

## *Rana chichicuahutla*, A NEW SPECIES OF LEOPARD FROG FROM THE MEXICAN PLATEAU

\*Orlando Cuéllar, †Fausto Méndez-De La Cruz & \*\*Maricela Villagrán-Santa Cruz.

\* Department of Biology. University of Utah. Salt Lake City, Utah. U.S.A. 84112.

† Instituto de Biología, UNAM. A.P. 70-153, México, D.F. 04510.

\*\* Lab. de Biología de la Reproducción. Facultad de Ciencias. UNAM. México, D.F. 04510.

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### RESUMEN

Se describe una especie nueva de rana de la altiplanicie Mexicana, *Rana chichicuahutla*. Esta rana solo se conoce del Lago de las Minas ubicado a 6 Km al Sur-Este de la ciudad de San José Alchichica, Estado de Puebla. El nombre específico se escogió por el pueblo de Chichicuahutla, el más cercano a la Laguna de las Minas. Se deriva del Nahuatl, significando "el que alimenta al bosque" (chichi= teta, cuahuitl= árbol, tlan= lugar de abundancia).

Palabras clave: Especie nueva, *Rana chichicuahutla*, Altiplano Mexicano

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### INTRODUCTION

The common leopard frog of North America *Rana pipiens*, once regarded as a single species, is now known to consist of numerous distinct species, collectively called the *Rana pipiens* complex (Mecham, 1971; Brown, 1973; Platz and Platz, 1973; Pace, 1974; Platz, 1976; Platz and Mecham, 1979; Hillis et al., 1983; Hillis and Frost, 1985; Hillis, 1988). Seven members of this complex occupy the central or eastern United States (*Rana pipiens*, *R. sphenoccephala*, *R. blairi*, *R. areolata*, *R. palustris*, *R. capito*). Two members have very restricted distributions in southwestern United States and may be extinct (*R. fisheri*, *R. onca*). One member is known only from the Huachuca Mountains of southeastern Arizona. Three members span the United States-Mexican border (*R. yavapaiensis*, *R. chiricahuensis*, *R. berlandieri*), but occur predominantly in Mexico. Two species occur in Central América (*R. miadis*, *R. taylori*), and the remaining are endemic to México, including *R. megapoda*, *R. dunnii*, *R. montezumae*, *R.*

*magnaocularis*, *R. brownorum*, *R. forreri*, *R. neovolcanica*, *R. spectabilis*, *R. omiltemana*, and *R. italoci*. Based on differences in melanism on the ventral surface of the head and trunk, Sanders and Smith (1971) divided all leopard frogs into the following two groups: *R. pipiens* of the United States lacking melanism, and *R. berlandieri* of Mexico having mottled throats and pectoral areas. Members of the *pipiens* species group also possess a distinct white stripe on the upper lip (supralabial).

The *R. pipiens* complex has now been divided further into alpha and beta divisions, each consisting of two species groups (Hillis et al., 1983; Hillis, 1988). The Alpha division consists of the northern (USA) *areolata* and the Mexican *montezumae* species groups, and the Beta consists of the northern (USA) *pipiens* and the Mexican *berlandieri* groups. The *berlandieri* contains the majority of species, of which *magnaocularis* and *yavapaiensis* occur in the Sierra Madre Occidental, *omiltemana* in the Sierra Madre del Sur, *forreri*

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along the Pacific coast: *berlandieri* along the Gulf coast, *neovolcanica*, *spectabilis* and *tlaloci* on the Mexican Plateau, and *miadis* and *taylori* along the eastern coast in Central America. The Mexican plateau group contains the most recently described species (Hillis and Frost, 1985), but several new ones from southern Mexico and Central America may be forthcoming (Hillis, 1988).

