 0.5 mile SE of Aukland (elevation ~1,300 feet) in June 1938; 1 frog from 6 miles NE of Three Rivers on March 29, 1952; and 2 frogs from 8.5 miles NW of Woodlake (elevation below 2,000 feet) in April 1952 (UCMVZ 2015). The U.C. Museum of Vertebrate Zoology also has frog specimens labeled as *Rana boylei* that were collected from elevations over 7,500 feet: 31 frogs from Quaking Aspen Meadow in July and August 1934; and 3 frogs from Long Meadow 3 miles NNE of Giant Forest in June 1955 (UCMVZ 2015); however, these specimens are likely mislabeled, since *Rana boylei* is not known to occur above 6,000 feet (Stebbins 1985; Stebbins and McGinnis 2012). Moyle documented foothill yellow-legged frogs from the Kaweah drainage during surveys from July 27 to September 4, 1970, including: South Fork Kaweah River; East Fork Kaweah River, approximately 8 miles ENE of Lake Kaweah; and North Fork Kaweah River, 2 miles W of Sequoia National Park (Moyle 1972, 1973; CNDDDB 2016).

<sup>114</sup> The University of Michigan Museum of Zoology has *Rana boylei* specimens collected in August 1940: 4 adults and 7 tadpoles from Deer Creek 4 miles below the highway to Cal Hot Springs; and 7 adults and 44 tadpoles from the White River 20 miles SE of Porterville (UMMZ 2001). Moyle documented foothill yellow-legged frogs from the Deer Creek/White Creek drainages during surveys from July 27 to September 4, 1970, including: Deer Creek; Tyler Creek (tributary to Deer Creek); and Deer Creek approximately 1.5 miles W of California Hot Springs (Moyle 1972, 1973; CNDDDB 2016). Moyle also documented *Rana boylei* in several small streams in the low foothills of Tulare County, including: Moore Creek (W of Aukland); Yokohl Creek (E of Exeter); and White River in southern Tulare County (Moyle 1972, 1973; CNDDDB 2016).



There are no known observations in any of these drainage since 1970.

#### Tule River

There are historical records from 1952-1970 throughout the Tule River drainage including Middle Fork Tule River; North Fork Tule River, North Fork of Middle Fork Tule River, Rancheria Creek and Tule River (Moyle 1972, 1973; CNDDDB 2016; UCMVZ 2015).<sup>115</sup>

There are no known observations in the Tule River drainage since 1970, other than a report of a single frog along the North Fork Tule River in 2004 (CNDDDB 2016).<sup>116</sup>

*Recent status:* Jennings and Hayes (1994) were unable to locate the species during resurvey efforts from 1988-1991 at any of 17 historical locations in Tulare County. The only documentation of foothill yellow-legged frogs in Tulare County since 1970 are two small and moderate populations in tributaries of the upper Kern River, and a report of a single frog in 2004 on the North Fork Tule River. The foothill yellow-legged frog is nearly extirpated from Tulare County.

#### Fresno County

##### Kings River

There are historical collection records from 1910-1970 in the Kings River drainage, including Big Creek, Kings River, Middle Fork Kings River, North Fork Kings River, Rush Creek, Sycamore Creek, Watts Creek, Watts Lake and White Deer Creek (Wright and Wright 1949; Moyle 1972, 1973; CAS 2001; CNDDDB 2016; UCMVZ 2015).<sup>117</sup>

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<sup>115</sup> The U.C. Museum of Vertebrate Zoology has *Rana boylei* specimens collected from the Tule River drainage in April 1952: 5 frogs from 5 miles ENE of Springville on the road to Camp Wishon (elevation ~4,000 feet); 7 frogs from 8.7 road miles ENE of Springville on the road to Camp Wishon; 1 frog from Camp Wishon; and 1 frog from 3.8 miles E of Springville (elevation ~3,500 feet) (UCMVZ 2015). The UCMVZ also has 1 frog collected from along Hwy. 190, 5.8 mi NE of Springville (elevation ~3,200 feet) in December 1970 (UCMVZ 2015). Moyle documented foothill yellow-legged frogs from throughout the Tule River drainage during surveys from July 27 to September 4, 1970, including: Rancheria Creek, tributary to Bear Creek, approximately 6 miles NNE of Springville; Middle Fork Tule River; North Fork Tule River; North Fork Tule River just N of Milo; and North Fork of Middle Fork Tule River about 0.2-1.5 miles WSW of Camp Wishon Forest Service Station (Moyle 1972, 1973; CNDDDB 2016).

<sup>116</sup> G. Adest reported a single adult *Rana boylei* on August 29, 2004 along the North Fork Tule River, about 2 miles NE of Springville; this was on private land, with the population threatened by bullfrogs and unregulated water withdrawals (CNDDDB 2016).

<sup>117</sup> The California Academy of Sciences has specimens collected from the Kings River Canyon in July 1910 (CAS 2001). The U.C. Museum of Vertebrate Zoology has specimens collected from the Kings River drainage: 14 frogs from the Sycamore Creek tributary at Dunlap in September and October 1916; 2 frogs from the Kings River at Minkler in October 1916; and 1 frog from the North Fork Kings River below Balch Camp in December 1970 (UCMVZ 2015). Wright and Wright (1949) recorded capturing *Rana boylei* in 1942 along Sycamore Creek, an intermittent stream of the lower foothills, in an area now submerged by Pine Flat Reservoir. Moyle (1972, 1973) reported the stream above the reservoir containing only bullfrogs (*Rana catesbeiana*), with a few *Rana boylei* found far up a small tributary. Moyle documented foothill yellow-legged frogs from tributaries to Pine Flat Reservoir during surveys from July 27 to September 4, 1970, including Big Creek, Rush Creek, White Deer Creek, Watts Lake and Watts Creek (Moyle 1972, 1973; CNDDDB 2016). The California Academy of Sciences has specimens collected from the Middle Fork Kings River in September 1953: 1 frog from 5 miles upstream of the junction with North Fork in September 1953 and 3 frogs from Mill Flat Campground (CAS 2001).

There are no known observations in the Kings River drainage since 1970. Sequoia and Kings Canyon National Park noted that the species had not been recorded in or near Kings Canyon National Park for more than 30 years despite substantial searching, and was considered locally extinct (SKCNP 2001).

#### San Joaquin River

There are historical collection records from 1945-1953 in the Big Creek and Dry Creek tributaries of the San Joaquin River and in Huntington Lake (TMM 2001; UCMVZ 2015).<sup>118</sup>

Fellers located small populations of foothill yellow-legged frogs from 1994-2007 in Jose Creek, a tributary of the San Joaquin which feeds Redinger Lake (CNDDDB 2016).<sup>119</sup> Surveys by PG&E (2000) were unable to locate the species on the San Joaquin River or in Millerton Lake or Kerckhoff Lake.

*Recent status:* Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at only 4 of 9 historical locations (44%) in eastern Fresno County. There are no recent sightings from the Kings River basin and the only known locality in eastern Fresno County with *R. boylei* is the Jose Creek tributary of the San Joaquin River.

#### Madera County

#### San Joaquin River

There are historical records from 1951-1970 in the Willow Creek and South Fork Willow Creek tributaries of the San Joaquin River and in Little Finegold Lake (Moyle 1972, 1973; PG&E 2000; CNDDDB 2016; UCMVZ 2015).<sup>120</sup>

Tietje and Vreeland (1997) failed to find *R. boylei* from 1987-1990 at the San Joaquin Experimental Range, in the Cottonwood Creek tributary to the San Joaquin River, using timed searches and pitfall traps. PG&E (2000) noted no recent records of the species in Willow Creek below Bass Lake; abundant predatory fish and bullfrogs in Willow Creek

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<sup>118</sup> The U.C. Museum of Vertebrate Zoology has collection specimens from the San Joaquin drainage: 4 frogs from 1.3 miles N of Big Creek along Hwy. 168 in July 1953; and 6 frogs from 1 mile W of Tollhouse, on the Dry Creek tributary, in September 1953 (UCMVZ 2015). The Texas Memorial Museum has a *Rana boylei* specimen collected in July 1945 from Huntington Lake, in the upper San Joaquin River drainage (TMM 2001).

<sup>119</sup> In the Sierra National Forest, from just downstream of Italian Bar Road upstream to Jose Basin Road: at the Mill Creek and Jose Creek confluence (Fellers site ID S-715), 9 adults, 3 juveniles and 2 egg masses were observed in 2002; and 5 adults, 37 subadults, 554 larvae and 150 egg masses were observed during visits in 1997, 1998, and from 2004-2007 (CNDDDB 2016). At Jose Creek and Million Dollar Road crossing (Fellers site ID S-464a and S-464b), 54 adults, 585 subadults and 441 egg masses observed during visits from 1994-1996, 1998, 2000, and 2003-2007 (CNDDDB 2016).

<sup>120</sup> The U.C. Museum of Vertebrate Zoology has 9 foothill yellow-legged frog specimens collected from the Willow Creek tributary at O'Neals from 1951-1953 (UCMVZ 2015). Moyle documented foothill yellow-legged frogs in the South Fork Willow Creek and at Little Finegold Lake during surveys from July 27 to September 4, 1970 (Moyle 1972, 1973; CNDDDB 2016). The foothill yellow-legged frog still occurred in Willow Creek below Bass Lake in the 1970s (PG&E 2000).

and reduced flows below Bass Lake were suspected to be factors in the frog's disappearance.

#### Fresno River

There are historical records from 1938-1970 in the Fresno River tributaries Carter Creek, Coarsegold Creek and Miami Creek (Madera County 2007; UCMVZ 2015).<sup>121</sup>

The species could not be found in Miami Creek or Carter Creek during focused surveys in 1989 and 2003 (Madera County 2007). There were reports of small numbers of *R. boylei* in China Creek in 1991 and Bass Lake in 1994; subsequent surveys and visits were unable to locate the species (PG&E 2000; CNDDDB 2016).<sup>122</sup>

#### Chowchilla River

Moyle documented foothill yellow-legged frogs in the Chowchilla River during surveys from July 27 to September 4, 1970 (Moyle 1972, 1973; CNDDDB 2016). There are no known recent records from the Chowchilla River.

*Recent status:* Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at only 3 of 6 historical locations (50%) in Madera County. There are no records of *R. boylei* from Madera County since 1994. The species may be extirpated from Madera County.

### Mariposa County

#### Merced River

There are numerous historical collection records from 1899-1980 throughout the Merced River drainage, within and to the west of Yosemite National Park, including Bear Creek, Big Creek, Blacks Creek, Corbet Creek, Feliciano Creek, Mariposa Creek, Merced River, Piney Creek, Pleasant Valley, Rancheria Creek, Sherlock Creek, Smith Creek, South Fork Merced River and Sweetwater Creek (Grinnell and Storer 1924; Martin 1940; Richards 1958; Moyle 1972, 1973; Drost and Fellers 1994; FMNH 2001; HMCZ 2001; UMMZ 2001; USNM 2001; CNDDDB 2016; UCMVZ 2015).<sup>123</sup>

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<sup>121</sup> The U.C. Museum of Vertebrate Zoology has 1 foothill yellow-legged frog specimen collected from Coarsegold Creek at Coarsegold in September 1938 (UCMVZ 2015). The foothill yellow-legged frog was observed in Miami and Carter creeks, tributaries of the upper Fresno River NW of Oakhurst, in the late 1960s and early 1970 (Madera County 2007).

<sup>122</sup> The CNDDDB has a record of 5 adult *Rana boylei* observed on August 25, 1994 on the N shore of Bass Lake, 0.25 miles NW of "The Pines" Village. These frogs were noted to be threatened by predation from non-native bullfrogs (CNDDDB 2016). There is also a CNDDDB record of a single adult frog observed in May 1991 in China Creek, 3 miles SW of Bass Lake; subsequent visits revealed only bullfrogs (CNDDDB 2016). Pacific Gas and Electric surveys (PG&E 2000) were unable to locate the foothill yellow-legged frog in Bass Lake, noting that the species was last recorded there in 1994. PG&E (2000) noted that a high level of recreation in the lake was suspected to be a factor in the frog's disappearance.

<sup>123</sup> The U.S. National Museum of Natural History has 7 *Rana boylei* specimens collected from Mariposa (presumably along Mariposa Creek) in October 1899 (USNM 2001). Grinnell and Storer (1924) found foothill yellow-legged frogs from 1911 to 1920 along Piney Creek and Pleasant Valley (now flooded by Lake McClure), E to Sweetwater Creek (near Feliciano Mountain) and to Smith Creek, E of Coulterville (Grinnell and Storer 1924; Drost and Fellers 1994). Grinnell and Storer (1924) observed tadpoles in Blacks Creek near Coulterville in May 1919, collected 6 adult frogs plus an adult female of breeding age (UCMVZ #5687-

Extensive resurveys of the Grinnell and Storer (1924) Yosemite transect (Drost and Fellers 1994, 1996), as well as searches of suitable *R. boylei* habitat in the Yosemite area (Yosemite Valley, Foresta, Wawona, and El Portal) (Fellers and Freel 1995; Fellers 1997; Moritz 2007) were unable to locate any foothill yellow-legged frogs. Moritz (2007) surveyed 32 localities in the Hetch-Hetchy Area (between Ranger Station and O'Shaughnessy Dam along Hetch Hetchy Road), 16 localities in the Foresta Area, (between Hodgdon Meadows Campground and Foresta Road along Big Oak Flat Road), 13 localities in Yosemite Valley (between Arch Rock entrance station and Happy Isles Nature Center), 11 localities in Lyell Canyon (between Tuolumne Meadows and Mount Lyell), 25 localities in Glen Aulin (between McGee Lake and California Falls, including Tenaya Lake, Olmsted Point, and Siesta Lake), 15 localities along Bridalveil Creek (between Glacier Point and Chinquapin), and 16 localities in the Wawona Area (between Mariposa Grove and Rail Creek along Wawona Road), without detecting the species.

Fellers located small populations in the 1990s in the Bull Creek tributary of the North Fork Merced River, with a single larva seen in Bull Creek in 2007 (CNDDDB 2016).<sup>124</sup> Small populations were documented from 1998-2009 in Sherlock Creek (CNDDDB 2016), but during a NPS and BLM survey of Sherlock Creek in spring of 2015, the creek was over-run with bullfrogs, and only 1 *R. boylei* was found by a crew of 6 searchers looking from the confluence with the Merced River for at least a few miles upstream (S.

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5692) from Smith Creek E of Coulterville in June 1915, and an adult female near Feliciana Mountain in November 1915. The Harvard Museum of Comparative Zoology has a *Rana boylei* specimen collected from 6 miles E of the W entrance to Yosemite National Park in August 1922 (HMCZ 2001). A 1924 Lyell Canyon expedition found the species in tributaries to the Merced River below El Portal (specimens are in CAS holdings) (Drost and Fellers 1994). The Field Museum of Natural History has a specimen collected from Yosemite, between Glacier Point and the Ranger Station, in May 1936 (FMNH 2001). The University of Michigan Museum of Zoology has foothill yellow-legged frog specimens collected from throughout the Merced River drainage in the 1930s to 1950s: a single frog from Briceburg in July 1938; 3 adults and 12 tadpoles taken from 14 miles S of Mariposa in August 1940; 1 tadpole from the bridge below Coulterville in August 1940; 1 frog from the Merced River 0.5 mile below Cascade Creek, in Yosemite National Park, in July 1948; and 4 frogs from Bower Cave, 6.5 miles S of Buck Meadows, in August 1950 (UMMZ 2001). Foothill yellow-legged frogs were documented at Wawona on the South Fork Merced River (Martin 1940) and at Fern Springs in Yosemite Valley (Richards 1958). The U.C. Museum of Vertebrate Zoology historical collection specimens include: 2 frogs from Pleasant Valley on May 17 and May 24, 1915; 1 frog from 3 miles NE of Coulterville on June 3, 1915; 6 frogs from Smith Creek, 6 miles E of Coulterville on June 5, 1915; 1 frog from 1 mile W of Coulterville on May 11, 1919; 10 frogs from Rancheria Creek, 2.8 miles SW of Briceburg on May 29, 1952; 2 frogs from 4.4 miles NE of Briceburg on July 11, 1952; 1 frog from 0.7 miles NE of Briceburg on November 16, 1952; 2 frogs from Big Creek at Fish Camp on April 19, 1953; 6 frogs from Merced River, 1.9 miles E of Indian Lodge, on April 19, 1953; 2 frogs from Feliciana Creek, 2 miles NE of Briceburg, on April 19, 1953; 1 frog from Rancheria Creek, 2.8 miles SW of Briceburg, on May 29, 1953; 1 frog from Bower Cave on March 8, 1953; 1 frog from 1.8 miles S of Briceburg on February 26, 1954; 1 frog from Bear Creek, 2 miles S of Briceburg, on April 7, 1954; 1 frog from Briceburg on April 26, 1955; 1 frog from the Bear Creek drainage, 0.8 miles SE of Briceburg, on March 1, 1957; 2 frogs from Bower Cave on May 30, 1959; and 2 frogs collected from 2.5 miles N of Midpines on an unknown date (UCMVZ 2015). Moyle documented foothill yellow-legged frogs in Corbet Creek (SE of Lake McClure), Sweetwater Creek, and Bear Creek (near Briceburg) during surveys from July 27 to September 4, 1970 (Moyle 1972, 1973; CNDDDB 2016). The U.C. Museum of Vertebrate Zoology has 2 tadpole specimens (MVZ #175103) collected July 8, 1980 from Sherlock Creek, E of Bear Valley (UCMVZ 2015).

<sup>124</sup> In Bull Creek at Road 02S02 (1 mile N of Little Grizzly Mountain, 4 miles N of Merced River Mile 101), Fellers observed 1 tadpole and 1 adult in June 1993. Along Bull Creek about 0.7 miles N of Kinsley Guard Station and about 3.6 miles NW of Jenkins Hill (Fellers site ID #Y-347D), Fellers observed 1 subadult frog on 10/12/93 and 1 subadult frog on 9/30/94. Along Bull Creek at the confluence with an unnamed tributary, about 0.5 miles SW of Anderson Flat and about 1.5 miles N of Little Grizzly Mountain (Fellers site ID #Y-347A), Fellers observed 1 subadult on 9/30/94, 1 larva on 6/17/96, 1 larva on 6/8/97, 1 adult and 1 subadult on 6/29/98, and 1 larva on 8/6/07.

Kupferberg, pers. comm., 2016). There was a report in 2008 of “many” foothill yellow-legged frogs along the Merced River downstream from McCabe Flat (CNDDDB 2016).<sup>125</sup>

*Recent status:* Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at only 1 of 5 historical locations (20%) in Mariposa County. Extensive surveys during the 1990s and 2000s (Drost and Fellers 1994, 1996; Fellers and Freel 1995; Jennings 1996; Fellers 1997; Moritz 2007) failed to locate any foothill yellow-legged frogs. The remaining populations appear to be small ones in the Merced River (and tributaries Bull Creek and Sherlock Creek) above Lake McClure. The species is nearly extirpated from Mariposa County.

### **Central/Northern Sierra Nevada**

The Northern/Central Sierra includes drainages of the Sierra foothills in Plumas, Butte, Yuba, Sierra, Nevada, Placer, El Dorado, Amador, Calaveras and Tuolumne counties. Sutter County is discussed here: a single historical record of *R. boylei* from Sutter Buttes (a small isolated range of eroded volcanic lava domes in the Central Valley), in northwestern Sutter County east of the Sacramento River, was likely a small disjunct population which is now extirpated.

There has been confusion over identification of some yellow-legged frog populations in the northern Sierra Nevada. While the foothill yellow-legged frog (*R. boylei*) inhabits low to moderate elevation streams from sea level to 1,830 m (6,000 feet) in California (Stebbins 1985; Stebbins and McGinnis 2012), the Sierra Nevada yellow-legged frog (*Rana sierrae*) occurs at elevations mostly above 1,820 meters (6,000 feet), with the lowest documented occurrence of this species in the Sierra foothills at 1,044 m (3,425 feet) (Jennings and Hayes 1994; USFS 2000). Historically, the ranges of *R. sierrae* and *R. boylei* abutted each other at mid-elevations in the western and northern Sierra Nevada, and the two species were sometimes found in close proximity to each other in the same drainages (Zweifel 1955). Though the two species can appear morphologically similar, genetic analysis can differentiate between the species (e.g. Lind et al. 2011; Poorten et al. 2013).

Hayes et al. (2013) reviewed the status of *R. boylei* on national forests in the northern and central Sierra Nevada (Lassen, Plumas, Tahoe, El Dorado and Stanislaus National Forests), and documented declines and apparent loss of many historic populations in the northern and central Sierra National Forests. Although *R. boylei* populations persist in many river basins, including the American, Clavey, Cosumnes, Feather, Merced, Mokelumne, Stanislaus, Tuolumne, and Yuba Rivers, the majority of the recent observations in these national forests are of small and scattered populations, with limited evidence of successful reproduction.

