ARIZONA GAME AND FISH DEPARTMENT
HERITAGE DATA MANAGEMENT SYSTEM

Animal Abstract **Element Code:** AAABH01080
Data Sensitivity: No

CLASSIFICATION, NOMENCLATURE, DESCRIPTION, RANGE

NAME: *Rana chiricahuensis*
COMMON NAME: Chiricahua Leopard Frog
SYNONYMS: *Lithobates chiricahuensis* (Platz and Mecham, 1979)
FAMILY: Anura: Ranidae

AUTHOR, PLACE OF PUBLICATION: Platz and Mecham. 1979. Copeia 1979:383-390.

TYPE LOCALITY: "Herb Martyr Lake (elev. 1768 m), 6 km W of Portal, Coronado National Forest, Cochise County, Arizona," USA.

TYPE SPECIMEN: HT: AMNH 100372. J.E. Platz, 10 September 1971.

TAXONOMIC UNIQUENESS: *Rana* is a large genus, including Old and New World species (Stebbins 1985). Once thought to be a single species, the *Pantherana* clade (informally termed as *Rana pipiens* complex) contains 30 species within Middle and North America and 7 species within Arizona (6 native and 1 introduced), (Hills 1988; Hillis and Wilcox 2005). Currently, the Chiricahua leopard frog population on the Mogollon Rim is morphologically distinct from populations of Chiricahua leopard frogs in southern Arizona, New Mexico and Mexico. In 2004, genetic analysis (mtDNA sequences) was used by Goldberg et al. to investigate the phylogenetic relationship of *Rana subaquavocalis* and *R. chiricahuensis* from localities throughout their Arizona range. They found two distinct lineages of *R. chiricahuensis*, one on the Mogollon Rim of central Arizona (northern population) and one in southern Arizona (southern population), and concluded that these two lineages could represent two distinct species, but suggest that a detailed examination of behavioral, ecological, and morphological differences between the two groups be conducted before this is determined. Hillis and Wilcox (2005), also suggests that the populations of Chiricahua leopard frogs from the Mogollon Rim are morphologically distinct from Chiricahua leopard frogs in southern Arizona, New Mexico, and Mexico, and that they may be referable to *R. fisheri* (a species described from southern Nevada, and considered extinct by many authors). They go on to state that "*Rana fisheri* appears to have been closely related to the Mogollon Rim populations of "*R. chiricahuensis*" based on morphological similarity, and the name *R. fisheri* may be applicable to these Mogollon Rim leopard frogs." If this is the case, then these disjunct populations would be separated by about 250 miles, which brings into question the genetic history of the other ranids found in between.

The *Rana subaquavocalis* samples from the Goldberg et al. (2004) study were on a short branch within the southern Arizona clade of *R. chiricahuensis*. The results are consistent with

the hypothesis that *chiricahuensis* and *subaquavocalis* are conspecific. (NatureServe 2006). Based on personal conversations with Sredl in the Fall of 2006, a nuclear DNA study is under way at the University of Arizona, to determine the taxonomic placement of the northern population of *R. chiricahuensis* (to elevate to separate species or not), and to definitively determine if *R. subaquavocalis* is conspecific with *R. chiricahuensis*. However, for the time being and for this abstract, the HDMS is tracking these two Rana's as separate species, and the northern and southern populations of Chiricahua leopard frogs as *R. chiricahuensis*. The USFWS Draft Recovery Plan (2005) for the Chiricahua leopard frog treats the Ramsey Canyon leopard frog (*R. subaquavocalis*) as *R. chiricahuensis* because it is likely to be recognized as such in the near future. In the event that the northern and southern populations are determined distinct and listed, then the Recovery Plan would most likely be revised to be a multispecies plan, with appropriate recovery criteria, strategies, and actions for both species. (USFWS 2005).