According to Hillis and Frost (1985), the above members of the Mexican Plateau are distinguished from all other leopard frogs by the following combination of morphological characters: presence of dorsolateral folds that are interrupted posteriorly and deflected medially, presence of numerous tubercles on the dorsal surface, absence of vestigial oviducts in males, absence of a complete supralabial stripe, small head, and a dark reticulate pattern on the posterior surface of the thighs. In this paper, we describe a new species from the Mexican Plateau, whose locality in the state of Puebla lies adjacent to the eastern limits of *R. spectabilis*, as described by Hillis *et al.* (1983) and Hillis and Frost (1985).

*Rana chichicuahutla*, sp. nov.

**Holotype.**

Colección de Herpetología, Instituto de Biología, Universidad Nacional Autónoma de México (Fig. 1). An adult female, collected June 10, 1993 by Orlando Cuéllar, Fausto R. Méndez and Maricela Villagrán, from Lago de Las Minas, about 6 Km SE San Jose Alchichica, Puebla, México, elevation 2324 m.

**Diagnosis.**

*Rana chichicuahutla* can be distinguished from other *Rana* members of the Mexican Plateau by the following combination of characters (live specimen): dorsolateral folds prominently raised, light brown, extending to snout, vocal sacs small, external and green; tympanum large, yellow green; supralabial stripes short, green and present only

behind tympanum; head much wider than long; snout relatively blunt; coloration of dorsal surfaces lime green; dorsal spots dark brown with smooth borders and distinct yellow-green halos; spots anterior to urostyle elongate, raised prominently and oriented longitudinally; posterior spots ovoid and oriented transversely; skin on back relatively smooth; dorsal tubercles few and prominent only posterior to urostyle.

**Description of holotype.**

Adult female with the following measurements in mm: snout-vent length 86, head length 21, head width 30, tibia-fibula length 44, tarsus length 23, foot length 40, vent to rear wrist length 78, internarial width 6, naris to lip height 8, eye to naris width 6, tympanum diameter 8; dorsolateral folds interrupted posteriorly, deflected medially; anterior dorsolateral fold length 45, terminal dorsolateral fold length 15, twenty-three spots between dorsolateral folds; spots anterior to urostyle bulge conspicuously; body sides with approximately twenty-five spots; ventral surface in live specimen whitish with yellow green on throat, chest, sides, thighs and wrists; chin and chest dusky in preserved specimen, otherwise white; eye pupil bordered with distinct bright yellow rim; rear legs relatively long with wrist extending to snout; dorsal surface of legs with 4-5 conspicuous dark brown crossbars extending across thigh, shank and wrist; hind feet webbed to the middle of the second phalanx; spade on the medial surface of the foot well developed (6 long); body proportions relatively stocky; body length (SVL) approximately 30 % greater than that of other holotypes in the Mexican Plateau (Table I), numerous small tubercles on posterior ventral surface of thighs.

**Paratype.**

A single adult male collected simultaneously with the holotype (Fig. 1, Table I), and similar to the holotype, except for its smaller body size and fewer number of dorsal and lateral spots. It lacks vestigial oviducts.



### Comparison with other species.

The only species of the Mexican Plateau that could possibly represent the same taxon as *R. chichicuahutla* is *R. spectabilis*, whose eastern boundary is only about 30 kilometers from the type locality of *R. chichicuahutla*. The ranges of *R. tlaloci* and *R. neovolcanica* are distributed much further west, about 200 and 400 km respectively. Yet, morphologically, *R. chichicuahutla* is more similar to *R. tlaloci* and *R. neovolcanica* than to *R. spectabilis*. The latter differs from all the others in two major characteristics: the presence of flat rather than prominently raised dorsolateral folds, and short legs whose wrists do not extend to the snout. The holotype of *R. spectabilis* also differs from that of *R. chichicuahutla* in having (1) numerous distinctly raised striations between the dorsolateral folds, (2) dorsal spots with dark borders, and (3) dorsolateral folds that are indistinct from the ground color. Also, the holotype of *R. chichicuahutla* is 28% larger than that of *R. spectabilis* (86 mm vs 67 mm) and its head is 25% wider (Table I).

