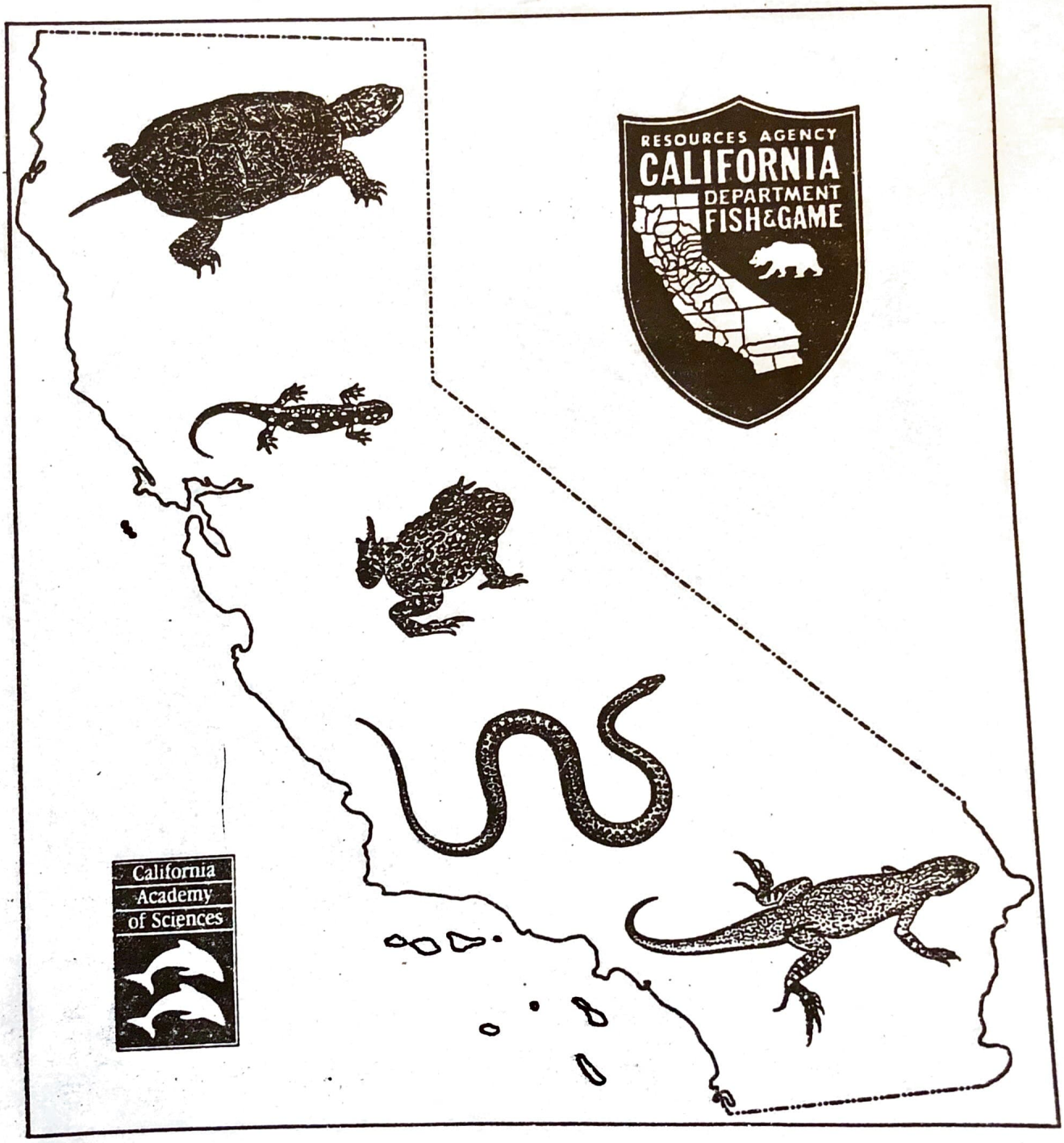
AMPHIBIAN AND REPTILE SPECIES OF SPECIAL CONCERN IN CALIFORNIA



CALIFORNIA DEPARTMENT OF FISH AND GAME

changes in the salinity gradients in coastal lagoons that could significantly impact the survivorship of *R. a. aurora* in a manner similar to that reported for *R. a. draytonii* (see Jennings and Hayes 1989) need study. Finally, because it is likely that many of the conditions that impact *R. a. aurora*, allowing for differences in their respective life histories, also impact *R. a. draytonii*, the account for the California red-legged frog should be read to gain a broader perspective on other potential impacts.

