State of California
Natural Resources Agency
Department of Fish and Wildlife

REPORT TO THE FISH AND GAME COMMISSION

EVALUATION OF THE PETITION FROM THE CENTER FOR BIOLOGICAL DIVERSITY TO LIST THE FOOTHILL YELLOW-LEGGED FROG (*RANA BOYLII*) AS THREATENED UNDER THE CALIFORNIA ENDANGERED SPECIES ACT

Prepared by
California Department of Fish and Wildlife

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I. Executive Summary

The Center for Biological Diversity (CBD) submitted a petition (Petition) to the Fish and Game Commission (Commission) to list the Foothill Yellow-legged Frog (*Rana boylii*) as threatened pursuant to the California Endangered Species Act (CESA), Fish and Game Code Section 2050 et seq.

The Commission referred the Petition to the Department of Fish and Wildlife (Department) in accordance with Fish and Game Code Section 2073. (Cal. Reg. Notice Register 2017, No. 3-Z, p. 46.) Pursuant to Fish and Game Code Section 2073.5 and Section 670.1 of Title 14 of the California Code of Regulations, the Department has prepared this evaluation report for the Petition (Petition Evaluation). The Petition Evaluation is an evaluation of the scientific information discussed and cited in the Petition in relation to other relevant and available scientific information possessed by the Department during the evaluation period. The Department's recommendation as to whether to make Foothill Yellow-legged Frog a candidate for listing under CESA is based on an assessment of whether the scientific information in the Petition is sufficient under the criteria prescribed by CESA to consider listing Foothill Yellow-legged Frog as threatened.

After reviewing the Petition and other relevant information, the Department makes the following findings:

- Population Trend. The Petition contains sufficient scientific information to indicate that Foothill Yellow-legged Frog populations have declined in portions of the species' range in California.

- Range. The Petition contains sufficient scientific information to indicate that the Foothill Yellow-legged Frog's occupied range in California has been reduced from its historical extent due to population extirpations, particularly in southern California and the southern Sierra Nevada.

- Distribution. The Petition contains sufficient scientific information to indicate that the distribution of extant Foothill Yellow-legged Frog populations within the species' current range has been reduced throughout much of California.

- Abundance. The Petition contains sufficient scientific information to indicate that the abundance of remaining Foothill Yellow-legged Frog populations have been reduced from historical numbers throughout parts of California.

- Life History. The Petition contains sufficient scientific information to indicate that some of the Foothill Yellow-legged Frog's life history traits render it particularly vulnerable to natural and anthropogenic impacts.

- Kind of Habitat Necessary for Survival. The Petition contains sufficient scientific information to indicate that Foothill Yellow-legged Frogs require specific habitat conditions for survival, particularly during early life stages.

- Factors Affecting the Ability to Survive and Reproduce. The Petition contains sufficient scientific information to indicate that Foothill Yellow-legged Frogs are adversely affected by a number of threats including, but not limited to, dams and diversions, invasive species, climate change, and pollutants.

- Degree and Immediacy of Threat. The Petition contains sufficient scientific information to indicate that impacts from the main factors threatening the long-term survival of Foothill Yellow-legged Frogs will continue and potentially worsen in the future.

- Impacts of Existing Management. The Petition contains sufficient scientific information to indicate that existing regulatory mechanisms and management plans do not adequately protect Yellow-legged Frogs from some impacts that threaten their long-term survival.

- Suggestions for Future Management. The Petition contains sufficient scientific information on additional management actions that may aid in maintaining and increasing self-sustaining populations of Foothill Yellow-legged Frogs in California.

- Availability and Sources of Information. The Petition contains a 35-page bibliography of literature cited and personal communications with credible sources, nearly all of which were provided to the Department on a CD upon request.

- A Detailed Distribution Map. The Petition contains four detailed maps containing information on the historical and contemporary distribution of Foothill Yellow-legged Frogs.

In completing its Petition Evaluation, the Department has determined the Petition provides sufficient scientific information to indicate that the petitioned action may be warranted. Therefore, the Department recommends the Commission accept the Petition for further consideration under CESA.

II. Introduction

A. Candidacy Evaluation

CESA sets forth a two-step process for listing a species as threatened or endangered. First, the Commission determines whether to designate a species as a candidate for listing by determining whether the petition provides "sufficient information to indicate that the petitioned action may be warranted." (Fish & G. Code, § 2074.2, subd. (e)(2).) If the petition is accepted for consideration, the second step requires the Department to produce within 12 months of the Commission's acceptance of the petition a peer reviewed report based upon the best scientific information available that indicates whether the petitioned action is warranted. (Fish & G. Code,

§ 2074.6.) The Commission based on that report and other information in the administrative record, then determines whether or not the petitioned action to list the species as threatened or endangered is warranted. (Fish & G. Code, § 2075.5.)

A petition to list a species under CESA must include "information regarding the population trend, range, distribution, abundance, and life history of a species, the factors affecting the ability of the population to survive and reproduce, the degree and immediacy of the threat, the impact of existing management efforts, suggestions for future management, and the availability and sources of information. The petition shall also include information regarding the kind of habitat necessary for species survival, a detailed distribution map, and other factors the petitioner deems relevant." (Fish & G. Code, § 2072.3; see also Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1).) The range of a species for the Department's petition evaluation and recommendation is the species' California range. (*Cal. Forestry Assn. v. Cal. Fish and Game Com.* (2007) 156 Cal. App. 4th 1535, 1551.)

Within 10 days of receipt of a petition, the Commission must refer the petition to the Department for evaluation. (Fish & G. Code, § 2073.) The Commission must also publish notice of receipt of the petition in the California Regulatory Notice Register. (Fish & G. Code, § 2073.3.) Within 90 days of receipt of the petition, the Department must evaluate the petition on its face and in relation to other relevant information and submit to the Commission a written evaluation report with one of the following recommendations:

- Based upon the information contained in the petition, there is not sufficient information to indicate that the petitioned action may be warranted, and the petition should be rejected; or

- Based upon the information contained in the petition, there is sufficient information to indicate that the petitioned action may be warranted, and the petition should be accepted and considered.

(Fish & G. Code, § 2073.5, subd. (a)(1) and (a)(2).) The Department's candidacy recommendation to the Commission is based on an evaluation of whether or not the petition provides sufficient scientific information relevant to the petition components set forth in Fish and Game Code Section 2072.3 and the California Code of Regulations, Title 14, Section 670.1, subdivision (d)(1).

In *Center for Biological Diversity v. California Fish and Game Commission* (2008) 166 Cal.App.4th 597, the California Court of Appeals addressed the parameters of the Commission's determination of whether a petitioned action should be accepted for consideration pursuant to Fish and Game Code Section 2074.2, subdivision (e), resulting in the species being listed as a candidate species. The court began its discussion by describing the standard for accepting a petition for consideration previously set forth in *Natural Resources Defense Council v. California Fish and Game Commission* (1994) 28 Cal.App.4th 1104:

> As we explained in *Natural Resources Defense Council* [citation], "the term 'sufficient information' in section 2074.2 means that amount of information, when

> considered with the Department's written report and the comments received, that would lead a reasonable person to conclude the petitioned action may be warranted." The phrase "may be warranted" "is appropriately characterized as a 'substantial possibility that listing could occur.'" [Citation.] "Substantial possibility," in turn, means something more than the one-sided "reasonable possibility" test for an environmental impact report but does not require that listing be more likely than not. [Citation.]

(*Center for Biological Diversity*, *supra*, 166 Cal.App.4th at pp. 609-10.) The court acknowledged that "the Commission is the finder of fact in the first instance in evaluating the information in the record." (*Id.* at p. 611.) However, the court clarified:

> [T]he standard, at this threshold in the listing process, requires only that a substantial possibility of listing could be found by an objective, reasonable person. The Commission is not free to choose between conflicting inferences on subordinate issues and thereafter rely upon those choices in assessing how a reasonable person would view the listing decision. Its decision turns not on rationally based doubt about listing, but on the absence of any substantial possibility that the species could be listed after the requisite review of the status of the species by the Department under [Fish and Game Code] section 2074.6.

(*Ibid*.)

B. Petition History

On December 14, 2016, CBD submitted the Petition to the Commission to list Foothill Yellow-legged Frog as threatened under CESA. On December 22, 2016, the Commission referred the Petition to the Department for evaluation. The Department requested of the Commission a 30-day extension to the 90-day Petition evaluation period on February 14, 2017. This Petition Evaluation report was submitted to the Commission on April 26, 2017.

The Department evaluated the scientific information presented in the Petition as well as other relevant information the Department possessed at the time of review. The Department did not receive any information from the public during the Petition Evaluation period pursuant to Fish and Game Code Section 2073.4. Pursuant to Fish and Game Code Section 2072.3 and Section 670.1, subdivision (d)(1), of Title 14 of the California Code of Regulations, the Department evaluated whether the Petition includes sufficient scientific information regarding each of the following petition components to indicate that the petitioned action may be warranted:

- Population trend;
- Range;
- Distribution;
- Abundance;

- Life history;
- Kind of habitat necessary for survival;
- Factors affecting ability to survive and reproduce;
- Degree and immediacy of threat;
- Impacts of existing management;
- Suggestions for future management;
- Availability and sources of information; and
- A detailed distribution map.

C. Overview of Foothill Yellow-legged Frog Ecology

Foothill Yellow-legged Frogs (*Rana boylii*) are part of the "true frog" family Ranidae. Species within the genus *Rana* from western North America possess dorsolateral folds, a glandular ridge extending from the eye area to the rump, a feature that is indistinct in Foothill Yellow-legged Frogs (Stebbins and McGinnis 2012). Foothill Yellow-legged Frogs are small- to medium-sized frogs with granular skin, even on the tympana, that gives them a rough appearance (Nussbaum et al. 1983, Stebbins and McGinnis 2012). Their dorsal coloration is typically gray, brown, reddish, or olive with brown-black flecking and mottling, which generally matches the substrate of stream in which they reside, and as their name suggests, the underside of their hind limbs and lower abdomen are yellow (Ibid.).

The Foothill Yellow-legged Frog was first described as a unique species in 1854, but a century of taxonomic uncertainty regarding its relationship with other Ranids followed before it was eventually recognized as a distinct species again by Zweifel (1955, 1968). Lind et al. (2011) identified substantial genetic partitioning between coastal and Sierra Nevada populations, two distinct northerly groupings, and a single sample in the southern Sierra Nevada from those in the central and northern Sierra Nevada. Individuals separated by a distance of 10 km (6.2 mi) may be effectively genetically isolated from one another (Dever 2007). Genetic isolation can occur at even shorter distances when populations are separated by dams, reservoirs, or reaches downstream of dams where flows fluctuate artificially (Peek 2010, 2012).

Foothill Yellow-legged Frogs historically ranged from the Willamette River drainage in Oregon to at least the San Gabriel River drainage in Los Angeles County, California, in foothill and mountain streams east of the Sierra-Cascade crest from sea level to 1,940 m (6,400 ft) (Hemphill 1952, Nussbaum et al. 1983, Stebbins 2003). Extirpations in the northern and southern portions of the species' range have resulted in a reduction in its current range from its historical extent; it appears to have disappeared from previously occupied sites south of Monterey County and in the southern Sierra Nevada (Hayes et al. 2016, Jennings and Hayes 1994, USFS 2011).

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 (Hayes and Jennings 1988, Nussbaum et al. 1983, Stebbins 1985). They have also been observed using isolated pools, vegetated backwaters, and streams lacking a rocky, cobble substrate (Ashton et al. 1998, Fitch 1938, Hayes and Jennings 1988). Post-metamorphic frogs (i.e., juveniles and adults) may overwinter in refugia from high winter flows such as small tributary streams, seeps, springs, and clumps of woody debris or vegetation (Bourque 2008, Gonsolin 2010, Rombough 2006, Van Wagner 1996). Breeding habitat is typically associated with low-gradient stream reaches at depositional features like lateral point bars and pool tail-outs, and egg masses are usually deposited on the downstream side of rocky substrates in shallow slow-moving water near the stream margin (Bondi et al. 2013, Kupferberg 1996a, Wheeler and Welsh 2008).

Foothill Yellow-legged Frog larvae (i.e., tadpoles) graze on algae attached to rocks and plants, while post-metamorphic frogs consume primarily terrestrial invertebrates, although aquatic invertebrates are also occasionally eaten (Ashton et al. 1998, Csuti et al. 2001, Fitch 1936, Jennings and Hayes 1994, Kupferberg 1997b, Nussbaum et al. 1983, Van Wagner 1996). A wide variety of native and non-native species prey on Foothill Yellow-legged Frogs including signal crayfish (*Pacifasticus leniusculus*), caddisfly larvae (Limnephilidae), California Giant Salamander larvae (*Dicamptodon ensatus*), Rough-skinned Newts (*Taricha granulosa*), American Bullfrogs (*Rana catesbeiana*), gartersnakes (*Thamnophis* spp.), mallards (*Anas platyrhynchos*), river otters (*Lontra* (= *Lutra*) *canadensis*), Centrarchids like bass (*Micropterus* spp.), Cyprinids like Sacramento pikeminnow (*Ptychocheilus grandis*), and other fish (Ashton and Nakamoto 2007, Corum 2003, Evenden 1948, Fidenci 2006, Fitch 1941, Hayes and Jennings 1988, Hayes et al. 2016, Kupferberg 1996a, Kupferberg 1997a, Paoletti et al. 2011, Rombough et al. 2005a, Rombough and Hayes 2005, Wiseman et al. 2005, Zweifel 1955).

III. Sufficiency of Scientific Information to Indicate the Petitioned Action May Be Warranted

The order in which the petition components are evaluated below reflects the order that they were provided in the Petition. This differs from their sequence in Fish and Game Code section 2072.3 and Section 670.1, subdivision (d)(1), of Title 14 of the California Code of Regulations, as well as in the Executive Summary and Introduction of this Petition Evaluation.

A. Range

1. Scientific Information in the Petition

The Petition, on pages 6 through 10, provides the following information on the Foothill Yellow-legged Frog's historical and current range. However, for purposes of this Petition Evaluation,

"range" is limited to the species' California range. (*Cal. Forestry Assn. v. Cal. Fish and Game Com., supra,* 156 Cal. App. 4th at p. 1551.)

The historical range of the Foothill Yellow-legged Frog included lower elevation streams draining the Pacific slope from the upper reaches of the Willamette River system in Oregon to northwestern Baja California (Hayes et al. 2016, NatureServe 2011). In California, the species occurred from the Oregon border to at least as far south as the Upper San Gabriel River, Los Angeles County, and may have occurred as far south as Orange County, southwestern San Bernardino County, and San Diego County.

