ARIZONA GAME AND FISH DEPARTMENT
HERITAGE DATA MANAGEMENT SYSTEM

Animal Abstract **Element Code:** AAABD04171
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CLASSIFICATION, NOMENCLATURE, DESCRIPTION, RANGE

NAME: *Craugastor augusti cactorum* (Taylor, 1939)
COMMON NAME: Western Barking Frog
SYNONYMS: *Eleutherodactylus cactorum* Taylor, 1939; *Eleutherodactylus augusti cactorum*; *Hylactophryne augusti cactorum*
FAMILY: Anura: Leptodactylidae

AUTHOR, PLACE OF PUBLICATION: Taylor, 1939 "1938", Univ. Kansas Sci. Bull., 25(17): 391. (*Eleutherodactylus cactorum*).

TYPE LOCALITY: "km. 226, 20 miles northwest of Tehuacán, [near Cacaloapam,] Puebla", Mexico.

TYPE SPECIMEN: Holotype: EHT-HMS 6383, by original designation; now FMNH 100021, E.H. Taylor and H.M. Smith 6383, adult female collected 30 August 1936, according to Marx, 1976, Fieldiana, Zool., 69: 47.

TAXONOMIC UNIQUENESS: *Craugastor augusti cactorum* is 1 of 4 subspecies of *Craugastor augusti* currently recognized, and the only one that occurs in Arizona. Specifically, this is the only Arizona representative of the family Leptodactylidae, which includes over 500 species of tropical frogs (Rorabaugh 2023). The other three subspecies of *C. augusti* that occur outside of Arizona include *C. a. latrans* (New Mexico and Texas), *C. a. augusti*, and *C. a. fuscofemora*. *Craugastor augusti cactorum* is quite similar to *C. a. augusti* in size and pigmentation, however the tympanum diameter to head width ratio is usually smaller in *C. a. cactorum* (Zweifel 1956; Zweifel 1967). Recent measurements in Arizona confirmed the small tympanum size (Goldberg and Schwalbe 2000). *C. a. cactorum* is the smallest of the subspecies in body length (Zweifel 1956). Differences in call structure, coloration, and mtDNA sequences strongly suggest that barking frogs in Arizona are reproductively isolated from those in New Mexico and Texas. The results indicate that either northern populations are connected via gene flow through southern Mexico (i.e., they are subspecies as currently recognized), or they represent independent lineages as originally described (i.e., western barking frogs, *C. cactorum* in Arizona, and the eastern barking frogs, *C. latrans* in New Mexico and Texas). Discrimination between these hypotheses awaits analysis of barking frog populations in Central Mexico. (Goldberg et al. 2004; NatureServe 2006; Frost 2008, 2009, 2021).

Based on phylogenetic analysis of nuclear and mitochondrial genes by Crawford and Smith (2005), it is inferred that *Craugastor* originated from a single dispersal northward from South

America about 80-60 million years ago. According to Crawford and Smith (2005), the taxonomic change to *Craugastor* "is also supported by the finding that the sister group of *Craugastor* might not even be an *Eleutherodactylus* (Darst and Cannatella 2004), but rather *Brachycephalus* or another eleutherodactyline genus." Furthermore, they propose a node-based definition of the new genus *Craugastor*, which the AZ Heritage Program accepts, and define it as the crown clade containing the following taxa and their MRCA (most recent common ancestor): *C. augusti*, *C. bocourti* (*alfredi* group), *C. bransfordii*, *C. daryi* (*milesi* group), *C. fitzingeri*, *C. gollmeri*, *C. megacephalus* (*biporacatus* group), *C. mexicanus*, *C. rhodopis*, and *C. ranoides* (*rugulosus* group).

DESCRIPTION: Adults are olive to green-gray to rusty-gray with dark irregularly shaped spots or blotches, often with light edges, dorsally. Juveniles have a prominent light band that darkens with age across the center of their backs, however this has not been observed in Arizona. Rorabaugh (2023) reports that the "small juvenile frogs can look like the adults or may have large black patches on the head and lower body." Their eyes are large and dark brown (Stebbins 1985; Schwalbe 1990). Males have dark tympana and during the breeding season, have dark throats, which become mottled in late summer. Females have white throats and pink tympana throughout the year (Goldberg and Schwalbe 2000). The snout-vent length for the species ranges from 5.0-9.5 cm (2.0-3.8 in) (Stebbins 1985). At Coronado National Memorial in Arizona, the mean size of females was 8.0 cm, while males were 7.2 cm (Goldberg and Schwalbe 2000). The frogs have a broad head and short legs, which gives them a squat, toad-like appearance. They have smooth skin and slender, unwebbed toes with prominent tubercles beneath the joints. Although they can make hops from boulder to boulder, they frequently walk in a stilted fashion with their hindquarters and heels off the ground. There is a fold of skin across the back of the head (intertympanic fold) and a circular fold on the belly. Their tympana are semitransparent and smooth (Stebbins 1985; Schwalbe 1990).