There have been severe declines in the central Sierra foothills (Moyle 1973; Drost and Fellers 1996) and populations in the northern Sierra may be in decline as well (Lannoo 2005). As discussed below by county, at least half of known historical locations have

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<sup>125</sup> In Sherlock Creek from the confluence with the Merced River to about 1 mile upstream of Lyons Gulch (SW of Telegraph Hill): 1 adult on 3/22/98; 7 frogs on 9/20/05; dead and live frogs and tadpoles in lower Sherlock Creek and at mouth of Merced River on 8/28/08; and 3 adults and 7 juveniles on 8/28/09 (CNDDDB 2016). The CNDDDB has a recent report of “many” *Rana boylei* observed in September 2008 along the Merced River downstream from McCabe Flat, about 1.5 miles NE of Telegraph Hill and 1.8 miles SE of Quartz Mountain (CNDDDB 2016).

been lost in every northern and central Sierra county except Plumas County, and most of the recently documented populations in the northern and central Sierra are small and scattered. Significant populations remain in El Dorado County (Rubicon River), Placer County (North Fork American River and North Fork of the Middle Fork American River), Nevada County (Middle Yuba River, South Yuba River and Bear River), and Plumas County (North Fork Feather River, Middle Fork Feather River, Oroleve Creek, South Fork Feather River, Spanish Creek, and Canyon Creek tributaries Slate Creek and Onion Creek).

### Central and Northern Sierra National Forests

Hayes et al. (2013) comprehensively reviewed the foothill yellow-legged frog's historical (prior to 1980) and recent (1980 to 2001) status across the five National Forests (Stanislaus, El Dorado, Tahoe, Plumas, and Lassen) in the northern and central Sierra Nevada, which overlap extensively with the range of the northern Sierra Nevada *R. boylei* population. Hayes et al. (2013) evaluated records from museum databases and more recent visual survey efforts. A summary of the findings of Hayes et al. (2013), by National Forest:

#### Stanislaus National Forest

Hayes et al. (2013) noted that a number of historical foothill yellow-legged frog records exist for the Stanislaus National Forest from the Middle and South Forks of the Tuolumne River, and the North Fork of the Merced River. In the Tuolumne River basin, collections were made from 1948 to 1974 in the South Fork Tuolumne River and Middle Fork Tuolumne River. In the North Fork Merced River basin, collections were made from Smith Creek in 1915 and the North Fork Merced River in the 1950s, and one record exists from Sherlock Creek in the 1980s. Numerous historical collection records from 1899 to 1953 exist for five major hydrographic basins that extend onto Stanislaus National Forest lands, downstream of the current National Forest boundary: the Mokelumne River (Licking Creek); Calaveras River (Big Trees Creek); Stanislaus River (Angels Creek and Moran Creek), Tuolumne River (Mocassin Creek, Turnback Creek and Woods Creek); and the Merced River (Blacks Creek, Cuneo Creek, Maxell Creek, Merced River and Piney Creek).

Hayes et al. (2013) noted that scattered sightings of foothill yellow-legged frogs exist for the Stanislaus National Forest and vicinity since 1980, but the earliest systematic surveys date from 1993. Recent records exist for the Calaveras, Clavey, Merced, Stanislaus, and Tuolumne River basins. Two historical sites have recent foothill yellow-legged frog sightings, and surveys since 1993 have identified 19 previously unidentified sites. In the Calaveras River drainage, a single frog was reported sighted from San Antonio Creek (Lind et al. 2003) but resurvey efforts 2033-2005 failed to locate the species: some possibility exists that foothill yellow-legged frogs have been extirpated from the Calaveras River. In the Clavey River drainage, foothill yellow-legged frogs were recorded reproducing from 1995-2002 and 2009-2010 in Bull Meadow Creek, Clavey River mainstem, and a Hull Creek tributary, but with low numbers of post-metamorphs. Kupferberg et al. (2013) documented breeding at 4 or 5 sites on the Clavey River. In the Merced River drainage, small numbers of were frogs recorded from 1995-2003 in Bull Creek, a tributary of the North Fork of the Merced River, with low numbers of post-metamorphs. In the Stanislaus River drainage, foothill yellow-legged frogs were found at 12 localities between 1993 and 2002, with evidence of reproduction in Rose Creek and

the mainstem Middle Fork Stanislaus River, and sightings in Coyote Creek and Skull Creek; overall, numbers of adults and juveniles were low, and indication of recruitment success was limited to 3 sites. In the Tuolumne River drainage, small numbers of foothill yellow-legged frogs were reported from 4 localities between 1993 and 2012, with evidence of reproduction in the North Fork Tuolumne River mainstem and Hunter Creek, and sightings in the mainstem Tuolumne River; indication of recruitment success was limited to 1 site (Hayes et al. 2013).

#### El Dorado National Forest

Hayes et al. (2013) noted historical records for the foothill yellow-legged frog on the Eldorado National Forest from 1916 and 1935 along the South Fork of the American River. Additional historical records exist downstream of the current National Forest boundary in two major hydrographic basins, the American (including Middle and South Forks) and Cosumnes Rivers. Collection records on the American River from 1850 to 1961 include from Dry Creek, North Fork of the American River, South Fork of the American River, Weber Creek and a tributary of Slate Creek; from the Cosumnes River basin include Squaw Hollow Creek and Martinez Creek in 1942. Hayes et al. (2013) noted no foothill yellow frog records from the 1970s from either the Eldorado National Forest or lands lower in elevation than Eldorado National Forest lands.

Systematic frog surveys in the Eldorado National Forest and region were not conducted until the 1990s. Foothill yellow-legged frogs were detected in the early 1990s (Martin 1992) in the Eldorado National Forest in South Fork American River tributaries Camp and Snow Creeks, as well as Bark Shanty Creek (this is at elevation 6,270 feet, so possibly could represent *R. sierrae*). A single frog was seen on Sopiago Creek, a third-order tributary of the Cosumnes River, but subsequent significant survey efforts found no other foothill yellow-legged frogs on this creek. Recent amphibian surveys for FERC relicensing have documented foothill yellow-legged frog populations in four major hydrographic basins: the Middle Fork of the American River and its tributaries, including the Rubicon River and Otter Creek; the South Fork American River and its tributaries, including Silver Creek and Soldier Creek; the Cosumnes River system, especially Camp Creek and its tributaries; and the North Fork Mokelumne and its tributaries, especially Camp, Green, and East Panther Creeks.

#### Tahoe National Forest

Hayes et al. (2013) noted scattered historical records from 1899-1969 of foothill yellow legged frogs for the Tahoe National Forest within the Yuba River drainage, and from drainages below National Forest lands including Deer Creek, Dry Creek, Middle Fork American River, Middle Fork Yuba River, Middle Yuba River, New York Creek, North Fork American River, North Fork Yuba River, South Honcut Creek, South Poorman Creek, South Yuba River, Washington Creek, Willow Creek and Yuba River.

Systematic surveys on the Tahoe National Forest were not initiated until the late 1990s (Koo and Vindum 1999). Very small numbers of foothill yellow-legged frogs were recorded at a number of localities on the North, Middle, and South Yuba Rivers, and the North and Middle Forks of the American River, including several localities for which historical records were lacking. Very small numbers of *R. boylei* were recorded at 10 localities in the North Yuba River system (Devil's Creek, Fiddle Creek, Humbug Creek, Kanaka Creek, North Yuba River and Woodruff Creek); a single frog was recorded from

the Middle Yuba River system (Grizzly Creek); 2 frogs were recorded in the South Yuba River; 1 frog was recorded in the North Fork American River system (North Shirttail Creek); and 2 localities were recorded on the Middle Fork American River system (single frogs in Skunk Canyon Creek and in North Fork of the Middle Fork of the American River). Hayes et al. (2013) had not incorporated *R. boylei* data from recent FERC surveys during in the South and Middle Forks of the Yuba River, the Bear River, the North Fork Middle Fork and the Middle Fork of the American River, and the Rubicon River (including tributary streams within these watersheds). The Nevada Irrigation District and PG&E conducted *R. boylei* surveys from 2008-2010 on the Middle Yuba and South Yuba – these data were not incorporated by Hayes et al. (2013).

#### Plumas National Forest

Hayes et al. (2013) noted many historical collections of foothill yellow-legged frog from 1924-1978 in the Plumas National Forest and other lands either in in-holdings or the westslope Sierra below the Plumas National Forest boundary. Historical records were primarily in the Feather River, Butte Creek and Chico Creek drainages, including Anderson Fork, Big Chico Creek, Butte Creek, Cherokee Creek, Dooley Creek, Feather River, Last Chance Creek, Little Butte Creek, Little North Fork of the Feather River, Middle Fork Feather River, Mud Creek, North Fork Feather River, Rock Creek, South Fork Feather River, Spanish Creek, Sulphur Creek and West Branch Feather River. By the end of the 1970s, foothill yellow-legged frogs had been recorded from 12 different localities on the Plumas National Forest, and 40 additional localities at elevations below Plumas National Forest lands. Foothill yellow-legged frogs seem to have disappeared from at least one valley floor at that time, but available data imply that species was still present over its Sierra range in this region.

Systematic surveys were initiated on the Plumas National Forest in the late 1990s (Koo and Vindum 1999); foothill yellow-legged frogs were recorded at only 45% of the sites where they were historically found. The species was recorded at 6 of 6 historical sites in the Canyon Creek drainage (including Onion and Slate Creeks); at 2 of 2 historical sites in the South Fork Feather River drainage (including Oroleve Creek); at only 2 of 4 sites in the Middle Fork of the Feather River; only 1 of 7 sites in the East Branch of the North Fork Feather River (Spanish Creek); and not located at 2 historical sites in Little Butte Creek; 1 historical site in Dry Creek; 1 historical site in the North Fork Yuba River; or 1 historical site in the West Branch Feather River. The Plumas National Forest has continued to conduct extensive amphibian surveys since the late 1990s, finding that all drainages in which foothill yellow-legged frogs were detected during 1990s CAS surveys still appear to have foothill yellow-legged frogs present, and detecting several locations in addition to the 24 historical sites. Extensive surveys and monitoring since 2001 of frog populations in reaches of the North Fork Feather River have documented an increasing *R. boylei* population on the Poe reach and a significant decline of the population on the Cresta reach. PG&E data and FERC data on *R. boylei* for hydropower relicensing activities had not yet been incorporated by Hayes et al. (2013).

#### Lassen National Forest

Hayes et al. (2013) noted only 3 historical records from 1938-1978 in Lassen National Forest, in tributaries of the North Fork Feather River and West Branch Feather River, and in Little Butte Creek. Resurveys from 1973-1978 revealed the species had been extirpated from the former site on Little Butte Creek. Several additional pre-1980 records



(from 1911-1970) exist downstream of the current National Forest boundary, in primary tributaries of the Sacramento River including Battle, Big Chico, Butte, Cow, Dye, Mill, Paynes, Rock and Stillwater Creeks, as well as the mainstem Sacramento River (Hayes et al. 2013). Resurveys from 1973-1976 in former collection localities on the Sacramento River could not find foothill yellow-legged frogs, making it possible that the species was extirpated on the mainstem Sacramento River by the mid-1970s.

Jennings documented dozens of foothill yellow-legged frogs in 1996 in Dye Creek and its tributaries. Hayes et al. (2013) noted scattered collection records and sighting since 1980 in Lassen National Forest under surveys through the Federal Energy Regulatory Commission (FERC) relicensing process. Small numbers of frogs were found in Antelope Creek, Indian Creek and Mill Creek from 2001-2003. Several records documented since 1980 also exist for drainages that extend onto Lassen National Forest, but the records of which are from elevations below National Forest lands.

## Tuolumne County

### Tuolumne River

There are historical collection records from 1932-1974 from the South Fork Tuolumne River, Middlefork Tuolumne River and tributaries of Don Pedro Reservoir, including Eleanor Creek, Hatch Creek, Turnback Creek and Woods Creek (Martin 1940; Richards 1958; Moyle 1972, 1973; USNM 2001; UCMVZ 2015; CNDDDB 2016).<sup>126</sup>

Small populations were documented in the 1990s and early 2000s in several tributaries above Don Pedro Reservoir, including Big Jackass Creek, Hunter Creek and Moccasin Creek (CNDDDB 2016).<sup>127</sup> Foothill yellow-legged frog habitat assessments were conducted in 2012 for FERC in the Tuolumne River upstream of areas regularly inundated by Don Pedro Reservoir, and the following tributaries: Big Creek, Blue Gulch, Deer Creek, Drainage #8, Fleming Creek, Hatch Creek, Kanaka Creek, Moccasin Creek, Poor Man's Gulch, Rogers Creek, Rough and Ready Creek, Six-Bit Gulch, Slate Creek, Smarts Gulch, Sullivan Creek, Tuolumne River, West Fork Big Creek, Willow Creek and Woods Creek (HDR 2013). Foothill yellow-legged frog surveys were performed at five of these streams from 6/18/12-6/21/12, focused on detecting frog larvae, adults and juveniles. No *R. boylei* were detected during surveys at any of the sites (HDR 2013).

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<sup>126</sup> Six frogs from 2 miles NW of Jacksonville in August 1932 (USNM 2001); and 2 frogs from Berkeley-Tuolumne Camp on the South Fork Tuolumne River on June 12, 1948; 1 frog from Sawmill Flat on Woods Creek on May 14, 1949; 1 frog from Woods Creek on April 23, 1950; 1 frog from Turnback Creek on April 15, 1951; 1 frog from 4 mi W of Hardin Flat on the South Fork Tuolumne River on August 31, 1962; 10 frogs (UCMVZ# 136239-136248) from Monroe Middlefork Camp, Middlefork of the Tuolumne River on July 8 and 15, 1972; and 1 frog from Monroe Middlefork Camp, Middle Fork Tuolumne River on August 2, 1974 (UCMVZ 2015; CNDDDB 2016). The species was reportedly once found at the base of Lake Eleanor Dam (elevation 4,657 feet) along Eleanor Creek, a tributary to Cherry Creek (Martin 1940; Richards 1958). Moyle documented foothill yellow-legged frogs in Hatch Lake (Hatch Creek tributary above Don Pedro) and Second Lake during surveys from July 27 to September 4, 1970 (Moyle 1972, 1973; CNDDDB 2016).

<sup>127</sup> Three eggs and 2 tadpoles observed in Hunter Creek at Forest Service Road 01N03 crossing, 2 miles S of Murphy Ranch, in 1993; 4 adults seen near Bull Meadow at the Forest Service Road 01N69 crossing, about 0.9 miles ESE of Clavey River mile 9, in 1993; several large tadpoles undergoing metamorphosis observed S of Table Mountain about 1 mile S of Yosemite Junction on May 15, 1997; and 2 adults and 4 egg masses observed near the confluence of Big Jackass Creek and Moccasin Creek, S of Highway 49, 4 miles E of Don Pedro Reservoir, on May 4, 2001 (CNDDDB 2016).

## Stanislaus River

David Martin documented 1 adult *R. boylei* on a tributary of the South Fork Stanislaus River, between river mile 24 and 25 (about 3 miles W of Cold Springs) in 1993 (CNDDDB 2016).

Small populations were documented consistently from 1993-2008 in Rose Creek, a tributary of the South Fork Stanislaus River (CNDDDB 2016).<sup>128</sup>

There is a *R. boylei* population in the Sand Bar Dam reach of the Stanislaus River (S. Kupferberg, pers. comm., 2016).

*Recent status:* Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at only 2 of 6 historical locations (33%) in Tuolumne County. Other than small populations documented in the Rose Creek tributary of the South Fork Stanislaus River through 2008, and a few small populations in the Tuolumne River above Don Pedro Reservoir through 2001, there are no other known recent observations in Tuolumne County. See the discussion above regarding recent Stanislaus National Forest surveys.

## Sutter County

There is a single historical record of *R. boylei* from Sutter Buttes (a small isolated range of eroded volcanic lava domes in the Central Valley), in northwestern Sutter County, east of the Sacramento River. This was likely a small disjunct population.

*Recent status:* Jennings and Hayes (1994) were unable to locate the species during resurvey efforts from 1988-1991 at the single historical location in Sutter County. There are no CNDDDB reports of *R. boylei* from Sutter County and the species is presumed to be extirpated from Sutter County.

## Calaveras County

### Stanislaus River

There are historical collection records from 1953 from the Stanislaus River drainage, including tributaries Angel's Creek and Moran Creek (UCMVZ 2015).<sup>129</sup>

There were small populations reported in the Coyote Creek tributary from 1993-2005 (CNDDDB 2016).<sup>130</sup>

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<sup>128</sup> At Italian Bar Road Crossing, about 2 miles NE of American Camp Station (Feller ID# Y-441C): 1 adult on 7/1/93; 1 subadult on 5/10/94; 1 subadult and 1 larva on 6/25/96; 1 adult and 105 larvae on 7/3/97; 1 adult, 221 larvae and 200 egg masses on 6/30/98; 1 adult on 6/17/99; 200 larvae and 200 egg masses on 6/1/00; 2 larvae on 8/30/02; and 1 adult on 6/2/03 (CNDDDB 2016). In Rose Creek at Forest Road 03N03 crossing (Fellers site ID# Y-441A&B): 1 adult on 7/1/93; 43 adults, 277 subadults, 117 larvae and 600 egg masses cumulatively during visits in 1994, 1996 and 2002-2008 (CNDDDB 2016). In Rose Creek at Eagle Creek (Fellers site ID# Y-441C): 1 adult and 33 subadults on 9/20/05; 1 larva on 9/1/06; and 6 adults and 204 larvae on 7/24/07 (CNDDDB 2016).

<sup>129</sup> Five frogs from Angel's Creek, 1.2 miles WSW of Murphys, on March 23, 1953; 2 frogs from Moran Creek, 1.5 miles E and 3 miles N of Avery, on May 10, 1953; and 2 frogs from near Hwy. 4 at the S boundary to Calaveras Big Trees State Park on March 10 and 23, 1953 (UCMVZ 2015).

## Mokelumne River

There is one historical collection record of 3 frogs from Licking Creek, a tributary of the South Fork Mokelumne River, in October 1899 (USNM 2001).

Small populations were documented in Jesus Maria Creek (a Mokelumne River tributary above Pardee Reservoir) in 2002, and along the North Fork Mokelumne River during 2001 and 2009 FERC amphibian surveys (CNDDDB 2016).<sup>131</sup>

*Recent status:* Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at only 2 of 9 historical locations (22%) in Calaveras County. Small populations were documented in the North Fork Mokelumne River drainage as of 2009, the Jesus Maria Creek tributary to the Mokelumne River in 2002, and the Coyote Creek tributary to the Stanislaus River as of 2005. See the discussion above regarding recent Stanislaus National Forest surveys.

## Amador County

There are no known historical collection records of *R. boylei* from Amador County.

## Mokelumne River

Small populations were documented during 2001 and 2009 FERC amphibian surveys in Amador County in the North Fork Mokelumne River and tributary Tiger Creek (CNDDDB 2016).<sup>132</sup> Garcia and Associates may have more recent survey data for this reach of the Mokelumne River.

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<sup>130</sup> A single frog was collected from the Coyote Creek tributary to New Melones Reservoir, from Natural Bridge SW to past Krappeau Gulch, in September 1993 (CAS 2001). Fellers observed *Rana boylei* along Coyote Creek at Natural Bridge, about 0.7 mile W of Sugarloaf Mountain, and about 2.1 miles S of Vallecito (Fellers site ID# Y-425A & Y-425B): a total of 8 adults, 49 subadults, 244 larvae and 3 egg masses observed at Y425A during annual surveys from 1993-2001, 2003 and 2005; and 1 adult and 5 subadults observed on 10/19/93 at Y-425B (CNDDDB 2016).

<sup>131</sup> Fellers observed 1 adult and 6 subadults in Jesus Maria Creek (a Mokelumne River tributary above Pardee Reservoir), about 0.64 mile W of the Spring Gulch Confluence (Fellers site ID# T-585), on August 12, 2002 (CNDDDB 2016). In the North Fork Mokelumne River, 0.9 mile W of Devils Nose (PG&E FYLF Site 16 and 30): 7 adults, 28 juveniles and 13 tadpoles from 5/15/01-9/7/01; 1 egg mass on 7/6/09; 1 adult, 17 tadpoles and 10 juveniles on 9/8/09; and 2 adults and 14 juveniles on 10/6/09 (CNDDDB 2016). North Fork Mokelumne River, from near river mile 114 to about 1.5 river miles upstream (about 5.5 miles S of Hams Station): unspecified number of tadpoles from 5/15/01-9/7/01; 2 adults on 7/8/09; 1 adult and 36 tadpoles on 9/10/09; and 2 adults and 25 juveniles on 10/8/09 (CNDDDB 2016). North Fork Mokelumne River, about 0.4 mile upstream from the mouth of Tiger Creek, 4.6 miles ENE of Pioneer: 80 tadpoles and 5 adults on 7/9/09; 1 tadpole, 5 juveniles and 4 adults on 9/9/09; and 7 juveniles and 2 adults on 10/7/09 (CNDDDB 2016). Bear River, about 20 m upstream from North Fork Mokelumne River, about 6.4 miles SE of Hams Station: 1 adult on 8/18/09 (CNDDDB 2016).

<sup>132</sup> Along North Fork Mokelumne River, about 0.4 mile upstream from the mouth of Tiger Creek: 80 tadpoles and 5 adults on 7/9/09; 1 tadpole, 5 juveniles and 4 adults on 9/9/09; and 7 juveniles and 2 adults on 10/7/09. Along Tiger Creek, 1 adult seen about 0.4 mile NE of the confluence with North Fork Mokelumne River on 8/19/09; and 1 adult seen about 1.3 miles ENE of the mouth of Tiger Creek on 8/19/09 (CNDDDB 2016).

