Catalogue of American Amphibians and Reptiles.

Heyer, W.R. and A.S. Thompson. 2000. *Leptodactylus rugosus*.

Leptodactylus rugosus Noble

Leptodactylus rugosus Noble 1923:297. Type locality, "near Kaieteur Falls, British Guiana" (now Guyana). Holotype, American Museum of Natural History (AMNH) A-1169, juvenile, collected by F.E. Lutz on 13 August 1911 (examined by WRH). See Remarks.

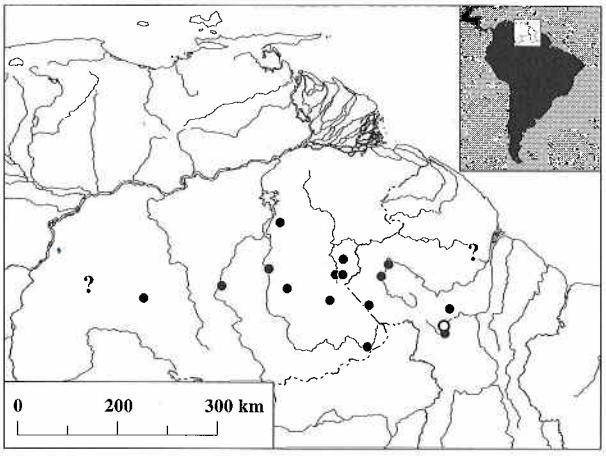
Leptodactylus rugosus Melin 1941:58, Fig. 32. Secondary homonym (replacement name = *Leptodactylus melini* Lutz and Kloss 1952:639). A junior synonym of *Adenomera hylaedactyla* Cope (see Heyer 1973:28).

Leptodactylus rugulosus: Duellman 1993:230. *Lapsus*.

• **CONTENT.** The species is monotypic.

• **DEFINITION.** Adult *Leptodactylus rugosus* are of moderate size, the head is about as wide as long, and the hind limbs are moderate in length (Table; see also Comments). Male vocal sacs are laterally expanded and are darkly pigmented. Male forearms are hypertrophied only in the largest individuals. Adult males have 1 or 2 black thumb spines on each hand and a pair of chest spines. Most individuals either lack dorsolateral folds or have one short pair of ridges or elongate warts in the shoulder region; rarely do individuals have a series of short ridges in the dorsolateral fold field. The toe tips are barely expanded and rounded. The toes lack fringes or lateral fleshy ridges. The upper shank and outer tarsus have few to many black and/or white tubercles and may or may not have a shagreen (sharkskin-like surface). The sole of the foot is smooth in about 50% of the individuals, the others have only a few black and/or white tubercles; only a very few individuals have a weakly developed shagreen on the sole of the foot. The pattern on the upper lip is variable, including no noticeable pattern (uniform), alternating dark and light vertical or oblique bars, an irregularly defined light area in the loreal region, and extensive dark mottling, heaviest near the mouth. Most specimens have a dorsal pattern of a series of 3–4 (rarely 2) pairs of large to small spots ranging from discretely defined to patterns of fusion with other spots both across as well as lengthwise along the dorsum; about a fourth of the specimens have uniform or almost uniform dorsal patterns. The species lacks light middorsal stripes. The belly pattern is quite variable, ranging from almost uniformly gray/brown to a boldly mottled pattern of light spots/flecks on a darker ground. The juvenile belly patterns are generally more distinctive than in adults. The patterns on posterior thigh surfaces are also quite variable, ranging from indistinctly mottled to distinctly mottled with small or large irregular spots to extensive light areas on either the upper or lower portion of the posterior thigh; no specimens have distinct light horizontal stripes on the lower portion of the posterior thigh. The dorsal surface of the shank has irregular dark cross-bands.

