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Evaluation of Critical Habitat for the California red-legged frog (Rana aurora draytonii)

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Abstract

The recovery plan for the California red-legged frog was reviewed. There are two main elements for our region in southern California. The first is the designation of critical habitat for recovery of this species. We suggest that the criteria for designation of critical habitat should be explicitly defined and listed. The map boundaries should then result from those criteria. This would reduce the maps to those specific areas with habitat in which recovery efforts could be made. Requiring large regions to await evaluation on an individual project basis undermines the support for the ESA and creates controversy where likely none should exist. The second element is restoration of the populations. While we support this effort, we are concerned with the use of extensive substrate disturbance in the survey for exotic pest species and the restrictive use of a single "genotype" used in recovery. Instead of seining to remove pests, we recommend careful evaluation of the literature with targeted research toward the different pests. We further suggest that having both Baja and LA populations is probably more appropriate and provides a better chance for having a survivable population.

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Summary

The recovery plan for the California red-legged frog was reviewed. There are two main elements for our region in southern California. The first is the designation of critical habitat for recovery of this species. We suggest that the criteria for designation of critical habitat should be explicitly defined and listed. The map boundaries should then result from those criteria. This would reduce the maps to those specific areas with habitat in which recovery efforts could be made. Requiring large regions to await evaluation on an individual project basis undermines the support for the ESA and creates controversy where likely none should exist. The second element is restoration of the populations. While we support this effort, we are concerned with the use of extensive substrate disturbance in the survey for exotic pest species and the restrictive use of a single "genotype" used in recovery. Instead of seining to remove pests, we recommend careful evaluation of the literature with targeted research toward the different pests. We further suggest that having both Baja and LA populations is probably more appropriate and provides a better chance for having a survivable population.

Historical Distribution, Biology and Current Status

– Refer to websites:

http://ecoregion.ucr.edu/full.asp?sp_num=17

http://ice.ucdavis.edu/Toads/aurora.html

Federal Register (www.access.gpo.gov/su_docs/fedreg/a000911c.html)

USFW (http://endangered.fws.gov/bulletin.html)

Significant Threats to the Species:

Fragmentation, degradation and loss of suitable breeding, non-breeding and dispersal habitat.

Introduction of exotic predators/competitors (e.g., bullfrog, predatory fish).

Introduction

In January of 2000, the U.S. Fish and Wildlife Service declared over 5.3 million acres as Critical Habitat Units for the California Red-Legged From (*Rana aurora draytonii*). In southern California, this was among the first proposed designations of large land area for this category. The goal of this designation, is to allow this species habitat in which to recover an adequate population for eventual delisting. This step has rarely been taken at such a large scale and in a location where high rates of development and human population growth is also occurring.

The California Red-Legged Frog is a particularly interesting case because it was so widespread and abundant. It thrived in aquatic freshwater habitats through much of the state ranging from ephemeral habitats to permanent streams and ponds. Largely because of its abundance and size, it became widely celebrated in the famous story of the jumping frog of Calavaras County. It declined rapidly in population because it became a preferred food item in many areas, and due to the fragmentation and exploitation of wetlands throughout the state. Secondly, exotic predators have been intentionally and unintentionally introduced that largely survive in the remaining habitats, in particular those with permanent water sources. With the rapid decline in such an abundant species, and the particular habitats in which it thrives, conflict was inevitable.

Stabilization versus Recovery

There are two steps designed to meet the threats to biodiversity under the Endangered Species Act. The first is to stabilize the existing population. This is usually undertaken by locating habitats in which it survived and setting those areas aside for protection. The second step is to recover the population. This can entail restoration of habitat, introductions of populations into previously occupied habitats, or artificial propagation and intense management of a species in a controlled environment.

Despite the difficulties, stabilizing the population by setting aside lands is only minimally controversial. Most people understand this process and, while the particular lands and amounts can be disputed, the necessity for such an effort rarely is.

Recovery is much more difficult and controversial from both sides. Retaining the original genetic composition is difficult when populations become very low. At the Santa Rosa Plateau, for example, only two males likely remain. In addition, lands that currently do not support the species and may have never supported the species are under the jurisdiction of the Fish and Wildlife Service or some other enforcement entity requiring special permits and consideration. Due to the backlog in permit evaluation, this can result in millions of dollars in costs for land development, if not outright take. Thus, the steps undertaken for recovering a species are difficult and always have an element of ignorance and chance.