### Karyotype

Prior to preservation, chromosomes from the female were obtained using standard human leucocyte culture techniques. As other species of the genus *Rana*, *R. chichicuahutla* has 13 pairs of chromosomes (Fig. 3), five large and eight small. Of the large, three pairs are metacentric (1, 4, 5) and two are submetacentric (2, 3). Pair 1 is distinctly larger than pairs 2-4, and one of its homologues may be longer than the other. The small pairs are all metacentric, or nearly so. One small pair has secondary constrictions (NOR), either 11 or 12. *R. chiricauhensis* has the constrictions on pair 12 (Green and Delisle, 1985). The large pairs grade in size from large to medium, while most of the small ones are similar sized, although pair 6 seems to be larger than the rest, and could be intermediate between the large and small pairs.

### Distribution

At the present time, *Rana chichicuahutla* is known only from the type locality. During one evening of searching on 10 June 1993, we detected three frogs among the bulrushes (*Juncus*, "Tules"), of which we captured two, the male and female in this paper (Table II). On 13 June 1994, we detected another four and captured two, both females. All females were gravid, so they were probably breeding, but we did not hear mating calls. The relative scarcity of frogs suggests that the population in this lake is very restricted, possibly only to the East shore where the bulrushes are most abundant. Whether the species occurs in other similar habitats in this valley (Cofre de Perote) remains to be determined. Lago de Las Minas was formed by a surface volcanic eruption leaving a deep crater at ground level, which subsequently filled with water. Judging from the presence of old beach terraces on the edge of the rim, about 6 meters above the present water level, the lake has decreased substantially since its original filling, probably during the Pleistocene. A water level marker constructed on the northeast end during the fifties shows that the lake has dropped approximately 2 m since then, undoubtedly due to extensive groundwater pumping for agricultural development. Water is now being pumped by all of the surrounding farms. The lake today is approximately 1 Km long by 0.5 wide. The above 2 m drop represents approximately 1 million cubic meters of lost water. Continued groundwater pumping at the present rate not only threatens this new species, but also the lake itself, since the original water source may not be replenished.

### Remarks

Platz (1991) shows the western boundary of *R. berlandieri* covering substantial parts of the range of *R. spectabilis* in southern Mexico, and probably the type locality of *R. chichicuahutla*. However, we are not aware that *R. berlandieri* has actually been collected from the Mexican Plateau.

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Nevertheless, *R. chichicuahutla* differs from *R. berlandieri* in several morphological traits which render it distinct: absence of supralabial stripes, absence of vestigial oviducts in males, and absence of conspicuous ventral pigmentation in live specimens. According to Platz (1991), the Rio Grande Leopard Frog (*R. berlandieri*) is distinguished by incomplete supralabial stripes "(absent or diffuse anterior to the eye)" and the presence of "prominent vestigial oviducts" in males. Ventral melanism may not be a reliable diagnostic character as proposed by Sanders and Smith (1971), because some members of the Alpha division also possess it (e.g. *R. chiricahuensis*, Platz and Mecham, 1979; *R. subaquavocalis*, Platz, 1993), and some live members of the Beta division may lack it (e.g. *R. chichicuahutla*). Amount of melanism on the throat could also be sex related. In view of the above differences, we suggest excluding *R. chichicuahutla* from the *berlandieri* sub-group, which supposedly was derived from *R. berlandieri*, a lowland coastal species.

