

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

Legal Status

Federal: Threatened. Final Critical Habitat (USFWS 2006). Critical Habitat proposed (USFWS 2008)

State: Species of Special Concern.



© Pierre Fidenci

Global and State Conservation Status: G4T2T3S2S3: Global Rank, G4 = A G4 = Apparently Secure: Uncommon but not rare; some cause for long-term concern due to declines or other factors; T-Rank, T2T3 = Same as state rank but related only to the status of the subspecies throughout its range; State Rank, S2S3 = somewhere between an S2 indicating imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state., and an S3 which indicates vulnerable in the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.

Recovery Plan: Recovery Plan for the California Red-Legged Frog (*Rana aurora draytonii*) (2002).

Species Description and Life History

California red-legged frogs are brown to reddish brown with prominent dorsolateral folds (Jennings and Hayes 1994, Stebbins 2003). Adult size ranges from 85 to 138 mm (3.35 to 5.43 in) in length from the snout to urostyle (frog homologue to pelvic bone) (Jennings and Hayes 1994). The dorsal surface is distributed with dark spots, occasionally with light centers (Storer 1925). The amount of red coloration present is variable; some individuals have no such coloration, and others may have red pigment distributed all over the dorsal and ventral surfaces of the body (Jennings and Hayes 1994). A dark mask bordered by a whitish jaw stripe is also usually present (Stebbins 2003).

Breeding occurs between late November and late April (Jennings and Hayes 1994). Males move to breeding sites 2 to 4 weeks before female arrival (Storer 1925). A pair moves into amplexus (breeding position), and the female moves the pair to the oviposition (egg-laying) site, where she deposits 2,000 to 6,000 eggs to an emergent vegetation brace (Storer 1925, Jennings and Hayes 1994). Hatching occurs in 6 to 14 days, depending on water temperature (Jennings 1988a). Thereafter, tadpoles require 11 to 20 weeks to complete metamorphosis (Storer 1925).

California red-legged frogs are most likely to make overland movements through upland habitats at night during wet weather (USFWS 2002, Bulger et al. 2003, Fellers and Kleeman 2007). During the course of a wet season, movements up to 1.6 km (1 mi) are possible (USFWS 2002). During dry weather, the subspecies tends to remain very close to a water source (M. Jennings pers. comm.). During dry weather, however, overland dispersal of the California red-legged frogs sometimes occurs in response to receding water (USFWS 2002). California red-legged frogs have been known to disperse distances up to 2.9 km (1.8 mi) from the breeding site to sites within stream systems (USFWS 2004, Fellers and Kleeman 2007).

Adult California red-legged frogs frequently remain near aquatic habitat; however, significant seasonal movements between local aquatic and terrestrial habitats have been documented (Jennings and Hayes 1994). Individuals have been observed more than 100m (328 ft) from water in adjacent dense riparian vegetation, although they typically occur within 60 m (200 ft) of water (USFWS 2004, Bulger et al. 2003, Fellers and Kleeman 2007).

Habitat Requirements and Ecology

A variety of habitats are used by the California red-legged frog, including ephemeral ponds, intermittent streams, seasonal wetlands, springs, seeps, permanent ponds, perennial creeks, human-made aquatic features, marshes, dune ponds, lagoons, riparian corridors, blackberry (*Rubus* spp.) thickets, non-native annual grasslands, and oak savannas (USFWS 2004). Arroyo willow (*Salix lasiolepis*) and emergent aquatic vegetation, such as cattails (*Typha* spp.) and bulrushes (*Scirpus* spp.), are important habitat components (Jennings and Hayes 1994). However, some stock ponds with no emergent vegetation have been documented to support the subspecies (USFWS 2002, Fellers and Kleeman 2007). The subspecies prefers deep, tranquil, or slow-moving water (Jennings and Hayes 1994). Historically, California red-legged frogs have been found at elevations ranging from sea level to 1,500 m (5,200 ft); however, almost all known populations occur below 1,050 m (3,500 ft) (USFWS 2002).