DESCRIPTION: A medium to large, stocky frog with adult lengths snout to vent from 5.0-13.5 cm (2.0-5.4 in). The ground color on the dorsum is green to brown; the upper lip stripe is faint or absent in front of the eye; the head and face is usually green. The skin is rougher with more tubercles, and dorsal spots are generally smaller and more numerous than in other leopard frogs. Dorsolateral folds are broken toward the rear of the body, angling inward. The eyes are higher on the head and more upturned than other Arizona leopard frogs. The hind feet are webbed, and males have a swollen and darkened thumb base. In adults (and some juveniles), the rear surface of the thigh is speckled with "salt and pepper" markings, or small dots each densely covered with light-tipped tubercles, usually on a dark ground color. (Stebbins 1985; Brennan and Holycross 2006). The venter is a dull whitish or yellowish color, while gray mottling usually occurs on the throat and sometimes on the chest. The groin and lower abdomen are often yellow. Platz (1988) notes that the "posterior surfaces of thighs have numerous small papilla, each surrounded by cream colored skin...adults have mottled venter and males along southern Arizona border have vestigial oviducts."

AIDS TO IDENTIFICATION: *R. chiricahuensis* is similar to the northern leopard frog (*R. pipiens*), but stockier, with a more rounded head, shorter limbs, and slightly upturned eyes (Stebbins 1985). The call is a "snore" of unusually high pulse rate (about 34 pulse/sec at 22^{o} C). The call is often a single note lasting 1-3 seconds (depending on temperature), which is intermittently repeated and terminated by a "tail" produced by slight change in pitch (Frost and Platz 1983; Platz and Mecham 1984).

R. chiricahuensis is sympatric with four members of the *R. pipiens* complex including the northern (*R. pipiens*), lowland (*R. yavapaiensis*), and plains (*R. blairi*) leopard frogs, and one undescribed species (*R.* sp. 1) of leopard frog (Platz and Mecham 1979, cited by Sredl *in* Lannoo 2005). Mecham (1968c, cited by Sredl *in* Lannoo 2005) found that in east-central Arizona, northern leopard frogs predominate in meadow-like habitats and Chiricahua leopard frogs predominate in rocky streams. In the Sulphur Springs Valley of southeastern Arizona, Frost and Bagnara (1977, cited by Sredl *in* Lannoo 2005) found plains leopard frogs to predominate in non-permanent and most semi-permanent tanks and sloughs, while Chiricahua

leopard frogs predominate in permanent tanks and streams. Physically, *R. pipiens* has a complete supralabial stripe and complete uninterrupted and undeflected dorsolateral folds, and adults have green pigment in the groin region, while males possess vestigial oviducts. Male *R. chiricahuensis*, unlike *R. yavapaiensis*, possess prominent vestigial oviducts (Platz 1988).

ILLUSTRATIONS:

Color drawing (Stebbins 1985: plate 15)
Color photo (Degenhardt et al. 1996: plate 24)
Color photos (Brennan and Holycross 2006: p. 46)
Color photo (J. Rorabaugh, USFWS 2005: p. 41)
Color photos of frog and egg mass (William Leonard 2003, *in* AmphibiaWeb at http://amphibiaweb.org/cgi-bin/amphib_query?)
Color photo of egg mass (William Leonard 2003, *in* http://calphotos.berkeley.edu/cgi/img_query?)
Color photo (Suzanne L. Collins 2001, *in* CNAH 1994-2006 at http://www.naherpetology.org/detail.asp?id=1160)
Color photos of northern and southern forms (Tom Brennan, *in* J. Rorabaugh at AZ PARC 2006 http://www.reptilesofaz.com/Turtle-Amphibs-Subpages/h-r-chiricahuensis.html)
Color photos (Erik F. Enderson at http://www.arts.arizona.edu/herp/RACH.html)
Color photos (Brad Moon 1990 and 2003, at http://calphotos.berkeley.edu/cgi/img_query?)
Color photo of tadpole (Ronn Altig 1998 at http://calphotos.berkeley.edu/cgi/img_query?)

TOTAL RANGE: Mountain regions of central and southeastern Arizona, southwestern New Mexico, south in the Sierra Madre Occidental to Western Jalisco, Mexico from 1066-2408 m (3500-7900 ft), (Platz and Mecham 1979; Sredl et al. 1997).

RANGE WITHIN ARIZONA: Arizona range is divided into two areas (Platz and Mecham 1979). The first (northern population) extends from montane central Arizona east and south along the Mogollon Rim to montane parts of west-southwestern New Mexico. The second is located in the mountains and valleys south of the Gila River in southeastern Arizona and southwestern New Mexico, and extends into Mexico (adjacent Sonora) along the eastern slopes of the Sierra Madre Occidental. According to J. Platz (personal communication cited by Sredl *in* Lannoo 2005), "Populations in the northern portion of the range may soon be described as a new species."