Extent of the Problem

In 1996, the U.S. Fish and Wildlife listed the California red-legged frog as a Federally Endangered species. Since that time, conservation efforts have been undertaken by various Federal, State, and local agencies and private organizations. In January of 2000, the U.S. Fish and Wildlife Service produced a Draft Recovery Plan for the California red-legged frog, designating core areas for focused recovery throughout the geographical and elevational range of the species in California. In September 2000, under the authority of the Endangered Species Act of 1973, the U.S. Fish and Wildlife proposed to designate thirty-one “Critical Habitat Units” for the California red-legged frog, totaling 5,373,650 acres. Approximately 39% of these critical habitat areas are in public ownership. This proposed designation was published in the *Federal Register* on September 11, 2000. In western Riverside County, the Critical Habitat Unit (#30) consists of portions of the Santa Rosa Plateau Ecological Reserve, the Santa Rosa Plateau, and the southern extent of the Santa Ana Mountains. This unit is primarily managed by the U.S. Forest Service, but contains about 30% privately owned lands (including the Nature Conservancy), and a small percentage managed by the State of California.

Historically, California red-legged frogs ranged from southern Shasta County in northern California southward throughout all counties west of the Sierras Nevada mountains, down

through San Diego County in southern California, and Santa Cruz Island (Figure 1 in draft recovery plan). The current distribution is much more limited (Figure 2, in draft recovery plan). Today, in southern California, (south of the Tehachapi Mountains), California red-legged frogs are currently known from only two locations, compared to over 80 historic records from this region. The existing locations are in Sierra Pelona (Los Angeles County) and the other in western Riverside County along Cole Creek on The Nature Conservancy's Santa Rosa Plateau Preserve.

The healthiest California red-legged frog populations persist and flourish where suitable breeding and nonbreeding habitats are interspersed throughout the landscape and are interconnected by *unfragmented* dispersal habitat. Connectivity of habitats that enable the exchange of genetic material from one sub-population of frogs to another is essential for the overall long-term survival and recovery of California red-legged frogs. Red-legged frogs breed in areas of permanent water, but may move from breeding sites at any time of the year and utilize habitats within stream channels, and up to 328 ft from permanent water within adjacent dense riparian vegetation. In addition, during the rainy season some individuals may travel more than two miles during migration events from one aquatic habitat to another over upland terrain, regardless of the vegetation, as long as there are no barriers to movement present. Thus, maintaining upland areas adjacent to aquatic habitat are just as important in maintaining viable populations of red-legged frogs as is the maintenance of riparian habitat and permanent pools of water.

Critical Habitat

"Critical Habitat" as defined by the U.S. Fish and Wildlife, consists of (i) geographic areas occupied by the species upon the time of listing (1996) as well as areas outside the geographic area occupied that are essential for the conservation of the species. "Conservation" means the use of all methods and procedures necessary to bring an endangered or threatened species to the point at which listing is no longer necessary.

Critical habitat determinations were based on the best scientific and commercial data available, after taking into consideration the economic impact, and any other relevant impact, of specifying a particular area as critical habitat. Referenced materials include conservation plans and efforts undertaken by local, State, Federal agencies and private organizations. Where the benefits of exclusion outweighed the benefits of including an area as critical habitat, the area was excluded, provided the exclusion did not result in extinction of the species.

Proposed critical habitat units were designated throughout the geographic and elevational range of the species and include areas that possess large continuous blocks of occupied habitat (data from 1985 to present), existing populations found on the edge of the current range, areas that represent the historic distribution of the species, and areas that provide connectivity between existing populations or between existing populations and unoccupied areas where red-legged frogs can be reestablished (which is essential to the recovery of the species). Of the approximate 5,373,650 acres designated as critical habitat, only around 17 percent is considered unoccupied habitat.

"Critical Habitat" for the California red-legged frog includes areas that support: (a) suitable aquatic habitat, (b) associated uplands, and (c) suitable dispersal habitat connecting suitable aquatic habitat. At a minimum, this will include two (or more) suitable breeding locations, one of which must be a permanent water source, associated uplands surrounding these water bodies

(extending to 500 ft from the water's edge), all within 1.25 miles of one another and connected by barrier-free dispersal habitat (of at least 500 ft in width)

Suitable *aquatic* habitat consists of *permanent* water bodies of virtually still or slow-moving fresh water including natural and man made ponds, backwaters within streams and creeks, marshes, lagoons, and dune ponds. Red-legged frogs are not characteristically found in deep lacustrine habitats (e.g. deep lakes and reservoirs). A minimum water depth of 20 cm during the entire tadpole rearing season (at least March through July), is required. Dense, shrubby riparian vegetation, e.g. willow (*Salix*) and bulrush (*Scirpus*) species, and bank overhangs are important features of California red-legged frog breeding habitat. Red-legged frogs tend to be found in greater numbers in deeper, cooler pools with dense emergent and shoreline vegetation.

Suitable *upland* habitat consists of all upland areas (riparian or otherwise) within 500 ft of the water's edge, (but not further than the watershed boundary). This upland habitat is important in maintaining the integrity of California red-legged frog aquatic/breeding habitat, as land use activities adjacent to and upstream of suitable aquatic habitat, greatly affect the quality of aquatic/breeding habitat downstream. Land use activities within the watershed may alter the quantity and timing of water flow. It may also alter the water and sediment quality.