CALIFORNIA RED-LEGGED FROG
Rana aurora draytonii Baird and Girard 1852

Description: A large (85.0-138.0 mm SUL) brown to reddish brown frog with prominent dorsolateral folds and diffuse moderate-sized dark brown to black spots that sometimes have light centers (Storer 1925; pers. observ.). Distribution of red or red-orange pigment is highly variable, but usually restricted to the belly and the undersurfaces of the thighs, legs, and feet. Some individuals have red pigment extending over all undersurfaces and upper surfaces of the body; other individuals lack red pigment entirely or have it restricted to the feet (pers. observ.). The groin has a distinct black region with a complex arrangement of light blotches that range from white to pale yellow in color. The posterior thigh is a nearly uniform brown color with 3-12 distinct white to lemon-yellow spots. The iris is dark brown with iridophores on the upper and lower portions of the iris (pers. observ.).

Taxonomic Remarks: See the northern red-legged frog (*Rana aurora aurora*) account for pertinent remarks. The California red-legged frog (*R. a. draytonii*) is a morphologically (larger body size, males have paired vocal sacs), behaviorally (males always call in air, adults do not leave the site of oviposition), and probably genetically distinct form (Hayes and Miyamoto 1984; Green 1985a; pers. observ.). Comprehensive study of the geographic pattern of morphological, behavioral, and genetic variation, some of which is underway, is needed to determine whether the California red-legged frog represents a distinct species.

Distribution: The historic range of this frog extends through Pacific slope drainages from the vicinity of Redding (Shasta County: Storer 1925) inland and at least to Point Reyes (Marin County: pers. observ.), California (coastally) southward to the Santo Domingo River drainage in Baja California, Mexico (Linsdale 1932). Historically, it also occurred in a few desert slope drainages in southern California (Jennings and Hayes 1994). Populations in central southern Nevada are introduced (Linsdale 1940, Green 1985b). In California, it occurs from Shasta County south to the Mexican border (Figure 17). The records for Santa Cruz Island have been shown to represent an introduction (Jennings 1988a). Its known elevational range extends from near sea level to around 1500 m, although some of the populations toward the upper limit of the range of this species may represent translocations (unpubl. data).

Life History: California red-legged frogs breed early in the year (late November-late April: Storer 1925; Hayes and Jennings 1986; S. Sweet, pers. comm.; pers. observ.), undoubtedly because they have a low embryonic critical thermal maximum (see Hayes and Jennings 1986) that restricts them to using a time-window with a high probability of ensuring embryonic survival. Males appear at breeding sites from 2-4 weeks before females (Storer 1925). At breeding sites, males typically call in small, mobile groups of 3-7 individuals that attract females (pers. observ.). Females move toward male calling groups and amplex a male. Following amplexus, females move to the site of oviposition and attach egg masses containing ca. 2,000 to 6,000 moderate-sized (2.0-2.8 mm in diameter), dark reddish brown eggs to an emergent vegetation brace (Storer 1925; pers.