California red-legged frogs are associated with three essential habitat components; these include (1) breeding habitat, (2) non-breeding habitat, and (3) migration corridors. Breeding habitats consists of ponds, marshes, and the lentic components of streams (Bugler et al. 2003). In Marin County, stock ponds are the most frequently used breeding sites (Fellers and Kleeman 2007). Non-breeding habitat may include nearly any area within 1-2 miles of a breeding site that stays moist and cool through the summer, and can include vegetated areas with coyote bush (*Baccharis pilularis*), California blackberry thickets (*Rubus ursinus*), and root masses associated with willow (*Salix* spp.) and California bay trees (*Umbellularia californica*). (Fellers 2007). Non-breeding habitat used by red-legged frogs may be extremely limited in size. For example, non-breeding red-legged frogs have been found in a 6-foot wide coyote bush thicket growing along a tiny intermittent creek surrounded by heavily grazed grassland (Fellers 2005). Potential sheltering habitat for red-legged frogs includes all aquatic, riparian, and upland areas within the range of the species and includes any landscape features that provide cover,

such as existing animal burrows, boulders or rocks, organic debris such as downed trees or logs, and industrial debris; agricultural features such as drains, watering troughs, spring boxes, abandoned sheds, or hay stacks may also be used (USFWS 1996). Incised stream channels with portions narrower and depths greater than 18 inches also may provide important summer sheltering habitat (USFWS 1996). Accessibility to sheltering habitat is essential for the survival of red-legged frogs within a watershed, and can be a factor limiting frog population numbers and survival. Effective migration corridors may be more degraded than the other habitat components and can include closely grazed fields or plowed agricultural lands (Fellers 2007). Riparian and aquatic corridors are not essential, or, in some cases, preferred as migration routes (Bulger et al. 2003, Fellers and Kleeman 2007).

California red-legged frogs are subject to predation by a number of native and non-native species. Some of the native predators include raccoons (*Procyon lotor*), garter snakes (*Thamnophis* spp.), great blue herons (*Ardea alba*), American bitterns (*Botaurus lentiginosus*), red-shouldered hawks (*Buteo lineatus*), and black-crowned night herons (*Nycticorax nycticorax*) (USFWS 2002, Fellers and Kleeman 2007). Non-native predators include crayfish, bullfrogs (*Rana catesbeiana*), and various fish species (USFWS 2002).

Invertebrates comprise most prey taken by California red-legged frogs, although vertebrates such as Pacific tree frogs (*Hyla regilla*) and California mice (*Peromyscus californicus*) comprise over half the prey consumed by larger frogs (USFWS 2002).

Juvenile frogs are active diurnally and nocturnally, while adult frogs are primarily nocturnal (Hayes and Tenant 1985). Local climate influences the red-legged frog's seasonal activity period (Storer 1925). In coastal areas with mild climates, individuals are rarely inactive; however, at inland sites with colder winters individuals may become inactive for longer intervals (M. Jennings pers. comm.).

Although California red-legged frogs may co-occur with foothill yellow-legged frogs (*Rana boylei*), differences in microhabitat preferences limit competition (Zeiner et al. 1988). Bullfrogs and exotic predatory fish, on the other hand, have caused significant deleterious impacts on the subspecies. Tadpoles reduce their level of activity when potential predators are present, which may inhibit foraging and may reduce size at metamorphosis (Lawler et al. 1999). Predation occurs during all life stages of the California red-legged frog (Lawler et al. 1999, Calef 1973). Pre-metamorphic natural mortality may be elevated enough that competition among post-metamorphic frogs is negligible (Calef 1973).

The most significant human-related sources of mortality of California red-legged frogs are loss of habitat due to urban development, conversion of native habitats to agricultural lands, introduction of non-native predators, and pesticide use (Fisher and Shaffer 1996, Hobbs and Mooney 1998, Davidson et al. 2002).

Species Distribution and Population Trends

Distribution

In California, the range of the California red-legged frog includes Pacific drainages from Shasta County south to the Mexican border (Jennings and Hayes 1994). In North America, the range of the California red-legged frog extends south from the California-Mexican border to the Santo Domingo River in Baja California Norte, Mexico (Linsdale 1932). There are no recorded historical or recent occurrences of California red-legged frogs within the Plan Area, although there are historical records (USFWS 2004) and one 1998 record (E. Stitt pers. comm.) from Cold Canyon Preserve, which lies south of the Yolo County line in northwestern Solano County. The 1998 Stitt record is a reported observation of a single individual near the confluence of Cold Canyon with Wild Horse Canyon.

Population Trends

There is little information available regarding population status and trends of California red-legged frogs outside of California (i.e., Baja California Norte, Mexico). However, as of 2003, at least two populations remained extant in Baja California Norte (Krofta 2003).