Suitable *dispersal* habitat consists of all upland and wetland habitat that connect two or more patches of suitable aquatic habitat within 1.25 miles of one another. Dispersal habitat must be at least 500 feet wide and free of barriers such as, heavily traveled roads (with more than 30 cars per hour), moderate to high-density urban or industrial developments, and large reservoirs.

When these three elements are all present, all other suitable aquatic habitat within 1.25 miles, and free of dispersal barriers, is also considered critical habitat. In contrast, ponds that support small populations of California red-legged frogs, but are not surrounded by suitable upland habitat or are cut off from other breeding ponds or permanent water sources by impassible barriers, are not considered critical habitat.

Significant Threats

A combination of factors has contributed to the decline of the California red-legged frog throughout their historic range in California. Factors include degradation and loss of habitat through agriculture, urbanization, mining, overgrazing, recreation, timber harvesting, invasion of nonnative plants, impoundments, water diversions, reservoir construction, degraded water quality, and introduced predators and competitors. These factors have resulted in the isolation and fragmentation of habitats within many watersheds, often precluding dispersal between subpopulations and jeopardizing their viability. Habitat fragmentation and degradation and the continued colonization of habitat by nonnative species may represent the most significant current threats to California red-legged frogs.

Exotic Species Introductions

All life-stages of the California red-legged frog are susceptible to predation and competition by various introduced species, such as the African clawed frog (*Xenopus laevis*), red swamp crayfish (*Procambarus clarkii*), signal crayfish (*Pacifastacus leniusculus*), bass (*Micropterus* spp.), catfish (*Ictalurus* spp.), sunfish (*Lepomis* spp.), and mosquitofish (*Gambusia affinis*).

Bullfrogs have been documented predating on tadpoles, juveniles and large adults. Researchers have noted survival rates of red-legged frog tadpoles of less than 5% in the presence of bullfrog tadpoles, whereas in ponds free of bullfrog tadpoles, survival rates were estimated in the range of

30-40%. Bullfrogs have a competitive advantage over red-legged frogs as well, as they are larger, have more generalized food habits, have an extended breeding season, and the tadpoles are generally unpalatable to predatory fish. Bullfrogs also interfere with red-legged frog reproduction - red-legged frogs have been observed mounted with both male and female bullfrogs.

Crayfish are also a threat to red-legged frogs, which consume the eggs and tadpoles, and carry fungal disease that may infect red-legged frogs (same fungus found to infect Leopard frogs in Arizona)(Russell Smith 2000, personal communication).

Predatory fish: Mosquito abatement efforts in California include stocking water bodies with mosquitofish (*Gambusia affiis*). Results of a study in artificial ponds showed that mosquitofish and bluegill (*Lepomis machrochirus*) were significant predators of red-legged frog larvae. Several studies show direct predation and injuries to tadpoles in tanks or ponds with mosquitofish, which resulted in reduced survival and recruitment of the red-legged frogs. However, while mosquitofish may eliminate red-legged frog tadpoles from simplified aquatic communities (i.e., degraded aquatic sites), mosquitofish do not affect the recruitment of red-legged frogs from natural, spatially complex pond communities, (i.e., ponds with dense vegetation, deep areas and submerged cobbles which provide refuge from attack). However, juveniles of red-legged frog from ponds with predatory fish, still metamorphose later and weigh about 1.3 less than tadpoles in ponds without predatory fish.

Habitat Fragmentation, Degradation and Loss

Habitat loss and degradation are the primary factors that have negatively affected the California red-legged frog throughout its range. Urbanization, agriculture, water impoundments, channelization of watercourses for flood control, water diversions, mining, livestock grazing and dairy farming, recreation and off-road vehicles, and timber harvesting have resulted in the fragmentation and isolation of red-legged frog habitat. With habitat fragmentation, dispersal opportunities are reduced and interactions between subpopulations can be precluded and thus jeopardize their viability. Isolated populations are vulnerable to extinction through random adverse environmental events and human-caused impacts. Further, dispersal between fragments exposes frogs to increased risk of predation.

Roads are an important human-caused landscape component hindering amphibian movement and thereby fragmenting amphibian populations. Based on genetic analysis, highways have been shown to effectively genetically isolate the common frog, *Rana temporaria*. Highways traveled by 26 cars per hour can reduce the survival rate of toads crossing roads to zero. In addition, there is a significant negative correlation between traffic density and the density of frog populations.