Larvae are elongate and depressed with low tail fins and are members of the semiterrestrial guild (Altig and Johnston 1989). The larvae have a series of glandular ridges on the body above the abdominal cavity. The oral disk is ventrally positioned, entire, and with an anterior gap. The tooth row formula is 2(1)/3(1). The spiracle is sinistral and the anal tube is median. Total length ranges from 32–37 mm (for Gosner stage 38–40 larvae). For the same larvae, the head-body length ranges from 9–10 mm; the eye diameter is 12–15% of the head-body length; and the oral disk width is 21–28% of the head-body length. The dorsum of the head-body is brown, the underside of the head-body is transparent with white flecks on the throat. The tail musculature is brown dorsally and cream ventrally. The tail fins are translucent with white flecks. Duellman (1997) stated the colors in life to be: "body reddish brown with dark brown



MAP. Distribution of *Leptodactylus rugosus*; the circle marks the type locality, dots indicate other records. The eastern question mark represents a probably incorrect locality based on correctly identified specimens; the western question mark represents a locality for which species identification is in doubt (see Distribution). The westernmost dot represents the locality of Maigualida (see Distribution). A range outline is not provided because the species occurs in disjunct rocky outcrops that are patchily distributed throughout the species' range (see Distribution).

FIGURE 1. *Leptodactylus rugosus*, KU 166527, male, 59.2 mm SVL, km 117–119 on road between El Dorado and Santa Elena de Uiarén, Bolívar, Venezuela (photograph courtesy of the Natural History Museum, The University of Kansas).

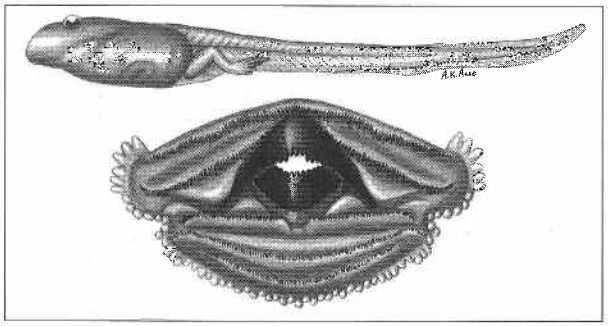


FIGURE 2. Tadpole of *Leptodactylus rugosus*, KU 167792, stage 39, TL 40.0 mm (illustrations courtesy of the Natural History Museum, The University of Kansas).

TABLE. Summary measurement data for *Leptodactylus rugosus*. Means are given in parentheses.

Measurement	Males	Females
SVL (mm)	51–72 (57.6)	54–74 (61.0)
Head length/SVL (%)	38–44 (40)	37–42 (40)
Head width/SVL (%)	37–41 (40)	38–43 (40)
Thigh length/SVL (%)	42–38 (45)	33–48 (44)
Shank length/SVL (%)	43–49 (46)	40–51 (46)
Foot length/SVL (%)	45–53 (48)	42–55 (48)

transverse marks; tail reddish brown with dark brown and greenish-blue spots; belly white; iris bronze with red median, horizontal streak."

The advertisement call consists of a single note per call, given at a rate of 1–7/min. Call duration ranges from 0.6–0.7 s. The call is complexly partially to completely pulsed with a rate of 92–98 pulses/s. The call is frequency modulated, rising faster at the beginning of the call than at the end. The call is intensity modulated, quickly reaching its loudest intensity, then slowly decreasing in intensity until the end of the call. The dominant frequency is the fundamental frequency. A short (ca. 0.03 s) pulse of lower frequency (600–700 Hz) is followed by a long pulse train in which the dominant frequency ranges from 1300–2700 Hz. Harmonics have been reported as absent (Heyer 1979) or present (Duellman 1997).