SPECIES BIOLOGY AND POPULATION TRENDS

BIOLOGY: *Rana chiricahuensis* are highly aquatic habitat generalists. Adults become active in February (Jennings 1988, 1990), and eggs are laid in spring and sporadically through the summer and fall. Male *R. chiricahuensis* usually call above water, but may also advertise below water (Degenhardt et al. 1996). Their call consists of a 1-3 second long, low-pitched, hollow snore (Brennan and Holycross 2006). Home ranges for males (dry season mean = 161.0 m^2; wet season mean = 375.7 m^2) tend to be larger than those for females (dry season

mean = 57.1 m²; wet season mean = 92.2 m²). Post-metamorphic Chiricahua leopard frogs are generally inactive from November-February, however, a detailed study of wintertime activity or habitat use has not been done. Although microsites for these hibernacula have not been studied, they likely over-winter near breeding sites. (Sredl, *in* Lannoo 2005). Life span and age at first reproduction are unknown, although preliminarily, skeletochronology of Chiricahua leopard frogs indicate that they can live =/< 6 years (Durkin 1996, cited by Sredl *in* Lannoo 2005).

In 1998, chytrid fungus (see Additional Information) was first identified in amphibian populations in Arizona. Chytridiomycosis was documented in *R. chiricahuensis* as early as 1992. "Presently in Arizona, one salamander species, Sonoran tiger salamanders (*A. tigrinum stebbinsi*), seven species of ranid frogs (Rio Grande leopard frogs [*R. berlandieri*], plains leopard frogs, American bullfrogs, Chiricahua leopard frogs, Ramsey Canyon leopard frogs, Tarahumara frogs, and lowland leopard frogs), and one treefrog (Canyon treefrog), have been affected by this fungus. All outbreaks have been a cool season phenomena, and the pathogen is well distributed in central and southeastern Arizona (Sredl et al., 2000)." (Sredl *in* Lannoo 2005). The fungus may be responsible for some of the declines seen in their populations in Arizona and New Mexico.

Common predators of adults and juveniles include the non-native American bullfrog (*R. catesbeiana*), native and non-native fishes, garter snakes (*Thamnophis* sp.), great blue herons (*Ardea herodias*), and mammals including rats, coyotes, gray foxes, raccoons, ringtail cats, coatis, black bears, badgers, skunks, bobcats, and mountain lions. Tadpoles are likely preyed upon by aquatic insects, crayfish, native and non-native fishes, garter snakes, great blue herons, and other birds. (Sredl, *in* Lannoo 2005). Anti-predator mechanisms of adult and juvenile Chiricahua leopard frogs include hopping into water (Frost and Bagnara 1977, cited by Sredl *in* Lannoo 2005), and the unusual ability to profoundly darken their ventral skin under conditions of low albedo (reflectance) and low temperature (Fernandez and Bagnara 1991 and Fernandez and Bagnara 1993, cited by Sredl *in* Lannoo 2005). This trait is thought to aid in escape from predators by reducing the amount of attention that bright flashes of white ventral skin would bring in the clear, swift moving streams they inhabit (low albedo environments). Vegetation, undercut banks, root masses, and other cover sites would probably be important retreats from predators.

REPRODUCTION: At high elevation, *R. chiricahuensis* breeds in late May through August (Zweifel 1968; Frost and Platz 1983). At lower, warmer localities, breeding occurs from mid-February through June and sporadically until September (Frost and Bagnara 1977; Frost and Platz 1983) and October. Scott and Jennings (1985) did not note a difference in the time of breeding and different elevations, but did find a relationship between the time of breeding and water temperatures at sites in New Mexico (Jennings 1988, 1990). Proximate cues that stimulate mating are not well studied, but oviposition has been correlated with rainstorms (Fernandez 1996) and changes in water temperature (Platz 1993).

