

California Red-Legged Frog (*Rana aurora draytonii*)



Status

- State:** Meets requirements as a “rare, threatened or endangered species” under CEQA
- Federal:** Threatened

Critical Habitat: Designated in 2001 (USFWS 2001) but rescinded in 2002 by court order except for one unit in the Sierra Nevada; proposed again in 2004 (USFWS 2004)

Population Trend

- Global:** State endemic; declining
- State:** Declining
- Within Inventory Area:** Apparently stable in some areas

Data Characterization

The location database for the California red-legged frog (*Rana aurora draytonii*) within its known range in California includes 419 data records dated from 1919 to 2001. Of these records, 344 were documented within the past 10 years; of these, 203 are of high precision and may be accurately located within the inventory area. Approximately 81 of these high-precision records are located within or near the inventory area. These records occur within non-native grassland, riparian forest, riparian woodland, riparian scrub, freshwater marsh, and wetland.

A moderate amount of literature is available regarding the California red-legged frog because of its threatened status and the recent trend in global decline in amphibians. Most of the literature pertains to habitat requirements, population trends, ecological relationships, threats, and conservation efforts. A final recovery plan for the California red-legged frog has been published by the U.S. Fish and Wildlife Service (2002).

Range

The historical range of the California red-legged frog extended along the coast from the vicinity of Point Reyes National Seashore, Marin County, California and inland from Redding, Shasta County southward to northwestern Baja California, Mexico (Jennings and Hayes 1985, Hayes and Krempels 1986). The current distribution of this species includes only isolated localities in the Sierra Nevada, northern Coast and Northern Traverse Ranges. It is still common in the

San Francisco Bay area and along the central coast. It is now believed to be extirpated from the southern Transverse and Peninsular Ranges (U.S. Fish and Wildlife Service 2002).

Occurrences within the ECC HCP/NCCP Inventory Area

Contra Costa and Alameda Counties contain the majority of known California red-legged frog occurrences in the San Francisco Bay Area (U.S. Fish and Wildlife Service 2002). However, this species seems to have been nearly eliminated from the western lowland portions of these counties, particularly near urbanization. Eighty-one occurrences of California red-legged frogs have been documented within the inventory area (California Natural Diversity Database 2001). Numerous ponds and creeks in Simas Valley support California red-legged frogs (Dunne 1995). Sizeable breeding populations are also found at Sand Creek (Black Diamond Mines Regional Park) and Round Valley (Round Valley Regional Preserve) (S. Bobzien in litt. 1900 cited in U.S. Fish and Wildlife Service 2002). Some of the highest densities of California red-legged frog occur in many of the stock ponds within the Los Vaqueros watershed.

Biology

Habitat

Within their range, California red-legged frogs occur from sea level to about 5,000 feet above sea level (U.S. Fish and Wildlife Service 2002). Almost all of the documented occurrences of this species, however, are located below 3,500 feet. Breeding sites include a variety of aquatic habitats—larvae, tadpoles and metamorphs use streams, deep pools, backwaters within streams and creeks, ponds, marshes, sag ponds, dune ponds, and lagoons. Breeding adults are commonly found in deep (more than 2 feet), still or slow-moving water with dense, shrubby riparian or emergent vegetation (Hayes and Jennings 1988). Adult frogs have also been observed in shallow sections of streams that are not shrouded by riparian vegetation. Generally, streams with high flows and cold temperatures in spring are unsuitable for eggs and tadpoles. Stock ponds are frequently used by this species if they are managed to provide suitable hydroperiod, pond structure, vegetative cover, and control of nonnative predators.

During dry periods, California red-legged frogs are seldom found far from water. However, during wet weather, individuals may make overland excursions through upland habitats over distances up to 2 miles. These dispersal movements are generally straight-line, point-to-point migrations rather than following specific habitat corridors. Dispersal distances are believed to depend on the availability of suitable habitat and prevailing environmental conditions. Very

little is known about how California red-legged frogs use upland habitats during these periods.

During summer, California red-legged frogs often disperse from their breeding habitat to forage and seek summer habitat if water is not available (U.S. Fish and Wildlife Service 2002). This habitat may include shelter under boulders, rocks, logs, industrial debris, agricultural drains, watering troughs, abandoned sheds, or hay-ricks. They will also use small mammal burrows, incised stream channels, or areas with moist leaf litter (Jennings and Hayes 1994; U.S. Fish and Wildlife Service 1996, 2002). This summer movement behavior, however, has not been observed in all California red-legged frog populations studied.

