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*Rana onca* Cope, 1875(b)  
RELICT LEOPARD FROG

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### 1. Historical versus Current Distribution.

Our taxonomy follows Jaeger et al. (2001), who ascribe recently extant leopard frog populations along the Virgin River from Littlefield, Arizona, downstream into the Black Canyon of the Colorado River below Hoover Dam in Nevada to relict leopard frogs (*Rana onca*). Some of these populations were formerly considered to be lowland leopard frogs (*R. yavapaiensis*; Platz, 1988). Populations of extinct leopard frogs from the Las Vegas Valley, Nevada, often synonymized with *R. onca* (see review in Jennings, 1988), are treated in this volume as Vegas Valley leopard frogs (*R. fisheri*).

Nevada, and along the Muddy River in Nevada. Jennings and Hayes (1994b) reported that the species was never recorded from "the Colorado River proper," but one observation at a site now inundated by Lake Mead indicates that it probably occurred in marsh habitat adjacent to the river (Cowles and Bogert, 1936). Leopard frogs also were collected from populations within the Black Canyon along the Colorado River, immediately downstream from Lake Mead. Populations in Utah appear to have been extirpated since the 1950s (Platz, 1984). Surveys in the 1990s revealed extant populations at six sites in three general areas: a spring-fed wetland adjacent to the Virgin River near Littlefield, Arizona; Rogers and Blue Point Springs near the Overton Arm of Lake Mead, Nevada; and three springs in Black Canyon below Lake Mead, Nevada (Jennings et al., 1995; Jaeger et al., 2001). Repeated surveys in 2001 and 2002, however, indicate that the Littlefield population has been extirpated, leaving only two general areas with extant populations. An additional population at the smallest site, Corral Spring, near Rogers Spring, was extirpated in 1995 (Bradford et al., 2004).

### 2. Historical versus Current Abundance.

The former abundance of relict leopard frogs is unknown. The species was once

### 3. Life History Features.

The life history of relict leopard frogs has not been well studied and much remains unknown. The information presented here is based on our unpublished observations and those of other researchers.

#### A. Breeding.

Reproduction is aquatic.  
i. Breeding migrations. Adults reside in and near breeding habitat; breeding migrations are unknown. Time of oviposition varies among sites and years. Observations of eggs and tadpoles imply favored breeding times from approximately February–April and November.

ii. Breeding habitat. Pools or slow-moving side areas of streams, with or without emergent vegetation, appear to be favored breeding sites. Oviposition sites have been in shallow water within a few centimeters of the water surface.

#### B. Eggs.

i. Egg deposition sites. Clutches are typically attached to vegetation or sticks at the water surface or submerged within a few centimeters of surface.

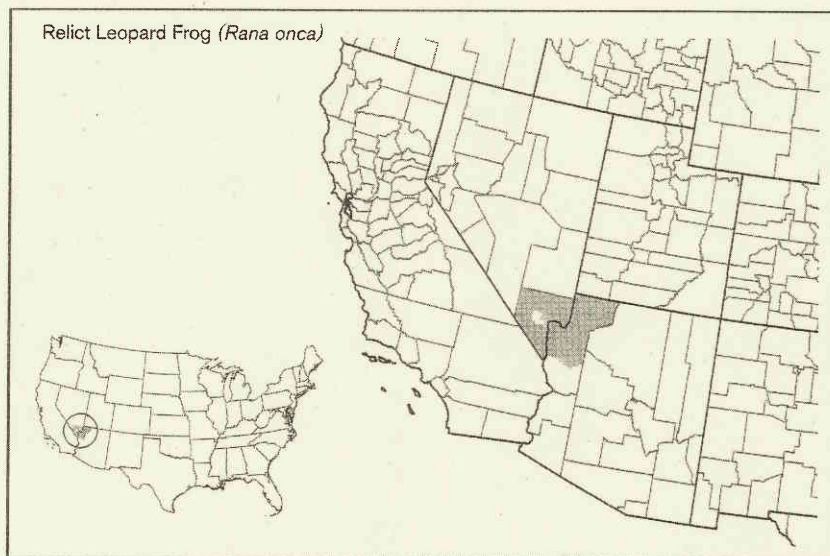
ii. Clutch size. Clutches consist of a globular cluster of many hundred eggs.

C. Larvae/Metamorphosis. Limited observations suggest that several months are required to reach metamorphosis.

D. Juvenile Habitat. Juveniles have been observed in the same areas as adults, and their habitat characteristics are likely similar to that of adults.

E. Adult Habitat. Adult frogs formerly inhabited permanent streams, springs, and spring-fed wetlands below approximately 600 m (Linsdale, 1940), wetlands adjacent to the Virgin River, and at least one wetland adjacent to the Colorado River at a site now inundated by Lake Mead (Cowles and Bogert, 1936). Observations suggest that adults prefer relatively open shorelines where dense vegetation does not dominate. The three general areas where frogs remained in the 1990s are quite different in many features. The Littlefield site is a small, marshy wetland formed by a spring near the shore of the Virgin River. Frogs there were found mostly near the spring source. The sites around the Overton Arm of Lake Mead are fast-moving streams formed by geothermal springs. The stream channels are cut into the gypsiferous soil and are mostly overgrown with dense stands of emergent vegetation. Habitats in the Black Canyon are geothermal springs that flow over more rocky substrates where mesquite and *Tamarix* sp. dominate the over-story vegetation, where present. Water sources for all five of the sites where frogs remain are geothermally influenced, with relatively constant water temperatures between 30–55 °C (Pohlmann et al., 1998).

