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Studies on the genus Leptodactylus (Amphibia: Leptodactylidae). II. Diagnosis and distribution of the Leptodactylus of Costa Rica

by

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This paper serves a dual purpose. It is an updating of TAYLOR'S (17, 18) evaluation of the diagnosis and distribution of the *Leptodactylus* of Costa Rica. Many new locality records are available; the specimens at hand indicate re-evaluations of certain species' status, and the tadpoles of all Costa Rican forms are now known. Second, the analysis of intra- and inter-population morphological variation forms part of the groundwork of my projected long-term study on the biosystematics of the genus *Leptodactylus*.

Adults of the genus *Leptodactylus* are distinguished from members of other frog families found in Costa Rica as follows (*Leptodactylus* characters in parentheses): representatives of the families Centrolenidae and Hylidae usually have a membranous web between the toes, and all phalanges terminate in an expanded disk (no toe webbing, no disks); members of the Bufonidae and Atelopodidae have a fleshy web between the toes, members of the Ranidae have a membranous web between the toes (no toe webbing); the representatives of the Dendrobatidae are distinguished by the presence of pairs of dermal scutes above the expanded finger and toe disks (no scutes, no disks); the representatives of the family Microhylidae of Costa Rica usually have an obvious amount of toe webbing and always have a fleshy fold across the palate (no web, no palatal fold); the monotypic Rhinophrynidae has four toes on each foot (five).

From other genera of leptodactylids, the genus *Leptodactylus* is distinguished as follows: *Engystomops* lacks vomerine teeth, and has a prominent tubercle on the mid-tarsus (vomerine teeth present, no tarsal tubercle); almost

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all *Eleutherodactylus* have webs between the toes and/or expanded digital disks (no webbing, no disks); species of *Eleutherodactylus* which lack webs and disks are difficult to distinguish from members of the genus *Leptodactylus* by use of external morphological characters. Technically, all *Leptodactylus* can be distinguished from all *Eleutherodactylus* by having the mesosternum with a bony style instead of a broad cartilaginous (may be calcified) plate.

Leptodactylus larvae are distinguished from other known larvae of Costa Rican families as follows: larvae of the family Microhylidae have a median spiracle (sinistral in *Leptodactylus);* tadpoles of the families Hylidae and Ranidae have a dextral anus (median); the only known *Atelopus* tadpole has a large sucking disk extending onto the belly (mouthparts not involving belly); bufonid tadpoles have an anterior and posterior oral papilla gap (anterior break only); centrolenid tadpoles have a posteriorly placed spiracle (near mid-body, not noticeably posterior); dendrobatid tadpoles may lack tooth rows, have lateral indentations of the oral disk, have a confluence of anterior and posterior (to beak) tooth rows, and are often found on the backs of adults (tooth rows present, basically emarginate oral disk, anterior and posterior tooth rows separate, larvae not found on back of adults); *Rhinophrynus* tadpoles lack tooth rows and a horny beak (present). Members of the genus *Eleutherodactylus* undergo direct development. *Engystomops* tadpoles have a median or dextral anus (variable within some populations [KU 104276]) and a laterally indented oral disk (median anus, basically emarginate oral disk).

MATERIAL AND METHODS

Morphological features were examined for series of specimens of each species, based largely on material at the University of Southern California (CRE). Definitions of characters and techniques follow PETERS (14), except for the following: *Adults.* All measurements were taken with either dividers and metric rule or metric calipers; head length was measured from the angle of the jaw to the tip of the snout; head width was taken as the widest portion of the head; for purposes of comparing finger lengths, the first (thumb) and second digits were measured from their confluence to the respective digital tips, fingers three and four were measured from their confluence to the respective digital tips; the femur and tibia were measured (when possible) while the right leg was held as a z, the femur at a right angle to the body, the tibia folded next to the femur; the femur was measured from mid-anus to the extremity, the tibia was measured as the greatest tibial length when the leg was positioned as above; the foot was measured from the posterior edge of the inner metatarsal tubercle to the tip of the fourth toe; snout-vent length is given in millimeters, the first number being the minimum, the second the median, the last the maximum measured; all measurements except snout-vent are given as percentages of the snout-vent length in the same manner. *Larvae.* Tadpoles were staged following GOSNER (9), all measurements were made with either a micrometer in a Wild stereoscopic microscope or dividers and metric rule, depending on the size of the tadpole;