• **DIAGNOSIS.** Adult *Leptodactylus rugosus* have toes free of webbing and lateral fringes and either very short, indistinct, or no dorsolateral folds. These features are shared with (at least some individuals of) *L. bufonius*, *L. labialis*, *L. labyrinthicus*, *L. laticeps*, *L. latinasus*, *L. lithonaetes*, *L. myersi*, *L. syphax*, and *L. troglodytes*. The upper shank and posterior tarsus of *L. bufonius*, *L. labialis*, *L. latinasus*, and *L. troglodytes* are covered with large prominent white tubercles and males lack cornified thumb spines; in contrast, the upper shank and posterior tarsus of *L. rugosus* has black-tipped tubercles (in some preserved specimens the black tips may be lost, leaving white tubercles which are noticeably smaller than those of *L. bufonius*, etc.), and the males have either 1 or 2 spines on each thumb. *Leptodactylus laticeps* has a tile-like dorsal pattern and is larger (minimum adult SVL 78 mm), than *L. rugosus* (maximum adult SVL 74 mm), which also lacks a distinct tile-like pattern. *Leptodactylus labyrinthicus* is larger (minimum adult SVL 117 mm) than *L. rugosus*, and no *L. labyrinthicus* have light loreal blotches, whereas several *L. rugosus* do. *Leptodactylus myersi* is larger (females 104–113 mm SVL, males 74–118 mm SVL) than *L. rugosus*, and *L. mysersi* males lack the chest spines found in *L. rugosus*. *Leptodactylus rugosus* is most likely to be confused with *L. lithonaetes* and *L. syphax*. The most distinctive characteristics among these three species are male secondary sexual characteristics. *Leptodactylus rugosus* has 1 or 2 black spines on each thumb and lack a patch of brown/black tubercles on the chin and throat; *L. lithonaetes* has a single black spine on