Foraging Requirements

California red-legged frogs consume a wide variety of prey. Adult frogs typically feed on aquatic and terrestrial insects, crustaceans and snails (Stebbins 1985, Hayes and Tennant 1985), as well as worms, fish, tadpoles, smaller frogs (e.g. *Hyla regilla*), and occasionally mice (*Peromyscus californicus*) (U.S. Fish and Wildlife Service 2002). Aquatic larvae are mostly herbivorous algae grazers (Jennings et al. in litt. 1992). Feeding generally occurs along the shoreline of ponds or other watercourses and on the water surface. Juveniles appear to forage during both daytime and nighttime, whereas subadults and adults tend to feed more exclusively at night (Hayes and Tennant 1985).

Reproduction

California red-legged frogs breed from November through April (Storer 1925, U.S. Fish and Wildlife Service 2002). Males usually appear at the breeding sites 2 to 4 weeks before females. Females are attracted to calling males. Females lay egg masses containing about 2,000 to 5,000 eggs, which hatch in 6 to 14 days, depending on water temperatures (U.S. Fish and Wildlife Service 2002). Larvae metamorphose in 3.5 to 7 months, typically between July and September (Storer 1925, Wright and Wright 1949, U.S. Fish and Wildlife Service 2002). Sexual maturity is usually attained by males at 2 years of age and females at 3 years of age.

Demography

Adult California red-legged frogs can live 8 to 10 years (Jennings et al. 1992), but the average life span is probably much lower (Scott pers. comm. in U.S. Fish and Wildlife Service 2002). Most mortality occurs during the tadpole stage (Licht 1974). No long-term studies have been conducted on the population dynamics of red-legged frogs.

Ecological Relationships

California red-legged frogs are primary, secondary, and tertiary consumers in the aquatic/terrestrial food web of their habitat. As described above, they prey on a wide variety of invertebrates and vertebrates, as well as algae as larvae. Numerous predators prey on these frogs, including raccoons (*Procyon lotor*), great blue herons (*Ardea herodias*), American bitterns (*Botaurus lentiginosus*), black-crowned night herons (*Nycticorax nycticorax*), red-shouldered hawks (*Buteo lineatus*), opossums (*Didpephis virginiana*), striped skunks (*Mehpitis mephitis*), spotted skunks (*Spilogale pituorius*), and garter snakes (*Thamnophis* spp.) (Fitch 1940, Fox 1952, Jennings and Hayes 1990, Rathbun and Murphy 1996). In some areas, introduced aquatic vertebrates and invertebrates also prey on one or more of the life stages of California red-legged frogs. These predators include bullfrogs (*Rana catesteiana*), African clawed frogs (*Xenopus laevis*), red swamp crayfish (*Procambarus clarkii*), signal crayfish (*Pacifastacus leniusculus*), bass (*Micropterus* spp.), catfish (*Ictalurus* spp.), sunfish (*Lepomis* spp.), and mosquitofish (*Gambusia affinis*) (Hayes and Jennings 1986).

Threats and Reasons for Decline

The viability of existing California red-legged frog populations is threatened by numerous human activities that often act synergistically and cumulatively with natural disturbances (i.e. droughts or floods) (U.S. Fish and Wildlife Service 2002). These activities include those that result in the degradation, fragmentation, and loss of habitat through agriculture, urbanization, mining, overgrazing, recreation, timber harvesting, nonnative plants, impoundments, water diversions, degraded water quality, and introduced predators.

Over 90% of the historic wetlands in the Central Valley have been lost due to conversion for agriculture or urban development (U.S. Fish and Wildlife Service 1978, Dahl 1990). This has resulted in a significant loss of frog habitat throughout the species' range (U.S. Fish and Wildlife Service 2002). Habitat along many stream courses has also been isolated and fragmented, resulting in reduced connectivity between populations and lowered dispersal opportunities. These isolated populations are now more vulnerable to extinction through stochastic environmental events (i.e. drought, floods) and human-caused impacts (i.e., grazing disturbance, contaminant spills) (Soulé 1998). In a comprehensive evaluation of prevailing hypotheses on the causes of declines in the California red-legged frog populations, Davidson et al. (2001) determined that there is a strong statistical correlation between locations where frog numbers had declined and upwind agricultural land use. They concluded that wind-borne agrochemicals may be an important factor in these declines.

Increasing urbanization in the Central Valley is also resulting in the continuing loss and fragmentation of California red-legged frog habitat and creates barriers to dispersal by frogs to neighboring populations. Isolated populations are subject to increased predation from nonnative predators, changes in hydroperiod due to

variable wastewater outflows, and increased potential for toxic runoff from developments. All of these conditions can reduce the viability of affected frog populations. Similarly, agricultural expansion in the Central Valley has resulted in habitat loss and fragmentation, the introduction of fertilizers, fungicides, pesticides, and herbicides into riparian ecosystems and water diversions and impoundments that can reduce historic flows necessary to support adequate aquatic habitat for frogs and other species (U.S. Fish and Wildlife Service 2002). Poorly managed recreation, mining, timber harvest, and infrastructure maintenance activities, such as road construction and repair, trail development and facilities development, can also have significant detrimental effects on remaining California red-legged habitat through disturbance, contamination, and introduction of nonnative species that prey on or compete with the frogs.