## Dry Creek

Small populations were observed during surveys in the early 2000s in Else Creek, an upper tributary of Dry Creek (CNDDDB 2016).<sup>133</sup>

*Recent status:* Jennings and Hayes (1994) were unable to locate the species during resurvey efforts from 1988-1991 at any of 3 historical locations in Amador County. Small populations were documented in the North Fork Mokelumne River and tributary Tiger Creek as of 2009, and in an upper tributary of Dry Creek in the early 2000s.

## El Dorado County

### South Fork American River

There are historical collection records from 1916-1953 in El Dorado County in the South Fork American River drainage, including the Indian Creek and Webber Creek tributaries (Slevin 1928; UCMVZ 2015).<sup>134</sup>

Small populations were documented in 1992 and 1993 in the South Fork American River tributaries Bark Shanty Canyon Creek and Snow Creek, with a significant population in the Indian Creek tributary in 2003 (CNDDDB 2016).<sup>135</sup>

Small populations were documented in 2002 and 2004 at various locations along the South Fork American River (CNDDDB 2016).<sup>136</sup> DTA and Stillwater Sciences (2005) conducted foothill yellow-legged frog surveys from 2002-2004 in moderate to high quality habitat within the 8-mile Slab Creek Dam Reach (from the base of Slab Creek Reservoir Dam downstream to White Rock Powerhouse). The surveys, conducted at 5 South Fork American River sites (downstream of Iowa Canyon Creek, at the confluence with Rock Creek, one mile downstream of Rock Creek, upstream of White Rock Powerhouse, and

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<sup>133</sup> At Indian Grinding Rock State Historic Park (1.1 miles NE of Pine Grove), 5 frogs in July 2000; 13 frogs in July 2001; and 1 adult on July 1, 2004 (CNDDDB 2016).

<sup>134</sup> The U.C. Museum of Vertebrate Zoology has historical collection specimens from the South Fork American River drainage in El Dorado County: 3 frogs from Fyffe in July 1916; 4 frogs from the S Fork American River, 2.5 miles W of Kyburz, in May 1935; 9 frogs from 7 miles W and 1 mile S of Placerville (likely the Indian Creek tributary) in November 1938; 4 frogs from Webber Creek, 2.2 miles WSW of Placerville, in June 1952; and 1 frog from 4 miles NW of Coloma, in May 1953 (UCMVZ 2015).

<sup>135</sup> Three adults and 150 tadpoles in Bark Shanty Canyon Creek (2.5 km NNW of Fitch Rantz Bridge and 3.3 km SE of Owens Camp Field Station) on 7/6/92; and 1 adult in Snow Creek at Big Pebble Canyon Road crossing (about 1.2 miles S of Iron Mountain Road, 1.5 miles E of Matulich Spring) in 1993 (CNDDDB 2016). A significant population (100 adults and juveniles, no distinction made) was seen in the Indian Creek tributary, 2 miles N of Lotus, on 10/27/03 (CNDDDB 2016).

<sup>136</sup> Two frogs just downstream of Blackbird Campground on 6/26/02; 12 tadpoles and 4 adults about 1.8 air miles ESE of Silver Creek Crossing (about 1.9 miles NE of Pollock Pines) on 8/7/02; 3 adults, 4 juveniles and 5 of unknown age about 0.9 mile ESE of Silver Creek Crossing (about 1.6 miles N of Pollock Pines), on 8/8/02; 2 adults, 1 juvenile and 6 tadpoles at gaging station about 0.16 mile NE of Silver Creek Crossing (about 2.1 miles N of Pollock Pines), on 8/8/02; 4 juveniles about 1.1 miles E of El Dorado Power House (about 2.3 miles NNW of Pollock Pines), on 8/8/02; and 1 adult and 2 tadpoles about 1.7 miles NW of USFS Pacific Ranger Station (about 2.3 miles ENE of Pollock Pines), on 8/30/02 (CNDDDB 2016). At El Dorado Power House (about 4.9 miles NE of Camino): 6 frogs on 6/27/02; 8 adults and 4 juveniles on 10/28/02; and 2 adults, 1 juvenile and 1 of unknown age on 10/30/02 (CNDDDB 2016). In the vicinity of Maple Grove Campground (about 2.2 to 3.5 miles ENE of USFS Pacific Ranger Station): 1 adult on 5/29/02; 1 adult and 1 of unknown age on 8/14/02; 7 juveniles on 10/30/02; and from June-October 2004, 1 juvenile, 2 metamorphs, 2 tadpoles and 3 egg masses at 3 sites (CNDDDB 2016).

at White Rock Powerhouse), and 2 tributary sites (the lower portion of Iowa Canyon Creek and the lower portion of Rock Creek), did not detect any *R. boylei*. In 2003, 1 adult foothill yellow-legged frog was incidentally observed on the South Fork American River approximately 0.5 miles upstream of White Rock Powerhouse.

Garcia and Associates (2010a) conducted foothill yellow-legged frog surveys for the El Dorado Irrigation District at 8 sites along the South Fork American River, on July 26 and 27, 2010. The survey included 3 sites upstream of Silver Creek, 1 site at the confluence with Soldier Creek, 1 site upstream of Ogilby Creek, and 3 sites near Maple Grove Campground. No *R. boylei* were detected at any of the sites. ECORP (2011) conducted foothill yellow-legged frog surveys in 2010 for the Sacramento Municipal Utility District along a 0.25 mile reach of the South Fork American River below Slab Creek Reservoir Dam and in 1,800 feet of lower Iowa Canyon Creek. No *R. boylei* were detected.

#### Middle Fork American River

2007 surveys by the Placer County Water Agency (PCWA) documented foothill yellow-legged frog breeding in the lower portions of the Rubicon River (below 3,350 feet) and Middle Fork American River (below 1,800 feet), four lower elevation tributaries (American Canyon Creek, Gas Canyon Creek, Todd Creek and Otter Creek), and comparison river reaches, Shirttail Creek and North Fork of the Middle Fork American River (PCWA 2008). *Rana boylei* were reported dispersed widely throughout the study area in varying densities depending on stream size, flow regulation, and water temperatures. Abundance was highest in the downstream reaches of the Rubicon River and in comparison reaches and tributaries. Abundance was low in the Middle Fork American River bypass reach upstream of Ralston Afterbay, and frogs were observed rarely in the Middle Fork American River peaking reach. No frogs were observed above approximately 1,800 ft in elevation on the Middle Fork American River, 3,350 ft elevation on the Rubicon River, and above 1,550 ft elevation on Long Canyon Creek (near the Long Canyon Creek confluence with the Rubicon River). Breeding was observed in the lower portions of the Rubicon River and Middle Fork American River bypass reaches, in four lower elevation tributaries (American Canyon Creek, Gas Canyon Creek, Todd Creek, and Otter Creek), and in the comparison river reaches. No egg masses were observed in the mainstem of the Middle Fork American River reach. Fall surveys generally reflected this distribution with the highest number of observed tadpoles and young-of-the-year in the Rubicon River, peaking reach tributaries, and at comparison sites.

The density of egg masses at breeding locations, as an index of population size, varied by river reach. The Rubicon River bypass reach had the highest density of egg masses (19 egg masses/km in the three lower sites) and the Middle Fork American River bypass reach had one of the lowest densities of egg masses (2 egg masses/km). The tributaries along the peaking reach (Todd Creek, Gas Canyon and Otter Creek) had moderate egg mass densities (average of 9 egg masses/km). Two of the unregulated comparison sites, Shirttail Creek and the upper site on the North Fork of the Middle Fork American River, had high egg mass densities similar to the lower Rubicon River of 17 egg masses/km and 14 egg masses/km, respectively. Two of the comparison survey sites, North Fork of the Middle Fork American River near the confluence with the Middle Fork American River and the mainstem of the North Fork American River near Shirttail Creek, had low egg mass densities (3 egg masses/km and 2 egg masses/km, respectively). (PCWA 2008)

Most of the PCWA survey results appear to have been submitted to the California Natural Diversity Database, with small numbers of foothill yellow-legged frogs reported from 2003 and 2007 surveys in the Middle Fork American River and the tributaries North Fork of the Middle Fork, Gas Canyon Creek and Otter Creek; one moderate and several small populations were reported in the Rubicon River and its tributaries Long Canyon Creek and Pilot Creek in 2007 (CNDDDB 2016).<sup>137</sup>

### Cosumnes River

There are historical collection records from 1942-1961 in the North Fork Cosumnes River drainage, including tributaries Martinez Creek and Squaw Hollow Creek (UMMZ 2001; UCMVZ 2015).<sup>138</sup>

Small populations were documented from 1992 to 1999 in the North Fork Cosumnes River and tributaries Camp Creek and Middle Fork Cosumnes River (CNDDDB 2016).<sup>139</sup>

*Recent status:* Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at only 1 of 9 historical locations (11%) in El Dorado County. However, small populations were documented from 1992-2007 in El Dorado County at multiple locations in the Cosumnes River, South Fork American River and

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<sup>137</sup> In the Middle Fork American River at Paradise Canyon, near Auburn State Recreation Area: 1 subadult on 11/2/03; 1 adult on 5/17/07; 1 adult on 6/5/07; and 5 adults on 8/23/07. In the Todd Creek tributary: 6 adults, 4 juveniles and 1 egg mass on 5/17/07; and 1 adult on 6/5/07. Along Gas Canyon Creek at Middle Fork American River (about 3.9 miles SE of Applegate): adults captured and released and 9 additional observed on 11/2/03; 9 adults, 4 juveniles and 4 egg masses on 5/17/07; 2 adults and 4 juveniles on 6/5/07; 7 adults on 8/22/07; and 1 adult on 8/23/07. At Poverty Bar along Middle Fork American River (about 2.3 miles ESE of Stony Hill, 6.7 miles ENE of Auburn): 7 adults, 2 juveniles and 22 young-of-year on 9/24/07. At Fords Bar along Otter Creek (about 2.4 miles W of Little Bald Mountain, 3.4 miles NNW of Georgetown): 2 egg masses on 5/23/07; 2 adults, 570 tadpoles and 1 egg mass on 6/6/07; and 2 adults, 86 young-of-year and 9 tadpoles on 8/31/07. At the junction of the Middle Fork American River and North Fork of Middle Fork American River (about 3.9 miles E of Foresthill): 2 egg masses on 5/23/07; 2 adults, 570 tadpoles and 1 egg mass on 6/8/07; and 2 adults, 86 young-of-year and 9 tadpoles on 8/31/07. (CNDDDB 2016). Along the Rubicon River (about 0.9 mile SE of Middle Fork American River confluence): 11 adults and 18 egg masses on 5/22/07; 15 adults, 3 juveniles, 2,910 tadpoles and 7 egg masses on 6/7/07; and 18 adults, 18 juveniles, 101 young-of-year and 49 tadpoles on 8/21/07. In the Rubicon River and Long Canyon Creek tributary (about 0.33 air miles E of Squaw Flat): 16 adults, 6 juveniles and 18 egg masses on 5/25/07; 16 adults, 11 juveniles, 4,850 tadpoles and 1 egg mass on 6/12/07; and 47 adults, 22 juveniles, 233 young-of-year and 117 tadpoles on 8/24/07. In the Rubicon River and tributary Pilot Creek (about 6.5 miles NE of USFS Georgetown Ranger Station): 16 adults, 2 juveniles, 96 young-of-year and 4 tadpoles on 8/28/07. Along the Rubicon River about 1.5 miles NE of Stumpy Meadows Lake: 200 tadpoles and 24 egg masses on 5/30/07; and 3 adults, 1 juvenile and 4,500 tadpoles on 6/14/07; 3 adults, 67 young-of-year and 25 tadpoles on 8/27/07. Along the Rubicon River, about 0.55 mile SSW of Ellicott Bridge: 2 adults and 4 egg masses on 5/29/07; 400 tadpoles on 6/13/07; and 1 young-of-year on 8/28/07. (CNDDDB 2016)

<sup>138</sup> An unknown number of tadpoles from the Martinez Creek tributary, 4 miles S of El Dorado, in October 1942; and 11 tadpoles from Squaw Hollow Creek (a tributary of Martinez Creek), near Placerville, in July 1942 (UMMZ 2001). The U.C. Museum of Vertebrate Zoology has a historical collection specimen of 1 frog from 2 miles S of El Dorado, on March 31, 1961 (UCMVZ 2015).

<sup>139</sup> One adult was observed in Camp Creek, 2.1 km S of Iron Mountain, on 6/17/92. In Camp Creek at old gaging site, 1.5 miles SSE of Jenkinson Lake: 1 frog observed and 2 other frogs heard jumping on 7/18/92; 6 tadpoles on 8/10/94; 4 adults and 2 subadults on 7/21/95; 4 adults and 2 large egg masses on 5/12/97; and 2 adults and 8 larvae on 8/25/99. In the North Fork Cosumnes River at the Sweeney Road Bridge Crossing, 2.5 miles SE of Pleasant Valley, an unknown number of tadpoles were observed on 8/11/94. In the Middle Fork Cosumnes River at the Mt. Aukum Road Bridge Crossing, 1.5 miles SSW of Somerset, 10+ tadpoles were observed on 8/23/94. (CNDDDB 2016).

Middle Fork American River drainages. Significant populations were recorded in the Rubicon River and its tributaries Long Canyon Creek and Pilot Creek, through 2007. See the discussion above regarding recent El Dorado National Forest surveys.

## Placer County

### North Fork American River

There is a historical collection record of 6 frogs from 3.0 mi NW of Cool, on April 11, 1952 (UCMVZ 2015).

Recent data suggest that the species still persists in a dozen or so localities in the foothills in Placer County, particularly the undammed North Fork American River (Lehr 1998; PLSWG 2002). In the 1990s and 2000s, there were scattered observations of small populations of frogs in Placer County in the North Fork American River and tributaries (including Canyon Creek, Codfish Creek, North Fork of the North Fork, Shirttail Creek and Yankee Jim Creek); one significant population of frogs was documented along the North Fork American River mainstem in 2007 (CNDDDB 2016).<sup>140</sup> Foothill yellow-legged frogs were reported to be “common” in the Shirttail Creek tributary during surveys on August 29 and 30, 2007 (CBI 2008).

### Middle Fork American River

There were scattered observations of small populations in the 1990s and 2000s in the Middle Fork American River and tributaries (including North Fork of the Middle Fork,

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<sup>140</sup> Along the North Fork American River, Mumford Bar Trail to 1 km E of Andrew Gray Creek, 10-20 adults and some juveniles were observed on 9/9/94 (CNDDDB 2016). The California Academy of Sciences has a juvenile frog specimen (CAS #205873) collected from the Shirttail Creek tributary, upstream from Sugar Pine Reservoir, on 7/2/98 (CAS 2001; CNDDDB 2016). A single adult was found along the Yankee Jim Creek tributary in Auburn State Recreation Area (2.75 air miles E of Weimar), on 4/20/00 (CNDDDB 2016). Along the North Fork American River, just downstream from the Ponderosa Way Bridge (9 miles NE of Auburn), 5 adults and 8 subadults were observed on 5/26/07; and more than 10 adults and over 100 young-of-year on 10/4/07 (CNDDDB 2016). Along the North Fork American River, about 0.4 mile upstream of Iowa Hill Road crossing (about 1.4 miles ENE of Colfax); 2 metamorphs were observed on 9/8/06; and 20 adults and 5 egg masses were observed nearby on 5/9/08. In an unnamed tributary to the North Fork American River, 1 mile NE of Colfax, 2 adults were observed on 8/9/07; along the North Fork American River, about 0.23 air miles N of Snakehead Point (about 3.6 miles SE of Dutch Flat), more than 10 adults and 100 young-of-year were observed incidentally on 8/31/07; at Codfish Falls, about 0.35 mile N of Codfish Creek and North Fork American River Crossing (about 1.9 miles E of Applegate), 4 adults were seen on 4/10/08; along an unnamed tributary just NE of the North Fork American River confluence (about 0.5 mile SSE of Dinner Tree and 2 miles ESE of Colfax), 2 gravid female adults and 1 unknown adult were observed on 4/26/08; on Moody Ridge, about 1.6 miles S of Alta and 2.1 miles SE of Dutch Flat, 2 adults and 13 juveniles were observed on 6/18/08; on a tributary about 0.3 miles W of the North Fork of the North Fork American River and Fulda Creek Crossing (about 1.7 miles SSE of Blue Canyon), single adult frogs were observed on 6/18/08 and 7/24/08; at Euchre Bar, where the North Fork of the North Fork American River and the North Fork American River branch (3 miles ESE of Alta), 13 adults, 12 juveniles, 310 larvae and 2 egg masses were observed on 6/17/08; along Canyon Creek and I-80 (about 0.8 mile ESE of Alta and 2.2 miles E of Dutch Flat), 1 juvenile was observed on 6/26/08, and 1 adult on 8/25/08. (CNDDDB 2016). North Fork American River, between Shirttail Canyon and Bunch Canyon (about 1.1 miles ENE of Big John Hill and 4.5 miles SE of Colfax) in 2008: Site A had 115 adults, 5,334 non-adults and 16 egg masses during three visits on 5/18/07, 6/4/07 and 8/20/07; and 11 adults on 5/17/08. Site B had 48 adults, 713 non-adults and 3 egg masses during three visits on 5/18/07, 6/4/07 and 8/20/07. Site C had 17 adults, 52 non-adults and 0 egg masses during three visits on 5/18/07, 6/4/07 and 8/20/07 (CNDDDB 2016).

Skunk Canyon Creek); moderate populations in Skunk Canyon Creek in 2002 and North Fork of the Middle Fork in 2007 (CNDDDB 2016).<sup>141</sup>

#### Dry Creek

ECORP (2006) did not detect foothill yellow-legged frogs during 2006 surveys in 3 reaches of the Clover Valley Creek tributary.

*Recent status:* Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at only 2 of 4 historical locations (50%) in Placer County. Small populations were documented in the 1990s and 2000s in the North Fork and Middle Fork American River drainages; with moderate populations along the North Fork American River mainstem and North Fork of the Middle Fork in 2007 and in Skunk Canyon Creek in 2002. See the discussion above regarding recent Tahoe National Forest surveys.

#### Nevada County

##### Yuba River

##### Mainstem Yuba

There is a historical collection specimen from the Deer Creek tributary drainage, in Olympic Park in Nevada City, from June 1903 (CAS 2001).

##### Middle Yuba

The species was reported (age/number not given) from the Kanaka Creek tributary in 1991 and Fellers documented *R. boylei* in small numbers from 1996-1997 at several sites along the Middle Yuba River and tributary Grizzly Creek (CNDDDB 2016).<sup>142</sup>

PG&E documented foothill yellow-legged frogs in 2008 in the Middle Yuba River below Milton Diversion Dam: relatively high numbers of egg masses and tadpoles were seen in the reach below the diversion dam downstream to Wolf Creek; and the species was

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<sup>141</sup> A single adult frog was collected (CAS 205859) from Skunk Canyon Creek, upstream from Mosquito Ridge Road, on 6/30/98; 26 adults were observed in this location on 7/18/02 (CAS 2001 CNDDDB 2016). The California Academy of Sciences has 1 frog larva specimen (CAS #206178) collected from the North Fork of the Middle Fork American River on 7/8/98 (CAS 2001); 3 adults were observed at this location 7/18/02; 15 adults, 3 juveniles and 13 egg masses on 5/23/07; 12 adults and 2,275 tadpoles on 6/8/07; 22 tadpoles and 1 egg mass on 6/11/07; and 23 adults, 2 juveniles, 115 young-of-year and 53 tadpoles on 8/24/07 (CNDDDB 2016). A single adult was observed on Ralston Ridge, about 1.3 miles E of the Middle Fork American River at Rubicon River (about 3.15 miles SE of Michigan Bluff), on 6/24/01 (CNDDDB 2016). Fellers made numerous observations in 3 sites along the Middle Fork American River, upstream of the confluence with the Rubicon River (Fellers site ID: T-562): 3 adults, 1 subadult and 6 larvae on 7/17/02; 1 adult, 5 subadults and 1 juvenile on 8/29/02; 1 adult on 5/22/07; 1 adult and 2 egg masses on 6/7/07; 1 adult, 28 young-of-year, 2 tadpoles and 2 egg mass on 8/21/07; 1 juvenile on 6/12/07; and 1 adult on 8/29/07 (CNDDDB 2016).