The species has disappeared from more than half of its historically occupied sites in California and Oregon, which has resulted in range contractions at the northern and southern boundaries (Lind 2005). In California, the species' decline is most severe in southern California where it appears to have been completely extirpated south of San Luis Obispo County and in the southern Sierra Nevada (Hayes et al. 2016, Jennings and Hayes 1994, USFS 2011).

2. Other Relevant Scientific Information

According to Thomson et al. (2016), the Foothill Yellow-legged Frog's presence in Baja California is based on an unverified account described by Loomis (1965). The Foothill Yellow-legged Frog's elevation range has been reported to extend from sea level to approximately 1,830 m (6,000 ft) (Stebbins and McGinnis 2012), although Hemphill (1952) observed the species at 1,940 m (6,400 ft).

3. Sufficiency of the Petition with regard to Range

The Department concludes that the Petition contains sufficient information on the historical and contemporary ranges of the species, which suggests the Foothill Yellow-legged Frog's range has contracted in southern California and the southern Sierra Nevada due to extirpation of populations once occurring in these regions.

B. <u>Kind of Habitat Necessary for Survival</u>

1. Scientific Information in the Petition

The Petition, on pages 11 and 12, provides the following information regarding Foothill Yellow-legged Frog habitat requirements.

In general 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 (Hayes and Jennings 1988, Nussbaum et al. 1983, Stebbins 1985). Within a single watershed, Foothill Yellow-legged Frogs can be found in first- to seventh- order streams (Bury and Sisk 1997), but occupied sites are typically small- to mid-sized streams with shallow flowing water (Hayes and Jennings 1988). They are mostly found near water, often in or near riffles and on open sunny banks (Stebbins 1985) but have been found as far as 80 m (262 ft) from water

(Rombough pers. comm. in Olson and Davis 2009). Foothill Yellow-legged Frogs have also been documented in atypical habitats like isolated pools, vegetated backwaters, and streams lacking a rocky, cobble substrate (Ashton et al. 1998, Fitch 1938, Hayes and Jennings 1988). Presence of introduced aquatic predators such as bullfrogs (*Rana catesbeiana*) and bass (*Micropterus* spp.) are negatively correlated with Foothill Yellow-legged Frog occurrence and abundance, even in otherwise suitable habitat (Hayes and Jennings 1986, 1988; Kupferberg 1997a).

Habitat requirements vary seasonally and by life stage. Juveniles and adults appear to overwinter in refugia from high winter flows such as small tributary streams, seeps, springs, and clumps of woody debris or vegetation (Bourque 2008, Gonsolin 2010, Rombough 2006, Van Wagner 1996). Breeding habitat is typically associated with low-gradient stream reaches at depositional features like lateral point bars and pool tail-outs (Kupferberg 1996a, Wheeler and Welsh 2008). Within these areas, females often deposit egg masses in shallow water toward the margin of the stream on the downstream side of rocky substrates within a narrow range of flow velocities (Bondi et al. 2013, Kupferberg 1996a), although they have been documented to oviposit at depths greater than 1 m (3.3 ft) and distances up to 20 m (65.6 ft) from the water's edge (Mokelumne River, unpublished data from Garcia and Associates for PG&E). Cobble and pebble are the preferred substrate for oviposition, but egg masses have also been found attached to aquatic vegetation, woody debris, gravel, and bedrock (Ashton et al. 1998, Bondi et al. 2013, Fuller and Lind 1992). Larvae actively thermoregulate (Brattstrom 1962) and prefer warm temperatures at or above 20º C (68º F) (Kupferberg et al. 2013). They require protection from swift flowing water, especially when they are approaching metamorphosis and are poor swimmers (Kupferberg et al. 2011).

2. Other Relevant Scientific Information

The Department possesses the following additional information relating to the Foothill Yellow-legged Frog's thermal and flow velocity habitat requirements.

Based on breeding experiments undertaken by Zweifel (1955), Thomson et al. (2016) report the critical thermal maximum (the temperature above which most individuals die) for Foothill Yellow-legged Frog embryos is 26º C (79º F). Catenazzi and Kupferberg (2013) reported that larvae preferred temperatures between 16.5 and 22.2º C (61.7 to 72.0º F) and that mortality increased within increasing deviation from this range in both warmer and cooler directions. They also found that Foothill Yellow-legged Frog distribution and abundance was positively associated with larval thermal preference (Ibid.).

Eggs are often deposited in areas with flows below 5 cm/s (9.8 ft/min) (Hayes et al. 2016). The flow velocity threshold at which egg masses will be scoured and displaced depends on factors such as water depth and the amount of protection provided by the substrate to which the egg mass is attached but can occur at mean column velocities of 10 cm/s (19.7 ft/min) or greater (Ibid.). This critical velocity for egg mass shearing is expected to become slower over the duration of development as layers of egg mass jelly disintegrate (Ibid.).

Low flow velocities are also particularly important during certain stages in larval development. Immediately after hatching and as they approach metamorphosis larvae are relatively poor swimmers (Kupferberg et al. 2011). Larvae swim freely in flows between 0 and 2 cm/s (0 to 3.9 ft/min) and seek shelter within the interstices of rocky substrates when velocities increase (Ibid.). While the velocity required to flush Foothill Yellow-legged Frog larvae downstream varies inversely with size, developmental stage, and proportion of time spent swimming, median critical velocity was determined to be 20.1 cm/s (39.6 ft/min), although flows as low as 10 cm/s (19.7 ft/min) were able to displace larvae approaching metamorphosis (Ibid.).

3. Sufficiency of the Petition with regard to Kind of Habitat Necessary for Survival

The Department concludes that Petition contains sufficient information on the breadth habitat types used by Foothill Yellow-legged Frogs, including information that suggests the species requires specific habitat conditions for survival, particularly during early life stages.

C. Life History

1. Scientific Information in the Petition

The Petition, on pages 5 and 6 and 11 through 14, provides the following information on Foothill Yellow-legged Frog life history, which includes descriptions of the species' identification, taxonomy, life cycle, diet, home range and movements, and mortality.

Foothill Yellow-legged Frogs are moderate in size, adults ranging from 37 – 82 mm (1.5 – 3.2 in) snout to urostyle length (SUL), with indistinct dorsolateral folds, fully webbed feet, slightly expanded toe tips, and rough pebbly skin (Stebbins 1951, 2003; Zweifel 1955). Their dorsal coloration is usually light and dark mottled gray, olive, or brown with variable amounts of brick red; a pale triangle is often present between the eyes and snout; and the undersides of the rear legs and posterior abdomen are yellow, fading into white anteriorly (Jones et al. 2005, Nussbaum et al. 1983, Stebbins 1951, Zweifel 1955). The species is sexually dimorphic; females attain a larger size than males, and mature males possess nuptial pads and proportionately larger forearm muscles and narrower waists than females (Hayes et al. 2016, Jennings and Hayes 1994). Juveniles look similar to adults except they are smaller (14 – 36 mm [0.6 – 1.4 in] SUL), have a more contrasting color, and lack significant yellow on their undersides (Jones et al. 2005, Nussbaum et al. 1983, Stebbins 1951, Zweifel 1955). Foothill Yellow-legged Frog larvae hatch out a dark brown or black but turn olive with a coarse brown mottling above and an opaque silvery color below (Hayes et al. 2016). Their eyes are positioned dorsally when viewed from above (i.e., within the outline of the head), and their mouths are large, downward-oriented and suction-like with several tooth rows (Ibid.). Foothill Yellow-legged Frog egg masses resemble a cluster of grapes approximately 45 to 90 mm diameter length-wise (1.8 – 3.5 in) and contain anywhere from about 100 to over 3,000 eggs (Hayes et al. 2016, Kupferberg et al. 2009c). The individual eggs are dark brown to black and surrounded by three jelly envelopes that range in diameter from approximately 3.9 to 6.0 mm (0.15 – 0.25 in) (Hayes et al. 2016, Storer 1925, Zweifel 1955).

Foothill Yellow-legged Frogs belong to the family Ranidae and were first described by Baird in 1854 as *Rana boylii* (Zweifel 1955). After substantial taxonomic uncertainty and several name changes, it was eventually recognized as a distinct species again by Zweifel (1955, 1968). Previously thought to be most closely related to Mountain Yellow-legged Frogs (*R. muscosa*) based on morphology (Zweifel 1955), genetic analyses undertaken by Macey et al. (2001) suggest they are more closely related to Oregon Spotted Frogs (*R. pretiosa*). Genetic differentiation within the species was recently described by Lind et al. (2011), who identified substantial partitioning between coastal and Sierra Nevada populations, two distinct northerly groupings, and a single sample in the southern Sierra Nevada from those in the central and northern Sierra Nevada. A genetic study by Dever (2007) suggested that individuals separated by a distance of 10 km (6.2 mi) may be effectively isolated from one another and not part of the same interbreeding population. Peek (2010, 2012) found that when populations are separated by dams, reservoirs, or reaches downstream of dams where flows fluctuate artificially, genetic isolation can be observed at even shorter distances.

The Foothill Yellow-legged Frog's life cycle is closely tied to seasonal timing of streamflow. Movement to breeding sites is triggered by warming water temperatures, decreasing flows, and increasing daylight. Adult males are likely territorial during breeding season but are infrequently heard; most calling occurs underwater (MacTauge and Northen 1993). Breeding begins as early as March at relatively warm coastal sites and as late as July in areas with snowmelt-dominated rivers (Ashton et al. 1998, Storer 1925, Wheeler et al. 2015, Zweifel 1955). Larvae can hatch in as few as 5 days or greater than 35 days depending on temperature (Ashton et al. 1998, Zweifel 1955). They typically remain near the egg mass for several days and then disperse a short distance into the interstitial spaces of the rocky substrate and may move downstream with moderate currents (Ashton et al. 1998). Duration of development and survival to metamorphosis are influenced by water temperature and velocity and quality and quantity of algal resources (Catenazzi and Kupferberg 2013, Furey et al. 2014, Kupferberg et al. 2011, Railsback et al. 2016). Time to metamorphosis typically takes three to four months (Zweifel 1955), and sexual maturity is usually attained at age one or two in males and two or three in females depending on latitude and elevation (Gonsolin 2010, Kupferberg et al. 2009c).

Foothill Yellow-legged Frog diet differs by life stage. Larvae scrape algae from rocks and plants and appear to grow fastest on epiphytic diatoms on filamentous algae such as *Cladophora* sp., which they have been observed preferentially feeding on (Ashton et al. 1998, Jennings and Hayes 1994, Kupferberg 1997b). Post-metamorphic Foothill Yellow-legged Frogs primarily feed on a variety of terrestrial invertebrates, although some aquatic invertebrates are also consumed. Prey items include flies, moths, mosquitos, hornets, ants, beetles, grasshoppers, water striders, snails, and arachnids (Csuti et al. 2001, Fitch 1936, Nussbaum et al. 1983, Van Wagner 1996).

Foothill Yellow-legged Frogs are primarily diurnal and may be active year-round where winter temperatures are warm enough (Airola 1980). Peak activity is in April and May during the breeding season (Airola 1980, Gonsolin 2010). Home range size and patterns of dispersal are not well understood (Jennings and Hayes 1994). Foothill Yellow-legged Frogs often use watercourses as movement corridors (Nussbaum et al. 1983) and are rarely found greater than 12 m (39 ft) from the stream channel (Bourque 2008), although one post-breeding female was

radio-tracked over a period of 60 days moving up a perennial stream channel to intermittent and tributary channels, over a ridge, and eventually downstream into perennial waters in an adjacent watershed (Bourque pers. comm. in Olson and Davis 2009). Bourque (2008) reported movement distances to and from breeding sites as far as 0.65 km (0.4 mi) for males and 7.04 km (4.4 mi) for females with median daily movements of 65.7 m (216 ft) and 70.7 m (232 ft), respectively. During the breeding season, adults congregate around breeding pools and become scarce by late summer, potentially dispersing into uplands or tributaries or reducing diurnal behavior (Ashton et al. 1998). Recently metamorphosed frogs show a strong tendency to move upstream during the fall and winter (Twitty et al. 1967).

Foothill Yellow-legged Frogs are preyed upon by a wide range of species during different life stages. Predators on eggs and larvae include signal crayfish (*Pacifasticus leniusculus*) and caddisfly larvae (Limnephilidae) (Kupferberg 1996a, Rombough and Hayes 2005), and Rough-skinned Newts (*Taricha granulosa*) (Evenden 1948). Post-metamorphic frogs are preyed upon by gartersnakes (*Thamnophis* spp.), (Fitch 1941, Zweifel 1955), river otters (*Lontra* (= *Lutra*) *canadensis*) (Hayes et al. 2016), and mallards (*Anas platyrhynchos*) (Rombough et al. 2005a). Foothill Yellow-legged Frogs are also vulnerable to predation by fishes, native and non-native, including bass, Sacramento pikeminnow (*Ptychocheilus grandis*), and others (Ashton and Nakamoto 2007 [cited as Ashton and Nakamoto 1997 in the Petition], Corum 2003, Hayes and Jennings 1988, Paoletti et al. 2011, Rombough and Hayes 2005).

2. Other Relevant Scientific Information

The Department does not possess any relevant scientific information regarding Foothill Yellow-legged Frog life history beyond what was provided in the Petition.

3. Sufficiency of the Petition with regard to Life History

The Department concludes the Petition contains sufficient information on the Foothill Yellow-legged Frog's life history to demonstrate some aspects may render it particularly vulnerable to natural and anthropogenic impacts.

D. Distribution and Abundance

1. Scientific Information in the Petition

The Petition, on pages 14 through 95, contains extensive detail on changes in Foothill Yellow-legged Frog distribution and abundance at regional, county, and watershed scales. The Petition notes that determining the abundance of Foothill Yellow-legged Frogs is problematic due to their cryptic coloration and dispersal across a range of channel sizes after the breeding season; therefore, visual counts such as those summarized in this section may not accurately reflect Foothill Yellow-legged Frog abundance at a site. Based on a population viability analysis (Kupferberg et al. 2009c), the Petition made the following qualifications regarding relative health of populations based on abundance when that information is available: populations with hundreds of breeding adults are considered robust, while populations in the single digits are

considered to be at high risk of extinction. Figure 1 shows recent and historical records of Foothill Yellow-legged Frogs.