Conservation and Management

The California red-legged frog was federally listed as threatened in 1996. Since then, numerous conservation efforts have been undertaken by various federal, state, and local and private organizations to minimize impacts and establish preserves and protective policies to ensure the viability of this species (U.S. Fish and Wildlife Service 2002). A final recovery plan for the California red-legged frog was completed in May 2002 that calls for the preservation of all known populations and their habitat, the establishment of a viable metapopulation, development of effective land use policies and guidelines, continued research on the ecological requirements of California red-legged frogs necessary for conservation, continued monitoring, and the establishment of an outreach program.

Federal Critical Habitat

In March of 2001, USFWS designated critical habitat for California red-legged frog in areas supporting biological and physical features essential to the conservation of the species within a 4 million-acre region (USFWS 2001). USFWS defined these essential features as aquatic and upland areas where suitable breeding and non-breeding habitat are interconnected by continuous dispersal habitat. In response to a lawsuit brought by the Home Builders Association of Northern California, a federal court remanded all but 200,000 acres of the critical habitat designation (a unit in the Sierra Nevada range) back to USFWS for reconsideration and additional economic analysis. To date, no revised critical habitat designation has been proposed by USFWS.

Modeled Species Distribution

Model Description

Assumptions

1. Ponds and streams in riparian woodland/scrub, wetland or seasonal wetland, annual grassland, alkali grassland, oak savanna, oak woodland, chaparral, non-urban ruderal (ruderal land cover areas outside existing urban land cover areas) and turf land-cover types were considered potential breeding habitat for California red-legged frog.
2. Streams in urban areas that are connected hydrologically to suitable breeding streams were also considered potential breeding habitat for this species. Underground streams were considered movement habitat only.
3. All non-urban non-aquatic land cover types within 1 mile of potential breeding sites were considered potential migration and aestivation habitat for this species. Ponds in urban areas with substantial areas of suitable aestivation habitat intact (>50% of 1-mile buffer) were considered to be suitable breeding habitat unless absence is verified by recent surveys.

Rationale

Breeding habitat: Breeding sites used by California red-legged frogs include a variety of aquatic habitats (Stebbins 1985, Hayes and Jennings 1988, USFWS 2000b). Larvae, tadpoles and metamorphs use streams, deep pools, backwaters within streams and creeks, ponds, and marshes. Breeding adults are commonly found in deep (more than 2 feet), still or slow-moving water with dense, shrubby riparian or emergent vegetation (Hayes and Jennings 1988). Adult frogs have also been observed in shallow sections of streams that are not shrouded by riparian vegetation. Generally, streams with high flows and cold temperatures in spring are unsuitable for eggs and tadpoles. Within the ECCC HCP/NCCP inventory area stock ponds are frequently used as breeding sites by this species if the ponds are managed to provide suitable hydroperiod, pond structure, vegetative cover, and control of nonnative predators. All existing ponds and streams within the inventory area were, therefore, considered potential suitable breeding habitats for California red-legged frogs.

Migration and aestivation habitat: During dry weather, California red-legged frogs are seldom found far from water. However, as ponds dry out these frogs disperse from their breeding sites to other areas with water or to temporary shelter or aestivation sites. This latter habitat may include small mammal burrows, incised stream channels, shelter under boulders, rocks, logs, leaf litter, agricultural drains, watering troughs, abandoned sheds or unused farm equipment (Jennings and Hayes 1994, USFWS 2000b). Movements of up to 1 mile from breeding sites to aestivation sites are apparently typical (Stebbins 2002), although some individual frogs have been found up to 2 miles away (USFWS 2000b). These dispersal and migration movements are generally straight-line, point-to-point migrations rather than following specific habitat corridors (USFWS 2000b,

Stebbins 2002). They may be along long-established historic migratory pathways that provide specific sensory cues that guide the seasonal movement of the frogs (Stebbins 2002). Dispersal distances are believed to depend on the availability of suitable habitat and prevailing environmental conditions. However, because the actual movement patterns of California red-legged frogs in these habitats is generally not known, for this model we conservatively estimated that all non-urban land cover areas within a radius of 1 mile from all potential breeding sites were potential migration and/or aestivation habitats for California red-legged frogs.

Model Results

Figure 1 shows the modeled potential habitat of the California red-legged frog within the ECCC HCP/NCCP inventory area. The habitat includes approximately two-thirds of the inventory area, and is primarily located along the hilly portions of the western side of this area. All documented occurrence locations fit well within the boundaries of the model.