<sup>142</sup> In the Kanaka Creek tributary (4 miles NNW of North Bloomfield) on 7/18/91 (CNDDDB 2016). Along Grizzly Creek (Fellers site ID# T-010), about 0.15 mile W of Grizzly Creek at Tyler Foote Road (1 adult and 4 subadults on 6/2/97); along Grizzly Creek (Fellers site ID# T-009), about 0.6 mile E of Grizzly Creek at Tyler Foote Road (2 subadults on 5/29/97); and in Barnhouse Ravine (Fellers site ID# P-347), about 0.9 mile S of Barnhouse Ravine at Middle Yuba River (1 adult on 9/5/96) (CNDDDB 2016).



observed upstream from Our House Reservoir to about river mile 30, between Wolf Creek and East Fork Creek (FERC 2013).<sup>143</sup>

### South Yuba

There are historical collection records from 1967-1973 in the South Yuba River and tributaries Poor Man Creek and Washington Creek, along with a report of “many” frogs seen in Poor Man Creek in 1967 (CAS 2001; UCMVZ 2015).<sup>144</sup>

Yarnell (1999) noted the species in Shady Creek, a tributary to the South Yuba River. There were small populations documented from 1991-2008 in the South Yuba River and tributaries Diamond Creek, Logan Canyon, Poor Man Creek and Washington Creek (CAS 2001; CNDDDB 2016).<sup>145</sup>

PG&E documented small numbers of foothill yellow-legged frogs in the South Yuba tributary Canyon Creek from 2008-2009 (FERC 2013).<sup>146</sup> Focused surveys by PG&E in 2008 also identified numerous small to moderate populations throughout the South Yuba River drainage, including in the Canyon Creek and Shady Creek tributaries (CNDDDB 2016).<sup>147</sup>

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<sup>143</sup> Along the Middle Yuba River about 2.75 miles SE of Alleghany, including Buckeye Ravine, Wolf Creek and Mohawk Ravine (9 adults, 6 juveniles, 80 larvae and 23 egg masses on 6/19/08; 5 adults, 2 juveniles, 140 larvae on 7/8/08; 10 larvae on 8/5/08; and 10 adults, 151 juveniles and 138 larvae on 9/5/08); at the Middle Yuba River and Indian Creek Crossing, upstream of Our House Dam (1 adult and 1 juvenile on 6/9/08; 45 adults and 58 juveniles on 6/24/08; 12 adults and 15 juveniles on 7/14/08; 12 adults and 17 juveniles on 7/22/08; 20+ frogs and dead larvae and juveniles on 8/22/08; 20 adults and 114 juveniles on 8/27/08; and 27 adults and 324 juveniles on 9/3/08); at Chinese Bar and National Gulch Crossing (2 adults and 3 juveniles on 7/7/08; 2 adults and 1 juvenile on 7/16/08; and 4 adults on 9/4/08); and about 0.3 miles ENE of Middle Yuba River and National Gulch Crossing (1 adult on 7/16/08; and 2 adults and 2 larvae on 9/4/08) (CNDDDB 2016).

<sup>144</sup> 1 frog from Poor Man Creek near the confluence with the South Yuba River, in September 1967 (CAS 2001); 13 frogs (MVZ 136314-136326) from South Yuba River at Washington and in Washington Creek on July 15, 1973 (UCMVZ 2015).

<sup>145</sup> In the South Yuba at Poorman Creek, 1 adult and 1 juvenile (CAS 203444, 203450) collected on 8/28/97; 2 adults seen on 7/5/99; and 4 adults, 24 juveniles, 11 larvae and 1 unknown seen in 2008 (CNDDDB 2016). In South Yuba River at Washington and in Washington Creek, 2 adults seen on 6/13/97; 3 adults seen in Washington Creek, 1 mile S of Washington, on 5/23/91 and 1 frog in 8/97 (CNDDDB 2016). One adult in an unnamed tributary to Diamond Creek on 6/3/91; 1 adult 3 miles W of Lake Spaulding on 6/5/91; 1 adult in a Diamond Creek tributary on 6/10/91; 1 adult near Zeibright Mine on 6/19/92; and 6 frogs in South Yuba River State Park on 9/6/06 (CNDDDB 2016). Fellers documented 1 adult and 1 subadult along Logan Canyon (site ID# T-025) on 6/13/97; and 10 adults, 24 juveniles, 64 larvae, 1 egg mass and 1 unknown frog in the South Yuba River at Scotchman Creek (Site ID# T-024) in 2008 (CNDDDB 2016).

<sup>146</sup> Below Towle Canal Diversion Dam frogs were found twice in 2008 and once in 2009 in the downstream portion of this reach; and frog egg masses were found in Canyon Creek about 9.3 miles downstream of Bowman-Spaulding Diversion Dam (FERC 2013).

<sup>147</sup> At the Humbug Creek Confluence (3 juveniles on 4/3/04; 3 adults, 3 juveniles and 6 egg masses on 6/2/08; 5 adults, 2 juveniles and 22 larvae on 6/23/08; 32 adults, 159 juveniles and 2 larvae on 9/16/08; and 117 juveniles on 9/16/08); South Yuba at Holbrook Flat (6 adults, 340 larvae and 1 egg mass on 6/14/08; and 25 juveniles and 2 larvae on 8/26/08); in the Canyon Creek tributary (15 adults observed cumulatively during visits on 6/4/08, 6/12/08, 6/19/08, 7/3/08, 7/10/08 and 8/5/08); at Purdon Creek Crossing (26 adults, 11 juveniles and 1 egg mass on 5/20/08; 15 adults, 3 juveniles, 2 larvae and 2 egg masses on 6/10/08; and 11 adults, 79 juveniles and 2 larvae on 9/12/08); along Canyon Creek (12 adults, 3 juveniles and 1 egg mass on 6/11/08; 1 adult on 7/28/08; 4 adults, 5 juveniles and 73 larvae on 8/12/08; and 2 adults and 13 juveniles on 9/18/08); at Spring Creek Crossing (41 adults, 8 juveniles and 310 larvae on 6/20/08; 32 adults, 4 juveniles and 29 larvae on 7/8/08; and 57 adults, 54 juveniles and 1 larva 9/9/08); about 0.3 mile E of South Yuba River and Diamond Creek Crossing (2 adults, 3 juveniles and 4 egg masses on 6/5/08); about

## Bear River

The City of Grass Valley noted declining populations of foothill yellow-legged frog in several creeks in the Grass Valley area: the lower portion of Wolf Creek, Squirrel Creek and South Fork Wolf Creek (Grass Valley 2000).

PG&E documented all life-stages of foothill yellow-legged frogs in “moderate to high numbers” from 2002-2009 in the Bear River below Dutch Flat Afterbay Dam, and a population in the Steepollow Creek tributary (FERC 2013; CNDDDB 2016).<sup>148</sup> The population at PG&E site 1A was very large (349 adults, 2,082 juveniles and 1,063 larvae in August 2008). Small populations were documented in the Greenhorn Creek tributary from 1997-2009 (CNDDDB 2016).<sup>149</sup> There were additional observations from 2007-2008 of small populations along the Bear River (CNDDDB 2016).<sup>150</sup>

*Recent status:* Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at only 2 of 5 historical locations (40%) in Nevada County. There were small populations documented in the 1990s and 2000s in the Middle Yuba, South Yuba and the Bear River drainages, with a large population in the Bear River and several moderate populations in the South Yuba and tributaries in 2008. See the discussion above regarding recent Tahoe National Forest surveys.

## Sierra County

There are no known historical museum collection specimens from Sierra County.

## North Yuba River

Small populations were documented in the North Fork Yuba River and a dozen tributaries (Cherokee Creek, Downie River, Fiddle Creek, Goodyears Creek, Grizzly Creek, Humbug Creek, Oregon Creek, Ramshorn Creek, Saint Catherine Creek, Slate

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1.1 miles W of South Yuba River and Fall Creek Crossing (1 adult on 6/5/08; and 7 adults, 12 juveniles and 5 larvae on 7/7/08); at Fall Creek Crossing (8 adults, 6 juveniles & 4 egg masses on 6/16/08); and along Shady Creek (39 adults and 19 larvae on 8/12/08) (CNDDDB 2016).

<sup>148</sup> At PG&E site 1A (2 adults/500 juveniles on 10/31/02; 45 adults/36 juveniles/85 larvae/66 egg masses on 6/5/02; and 49 adults/1,885 juveniles/1 larva in 10/03); at PG&E site 1B (67 adults/83 juveniles/188 larvae/2 unknown in 6/08; 22 adults/288 juveniles/187 larvae/15 egg masses/321 unknown in 6/08; 349 adults/2,082 juveniles/1,063 larvae in 8/08; 250 larvae in 9/08; and 10 larvae in 8/09); at PG&E site 2 (6 adults on 11/1/02; 9 adults/2 juveniles on 6/4/02; 7 adults/5 juveniles/1 egg mass on 6/17/02; and 9 adults/5 juveniles on 10/303); and at PG&E site 3 (11 adults/10 juveniles/7 egg masses on 6/4/02; 13 adults/10 juveniles/7 larvae/23 egg masses on 6/16/02; and 9 adults/59 juveniles/19 larvae on 10/2/03). (CNDDDB 2016)

<sup>149</sup> Three adults and 720 subadults seen along Greenhorn Creek (Fellers site ID# T-114, about 0.6 miles downstream from the South Fork Confluence) on 9/27/97, 2 adults (MRJ #1484, CAS #238587) collected on 8/13/99, and 80 larvae observed on 6/9/00; 4 adults observed in the Missouri Canyon Creek tributary (0.75 mile NW of Pleasant Peak) on 11/2/01; and 3 adults observed along Greenhorn Creek (0.5 mile SW of Arrowhead Mine and 1.5 miles E of Highway 174), on 8/11/09 (CNDDDB 2016).

<sup>150</sup> Stump Canyon (2 adults on 5/22/08; 3 adults and 1 juvenile on 9/11/08; and 2 adults on 9/15/08); about 2.7 miles N of Hayford Hill and 4.1 miles NE of Chicago Park (12 larvae on 6/25/08); about 1.8 miles W of Colfax and 2.8 miles SSW of Chicago Park (2 juveniles on 6/15/08); about 2 miles SW of Colfax and 4.4 miles SSW of Chicago Park (1 juvenile and 1 unknown age on 6/9/08; 5 adults and 3 juveniles on 6/24/08; and 6 adults on 8/28/08); and at Dog Bar Bridge (2 juveniles on 9/28/07; 1 juvenile on 6/2/08; and 1 juvenile on 6/15/08)(CNDDDB 2016).

Creek, Woodruff Creek and Willow Creek) in the late 1990s and early 2000s (CAS 2001; CNDDDB 2016).<sup>151</sup>

### Middle Yuba River

Small populations were documented from 1997-2008 in 3 tributaries of the Middle Yuba River: Grouse Creek, Kanaka Creek and Wolf Creek (CNDDDB 2016).<sup>152</sup>

*Recent status:* Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at only 1 of 4 historical locations (25%) in Sierra County. Small populations were documented in the late 1990s and 2000s in the North Fork Yuba River and a dozen of its tributaries, as well as 3 tributaries of the Middle Yuba River. See the discussion above regarding recent Tahoe National Forest surveys.

### Yuba County

#### Yuba River

There are historical collection records from 1899-1938 in the North Fork Yuba River and tributary Moonshine Creek (USNM 2001).<sup>153</sup>

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<sup>151</sup> In the North Fork Yuba River, from the mouth of Humbug Creek to Devils Canyon Creek, 1 adult (CAS #202875) was collected on 5/17/97; 3 adults and 1 juvenile (CAS #205943-205946) were collected on 7/14/98; and 1 adult (CAS #205953) was collected on 7/15/98 (CAS 2001; CNDDDB 2016). In Cherokee Creek, 1 subadult (CAS #203371) was collected on 8/21/97 (CAS 2001; CNDDDB 2016). In the Downie River along Sailor Ravine, Fellers (site ID# T-058) observed 1 adult on 7/22/97 (CNDDDB 2016). In Fiddle Creek, 1 adult (CAS #203284) was collected at Fiddle Creek Ridge Trailhead on 7/21/97; and at Fiddle Creek Campground at North Yuba River near Highway 49, Fellers (site ID# T-050) observed 3 adults and 5 subadults on 7/7/97 (CAS 2001; CNDDDB 2016). In Goodyears Creek (about 0.4 air mile NNE of North Yuba River confluence and 0.5 mile N of Goodyears Bar), Fellers (site ID# Y-821A) observed 3 subadults on 6/19/97 (CNDDDB 2016). In Grizzly Creek, 1 adult (CAS #202921) was collected at Pike City Road on 5/20/97; and along an unnamed tributary of Grizzly Creek (about 0.5 mile E of Pike and 1.1 miles ESE of Alaska Peak), Fellers (site ID# T-014) observed 1 subadult on 6/10/97 (CNDDDB 2016). In Humbug Creek, at the mouth at the North Fork Yuba River, frogs were collected in May 1997 and July 1998 (CAS 2001). Fellers (site ID# T-016C) observed 1 adult along Oregon Creek (about 0.4 mile NE of American Flat, and 1.2 miles NNW of Alleghany) on 6/8/99 (CNDDDB 2016). In Ramshorn Creek (about 0.35 air mile NNW of North Yuba River Confluence and 0.35 mile NW of Ramshorn Campground), Fellers (site ID# Y-822) observed 3 adults on 5/24/95 (CNDDDB 2016). In Saint Catherine Creek a frog was collected on 7/21/98 (CAS 2001). In Slate (Castle) Creek (0.7 km N of Slate Castle), 2 adults were observed on 9/2/92; and along a tributary to Slate Creek (about 0.8 mile W of Little Table Rock Reservoir), 1 adult and 2 metamorphs were observed in October 2000 (CNDDDB 2016). In Willow Creek (In Oak Valley, about 0.4 mile W of North Yuba River and Indian Creek Crossing), 2 adults and 6 juveniles were observed on 8/21/08 (CNDDDB 2016). In Woodruff Creek, approximately 2.0 miles S of Goodyear's Bar, 3 adults were observed on 8/25/92; in an unnamed tributary to Woodruff Creek along Mountain House Road, 1 juvenile (CAS #202880) was collected on 5/31/97 and 1 adult (CAS #202918) on 5/20/97; and 0.6 mile S of Goodyear's Bar, Fellers (site ID# T-031) observed 3 adults on 6/18/97 and 1 adult (CAS #203285) was collected on 7/21/97 (CNDDDB 2016).

<sup>152</sup> In Grouse Creek, just N of Squirrel Creek, Fellers (site ID# T-034) observed 3 subadults on 6/30/97; and in the Grouse Creek headwaters (along Forest Road 180-8), 1 adult was observed on 6/26/08 and 2 adults on 8/4/08 (CNDDDB 2016). In Kanaka Creek, 5 miles N of North Bloomfield (Fellers site ID# T-092B), 1 adult (CAS #203363) was collected on 6/16/97; 24 adults and 1 subadult on 6/8/99; 7 adults on 6/16/00; and at a nearby site 2 adults and 5 juveniles on 5/14/08 (CNDDDB 2016). Along Kanaka Creek (about 1.7 miles SW of Alleghany, and 2.7 miles SSW of Forest), Fellers (site ID# T-092) observed 1 subadult and 6 larvae on 8/26/97 (CNDDDB 2016). Along an unnamed tributary to Kanaka Creek (at Pliocene Ridge), 3 adults were observed on 5/14/08; 2 adults on 5/21/08; 1 adult on 6/26/08; and 1 adult on 8/4/08 (CNDDDB 2016). In Wolf Creek on 6/19/08, 2 adults were observed about 0.8 mile NNE of Wolf Creek and Middle Yuba River Crossing, and 1 adult and 1 juvenile about 1.1 miles NNE of Wolf Creek and Middle Yuba River Crossing (CNDDDB 2016).

The species was known to occur in the 1990s in the lower Yuba River at lower elevations (PG&E 2000). Fellers documented small populations from 1996 to 2000 in the Oregon Creek, Willow Creek and Mosquito Creek tributaries to the North Fork Yuba River above New Bullards Bar Reservoir (CNDDDB 2016).<sup>154</sup> There were collections and observations of single frogs in the Slate Creek tributary of the North Fork Yuba River in 1998 and 2006 (CAS 2001; CNDDDB 2016).<sup>155</sup>

The Yuba County Water Agency initiated frog surveys as part of a FERC project on the Yuba River, New Bullards Bar Reservoir on the North Yuba River, Middle Yuba River and Oregon Creek in Yuba County (YCWA 2011). The Yuba County Water Agency (2011) cited 7 California Academy of Sciences historic records in Yuba County outside of the project area. Vindum and Koo (1999) cited historical Yuba County records for the drainages of the North, Middle, and South Yuba rivers above the YCWA project reaches. Foothill yellow-legged frog records within the project area were noted in the vicinity of Log Cabin Diversion Dam on Oregon Creek (adults and subadults), and upstream and downstream of Our House Diversion Dam on the Middle Yuba River (YCWA 2011). YCWA (2011) cited 16 Tahoe National Forest reports of *R. boylei* in the project area, mostly in Oregon Creek, North Yuba River, Kanaka Creek, Grizzly Creek, Woodruff Creek, Grizzly Gulch, and the Middle and South Yuba rivers. During stream habitat mapping in 2009, the YCWA incidentally observed *R. boylei* in Oregon Creek and in the Middle Yuba River downstream of Our House Diversion Dam (YCWA 2011).

#### Dry Creek

There are historical collection records from 1943-1952 in the Dry Creek drainage (CAS 2001: UCMVZ 2015).<sup>156</sup>

There are no known recent records from Dry Creek.

*Recent status:* Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at 2 of 3 historical locations (67%) in Yuba County. Small populations were documented in the 1990s and 2000s in the lower Yuba River, Middle Yuba River, South Yuba River, and the North Yuba River and its tributaries

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<sup>153</sup> Three frogs from Bullards Bar on the North Fork Yuba River in August 1899 (USNM 2001); and 2 frogs from the Moonshine Creek tributary of the Yuba River in September 1938 (USNM 2001).

<sup>154</sup> One adult and 3 subadults along Oregon Creek (Fellers site ID# P-345), about 0.5 mile NNE of Oregon Creek Campground (about 3.7 miles SSW of Camptonville), on 9/6/96; 3 adults along Oregon Creek (Fellers site ID# T-016) at Gaging Station (about 0.4 mile S of Camptonville and 0.7 mile NE of Log Cabin Dam), on 6/10/97; 1 adult at the confluence of Willow Creek and Horse Creek (Fellers site ID# T-017) at Pendola Road (about 0.8 mile WNW of Camptonville), on 6/11/97; 1 adult and 1 subadult along Mosquito Creek at Oregon Creek (Fellers site ID# T-035), near Hwy. 49 and Celestial Valley (about 2.8 miles SSW of Camptonville), on 6/24/97; and in Oregon Creek at Middle Yuba River (Fellers site ID#), Oregon Creek Campground (about 1.5 miles SW of Celestial Valley and 4.2 miles SSW of Camptonville), 7 adults observed on 6/7/99; and 10 adults and 18 subadults observed on 6/15/00 (CNDDDB 2016).

<sup>155</sup> Collections were made from two locations above Slate Creek Reservoir in September 1998 (CAS 2001). An adult female was observed along a tributary to Slate Creek, just E of the confluence (about 0.8 mile WNW of Poverty Hill), in July 2006 (CNDDDB 2016).

<sup>156</sup> Two adults, 2 juveniles and larva from between Brownsville and Challenge (3 miles W of Challenge), in September 1943 (CAS 2001); and 9 frogs from 2.6 miles ENE of Rackerby (possibly in the Dry Creek drainage) on March 2, 1952 (UCMVZ 2015).

(notably Slate Creek and Oregon Creek). See the discussion above regarding recent Tahoe National Forest surveys.

### Butte County

#### Mud Creek/Rock Creek

There are historical collection records from 1945-1952 in Mud Creek and Rock Creek (UCMVZ 2015).<sup>157</sup>

Gallaway (1999) noted that foothill yellow-legged frogs had been observed in Mud Creek and Rock Creek. There are no more recent observations known.

#### Big Chico Creek

Twelve frogs were collected from Big Chico Creek, 8 miles NE of Chico, on October 21, 1945 (UCMVZ 2015).

Gallaway (1999) noted foothill yellow-legged frogs were common along Big Chico Creek within the Big Chico Creek Ecological Preserve, and had been observed along small tributaries. There are no more recent observations known.

#### Butte Creek

There are historical collection records from 1945-1953 in Butte Creek and Little Butte Creek (UCMVZ 2015).<sup>158</sup> Lassen and Plumas National Forests (LND and PNF 1999) noted Chico State University museum records of historical occurrences of *R. boylei* downstream of the forest boundary in Butte Creek.

Resurveys from 1973-1978 revealed the species had been extirpated from former the former site on Little Butte Creek (Hayes et al. 2013). Systematic surveys on the Plumas National Forest in the late 1990s (Koo and Vindum 1999) failed to locate the species at 2 historical sites in Little Butte Creek. *Rana boylei* was still present in Butte Creek and at Centerville in the 1990s (PG&E 2000). There are no recent observations known.

#### Dry Creek

There are historical collection records from 1937-1950 in Dry Creek (CAS 2001; UCMVZ 2015).<sup>159</sup>

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<sup>157</sup> Single frogs collected from Richardson Springs along Mud Creek, on September 14, 1945 and April 1, 1952; and 3 frogs at Cohasset Pioneer Spring, in the Anderson Fork of Rock Creek, in April 1950 (UCMVZ 2015).

<sup>158</sup> Two frogs were collected from De Sabla on October 21, 1945; 1 frog at Centerville covered bridge on January 2, 1946; 3 frogs from Little Butte Creek, and at and near Magalia Dam and Reservoir, on March 23, 1946; 4 frogs from 1.6 miles W of De Sabla on March 1, 1952; 1 frog N of Butte Creek, 7 miles E of Chico, on April 22, 1952; and 1 frog from Magalia on May 2, 1953 (UCMVZ 2015).