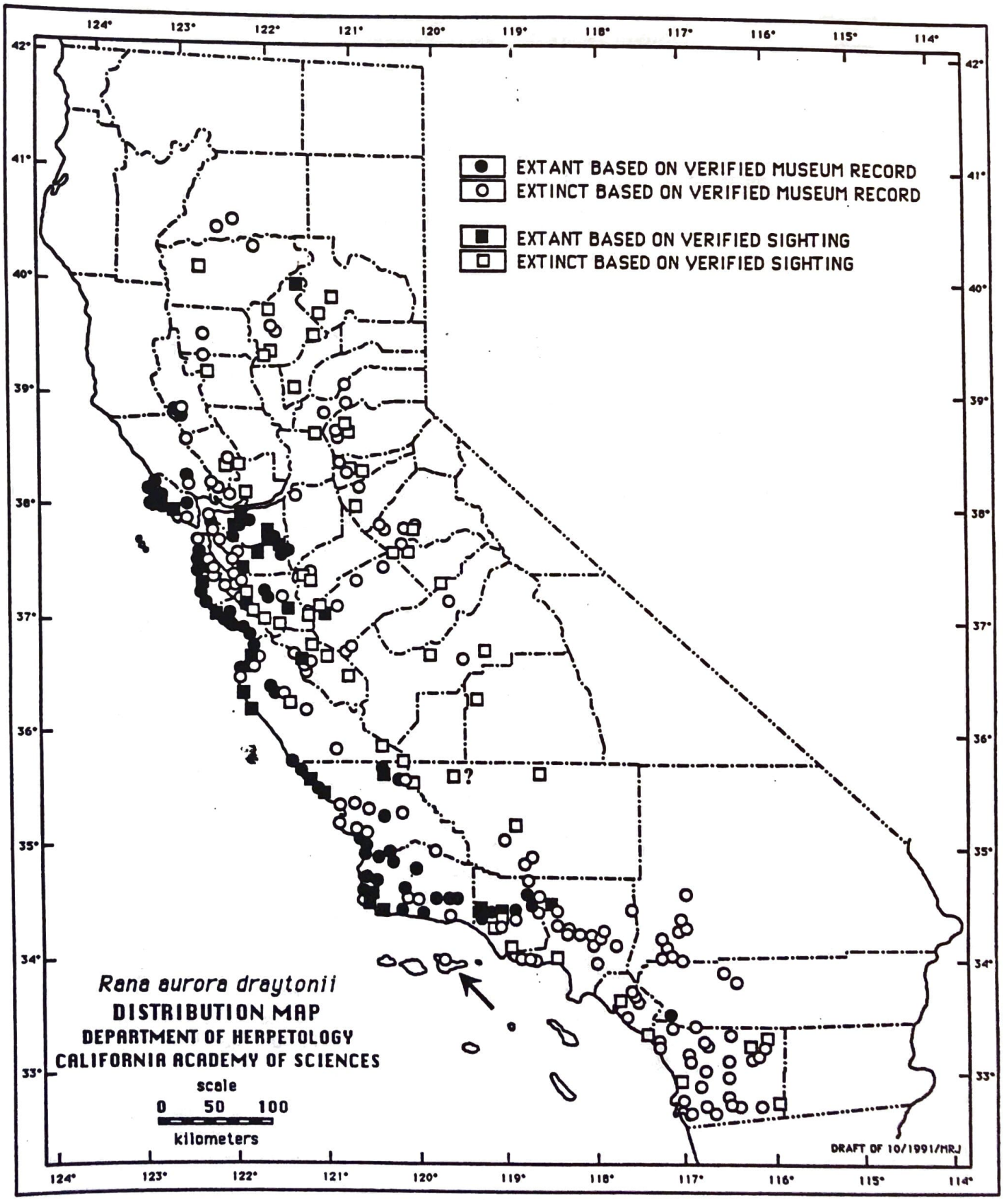


Figure 17. Historic and current distribution of the California red-legged frog (*Rana aurora draytonii*) in California based on 762 locations from 1229 museum records and 291 records from other sources.

observ.). Embryos hatch 6-14 days after fertilization, and larvae require 4-5 months to attain metamorphosis (Storer 1925). Larvae are thought to be algal grazers, but the foraging ecology of larval *R. a. draytonii* is unknown. Larvae are infrequently observed in the field because they spent most of their time concealed in submergent vegetation or organic debris (pers. observ.). Larvae, which are not known to overwinter, typically metamorphose between July and September (Storer 1925; pers. observ.). Postmetamorphs grow rapidly, and sexually maturity can be attained at 2 years of age by males and 3 years of age by females (Jennings and Hayes 1985), but both sexes may not reproduce until 3 and 4 years of age, respectively (pers. observ.). Females attain a significantly larger body size than males (138 mm vs. 116 mm SUL: Hayes and Miyamoto 1984). No data are available on the longevity of California red-legged frogs.

Unlike northern red-legged frogs, adult California red-legged frogs do not appear to move large distances from their aquatic habitat, although they are known to make pronounced seasonal movements within their local aquatic and terrestrial habitats. Adult *R. a. draytonii* move seasonally between the site of oviposition and the foraging habitat occupied in spring and summer (Jennings and Hayes 1989; pers. observ.), but a few data indicate that they move into terrestrial riparian thickets during the fall (Rathbun et al. 1993). It is also known that during periods of high water flow, California red-legged frogs are rarely observed (S. Sweet, pers. comm.; pers. observ.). Where frogs go during this interval is not well understood, but at least some individuals have been observed concealed in pockets or small mammal burrows beneath banks stabilized by shrubby riparian growth (pers. observ.). Nevertheless, much of the movement ecology of *R. a. draytonii* remains poorly understood.