The large size of the habitat is due to the high number of ponds that provide potential breeding habitat and the potential dispersal distance of this species. Because the actual movement patterns of the frogs away from breeding sites is not known (but is believed to often be line-of-sight), we used conservative estimates of the movement/dispersal habitat requirements based on known distances of movement of individuals provided in available reports. We then included all potentially suitable habitats within a radius based on the mode of long-range distances moved by the frogs and classified these areas as suitable movement habitat for the species. Although the model underestimates the extent of ponds and other aquatic features, it is unknown whether the model underestimates or overestimates the extent of suitable breeding habitat for the California red-legged frog because, with the exception of the Los Vaqueros watershed and East Bay Regional Park lands, the suitability of these ponds (both mapped and unmapped) for this species is unknown.

Two aquatic sites in Brentwood are surrounded by urban development but may still support this species. The DFG and the U.S. Fish and Wildlife Service (FWS) have agreed to field verify these sites to determine if California red-legged frog are present. Until these surveys are complete, we will assume presence at these sites.

Literature Cited

Dahl, T. E. 1990. Wetland losses in the United States, 1978s to 1980s. U.S. Fish and Wildlife Service, Washington, DC.

- Davidson, C., H. B. Shaffer, and M. R. Jennings. 2001. *Declines of the California red-legged frog: climate, UV-B, habitat, and pesticides hypotheses*. *Ecological Applications* 11(2):464–479.
- Fitch, H. S. 1940. *A biogeographical study of the ordinoidea Artenkreis of garter snakes (genus Thamnophis)*. University of California Publications in Zoology 44(1):1–150.
- Fox, W. 1952. *Notes on feeding habits of Pacific coast garter snakes*. *Herpetologica* 8(1):4–8.
- Hayes, M. P. and M. R. Jennings. 1986. *Decline of ranid frog species in western North America: Are bullfrogs (Rana catesbeiana) responsible?* *Journal of Herpetology* 20(4):490–509.
- Hayes, M. P. and D. M. Krempels. 1986. *Vocal sac variation among frogs of the genus Rana from western North America*. *Copeia* 1986(4):927–936.
- Hayes, M. P. and M. R. Tennant. 1985. *Diet and feeding behavior of the California red-legged frog Rana aurora draytonii (Ranidae)*. *The Southwestern Naturalist* 30(4):601–605.
- Jennings, M. R. and M. P. Hayes. 1985. *Pre- 1900 overharvest of California red-legged frogs (Rana aurora draytonii): The inducement for bullfrog (Rana catesbeiana) introduction*. *Herpetological Review* 32(1):94–103.
- . 1990. Final report on the status of the California red-legged frog (*Rana aurora draytonii*) in the Pescadero Marsh Natural Preserve. Prepared for the California Department of Parks and Recreation under contract No. 4-823-9018 with the California Academy of Sciences.
- . 1994. Amphibian and reptile species of special concern in California. Report prepared for the California Department of Fish and Game, Inland Fisheries Division, Rancho Cordova, CA.
- Licht, L. E. 1974. *Survival of embryos, tadpoles, and adults of the frogs Rana aurora aurora and Rana pretiosa pretiosa sympatric in southwestern British Columbia*. *Canadian Journal of Zoology* 52(5):613–627.
- Rathbun, G. B. and T. G. Murphy. 1996. *Evaluation of a radio-belt for ranid frogs*. *Herpetological Review* 27(4):197–189.
- Soulé, M. 1998. *Viable Populations for Conservation*. Cambridge University Press, Great Britain.
- Stebbins, R. C. 1985. *A field guide to western reptiles and amphibians*. Houghton Mifflin Company, Boston, MA.

- Storer, T. I. 1925. *A synopsis of the amphibia of California*. University of California Publications in Zoology 27:1–342.
- U. S. Fish and Wildlife Service. 1978. Concept plan for waterfowl wintering habitat preservation, Central Valley, California. Region 1, Portland, OR.
- . 1996. Endangered and threatened wildlife and plants: determination of threatened status for the California red-legged frog. Federal Register 61(101):25813–25833. May 23.
- . 2001. Endangered and threatened wildlife and plants: final determination of critical habitat for the California red-legged frog. Federal Register 66(49):14626–14670. March 13.
- . 2002. Recovery plan for the California red-legged frog (*Rana aurora draytonii*). U.S. Fish and Wildlife Service, Portland, OR.
- . 2004. Endangered and threatened wildlife and plants: proposed designation of critical habitat for the California red-legged frog. Proposed Rule. Federal Register 69(71):19620–19642. April 13.
- Wright, A. H., and A. A. Wright. 1949. *Handbook of frogs and toads of the United States and Canada*. Comstock Publishing Company, Ithaca, N.Y.