The California red-legged frog has experienced severe declines in the Central Valley and southern California (Jennings and Hayes 1994), having lost approximately 70 percent of its former range (USFWS 2004). Surveys conducted by Jennings and Hayes (1994) over the course of 10 years indicated that, as of 1994, the subspecies had been extirpated from 99 percent of its historical range in the Central Valley. Prior to the recent discovery of two populations, the subspecies was believed extirpated from most of its range in the southern Transverse and Peninsular Ranges (USFWS 2004). At the Nature Conservancy's Santa Rosa Plateau Ecological Reserve in Riverside County, only three male individuals are known to remain (Krofta 2003). Sizeable populations of red-legged frogs are known to exist only in coastal drainages between Point Reyes and Santa Barbara (Jennings and Hayes 1994). Because California red-legged frogs have not been documented in Yolo County, population status or trends for the subspecies in the County are presently unknown.

The principal factors contributing to the decline of the California red-legged frog are loss of habitat due to urban development, conversion of native habitats to agricultural lands, introduction of non-native predators, and pesticide use (Fisher and Shaffer 1996, Hobbs and Mooney 1998, Davidson *et al.* 2002). Habitat loss and fragmentation result in small, isolated populations, which reduce individual movements and genetic exchange between populations.

Threats to the Species and Other Conservation Issues

Habitat loss, degradation, and fragmentation are significant factors in declining populations of California red-legged frogs. Conversion of lands to agricultural and urban uses, overgrazing, mining, recreation and off-road vehicles, and timber harvesting have all contributed to habitat losses and disturbances. Urbanization often fragments habitat and creates barriers to dispersal (USFWS 2002). Road densities generally increase as a consequence of urbanization. Roads can create significant barriers to frog and toad dispersal (Reh and Sites 1990) and reduce population densities due to mortality caused by automobile strikes (Fahrig *et al.* 1995).

The conversion of natural lands to agricultural uses, such as stands of monotypic row crops, can alter habitats to the extent that they become uninhabitable for California red-legged frogs (USFWS 2002). Fisher and Shaffer (1996) suggest that intense farming within the San Joaquin Valley has resulted in drastic declines in California red-legged frog populations, resulting in little suitable habitat. Pesticides, herbicides, and other agrochemicals are known to be toxic to various life stages of ranid frogs (Hayes and Jennings 1986). Pesticide drift has also been suggested as a potential cause of declining populations of four species of ranids in California, including California red-legged frogs (Davidson *et al.* 2002).

Exotic predatory fish and bullfrogs also pose significant threats to California red-legged frogs. Bullfrogs have been implicated in the decline of the subspecies in several studies (Fisher and Shaffer 1996, Kiesecker and Blaustein 1998, Lawler *et al.* 1999), and Moyle (1973) indicated that bullfrogs might have been the most important factor in the extirpation of California red-legged frogs from the Central Valley floor. Hayes and Jennings (1986) noted that locations in which exotic fish were present contained few California red-legged frogs. Bullfrogs depredate and out-compete California red-legged frogs (Hayes and Jennings 1986). They consume a wider variety of prey, have a longer breeding season, and are larger than California red-legged frogs.

Water diversions and impoundments have altered habitats and made them less suitable for many ranid species (Jennings 1996). The creation of reservoirs through dam construction in the Central Valley and southern California has directly eliminated, fragmented, or isolated populations of California red-legged frogs (USFWS 2002). Smaller impoundments and water diversions can also preclude or inhibit dispersal (USFWS 2002) and reduce high flows required to maintain deep holes in streams (Rathbun in litt. in USFWS 2002). The stock ponds and small reservoirs formed by smaller impoundments and water diversions often contain exotic fishes and bullfrogs that prey on red-legged frogs (G. Rathbun and M. Jennings in litt. 1993, in USFWS 2002).

In some areas, California red-legged frogs appear to thrive in areas with managed grazing, and grazing may actually improve habitat conditions at sites where stock ponds have been constructed (USFWS 2002). However, unmanaged cattle trample and eat emergent riparian vegetation, resulting in severe habitat disturbances (Gunderson 1968, in USFWS 2002; Duff 1979, in USFWS 2002), causing increases in water temperatures

(Van Velson 1979, in USFWS 2002). These effects diminish habitat quality for red-legged frogs and improve conditions for bullfrogs and exotic predatory fish (USFWS 2002). Grazing in riparian areas can result in the loss of willows (Duff 1979, in USFWS 2002), which are associated with the greatest densities of California red-legged frogs (Jennings 1988a, 1988b). High stocking rates can also result in increased erosion in the watershed (Lusby 1970, in USFWS 2002; Winegar 1977, in USFWS 2002) and sedimentation in the stream (Gunderson 1968, in USFWS 2002), which, in turn, can alter primary productivity and fill interstitial spaces of the streambed substrate with fine alluvium. This fill impedes water flow, reduces dissolved oxygen levels, and restricts waste removal (Chapman 1988, in USFWS 2002).