Postmetamorphs have a highly variable animal food diet (Hayes and Tennant 1986). Most prey that can be swallowed that are not distasteful are eaten, with larger frogs capable of taking larger prey. Frogs (Anura) and small mammal prey may contribute significantly to the diet of adults and subadults (Arnold and Halliday 1986, Hayes and Tennant 1986). Adult frogs appear to use vibrations transmitted along willow branch runways to detect approaching small mammal prey (see Hayes and Tennant 1986; pers. observ.).

In general, adult frogs are quite wary. Highly nocturnal (Storer 1925, Hayes and Tennant 1986), adults appear to face frequent attempts at predation by wading birds (e.g., black-crowned night herons [*Nycticorax nycticorax*], bitterns [*Botaurus lentiginosus*]), judging from the number of dorsal puncture-like wounds observed on frogs (pers. observ.). Moreover, adult frogs also seem to use vibrations transmitted along willow branches or vegetation upon which they are resting to detect the approach of certain predators (e.g., raccoons). In contrast, juveniles (≤ 60-65 mm SUL) are much less wary, are frequently active diurnally, and spend much of the daytime hours basking in the warm, surface-water layer associated with floating and submerged vegetation (see Hayes and Tennant 1986), where they can fall prey to predators such as San Francisco garter snakes (Wharton 1989) and two-striped garter snakes (*Thamnophis hammondii*: Cunningham 1959a). California red-legged frogs are seasonal prey in the diet of the San Francisco garter snake (Wharton 1989).

Habitat: Habitat of California red-legged frogs is characterized by dense, shrubby riparian vegetation associated with deep (≤ 0.7 m), still or slow-moving water (Jennings 1988b, Hayes and Jennings 1988). The shrubby riparian vegetation that structurally seems to be most suitable for California red-legged frogs is that provided by arroyo willow (*Salix lasiolepis*); cattails (*Typha* sp.) and bulrushes (*Scirpus* sp.) also provide suitable habitat (Jennings 1988b). Although California red-legged frogs can occur in ephemeral or permanent streams or ponds, populations probably cannot be maintained in ephemeral

streams in which all surface water disappears. Water should have a salinity of ≤ 4.5 $^{o}/_{oo}$ to ensure the survival of embryonic stages (Jennings and Hayes 1989). Juvenile frogs seem to favor open, shallow aquatic habitats with dense submergents (pers. observ.).

Status: Endangered in the Central Valley hydrographic basin (includes the Sacramento, San Joaquin, Kings, Kaweah, and Kern River systems) and in southern California from the Santa Clara River system south to the Mexican border; Threatened throughout the remainder of its range in California; once the abundant species of large ranid frog throughout most of lowland California, this species has sustained large reductions both in geographic range and in the size of local populations. Historically, California red-legged frogs were heavily commercially exploited for food, a situation that led to their becoming severely depleted by the turn of the century (Jennings and Hayes 1985). Continued exploitation of depleted populations and the prior and subsequent establishment of a diverse exotic aquatic predator fauna that includes bullfrogs, crayfish, and a diverse array of fishes likely contributed to the decline of the California red-legged frog (Hayes and Jennings 1986), although it is not understood which exotic aquatic predator or predators may have been most significant (Hayes and Jennings 1988). Further, habitat alterations that are unfavorable to California red-legged frogs and favorable to most of the exotic aquatic predators are confounded with potential direct effects of predation by such exotics (Hayes and Jennings 1986). The tone of these suggestions is not new. Nearly 20 years ago, Robert L. Livezey (in litt., 3 February 1972 to Leonard Fisk, then Senior Fishery Biologist with CDFG charged with investigating the state of non-game amphibians and reptiles) attempted to draw attention to the fact that he believed that the California red-legged frog has suffered a drastic reduction over the previous 15 to 20 years because of bullfrogs and expanding human activities. Regardless of the exact cause, our surveys for California red-legged frogs at over 95% of the historical localities in the Central Valley hydrographic basin over the last 10 years indicate that this species has probably disappeared from over 99% of its former range within that region. The few remaining populations are threatened by proposed reservoir construction, off-road vehicle use, and continued habitat degradation due to the cumulative effects of abusive land use practices, especially with regard to livestock grazing (pers. observ.; see Kauffman et al. 1983; Kauffman and Krueger 1984; Bohn and Buckhouse 1986) and development of groundwater resources (see Groeneveld and Griepentrog 1985). The only locality within the Central Valley hydrographic basin that supports California red-legged frogs that receives some degree of protection, the Corral Hollow Ecological Reserve, is currently threatened by siltation promoted by an off-road vehicle park and livestock grazing practices upstream. Similarly, between the Santa Clara River system and the Mexican border, extant populations of California red-legged frogs are known from only four relatively small areas. These combined areas represent no more than 1% of the area historically occupied by California red-legged frogs within that region. Additionally, no more than 10% of the localities where California red-legged frogs were recorded within the Salinas River hydrographic basin and inner Coast Ranges between the Salinas basin and the San Joaquin south of the Pacheco Creek drainage still have *R. a. draytonii.*