Egg masses have been reported in all months, but reports of oviposition in June are uncommon (cited by Sredl *in* Lannoo 2005), which may be due to lower water levels and higher temperatures before the summer rainy season begins. Females deposit 300-1485 eggs in spherical masses attached to submerged vegetation, suspended within 5 cm of the surface (Jennings and Scott 1991). Zweifel (1968b cited by Sredl *in* Lannoo 2005) noted the water temperature range for *R. chiricahuensis* embryos was 12.0-31.5 ºC, while in New Mexico R.D.J. (personal observations, cited by Sredl *in* Lannoo 2005) noted water temperatures ranged from 12.6 ºC at a stock tank to 29.5 ºC recorded at a warm spring. Based on the closely related Ramsey Canyon leopard frog (*R. subaquavocalis*), eggs take approximately 14 days to hatch (Platz 1993). Larvae metamorphose in 3-9 months (Jennings 1988, 1990). Tadpoles are known to over-winter (Frost and Platz 1983).

FOOD HABITS: Adults eat arthropods and other invertebrates (Stebbins 1985; Degenhardt et al. 1996). Larvae are herbivorous and likely eat available food items including algae, organic debris, plant tissue, and minute organisms in the water (Marti and Fisher 1998). Stomach analyses of other members of the leopard frog complex from the western United States show a wide variety of prey items, including many types of aquatic and terrestrial invertebrates (e.g., snails, spiders, and insects) and vertebrates (e.g., fish, other anurans [including conspecifics], small birds; Stebbins 1951).

HABITAT: The primary habitat type of *R. chiricahuensis* is oak, mixed oak and pine woodlands. Other habitat types range into areas of chaparral, grassland, and even desert. *R. chiricahuensis* are habitat generalists that live and breed in lentic and lotic habitats in natural and man-made systems (Mecham 1968; Zweifel 1968; Frost and Bagnara 1977; Scott and Jennings 1985; Sredl and Saylor 1998; Sredl *in* Lannoo 2005). Natural aquatic systems include cienegas, rocky streams with deep rock-bound pools, river overflow pools, oxbows, permanent springs, permanent pools in intermittent streams, and beaver ponds. Man-made aquatic systems include earthen stock tanks, livestock drinkers, irrigation sloughs, wells, mine adits, abandoned swimming pools, and ornamental backyard ponds.

ELEVATION: Elevations of localities range from 1,000-2,710 m (Platz and Mecham, 1979; Sredl et al., 1997); central and eastern Arizona localities range from (3,050-) 3,281 – 8,890 ft ([930-] 1000-2710 m).

PLANT COMMUNITY: Wide variety of permanent and semi-permanent aquatic systems in oak, mixed oak and pine woodlands, but also chaparral, grassland, and desert habitats (Mecham 1968; Zweifel 1968; Frost and Bagnara 1977; Scott and Jennings 1985; Stebbins 1985; Sredl and Saylor 1998). Vegetation that has been associated with egg masses includes *Potamogeton* sp., *Rorippa* sp., *Echinochloa* sp., and *Leersia* sp. (Sredl *in* Lannoo 2005).

POPULATION TRENDS: Statewide decline (Sredl et al. 1997). Local abundance appears to fluctuate greatly. According to NatureServe (2006), "Total adult population size is unknown but likely exceeds 10,000." It is known from several dozen locations in Arizona and New Mexico, in addition to others elsewhere in the range. Historically it occurred at 212 sites in

Arizona, 170 in New Mexico, and 12-13 in Mexico (USFWS 2000), which includes both northern and southern populations. Where still present, populations are few, small, and widely scattered. Possibly some disappearances from historical sites represent natural fluctuations rather than long-term declines caused by human impacts, but in most areas disappearances appear to reflect real, on-going declines. (USFWS 2000).

According to the 2004 Assessment (Santos-Barrera et al.) in 2006 IUCN Red List, "Listed as Vulnerable because of an observed population decline, estimated to be more than 30% over the last three generations, inferred from a shrinkage in distribution due to habitat destruction and degradation, and the effects of exotic species, disease, and unknown factors. The generation length is estimated to be five years."