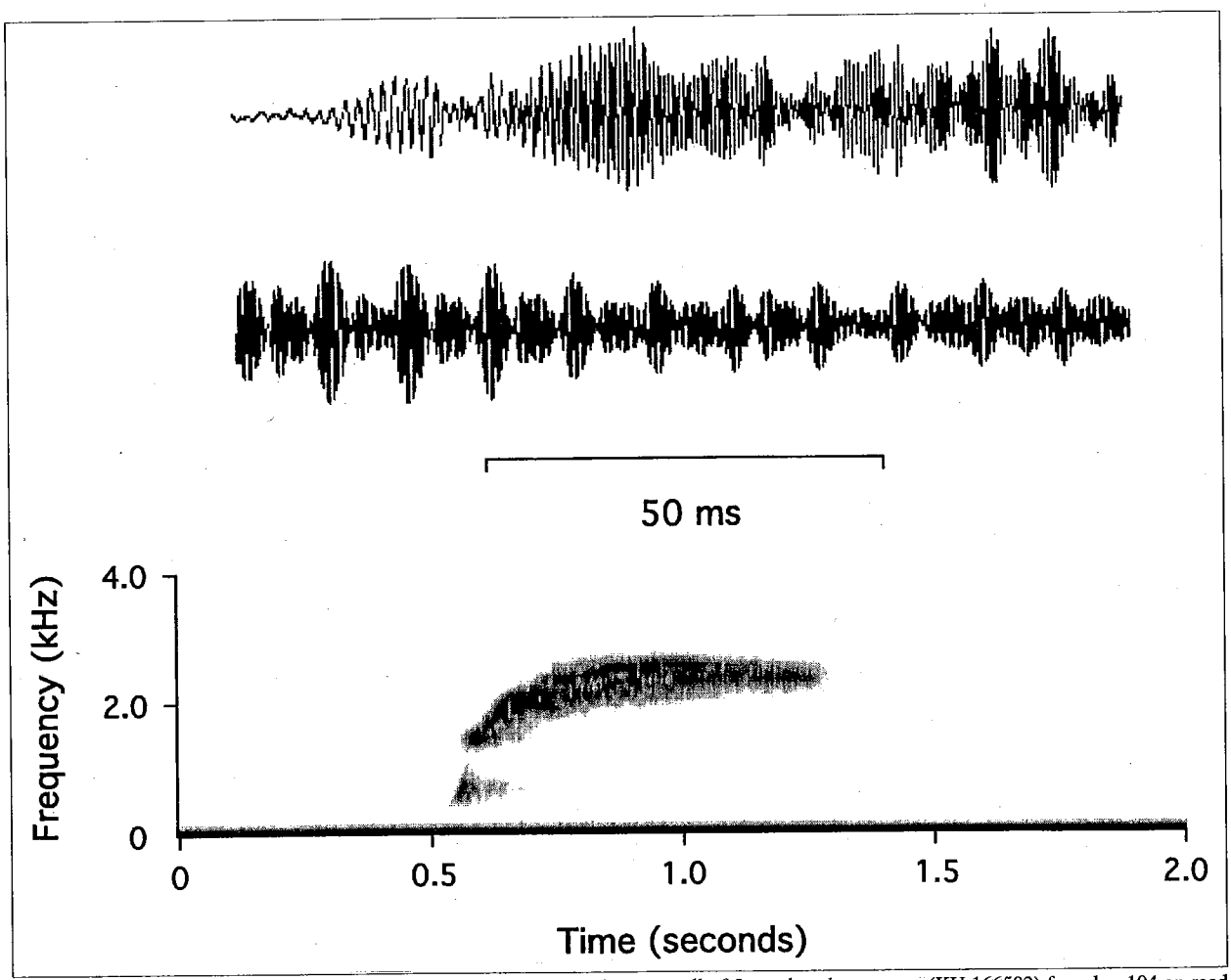


FIGURE 3. Wave form and audiospectrogram displays of the advertisement call of *Leptodactylus rugosus* (KU 166502) from km 104 on road between El Dorado and Santa Elena de Uiarén, Bolívar, Venezuela. Upper wave form portion is at beginning of call; lower wave form portion begins at 1.0 s time marker on audiospectrogram.

each thumb and a patch of brown/black tubercles on the chin and throat; all *L. syphax* have 2 black spines on each thumb. In addition, *L. syphax* commonly has a dorsal pattern of low contrast quadrangular ocellations, a pattern that does not occur in *L. rugosus*.

Larvae lack dorsal fins on the anterior half of the tail, a condition shared only with *L. lithonaetes* larvae among *Leptodactulus* species for which larvae have been described. The larvae of these two species are extremely similar to each other and may be indistinguishable. For the limited samples available, the most diagnostic feature is the number of labial teeth on one side of the split tooth row anterior to the beak (row A-2) for Gosner stage 33–42 larvae: 50–56 for *L. rugosus* and 37–51 for *L. lithonaetes*.

• **DESCRIPTIONS.** Noble (1923) provided morphological characteristics of the holotype. Detailed character descriptions of adults and juveniles including color patterns are in Donnelly and Myers (1991) and Heyer (1979, 1995). Rivero (1961) briefly described adult morphology but some, if not all, of the specimens he based the description on are *L. lithonaetes*. Detailed descriptions on the tadpole can be found in Duellman (1997), Heatwole et al. (1965), and Heyer (1979). Descriptions of the advertisement calls are in Duellman (1997) and Heyer (1979). Rivero's (1961) verbal description of the advertisement call is probably based on *L. sabanensis* or ally, but certainly is not the same as the *L. rugosus* call described from recordings. Schlüter (1994) has a brief description of adult life colors.

• **ILLUSTRATIONS.** A color photograph of an adult is in Duellman (1997) and Gorzula and Señaris (1999). Other photographs are in Donnelly and Myers (1991) and Schlüter (1994). Pictures of juveniles are in Donnelly and Myers (1991) and Heyer (1995). Drawings of the tadpoles can be found in Duellman (1997) and Heatwole et al. (1965). Color photographs of the larvae are in Gorzula and Señaris (1999). Audiospectrograms of the mating call are in Duellman (1997), Heyer (1979), and Schlüter (1994). Waveforms of advertisement calls are in Duellman (1997) and Heyer (1979).