<sup>159</sup> Three frogs were collected near Cherokee ("over the divide in the Sacramento River drainage" presumably in the Dry Creek tributary) in April 1937 (CAS 2001); 1 frog was collected from Cherokee on May 18, 1946; and 1 frog from Cole Canyon Falls, 3 miles S of Pentz, on April 20, 1950 (UCMVZ 2015).

Systematic surveys on the Plumas National Forest in the late 1990s (Koo and Vindum 1999) failed to locate the species at one historical site in Dry Creek. A single adult frog was caught and released in the West Branch Clear Creek tributary of Dry Creek on 10/26/15 (CNDDDB 2016).

#### Cottonwood Creek

Slevin (1928) noted that foothill yellow-legged frogs were found historically in Chamber's Ravine N of Oroville (in the Little Cottonwood Creek drainage); this probably referred to 6 frogs collected from May 26-29, 1912 (UCMVZ 2015).

*Rana boylei* was reported to be present in the 1990s in Cottonwood Creek in Coal Canyon, W of Lake Oroville (PG&E 2000). There are no recent observations known.

#### Feather River

##### Main Feather River

Three frogs were collected from Bidwell Bar Park on March 9, 1941 (UCMVZ 2015).

##### West Branch Feather

In the West Branch Feather River drainage, 13 frogs were collected from Cherokee Creek in April 1937 (CAS 2001).

*Rana boylei* was reported to be present in the 1990s in the West Branch Feather River near Lime Saddle (PG&E 2000). Systematic surveys on the Plumas National Forest in the late 1990s (Koo and Vindum 1999) failed to locate the species at 1 historical site in the West Branch Feather River. There are no recent observations known.

##### Middle Fork Feather

There is a historical collection record of a single frog (MVZ 117615) from the Little North Fork of the Middle Fork Feather River, 2 miles upstream from the junction with the Middle Fork Feather River, on November 29, 1971 (CNDDDB 2016; UCMVZ 2015).

Fellers documented small populations from 1996-1998 in the Middle Fork Feather River, South Branch Middle Fork Feather River and Fall River (CAS 2001; CNDDDB 2016).<sup>160</sup>

##### South Fork Feather

There are collection records from 1998-1999 in the South Fork Feather River drainage (CAS 2001; CNDDDB 2016).<sup>161</sup>

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<sup>160</sup> Fellers observed 2 adults and 1 subadult along the Middle Fork Feather River at the Little North Fork of Middle Fork Feather River (near Milsap Bar and Gauging Station; Fellers site ID# U-033), on 6/25/96; 5 adults along the South Branch Middle Fork Feather River at Milsap Bar Campground (just NE of the confluence with the Middle Fork Feather River; Fellers site ID# U-032), on 6/25/96; and 1 adult along Fall River about 0.8 mile NNE of Feather Falls (about 1.2 air miles NE of Middle Fork Feather River confluence; Fellers site ID# U-036), on 7/2/96 (CNDDDB 2016). There are collection records of: 1 subadult (CAS #205588) from E of Milsap Bar along Forest Road 22N62, on 6/2/98; and 1 subadult (CAS #205590) from along Forest Road 22N62, 0.8 mile NE of Milsap Bar, on 6/2/98 (CAS 2001; CNDDDB 2016).

## North Fork Feather

A single frog was collected from Yankee Hill on April 14, 1950 (UCMVZ 2015).

The species was reported during 1994 surveys in the Bear Ranch Creek and Flea Valley Creek tributaries to the North Fork Feather River; and a single frog was observed in a pool along an unnamed tributary to the North Fork Feather River (about 1.7 miles ESE of Jarbo Gap) on 7/27/98 (CNDDDB 2016). One adult male and 1 adult female frog were observed in the North Fork Feather River in the vicinity of Bardees Bar (about 1.15 miles W of Hungary Hunt Peak and 1.75 miles WSW of Big Bar Mountain), in May 2008 (CNDDDB 2016).

## Honcut Creek

A single frog was collected from 3.1 miles NE of Bangor, in the South Honcut Creek drainage, on March 2, 1952 (UCMVZ 2015).

There are no recent observations known.

*Recent status:* As late as the 1980s, *R. boylei* was found in Butte County in “most drainages” east of the Central Valley floor at elevations as low as 250 feet (Hayes and Cliff 1982). Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at only 5 of 17 historical locations (29%) in Butte County. No foothill yellow-legged frogs were found within Butte County within during Lassen and Plumas National Forest surveys conducted from 1990-1998, despite surveys of areas of potentially suitable habitat within the elevational range of the species (LNF and PNF 1999). See the discussion above regarding recent Plumas and Lassen National Forest surveys.

## Plumas County

### Feather River

There are historical collection records from 1899-1952 in the Rice Creek tributary of the North Fork Feather River; the Rock Creek, Spanish Creek, Indian Creek and Last Chance Creek tributaries of the East Branch of the North Fork Feather River; and the Onion Valley Creek tributary of the Middle Fork Feather River (CAS 2001; UMMZ 2001; UCMVZ 2015).<sup>162</sup>

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<sup>161</sup> One adult male (CAS #206366) from Oroleve Creek along Forbestown Dam Road on 10/8/98; and 1 adult male (CAS #209716) from the South Fork Feather River at Forest Road 22N24, on 8/11/99 (CAS 2001; CNDDDB 2016).

<sup>162</sup> Nine frogs from Quincy (possibly the Spanish Creek tributary of North Fork Feather River) in September 1899 (CAS 2001); 1 frog from Meadow Valley (likely Meadow Valley Creek) in June 1924 (CAS 2001); 1 frog from Feather River Meadows (the Rice Creek tributary to North Fork Feather River) on 21 July 21, 1938 (UCMVZ 2015); 6 frogs from 1.5 miles WSW of McKesick Peak (likely in the Last Chance Creek tributary of North Fork Feather River, above Lake Almanor) on July 15, 1941 (UCMVZ 2015); 3 frogs from 9 miles NNW of Beckwourth in 1942 (UMMZ 2001); 1 frog from Onion Valley Creek, near Middle Fork Feather River in July 1947 (CAS 2001); 1 frog from 8 miles SW of Quincy Meadows Valley in June 1951 (UMMZ 2001); 4 frogs from 5 miles SW of Quincy Rock Creek in July 1951 (UMMZ 2001); and 28 frogs from 5.5 miles W of McKesick Peak (Last Chance Creek drainage) on May 31, 1952 (UCMVZ 2015).

The California Academy of Sciences has a single specimen (CAS #206271) collected from Spanish Creek on 9/3/98 (CAS 2001; CNDDDB 2016). This is likely the population referred to by PG&E (2000), in a drainage adjacent to the North Fork of the Upper Feather River in 1998. Plumas National Forest surveys of the best, accessible habitat from 1993-1998 located *R. boylei* in Fall River, Little North Fork Feather River, Middle Fork Feather River, and South Branch Middle Fork Feather River; with “numerous” sightings in the Middle Fork, Oroleve Creek and Spanish Creek; and an “abundant” population along the South Fork Feather River in 1995 (LNF and PNF 1999; Vindum and Koo 1999).

There was still an apparently significant foothill yellow-legged frog population in Spanish Creek in the 2000s, since a telemetry study done from June 2005 to 2008 used over 50 adult frogs from a site just N of the confluence of Spanish Creek and Bean Creek, with an unknown number of tadpoles and egg masses also observed at the site (CNDDDB 2016). Questions about the affiliation of the Spanish Creek population with the Sierra Nevada yellow-legged frog (*R. sierrae*) or the foothill yellow-legged frog (*R. boylei*) remained after 1 of 4 samples collected from the Bean Creek tributary was identified as *R. sierrae*, with 3 samples identified as *R. boylei* (Lind et al. 2011). Poorten et al. (2013) did subsequent genetic analysis of 7 frogs from Spanish Creek and demonstrated that they were all *R. boylei*. There is only one other CNDDDB record in Plumas County from the 2000s: 1 adult female observed along the South Fork Rock Creek in June 2005 (CNDDDB 2016).

#### North Yuba River

Plumas National Forest surveys of the best, accessible habitat from 1993-1998 located *R. boylei* in Flea Creek, Onion Creek and Slate Creek; with “numerous” sightings in Slate Creek and Onion Creek (LNF and PNF 1999; Vindum and Koo 1999). There are recent CNDDDB observations and collections of small numbers of frogs from Slate Creek and Onion Creek in the 1990s and in 2006 (CNDDDB 2016).<sup>163</sup>

*Recent status:* Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at only 4 of 11 historical locations (36%) in Plumas County. Koo and Vindum (1999) found foothill yellow-legged frogs at only 45% of historical sites on the Plumas National Forest in the late 1990s. In the Feather River drainage, significant populations remain in North Fork Feather River, Middle Fork Feather River, Oroleve Creek, South Fork Feather River and Spanish Creek. In the Yuba River drainage, significant populations remain in Canyon Creek tributaries Slate Creek and Onion Creek. The species appears to be extirpated from most historic sites in the East Branch of the North Fork Feather River, Little Butte Creek, Dry Creek, North

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<sup>163</sup> A single adult was observed along Onion Creek, just E of Diamond Springs Hill (about 0.8 mile NNE of Diamond Ravine confluence) on 6/6/96; 4 adults were observed along Slate Creek about 0.3 air miles SSW of American House Ravine confluence (about 1 mile NNW of Poverty Hill), on 6/19/96 (CNDDDB 2016). The California Academy of Sciences has 6 specimens of adults and larva collected from 6 sites in Onion Creek, Slate Creek and the vicinity of Slate Creek Reservoir from July to October 1998 (CAS 2001; CNDDDB 2016). In Slate Creek N of Forest Road 512 (3 miles SE of Little Grass Valley Reservoir), 1 adult female (CAS #209249) was collected on 7/23/99; and 1 adult and 4 juveniles were observed on 9/3/09 (CAS 2001; CNDDDB 2016). Two subadults were observed along American House Ravine, a tributary of Slate Creek, about 0.4 mile NW of their confluence, in July 2006 (CNDDDB 2016).



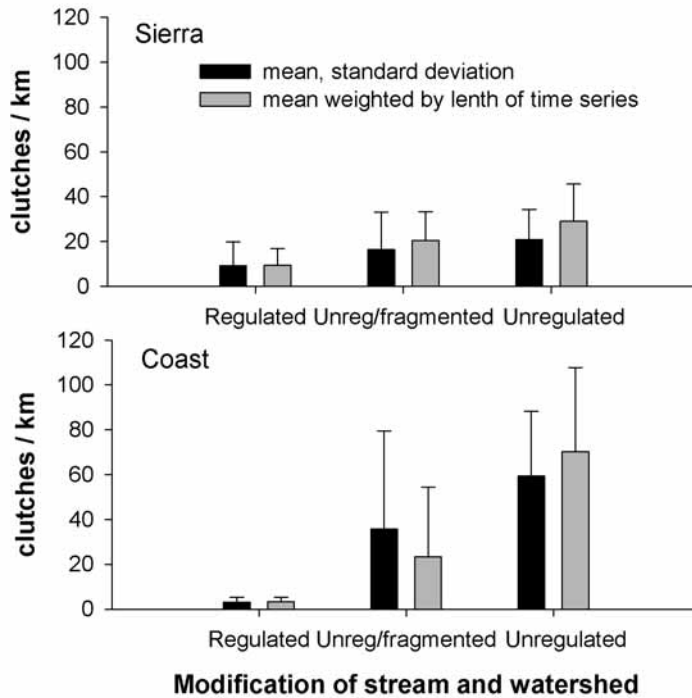
Fork Yuba River, and West Branch Feather River (Hayes et al. 2013). See the discussion above regarding recent Plumas and Lassen National Forest surveys.

### Population Trends

The best measures of long term (i.e. > 50 yr) population trends for foothill yellow-legged frogs are re-survey efforts at known historical and former localities (e.g. Sweet 1983; Jennings and Hayes 1994; Drost and Fellers 1996; Borisenko and Hayes 1999; Lind 2005; Davis and Olson 2008; Olson and Davis 2009). Over shorter and more recent time scales, several researchers and utility companies have been collecting time series data from egg masses in several northern California rivers (see summary by Peek and Kupferberg 2016).

Across California in the last 25 years, breeding season censuses of *R. boylei* have been conducted by researchers, government agencies, and utility companies, in both regulated and unregulated systems. Because each female *R. boylei* lays one discrete clutch of eggs which is readily visible and countable, it has become standard practice to assess their abundance by taking a census of egg masses. Peek and Kupferberg found information for 50 sites which met the following criteria: multiple visits over the course of the breeding season; experienced surveyors; search reach includes more than a single riffle-pool sequence (i.e. not isolated spot checks of breeding sites). With multiple visits, previously overlooked clutches are found upon return, and therefore detectability is high. Two-way Analysis of Variance was used to compare the natural log of mean breeding density (clutches·km<sup>-1</sup>), of coastal and montane populations in rivers with three levels of modification by dams: flow regulation by an upstream dam; no flow regulation but embedded in a regulated watershed (e.g. a free-flowing tributary of a regulated river, or upstream of a reservoir); or unaffected locally by flow regulation and habitat fragmentation). The sites used were not a random sample of extant populations and many sites were censused in only one or two years (n=29 sites). Some sites (n=11) were censused more than 10 years. Peek and Kupferberg calculated weighted means using the number of years sampled as a weighting factor. Comparison of weighted and unweighted means (Fig. 5), indicates that any bias inherent in compiling information collected for disparate purposes did not greatly affect the overall pattern. The metric used to indicate population size, clutch density, was significantly lower where streams and watersheds are modified flow regulation and fragmentation of the habitat by reservoirs and dam control of flow.

For populations with four or more consecutive years in the time series, Peek and Kupferberg (2016) found that there was significantly higher inter-annual variability in the regulated river populations. They concluded that when high variability is combined with sparse density, population trends may not be detectable prior to the point when populations fall below critical thresholds.



**Figure 6.** Significant effect of flow regime on breeding population abundance in 50 sampled populations. Two-way ANOVA: Reg vs. Unreg. vs. Unreg. in modified watershed  $F_{2,44}=10.9$ ,  $p<0.001$ ; Coastal vs. Sierran,  $F_{1,44}=2.6$ ,  $p=0.1$ ; Location x Flow regime  $F_{2,44}=1.1$ ,  $p=0.33$ .

### Rangewide

Lind (2005) assessed foothill yellow-legged frogs across their entire geographic range (excluding the lone record from Baja California), with a composite of data from the interval 1996-2000. Lind (2005) revealed that foothill yellow-legged frogs had disappeared from 51 percent of their historical localities throughout their range. This dramatic disappearance across the species' geographic range may even be underestimated (Hayes et al. 2013, 2016). Lind (2005) compiled unique localities in Oregon ( $n = 90$ ) and California ( $n = 1,049$ ), and using a stratified random selection process, chose a subset of 372 California sites and all the Oregon sites for status assessment. To evaluate persistence of frogs at historic sites, she eliminated sites from her sample that were detected after 1975, and used resurveys of sites conducted in the 1980s and 1990s to determine current status. Of the 394 historic sites remaining in her sample, she found frogs were absent from 201 (51%).

### California

Jennings and Hayes (1994) comprehensively evaluated the status of *R. boylei* in California: they reviewed all available reports, surveys, and CDFG files and data, conducted field reconnaissance from 1988-1991, searched museum specimens and field notes of naturalists, and relied on their 25 years of field experience for historical locations. Jennings and Hayes (1994) found that the species had been extirpated from at least 225 of 425 known historical locations (53%) and had disappeared from 45 percent of its historic range in California by 1991. While the number of populations is important, population size is also critical (Lanoo 2005). Fellers (2005) found that only 30

of the 213 sites in California with foothill yellow-legged frogs (14%) had populations estimated to be 20 or more adult frogs.

#### Southern California

A large decline occurred in southern California (Sweet 1983; Jennings and Hayes 1994), with the species likely extirpated from the Tehachapi Mountains southward (Drost and Fellers 1996). Jennings and Hayes (1994) found that the species had been completely extirpated from 21 of 21 historical sites (100%) in the southern transverse ranges. Jennings and Hayes (1994) recommended endangered status for the species in southern California, but foothill yellow-legged frogs are now extirpated from all of southern California.

#### South Coast

The species is still present but nowhere abundant in coastal California from Monterey County southward to northwestern San Luis Obispo County. Jennings and Hayes (1994) recommended endangered status in central California south of the Salinas River, Monterey County. Jennings and Hayes (1994) found that the species had been extirpated from 81 of 118 historical sites (69%) in southern coastal California. The foothill yellow-legged frog is now nearly extirpated from the south coast region, with the exception of some recent sightings in the Salinas River drainage and some small coastal streams in San Luis Obispo and Monterey counties.

#### Central Coast/Bay Area

There have been dramatic declines in many parts of the greater San Francisco Bay Area, with the species still present but nowhere abundant. There appear to be significant populations of foothill yellow-legged frogs remaining in the Diablo Range through western Fresno, San Benito, western Stanislaus, Santa Clara and Alameda counties. The species appears to be extirpated from Monterey County north of the Salinas River and western San Joaquin County; and may be near extirpation in western Merced, Contra Costa, Santa Cruz and San Mateo counties.

#### Marin/Sonoma

The species has been extirpated from many former localities and watersheds in Marin County, with only one significant population remaining in Big Carson Creek. The species is still widely distributed throughout Sonoma County, including in many tributaries of the Russian River drainage, the South Fork Gualala River drainage, the watersheds of the Laguna de Santa Rosa, Petaluma River, Sonoma Creek and Adobe Creek, and in a few coastal streams. However, there are no reports in Sonoma County of populations with more than 50 adults.

#### North Coast

The largest foothill yellow-legged frog populations in California are in the north coast range, with healthy populations scattered throughout the region. The strongholds for the species are in the Smith River; Red Cap Creek tributary of the Klamath River; South Fork Trinity River; North, Middle and South Forks of the Eel River; Redwood Creek;

coastal tributaries in Mendocino County; and Russian River tributaries. However, only 6 sites in northern California have estimated populations exceeding 100 adult frogs, with an additional 9 sites having > 50 adult frogs (Lannoo 2005). There have been documented declines in this region. Jennings and Hayes (1994) found that the species had been lost from 39 of 165 historical sites (24%) in the north coast of California.

#### Upper Sacramento River

There have been documented declines in the upper Sacramento River basin: Jennings and Hayes (1994) were able to locate the species during resurvey efforts from 1988-1991 at only 3 of 14 historical locations (21%) in Shasta County and only 3 of 7 historical locations (43%) in eastern Tehama County. The species persists in small numbers in Shasta County in more than three dozen tributaries in the Sacramento River drainage, with larger populations in the Sacramento River (near Dog Creek and Campbell Creek) and in Willow Creek and tributaries. Small numbers of frogs persist in eastern Tehama County in the Battle Creek, Paynes Creek, Antelope Creek, Little Antelope Creek, Mill Creek, and Deer Creek drainages.

#### Sierra Nevada

The foothill yellow-legged frog was historically common across stream ecosystems of the lower west slope Sierra Nevada (roughly one-quarter of its historical geographic range), but the species now appears to be increasingly rare and near extirpation over at least two-thirds of its Sierra Nevada range (Hayes et al. 2013, 2016).

Historical data indicate that foothill yellow-legged frogs occurred in westside streams at low to moderate elevations all along the west slope of the Sierra Nevada (Storer 1925; Stebbins 1951, 2003; Zweifel 1955; Jennings and Hayes 1994). No quantitative abundance data exist for the Sierran slope prior to the introduction of exotic fishes and major hydrological changes. Storer (1925) suggested that the species was widespread on the Sierran slope, and Zweifel (1955) indicated that the species was at least moderately abundant at scattered locations over that region. Moyle (1973), whose data were collected after significant incursion by introduced fish fauna, indicated that the species was still moderately abundant in foothill streams in the 1970s. In the Sacramento Valley hydrographic basin, low elevation areas make up a large portion of the valley floor, where presumably suitable foothill yellow-legged frog breeding habitat once existed (Hayes et al. 2013, 2016). The species range once extended to the valley floor margin at least in the 1920s, 1930s, and 1940s (Storer 1925, Wright and Wright 1949). The scarcity of records undoubtedly underestimate the historical distribution of the species in this region, as all records are pre-1930, prior to the major hydrological changes and expansion of exotic aquatic predators that changed much of the lowland Central Valley in California to its present condition (Moyle 2002).

Surveys extending back to the 1990s indicated that foothill yellow-legged frogs have disappeared from most of the southern half of the Sierran slope, from approximately Madera County southward (Jennings and Hayes 1994; Jennings 1995, 1996). Throughout the entire Sierra Nevada, the species had been extirpated from 105 of 142 historical sites (74%) and had disappeared from at least 66% of its historical range by the early 1990s (Jennings and Hayes 1994; Jennings 1996).