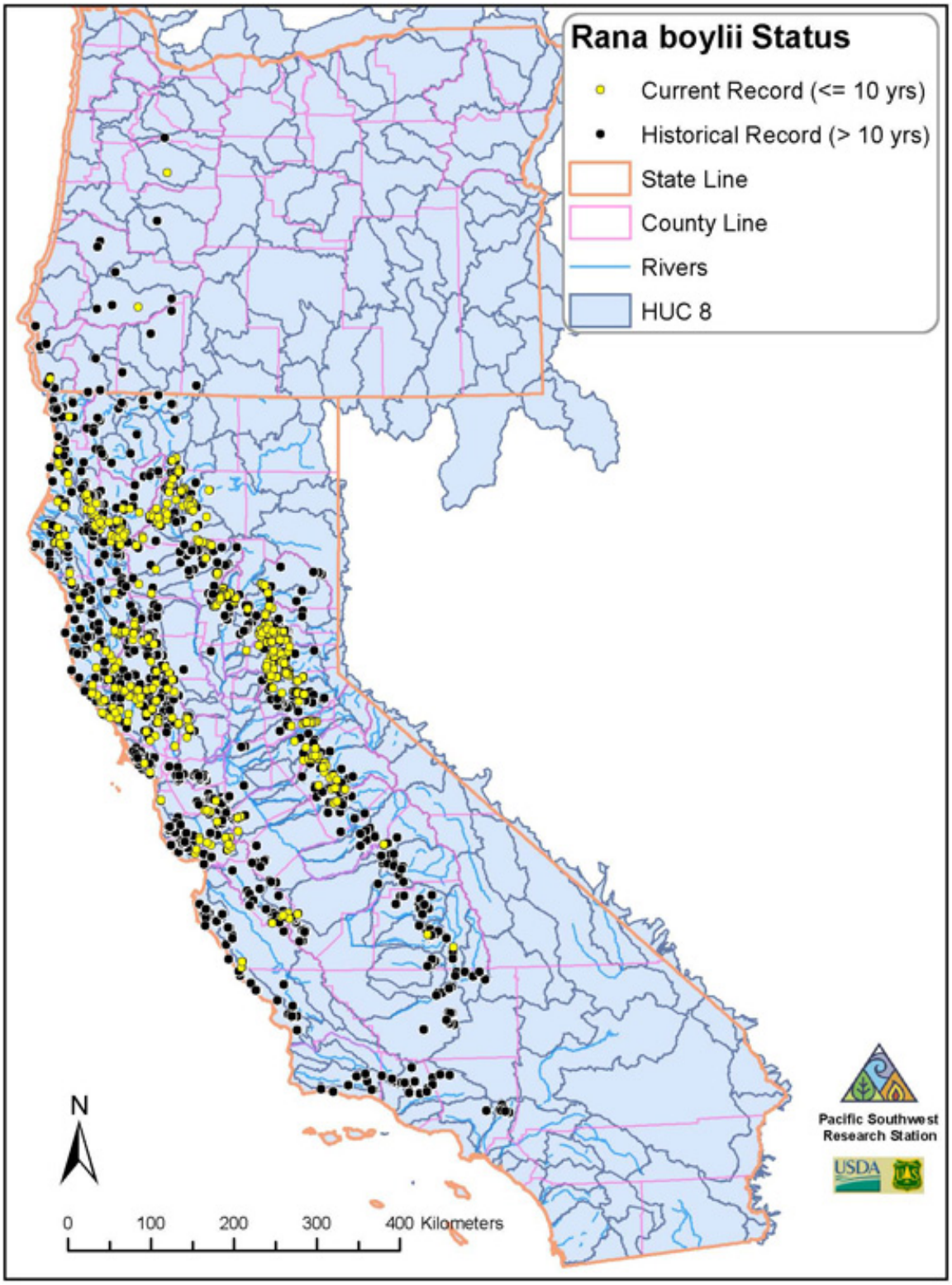

Figure 1. Foothill Yellow-legged Frog Distribution (USFS 2011)

Southern California

This region includes San Diego, Orange, San Bernardino, Los Angeles, Ventura, and Santa Barbara counties.

San Diego, Orange, and San Bernardino counties are outside of what is considered the known historical range of the Foothill Yellow-legged Frog; however, there are numerous museum specimens from this area from the 1920s to the 1960s that were labeled "*Rana boylii*". As previously mentioned, there was much taxonomic uncertainty surrounding this species' relationships with other Ranids, and many of these have since been correctly identified as Southern Mountain Yellow-legged Frogs (UCMVZ 2001, 2015; UKMNH 2001). However, the Petition states there are specimens from each of these counties that were collected well below the known elevation for Southern Mountain Yellow-legged Frogs that may warrant investigation. Nevertheless, there are no current records of Foothill Mountain Yellow-legged Frogs from these counties.

Los Angeles, Ventura, and Santa Barbara counties are within what is considered the known historical range of Foothill Yellow-legged Frogs. There are historical records of Foothill Yellow-legged Frogs at reasonably low elevations from the foothills of the San Gabriel Mountains, the greater Los Angeles floodplain, and the Santa Clara River drainage in Los Angeles County; from several creeks and tributaries within the Santa Clara River drainage in Ventura County; and from the Santa Ynez River drainage and two small coastal streams in Santa Barbara County (CAS 2011; CNDDB 2016; Cornell University 2002; HMCZ 2001; Jennings and Hayes 1994; SBMNH 2001; UCMVZ 2011, 2015; UMMZ 2001). Despite repeated surveys, the last reliable sighting of a Foothill Yellow-legged Frog in this region is from Piru Creek in Los Angeles County in 1977, and the species is considered extirpated from Southern California (Jennings and Hayes 1994, Sweet 1983).

South Coast

This region consists of San Luis Obispo County and the portion of Monterey County that includes coastal drainages south and west of the Santa Lucia Range.

There are historical records of Foothill Yellow-legged Frogs from numerous river tributaries, streams, and creeks in this region; however, most of the museum collections only date to the 1950s (CNDDB 2016, LPNF 2001, SBMNH 2001, UCMVZ 2015). Between 1988 to 1991, Jennings and Hayes (1994) found Foothill Yellow-legged Frogs present at 3 of 11 historically occupied sites (27%) in San Luis Obispo County; however, the last documented occurrence in the county was an individual collected from Little Pico Creek SSE of San Simeon in 1999 (CNDDB 2016). In Monterey County, Foothill Yellow-legged Frogs were verified to be present at four drainages in the 1990s (Jennings and Hayes 1994, Stephenson and Calcarone 1999); however, none were found during resurveys of two of these in 2014 (S. Kupferberg pers. comm. 2015). The species may be near extirpation in the South Coast.

Central Coast

This region includes portions of Monterey, San Benito, Santa Cruz, San Mateo, Fresno, Merced, Stanislaus, and San Joaquin counties.

Historical records of Foothill Yellow-legged Frogs exist from several locations within the Salinas River, Carmel River, and Santa Lucia Range watersheds (CAS 2001, CNDDB 2016, FMNH 2001, UCMVZ 2015, Zweifel 1955) in Monterey County. Jennings and Hayes (1994) were able to document presence at 5 of 12 of historical locations (42%) from 1988-1991. Small populations were observed in Salinas River tributaries in the early 2000s, and the species is presumed to occur at the Hastings Reserve within the Carmel River drainage (UCNRS 2015); however, there are no documented sightings in this county since 2002 (CNDDB 2016).

There are numerous historical records of Foothill Yellow-legged Frogs from the Salinas River drainage, including Pinnacles National Monument, the San Benito River drainage, and Panoche Creek in San Benito County (CAS 2001, SDNHM 2001, UCMVZ 2015). The species was considered “abundant” and “quite common” in Pinnacles in the 1950s (Banta and Morafka 1967, Wauer 1958) and was still present in the mid-1960s (De Foe 1963, Morafka 1965) but was considered “rare” by the mid-1980s (Fellers 1986). Extensive surveys from 1992-1994 failed to detect them (Ely 1993, 1994), and the species was considered extirpated from Pinnacles by 2002 (Fesnock and Johnson 2002). Large populations of Foothill Yellow-legged Frogs were observed on Bureau of Land Management land in the upper San Benito River watershed above and below Hernandez Reservoir during surveys in 1992 (Ely 1992), and the species remained locally abundant in some streams through 2009 (CNDDB 2016; USBLM 2009, 2013). Small to moderate populations were documented in tributaries to Panoche Creek in the 1990s (CAS 2001, CNDDB 2016); however, there have been no reports of Foothill Yellow-legged Frogs from this drainage in the past two decades. Jennings and Hayes (1994) located the species in 3 of 11 historical locations (27%) between 1988 and 1991 in San Benito County.

There are historical records of Foothill Yellow-legged Frogs from the San Lorenzo River and tributaries, tributaries to the Pajaro River and Watsonville Slough, and Aptos, Soquel, and Waddell creeks in Santa Cruz County (CNDDB 2016, HMCZ 2001, LSUMNS 2001, Slevin 1928, UCMVZ 2015). The species was considered “virtually extinct” in the Santa Cruz Mountains by the 1990s (R. Seymour and M. Westphal pers. comms. 1996). Small numbers of Foothill Yellow-legged Frogs were reported from the Aptos Creek watershed in1998, and small to moderate populations were reported from 1992-2008 in the Soquel Creek drainage (CNDDB 2016). Jennings and Hayes (1994) found the species at 3 of 4 historical locations (75%) they surveyed in Santa Cruz County between 1988 and 1991.

There are numerous historical records of Foothill Yellow-legged Frogs from the Pescadero Creek watershed and a couple from San Gregorio Creek in San Mateo County (CAS 2001, UCMVZ 2015). Jennings and Hayes (1994) found the species at 4 of 9 of historical sites (44%) in the county from 1988-1991, but the last documented sighting was a single individual at Pescadero Creek County Park in 1999 (CNDDB 2016).

There are some historical records of Foothill Yellow-legged Frogs from creeks that drain into the San Joaquin Valley from western Fresno, Merced, Stanislaus, and San Joaquin counties (CAS 2001, CNDDB 2016, Ely 1992, HWCSP 2015, UCMVZ 2015, UMMZ 2001). While Fellers (1994) reported healthy reproducing populations in western Fresno County, Jennings and Hayes (1994) were unable to find Foothill Yellow-legged Frogs at any of the six locations they surveyed there from 1988-1991. Small to large populations were documented in the mid-1990s in one watershed (CAS 2001, Ely 1992), but by the 2000s, there was only one report of a single small population (CNDDB 2016). The last records of Foothill Yellow-legged Frogs in western Merced County were of small populations in the Los Banos Creek watershed from 1985-1988 (CNDDB 2016). In western Stanislaus County, the most recent records of Foothill Yellow-legged Frogs were of very small populations documented along Del Puerto Creek from 2000-2008, and small numbers were reported in 2005 in a tributary to Orestimba Creek (CNDDB 2016). Museum collections suggest Lower Corral Hollow Creek in western San Joaquin County supported a relatively large population, but the last record of a Foothill Yellow-legged Frog in this drainage is from 1971 (CNDDB 2016).

Bay Area

This region includes portions of San Francisco, San Mateo, Santa Clara, Alameda, Contra Costa, Solano, Napa, Sonoma, and Marin counties.

There is a single historical record of Foothill Yellow-legged Frogs from San Francisco in 1938 (CAS 2001), and resurvey efforts between 1988 and 1991 failed to detect the species (Jennings and Hayes 1994). Foothill Yellow-legged Frogs were collected from two localities in San Mateo County in 1899 and 1915 (CAS 2001, Slevin 1928, USNM 2001), but there have been no recent observations.

Numerous historical records exist for Foothill Yellow-legged Frog populations throughout Santa Clara County (CAS 2001, CDFG 1975, CMNH 2001, CNDDB 2016, Cornell 2002, FMNH 2001, LSUMNS 2001, Slevin 1928, TMM 2001, UCMVZ 2015, UMMZ 2001, USACE 2001, USNM 2001), and the species was likely present in nearly all of the larger perennial streams in Santa Clara County except the lower portions of Coyote Creek and Guadalupe River (H.T. Harvey and Associates 1999). There are no recent observations of Foothill Yellow-legged Frogs from Saratoga, Stevens, or San Francisquito creeks; the species in the latter watershed was described as “fairly common” in the 1960s (Launer et al. 1999). Jennings and Hayes (1994) located the species at 8 of 14 historical locations (57%) in Santa Clara County from 1998-1991. H.T. Harvey and Associates (1999) conducted widespread surveys in 1999 and concluded Foothill Yellow-legged Frogs had essentially disappeared from low-lying areas that had been converted to agricultural and urban uses as well as many perennial streams below major reservoirs, but they were still relatively abundant in foothill and mountain streams in the eastern portion of Santa Clara County. Small populations have been documented as recently as 2000 in the Guadalupe River watershed, 2007 in the Pajaro River watershed, and 2011 in headwater tributaries of the Mountain Hamilton/Alameda Creek watershed (CNDDB 2016). Small to moderate populations have been documented throughout the Coyote Creek watershed from

1986-2004 and as recently as 2016 (CAS 2001, CNDDB 2016, Gonsolin 2010, HWCSP 2015, PRA 1997).

There are historical records of Foothill Yellow-legged Frogs from several locations within the Alameda Creek watershed in Alameda County, as well as a population from Corral Hollow Creek, and two specimens collected from Oakland and Berkeley around the turn of the 20th century (CAS 2001, CMNH 2001, Schoenherr 1992, Slevin 1928, UCMVZ 2015, UMMZ 2001). The largest Foothill Yellow-legged Frog population in Alameda County, and potentially the entire Bay Area, inhabited upper Alameda Creek within the Sunol Regional Park; nearly 300 individuals were found at 4 locations during surveys from July through October 1996 (CNDDB 2016, EBRPD 1998). Jennings and Hayes (1994) found Foothill Yellow-legged Frogs in 4 of 13 historical locations (31%) surveyed between 1988 and 1991. During extensive surveys from 1997-1999 on East Bay Regional Park District lands, Foothill Yellow-legged Frogs were found in the upper Alameda Creek watershed but were extirpated or absent from all other streams surveyed (Bobzien and DiDonato 2007). One population was described as “abundant” as recently as 2006 (B. Sak pers. comm. 2006); however, this population has since crashed as a result of the drought (S. Kupferberg pers. comm. 2015). Prior to 1997, Foothill Yellow-legged Frogs were observed “frequently” along several miles of Corral Hollow Creek, but by the late 1990s it was restricted to the upper half mile of the creek (CNDDB 2016, Jones & Stokes 2000).

There are historical records of Foothill Yellow-legged Frogs from several creeks in Contra Costa County, and the species was apparently once abundant in San Pablo Creek near Orinda (G. Beeman pers. comm. 2002; CAS 2001; CNDDB 2016; UCMVZ 2001, 2015; USACE 2001). Jennings and Hays (1994) found the species at 3 of 9 historical locations (33%) in the county surveyed between 1988 and 1991 and suspected 8 of 11 historical populations had been extirpated. Foothill Yellow-legged Frogs were extirpated from East Bay Municipal Utility District watershed lands as early as the 1950s (EBMUD 1994); none were found by Bobzien and DiDonato (2007) during surveys of East Bay Regional Park District lands from 1997-1997; and there are no records within the East Contra Costa County Habitat Conservation Plan area (CCC 2006). Small numbers of Foothill Yellow-legged Frogs were still present in headwater tributaries draining Mt. Diablo in the early 2000s (G. Beeman pers. comm. 2002), but there have been no more recent observations from the county.