Instead, we relegate it to its own distinct group, the Altiplano or Mexican Plateau group, including *R. neovolcanica*, *R. spectabilis* and *R. tlaloci*, all of which share similar high elevation habitats in central Mexico. Similarly, species inhabiting western deserts, such as *R. onca*, *R. fisheri*, *R. chiricahuensis*, *R. yavapaiensis* and *R. subaquavocalis* should be included together as another natural group, which we herein describe as the Sonora group. Species inhabiting the Sierra Madre Occidental, such as *montezumae*, *megapoda* and *dunni*, are relegated to the Sierra Madre Occidental group; those inhabiting lowland regions along the Pacific coast, such as *magnaocularis* and *forreri* to the Pacific group, and those inhabiting the Sierra Madre del Sur, such as *omiltemana*, to the Sierra Madre del Sur group. Finally, excluding *R. fisheri* and *R. onca* from the *berlandieri* group, where they are now arbitrarily included (Hillis, 1988), despite their distribution in the southwestern United States, the original *berlandieri* group would then consist of only *R. berlandieri*, occupying lowland habitats along the Mexican Gulf

coast. Such natural divisions eliminate the cumbersome classification of the Alpha and Beta Divisions, which is partially arbitrary, derived electrophoretically from small sample sizes (Hillis et al., 1983), and ignores geographic history and morphology. Table III compares some major morphological traits between members of the Alpha and Beta divisions, demonstrating absence of correlation between and within divisions. For instance, *R. berlandieri* and *R. chiricahuensis*, which are classified in different divisions, share identical morphological features; whereas *R. pipiens* and *R. onca*, which are classified in the same division, share none of the same features. At least on morphological grounds, the present Alpha and Beta divisions are meaningless.

### Etymology.

We elected *chichicuahutla* for the name of a small village adjacent to the lake, meaning (in Azteca, Nahuatl) "the one who nourishes the forest" (chichi = breast, cuahuatl = tree, tlan = place of abundance). In ancient times, this lake apparently supported a rich forest around its shores.

### ACKNOWLEDGMENTS

We are grateful to Gabriel Barrios Quiroz, Maria Leticia López, Maria Antonieta Martínez, Maria Lidia Mateos and Felipe Rodríguez Romero for providing assistance in the field, to Gustavo Casas-Andreu for bibliographic assistance, to David Jenkins for obtaining the chromosomes and to CONACYT (Grant No. 400355-5-2155 N9303) for financial support. We are especially grateful to Felipe Rodríguez for technical assistance

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Table I. Comparison of holotype measurements (mm) between *Rana chichicuahutla* and three other species of the Altiplano (Mexican Plateau) group. SVL=snout to vent length, HL=head length, HW=head width, TFL=tibia-fibula length, TL=tarsus length, FL=foot length, VWL=vent to wrist (rear) length, INW=internarial width, NLH=naris to lip height, ENW=eye to naris width, TD=tympanum diameter, ADF=anterior dorsolateral fold length, terminal dorsolateral fold length, NDS=number of dorsal spots between folds, NSS=number of side spots, ?=not given in literature.

*Rana chichicuahutla*

	SV L	HL	H W	TF L	TL	FL	V W L	IN W	NL H	EN W	TD	AD F	TD F	ND S	NS S
MALE	62	17	21	32	16	29	56	5	5	4	5	31	9	14	13
FEMALE	86	21	30	44	23	40	78	6	8	6	8	45	15	23	25

*Rana neovolcanica*

	SV L	HL	H W	TF L	TL	FL	V W L	IN W	NL H	EN W	TD	AD F	TD F	ND S	NS S
FEMALE	71	25	24	42	23	42	?	5	?	6	6	?	?	21	?

*Rana spectabilis*

	SV L	HL	H W	TF L	TL	FL	V W L	IN W	NL H	EN W	TD	AD F	TD F	ND S	NS S
FEMALE	67	21	24	36	19	37	?	5	?	5	6	?	?	18	?

*Rana tlaloci*

	SV L	HL	H W	TF L	TL	FL	V W L	IN W	NL H	EN W	TD	AD F	TD F	ND S	NS S
FEMALE	67	21	24	36	19	37	?	5	?	5	6	?	?	18	?