These data generally agree with the more recent survey efforts of Lind (2005), indicating that foothill yellow-legged frog populations have become even more sparse over this portion of the Sierran slope. Further, evidence exists of considerable local extirpation from different drainage systems in the northern half of the Sierra Nevada, a pattern that becomes less widespread as one moves north (Lind 2005). Fellers (2005) found occupancy of foothill yellow-legged frog sites in the Sierra Nevada was about 12 percent, but historical occupancy of these sites is unknown. Lind (2005) used a randomized selection of 47 historically occupied sites from across the Sierra Nevada and found that 51% (n = 24) of the sites were currently unoccupied. The species' disappearance is more pronounced with decreasing latitude and the species is near extirpation over roughly the southern half of its Sierran range. The species appears to be moving slowly, but inexorably toward extirpation across its Sierran range in a northerly direction (M. Jennings, pers. comm., 2006, as cited in Hayes et al. 2013).

#### Southern Sierra Nevada

Moyle (1973) found *R. boylei* at only 30 of 95 sites (31%) sampled in the southern and central Sierra Nevada foothills (from the Yosemite area south) in 1970, and believed the species was declining at that time. The species was thought to be near extirpation from the southern Sierra Nevada by the 1990s due to the paucity of observations during focused surveys and resurveys (Fellers 1994; Jennings and Hayes 1994; Fellers and Freel 1995; Drost and Fellers 1996; Fellers 1997). Jennings and Hayes (1994) recommended threatened status in the west slope drainages of the Sierra Nevada. Jennings (as cited by Lannoo 2005) considered the situation for foothill yellow-legged frogs in the southern Sierra Nevada foothills bleak, with no populations that are likely to remain viable. *Rana boylei* is extirpated from Yosemite, Sequoia and Kings Canyon National Parks, and near extirpation in Sequoia and Sierra National Forests, with few extant populations and limited distribution (Hayes et al. 2013, 2016). The species is now nearly extirpated from the southern portion of its Sierra range. The few known populations remaining in the southern Sierra Nevada are in Mariposa County (Merced River and tributaries), eastern Fresno County (Jose Creek), and Tulare County (tributaries of the North Fork Kern River and upper Kern River).

#### Central/Northern Sierra Nevada

There have been documented declines and apparent loss of many historic populations in the northern and central Sierra National Forests (Hayes et al. 2013, 2016). Although *R. boylei* populations are still extant in many river basins, including the American, Clavey, Cosumnes, Feather, Merced, Mokelumne, Stanislaus, Tuolumne, and Yuba Rivers, the majority of the recent observations in these national forests are of small and scattered populations, with limited evidence of successful reproduction.

There have been severe declines in the central Sierra foothills (Moyle 1973; Drost and Fellers 1996) and populations in the northern Sierra may be in decline as well (Lannoo 2005). Jennings and Hayes (1994) recommended threatened status in the west slope drainages of the Sierra Nevada. At least half of known historical locations have been lost in every northern and central Sierra county (Tuolumne, Calaveras, Amador, El Dorado, Placer, Nevada, Sierra, Yuba, and Butte) except Plumas, and most extant populations are small and scattered. Significant populations remain in El Dorado County (Rubicon River), Placer County (North Fork American River and North Fork of the Middle Fork

American River), Nevada County (Middle Yuba River, South Yuba River and Bear River), and Plumas County (North Fork Feather River, Middle Fork Feather River, Oroleve Creek, South Fork Feather River, Spanish Creek, and Canyon Creek tributaries Slate Creek and Onion Creek).

## **FACTORS AFFECTING ABILITY TO SURVIVE AND REPRODUCE**

The decline of foothill yellow-legged frogs across their range in California can be attributed to a combination of anthropogenic stressors. Primary threats include habitat loss, fragmentation, and degradation of in-stream conditions via water abstraction, flow diversion, and flow regulation.

Extirpation has occurred more frequently downstream of dams than in free-flowing systems and extirpation is positively correlated with the height of upstream dams (Lind 2005; Kupferberg et al. 2012). Dams and reservoir operations suppress winter peak discharges and thus allow woody riparian vegetation to encroach into the active channel. The roots stabilize the cobble and gravel bar features where frogs congregate in groups (called leks) to find mates and to lay eggs. In regulated rivers, vegetation encroachment often eliminates the suitability of these bars for breeding via shading and/or changing bar shape and bank slope. The diminution of winter flooding and conversion of ephemeral water bodies to permanent ones also promotes populations of non-native taxa such as bullfrogs, crayfish, and bass in managed river systems (Fuller et al. 2011). Bullfrogs and crayfish negatively affect amphibian populations in general (Kats and Ferrer 2003) and are implicated in declines of foothill yellow-legged frogs specifically (Moyle 1973; Hayes and Jennings 1986; Kupferberg 1997a). Ill-timed water releases through dams have the potential to create lethal velocities for early life stages and cold hypolimnetic releases shift water temperatures below the thermal tolerances for tadpoles (Catenazzi and Kupferberg 2013).

Generally, activities that disrupt the natural flow and sediment transport regime of rivers, including timing of flows, water depths, velocities, or water temperature can affect foothill yellow-legged frogs (Lind 2005; Yarnell et al. 2010; Kupferberg et al. 2012). Direct and indirect impacts associated with changes to instream flows include: desiccation or stranding of eggs or tadpoles due to rapid reductions in flow, delays in breeding and embryo or tadpole development due to cold water temperatures (Wheeler et al. 2014), declines in algal productivity and shifts in species composition of periphyton (Catenazzi and Kupferberg 2013; Furey et al. 2014), reduced resources for tadpoles, and reduced insect abundance and food-web repercussions. If sufficiently high, reservoir management releases and flow releases to benefit salmonids during the spring of otherwise dry years could dislodge egg masses and displace larvae downstream (Railsback et al. 2016).

In addition to the association of decline with the presence of large dams, demographic patterns of decline also indicate that extirpations are more frequent downwind of regions with extensive aerial spraying of pesticides (Davidson et al. 2002). Experiments show that tadpoles of foothill-yellow legged frogs are sensitive to low concentrations of organophosphate pesticides and their oxon derivatives (Sparling and Fellers 2007, 2009). NatureServe (2011) also notes other threats to the foothill yellow-legged frog from non-selective logging practices, and other habitat degradation and disturbance caused by excessive livestock grazing and in-stream suction dredge mining.

A detailed examination of the threats faced by foothill yellow-legged frogs is provided by Olson and Davis (2009).

### Climate Change

Climate change is already causing a rise in temperatures across the United States and an increase in extreme weather events, such as droughts and floods (Parmesan et al. 2000; NSC 2003; CCSP 2008; Karl et al. 2009). Climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field et al. 1999; Cayan et al. 2005; IPCC 2007). California is likely to see average annual temperatures rise by 1.5 - 4.5°C in the next century, with summer stream flow and soil moisture required for plant growth likely to decrease (Field et al. 1999; Cayan et al. 2008). Since 1895, annual average air temperatures in California have increased by about 1.5 degrees Fahrenheit, with minimum temperatures increasing at a rate almost twice as fast as the increase in maximum temperatures, and warming accelerated over the past three decades in most regions of the state (Kadir et al. 2013). Climate models predict more variable annual precipitation, and decreased spring and summer runoff as a result of lower annual snowpack (Smith and Tirpak 1989; USEPA 1997; Johnson et al. 1999). It is predicted that precipitation will come earlier in the spring in the form of rain rather than snow. Consequently, the hydrograph will shift to earlier snowmelt, lower snowpack, more winter rain, and higher winter storm runoff events (Maurer et al. 2007; Stewart 2009; Young et al. 2009). The low flow season will likely be longer, so water temperatures may be higher which may result in stress for species adapted to more moderate temperature regimes. Spring snowmelt from the Sierra Nevada has already declined over the past century, with changes in the timing and amount of precipitation in California and changes in the timing of Sierra runoff (Aguado et al 1992; Kadir et al. 2013). The portion of Sierra runoff that occurs between April and June has declined by about 9 percent (Kadir et al. 2013).

Climate change is particularly problematic for amphibian populations because they are ectothermic. As such, they are sensitive to changes in air and water temperature, precipitation, and the hydroperiod (length of time and seasonality of water presence); their body temperatures and activity cycles are dependent on the presence of optimal environmental conditions (Lind 2008). Case et al. (2015) evaluated relative sensitivity to climate change of species in Northwestern North America, using a combination of scientific literature and expert knowledge to assess the relative sensitivity to climate change of 195 plant and animal species in the northwestern North America. Amphibians and reptiles were, as a group, estimated to be the most sensitive to climate change.

Some amphibians have shown a trend towards earlier breeding, apparently in response to global warming (Beebee 1995, Blaustein et al. 2001, Gibbs and Breisch 2001). If such shifts in activities occur inconsistently with other ecological events (e.g., emergence of their insect prey), growth and survival rates could be affected. Species associated with ephemeral waters, such as shallow ponds and intermittent streams, may be particularly vulnerable to altered precipitation patterns (Dodd 1997, Lind 2008, McMenamina et al. 2008).

Changes in frequency, duration, and magnitude of droughts or severe winters resulting from climate variability may have considerable negative impacts on foothill yellow-legged frog populations. Population declines of foothill yellow-legged frogs have been attributed in part to extended drought (Jennings and Hayes 1994). Decreases in summer runoff may result in the loss of foraging and refuge habitat for adults and juveniles. As frogs congregate at shrinking pools in rivers as they dry, densities become locally concentrated and the probability of transmission of diseases and parasites increases. Changes in temperature may affect parasite prevalence (Kupferberg et al. 2009a) and pathogen virulence (Carey et al. 1999), making foothill yellow-legged frogs more susceptible to disease. Further, experimental increase in stream water temperature has been shown to decrease invertebrate density and biomass in invertebrates (Hogg and Williams 1996) and may have a negative impact on the foothill yellow-legged frog prey base.

Changes in climatic patterns, particularly those linked to precipitation, may have substantial impacts on foothill yellow-legged frogs. Low precipitation and increased variability in precipitation were both negatively related to frog presence (Lind 2005). Evidence also suggests that low precipitation may increase dam effects (Lind 2005). Climate change is predicted to reduce the habitat suitability for foothill yellow-legged frogs at lower latitudes and elevations. Current foothill yellow-legged frog distribution may be an indication that climate change has already influenced the species (Lind 2005). Although other factors may confound the influence of climate change on distribution patterns, short-term oscillations and drought severity have been greater at lower latitudes in California (Cook et al. 2004), where foothill yellow-legged frogs appear to be in dramatic decline.

Climate change appears to already be a contributing factor in the decline of the foothill yellow-legged frog (Fellers 2005, Olson and Davis 2009). Continued climate change is likely to cause further range contraction for the foothill yellow-legged frog, with loss of southernmost populations, as well as potential habitat shift upward in elevation as temperatures increase and precipitation becomes more variable.

Davidson et al. (2002) examined the spatial patterns of declining frogs in California and hypotheses of spatial patterns of climate change. For foothill yellow-legged frogs, they found a north-to-south gradient of increasing frog losses, consistent with climate change hypotheses (more losses at drier sites to the south). Lind (2005) considered climate change as a potential threat to foothill yellow-legged frog, due to precipitation being associated with frog presence.

Kupferberg et al. (2009a) presented data supporting a link between periods of unusually warm summer water temperatures during 2006 and 2008 in a northern California river, outbreaks of the parasitic copepod *Lernaea cyprinacea*, and malformations in tadpoles and young of the year foothill yellow-legged frogs. *Rana boylei* are likely to have increased vulnerability to pathogens due to projected climate changes. Changes in climatic regimes are likely to increase pathogen virulence and amphibian susceptibility to pathogens (Pounds et al. 2006, Pounds et al. 2007, Gervasi et al. 2008, Alford 2011).

#### Dams, Water Development and Diversions

Water development and diversions are the primary (and most well-documented) cause of declines in foothill yellow-legged frogs and water developments on natural waterways



have greater potential to alter habitat for the foothill yellow-legged frog than any other risk factor (Hayes et al. 2013, 2016). In California, the Mediterranean climate produces a very distinct hydrologic signature with high and variable water flows in the fall, winter, and spring; and low, receding, stable flows in the summer. Foothill yellow-legged frogs are adapted to this flow regime, especially spring (rain or snowmelt) recession flows (Yarnell et al. 2010). Modifications to that hydrologic regime can disrupt species responses to environmental cues and have direct effects on survival of aquatic life stages.

Water development and diversions result in hydrological changes that chronically affect several aspects of the frog's life history. Hayes et al. (2013, 2016) note recent studies from both regulated and unregulated rivers have demonstrated that both landscape scale changes and small-scale changes in local habitat conditions, such as water velocities, depths, and temperatures, that often result from water management activities, can lead inconsistent environmental cues for frog breeding, lower growth rates for tadpoles, scouring and/or stranding of egg masses and tadpoles, reductions of overall habitat suitability for breeding and rearing, barriers to gene flow around reservoirs, and establishment of non-native predators in reservoirs that then spread into the rivers.

Water developments exist as two major types: impoundments and diversions. Impoundments block streams with a structure such that natural flows are impeded and water is pooled upstream. Impoundment size varies throughout the foothill yellow-legged frog range, ranging from smaller dams created for water gauging stations and improved fisheries to larger dams created for hydroelectric generation or flood control. Diversions are created for the purpose of removing and delivering water to off-site locations. Some diversions are associated with impoundments, whereas others involve pumping water directly from the waterway or indirectly through groundwater pumping. The California Water Plan Update (CDWR 1998) indicates that dams and diversions are found on most Sierra Nevada streams (Moyle and Randall 1998) and a majority of these alterations exist within the elevational range of the foothill yellow-legged frog.

Reservoir placement on Sierran streams has converted many lotic aquatic habitats to lentic conditions, resulting in habitat with reduced flows, increased depths, and altered temperature and dissolved oxygen regimes (Petts 1980, 1984; Mount 1995). These changes result in direct loss of required habitat for stream-dwelling foothill yellow-legged frogs, which have evolved to inhabit free-flowing, well-oxygenated water with coarse substrates. In an evaluation of the distribution of reservoirs in the Sierra Nevada, Kondolf et al. (1996) found reservoirs had eliminated an estimated 9,972 km (6,209 mi) of aquatic habitat. Given the distribution of reservoirs, foothill yellow-legged frogs could have been historically present in much of this lost habitat. Sierran reservoirs currently inundate at least eight sites once occupied by foothill yellow-legged frogs (Hayes et al. 2013, 2016).

Regulation of flows downstream of dams is associated with lower frog abundances, with *R. boylei* breeding populations on average 5 times smaller in regulated rivers than in unregulated rivers (Kupferberg et al. 2012). Lind (2005) previously found an impoundment effect on foothill yellow-legged frogs; the species was associated with streams lacking dams or with streams with small dams located far upstream of foothill yellow-legged frog occupied locations. Lind (2005) found that former yellow-legged frog localities throughout California where frogs are now extirpated were characterized by higher numbers of all dams upstream, greater number of very large dams upstream,

greater maximum height of dams upstream and closer proximity to upstream dams. Large regulated streams typically have substantially lower numbers of foothill yellow-legged frogs than unregulated streams (Hayes et al. 2013, 2016). At least one large reservoir ( $\geq 100,000$  ac-ft) exists in the foothill region of every major Sierran stream below 600 m (1,968 ft) (Hayes et al. 2013, 2016). Several major streams (such as the Pit River, Feather River, American River, Mokelumne River, Tuolumne River and San Joaquin River) have two or more reservoirs (of varying size) in linear sequence, and a few large reservoirs also occur at higher elevations on major stream tributaries (Hayes et al. 2013, 2016). Additionally, several hundred medium-sized ( $< 100,000$  ac-ft and  $\geq 25,000$  ac-ft) and small reservoirs ( $< 25,000$  ac-ft) are broadly distributed at elevations below 1,828 m (6,000 ft) over the Sierra Nevada (Mount 1995).

An extensive survey effort by Garcia and Associates (2002) on the North Fork Feather River failed to find foothill yellow-legged frogs in habitats which appeared suitable for this species in the Rock Creek reach. The study areas were below impoundments operated by Pacific Gas & Electric for hydroelectric power generation. However, foothill yellow-legged frogs are present in the Poe reach at decent numbers, and very low numbers in the Cresta reach of the North Fork Feather River (S. Kupferberg, pers. comm., 2016). On the main stem of the Trinity River, northern California, unnatural flow regimes and loss of habitat caused by dam construction are the greatest threats (Ashton et al. 1997). A study on the Trinity River below Lewiston Dam, reported a 94 percent loss of potential breeding habitat after construction of the dam (Lind et al. 1996). After Trinity River flood flows were reduced, there was encroachment by riparian vegetation and reduced cobble/gravel bar formation. Flow releases had been reduced to 10–30 percent of pre-dam operation flows in both total volume and in periodic high flows (i.e., storm runoff) (Lind et al. 1996). Egg masses have been scoured in several years by high late spring releases from Lewiston Dam (Lind et al. 1996). Ellis and Cook (2004) reported half of known egg masses were scoured by five days of high flow releases on the Pit River in California. They suggested duration of high flows and change in current direction (shearing) had a higher impact than overall magnitude. Jackman et al. (2004) also found pulsed flows scoured half of the egg masses on the North Fork Feather River, in only one day. Egg masses may be left to desiccate if receding high flows are poorly timed (Lind et al. 1996; Ashton 1998).

High aseasonal flow releases from dams in late spring sometimes result in scouring of egg masses, whereas receding high flows, if poorly timed, can leave egg masses stranded “high and dry” (Lind et al. 1996). Bobzien and DiDonato (2007) concluded from frog breeding surveys in Alameda Creek in Alameda County, California, that unnatural and consistently higher discharge and irregular flows associated with dam releases appears to be a major factor in poor reproductive conditions for the frog, when compared to stream reaches with natural hydrology.

Kupferberg et al. (2009b), based on review of the literature and FERC-related reports, found foothill yellow-legged frog egg masses are negatively affected by pulsed flows (large magnitude flow fluctuations in rivers with dams) via scouring if flows occur during or after oviposition and desiccation if oviposition occurs during high flows and subsequently drops. Tadpole stranding and potential negative effects on metamorphs have been documented in multiple studies. South Fork Eel River population monitoring shows that the magnitude and timing of spring pulse flows are key factors in survival of eggs and tadpoles. While large magnitude spring pulses decrease egg survival, smaller

pulses later in the spring cause even higher mortality. Fluctuations in population growth are associated with spring pulse events three years prior. Experiments suggest that during pulse flows tadpoles seek refuge from higher velocities in the substrate, but many are swept downstream. Tadpoles confined to refugia face energetic costs in terms of growth and development. Kupferberg et al. (2011) explored the effects of pulsed flows from dams on foothill yellow-legged frog tadpoles, and found that typical velocity increases in near shore habitats (provided for recreational flows for white water boating or peaking releases for hydroelectric power generation) caused tadpoles approaching metamorphosis to be displaced, and that tadpoles exposed to repeated sub-critical velocity stress grew significantly less and experienced greater predation than tadpoles reared at ambient velocities.

Dams not only eliminate habitat and cause local extirpations, and they also interfere with normal dispersal and movements, which can impede recolonization after local extirpations (Fellers 2005; Peek 2010). Kupferberg et al. (2009b) found that water control management that avoids aseasonal flow fluctuations would benefit foothill yellow-legged frogs, and other taxa, whose lifecycles are synchronous with the natural timing of runoff in California's rivers. Most recently, Kupferberg et al. (2012) found that the foothill yellow-legged frog is more likely to be absent downstream of large dams than in free-flowing rivers, and breeding populations are on average 5 times smaller in regulated rivers than in unregulated rivers.

Dam-controlled flows and lack of winter flooding likely results in stable pool areas with established aquatic vegetation (Lind et al. 1996, Kupferberg 1996), and this can increase suitable habitat for exotic species such as bullfrogs (Ashton et al. 1997). Decreased flows can force frogs into permanent pools where they are more susceptible to predation (Hayes and Jennings 1988).

### Disease

Amphibian declines in the United States and Panama have been linked to the introduced fungus *Batrachochytrium dendrobatidis* (Bd), which causes chytridiomycosis (Fellers 2001). This disease causes abnormalities in jaw sheaths and teeth rows of tadpoles, and is invariably fatal in populations of some species. Foothill yellow-legged frogs are hosts to this amphibian fungal pathogen. There is conflicting evidence about the lethality of Bd infection for foothill yellow-legged frogs under laboratory conditions (Davidson et al. 2007; Padgett-Flohr pers. comm. to S. Kupferberg) and its population effects are unknown (Fellers 2005). Infection with Bd does appear to have negative effects on growth of *R. boylei* in the lab and in the field (Davidson et al. 2007; Lowe 2009). In laboratory experiments, Davidson et al. (2007) found that chytrid infection reduced growth of newly metamorphosed foothill yellow-legged frogs by approximately one-half and that exposure to the pesticide carbaryl likely increases susceptibility to chytrid infection.

Bd has been detected in *R. boylei* in California (Fellers 2001; Davidson et al. 2007; Johnson and Saulino 2007; Lowe 2007, 2009; Padgett-Flohr and Hopkins 2009; Adams et al. in press). Fellers (2001) sampled 25 counties in California and found chytridiomycosis in six species of amphibians including foothill yellow-legged frogs in 10 counties at 73 sites. Johnson and Saulino (2007) found Bd in all anuran species, including foothill yellow-legged frogs, in and around Pinnacles National Monument, and

at a few sites in the western foothills of the San Joaquin Valley. Foothill yellow-legged frogs infected with Bd have been found at 10 of 12 sites sampled in the Diablo Mountains, San Benito County, and western San Joaquin foothills, Fresno County, California, in 2006 (Lowe 2007, 2009). However, most of post-metamorphic frogs were not infected. All foothill yellow-legged frogs >40 mm were chytrid free.