eye diameter was taken as the greatest horizontal diameter; body length was measured ventrally, from the tip of the snout to the joining of the anal tube with the body, or the posterior confluence of the legs if the anal tube had been resorbed; body width was taken ventrally as the greatest width of the body; body height was taken vertically as the greatest depth of the body; oral disk width was taken ventrally (or more or less head-on depending on the position of the mouthparts) as the greatest width of the oral disk; the oral papilla gap was measured between the dorsal origins of the oral papillae; measurements are given in the manner indicated for adults; rows of papillae are given in formulae, such as 1-2-3-2 (Fig. 6), 1 indicates a single row of papillae anteriorly, 2 indicates a change to a double row of papillae anterolaterally, 3 indicates a change to three papillae rows in width laterally, and 2 indicates a change to a double row of papillae posteriorly on the oral disk.

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SPECIES ACCOUNTS

Leptodactylus bolivianus Boulenger

1898. *Leptodactylus bolivianus* Boulenger: 4-5 (Holotype: Genoa Mus. 28875 A, Bolivia: Barraca and Missiones Mosetenes); 1954, Taylor: 617-620 (redescription).

DIAGNOSIS - Adult: From all *Leptodactylus* of Costa Rica except *L. melanonotus, L. bolivianus* is distinguished by the extensive fringing on the sides of the toes. *L. melanonotus* is a small robust frog *(L. bolivianus* resembles *Rana pipiens),* has vomerine teeth in transverse series posterior to the choanae (arched, partly between), and reaches 45 mm standard length (95 mm).

Larva: Only *L. melanonotus* sometimes shares the characteristic of entire

tooth rows (formula 2/3). From *L. melanonotus, L. bolivianus* is distinguished by a narrow anterior gap in the oral papillae (21-31% of oral disk width in *L. bolivianus,* 40-60% in *L. melanonotus).*

SUMMARY OF CHARACTERISTICS - Adult: Snout subovoid to subelliptical from above, rounded to rounded acute in profile; tympanum distinct, horizontal diameter just over ½ to ⅔ eye diameter; male vocal slits elongate, arise laterally to tongue, almost parallel to jaw; single internal vocal sac in males; vomerine teeth in arched series, extend from between choanae posteriorly; head length greater than or equal to width, 35-37.0-39% standard length; head width 32-34.4-37% standard length; first finger much longer than second, first shorter than third, second longer than fourth; two horny spines on male thumb; male arm hypertrophied; back and upper femur smooth to tuberculate, upper tibia tuberculate; one pair of dorsolateral folds from back of eye to sacrum, supratympanic fold extends to shoulder, lateral folds from tympanum to groin developed or not; gland present at angle of jaw; post-tympanic gland present; diffuse glands ventrolaterally on body and back of limbs developed or not; toes with well-developed lateral fringes; metatarsal ridge present; inner tarsal fold well-developed from below tibio-tarsal articulation to the inner metatarsal tubercle; lower tarsus moderately to heavily covered with small, black-tipped tubercles; sole of foot moderately covered with small, black-tipped tubercles; dark canthal stripe extends posteriorly from eye along the supratympanic fold; interorbital dark blotch sometimes continuing as broad dark dorsal band to axillary region or beyond; dorsolateral folds dark, continuous or broken; posterior portion of lateral band light, rest of dorsal body more or less ocellated; posterior face of arm dark, upper surface may be uniform or spotted; upper legs with oblong spots appearing as barred; chin suffused with melanophores; rest of ventral surfaces almost immaculate to mottled; posterior thigh mottled to almost spotted; standard length of males to 94 mm, females to 88 mm; femur shorter than or equal to tibia, 38-47.4-51% standard length; tibia shorter than foot, 48-51.2-54% standard length; foot longer than femur, 49-53.2-57% standard length (Fig. 1).