Chytridiomycosis and other infectious diseases have been found in many amphibian populations known to be declining (Daszak *et al.* 1999; Green and Sherman 2001; USFWS 2000, 2002). Although widespread chytridiomycosis in California red-legged frogs has not been documented, an infected tadpole was collected in Calabajas Pond on the Ellicott Slough NWR in Santa Cruz County (G. McLaughlin in litt. 2000, in USFWS 2002). Several other emerging diseases, such as those caused by iridoviruses and ranaviruses, have been implicated in mass deaths of other amphibian species in Europe, Asia, and North America (Daszak *et al.* 1999). Although currently not known or suspected to have infected any local red-legged frog populations, if introduced, these pathogens have the potential to produce similar die-offs.

Although there is no recorded occurrence of California red-legged frogs in Yolo County, there are historical records (USFWS 2004) and one 1998 record (E. Stitt pers. comm.) from Cold Canyon Preserve, which lies south of the Yolo County line in northwestern Solano County. In southwestern Yolo County and northwestern Solano County, qualitative habitat characteristics appear very similar (J. Gerlach pers. comm.). Additionally, land in southwest Yolo County is almost exclusively under private ownership, consisting primarily of tracts of large ranches. The effect of private land ownership in this part of the county is a lack of accessible research locations. The inaccessibility and apparent suitability of habitat in southwest Yolo County suggests the possibility that California red-legged frogs may be present in this part of the county.

The USFWS's *Recovery Plan for the California Red-Legged Frog* (USFWS 2002) is a comprehensive plan to delist the California red-legged frog. The Recovery Plan outlines a series of guidelines to be used in the implementation of California red-legged frog recovery tasks. Those guidelines recommend specific actions designed to protect California red-legged frogs and their habitat, and are applicable to conservation and recovery efforts that may be required within the Plan Area, should the subspecies be detected. Any required conservation efforts or mitigation measures within the Plan Area for the subspecies should be consistent with the Recovery Plan. The major headings of the Recovery Plan include the actions considered most important for conservation and are listed below:

- Protect suitable habitats and buffers in perpetuity.
- Develop and implement guidelines for maintaining adequate water flow regimes, particularly in California red-legged frog habitats downstream of impoundments, water diversions, and residential or industrial developments.
- Develop and implement best management practices to prevent or minimize adverse impacts to the California red-legged frog from in-stream and stream bank activities associated with mining operations.
- Control/eliminate non-native species/predators (plants, vertebrates, invertebrates) using methods that are determined to be the most effective.
- Reduce the detrimental effects of livestock grazing and increase incidental benefits associated with livestock grazing on public and private lands.
- Reduce the effects of timber harvest activities on the California red-legged frog and its habitat.
- Develop site-specific guidelines for recreational activities to reduce or eliminate impacts to the California red-legged frog where these activities pose an on-going threat to habitat quality.
- Decrease the exposure of the California red-legged frog and their habitat to contaminants.
- Develop guidelines for fire management practices (i.e., prescribed burns, emergency fire suppression, emergency water use) to decrease incidental impacts to the California red-legged frog.
- Develop and implement best management practices to prevent or minimize adverse impacts to the California red-legged frog from in-stream and stream bank activities associated with flood control actions.
- Implement watershed management and protection plans using cooperative agreements and existing incentive programs.

Contributors to this species account:

Randy Siske, HT Harvey & Associates
Eric Hansen, Independent Biological Consultant

References

Photo Credit: Copyright © 2003 Pierre Fidenci

Bulger, J. B., N. J. Scott, Jr., and R. B. Seymour. 2003. Terrestrial activity and conservation of adult California red-legged frogs *Rana aurora draytonii* in coastal forests and grasslands. *Biological Conservation* 110:85-95.

Calef, G.M. 1973. Natural mortality of tadpoles in a population of *Rana aurora*. *Ecology* 54:741–758.