Histological examination of museum specimens of the foothill yellow-legged frog indicates that Bd has been present since at least 1961 in the Alameda Creek watershed in Alameda County (Padgett-Flohr and Hopkins 2009). In the fall of 2013, foothill yellow-legged frogs in the Little Yosemite reach of Alameda Creek experienced an outbreak of Bd in which dead and dying juveniles were observed (Adams et al. in press), a location where annual amphibian breeding censuses have been conducted since 2003. Adams et al. (in press) attribute the die-off to an outbreak of chytridiomycosis, caused by Bd, in which recently metamorphosed frogs had the highest Bd loads among sampled individuals and was confirmed by necropsy and histological examination. Although chytrid infections have been documented by others over the last decade many miles upstream of Calaveras Reservoir, these were the first indications of the effects of Bd infection among the lotic-breeding frogs downstream of the dam. In contrast to laboratory investigations of *R. boylei* from a North Coast California source population by others, these observations corroborate observations that *R. boylei* is susceptible to the lethal consequences of chytridiomycosis. The outbreak coincided with extremely low stream flows that concentrated frogs in drying pools and expanded the spatial distribution of non-native bullfrogs in the stream network. Infection intensity and prevalence has varied through time, but over a 2 year sampling period (fall 2013 through fall 2015) the strongest predictor of Bd load was the presence of bullfrogs. Bullfrogs may represent a reservoir for Bd when foothill yellow-legged frogs in the population are Bd negative. Over three years of drought, the number of *R. boylei* egg masses per stream kilometer (an index of adult female population size), upstream of the dams that regulate flow, has decreased to the extent that abundance is no longer greater than in the regulated reaches where Bd and anthropogenic stressors occur.

An 11 year study on Bd infections of the related Sierra Nevada yellow-legged frog (*R. sierrae*) and southern mountain yellow-legged frog (*R. muscosa*) revealed the extirpation of over 100 populations since 1997, and after the introduction of Bd (Vredenburg et al. 2009). The disease spread at approximately 1 km a year in an easterly direction. Infections of frog populations reached 100 percent within weeks. All populations were stable prior to the onset of Bd invasion. Although mass die-offs from Bd have not yet been observed for *R. boylei* as they have for other ranid frogs in California (Vredenburg et al. 2010), the recent die-off in Alameda Creek and the potential for catastrophic, population level impacts is concerning

In the main stem of the Trinity River, there is evidence of fungal infections on foothill yellow-legged frog egg masses (Ashton et al. 1997), possibly with the water mold *Saprolegnia* sp. which Blaustein et al. (1994) and Kiesecker and Blaustein (1997) found to be fatal for other species of frogs.

Known from related species are the bacterial disease "red leg" (*Aeromonas hydrophila*) (e.g., *R. muscosa*, Bradford 1991) and iridoviruses (Ranavirus species), which are a complex of viruses found in frogs and fish (Mao et al. 1999).

## Invasive Species

A host of native vertebrates (e.g. birds and snakes) and aquatic invertebrates (e.g. dragonfly nymphs) feed on foothill yellow-legged frogs and their tadpoles (Fitch 1936, 1941; Everdon 1948; Zweifel 1955; Milne and Milne 1980; Nussbaum 1983; Jennings and Hayes 1994; Lind and Welsh 1994; Duellman and Trueb 1986; Jennings 1988; Moyle and Brown 1997; Ashton et al. 1998; Fellers 2005; Olson and Davis 2009), but nonnative predators are a primary threat to the species.

It is well documented that foothill yellow-legged frog adults, larvae, and/or eggs are vulnerable to an array of non-native predators such as predatory fishes, bullfrogs, and crayfish (Moyle 1973; Hayes and Jennings 1986; Lind et al. 1996; Kupferberg 1996b; Ashton et al. 1997; Lind et al. 2003; Fellers 2005; Paoletti 2009; Paoletti et al. 2011). Invasive bullfrogs and crayfish negatively affect amphibian populations in general through direct predation and competition for resources (Hayes 1985; Hayes and Jennings 1986; Jennings 1988; Kupferberg 1996b; Kats and Ferrer 2003). Centrarchid fishes readily eat *Rana* eggs (Werschkul and Christensen 1977) and where introduced into foothill streams may contribute to the elimination of *R. boylei*. Rombough et al. (2005) found that foothill yellow-legged frog abundance and production was inversely related to abundance of smallmouth bass (*Micropterus dolomieu*) and American bullfrogs (*R. catesbeiana*). Borisenko and Hayes (1999) found exotic bullfrogs and fishes occurred significantly more often at historic yellow-legged frog sites in Oregon that lacked yellow-legged frogs during their resurveys. Rombough (2006b) found smallmouth bass were the best predictor of absence of yellow-legged frog in Cow Creek, Oregon, having an inverse relation to the yellow-legged frogs; Rombough also found bullfrogs were negatively correlated with yellow-legged frog distributions. Bullfrogs have been linked to the observed reduction of foothill yellow-legged frog populations in the Sierra Nevada (Moyle 1973). Kupferberg (1997) found foothill yellow-legged frogs to have decreased abundance in stream reaches in northern California occupied by bullfrogs; and that bullfrog larvae perturbed aquatic community structure and exerted detrimental effects on foothill yellow-legged frog populations. Interspecific matings between male foothill yellow-legged frog and female bullfrogs have been observed; these interactions with non-native bullfrogs might reduce the reproductive output of foothill yellow-legged frogs (Lind et al. 2003).

Predation by feral pigs is a concern for *R. boylei* in some locations (Ely 1993, 1994).

The invasive New Zealand mudsnail (*Potamopyrgus antipodarum*) is an emerging concern for California waterways, and according to the United States Geological Survey's Non-Indigenous Aquatic Species Database (Foster et al. 2016) these snails occur in watersheds with extant populations of *R. boylei*. The influences of this snail on *R. boylei* are not known, but experiments have shown that they have negative competitive effects on western toad (*Anaxyrus boreas*) tadpole survival (Bennett et al. 2015). The mudsnails have the ability to reproduce quickly, grow rapidly and mass in high densities, and can alter macroinvertebrate community composition and food web function (Alonso and Castro-Díez 2008).

Kupferberg et al. (2009a) found evidence between unusually warm summer water temperatures and outbreaks of the parasitic non-native copepod *Lernaea cyprinacea*, and malformations in *R. boylei* tadpoles and young of the year.

## Livestock Grazing

The potential negative effects of intensive livestock grazing on foothill yellow-legged frogs include: the possibility for cattle directly crushing individuals; trampling of stream banks resulting in soil compaction, loss or reduction in vegetative bank cover, stream bank collapse, and increased instream water temperatures from loss of shade; and added sedimentation of stream segments at crossings or other stream areas if used in a very concentrated manner by livestock for watering or grazing on riparian vegetation.

Further investigation is needed to evaluate the extent of livestock grazing impacts on instream habitat quality and population dynamics of *R. boylei* because research on this topic had been focused on different taxa and the results are equivocal. Grazing of livestock at high densities in the absence of off-channel water sources can result in bank erosion, degrading shorelines and increasing stream sedimentation (Davis and Olson 2009). The Sierra Nevada Ecosystem Project, an assessment of the Sierra Nevada ecoregion, concluded that more open vegetation resulting from overgrazing can expose amphibians in general to predation and desiccation, and direct trampling by livestock is likely an important cause of mortality for some taxa (SNEP 1996). A subsequent fencing/cattle exclusion experiment conducted in Sierran wet meadows, however, showed no effect of grazing on toad populations (McIlroy et al. 2013). Masters (1997b) described the negative impacts of cattle grazing on habitat used by foothill yellow-legged frogs in Jackson Creek, in the Umpqua National Forest, Oregon:

Direct impacts of cattle in riparian areas include crushing eggs and tadpoles of foothill yellow-legged frogs, as well as juveniles and adults...Indirect impacts include alteration and/or elimination of vegetation, alteration of the microhabitat conditions, degradation of water quality, alteration of the structure and composition of the vegetation, and introduction of non-native vegetative species...Increased sedimentation covers up the cobble-sized rocks that the foothill yellow-legged frog requires for breeding, tadpole development, and juvenile and adult habitat. The cowpies and urine degrade the water quality...sedimentation, resulting from cattle grazing...reduces the interstitial spaces available for use by tadpoles and it may inhibit attachment of egg masses.

In some locations and under certain circumstances, managed cattle grazing can help keep vegetation from encroaching into the active channel; too much canopy cover can make sites unsuitably shady for foothill yellow-legged frogs (S. Kupferberg, pers. comm., 2016). Thus, controlled livestock exclosure experiments are needed to determine the net effects of grazing on *R. boylei*.

## Logging

Timber harvest without sufficient riparian buffer zones can decrease populations of aquatic amphibians such as the foothill yellow-legged frog by increasing water temperatures to lethal levels and by causing siltation of streambeds (Corn and Bury 1989). Even partial removal of stream canopy can increase water temperatures and decrease relative humidity along the stream corridor in headwater reaches which can

make these areas unsuitable for amphibians (Bury and Corn 1988). High levels of silt inhibit the attachment of frog egg masses to the substrate (Applegarth 1994, Ashton et al. 1997), and excessive accumulation of silt on the egg masses likely has adverse effects on embryo development (Jennings and Hayes 1994). Silt also reduces the interstitial spaces available for use by tadpoles, reduces algal growth on which the tadpoles feed (Power 1990), and can have a significant negative impact on adult frog food resources such as aquatic macro-invertebrates (Petts 1984). Sediment impacts likely adversely affect preferred foothill yellow-legged frog habitat through bed aggradation, surface texture fining or changes in hydraulic geometry (Yarnell 2000).

### Marijuana Cultivation

Cultivation of *Cannabis*, i.e. marijuana, is a threat to foothill yellow-legged frogs and their habitat, by the direct effects of illegal and legal water extraction that de-waters the streams where frogs live, introduction of pesticides and chemical fertilizers into waterways, denuding terrestrial habitat adjacent to streams and terracing the slopes, and by promoting the growth of toxic cyanobacteria (Gonsolin 2010; Bauer et al. 2015; Carah et al. 2015; Power et al. 2015). This impact is a major threat to *R. boylei* in Northern California, where marijuana cultivation is concentrated, and the severity of the impacts is exacerbated by ongoing drought conditions. Gonsolin (2010) noted the decline of a *R. boylei* population in the upper Coyote Creek watershed, Santa Clara County, due to impacts from illegal marijuana cultivation.

### Mining

Ashton et al. (1997) explained that mining can have deleterious effects on egg masses and tadpoles, as well as disturbing postmetamorphic behavior patterns.

Suction-dredge mining, in which water, sediment, and rocks are vacuumed from portions of streams and rivers, and the spoils re-deposited in the stream (CSLC 1993; Harvey and Lisle 1998), may increase suspended sediment, modify stream geomorphology, directly remove aquatic organisms, and rearrange the substrate of streams (CDFG 1994, 2012). This form of mining may have effects on frog reproduction by disturbing adults during courtship and breeding activities, or disrupting habitat during the reproductive season. Dredging up stream substrates can result in displacement, burial, or suffocation of eggs or tadpoles (CDFG 1994, Harvey and Lisle 1998). Depending on the size and stage of foothill yellow-legged frog tadpoles, they would not be able to swim away from the strong vacuums created by suction dredging as they can be entrained into currents as slow as 0.33 feet per second (Kupferberg et al. 2011). In response to elevated currents, these tadpoles seek shelter in interstitial spaces in the substrate. Because of this behavior, this species is particularly vulnerable to suction of sediments.

Sweet (1992) observed mortality of eggs and larvae of the stream-breeding arroyo toad (*Anaxyrus californicus*); mortality was a direct effect of increased sedimentation that resulted from suction-dredge mining. Suction-dredging may cause movement of instream habitat features such as rock substrates and woody debris, which may be used by foothill yellow-legged frogs for overwintering. Dredging may also affect foothill yellow-legged frog prey base.

Although a moratorium in California currently prohibits CDFW from issuing suction dredge permits (California Fish & Game Code §5653.1, subdivision a), and use of

related equipment in any river, stream, or lake through 30 June 2016 (California Fish & Game Code §5653.1, subdivision b), suction-dredge mining may be permitted in the future. Many of the foothill streams in the northern Sierra Nevada have regulated and unregulated recreational gold mining activities, which alter the streambed and are likely having a serious, negative impact on the frog fauna (Lannoo 2005).

Gravel mining that removes stream substrates puts all life history stages of foothill yellow-legged frogs at risk of direct mortality if such mining occurs at occupied sites (Olson and Davis 2009).

The tailings of abandoned mines and settling ponds often have contaminants such as mercury that could be harmful to frogs (Olson and Davis 2009). Hothem (2007) discussed harmful mercury levels found in foothill yellow-legged frogs in Harley Gulch, within the Cache Creek watershed in Lake County, California, an area with abundant geologic sources of mercury and a long history of mercury mining and contamination. Hothem (2007) documented that mercury concentrations of 100% of the 13 foothill yellow-legged frogs collected in 1997-1998 from Harley Gulch exceeded the EPA mercury criterion (0.3 µg/g) for issuance of health advisories for human fish consumption and 100% also exceeded the methylmercury criterion for the protection of piscivorous wildlife; and that 31% exceeded FDA criterion (1.0 µg/g) for regulation of commercial fish.

Mining activities likely contributed to the extirpation of the yellow-legged frog population from Baja (Welsh 1988).

### Off-road Vehicles

Damage to montane stream habitat from off-road vehicles is credited as a partial cause of the extirpation of the foothill yellow-legged frog from some southern California coastal streams (Sweet 1983). Off-road vehicle activity also likely eliminated a frog population from Corral Hollow in San Joaquin County (Jones & Stokes 2000). M.R. Jennings documented motorcycle use in riparian zones that crushed juvenile and adult foothill yellow-legged frogs (SNEP 1996).

### Pollution

In the Sierra Nevada foothills of California, air-borne pesticides that move east on the prevailing winds blowing across the highly agriculturalized Central Valley are likely to be the primary threat to foothill yellow-legged frogs (LeNoir et al. 1999; Sparling et al. 2001; Hayes et al. 2002b; Fellers 2005; Sparling and Fellers 2007; Sparling and Fellers 2008). Pesticide drift from the Central Valley to the Sierra Nevada, and high pesticide levels in the bodies of Sierra Nevada amphibians, have been well documented in California by Davidson et al. (2002). They found a strong positive association between declines of both California red-legged frogs and foothill yellow-legged frogs in areas downwind of agricultural land use. The populations of foothill yellow-legged frogs in greatest decline are all downwind of highly impacted (mostly agriculturalized) areas, while the largest, most robust frog populations are along the Pacific coast (Fellers 2005).

Davidson et al. (2002) found evidence that airborne agrochemicals have played a significant role in the decline of the foothill yellow-legged frog. Davidson (2004)



examined the association between the spatial patterns of declines for five California amphibian species and historical patterns of pesticide use in California from 1974 to 1991, and found that historical pesticide use was a strong, significant variable in population declines for the foothill yellow-legged frog, especially so for organophosphates and carbamates. In particular, Davidson et al. (2002) found that sublethal exposure to the pesticide carbaryl likely inhibits the innate immune defense of foothill yellow-legged frogs and increases susceptibility to disease. Kerby and Sih (2015) conducted three separate laboratory studies examining the toxicity of the insecticide carbaryl on foothill yellow-legged frogs and found that *R. boylei* are more susceptible to pesticide exposure than Pacific tree frogs (*Pseudacris regilla*), and exposure to carbaryl reduced the ability of *R. boylei* to compete with tree frogs. Kerby and Sih (2015) also showed a remarkable increase in mortality (50%) for *R. boylei* exposed to carbaryl with an invasive crayfish (*Pacifastacus leniusculus*) predator present. Buck et al. (2015) demonstrated that exposure of larval and metamorphic amphibians to ecologically relevant concentrations of pesticide mixtures (chlorpyrifos, carbaryl, permethrin, and endosulfan) or herbicides (glyphosate, acetochlor, atrazine, and 2,4-D) altered post-metamorphic susceptibility to Bd load in Pacific treefrogs, spring peepers and western toads.

Fellers et al. (2007) exposed tadpoles for long periods of time in a laboratory to environmentally realistic concentrations of pesticides still in use. They concluded these pesticides are at sufficient concentration levels in the Sierra Nevada to cause a significant decrease in survival rates. Sparling and Fellers (2007) found that environmental concentrations of the pesticides chlorpyrifos, malathion and diazinon and their oxons can be harmful to populations of the foothill yellow-legged frog. Compounds from the breakdown of chlorpyrifos, malathion, and diazinon were found to be 10 to 100 times more toxic than the parent compounds (Sparling and Fellers 2007). Chlorpyrifos was three times more toxic and Endosulfan was 40 times more toxic to foothill yellow-legged frogs. Sparling and Fellers (2009) established the chronic toxicity of chlorpyrifos and endosulfan, two of the insecticides most commonly used in the Central Valley and found in the mountains, which likely contributes to observed declines in the frog. Kerby (2007) examined the sublethal effects of four pesticides on foothill yellow-legged frogs and found significant alteration of behavior and development.

Hayes et al. (2002) found hermaphroditism and other deformities in leopard frogs (*Rana pipiens*) exposed to commonly occurring levels of the widely used herbicide atrazine, both in the laboratory, and in the field. Hayes et al. (2006) found mixtures of pesticides to have much greater effects on frogs than single pesticides, and suggested that studies examining single pesticides may underestimate pesticide impacts on amphibians. Colborn and Clement (1992) attributed foothill yellow-legged frog population declines to endocrine mimicking chemicals that entered the ecosystem through pesticides and fungicides. Foothill yellow-legged frogs are far more susceptible to pesticides than Pacific chorus frogs (Fellers and Kleeman 2009).

Agricultural fertilizers have been linked to amphibian deaths, including in a study showing that several frog, toad, and other amphibian species in Oregon can be highly susceptible to fairly low levels of nitrate and nitrite exposure, especially at more vulnerable larval stages (Marco et al. 1999; Marco and Blaustein 1999). Marco et al. (1999) found that moderate exposure to nitrates and nitrites resulted in reduced feeding activity, disequilibrium, physical abnormalities, paralysis, and even death among some

tadpoles and young frogs. Levels of nitrite considered safe for human drinking water killed over half of Oregon spotted frog (*Rana pretiosa*) tadpoles after 15 days of exposure. Nitrates are of low toxicity but can cause health problems when reduced to nitrites. Nitrite levels can become high in specific areas such as shore sites with high contents of organic matter and can be concentrated due to waste from livestock. Nitrate can be reduced to nitrite in the gastrointestinal tract of amphibians, especially in younger animals (Marco et al. 1999; Marco and Blaustein 1999). Additionally, nitrate deposition from air pollution can greatly alter lake ecosystems, and may shift the normal ecological balance in a manner that increases the ability for disease to take hold in amphibians (V. Vredenburg, pers. comm., 2000).

Ashton et al. (1997) mentioned the potential for spills of toxic materials into streams along roads along the Trinity River in northern California. Bury (1972) found that spilled diesel fuel had negative impacts on foothill yellow-legged frog tadpoles and partially transformed individuals but apparently little impact on adults.

Mercury contamination is another threat to the frog. Hothem et al. (2010) found mercury concentrations in the foothill yellow-legged frog that were high enough to pose a potential hazard to human or wildlife consumption, with the total Hg concentration exceeding the FDA criterion (1.0 µg/g) for regulation of commercial fish in at least one sample at 24 percent of the yellow-legged frog sites, with 13 of the sites (62 percent) exceeding the EPA Hg criterion (0.3 µg/g) for issuance of health advisories for fish consumption. Research shows that mercury likely adversely affects amphibian development and can decrease survival through metamorphosis (Unrine et al. 2004). Other effects can include impaired reproduction, growth inhibition, behavioral modification, and various sublethal effects (Zillioux et al. 1993).

### Recreation

There are potential threats to foothill yellow-legged frogs related to recreation (Olson and Davis 2009). Jet boats create waves that could potentially result in dislodgement and loss of egg masses, stranding of tadpoles, disruption of adult basking behavior, and erosion of shorelines (Borisenko and Hayes 1999).

Vehicles driven along stream gravel bars and recreationists fishing, swimming, walking or camping along shores likely adversely affects frogs, including disruption of frog basking opportunities (Borisenko and Hayes 1999). The Marin Municipal Water District documented that people and dogs have been known to squash the eggs of foothill yellow-legged frogs in Little Carson Creek in Marin County (Prado 2005). A concern in the Little Yosemite area of Alameda Creek in Alameda County is intensive disturbance to yellow-legged frog breeding habitat by humans and dogs (S. Kupferberg, J. Miller, pers. observ.).

### Roads and Urbanization

Roads and urbanization are logical potential threats to this frog (Davis and Olson 2009). The human population continues to increase within its range and this results in continued expansion of urban and agricultural areas and construction of new roads. Road construction crossing streams likely adversely affects frogs due to sedimentation during road building, maintenance or failures. As explained above, sediments can

embed stream substrates and remove interstitial spaces used by these frogs. The use of culverts that do not easily pass frogs also impacts population connectivity. Lind (2006) found that foothill yellow-legged frog presence was associated with less urban development nearby, using data from both Oregon and California.