AIDS TO IDENTIFICATION: The fold of skin on the back of the head and circular fold on the belly, along with the tubercles on the feet, distinguish this species from other Arizona anurans. The distinctive call sounds like a series of small dog barks in 2-3 second intervals in New Mexico and Texas (Zweifel 1967; Stebbins 1985) or in Arizona the croak of a raven (Schwalbe, 1997). The juvenile color pattern of a light band across the center of their dark backs is distinctive, but has not been observed in Arizona. The subspecies *C. a. cactorum* can be distinguished from the other subspecies by their smaller tympana (Zweifel 1956; Goldberg and Schwalbe 2000). The tympana diameter/head width ratio is usually less than 0.17 (Zweifel 1956).

ILLUSTRATIONS:

Color drawing (Behler and King 1979: p. 154)
Black and white photo (Bezy et al. 1966: fig. 1, p. 223)
Black and white drawing (Stebbins 1985: pl. 12)
Color drawing (Conant 1975: pl. 45)
Color photo (Schwalbe 1990)

Black and white photo (Zweifel 1956)
Color photos of frog and habitat (Randall Babb, in Wismann 2001)
Color photo by Randy Babb (*in* https://reptilesofaz.org/turtle-amphibs-subpages/h-c-augusti/)
Color photos by Tom Brennan (*in* https://reptilesofaz.org/turtle-amphibs-subpages/h-c-augusti/)

TOTAL RANGE: Southern Arizona (Quinlan, Santa Rita, Patagonia, Huachuca, and Pajarito Mts.) and northeastern Sonora (Sierra El Tigre) south along the Pacific Coast foothills of Western Mexico.

RANGE WITHIN ARIZONA: Known from rocky outcrops in Cochise and southern Pima and Santa Cruz counties, in the mountain ranges of Quinlan, Santa Rita, Patagonia, Huachuca, and Pajarito mountains. According to Rorabaugh (2023), "the species potentially occurs in other southeastern Arizona mountain ranges, and should be looked for in the Peloncillo, Mule, Whetstone, and Baboquivari mountains." There is an unconfirmed old report (Wright and Wright 1949) of the species from the Sierra Anchas in Gila County, but this was probably a mis-identification.

SPECIES BIOLOGY AND POPULATION TRENDS

BIOLOGY: These secretive frogs are terrestrial and are found in areas with limestone and other rock outcrops. The frog is nocturnal, spending the day under rocks, or in mines, wells, caves, or fissures (Stebbins 1985, Schwalbe 1990, Goldberg and Schwalbe 2000). When threatened, it inflates to several times its normal size. The skin fold on the belly may be useful in helping it to cling to the sides of caves. There is little life history information available. The longest documented lifespan of a wild individual is 5 years as an adult (Goldberg and Schwalbe, unpublished data).

Western barking frogs in Arizona moved up to 50 m from overwintering to calling sites at the beginning of the beginning of the breeding season (Goldberg and Schwalbe 2000, *in* Amphibiaweb 2009). Advertisement calls of frogs from Arizona were significantly longer in duration, higher in frequency, and had longer duration pulses than those of frogs from either New Mexico or Texas; frogs from these later two sites were indistinguishable in these call variables (Goldberg et al. 2004). Their call is ventriloquistic, making them difficult to locate even after they are detected; most are located by their distinctive and loud "*Walk-walk*" or "*Whaa-whaa-whaa-whaa*" call. In Arizona, for only two to four weeks on rainy nights after the start of the summer rains in June-July (Goldberg and Schwalbe 2004). Frogs call dependably for only two or three nights following the first heavy monsoon storm of the season (Rorabaugh 2023).

REPRODUCTION: Males begin calling with the onset of the summer rainy season. The large-yolked, unpigmented eggs are laid in moist or rain-filled cracks, fissures, and in caves on land (Stebbins 1985; Wright and Wright 1949). Clutches contain from 50-76 eggs (Goldberg,

accessed 2006). Jameson (1950) hypothesized that male barking frog's guard the egg clutch and maintains the eggs moisture levels by body excretion. However, based on radio-tracking data there is possible parental care of the egg clutch by females, since males move too frequently to guard them (Goldberg and Schwalbe 2000).

The young undergo direct development within the egg and hatch as small frogs in approximately one month (Stebbins, 1985; Schwalbe, 1990; Schwalbe, 1997), unlike other frogs and toads in Arizona who have an aquatic larval stage. Frogs hatch in about (20-)25 to 35 days (Schwalbe, 1990; Rorabaugh, 2023). Anecdotal evidence from Arizona suggests that one clutch may have hatched in 21 days (Goldberg and Schwalbe, *in* Goldberg 2006).