Larva: Nostril midway between anterior edge of eye and tip of snout or slightly nearer eye; internareal distance slightly less than interorbital distance; eye small, diameter 5-7-10% of body length; mouth subterminal; oral papillae rows 1-2-3-2; oral disk entire; oral disk width 20-24.3-28% of body length; oral papilla gap 21-26.2-31% of oral disk width; tooth row formula 2/3, all tooth rows equal length; tooth row anterior to beak usually with more denticles (130-200) than row just posterior to beak (120-185); beak teeth small, blunt; dorsal tail fin origin at tail-body juncture; tail height just greater than body height; tail tip bluntly pointed; extensive to moderate suffusion of brown or black melanophores dorsally; concentration of melanophores posteromedially to nostrils; light spot under eye; lighter areas over tail musculature on body; side may be reticulated or uniformly suffused with melanophores; lateral line system not evident; few melanophores on oral papillae; no melanophores just posterior to mouthparts, otherwise anterior venter lightly suffused with melanophores; belly with few or no melanophores; anal tube with a few scattered melanophores or not; tail generally suffused with melanophores, with scattered light specks; total length largest specimen, stage 34, 32 mm; body length 32-39.1-44% of total length. (Figs. 6, 11, 16).

LOCALITIES: GUANACASTE: Río Bebedero, 5 km S Bebedero, 5 m; 0.8 km E Finca Jiménez along Río Higuerón, 11 m; Finca Taboga, 9.7 km S and 8.0 km W of Cañas, 4 m; PUNTARENAS: 1.6 km E of Volcán de Buenos Aires, Cone Finca, 400 m; 9.6 km W Buenos Aires at Río Volcán, 400 m; Coto, km 47 on Rail from Golfito, 75 m; Esterillos Oeste, 15 km SE Jacó, 10 m; Golfito, 5 m; 3 km E, 9.6 km ESE Golfito, 10 m; Palmar Norte, 20 m; Palmar Sur, 16 m; 5.6 km SE, 7 km SE Palmar Sur, 15 m; 3-5 km W Palmar Norte on rd. to Puerto Cortés, 10 m; 39 km E Palmar Norte, 4 km E Río La Vieja, 150 m; Parrita, La Julieta, Finca La Ligia, 5 m; Quebrada, 1 km NW of Pochotol, Playa Hermosa, 2m; Rincón, vic. Camp Seattle, 50 m; 2.4 km WSW Rincón de Osa; 24-32 km W San Isidro de El General; Villa Neily, 75 m; 14.5 km NW Villa Neily at Río Claro, 60 m (Fig. 22).

REMARKS: I tentatively allocate the Costa Rican population to *L. bolivianus* Boulenger rather than *L. insularum* Barbour. A re-examination of the *ocellatus*-complex is needed to clarify the species limits within the group. Until that time, I follow RIVERO (16) rather than MINTON & SMITH (13) in regarding *L. insularum* a synonym of *L. bolivianus,* instead of recognizing two species.

The prominent toe-fringing of this species and *L. melanonotus* is evident in late stage tadpoles (stage 40 on) and persists throughout the remaining developmental stages.

Leptodactylus labialis (Cope)

1877. *Cystignathus labialis* Cope: 90 (Holotype: USNM 31302, Mexico?)
1881. *Leptodactylus labialis,* Brocchi: 20 (Cites Cope's record); 1954, Taylor: 613-617 (redescription).

DIAGNOSIS - Adult: The light longitudinal stripe on the posterior thigh distinguishes *L. labialis* from *L. bolivianus, L. melanonotus,* and *L. pentadactylus. L. poecilochilus* has a smooth ventral tarsus and foot; the tarsus and foot of *L. labialis* is white tuberculate.

Larva: The blotched tail of *L. labialis* distinguishes it from larvae of *L. bolivianus* and *L. melanonotus. L. labialis* larvae have subterminal mouthparts and a light spot immediately posterior to the oral disk, distinguishing them from *L. pentadactylus* larvae which have almost terminal mouthparts and lack a distinct light spot behind the mouthparts. *L. labialis* larvae are difficult to distinguish from *L. poecilochilus* larvae *(L. poecilochilus* characteristics in parentheses): *L. labialis* larvae are uniformly patterned (dark-flecked); are blunt snouted (snout elongately rounded); are large eyed, horizontal diameter 12-16% of body length (eye moderate, 9-14% body length); lack a light mid-dorsal stripe (present or absent); and have few denticles in the tooth rows just anterior and posterior to the beak, 46-101 and 59-104 respectively (64-142 and 92-152).