• **DISTRIBUTION.** *Leptodactylus rugosus* is known from few localities in the eastern part of Estado de Bolívar, Venezuela and west of the Essequibo River in Guyana. The species apparently is restricted to granitic and sandstone habitats in the Guiana shield region. Duellman (1999) tabled its distribution as Amazon Basin-Guiana lowlands. Gorzula and Señaris (1999) and Rivero (1964b) included its distribution in the Venezuelan Guayana frog fauna. A range map was provided by Heyer (1979, 1995). The Venezuelan localities of Maigualida, Amazonas and Cerro Guanay, Bolívar reported by Gorzula and Señaris (1999) lie in between the distributions of *L. lithonaetes* and *L. rugosus* mapped by Heyer (1995). The specimen from Maigualida is an adult male (MHNLS 11388, not 11389 as reported, *fide* C. Señaris, pers. comm.), 58.1 mm SVL, with diagnostic features of *L. rugosus*. Specimens from Cerro Guanay are juveniles; adult males need to be examined from that locality to determine whether the specimens are *L. lithonaetes* or *L. rugosus*. All specimens in museum collections from Kartabo, Guyana were collected by William Beebe. Kartabo was a research station operated by the New York Zoological Society. The description of the site (Beebe 1925) excludes rocky habitats, making it very likely that Beebe actually collected the specimens somewhere else in Guyana. Beebe apparently did not take care in associating locality data with specimens he collected. Lynch (1976) noted that the holotype of *Eleutherodactylus beebei* Cochran 1956, which Beebe had recorded as collected at Kartabo, was a synonym of *E. inoptatus*, known only from Hispaniola, where Beebe also collected. The specimen of *L. rugosus* reported by Freed (1993) from the Kanuku Mountain region of Guyana is actually *L. petersii* (CM 136149, examined by WRH).

• **FOSSIL RECORD.** None.

• **PERTINENT LITERATURE.** Morpology and systematics of *Leptodactylus rugosus* have been dealt with most extensively in the literature. No detailed research studies have addressed the biology of *L. rugosus*, and most of the available biological data are brief observations.

Donnelly and Myers (1991), Duellman (1997), Heatwole et al. (1965), Hoogmoed and Gorzula (1979), and Schlüter (1994) described habitat and behavior. Larval behavior was mentioned by Duellman and Trueb (1986) and Gorzula and Señaris (1999). The species was listed in a paper on the adaptive ecology of *Leptodactylus* species groups (Heyer 1969). Relationships were analyzed in Heyer (1995) and Maxson and Heyer (1988). Heyer (1972) and McCranie et al. (1980) compared *L. rugosus* with new species of the same genus. *Leptodactylus rugosus* was included in faunal lists by Barrio (1998), La Marca (1992, 1995, 1997), and Pefaur (1992). Frost (1985) and Gorham (1966) included the species in taxonomic lists. Rivero (1964a) reported on a specimen in a Venezuelan collection. Locality data were listed in Heyer (1979) and Rivero (1961). Hoogmoed (1979) listed the species as an example of a Guianian endemic. Rivero-Blanco and Dixon (1979) indicated that the species is restricted to the Guiana region and occurs within the Dry Forest vegetation zone in the Llanos and Yuruari Savannah regions in Venezuela. The species was included in general distributional analyses by Heyer (1988) and Heyer and Maxson (1982). The species was included in a study of sexual selection and sexual dimorphism by Shine (1979). Duellman (1997) discussed reproduction. Altig and Johnston (1989) and Duellman (1993) placed larval *L. rugosus* in the semiterrestrial guild. Lescure (1979) compared the tadpoles of *L. fallax* and *L. rugosus*. Abundance information is in Donnelly and Myers (1991). Data for caerulein skin secretions were included in a data-table by Erspamer (1994). Liner (1994) listed the species in a bibliographic compilation.