Small to moderate populations of Foothill Yellow-legged Frogs have been reported from the early to mid-2000s in tributaries to Lake Berryessa and Putah Creek, Alamo and Ulatis creeks, and a tributary to Ledgewood Creek in Solano County (CNDDB 2016, Solano County Water Agency 2002).

Foothill Yellow-legged Frogs historically occurred in relatively large numbers at some locations in Napa County and were widely distributed within the Napa River and Putah Creek watersheds (CAS 2001, CNDDB 2016, FMNH 2001, UCMVZ 2015). Small to very small populations were observed as recently as the 1990s in a few Putah Creek tributaries, the 2000s in some Napa River watershed creeks, and 2007 in Milliken and Capell creeks (CNDDB 2016, Napa County 2016).

In Sonoma County, Foothill Yellow-legged Frogs were historically collected from tributaries throughout the Russian River, Gualala River, Petaluma River, and Sonoma Creek watersheds, sometimes in large numbers (CAS 2001, CMNH 2001, FMNH 2001, LSUMNS 2001, UCMVZ 2015, UMMZ 2001). The species was considered “common” and was found in “large numbers” in the Sonoma Mountains east of Petaluma in the 1990s (Harvey et al. 1992). Foothill Yellow-legged Frogs continued to be documented throughout Sonoma County into the 1990s and 2000s, but the records are of small populations with the exception of a half-dozen moderate (20+ individuals) to moderately large (50+ adults and sub-adults) populations (CNDDB 2016).

Foothill Yellow-legged Frogs were historically found throughout Marin County, including the Lagunitas Creek drainage, tributaries on Mount Tamalpias, Redwood Creek, tributaries to Bolinas Lagoon and Tomales Bay, in apparently high abundance if collection numbers are any indication (CAS 2001, CMNH 2001, GANDA 2010a, LSUMNS 2001, TMM 2001, UCMVZ 2015, UKMNH 2001, UMMZ 2001, USNM 2001). However, surveys in the 1990s and 2000s failed to find the species in many previously occupied sites, including a population that had been considered abundant as recently as the early 2000s (Ely 1993, Fong 1997, GANDA 2010a). Foothill Yellow-legged Frogs appear to have been extirpated from most former locations and watersheds; only two known populations remain within Mount Tamalpias tributaries (CNDDB 2016, GANDA 2010a, MMWD 2014), although small populations may still occur in some Tomales Bay tributaries (GANDA 2010a).

Upper Sacramento River

This region consists of Yolo, Colusa, Glenn, Tehama, and Shasta counties.

Small populations of Foothill Yellow-legged Frogs were reported between 1997 and 2000 at a few locations in the Cache Creek drainage in northwestern Yolo County (CAS 2001, CNDDB 2016, Yolo County 2013), and there was a historical record from Putah Creek west of Winters (Harvey et al. 1992, Slevin 1928). The Petition notes that the paucity of Foothill Yellow-legged Frog locations in Yolo County suggests the species may never have been common (Yolo County 2013).

There are historical records of Foothill Yellow-legged Frogs from the Stony Creek drainage and one from Sand Creek 5 miles west of Arbuckle in Colusa County (CAS 2001, CNDDB 2016, UCMVZ 2015). Based on collections, it appears the species was relatively common in the Stony Creek drainage (UCMVZ 2015) and continued to be relatively abundant in Mill Creek and Little Stony Creek as recently as 2008 (CNDDB 2016, Fellers 1996). Small populations were observed in other creeks within this drainage as well as Cache Creek tributaries, Bear Creek, and Sulphur Creek from the 1990s and early 2000s (CNDDB 2016).

Foothill Yellow-legged Frogs were known historically from a handful of locations in the Stony Creek and Black Bear River drainages in Glenn County (CAS 2001, CNDDB 2016, Slevin 1928, UCMVZ 2015), and small populations were documented in the former as recently as 2000 with a single observation of a juvenile in the latter in 1999 (CAS 2001, CNDDB 2016).

Historical records of Foothill Yellow-legged Frogs exist for Battle Creek, Paynes Creek, and Antelope Creek drainages, as well as Dye Creek, Mill Creek, Deer Creek, and the Sacramento River near Red Bluff in Tehama County (CNDDB 2016, LNF and PNF 1999, UCMVZ 2015, UMMZ 2001). With the exception of the Sacramento River locality, which is extirpated, all of these watersheds were still supporting the species in small numbers in the 1990s and 2000s (CAS 2001, CNDDB 2016, Fellers 1996, Hayes et al. 2013). Jennings and Hayes (1994) found the species at 3 of 7 (43%) historically occupied sites (43%) in the eastern part of the county during surveys from 1988-1991. No Foothill Yellow-legged Frogs were found during amphibian surveys from 1990-1998 in the Lassen National Forest (LNF and PNF 1999), but according to Hayes et al. (2013), there had been some scattered sightings in the area as part of Federal Energy Regulatory Commission surveys. A relatively large population (79 over 2 years) was found in the Red Bank Creek watershed in the mid-2000s (Bourque 2008), and at least 10 adults and 1 egg mass were observed in Antelope Creek in 2016 (CNDDB 2016).

Foothill Yellow-legged Frog historical collections were made throughout the upper Sacramento River tributary creeks in Shasta County (CAS 2001, FMNH 2001, UCMVZ 2015, UMMZ 2001, USNM 2001). The species was found at 3 of 14 historical locations (21%) in the county during surveys from 1988-1999 by Jennings and Hayes (1994); however, small populations were recorded in three dozen tributaries in the 2000s (CNDDB 2016, FERC 2001).

Northern Coastal California

This region consists of Lake, Mendocino, Humboldt, Trinity, Siskiyou, and Del Norte counties.

Foothill Yellow-legged Frogs were historically collected from the Eel River, Clear Lake, Cache Creek, and Putah Creek drainages in Lake County (CAS 2001, CNDDB 2016, UCMVZ 2015), some of which were documented to “moderately abundant” in the mid-1950s (CNDDB). Small to moderately large populations have been documented in all of the historically occupied watersheds as recently as 2000 (Clear Lake tributaries) with some as recent as 2008 (Eel River watershed) (CNDDB 2016). While reported numbers are small from many sites, no known extirpations have occurred in Lake County.

There are numerous historical collection records of Foothill Yellow-legged Frogs from across several watersheds in Mendocino County including the Eel, Tenmile, Noyo, Big, Navarro, Garcia, Gualala, and Russian rivers, as well as some small coastal rivers: some collections suggest large populations like those from the South and Middle Forks of the Eel River (CAS 2001, CMNH 2001, CNDDB 2016, FMNH 2001, LSUMNS 2001, SDNHM 2001, UCMVZ 2015, UMMZ 2001, USMN 2001). The species was still widespread in all the major watersheds as recently as the 1990s and 2000s, including some moderately abundant populations in the Eel and Russian River watersheds (CNDDB 2016, Fellers 1996, D. Matson pers. comm. 2001).

Historical collection records of Foothill Yellow-legged Frogs exist from numerous locations throughout Humboldt County including the Klamath, Trinity, Redwood Creek, Mad, Eel, Van Duzen, and Mattole rivers and Redwood Creek; some were relatively large from Maple Creek within the Mad River drainage and from Redwood Creek (CAS 2001, CMNH 2001, CNDDB 2016, FMNH 2001, RNSP 2001, SDNHM 2001, UCMVZ 2015, UMMZ 2001, USNM 2001). As

of the 1990s, the species was still well-distributed through the watersheds in the county (CNDDB 2016; D. Matson pers. comm. 2001, RNSP 2001; USDA 1994, 1995a, 1995c, 1999; USDA and USDI 1996, 1998; Welsh and Hodgson 2011). In addition, relatively abundant populations were documented in some areas into the 2000s (CNDDB 2016), as well as during single pass egg mass surveys conducted by the Department between 2010 and 2016 along reaches of the Mad River, South Fork Eel River and one of its tributaries (M. van Hattem pers. comm. 2016).

There are historical collections of Foothill Yellow-legged Frogs from the Trinity, Salmon, Mad, and Eel rivers and Cottonwood Creek within Trinity County with large numbers taken from the Trinity River and its tributaries and the Mad River (Bury 1969, CAS 2001, CMNH 2001, CNDDB 2016, LSUMNS 2001, Slevin 1928, UCMVZ 2015, UMMZ 2001, USDA 1999). The species was common in the 1990s in the North Fork and Middle Fork Eel River drainages, but its current status is unknown, and despite declines along the mainstem Trinity River downstream of Lewiston Dam, the species continues to be widespread throughout the river basin through the 2000s with a particularly large population along the South Fork Trinity River (CNDDB 2016).

Historical records of Foothill Yellow-legged Frogs exist from the Klamath and Sacramento River drainages in Siskiyou County (CAS 2001, CNDDB 2016, LSUMN 2001, UCMVZ 2015, UMMZ 2001). The species was reportedly “fairly common” in the 1990s in the former (KNF 1999), and small numbers have been reported throughout the latter as recently as 2003 (CNDDB), but overall current status is unknown.

There are historical collections of Foothill Yellow-legged Frogs from the Rogue River and Smith River watersheds in Del Norte County (CAS 2001, CMNH 2001, FMNH 2001, RNSP 2001, SDMNH 2001, UCMVZ 2015, UMMZ 2001, UTA 2001). The species was found in most Smith River tributaries in the 1990s and was considered abundant in the Middle Fork (USDA 1995b, 1999) with an apparently stable population documented on Hurdygurdy Creek as recently as the mid-2000s (Wheeler et al. 2006). In addition, a small number of Foothill Yellow-legged Frogs were discovered on a tributary to the Klamath River in 1990 (CNDDB 2016), but there have not been any more recent records from the county.

Southern Sierra Nevada

This region consists of eastern Kern, Tulare, Fresno, Madera, and Mariposa counties. Like Southern California, there are a few dubious Foothill Yellow-legged Frog specimens based on elevation that may be Mountain Yellow-legged Frogs; the two species’ ranges historically abutted each other in mid-elevation streams in this region (Zweifel 1955).

There are historical records of Foothill Yellow-legged Frogs from the Kern River watershed, Tehachapi Creek, Caliente Creek, and Tejon Creek in Kern County (CAS 2001, CNDDB 2016, LSUMNS 2001, UCMVZ 2015, USNM 2001). There are no records from the county since 1967, and Jennings and Hayes (1994) were unable to locate the species at 15 historical sites in the county from 1988-1991. Foothill Yellow-legged Frogs are considered extirpated from Kern County.

Historical collections of Foothill Yellow-legged Frogs exist from the Kern River, Kaweah River, Deer Creek/White River, and Tule River drainages in Tulare County (CAS 2001; CNDDB 2016; HMCZ 2001; UCMVZ 2015; UMMZ 2001; USNM 2001). Jennings and Hayes (1994) were unable to locate the species during surveys from 1988-1991 at 17 historic locations within the county. The only records since 1970 are one small and one moderate-sized population found between 1998 and 2008 in the Kern River drainage and an observation of a single individual in the Tule River drainage from 2004 (CNDDB 2016). The Foothill Yellow-legged Frog is nearly extirpated from Tulare County.

There are historical records of Foothill Yellow-legged Frogs from the Kings River and San Joaquin River watersheds in Fresno County (CAS 2001; CNDDB 2016; TMM 2001; UCMVZ 2015; Wright and Wright 1949). Despite many surveys, the species has not been seen in over 30 years in the Kings River drainage (SKCNP 2001). Jennings and Hayes (1994) found the species at 4 of 9 historic locations (44%) in eastern Fresno County from 1988-1991. No Foothill Yellow-legged Frogs were found during surveys on the San Joaquin River (PG&E 2000), but small populations were found in a tributary to the San Joaquin River between 1994 and 2007 (CNDDB 2016).

Foothill Yellow-legged Frogs were found historically in the San Joaquin River and Fresno River drainages in Madera County (CNDDB 2016; Madera County 2007; PG&E 2000, UCMVZ 2015). In addition, Moyle (1972, 1973) documented the species in Chowchilla River in 1970; however, there are no more recent records from that watershed (CNDDB 2016). Jennings and Hayes (1994) relocated the species at 3 of 6 of historical sites (50%) surveyed from 1988-1991. The most recent sightings were in 1991 and 1994 of small populations within the Fresno River watershed (CNDDB 2016), but subsequent survey efforts failed to find the species (PG&E 2000). Foothill Yellow-legged Frogs may be extirpated from Madera County.

There are numerous historical collection records for Foothill Yellow-legged Frogs from throughout the Merced River drainage in Mariposa County (CNDDB 2016, FMNH 2001, Grinnell and Storer 1924, HMCZ 2001, Martin 1940, Richards 1958, UMMZ 2001, USNM 2001). According to Storer's field notes, the species appeared to be relatively common, but extensive resurveys of the Grinnell and Storer Yosemite transect and other areas in Yosemite failed to find Foothill Yellow-legged Frogs within the park (Drost and Fellers 1994, Fellers 1997, Fellers and Freel 1995, Jennings 1996, Moritz 2007). Small populations were located in North Fork tributaries in the 1990s through 2009, but resurveys only detected a single individual (CNDDB 2016, S. Kupferberg pers. comm. 2016). Jennings and Hayes (1994) found Foothill Yellow-legged Frogs at 1 of 5 of historical locations (20%) from 1988-1991 in Mariposa County. The species is likely extirpated from most of the county with the possible exception of small populations upstream of Lake McClure.

Central/Northern Sierra Nevada

This region consists of Tuolumne, Sutter, Calaveras, Amador, El Dorado, Placer, Nevada, Sierra, Yuba, Butte, and Plumas counties.

There are historical records of Foothill Yellow-legged Frogs from several sites within the Tuolumne River watershed in Tuolumne County (CNDDB 2016; Martin 1940; Moyle 1972, 1973; Richards 1958, UCMVZ 2015, USNM 2001). Jennings and Hayes (1994) found the species at 2 of 6 historical locations (33%) surveyed from 1988-1991. Small populations were documented in the 1990s and early 2000s (CNDDB 2016), but focused surveys in 2012 failed to detect the species (HDR 2013). Small populations were documented between 1998 and 2003 in portions of the Stanislaus River watershed (CNDDB 2016), but currently there is only one known population from the Sand Bar Dam reach of the Stanislaus River (S. Kupferberg pers. comm. 2016).

There is a single historical record of Foothill Yellow-legged Frogs from the Sutter Buttes in Sutter County, but Jennings and Hayes (1994) were unable to relocate the species. This population is likely extirpated.