FOOD HABITS: The diet consists of a variety of invertebrates. Scat analyses and observations of the population inhabiting Coronado National Memorial have yielded the following prey items: field crickets (*Acheta assimilis*), scorpions (*Vaejovis* sp.), silverfish (*Lepisma* spp.), centipedes (*Scolopendra* spp.), kissing bugs (*Triatoma* spp.), short-horned grasshoppers (Acrididae), spiders, ant lions (*Hesperoleon niger*), and longhorned katydids (Tettiganiidae) (Schwalbe 1990; Schwalbe 1997; Goldberg and Schwalbe 2000). In captivity they have eaten cliff chirping frogs (Rorabaugh 2023).

HABITAT: In Arizona, western barking frogs inhabit outcrops or caves on rocky slopes in often scrubby oak or pine-oak woodlands, within the Madrean evergreen woodlands and woodland-grassland ecotones. These habitats can be characterized by outcrops of limestone, rhyolite, granite, and perhaps other rock types with deep fissures, holes, and caverns where barking frogs can escape climatic extremes (Rorabaugh 2023). It is strongly associated with Naco Group limestone in the Huachuca Mountains. (Bezy et al. 1966; Goldberg and Schwalbe 2000; Schwalbe 1990). Permanent water is not a necessary component of their habitat.

Breeding Habitat: Barking frogs normally call from rock fissures and crevices in the rock outcrops they occupy (Jameson 1954; Schwalbe et al. 1997; Goldberg and Schwalbe 2000, *in* Amphibiaweb 2009).

ELEVATION: 4,200 – 6,200 feet (1280-1890 m). At Coronado National Memorial in Arizona, individuals were caught from 5,250 - 6,200 ft. (1600-1890 m) (Goldberg and Schwalbe 2000).

PLANT COMMUNITY: In Arizona, the western barking frog is found within Madrean evergreen woodlands (Bezy et al. 1966; Goldberg and Schwalbe 2000). The species has been found in yucca-covered hills, brushy woodlands, open pine forests, juniper-live oak woodland, and low dense clumps of cactus (Stebbins 1985).

POPULATION TRENDS: The secretive habits of barking frogs make detection of them difficult; their distribution in Arizona is still largely unknown (Amphibiaweb 2009). At Coronado National Memorial the populations seems to be small, yet the survival rate quite

high. Because the populations are estimated to be so small, stochastic events threaten their persistence (Goldberg and Schwalbe 2000).

SPECIES PROTECTION AND CONSERVATION

ENDANGERED SPECIES ACT STATUS: None

STATE STATUS: 2 at full species level (AZGFD, AWCS 2022)
[1B at full species level (AGFD SWAP 2012)]
[WSC at full species level (AGFD, WSCA 1996 in prep)]
[Endangered at full species level (AGFD, TNW 1988)]

OTHER STATUS: Not BLM Sensitive (USDI, AZ BLM 2010, 2017)
[Bureau of Land Management Sensitive, USDI, BLM AZ 2008]
Forest Service Sensitive (USDA, FS Region 3 1999, 2007, 2013)
LC at full species level (Santos-Barrera 2004, *In* IUCN 2006)

MANAGEMENT FACTORS: In order to gain insight into the location and size of populations, call counts should be performed in areas with rocky outcrops during the first two weeks of the summer monsoon season. There is a very small window of opportunity to detect these frogs and visual encounter surveys are inappropriate for this species. Monitoring sites should then be established so that managers can uncover population trends. Damage to habitat patches may heavily impact the survival of this species. In southern Arizona, rocky areas between 5000 and 7000 ft., especially with southeasterly slopes, should not be developed until they have been surveyed for barking frogs at the appropriate time of year (Goldberg and Schwalbe 2000).

PROTECTIVE MEASURES TAKEN: In Arizona, an Arizona fishing license is required to collect amphibians. Arizona Game and Fish Commission Order 41 allows for the collection and possession of 10 individuals of this species per year.

SUGGESTED PROJECTS: Research into population dynamics is needed, along with information on life history, distribution, population sizes, and population trends.

LAND MANAGEMENT/OWNERSHIP: BIA – Tohono O'odham Nation; BLM – Tucson Field Office; NPS – Coronado National Monument; USFS – Coronado National Forest; Private.

SOURCES OF FURTHER INFORMATION

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ADDITIONAL INFORMATION:

The specific name *augusti* is in honor of the 19th century French herpetologist August Duméril. Taylor collected the subspecies type specimen in a cactus patch, thus *cactorum*. The trinomal was first used by Zweifel 1956 (Zweifel 1967). The frogs can be difficult to find when following the sound of their call and have been called ventriloquists by many (Wright and Wright 1949; Bezy et al. 1966; Schwalbe 1990).

As much as 39 and 45 years respectively, have passed between finding specimens of this elusive frog in the Pajarito and Santa Rita mountains. Unless one is in the right place at the right time, this species can be nearly impossible to locate. (Rorabaugh 2023).

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