Significant numbers of California red-legged frogs occur only in the relatively small coastal drainages between Point Reyes (Marin County) and Santa Barbara (Santa Barbara County). The drainages within this region are characterized by more suitable habitat and a less frequent occurrence of exotic aquatic predators than elsewhere. Yet, even the California red-legged frogs within this region are threatened by an exotic aquatic predator fauna that is still slowly expanding its range, continuing habitat degradation because of abusive grazing practices, and decreased water quality because of increases salinities related to decreased freshwater flows because of increased human use and recent decreases in annual rainfall potentially related to global climate changes.

Management Recommendations: Riparian habitats where California red-legged frogs still occur need a greater degree of protection. In particular, emphasis needs to be placed on retaining the dense riparian vegetation associated with deep water habitats used by this taxon. Additionally, the water quality standards (e.g., low salinity levels: Jennings and Hayes 1989) and water flow regimes of such sites need to be maintained. This taxon is suspected of being particularly sensitive to changes in water quality due to a variety of factors (e.g., various herbicides and pesticides, sulfate ions) that have not been examined specifically for their effects on the developmental stages of this taxon; these urgently need study. The local hydrology of sites where California red-legged frogs still occur should be carefully monitored. Impacts such as additional withdrawals of surface and groundwater that modify existing flow regimes and can change water quality should especially be avoided. Particular efforts need to be made to reduce or eliminate habitat modification that results from overgrazing because grazing and similar land use practices are especially effective at reducing or eliminating the dense riparian cover required by California red-legged frogs. Despite the fact that the total protection of entire local hydrographic basins has been suggested (Moyle 1973, Hayes and Jennings 1988), that suggestion remains unimplemented. That approach may ultimately be the only way to protect some of the remaining populations of this taxon.

FOOTHILL YELLOW-LEGGED FROG
Rana boylii Baird 1854

Description: A moderate-sized (37.2-82.0 mm SUL) highly variably colored frog, but usually dark to light gray, brown, green, or yellow with a somewhat mottled appearance often with considerable amounts of brick or reddish pigment, and rough, tubercled skin (Zweifel 1955; unpubl. data). A light band is present between the eyelids that often appears as a pale triangle between the eyelids and the nose. Undersurfaces of the legs and lower belly are yellow or orangish-yellow, the latter color usually present on the largest individuals (pers. observ.). The iris is silvery gray with a horizontal, black countershading stripe (pers. observ.).

Taxonomic Remarks: Since the work of Zweifel (1955), this frog has been recognized as a distinctive species. An understanding of the genetic and karyologic variation within *R. boylii* is limited to 13 populations in central and northern California and one population in Oregon (Houser and Sutton 1969; Haertel et al. 1974; Case 1976, 1978a, 1978b; Green 1986a, 1986b). Available data indicate complex genetic variation within *R. boylii*, but data are both difficult to interpret because of some lumping of nearby populations (Case 1978b) and too few to identify any geographic patterns to genetic variation conclusively. A sound understanding of the geographic pattern of genetic variation in *R. boylii*, with the intent of distinguishing potentially cryptic taxa, is needed.

Distribution: Historically, this species was known to occur in most Pacific drainages from the Santiam River system in Oregon (Mehama, Marion County) to the San Gabriel River system (Los Angeles County) in California (Storer 1923, 1925; Fitch 1938; Marr 1943; Zweifel 1955). Its known elevational range extends from near sea level to ca. 2040 m (lower end of La Grulla Meadow, Baja California, Mexico; Stebbins 1985). No desert slope populations are known, but an isolated outpost has been reported from the Sierra San Pedro Mártir, Baja California, Mexico (Loomis 1965). In California, *R. boylii* was historically distributed throughout the foothill portions of most drainages from the Oregon border to the San Gabriel River (Figure 18). Its known elevation range in California extends from near sea level to 1940 m (Snow Mountain, Trinity County: Hemphill 1952).

6,360 ft