## **INADEQUACY OF EXISTING REGULATORY MECHANISMS**

### Federal Regulatory Mechanisms

Existing federal regulatory mechanisms that have the potential to provide some form of protection for the foothill yellow-legged frog include occurrence on federally protected land, consideration under the National Environmental Policy Act or the Clean Water Act, and coverage under Habitat Conservation Plans.

#### Occurrence on National Forests/BLM Lands

Populations of foothill yellow-legged frogs occur on national forest lands and Bureau of Land Management (BLM) lands in California. The foothill yellow-legged frog is listed on the USDA Forest Service Region 5 (California) Sensitive Species List. However, this designation as a “sensitive species” offers little protection for individual frogs, frog populations or frog habitat. The designation merely requires that the impacts to the species be considered, but does not prevent agency actions, such as logging, road building, cattle grazing or mining, that could harm the species or its habitat. Sensitive species cannot be impacted without an analysis of significance of adverse effects on the populations, their habitat, and on the viability of the species as a whole. All Forest Service planned, funded, executed, or permitted programs and activities are reviewed under NEPA for possible effects on sensitive species, through a Biological Assessment and Evaluation. Yet the Forest Service can conclude in a Biological Evaluation that even though individual frogs or frog populations will be harmed or destroyed by an action, it can still carry out this action.

The Forest Service adopted the Sierra Nevada Forest Plan Amendment in 2001 after more than a decade of scientific study, to direct the management of 11.5 million acres of California's national forest lands in the Sierra. The Sierra Nevada Forest Plan Amendment represented a shift in Forest Service management to ecosystem management principles. However, as it has been implemented, the Sierra Nevada Forest Plan arguably has not provided adequate protection for the foothill yellow-legged frog from water withdrawals, river flow regulation by dams, hydrologic alteration of wet meadows by livestock grazing, and sedimentation from forest roads, which are all permitted or agency-directed actions on national forest lands (C. Frissell, pers. comm., 2015).

The Sierra Nevada Forest Plan Amendment committed the Forest Service to completing a Conservation Assessment for the foothill yellow-legged frog in cooperation with other federal agencies, state agencies, universities, and research scientists (USDA Forest Service 2001). The Conservation Assessment was published in 2016 (Hayes et al. 2016). Conservation Assessments provide only management recommendations, not mandated habitat protections. The Conservation Assessment is envisioned as the first of a three-phase process that also includes a Conservation Strategy and a Conservation Agreement. However, this process is moving far too slowly to provide protection for

foothill yellow-legged frogs. The Conservation Assessment alone took more than a decade to produce. The Sierra Nevada Plan's primary emphasis is on terrestrial species, but it also contains an Aquatic Conservation Strategy focused on reducing some threats to amphibians, including the foothill yellow-legged frog. Some of these measures include changes to livestock grazing and exotic fish stocking practices. Yet at the same time, the plan contains proposed management activities (such as fire and fuels management) that may increase risk of habitat degradation for yellow-legged frogs. For example, extensive fuels treatments (e.g., prescribed burning and mechanical thinning of trees) are proposed at lower elevations because these areas contain large wildland/urban interface zones. Some of these treatments may occur within riparian areas, resulting in unknown effects on the foothill yellow-legged frog.

In addition, the Sierra Nevada Forest Plan Amendment has been under attack since its adoption, with ongoing efforts by legislators and industry to increase the amount of logging allowed, limit protections for forests, water quality and wildlife, and to weaken forest monitoring requirements by reducing the management indicator species lists that are tracked across Sierra Nevada national forests.

In 1994 the U.S. Forest Service and Bureau of Land Management adopted the Northwest Forest Plan (USDA and USDI 1994), establishing different land allocations and standards and guidelines intended to conserve and restore both terrestrial and aquatic ecosystems. The Northwest Forest Plan established "riparian reserves" and includes an Aquatic Conservation Strategy that is generally protective of habitat for the foothill yellow-legged frog, in that it sets buffers on logging for year round and intermittent streams, among other measures.

However, as it has been implemented, the Northwest Forest Plan arguably has not provided adequate protection for the foothill yellow-legged frog from water withdrawals, river flow regulation by dams, hydrologic alteration of wet meadows by livestock grazing, and sedimentation from forest roads, which are all permitted or agency-directed actions on national forest lands (C. Frissell, pers. comm., 2015). Frissell (2013, 2014) discussed ongoing efforts by the U.S. Forest Service, BLM and political leaders to alter the Northwest Forest Plan by reducing the area of Riparian Reserves, while also increasing the basis for commercial logging from near-stream and potentially unstable lands. Frissell (2013, 2014) and Heiken (2013) evaluated the potential environmental consequences of altering Riparian Reserve protections in the Northwest Forest Plan to allow more systematic and aggressive logging within Riparian Reserves (mostly as commercial thinning), including alteration of thermal regimes and increased summer stream temperatures, increased erosion and sediment delivery to streams, and diminished capacity of riparian forests to filter nutrients loads that are a threat to water quality. The Forest Service and BLM are moving forward with attempts to revise the Northwest Forest Plan to reduce stream buffers and weaken the Aquatic Conservation Strategy (USBLM 2015b).

The three National Parks (Yosemite, Kings Canyon, and Sequoia National Parks) that encompass a small portion of the historical range of the foothill yellow-legged frog all have guiding principles, management goals and management plans that are beneficial for aquatic ecosystems, but the species is already extirpated from all three of these parks.

Even on federal lands that are protected for ecological values, foothill yellow-legged frogs are not protected from threats such as drifting pesticides or impacts from nonnative predators.

#### National Environmental Policy Act

The National Environmental Policy Act of 1969 (NEPA) (42 U.S.C.4321-4370a) requires federal agencies to consider the environmental impacts of their actions. The NEPA process requires these agencies to describe a proposed action, consider alternatives, identify and disclose potential environmental impacts of each alternative, and involve the public in the decision-making process. Most actions taken by the federal agencies such as the National Park Service, U. S. Forest Service, and the Bureau of Land Management that could affect the foothill yellow-legged frog are subject to the NEPA process. NEPA does not, however, prohibit these agencies from choosing alternatives that will negatively affect individual frogs, populations of foothill yellow-legged frogs, or potential foothill yellow-legged frog habitat. De facto evidence of NEPA's inability to protect the foothill yellow-legged frog is that the species has declined precipitously in spite of the existence of NEPA for more than 45 years.

#### Clean Water Act

Under Section 404 of the Clean Water Act, 33 U.S.C. §§ 1251 et seq. ("CWA"), discharge of pollutants, including dredged or fill material, into "Waters of the U.S." is prohibited absent a permit from the U.S. Army Corps of Engineers. Theoretically the CWA should provide some protection for stream and wetland habitats used by foothill yellow-legged frogs. However, the implementation of the CWA regulatory scheme and the Section 404 program in particular have fallen far short of Congress's intent to protect wetlands and water quality. A National Research Council report entitled "Compensating for Wetland Losses Under the Clean Water Act" concluded that the goal of no net loss of wetlands has not been achieved through the Army Corps regulatory program, and that applicants often do not follow through on promised mitigation packages (National Research Council 2001). These failures of the Army Corps regulatory scheme are due in part because the Corps' implementation of the individual permitting process has allowed too much development while requiring too little avoidance and mitigation. Also, in permitting projects, the Army Corps often takes a very limited view of a project, looking only at impacts in the project footprint. The CWA has been and will continue to be inadequate to ensure the continued survival of the foothill yellow-legged frog.

#### Habitat Conservation Plans

There are only four Habitat Conservation Plans in California within the range of the species that include the foothill yellow-legged frog as a covered species: the San Joaquin County Multi-Species Habitat Conservation and Open Space Plan; East Contra Costa County HCP/NCCP; Humboldt Redwood Company (formerly Pacific Lumber, Headwaters) HCP; and Santa Clara Valley HCP/NCCP (USFWS 2015).

Two of these HCPs – the San Joaquin County HCP and the East Contra Costa County HCP - no longer have extant foothill yellow-legged frog populations within their plan areas. The San Joaquin County HCP referred to four historic records of *R. boylei* from San Joaquin County, with the most recent observation in the Corral Hollow area in 1977, and defined the status of the species in the county as unknown (San Joaquin County

2000). Though the HCP set out some incidental take minimization measures for foothill yellow-legged frogs, the species is likely already extirpated from lower Corral Hollow Creek, western San Joaquin County and the HCP plan area. The East Contra Costa County HCP noted that there are no recent documented occurrences of foothill yellow-legged frogs within the eastern Contra Costa Habitat Conservation Plan inventory area, covering major portions of eastern Contra Costa County (CCC 2006).

The Humboldt Redwood Company HCP (HRCHCP) noted that foothill yellow-legged frogs were “commonly observed” in the HCP area along the Eel River and Van Duzen River; also reported from the Yager and Bear-Mattole watershed areas, and were “suspected to occur” in suitable habitat in the Humboldt watershed area (HRC 1999). While the HRCHCP’s amphibian and reptile conservation plan contains vague promises of retention of habitat diversity and mix of forest types post-logging (HRC 1999), no concrete measures are specified to protect or enhance habitat specifically for foothill yellow-legged frogs, and the plan allows levels of timber harvest and road building likely to be detrimental to the species. The HRCHCP allows logging of a substantial portion of remaining late-successional forest on their lands; of an estimated 26,147 acres of old-growth (12% of their total lands), 57% is available for harvest (USDI et al. 1999).

The Santa Clara Valley HCP (SCVHCP) noted that foothill yellow-legged frogs had essentially disappeared from the farmed and urbanized lowland areas of Santa Clara County, as well as many of the perennial streams below major reservoirs; but still occurred in Santa Clara County in the upper reaches of Coyote Creek, nearly all of the streams in the Pajaro River watershed, Penitencia Creek, and in the Santa Cruz Mountains west of Gilroy (ICF 2012).

The SCVHCP anticipated potential direct impacts from projects in stream channels that could result in removal of cobblestone substrate or riparian vegetation, increase in erosion and sediment discharge, creation of pooling habitat where higher risk of predation exists for frogs, and dewatering of breeding locations. The SCVHCP anticipated permanent impacts in up to 5.7 stream miles and temporary impacts in up to 2.0 miles of modeled primary and secondary habitat for foothill yellow-legged frogs.

The SCVHCP included no conservation efforts within the study area that directly target the recovery of this species, but noted that stream restoration projects that return creeks and streams to natural flow regimes would benefit the species. The SCVHCP proposed to acquire a minimum of 80 miles of primary and secondary modeled habitat for the foothill yellow-legged frog for the SCVHCP’s Reserve System; but only proposes to protect 32-44% of the 690 miles of foothill yellow-legged frog modeled primary and secondary habitat within the study area.

The HCP Reserve System was expected to protect only 4 known occurrences of the foothill yellow-legged frog: 3 on Llagas Creek above Chesbro Reservoir and 1 on San Felipe Creek above Anderson Reservoir. The SCVHCP notes that the species could possibly occur on the Reserve System on Upper Penitencia Creek, Uvas Creek below Uvas Reservoir, and Little Arthur Creek, but the species presence had not been documented. The SCVHCP prioritizes acquisition of streams for the Reserve System by: sites with documented records of breeding foothill yellow-legged frog; sites with known occurrences, but no documented breeding; and sites without known occurrences of foothill yellow-legged frogs but with western pond turtle habitat and known occurrences of other covered amphibian species. The SCVHCP proposed to “restore” from 1.0 to

10.4 miles of streams, with a goal of supporting breeding of yellow-legged frogs, by adding sediment to stream courses so that sand bars will form to create egg laying substrate, or adding large rocks to the stream course for the same purpose. Management will include selectively applying herbicides or other treatments to control nonnative invasive vegetation along creek corridors that might inhibit sediment movement and restrict the creation of egg laying habitat. Proposed management techniques and tools include stream channel rehabilitation, planting native understory and overstory riparian vegetation, adding rocky substrate to the stream channel, and translocation to help establish new populations.

Very few extant foothill yellow-legged populations will gain any protection from the two HCPs which overlap with the current range of the species.

In addition, coverage by an HCP is not a guarantee of protection for a species. Kareiva et al. (1999) thoroughly discussed the failure of most HCPs to protect and recover listed species that are covered under HCP agreements. Kareiva et al. (1999), in a nationwide study of HCPs by the National Center for Ecological Analysis & Synthesis and the American Institute of Biological Sciences, found that most HCPs contributed to habitat losses for the targeted species, failed to meet recovery goals, and suffered from poor planning and plan evaluation. Kareiva et al. (1999) documented that nearly 30% of HCPs “take” 100% of the focal species’ populations or habitat in the permit area; about 50% of HCPs allowed 50% or more of the species’ populations or habitat in the plan area to be taken; 43% of the time, HCPs failed to provide sufficient mitigation measures; 23% of the time, species and their habitats were taken before mitigation measures were implemented and found effective (most HCPs failed to reduce allowed take levels or use other more conservative approaches in the face of inadequate information or uncertainties); 33% of HCPs failed to secure up-front funding to ensure that mitigation actually occurs; and 81% of HCPs studied had irreversible impacts. Not surprisingly, HCPs that failed to adequately conserve species also tended to lack rigorous impact assessments and planning. Kareiva et al. (1999) found that: 75% of the time, impacts to species were not adequately studied by HCPs; 42% to 49% of the time, HCPs failed to quantify how much of a species’ habitat and population, respectively, would be taken; most HCPs used low quality data to evaluate their mitigation measures; and 25% of the time, sufficient information did not exist to determine how HCPs would affect the species’ viability.

Several other studies have documented a variety of shortcomings regarding the scientific foundation and conservation promises of HCPs (e.g. Hood 1998; Smallwood et al. 1998; Bowler 2000; Smallwood 2000; Harding et al. 2001; Wilhere 2002). Rahn et al. (2006) found that the conservation benefits of multispecies HCPs (MSHCPs) to individual covered species may be overestimated. Rahn et al. (2006) reviewed the species selected for coverage in 22 MSHCPs from USFWS Region 1, and found that conservation measures were often not clearly defined, and that the presence of the species in the planning area was not even confirmed for 41% of covered species. Owley (2015) used a case study approach to illustrate the concerns associated with whether federal and local agencies are able to locate, understand, track and adequately enforce HCP mitigation requirements and conservation easements, focusing on four HCPs in California (San Bruno Mountain HCP in San Mateo County, approved in 1983; Lytle Creek Turnout Low-Effect HCP in San Bernardino County, approved in 2009; Cushenbury Sand and Gravel HCP in San Bernardino County, approved in 1996; and

Wildcat Line Property HCP in Monterey County, approved in 2001). Owley (2015) found that the government entities involved in these HCPs struggled to locate and understand the permits themselves, let alone the details of the compensatory mitigation projects, and that county offices charged with recording property restrictions on conservation easements often had inadequate records of land use restrictions.

### State Regulatory Mechanisms

The state of California lists the foothill yellow-legged frog as a “Species of Special Concern.” This is an administrative designation and carries no formal legal status.

#### Natural Community Conservation Plans

Of the 9 approved Natural Community Conservation Plans (NCCP) in California, only 2 are within the range of the foothill yellow-legged frog: the East Contra Costa County NCCP and Santa Clara Valley NCCP (CDFW 2015). These plans are joint NCCP/HCPs, and the limitations of these plans for protecting foothill yellow-legged frogs was discussed above. Of NCCPs in the planning phase, only one, the Butte Regional Conservation Plan, lists the foothill yellow-legged frog as a proposed covered species (CDFW 2015).

#### California Environmental Quality Act

The environmental review process under the California Environmental Quality Act (“CEQA”, California Public Resources Code §§ 21000-21177) requires state agencies, local governments and special districts to evaluate and disclose impacts from “projects” in the state. CEQA declares that it is the policy of the state to prevent “the elimination of fish or wildlife species due to man’s activities, ensure that fish and wildlife populations do not drop below self-perpetuating levels, and preserve for future generations representations of all plant and animal communities” (California Public Resources Code, section 21001(c)). The CEQA process is triggered when discretionary activities of state agencies may have a significant effect on the environment. When the CEQA process is triggered, it requires full disclosure of the potential environmental impacts of proposed projects. The operative document for major projects is usually the Environmental Impact Report.

Under CEQA, Species of Special Concern must be considered during the environmental review process, with an analysis of the project impacts on the species, only if they meet the criteria of sensitivity under Section 15380 of the CEQA Guidelines. However, project impacts to foothill yellow-legged frogs are often not analyzed because project proponents are able to claim insignificant impacts to non-listed species if the project does not have population-level or regional effects or impacts a small proportion of the species’ range.

Theoretically, besides ensuring environmental protection through procedural and informational means, CEQA also has substantive mandates for environmental protection. The most important of these is the provision requiring public agencies to deny approval of a project with significant adverse effects when feasible alternatives or feasible mitigation measures can substantially lessen such effects. In practice, however, this substantive mandate is rarely implemented, particularly with regard to instream



projects, water diversions, mining permits, grazing permits and projects causing pollution and sedimentation that have impacted and continue to impact habitat for foothill yellow-legged frogs. If significant impacts remain after all mitigation measures and alternatives deemed feasible by a lead agency have been adopted, a lead agency is allowed under CEQA to approve a project despite environmental impacts if it finds that social or economic factors outweigh the environmental costs. It is important to note that CEQA is not, nor was it ever intended to be, a habitat protection mechanism.

### Regional and Local Government Plans

Madera County adopted a Yellow-legged Frog Conservation Program in 1997, which contained some measures to protect suitable primary frog habitat “from the direct significant impact of human activity,” however the foothill yellow-legged frog may already be extirpated from Madera County.

*Summary.* The perilous status of the foothill yellow-legged frog reflects the overall failure or inability of existing federal and state regulatory mechanisms to protect foothill yellow-legged frog habitat and provide for the conservation of the species. Neither CEQA nor any other state or local regulatory mechanism provide protection from factors adversely impacting foothill yellow-legged frogs such as invasive species, pollutants and pesticides, disease or climate change. Without state listing, reintroduction of the species at unoccupied historic sites and implementation of confirmed frog habitat enhancement methods (e.g. Kupferberg 1996a; Lind et al. 1996; Lind and Shaffer 2005; Yarnell 2005) are unlikely to be utilized.

## **RECOMMENDED MANAGEMENT AND RECOVERY ACTIONS**

Recommended management actions for foothill yellow legged frogs will vary depending on the type of river system where a given extant population remains, either with flows regulated by dams or in free-flowing systems that may be subject to other forms of human perturbation (such as illegal diversion of flows in summer for *Cannabis* cultivation or excessive sedimentation and hillslope erosion due to road building and other types of land use in the upland portions of the watersheds).

Require frog-friendly flow regimes: In rivers with dams, a-seasonal flow fluctuation which could cause stranding and scouring of egg masses and tadpoles should be prohibited. Limit pulsed flows from dams during or after oviposition and during tadpole development. For rivers with frog populations below dams, flow regimes should be developed that mimic natural seasonal flows to which the various life stages of *R. boylei* are adapted to. Maintaining thermal regimes below dams that are conducive to larval survival and rapid development will also be important.

Stream channel habitat restoration: Where upstream dam operations have artificially cooled downstream river reaches, suppressed flood disturbance, limited sediment supply, and allowed encroachment of woody riparian vegetation into the active channel (thus reducing frog opportunities for thermoregulatory behaviour), create thermal habitat heterogeneity by restoring gently sloping and sun-lit gravel bars used for breeding and by enhancing edgewater habitats.

Eradication of invasive predators: Conduct active eradication and management efforts to decrease the abundance of bullfrogs (removing egg masses, netting tadpoles, hunting adult frogs, etc.). Develop eradication or control programs for non-native fish and crayfish which are predators of frogs, tadpoles, and egg masses. In managed rivers, manipulate stream flows to negatively affect non-native taxa not adapted to a winter-flood/summer drought flow regime.

Mitigate impacts of *Cannabis* cultivation: Direct some of the money that will be gained from new *Cannabis* taxes to rehabilitation of *R. boylei* streams, including for law enforcement to end illegal dewatering of creeks, and to conduct clean-up of spilled diesel fuel, fertilizers and rodenticides.

Prohibit habitat damage: Ensure that state regulations for timber harvest within watersheds with yellow-legged frogs adequately prevent siltation of streambeds or increase of water temperatures to lethal levels. Prohibit instream gravel mining or dredging in stream reaches with yellow-legged frogs. Ensure that all state-managed off-road vehicle areas are not negatively impacting yellow-legged frogs or their habitat.

Restrict pesticides: Determine where and which pesticide uses should be restricted to prevent harm to yellow-legged frogs.

Reintroduction: Explore reintroduction of foothill yellow-legged frogs into stream systems with appropriate habitat within the historical range of the species. Start with streams in the National Parks once the stressors have been removed, such as post-eradication of bullfrogs in Yosemite National Park.

Curate locality data: The California Department of Fish and Wildlife should take responsibility for, or find a curator to maintain a repository of, all the foothill yellow-legged frog survey data collected by agencies, utilities and researchers, and submitted to the CNDDDB.

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