Foothill Yellow-legged Frogs were historically collected from a few locations within the Stanislaus River and Mokelumne River watersheds in Calaveras County (UCMVZ 2015, USMN 2001). The species was found at 2 of 9 historic sites (22%) in the county surveyed between 1988 and 1999 by Jennings and Hayes (1994). Small populations have been recorded from tributaries in both watersheds in Calaveras County from as recently as the mid- to late 2000s (CNDDB 2016).

The Petition states there were no historical localities of Foothill Yellow-legged Frogs from Amador County; however, it also states that Jennings and Hayes (1994) resurveyed 3 historic locations between 1988 and 1991 and failed to detect the species at any of them. Since that time, small populations were found in a tributary to Dry Creek in the early 2000s and during Federal Energy Regulatory Commission amphibian surveys in 2001 and 2009 within the Mokelumne River drainage (CNDDB 2016).

There are numerous historical records of Foothill Yellow-legged Frogs in the South Fork American River and Cosumnes River drainages in El Dorado County (UCMVZ 2015, Slevin 1928). Jennings and Hayes (1994) found the species at 1 of 9 historical sites (11%) surveyed between 1988 and 1991. Since then, small populations on the South Fork American River were documented between 2002 and 2004 (CNDDB 2016), but several other efforts between 2002 and 2011 failed to detect the species in this watershed (Devine Tarbell & Associates and Stillwater Sciences 2005, ECORP 2011, GANDA 2010b). Numerous breeding populations of Foothill Yellow-legged Frogs were documented by the Placer County Water Agency (PCWA 2008) throughout the Middle Fork American River watershed in 2007. The species was reportedly widespread, and abundance and density of egg masses varied by stream size, flow regulation, and water temperatures, which were greatest along downstream reaches of the Rubicon River (Ibid.). Small populations of Foothill Yellow-legged Frogs were documented during the 1990s within the Cosumnes River watershed, but no more recent records exist from this area (CNDDB 2016).

The Petition states there was one historical location of Foothill Yellow-legged Frogs within the North Fork American River watershed in Placer County (UCMVZ 2015); however, it also states that Jennings and Hayes (1994) resurveyed 4 historical sites from 1988-1991 and found the

species at 2 (50%). Small populations were recorded from about a dozen sites in Placer County in the 1990s and 2000s, many from undammed locations within the North Fork watershed, but also from a couple sites within the Middle Fork American River watershed (CBI 2008, CNDDB 2016, Lehr 1998).

There are historical collections of Foothill Yellow-legged Frogs from a tributary to the mainstem Yuba River and South Fork Yuba River drainages in Nevada County (CAS 2001, UCMVZ 2015). Jennings and Hayes (1994) found the species at 2 of 5 historical sites (40%) in the county from 1988 to 1991. Foothill Yellow-legged Frogs were found in small numbers in the 1990s along some tributaries to the Middle Fork Yuba River (CNDDB 2016), and PG&E documented relatively high numbers of egg masses and larvae in the mainstem Middle Fork Yuba River and tributaries in 2008 (FERC 2013). Small populations were reported from the South Fork Yuba River and tributaries between 1991and 2008 (CAS 2001, CNDDB 2016), and PG&E documented numerous small populations throughout the South Fork Yuba River drainage in 2008 and 2009 (CNDDB 2016, FERC 2013). Declining populations were documented by the City of Grass Valley in a portion of the Bear River drainage (Grass Valley 2000), but PG&E documented all life stages in moderate to high numbers from 2002-2009 in the Bear River and its tributaries; one population was very large (349 adults, 2,082 juveniles, and 1,063 larvae in August 2008) (CNDDB 2016, FERC 2013), Additional small populations have been documented in the watershed from 2007-2008 (CNDDB 2016).

The Petition states there are no historical records of Foothill Yellow-legged Frogs from Sierra County; however, it also states Jennings and Hayes (1994) were successful in relocating the species at 1 of 4 historical sites (25%) in the county between 1988 and 1991. Small populations were documented in the North Fork Yuba River and a dozen of its tributaries in the late 1990s and early 2000s, as well as from three tributaries to the Middle Fork Yuba River between 1997 and 2008 (CAS 2001, CNDDB 2016).

There are historical records of Foothill Yellow-legged Frogs from the North Fork Yuba River and one if its tributaries, as well as from the Dry Creek drainage in Yuba County (CAS 2001, UCMVZ 2015, USNM 2001). Jennings and Hayes (1994) found the species at 2 of 3 of historical locations (67%) in the county resurveyed between 1988 and 1991. Foothill Yellow-legged Frogs were documented to occur in the lower Yuba River in the 1990s (PG&E 2000), and some small populations and single individuals were observed from the mid-1990s to the mid-2000s in tributaries to the North Fork Yuba River, but there are no records from Dry Creek since the early 1950s (CAS 2001, CNDDB 2016).

Foothill Yellow-legged Frogs were collected historically from the Feather River watershed and several creeks in Butte County including Mud Creek/Rock Creek, Big Chico Creek, Butte Creek, Dry Creek, Cottonwood Creek, and Honcut Creek (CAS 2001, CNDDB 2016, Slevin 1928, UCMVZ 2015). Hayes and Cliff (1982) noted that Foothill Yellow-legged Frogs were found in most drainages in Butte County as low as 72 m (250 ft). By the early 1990s, the species was becoming harder to find; Koo and Vindum (1999) did not relocate them at several historical locations within the Plumas National Forest in the 1990s. Jennings and Hayes (1994) found the species at 5 of 17 historical sites (29%) in the county from 1988-1991. With the exception of a

single male and female on the North Fork Feather River in 2008 and a single individual observed in a tributary to Dry Creek, all other records in Butte County date back to the 1990s (CNDDB 2016, Gallaway 1999, PG&E 2000).

There are historical collections of Foothill Yellow-legged Frogs from tributaries to the North Fork, the East Branch of the North Fork, and the Middle Fork Feather River in Plumas County (CAS 2001, UCMVZ 2015, UMMZ 2001). Jennings and Hayes (1994) located the species at 4 of 11 historically occupied sites (36%) in the county during surveys between 1988 and 1991, and Koo and Vindum (1999) found Foothill Yellow-legged Frogs at 45% of historical sites on the Plumas National Forest. The species appears to be extirpated from most historical sites in the East Branch of the North Fork Feather River, Little Butte Creek, Dry Creek, North Fork Yuba River, and West Branch Yuba River (Hayes et al. 2013), but populations remain in the North and South Forks of the Feather River watersheds (CNDDB 2016).

2. Other Relevant Scientific Information

The Department possesses the following additional information regarding Foothill Yellow-legged Frog distribution and abundance. If a geographic region is not discussed below, it means the Department does not possess any additional relevant scientific information for that particular area at this time. However, due to statutory time limitations on completing the Petition Evaluation, the Department could not process all the unpublished data it possesses, so the information below should not be considered a complete record.

South Coast

A robust population of Foothill Yellow-legged Frogs was reported to exist in the Arroyo de la Cruz watershed in in San Luis Obispo County in1993 in the upper two miles of the mainstem Arroyo de la Cruz and in the two tributaries that join to form the mainstem (Burnett Creek and Marmalejo Creek). The lands in this watershed are apparently owned by the Hearst Corporation, and access is restricted. The Petition reports that there have been no documented observations of Foothill Yellow-legged Frogs in this county since 1999; however, in 2004, baseline environmental documents prepared by consultants for the Hearst Ranch noted that Foothill Yellow-Legged Frogs were still present at those sites (J. Nelson pers. comm. 2017). The population's current status is unknown.

Central Coast

Approximately 25-30 Foothill Yellow-legged Frogs were observed on July 12, 2012, in Lewis Creek near the Monterey/San Benito County line (HERP 2016), an area the Petition described as having small populations present in the 1990s but no recent records.

Recent (2013-2015) "routine sightings" of Foothill Yellow-legged Frogs have been reported in the Soquel Creek watershed in Santa Cruz County (J. Jankovitz pers. comm. 2017) in an area described in the Petition as having small to moderate populations as recently as 2008. These sightings have been anecdotal to fisheries surveys and habitat restoration project evaluations and do not represent a comprehensive population survey; however, the frequency of sightings and numbers observed suggest a potentially robust population occurs here (Ibid.).

Bay Area

The Department conducted numerous stream surveys for salmonids within the Russian River watershed (Sonoma and Mendocino counties) from 1995 to 2007 (CDFW unpublished data). Survey reaches generally ranged from around 90-460 m (300-1,500 ft) in length. Incidental observations of sensitive species of amphibians, including Foothill Yellow-legged Frogs, were also tallied during these steam surveys; however, life stage was not recorded. It is assumed that numbers represent post-metamorphic frogs. The Petition stated that nearly all populations documented in the 2000s were small throughout the Russian River drainage with the exception of a moderate-sized population (20-49 individuals) on Cherry Creek and a moderately large population (50-99 individuals) on Gird Creek with populations on Miller, Porter, and Ward creeks also being “notable.” While the following data are not any more current than the information in the Petition, they augment what was known about the distribution and abundance of the species and demonstrate that larger populations occurred at that time. Only observations of 10 or more Foothill Yellow-legged Frogs within a particular stream are reported below; in some cases, numbers are combined from more than one reach. Smaller numbers of the species were also recorded in numerous creeks within the greater Russian River watershed during the period surveys were conducted.

Black Rock Creek (Lower Russian River, Sonoma County) on 9/23/1996: 11

Devil Creek (Lower Russian River, Sonoma County) on 10/8/1996: 19

Gilliam Creek (Lower Russian River; Sonoma County) on 10/9 and 10/11/2001: 23

Kidd Creek (Lower Russian River, Sonoma County) on 10/9/2001: 10

Ingalls Creek (Middle Russian River, Sonoma County) on 10/3/1996: 18

Bluegum Creek (Middle Russian River; Sonoma County) on 10/15/1996: 53

Pechaco Creek (Middle Russian River, Sonoma County) on 10/28/1998: 10

Lovers Gulch Creek (Middle Russian River; Sonoma County) on 10/11/1999: 12

Hale Creek (Middle Russian River; Sonoma County) on 11/3/2000: 151

Gird Creek (Middle Russian River; Sonoma County) on 10/22/2001: 21

Pena Creek (Middle Russian River, Sonoma County) on 10/20/1998: 10

Pena Creek (Middle Russian River; Sonoma County) on 10/9 and 10/12/2001: 23

Redwood Creek (Middle Russian River; Sonoma County) on 10/2/2001: 10

Squaw Creek (Middle Russian River; Sonoma County) on 10/15/2001: 17

Chapman Branch (Middle Russian River; Sonoma County) on 10/20/1998: 19

Eldridge Creek (Upper Russian River; Mendocino County) on 10/22/1999: 14

Forsythe Creek (Upper Russian River; Mendocino County) on 10/26/1999: 10

Jack Smith Creek (Upper Russian River; Mendocino County) on 10/18 and 10/21/1999: 35

Johnson Creek (Upper Russian River; Mendocino County) on 10/18/2001: 17

McClure Creek (Upper Russian River; Mendocino County) on 10/24/2001: 18

Morrison Creek (Upper Russian River; Mendocino County) on 10/15 and 10/16/2001: 53

South Branch Robinson Creek (Upper Russian River; Mendocino County) on 9/28/2001: 48

Miners Creek (Upper Russian River; Mendocino County) on 8/7/2003: 10

Upper Sacramento River

The Department recorded incidental observations of Foothill Yellow-legged Frogs in the Stony Creek drainage (Colusa, Glenn, and Lake counties) during snorkel and electroshocking fish surveys in the 2000s that generally support the population distribution and abundance data in the Petition from this area (CDFW unpublished data). In 2001, a field note from surveys along the Middle Fork exclaimed “Foothill Yellow-legged Frogs (lots!).” In 2008, 33 adults were observed in the North Fork, 1 in the South Fork, 3 in the Middle Fork, and 31 in the mainstem. In 2009, “many *R. boylii* adults and larvae observed in section” was recorded from a 208 m (684 ft) survey reach along the North Fork. In the same year, the species was present at all three reaches surveyed along 11.3 km (7 mi) span of the South Fork, although no counts were recorded.

Northern Coastal California

The Department incidentally recorded Foothill Yellow-legged Frogs in the course of conducting snorkel surveys throughout much of this region between 2009 and 2015 (CDFW unpublished data, J. Garwood pers. comm. 2017), many of which occurred in Humboldt County where the Petition stated there were a paucity of surveys or records from the 2000s in many of these watersheds. The following data suggest there are still sufficiently large, reproducing, well-distributed populations of Foothill Yellow-legged Frogs in Northern Coastal California.

Blue Slide Creek (Mattole River watershed; Humboldt County) in 2015: 135 mostly subadults.

Grindstone Creek (Mattole River watershed; Humboldt County) in 2013: 25 adults.

Mattole Canyon Creek (Mattole River watershed; Humboldt County) during 2014-2015: 59 adults and 3 larvae.

Fourmile Creek (Mattole River watershed; Humboldt County) during 2014-2015: 26 adults.

North Fork Fourmile Creek (Mattole River watershed; Humboldt County) during 2014-2015: 22 adults.

Sholes Creek (Mattole River watershed; Humboldt County) during 2013-2015: 25 adults.

Mattole River mainstem (Humboldt County) during 2014-2015: 891 mixture of adults, subadults, and larvae (including 500 subadults in one survey section).

Van Duzen River mainstem (Humboldt County) during 2013-2016: 13 adults.

Big River mainstem (Mendocino County) during 2009-2010: 59 unknown life stage.

Navarro River mainstem (Mendocino County) during 2009-2013: 107 unknown life stage.

North Fork Smith River (Del Norte County) during 2012-2014: Small numbers of adults and 500 larvae.

Patrick Creek (Smith River drainage; Del Norte County) during 2012: Small numbers of adults and >100 larvae.

Cedar Creek (Smith River drainage; Del Norte County) during 2011-2016: 44 adults and subadults.

Hurdygurdy Creek (Smith River drainage; Del Norte County) during 2014-2015: 14 adults and 6 larvae.

Mill Creek (Smith River drainage; Del Norte County) during 2014-2015: 10 adults.

South Fork Smith River (Smith River drainage; Del Norte County) during 2012-2016: 32 adults, subadults, and larvae.

Smith River mainstem (Del Norte County) during 2012-2016: 199 adults, subadults, and larvae, as well as 4 egg masses.

3. Sufficiency of the Petition with regard to Distribution and Abundance

The Department concludes the Petition contains sufficient information on Foothill Yellow-legged Frog distribution and abundance to suggest both have been reduced over parts of the species' range in California.

E. Population Trend

1. Scientific Information in the Petition

The Petition, on pages 95 through 100, contains the following information on Foothill Yellow-legged Frog population trends across its complete range in California and Oregon, within California, and at regional scales.