Modification of Water Flows:

Urbanization results in additional water sources into wetlands and stream courses associated with irrigation and home use activities, especially during the summer months. This often drastically alters the hydroperiod (quantity and timing of flows) and converts seasonal streams and wetlands to year-round aquatic habitat. Such alteration allow exotic species such as bullfrogs and nonnative warm water fish species to invade the habitat and further affect California red-legged frog populations. California red-legged frogs are rarely found in areas where a large majority of the watershed has been developed.

Water Quality:

Wetlands adjacent to undeveloped lands tend to have richer populations of native amphibians. As watersheds are developed, the amount of *sediments* containing organic matter, pesticides, fertilizers, heavy metals and other debris increases in streams and wetlands.

Water *temperature* and *salinity* are also important factors. Exposing eggs to salinities greater than 4.5 % cause 100% mortality. California red-legged frog eggs require cold water (<64.9ºF) to develop properly, and adult frogs stress and may die (if prolonged) when exposed to water temperatures at or above 84ºF. Thus, maintenance of cool water pools (via water depths of at least 8 in, and vegetation cover) is important to red-legged frog survival.

California Red-Legged Frog Restoration/Re-Introduction – Santa Rosa Plateau

When the populations reach the level where sustaining or recovering a population naturally is not possible, intentional restoration must be undertaken. There are two simultaneous strategies for recovering populations of the Red-Legged Frog. These are control of exotic competitors and predators, and a re-introduction from another source population. Each contains elements of controversy.

Control of Exotic Predators/Competitors

Under the direction of the L.A. Zoo, the USFW Oceanside office, and the efforts of SRP managers and biologists, a recovery plan for the California red-legged frog at the Santa Rosa Plateau is being developed. Currently there are only two male red-legged frogs on the Plateau (versus 6 males and 1 female three years ago). A key step in the recovery plan is to establish an ongoing program of exotic predator/competitor extirpation from the site and adjacent source areas (such as stock ponds and other standing water on private lands). Known exotic predators/competitors include mosquito fish, sunfish, blue gill, crayfish and perhaps most importantly, bullfrogs. Extirpation activities include removal of adult bullfrogs from ponds/creeks at night, (and destroying thereafter once a positive identification has been made), and drawing seine nets through all ponds and creeks one time per week. Seine nets capture all species including the red-legged frog (adults, tadpoles), predatory fish, crayfish and bullfrog (adults, tadpoles) - Only red-legged frogs are returned to the ponds.

Re-Introduction from Source Populations

There are no known remaining female red-legged frogs in Riverside and San Diego counties. For this reason, extant populations in L.A. County and Baja California have been considered for use in the Re-Introduction program. Some genetic analyses (U.C. Davis, and L.A. Zoo) indicate Baja California populations of the red-legged frog are more closely related to the Santa Rosa Plateau red-legged frogs, than are the L.A. County populations. Thus, the recovery program hopes to use adults and tadpoles from Baja California. Adults will be released into perennial pools immediately after capture during the spring months, while tadpoles will be raised in captivity, and released to ponds as metamorphs before the winter months (i.e., metamorphs are tadpoles that have just metamorphosed into frogs, and prior to their first over wintering when they become juveniles). This introduction of red-legged frogs from Baja is planned to continue for several years. Assuming that a base population of red-legged frogs is established at the SRP, it in turn will be used to repopulate other areas in Riverside and San Diego Counties.

Problems and Concerns

Three concerns have been raised regarding the recovery effort in southern California that we will address. These are the large amounts and unclear designation of the critical habitat area, the genetic status of the populations used for restoration, and the practices for removal of presumed predators.

Critical Habitat Designation

Large amounts of land were designated as critical habitat and rather ambiguous maps prepared that show where permits are needed for restoring these populations. Unfortunately it is extremely easy to make an ambiguous map overlaying all areas where the frog may have existed. This includes most of the riparian areas in the region. Further, if these areas are to be protected from pesticide, runoff events, and nutrient inputs, then virtually the entire watershed becomes part of these designated lands.

Unfortunately, as in too many cases, the map appears to drive the process. The criteria for designation of critical habitat should be explicitly defined and listed. The map boundaries should then result from those criteria. This would reduce the maps to those specific areas with habitat in which recovery efforts could be made. Requiring large regions to await evaluation from a FWS office that is consistently undermanned undermines the support for the ESA and creates controversy where likely none should exist.

We strongly urge careful use of maps and critical habitat designation to those lands for which specific criteria for set-aside is formulated. While this may initially take more care and resources, in the long run, it will make more support for the ESA and for recovery of endangered species.

Genetic basis for recovery population selection

Research on other species suggests that selection of the "most similar" genotypes may not be a good idea, especially since both populations are removed from the original area. Climate, habitat, and other unknown factors are different from both source populations. Having both Baja and LA populations is probably more appropriate and provide a better chance for having a survivable population.

Seining

This practice can be very damaging to potential habitat for the frog as well as other organisms. We recommend careful evaluation of the literature with targeted research toward the different pests.

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