- Daszak, P., L. Berger, A.A. Cunningham, A.D. Hyatt, D.E. Green, and R. Speare. 1999. Emerging infectious diseases and amphibian population declines. *Emerging Infectious Diseases* 5(6):735-748.
- Davidson, C., H.B. Shaffer, and M.R. Jennings. 2002. Spatial tests of the pesticide drift, habitat destruction, UV-B, and climate-change hypotheses for California amphibian declines. *Conservation Biology* 16:1588-1601.
- Fahrig, L., J.H. Pedlar, S.E. Pope, P.D. Taylor, and J.F. Wegner. 1995. Effect of road traffic on amphibian density. *Biological Conservation* 13:177-182.
- Fellers, G. M. and P. M. Kleeman. 2007. California red-legged frog (*Rana draytonii*) movement and habitat use: implications for conservation. *Journal of Herpetology*. 41(2): 271-281
- Fellers, G.M. 2005. *Rana draytonii* Baird and Girard, 1852b California red-legged frog. Pages 552-554 in M. Lannoo (editor). *Amphibian declines the conservation status of United States species*. University of California Press. Berkeley, California.
- Fisher, R.N. and H.B. Shaffer. 1996. The decline of amphibians in California's Great Central Valley. *Conservation Biology* 10:1387-1397.
- Green, D.E. and C.K. Sherman. 2001. Diagnostic histological findings in Yosemite toads (*Bufo canorus*) from a die-off in the 1970s. *Journal of Herpetology* 35(1):92-103.
- 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* 20:490-509.
- 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* 30:601-605.
- Hobbs, R.J. and H.A. Mooney. 1998. Broadening the Extinction Debate: Population Deletions and Additions in California and Western Australia. *Conservation Biology* 12:271-283.
- Jennings, M.R. 1988a. Natural history and decline of native ranids in California. Pages 61-72 In: *Proceedings of the conference on California herpetology*. H. F. Delisle, P. R. Brown, B. Kaufman, and B. M. McGurty (eds.). *Southwestern Herpetologists Society Special Publication*.
- Jennings, M.R. 1996. Status of amphibians. *Sierra Nevada Ecosystems Project: final report to Congress. Volume II: Assessments and scientific basis for management*

- options. University of California, Centers for Water and Wildland Resources, Davis, CA.
- Jennings, M.R. and M.P. Hayes. 1994. Amphibian and reptile subspecies of special concern in California. California Department of Fish and Game, Inland Fisheries Division, Rancho Cordova, CA. iii+255 pp.
- Kiesecker, J.M. and A.R. Blaustein. 1998. Effects of introduced bullfrogs and smallmouth bass on microhabitat use, growth, and survival of native red-legged frogs (*Rana aurora*). *Conservation Biology* 12:776–785.
- Krofta, D.M. 2003. California red-legged frog: jumping to survival. *Endangered Species Bulletin* May-June 2003.
- Lawler, S.P., D. Dritz, R. Strange, and M. Holyoak. 1999. Effects of introduced mosquitofish and bullfrogs on the threatened California red-legged frog. *Conservation Biology* 13:613-622.
- Linsdale, J.M. 1932. Amphibians and reptiles from Lower California. *University of California Publications in Zoology* 38:345-386.
- Moyle, P.B. 1973. Effects of introduced bullfrogs, *Rana catesbeiana*, on the native frogs of the San Joaquin Valley, California. *Copeia* 1973 (1):18–22.
- Reh, W. and A. Seitz. 1990. The influence of land use on the genetic structure of populations of the common frog (*Rana temporaria*). *Biological Conservation* 54:239-249.
- Stebbins, R.C. 2003. *A Field Guide to Western Reptiles and Amphibians*. Third edition Houghton Mifflin Company, Boston, MA. 533 pp.
- 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 (USFWS). 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, 1996.
- U.S. Fish and Wildlife Service (USFWS). 2002. *Recovery Plan for the California Red-Legged Frog (Rana aurora draytonii)*. Portland, OR. vii + 173 pp.
- U.S. Fish and Wildlife Service (USFWS). 2006. Designation of Critical Habitat for the California Red-Legged Frog, and Special Rule Exemption Associated With Final Listing for Existing Routine Ranching Activities; Final Rule. *Federal Register* 71:19243-19346.

U.S. Fish and Wildlife Service (USFWS). 2008. Revised Critical Habitat for the California Red-Legged Frog (*Rana aurora draytonii*); Proposed Rule. Federal Register 73:53491-53680.

Walters, B. 1975. Studies of interspecific predation within an amphibian community. *Journal of Herpetology* 9(3):267–279.

Zeiner, D.C., W.F. Laudenslayer, Jr., and K.E. Mayer (compiling editors). 1988. California's Wildlife. Volume I. Amphibians and reptiles. California Statewide Wildlife Habitat Relationships System, California Department of Fish and Game, Sacramento, CA.

Personal Communications

Jennings, Mark. Herpetologist. Rana Resources, Sacramento, CA. June 14, 2001 – discussion.

Stitt, Eric. Herpetologist. The Rincon Institute, Tucson, Arizona. December 9 and 10, 2004 – e-mail correspondence.