SPECIES PROTECTION AND CONSERVATION

ENDANGERED SPECIES ACT STATUS: LT (USDI, FWS 2002)
[PT USDI, FWS 2000]
[C USDI, FWS 1996]
[C1 USDI, FWS 1994]
[C2 USDI, FWS 1991]

STATE STATUS: WSC (AGFD, WSCA in prep)
[State Candidate AGFD, TNW 1988]

OTHER STATUS: Forest Service Sensitive (USDA FS Region 3 1999)
[Forest Service Sensitive USDA, FS Region 3 1988]
Determined Threatened (Secretaría de Medio Ambiente 2000)
[Listed Threatened, Secretaría de Desarrollo Social 1994]
VU (Santos-Barrera in et al. IUCN Red List 2006)

MANAGEMENT FACTORS: "Most important threats are disease (Chytridiomycosis), non-native predators and competitors (bullfrogs, sport fish, crayfish), effects of small, isolated populations, loss of aquatic habitat through drying, damming, diverting, or siltation, and heavy grazing" (USFWS 2002, in Santos-Barrera et al. 2004). This chytrid fungus has also infected six other ranid frogs and two other amphibians, causing mass die-offs and local extirpations (Sredl et al. 2000).

PROTECTIVE MEASURES TAKEN: *R. chiricahuensis* are a closed season species. Collection of leopard frogs requires a specific or similar permit (Arizona Game and Fish Department 2001). *R. chiricahuensis* has been listed as threatened under the Endangered

Species Act of 1973 (USDI, FWS 2002), with a Draft Recovery Plan released in April 2006 (USFWS 2005).

SUGGESTED PROJECTS: Priority research topics include identification of the importance of disease, pesticides and other contaminants, climate change, UV radiation, fire management, and possibly other threats to the status and recovery potential of the Chiricahua leopard frog. Also, research is needed on the key aspects of the status, distribution and ecology.

Life history studies needed include those on breeding migrations; proximate cues that stimulate mating; hatching time of egg masses; age and size at reproductive maturity (which are poorly known); juvenile habitat preference and use; and comprehensive studies on the feeding behavior or diet of Chiricahua leopard frog larvae or adults (which have not been conducted).

Additional studies are need on the mechanisms by which Chiricahua leopard frogs survive the loss of surface water; relationship between Chiricahua leopard frogs and non-native predators; wintertime activity or habitat use - these frogs likely over-winter near breeding sites, although microsites for these hibernacula have not been studied; and additional behavioral and morphological work to accompany the genetic work that has been done to separate the northern population to its own specific (species) level.

LAND MANAGEMENT/OWNERSHIP: BIA – most sites on the Fort Apache and San Carlos Apache Reservations are from before the mid 1980s, unsure of current status on these lands; BLM – Tucson Field Office; USFS - Apache-Sitgreaves, Coconino, Coronado, and Tonto National Forests; USFWS – Buenos Aires and San Bernardino National Wildlife Refuges; State Land Department; AGFD - Cunningham Tracts and Sipe White Mountain Wildlife Area; TNC – Canelo Hills Cienega and Muleshoe Ranch Preserves; Audubon Research Ranch; Private.

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ADDITIONAL INFORMATION:

The genus name *Rana* (true frog) is Latin, and probably mimics how the Romans heard their call. The species name *chiricahuensis* New Latin (NL) and references the type locality, the Chiricahua Mountains, Arizona. (Beltz, 2006).

"Chytridiomycosis is a recently recognized cutaneous infection of both wild frogs and toads (Berger et al., 1998; Bosch et al., 2000) and captive frogs (Pessier et al., 1999) caused by the fungal agent *Batrachochytrium dendrobatidis*. … Clinical signs include lethargy, abnormal posture, loss of the righting reflex, and death (Daszak et al., 1999). The infection results in a severe diffuse dermatitis characterized by epidermal hyperplasia, hyperkeratosis, and variable degrees of cutaneous ulceration and hyperemia." (Bradley et al., 2002).

Recovery Criteria (USFWS 2005): The Chiricahua leopard frog will be considered for delisting when the following quantitative criteria are met in each Recovery Unit (RU):

1. At least two metapopulations located in different drainages (defined here as USGS 10-digit Hydrologic Units) plus at least one isolated and robust population in each RU exhibit long-term persistence and stability as demonstrated by a scientifically acceptable population monitoring program.
2. Aquatic breeding habitats, including suitable, restored, and created habitats necessary for persistence of metapopulations and isolated populations identified in criterion 1, are protected and managed in accordance with the recommendations in this plan.
3. The additional habitat needed for population connectivity, recolonization, and dispersal is protected and managed for Chiricahua leopard frogs, in accordance with the recommendations of this plan.
4. Threats and causes of decline have been reduced or eliminated, and commitments of long-term management are in place in each RU such that the Chiricahua leopard frog is unlikely to need protection under the ESA in the foreseeable future.

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