The best measures of long-term (i.e., > 50 years) population trends for Foothill Yellow-legged Frogs involve resurveying historically occupied sites (e.g., Borisenko and Hayes 1999, Davis and Olson 2008, Drost and Fellers 1996, Jennings and Hayes 1994, Lind 2005, Olson and Davis 2009, Sweet 1983). For population trends over shorter, more recent, timeframes, repeated egg mass censuses have been undertaken by researchers, government agencies, and utility companies because each adult female Foothill Yellow-legged Frog lays one discrete clutch of eggs that are easily detectable. Peek and Kupferberg (2016) determined that there was significantly higher inter-annual variability in egg mass density in regulated river populations than those in unregulated channels. They concluded that population trends may not be detectable when high variability was combined with sparse densities (Ibid.).

Oregon and California

Lind (2005) assessed Foothill Yellow-legged Frog population status across their range in California and Oregon using a subset of historical sites and resurvey efforts. She determined that the species had disappeared from 201 of 394 of the historical localities (51%) in the dataset. Hayes et al. (2013, 2016) suggest this may be an underestimate of the number of populations that have been extirpated.

California

Jennings and Hayes (1994) thoroughly researched Foothill Yellow-legged Frog historical observations, compiling information from reports, surveys, Department files and data, searched museum specimens and naturalists' field notes, and conducted field surveys between 1988 and 1991. They found that Foothill Yellow-legged Frogs had been extirpated from at least 225 of 445 known historical locations (53%) and had disappeared from 45% of their historical range in California by 1994 (Ibid.). For a species to survive in the long-term, populations need to be large enough to be self-sustaining (Lanoo 2005). Fellers (2005) determined that 30 of the 213 sites in California (14%) with Foothill Yellow-legged Frogs had populations estimated to be 20 or more adults.

Southern California

Foothill Yellow-legged Frogs are extirpated from 21of 21 historically occupied sites (100%) in Southern California (Jennings and Hayes 1994). Drost and Fellers (1996) also concluded the species is likely extirpated from the Tehachapi Mountains southward.

South Coast

The species is still present in some coastal drainages and in the Salinas River watershed from Monterey County to northwestern San Luis Obispo County but in lower abundance. Jennings and Hayes (1994) found that Foothill Yellow-legged Frogs had been extirpated from 81 of 118 of historical sites (69%) from the South Coast.

Central Coast/Bay Area

Foothill Yellow-legged Frogs have declined in abundance and distribution through many parts of the greater Bay Area. There appear to be relatively stable populations remaining in the Diablo Range through western Fresno, San Benito, western Stanislaus, Santa Clara, and Alameda counties. Foothill Yellow-legged Frogs appear to be extirpated from Monterey County north of the Salinas River and western San Joaquin County. They may be near extirpation in western Merced, Contra Costa, Santa Cruz, and San Mateo Counties.

Marin/Sonoma

Foothill Yellow-legged Frogs have been extirpated from many historic locations in Marin County, and there may be only one relatively stable population remaining at Big Carson Creek. The species is still widely distributed throughout Sonoma County; however, there are no published reports of populations with over 50 adults.

North Coast

The largest populations of Foothill Yellow-legged Frogs in California occur in the North Coast Range with healthy populations distributed throughout the region; however, only 6 sites have estimated populations of greater than 100 adults and an additional 9 sites with greater than 50 adults. By the early 1990s, Jennings and Hayes (1994) determined they had been lost from 39 of 165 of historically occupied sites (24%) in this region.

Upper Sacramento River

Foothill Yellow-legged Frogs have declined from the upper Sacramento River basin; the proportion of historically occupied sites that were resurveyed by Jennings and Hayes (1994) in the early 1990s was 21% for Shasta County, and 43% for western Tehama County. The species remains in dozens of tributaries and creeks, but most populations are small.

Southern Sierra Nevada

Declines in Foothill Yellow-legged Frogs in the Southern Sierra Nevada were suspected by Moyle (1973) when he found the species at only 30 of 95 of the sites he sampled (31%) from the vicinity of Yosemite south. The species was thought to be near extirpation due to the low incidence of finding them during resurvey efforts (Drost and Fellers 1996; Fellers 1994, 1997; Fellers and Freel 1995). Foothill Yellow-legged Frogs are extirpated from Yosemite and Sequoia and Kings Canyon National Parks and near extirpation in Sequoia and Sierra National Forests (Hayes et al. 2013, 2016). Remaining populations are few and limited in distribution to Mariposa, Tulare, and eastern Fresno counties.

Central/Northern Sierra Nevada

Foothill Yellow-legged Frogs have experienced widespread declines in abundance and distribution across this region. The species is now gone from at least half of known historical locations in every county within this region except Plumas. Most extant populations are small and isolated from each other with little evidence of successful reproduction. Stable populations remain in El Dorado, Placer, Nevada, and Plumas counties.

2. Other Relevant Scientific Information

The Department does not possess any additional relevant scientific information on Foothill Yellow-legged Frog population trends beyond what was provided in Section D.2. above.

3. Sufficiency of the Petition with regard to Population Trend

The Department concludes the Petition contains sufficient information to indicate that Foothill Yellow-legged Frog populations may have declined in portions of the species' range in California.

F. Factors Affecting the Ability to Survive and Reproduce and Degree and Immediacy of Threat

1. Scientific Information in the Petition

The Petition, on pages 100 through 113, contains the following information regarding threats to Foothill Yellow-legged Frog long-term survival. A combination of anthropogenic stressors have led to the decline of the species throughout its range in California, primarily through habitat loss, fragmentation, and degradation of instream habitat conditions.

Climate Change

Climate change models for terrestrial systems in the Northern Hemisphere predict warmer temperatures, more intense precipitation events, and increased summer drying (Cayan et al. 2005, Field et al. 1999, IPCC 2007). Precipitation is predicted to fall earlier in the spring as rain rather than snow, which will shift the hydrograph to lower snowpack, earlier snowmelt, more winter rain, and higher winter storm runoff events (Maurer et al. 2007, Stewart 2009, Young et al. 2009). California is likely to experience an increase in average annual temperature of 1.5 – 4.5º C (2.7 – 8.1º F) in the next century (Cayan et al. 2008, Field et al. 1999). This combined with changes in precipitation will likely increase the low flow season and increase water temperatures, which may stress species that are adapted to more moderate temperature regimes. Spring snowmelt has already declined in the Sierra Nevada over the past century as a result of changes in timing and amount of precipitation; the portion of Sierra runoff between April and June has declined by 9% (Aguado et al. 1992, Kadir et al. 2013).

As ectotherms, amphibians are particularly sensitive to changes in air and water temperatures, precipitation, and hydroperiod because their body temperatures and activity cycles depend on the availability of optimal environmental conditions in their habitat (Lind 2008). Shifts to earlier breeding have already been observed in some species of amphibians, presumably in response to warming temperatures (Bebee 1995, Blaustein et al. 2001, Gibbs and Breish 2001). If shifts in activities such as breeding are not accompanied by shifts in other critical environmental factors such as emergence of insect prey, growth and survival may be effected.

Changes in frequency, duration, and magnitude of droughts and in runoff quantity and timing may have significant adverse impacts on Foothill Yellow-legged Frogs. Jennings and Hayes (1994) attributed population declines in part to drought. Decreases in summer runoff may result in the loss of foraging and refuge habitat for adults and juveniles, and increasing stream water temperature has been shown to decrease invertebrate density and biomass (Hogg and Williams 1996), which could negatively impact the species' prey base. In addition, as streams dry, Foothill Yellow-legged Frogs congregate in remaining wetted areas, increasing their contact and probability of transmitting diseases and parasites. Increased summer water temperatures were implicated in outbreaks of the parasitic copepod *Lernaea cyprinacea* and malformations in Foothill Yellow-legged Frog larvae and young-of-the-year in California (Kupferberg et al. 2009a). Changes in climatic regimes are likely to increase pathogen virulence and amphibian susceptibility to pathogens (Alford 2011, Gervasi et al. 2008, Pounds et al. 2006, Pounds et al. 2007).

Changes in climatic patterns, particularly those linked to precipitation, may have substantial impacts on Foothill Yellow-legged Frog populations, particularly those at lower latitudes and elevations. Climate change appears to already be a contributing factor in decline of the species (Fellers 2005, Olson and Davis 2009). Low precipitation and increased variability in precipitation were both inversely related to Foothill Yellow-legged Frog presence (Lind 2005), and drought severity has been greater at lower latitudes in California (Cook et al. 2004). Davidson et al. (2002) found a north-to-south gradient of increasing Foothill Yellow-legged Frog losses, consistent with climate change hypotheses (i.e., more losses at drier sites to the south). Continued climate change is likely to cause further contraction of the Foothill Yellow-legged Frog's range with loss of southernmost populations, as well as potential habitat shift upward in elevation, as temperatures increase and precipitation becomes more variable.

Dams, Water Development, and Diversions

Water development and diversions are the primary and most well-documented cause of Foothill Yellow-legged Frog declines and have a greater potential to alter habitat for the species than any other risk factor (Hayes et al. 2013, 2016). Water management activities can produce landscape and localized changes in habitat conditions, such as water velocities, depths, and temperatures, that can lead to inconsistent environmental cues for breeding, lower growth rates in larvae, scouring and/or stranding of egg masses and larvae, 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 (Ibid.).

There are two major types of water developments: impoundments and diversions. Impoundments block streams with a structure (most often a dam) such that natural flows are impeded and water is pooled upstream, while diversions remove water and deliver it to off-site locations. At least one large reservoir exists in the foothill region of every major stream in the Sierra Nevada below 600 m (1,968 ft), and several major streams and rivers have two or more reservoirs in linear sequence (Ibid.) In addition, several hundred medium-sized and small reservoirs are broadly distributed at elevations within the Foothill Yellow-legged Frog's range over the Sierra Nevada (Mount 1995).

Reservoirs convert lotic (flowing) aquatic habitats to lentic (still) conditions, resulting in habitat with reduced flows, increased depths, and altered temperature and dissolved oxygen regimes (Mount 1995; Petts 1980, 1984). Because Foothill Yellow-legged Frogs have evolved to inhabit free-flowing, well-oxygenated water with coarse substrates, these alterations result in direct loss of required habitat for the species. At least eight historically occupied sites in the Sierra Nevada are currently inundated by reservoirs (Hayes et al. 2013, 2016), and given the number and location of dams, it is likely Foothill Yellow-legged Frogs could have historically occupied many of these sites.

In addition to direct loss of habitat within the footprint of the reservoir, degradation of upstream and downstream habitat can be severe. Lind et al. (1996) reported a 94% loss of potential breeding habitat after construction of the Lewiston Dam on the Trinity River in Northwestern California. Dam operations reduced flood flows to 10-30% in total volume and periodic high flows (i.e., storm runoff) from pre-dam conditions, which facilitated encroachment by riparian

vegetation and reduced cobble/gravel bar formation (Ibid.). In addition, regulated flows and lack of winter flooding can create stable pool areas with established aquatic vegetation (Kupferberg 1996a, Lind et al. 1996), which increases suitable habitat for exotic species such as bullfrogs (Ashton et al. 1998). And decreased flows that result in drying channels can force Foothill Yellow-legged Frogs into permanent pools where they are more susceptible to predation (Hayes and Jennings 1988).

Foothill Yellow-legged Frogs are adapted to the distinct hydrograph created by California's Mediterranean climate, which is marked by high and variable water flows in the fall through spring and low, receding, stable flows in the summer (Yarnell et al. 2010). Water development and diversions cause changes to the hydrograph that recurrently affect several aspects of the species' life history, which can result in reduced abundance and even extirpation (Hayes et al. 2013, 2016). Foothill Yellow-legged Frog breeding populations were five times smaller on average in rivers with regulated flows than in unregulated rivers (Kupferberg et al. 2012). In studying Foothill Yellow-legged Frog distribution, Lind (2005) identified an impoundment effect. The species was associated with streams lacking dams or with streams with small dams that were located far upstream of occupied locations, and extirpated localities 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 (Ibid.). Along with eliminating habitat and causing local extirpations, dams fragment stream habitat, which interferes with normal dispersal and movements and can impede recolonization after local extirpations (Fellers 2005, Peek 2010).

In addition to a reduction of suitable breeding habitat downstream of dams, aseasonal releases can result in significant loss of annual breeding efforts. High flow releases in late spring can result in scouring of egg masses downstream, whereas poorly timed receding flows can leave egg masses stranded on land to desiccate (Kupferberg et al. 2009b, Lind et al. 1996). Scouring of egg masses has been documented at several locations across the species' range in California including the Trinity River (Lind et al. 1996a), Pit River (Ellis and Cook 2004), and North Fork Feather River (Jackman et al. 2004). In Alameda Creek, Bobzien and DiDonato (2007) concluded that unnatural and consistently higher discharge and irregular flows appeared to be a major factor in poor reproductive conditions for Foothill Yellow-legged Frog populations below dams when compared to those occupying stream reaches with natural flows.

In addition to aseasonally high flows scouring egg masses, summer pulse flows, primarily provided for white water rafting recreation or hydroelectric power generation, can displace larvae approaching metamorphosis (Kupferberg et al. 2011). Experiments suggest that during these pulse flows, larvae seek refuge from higher velocities in the substrate, but many are washed downstream (Ibid.). Larvae exposed to repeated sub-lethal velocities grew significantly less and experienced higher predation than larvae reared at ambient velocities, suggesting there is an energetic cost associated with pulse flows during this stage of development (Ibid.)

Disease

The introduced fungal pathogen *Batrachochytrium dendrobatidis* (Bd), which causes chytridiomycosis, is responsible for amphibian declines in the United States and Central

America (Fellers 2001). This disease causes abnormalities in jaw sheaths and teeth rows of larvae and is fatal in some species. Bd has been detected in Foothill Yellow-legged Frogs in California by several researchers sampling over large areas of the state (Adams et al. in press; Fellers 2001; Davidson et al. 2007; Johnson and Saulino 2007; Lowe 2007, 2009; Padgett-Flohr and Hopkins 2009), but its population-level effects are unknown (Fellers 2005). Most post-metamorphic frogs were not infected, and all individuals >40 mm were Bd-free. While Foothill Yellow-legged Frogs are hosts to Bd, there is conflicting evidence regarding its lethality under laboratory conditions (Davidson et al. 2007, G. Padget-Flohr pers. comm. to S. Kupferberg), although Bd infection does appear to negatively affect growth in the lab and the field (Davidson et al. 2007, Lowe 2009). In laboratory experiments, Davidson et al. (2007) found that Bd 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 Bd infection.