F. Home Range Size. Adult frogs are usually found at the water's edge and occasionally in adjacent low riparian vegetation or a few meters beyond. In a 3-yr mark-recapture study of an isolated



The historical distribution of relict leopard frogs is not well documented. This species was first identified from a single individual probably collected in the Virgin River Valley, Washington County, Utah (Cope, 1875, in Tanner, 1929). Their distribution historically has been characterized as springs, streams, and wetlands within the Virgin River drainage from the vicinity of Hurricane, Utah, to the Overton Arm of what is now Lake Mead,

considered to be extinct (Platz, 1984; Jennings, 1988), but this designation resulted in part from taxonomic confusion with lowland leopard frogs (Jaeger et al., 2001). The current abundance of relict leopard frogs is quite low. Counts and limited efforts at mark-recapture estimation suggest that the total number of metamorphosed individuals at all sites in the late 1990s was little more than 1,100 (Bradford et al., 2004).

550-m stream reach at Blue Point Spring, the mean distance moved between captures averaged 18 m, and the longest distance recorded between recaptures was 120 m (Bradford et al., 2004).

**G. Territories.** Unknown.

**H. Aestivation/Avoiding Desiccation.** Species is found only in permanently wet sites, and individuals show no evidence of diminished activity during summer or dry weather periods.

**I. Seasonal Migrations.** None evident.

**J. Torpor (Hibernation).** There is no evidence that adults enter refugia or become inactive during part of the year. However, adults are more difficult to find during the coldest months (December–January), even in warm, geothermally influenced, waters.

**K. Interspecific Associations/Exclusions.** Relict leopard frogs coexist with red-spotted toads (*Bufo punctatus*), Woodhouse's toads (*B. woodhousii*), Pacific treefrogs (*Pseudacris regilla*), and (at least historically) Arizona toads (*B. microscaphus*). Relict leopard frogs will also coexist with exotic fishes (mostly small and tropical) in Blue Point and Rogers Springs (Courtenay and Deacon, 1983). Exotic American bullfrogs (*R. catesbeiana*), crayfish, and game-fishes inhabit areas where relict leopard frogs have been extirpated, suggesting that these introduced species may have been a factor in population extinctions (Jennings and Hayes, 1994b).

**L. Age/Size at Reproductive Maturity.** Unknown for females. Males reach reproductive maturity at approximately 42 mm SVL, based on the appearance of pigmented thumb pads. At Blue Point Spring, this size appears to be reached during the first year because smaller individuals are rarely found a year after oviposition.

**M. Longevity.** In a 4-yr mark-recapture study at one site, population turnover was relatively high, with survivorship of adults averaging 0.27/yr (Bradford et al., 2004). Longevity may be greater for a few individuals; a marked individual at a different site was at least 4 yr old.

**N. Feeding Behavior.** Diet unknown; presumably similar to other *Rana* species.

**O. Predators.** Predators not documented. Probably eaten by American bullfrogs, where the two species co-occur (recently, Virgin River near Littlefield; historically, in Utah and along the Muddy River, Nevada), and western terrestrial garter snakes (*Thamnophis elegans*) in portions of Utah.

**P. Anti-Predator Mechanisms.** Frogs are drab in color and cryptic in appearance. When approached, individuals typically remain motionless until flight to water, where they often seek shelter among submerged vegetation or under rocks. During daylight, individuals are found in less conspicuous locations than at night.

**Q. Diseases.** Unknown.

**R. Parasites.** Unknown.

#### 4. Conservation.

The extinction of relict leopard frog populations throughout the species' range occurred concomitantly with the elimination or dramatic alteration of aquatic habitat due to agriculture, marsh draining, and water development. The introduction and spread of American bullfrogs, crayfish, and predaceous fishes have also been implicated in population declines (Jennings and Hayes, 1994b).

At present, the remaining populations appear to be vulnerable to extinction; in May 2002, this species was petitioned by the Center for Biodiversity and the Southern Utah Wilderness Alliance to the U.S. Fish and Wildlife Service for listing under the U.S. Endangered Species Act. *Rana onca* currently is designated by the U.S. Fish and Wildlife Service as a federal candidate for listing, which means that sufficient information exists to list it but this action is precluded by higher priorities. The sites occupied by extant populations are small, population sizes are small, and population turnover appears to be relatively rapid. Moreover, remaining populations occur in only a few sites that are largely isolated from one another. Historically, relict leopard frogs were probably distributed in patches of suitable habitat throughout the regional river system. Extinction and subsequent recolonization of patches may have been an important and dynamic process in maintaining long-term population viability. Currently, the river system in the historical range of relict leopard frogs now forms Lake Mead and Lake Mojave or is otherwise degraded and occupied by American bullfrogs and other exotic species. Consequently, the opportunities for colonization of new sites, recolonization of former sites, and dispersal among the two areas containing extant populations appears to be largely precluded.

Specific potential threats to the few remaining populations include the spread of American bullfrogs and other exotic species into remaining sites, the spread of disease (Carey et al., 1999, Daszak et al., 1999), and the possibility of short-term demographic declines causing extinctions in small populations. Also, vegetation encroachment may be reducing the quality of remaining habitats because of changes in disturbance regimes and/or the establishment of exotic vegetation. Unfortunately, critical information on habitat characteristics is not known. These frogs appear to favor habitats that are somewhat disturbed with reduced vegetation cover. Thus, control of disturbance factors such as burro grazing may actually result in population declines. On the other hand, dense vegetation may be a critical factor in keeping bullfrogs from colonizing some remaining sites. All the remaining five

sites occupied by relict leopard frogs are within Lake Mead National Recreation Area. Developing meaningful management options for these populations obligates the need for a clear understanding of habitat characteristics and factors that have maintained the viability of the remnant populations while all others have gone extinct.

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