Several citations before 1995 included data for *L. lithonaetes* and/or *L. myersi*, and determining whether Duellman (1993, larvae), Rivero (1964a), and Rivero-Blanco and Dixon (1979) included information for *L. lithonaetes* as well as *L. rugosus* is impossible. Data or citations in La Marca (1992, 1995, 1997), Liner (1994), Pefaur (1992), and Rivero (1964b) represented a combination of information on *L. lithonaetes* and *L. rugosus*. Data used in Erspamer (1994) and Shine (1979) may have pertained to *L. lithonaetes, L. myersi,* and/or *L. rugosus*. The data used in analyses in Heyer (1969) probably included those from *L. lithonaetes, L. myersi,* and *L. rugosus*, and data used in analyses in Heyer (1988), Heyer and Maxson (1982), and Hoogmoed (1979) definitely included those from *L. lithonaetes, L. myersi,* and *L. rugosus*. The skin compounds for *L. rugosus* reported in the paper by Flier et al. (1980) were based on specimens from Cerro Yapacana (C.W. Myers, in litt.), which are now recognized as *L. lithonaetes*. The taxonomic information in Frost (1985) applied only to *L. rugosus*, but the distribution data were based on *L. lithonaetes, L. myersi,* and *L. rugosus*. The morphological and locality data in Heyer (1979) were an amalgum of *L. lithonaetes, L. myersi,* and *L. rugosus* data, although larval and advertisement call data pertained solely to *L. rugosus*. Some, if not all, of the specimens used for the morphological descriptions and locality data in Rivero (1961) were *L. lithonaetes*, but all of the natural history/habitat data that were associated with specific localities pertain to *L. lithonaetes*.

The behaviorial observations of larvae in Duellman and Trueb (1986) were based on Duellman's personal observations of *L.*

rugosus, principally at km 104 on the El Dorado–Santa Elena de Uiarén road (W.E. Duellman, in litt.). Lescure (1979) referred to data in Heatwole et al. (1965) for *L. rugosus*.

• **NOMENCLATURAL HISTORY.** Prior to 1995, *Leptodactylus rugosus* was considered to include forms that occupied rocky habitats from western Colombia throughout southern Venezuela and the Guianas. Heyer (1995) discussed variation in this assemblage and concluded that at least three species were represented, *L. lithonaetes* from western Colombia and the Estado of Amazonas area of Venezuela, *L. myersi* from northern Brazil, Surinam, and French Guiana, and *L. rugosus*.

• **REMARKS.** Noble stated the holotype was an adult male, but Donnelly and Myers (1991) pointed out the holotype is a juvenile.

We found only two uses of a "common" name for *Leptodactylus rugosus*. Frank and Ramus (1995) proposed the name White-lipped frogs for the genus *Leptodactylus* and the Guyana White-lipped Frog as the name for *L. rugosus*. Most *Leptodactylus* species do not have white lips, invalidating their "common" name for the genus. Most *L. rugosus* also do not have any sort of condition that would be interpreted as having white lips and the species occurs in Venezuela in addition to Guyana, invalidating their "common" name for the species. Barrio (1998) coined the awkward name sapo-rana rugoso oriental. Common names should be those used by the people living in the region where the species occurs. As we are unaware of any such name for *L. rugosus,* we propose that the species should be referred to by its scientific name for all purposes.

• **ETYMOLOGY.** Noble (1923) did not specifically indicate the derivation of the species name, but it certainly refers to the rugose, warty, and tuberculate dorsum characteristic of members of the species.

• **COMMENTS.** Adult size and leg length categories were defined to encompass the range of variation observed within the genus *Leptodactylus*. The definitions used for adult size are: (1) small, males < 35 mm SVL, females < 45; (2) moderate, males > 35 mm SVL, females > 45, both sexes < 90; (3) large, both sexes > 90 mm SVL. The definitions used for leg length are: (1) short, with at least two of the following conditions applying, thigh < 40% SVL, shank < 42% SVL, foot < 45% SVL; (2) moderate, with at least two of the following, thigh 40–45% SVL, shank 42–50% SVL, foot 45–55% SVL; (3) long, with at least two of the following, thigh > 45% SVL, shank > 50% SVL, foot > 55% SVL. The definitions allocate most species to a single category. However, if a species is intermediate, both descriptors are used, e.g., moderately small size.

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