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). Padgett-Flohr and Hopkins (2009) determined through histological examination of museum specimens of Foothill Yellow-legged Frogs that Bd has likely been present in the Alameda Creek watershed in Alameda County since at least 1961. Bd had been detected by others over the last decade many miles upstream of the site, but this die-off event was the first documented negative effect of Bd infection among Foothill Yellow-legged Frogs in the watershed (Adams et al. in press). The outbreak coincided with extremely low stream flows, which concentrated frogs in drying pools and expanded the spatial distribution of non-native bullfrogs in the stream network (Ibid.). Bullfrogs may represent a reservoir for Bd when Foothill Yellow-legged Frogs in the population are Bd negative because the strongest predictor of Bd load in Foothill Yellow-legged Frogs was the presence of bullfrogs (Ibid.). Although Foothill Yellow-legged Frogs have not experienced the kind of catastrophic die-offs across its range like those observed in the Sierra Nevada Yellow-legged Frog (*R. sierrae*) and Southern Mountain Yellow-legged Frog, this die-off event proves the species is susceptible to large-scale mortality from chytridiomycosis under certain conditions.

Other potential Foothill Yellow-legged Frog pathogens include *Saprolegnia* sp., a water mold observed on amphibian egg masses in the Trinity River (Ashton et al. 1998); the bacteria *Aeromonas hydrophilia*, which is responsible for “red leg” disease; and iridioviruses (*Ranavirus* spp.), which are found in fish and frogs.

Invasive Species

Non-native predators such as predatory fishes, bullfrogs, and crayfish are a primary threat to Foothill Yellow-legged Frogs (Ashton et al. 1998, Fellers 2005, Hayes and Jennings 1986, Kupferberg 1996b, Lind et al. 2003, Lind et al. 1996, Moyle 1973, Paoletti 2009, Paoletti et al. 2011).

Bullfrogs and crayfish adversely affect amphibian populations in general through direct predation as well as competition for resources (Hayes 1985, Hayes and Jennings 1986, Jennings 1988, Kats and Ferrer 2003, Kupferberg 1996b). Centrachid fishes readily eat Ranid

eggs (Werschkul and Christensen 1977) and may contribute to the extirpation of Foothill Yellow-legged Frog populations. Rombough et al. (2005b) reported that Foothill Yellow-legged Frog abundance and production was inversely related to abundance of smallmouth bass (*Micropterus dolomieu*) and bullfrogs. Borisenko and Hayes (1999) found bullfrogs and fishes occurred significantly more often at sites where Foothill Yellow-legged Frogs had been extirpated than extant sites. Bullfrogs have been linked to decreased Foothill Yellow-legged Frog abundance in the Sierra Nevada (Moyle 1973) and the North Coast (Kupferberg 1997a); in the latter system, it was discovered that bullfrog larvae perturbed the aquatic community structure, resulting in negative effects on Foothill Yellow-legged Frog populations (Ibid.). In addition, interspecific pairings due to mate-confusion between male Foothill Yellow-legged Frogs and female bullfrogs have been observed, which has the potential to reduce the reproductive output of Foothill Yellow-legged Frogs (Lind et al. 2003).

The invasive New Zealand mudsnail (*Potamopyrgus antipodarum*) is an emerging concern for California waterways due to their ability to grow and multiply rapidly, attaining high densities that can alter macroinvertebrate community composition and food web function (Alonso and Castro-Díez 2008). New Zealand mudsnails occur in watersheds with extant populations of Foothill Yellow-legged Frogs (Foster et al. 2016), and while experiments have demonstrated the mudsnails can have adverse effects on survival of Western Toad (*Anaxyrus boreas*) larvae (Bennett et al. 2015), their impact on Foothill Yellow-legged Frogs in the wild is unknown.

Ely (1993, 1994) reported that predation by feral pigs (*Sus scrofa*) is a concern for Foothill Yellow-legged Frogs in some locations, and as previously mentioned, Kupferberg et al. (2009a) found evidence that unusually warm summer water temperatures were associated with outbreaks of the parasitic non-native copepod *Lernaea cyprinacea* and malformations in Foothill Yellow-legged Frog larvae tadpoles and young of the year.

Livestock Grazing

Masters (1997) described the negative impacts of cattle grazing on habitat used by Foothill Yellow-legged Frogs from a site in Oregon, which included crushing eggs, larvae, juveniles, and adults; elimination of vegetation; introduction of non-native vegetation; alteration of vegetation composition and structure; degradation of water quality from urine and feces; alteration of microhabitat conditions; and erosion resulting in sedimentation covering cobble-sized rocks used for breeding and reducing the interstitial spaces used by larvae.

In addition, overgrazing that results in open vegetation can expose amphibians to increased risk of predation and desiccation (SNEP 1996), but in some locations carefully managed grazing could be used as a tool to keep vegetation from encroaching into the active channel because too much canopy cover can make sites unsuitably shady for Foothill Yellow-legged Frogs (S. Kupferberg pers. comm. 2016).

Logging

Timber harvest in the absence of sufficient riparian buffer zones can decrease populations of Foothill Yellow-legged Frogs by increasing water temperatures to lethal levels and by causing

siltation of streambeds (Corn and Bury 1989). High levels of silt can hamper attachment of egg masses to substrate (Applegarth 1994, Ashton et al. 1998), inhibit embryonic development (Jennings and Hayes 1994), reduce the interstitial spaces available for use by larvae and algal growth on which they feed (Power 1990), and negatively impact adult prey such as aquatic macro-invertebrates (Petts 1984).

Marijuana Cultivation

Cultivation of *Cannabis* (i.e., marijuana) is a threat to Foothill Yellow-legged Frogs and their habitat, particularly in Northern California where it is concentrated and its effects are magnified by prolonged drought conditions. Marijuana cultivation can adversely impact the species by legal and illegal water extraction that can dewater the streams, introducing pesticides and chemical fertilizers into waterways, denuding terrestrial habitat adjacent to streams and terracing the slopes, and promoting the growth of toxic cyanobacteria (Bauer et al. 2015, Carah et al. 2015, Gonsolin 2010). Gonsolin (2010) observed the decline of a Foothill Yellow-legged Frog population in the upper Coyote Creek watershed, Santa Clara County, due to impacts from illegal marijuana cultivation.

Mining

Mining activities, particularly suction dredging and gravel mining, can adversely affect all life stages of Foothill Yellow-legged Frogs and substantially degrade the species' habitat (Ashton et al. 1998, Olson and Davis 2009). Suction dredging can increase suspended sediment; modify stream geomorphology, directly remove aquatic organisms; and rearrange the substrate of streams (CDFG 1994, 2012). It can adversely impact reproduction by disturbing adults during courtship and breeding activities; disturbing habitat during the reproductive season; and displacing, burying, or suffocating eggs and larvae (CDFG 1994, Harvey and Lisle 1998). Suction dredging can also kill larvae that cannot escape the vacuum, remove or displace overwintering habitat such as woody debris, and adversely affect Foothill Yellow-legged Frog prey base. A moratorium in California prohibited the Department from issuing suction dredge permits and use of related equipment in any river, stream, or lake through 30 June 2016, but it may be permitted in the future.

Many northern Sierra Nevada foothill streams 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). In addition, abandoned mine tailings and settling ponds are often contaminated with heavy metals like mercury that are detrimental (Olson and Davis 2009). Mercury concentrations in 100% of 13 Foothill Yellow-legged Frogs collected in the late 1990s from the Cache Creek watershed in Lake County exceeded the EPA mercury criterion for issuance of health advisories for human fish consumption and the methylmercury criterion for the protection of piscivorous wildlife (Hothem 2008).

Off-road Vehicles

According to Sweet (1983) off-road vehicle damage to Foothill Yellow-legged Frog habitat contributed to the species' extirpation from some Southern California coastal streams. In

addition, the disappearance of Foothill Yellow-legged Frogs from Corral Hollow in San Joaquin County may have been as a result of off-road vehicle damage (Jones & Stokes 2000).

Pollution

A number of pollutants found in the environment have the potential to adversely impact Foothill Yellow-legged Frogs including air-borne pesticides, herbicides, fertilizers, air pollution, and mercury contamination. Toxic material spills are also a concern where roads and railroads occur near streams (Ashton et al. 1998).

Easterly prevailing winds from the Central Valley carry herbicides and pesticides into the Sierra Nevada foothills where they are deposited on the land and in the water and are taken up into the tissues of amphibians, including Foothill Yellow-legged Frogs. Davidson et al. (2002) found a strong positive association between declines Foothill Yellow-legged Frogs in areas downwind of agricultural land use and that sublethal exposure to the pesticide carbaryl likely inhibits their innate immune defense, increasing susceptibility to disease. Kerby and Sih (2015) reported that exposure to carbaryl reduced Foothill Yellow-legged Frogs' ability to compete with Pacific Treefrogs (*Pseudacris regilla*) and increased mortality 50% when exposed to the pesticide with signal crayfish present. Sparling and Fellers (2007) determined that compounds derived from the breakdown of commonly used pesticides are 10-100 times more toxic than their parent compounds on Foothill Yellow-legged Frogs, and they concluded the pesticides found in the Sierra Nevada are at sufficient concentration levels to cause a significant decrease in survival rates. In addition, sublethal effects of pesticides in Foothill Yellow-legged Frogs have been observed including significant alteration of behavior and development (Kerby 2007). Studies that examine the effects of individual pesticides may be underestimating the impacts because mixtures of pesticides, like those found deposited in the wild, have much greater adverse effects on frogs than single pesticides (Hayes et al. 2006).

Hayes et al. (2003) observed hermaphrodism and deformities in Northern Leopard Frogs (*R. pipiens*) exposed to the widespread herbicide atrazine. Marco et al. (1999) reported reduced feeding activity, disequilibrium, physical abnormalities, paralysis, and even death in some larval and young Oregon Spotted Frogs exposed to moderate concentrations of nitrates and nitrites. In addition to drift from aerially applied fertilizers, nitrate can be deposited in higher elevations from air pollution and from livestock waste. 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).

Mercury contamination is another threat to the Foothill Yellow-legged Frogs in some areas of California. Research shows that mercury can adversely affect amphibian development and 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). As previously mentioned under "Mining," several Foothill Yellow-legged Frogs from the Cache Creek area had mercury concentrations high enough to pose a potential hazard to human or wildlife consumption (Hothem 2008).

Recreation

Foothill Yellow-legged Frogs and their habitat can be adversely impacted by some forms of recreation. Any activities undertaken near a stream bank or in the stream could potentially disturb basking behavior or crush or displace egg masses or small larvae including wakes caused by motor boats, vehicles driving on gravel bars, people camping, angling, swimming, and waking dogs (Borisenko and Hayes 1999). There are documented cases of Foothill Yellow-legged Frog egg masses being crushed by dogs and people in Little Carson Creek in Marin County (Prado 2005), and intensive disturbance by humans and dogs in breeding habitat in the (S. Kupferberg pers. comm., J. Miller pers. obs.).

Roads and Urbanization

As the population in California continues to grow, habitat is converted to urban and suburban uses and roads are constructed to connect newly developed areas. Roads that span over streams likely have some adverse effect on Foothill Yellow-legged Frogs through sedimentation during road construction, maintenance work disturbances, potential culvert or foundation failures, or use of culverts that frogs will not pass through. Using data from Oregon and California, Lind (2005) found that Foothill Yellow-legged Frog presence was associated with less urban development nearby.

2. Other Relevant Scientific Information

The Department does not possess any additional relevant scientific information beyond what was provided in the Petition regarding factors affecting the Foothill Yellow-legged Frog's ability to survive and reproduce or the degree and immediacy of those threats.

3. Sufficiency of the Petition with regard to Factors Affecting the Ability to Survive and Reproduce and Degree and Immediacy of Threat

The Department concludes that the Petition contains sufficient information to suggest that Foothill Yellow-legged Frogs are adversely affected by a number of on-going and future threats including, but not limited to, dams and diversions, invasive species, climate change, and pollutants.

G. Impact of Existing Management Efforts

1. Information in the Petition

The Petition, on pages 113 through 119, contains the following information related to federal and state regulatory mechanisms that have the potential to provide some form of protection for the Foothill Yellow-legged Frog. Federal regulatory mechanisms include occurrence on federally managed lands, consideration under the National Environmental Policy Act (NEPA) or the Clean Water Act (CWA), and coverage under Habitat Conservation Plans (HCP). State regulatory mechanisms include coverage under Natural Community Conservation Plans (NCCP) and consideration under the California Environmental Quality Act (CEQA).

Occurrence on Federal Land

Foothill Yellow-legged Frogs occur in National Forests and on Bureau of Land Management (BLM) lands in California. The Foothill Yellow-legged Frog is listed as Sensitive by the Forest Service, a designation that offers little protection for the species or its habitat. A “Sensitive” designation requires that project impacts be considered under NEPA through a Biological Assessment and Evaluation, but it does not mean a project with substantial adverse effects to Foothill Yellow-legged Frogs cannot be approved.

The Forest Service adopted the Sierra Nevada Forest Plan Amendment (Amendment) in 2001, which was intended to shift management of 4.65 million ha (11.5 million ac) of National Forests in the Sierra Nevada to ecosystem management principles. In practice, it has not provided adequate protection for Foothill Yellow-legged Frogs from water withdrawals, river flow regulation, livestock grazing, and sedimentation from forest roads. The Amendment committed the Forest Service to completing a Foothill Yellow-legged Frog Conservation Assessment in cooperation with other federal and State agencies, universities, and research scientists, which was published in 2016 (Hayes et al. 2016); however, this document only provides management recommendations, not mandated protections. While the Amendment contains an Aquatic Conservation Strategy that focuses on reducing some threats to amphibians such as changes to livestock grazing and fish stocking, the primary focus of the Amendment is on terrestrial ecosystems. It contains some management recommendations, like fuels treatments at lower elevations due to their large wildland/urban interface areas that could increase the risk of habitat degradation for Foothill Yellow-legged Frogs. And since its adoption, the Amendment has been under attack by legislators and industry that want to weaken environmental protections and monitoring to increase logging.

The Forest Service and BLM adopted the Northwest Forest Plan (Plan) in 1994, which included an Aquatic Conservation Strategy and established “riparian reserves” that set protective buffers from logging along perennial and intermittent streams, among other measures. However, like the Amendment, in practice, it has not been effective in preventing damage and is jeopardized by efforts to weaken environmental protections by reducing Riparian Reserves to allow for more logging on near-stream and unstable lands (Frissell 2013, 2014). The Forest Service and BLM are in the process of revising the Plan to reduce stream buffers and weaken the Aquatic Conservation Strategy (USBLM 2015). If adopted, logging near streams could alter thermal regimes, increase summer stream temperatures, increase erosion and sediment delivery to streams, and diminish the capacity of riparian forests to filter nutrient loads that threaten water quality (Frissell 2013, 2014; Heiken 2013).

While the three National Parks (Yosemite, Kings Canyon, and Sequoia) within the Foothill Yellow-legged Frog’s historical range in the Sierra Nevada have guiding principles, management goals and management plans that are beneficial for aquatic ecosystems, the species is already extirpated from them, and even federal lands such as these are not protected from threats such as pesticide drift and invasive predators.