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Table II. Comparison of morphological features between *Rana chichicuahutla* and three other species of leopard frogs from the Mexican Plateau. Ant. = anterior, Post. = posterior, ? =not given in literature.

	<i>chichicuahutla</i>	<i>neovolcanica</i>	<i>spectabilis</i>	<i>tlaloci</i>
Dorsal Fold Type	Raised	Raised	Flat	Raised
Dorsal Fold Color	Light Brown	White	Green-Bronze	Bronze
Dorsal Fold Extent	To Snout	To Eye	To Eye	To Eye
Vocal Sac Type	External	External	Eversible	External
Vocal Sac Color	Green	Pigmented	?	Pigmented
Tympanum Color	Yellow-Green	Yellow-Brown	Bronze	Bronze
Supralabial Stripe	Absent	Present	Absent	Indistinct
Hind Wrist Stretch	Past Snout	Past Snout	Before Snout	Past Snout
Dorsal Ground Color	Lime Green	Tan Greenish	Metallic Green	Golden Tan
Dorsal Spot Color	Dark Brown	Dark Brown	Bronze	Dark Brown
Dorsal Spot Border	Smooth	Irregular	Smooth	Irregular
Dorsal Spot Shape	Elongate	Ovoid	Ovoid	Ovoid
Ant. Spot Direction	Longitudinal	Variable	Longitudinal	Variable
Post. Spot Direction	Transverse	Variable	?	Variable
Halo Around Spots	Yellow Green	Light Green	None	None
Belly Color	Yellow-White	White	Sulphur-Yellow	Cream-White
Ventral Leg Color	Yellow-White	White	Sulphur-Yellow	Cream-White
Throat-Chin Color	Yellow-White*	Dusky	Melanistic	Dusky
Color of Eye Rim	Bright Yellow	?	?	?
Band Through Eye	Absent	Present	?	?
Dorsal Tubercles	Vague	Pronounced	Vague	Pronounced

Table III. Comparison of morphological characteristics between some members of the Alpha and Beta divisions of the Leopard Frog Complex, *Rana chiricahuensis* (Platz and Mechan, 1984), *R. neovolcanica*, *R. spectabilis* and *R. tlaloci* (Hillis and Frost, 1985), *R. onca* (Jennings, 1988), *R. pipiens* (Platz, 1988), *R. yavapaiensis* (Platz, 1988), *R. berlandieri* (Platz, 1991), *R. blairi* (Brown, 1992), *R. subaquavocalis* (Platz, 1993).

SPECIES	FOLDS	STRIPES	THROAT	OVIDUCTS	DIVISION
<i>Chiricahuensis</i>	Deflected	Incomplete	Mottled	Vestigial	Alpha
<i>Subaquavocalis</i>	Deflected	Incomplete	Mottled	Vestigial	Alpha
<i>Berlandieri</i>	Deflected	Incomplete	Mottled	Vestigial	Beta
<i>Pipiens</i>	Complete	Complete	White	Vestigial	Beta
<i>Blairi</i>	Deflected	Complete	?	None	Beta
<i>Yavapaiensis</i>	Deflected	Incomplete	White	None	Beta
<i>Onca</i>	Short	Incomplete	Mottled	None	Beta
<i>Neovolcanica</i>	Deflected	Imcomplete	Dusky	None	Beta
<i>Spectabilis</i>	Deflected	None	Mottled	None	Beta
<i>Tlaloci</i>	Deflected	None	White	None	Beta



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Fig. 1. Side view of holotype



Fig. 2. Top view of holotype and paratype

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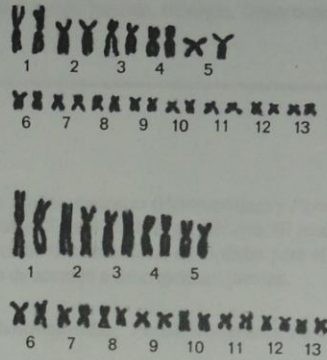


Fig. 3. Karyotype of holotype