National Environmental Policy Act

NEPA requires federal agencies to consider the environmental impacts of their actions through a process where they describe a proposed action, consider alternatives, identify and disclose potential environmental impacts of each alternative, and involve the public in the decision-making process. NEPA does not prohibit agencies from choosing alternatives that will adversely affect Foothill Yellow-legged Frogs or their habitat. In spite of NEPA being in place for 45 years, the species has continued to decline on federal lands throughout most of California.

Clean Water Act

Under Section 404 of the CWA, discharge of pollutants, including dredge or fill material, into "waters of the U.S." is prohibited without a permit from the U.S. Army Corps of Engineers (USACE). According to a report entitled "Compensating for Wetland Losses Under the Clean Water Act," the goal of no net loss of wetlands has not been achieved through the USACE regulatory program, partly because permittees do not follow through on required mitigation packages (National Research Council 2001). In addition, the USACE regulatory program has allowed development with too few requirements to avoid and mitigate impacts, and it only looks at the project footprint when evaluating impacts.

Habitat Conservation Plans

There are four HCPs within the Foothill Yellow-legged Frog's range in California that include it as a covered species: the San Joaquin County Multi-species HCP 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). The species is likely extirpated from the coverage areas of the first two HCPs, and very few extant populations will gain any protection from the last two.

Depending on the waterway, Foothill Yellow-legged Frogs are considered common, rare, or potentially absent in the rivers and streams within the Humboldt Redwood Company HCP (HRCHCP) area. There are no species-specific conservation measures within the HRCHCP, but there is an amphibian and reptile conservation plan that describes a promise to retain habitat diversity and a mix of forest types post-logging. The HRCHCP permits logging 57% of the remaining 10,580 ha (23,147 ac) of old growth forest within the plan area, and the total level of timber harvest and road building will likely have an overall adverse impact on the species.

Foothill Yellow-legged Frogs are considered extirpated from the lowlands and below most dams within the Santa Clara Valley HCP (SCVHCP) area, but populations are still extant in streams above the reservoirs. Approximately 9.2 km (5.7 mi) of modeled Foothill Yellow-legged Frog stream channels are expected to be permanently impacted by covered activities and 3.2 km (2.0 mi) are expected to be temporarily impacted. The SCVHCP proposed to acquire a minimum of 129 km (80 mi) of primary and secondary modeled habitat for the species into the SCVHCP's Reserve System and to restore 1.6-16.9 km (1.0-10.4 mi) of streams with a goal of to supporting Foothill Yellow-legged Frog breeding. However, the SCVHC only proposes to protect 32-44% of the 1,110 km (690 mi) of modeled primary and secondary habitat within the plan area. The HCP

Reserve System was expected to protect only four known Foothill Yellow-legged Frog populations in the plan area, although the species could be present in areas of suitable habitat and just haven't been documented yet.

Coverage under an HCP does not guarantee a species will be better off (or recovered) in the long run, and numerous analyses of the failures of HCPs to achieve their desired goals are presented on pages 117-118 in the Petition (Bowler 2000, Harding et al. 2001, Hood 1998, Kareiva et al. 1999, Owley 2015, Rahn et al. 2006, Smallwood 2000, Smallwood et al. 1998, Wilhere 2002). Issues include, but are not limited to, insufficient and/or poorly defined mitigation measures; allowance of too much take of individuals or habitat; failure to properly take inadequate data and uncertainties into account; failure to secure adequate funding for preserve acquisition and management; and improper or inadequate tracking of mitigation obligations, including recording conservation easements and effectiveness monitoring.

The State of California lists the Foothill Yellow-legged Frog as a "Species of Special Concern," but this administrative designation carries no formal legal status.

Natural Community Conservation Plans

Of the nine NCCPs approved in California, two are within the Foothill Yellow-legged Frog's range: the East Contra Costa County NCCP and the Santa Clara Valley NCCP (CDFW 2015). These plans are joint HCP/NCCPs, so the discussion above regarding the limitations of the HCPs to protect the species applies here. Currently, there is one other NCCP that's in a planning phase and lists Foothill Yellow-legged Frog as a covered species: Butte Regional Conservation Plan (Ibid.).

California Environmental Quality Act

CEQA requires State agencies, local governments, and special districts to evaluate and disclose project impacts when they undertake discretionary activities that may have a significant effect on the environment. The CEQA statute language includes "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." CEQA has procedural mandates for environmental protection that include a provision requiring lead agencies to deny approval of a project that would have significant adverse impacts when feasible alternatives or mitigation measures exist and can reduce the impacts to less than significant; however, if social or economic factors outweigh environmental costs, they can approve the project after all the feasible avoidance and mitigation measures are adopted. Under CEQA, lead agencies are only required to consider project impacts on Species of Special Concern if they meet the criteria of sensitivity under Section 15380 of the CEQA Guidelines. In practice, this means that unless a project is likely to have significantly adverse impacts at a population or regional level, the lead agency does not have to consider Foothill Yellow-legged Frogs.

Regional and Local Government Plans

Madera County adopted a Foothill Yellow-legged Frog Program in 1997 that included measures to protect suitable habitat from significant anthropomorphic activities, but the species may already be extirpated from the county.

Summary

In spite of existing regulatory and voluntary conservation mechanisms, Foothill Yellow-legged Frog populations continue to decline and disappear. They do not provide the type of protections that address impacts from invasive species, pollutants and pesticides, disease, and climate change. Without state listing, conservation methods such as reintroductions and habitat restoration are unlikely to be utilized.

2. Other Relevant Information

The Department does not possession any addition relevant information regarding the impact of existing management but does have three points of clarification. First, while the Species of Special Concern designation carries no formal protections, its intent is to draw attention to a species and implement proactive conservation measures before it warrants the special protections afforded by CESA. Second, the intent of an HCP is not to recover covered species; its measures are meant to provide protection for the species and mitigate incidental take from covered activities. Nearly all of the reports citing the failures or limitations of HCPs were written over 15 years ago when their development was still relatively new and well before the finalization of the SCVHCP.

Finally, the purpose of NCCPs is to sustain and restore covered species and habitat necessary to maintain continued viability of biological communities impacted by human changes to the landscape. NCCPs must ensure implementation of mitigation and conservation measures roughly proportional in time and extent to impacts on covered species or habitat and protect and maintain habitat areas large enough to support sustainable populations of covered species. The Petition states that only 32-44% of modeled Foothill Yellow-legged Frog habitat within the SCVHCP area is proposed for protection under the SCVHCP. However, the SCVHCP limits direct impacts from covered activities to less than 1% of the total modeled Foothill Yellow-legged Frog habitat in the plan area. Because mitigation and conservation measures under the SCVHCP must be roughly proportional to any impacts on Foothill Yellow-legged Frog and its habitat, the Department expects that implementation of the SCVHCP will protect adequate habitat to support sustainable populations of the Foothill Yellow-legged Frog.

3. Sufficiency of the Petition with regard to Impacts of Existing Management Efforts

The Department concludes that the Petition contains sufficient information to suggest that existing regulatory mechanisms and management plans do not adequately protect Yellow-legged Frogs from impacts that threaten their long-term survival.

H. Suggestions for Future Management

1. Information in the Petition

The Petition, on pages 119 to 120, contains the following suggestions for future management.

Require frog-friendly flow regimes: In rivers with Foothill Yellow-legged Frog populations below dams, prohibit aseasonal flow fluctuations that could strand or scour egg masses and larvae, develop flow regimes that mimic the natural seasonal flows the species is adapted to, and maintain thermal regimes that are conducive to larval survival and rapid development.

Restore stream channel habitat: In rivers with Foothill Yellow-legged Frog populations below dams where operations have artificially cooled the water, suppressed flood disturbance, limited sediment supply, and facilitated encroachment of woody riparian vegetation into the active channel, create thermal habitat heterogeneity by restoring gently sloping and sun-lit gravel bars used for breeding.

Eradicate invasive predators: Conduct active eradication and management efforts to decrease the abundance of bullfrogs, non-native fish, and crayfish. In managed rivers, manipulate stream flows to negatively affect non-native species that are not adapted to a winter flood/summer drought flow regime.

Mitigate impacts of marijuana cultivation: Direct some of the money collected through taxes on *Cannabis* sales through Proposition 64 to rehabilitate streams with Foothill Yellow-legged Frogs. This includes funding law enforcement to find and stop illegal dewatering of streams as well as site remediation to remove pollutants.

Prohibit habitat damage: Ensure that State regulations for timber harvests within watersheds occupied by Foothill Yellow-legged Frogs adequately prevent siltation in streambeds or increases in water temperatures above lethal levels. Prohibit instream gravel mining or dredging in occupied reaches. Ensure all State-managed off-road vehicle areas are not adversely affecting the species and its habitat.

Restrict pesticides: Determine where and which pesticide uses should be restricted to reduce harm to Foothill Yellow-legged Frogs.

Reintroduction: Explore reintroduction of Foothill Yellow-legged Frogs to sites within the species' historic range with appropriate habitat, starting with National Parks once the stressors have been removed (e.g., post-bullfrog eradication in Yosemite National Park).

Curate locality data: The Department should take responsibility for, or find a curator to maintain a repository of, all Foothill Yellow-legged Frog survey data collected by agencies, utilities, and researchers, and submitted to the California Natural Diversity Database.

2. Other Relevant Information

Most of the following recommendations are adapted from the Foothill Yellow-legged Frog species account in the recently published California Amphibian and Reptile Species of Special Concern (Thomson et al. 2016).

Explore dam removal: Where appropriate, removing dams can benefit multiple species and improve ecosystem function.

Consider Foothill Yellow-legged Frogs during river restoration projects: Sometimes habitat management and restoration projects target specific taxa and don't consider the potentially negative effects to sympatric species. For example, placement of instream structures to improve habitat for fish can adversely impact Foothill Yellow-legged Frogs (Fuller and Lind 1992).

Prioritize conservation of southern populations: Due to the degree of losses experienced in the southern part of California and the high degree of genetic diversity found in this part of the species' range (Lind et al. 2011), funding and conservation efforts should be prioritized here, including an attempt to relocate potentially remnant populations.

Remove anthropogenic features that support invasive species: Remove artificial pools such as abandoned mine tailing ponds that support bullfrog breeding.

Increase understanding of population dynamics: Currently, the mechanisms underlying hydrological impacts on Foothill Yellow-legged Frogs are best understood at the egg mass stage, but more research is needed into survival of larvae and juveniles, particularly during overwintering.

Conduct a range-wide landscape genomics study: Advances in genetic techniques allow for analysis of large datasets at reasonable prices, and the results can help identify genetic hotspots, barriers to dispersal, and where management units should be drawn that can inform potential future reintroductions.

Maintain adequate riparian buffers: Reduce the risk of habitat degradation from adjacent activities like timber harvest, agriculture, and grazing by maintaining robust riparian buffers around extant populations and in sites suitable for or identified for potential future reintroductions.

3. Sufficiency of the Petition with regard to Suggestions for Future Management

The Department concludes that the Petition contains sufficient information to demonstrate that additional management efforts may aid in maintaining and increasing self-sustaining populations of Foothill Yellow-legged Frogs in California.

I. Availability and Sources of Information

1. Information in the Petition

The Petition contains a 35-page bibliography, on pages 121 through 155, of literature cited and personal communications with credible sources, the vast majority of which were provided to the Department on a CD upon request.

2. Other Relevant Information

The Department used publicly available information and provided citations. The Department also used unpublished reports and data as well as personal communications that can be provided upon request. The Department did not receive any information from the public during the Petition Evaluation period pursuant to Fish and Game Code Section 2073.4.

3. Sufficiency of the Petition with regard to Availability and Sources of Information

The Department concludes the Petition contains sufficient sources of information that are readily available to attempt to determine the status of the Foothill Yellow-legged Frog.

J. Detailed Distribution Map

1. Information in the Petition

The Petition contains four detailed maps, on pages 7 through 10, depicting historical and current distribution of Foothill Yellow-legged Frogs.

2. Other Relevant Information

The Department does not possess any additional relevant information regarding Foothill Yellow-legged Frog distribution that would substantively change the maps provided in the Petition.

3. Sufficiency of the Petition with regard to a Detailed Distribution Map

The Department concludes the Petition contains a sufficient depiction of the Foothill Yellow-legged Frog's historical and current distribution.

IV. Status of the Species

The Foothill Yellow-legged Frog's range has contracted in California; the species appears to be extirpated from its former range in Southern California and near extirpated from the southern Sierra Nevada. Within its current range, the Foothill Yellow-legged Frog's distribution and abundance have declined in some areas. The species' life cycle is closely tied to seasonal stream flows, and it requires specialized habitat conditions for successful reproduction.

Changes in natural flow regimes as a result of dams and diversions appear to be a primary threat to long-term survival of the species. As an ectotherm with highly permeable skin, the Foothill Yellow-legged Frog is particularly sensitive to climate change and pollution. Invasive species and incompatible land uses near stream habitats may also threaten the species' long-term survival.

Having reviewed and evaluated the Petition on its face and in relation to other relevant information, including the material referenced in the Petition and other information in possessed or received by the Department, the Department has determined that there is sufficient scientific information available at this time to indicate that the petitioned action may be warranted and recommends that the Petition be accepted and considered. (See Fish & G. Code, § 2073.5, subd. (a)(2); Cal. Code Regs., tit. 14, § 670.1, subd. (d).)

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Personal Communications

Beeman, Gary. Beeman & Associates, Lafayette, CA.

Garwood, Justin. Environmental Scientist. California Department of Fish and Wildlife. Electronic mail received January 26, 2017.

Jankovitz, Jon. District Fisheries Biologist, California Department of Fish and Wildlife. Electronic mail received February 2, 2017.

Kupferberg, Sarah. Visiting Scholar, Ph.D. Integrative Biology, U.C. Berkeley.

Matson, Dan. Ranger Unit Chief, Jackson Demonstration State Forest, Department of Forestry and Fire Protection, Willits, CA.

Miller, Jeff. Alameda Creek Alliance, Center for Biological Diversity.

Nelson, Jennifer. Environmental Scientist, California Department of Fish and Wildlife. Electronic mail received February 2, 2017.

Sak, Brian. Fisheries Biologist, San Francisco Public Utilities Commission.

Seymour, Rich. Wildlife Biologist, Coyote Creek Riparian Station.

van Hattem, Michael. Senior Environmental Scientist Specialist, Habitat Conservation Branch, California Department of Fish and Wildlife.

Vredenburg, Vance. University of California Museum of Vertebrate Zoology, Department of Integrative Biology, Berkeley, CA.

Westphal, Mike. Biologist, Coyote Creek Riparian Station.