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REDESCRIPTION OF THE PLETHODONTID SALAMANDER *BOLITOGLOSSA LIGNICOLOR* (PETERS), WITH REMARKS ON THE STATUS OF *B. PALUSTRIS* TAYLOR

By Arden H. Brame, Jr. and David B. Wake
Department of Biology, University of Southern California
Los Angeles 7, California

Recently, while examining Costa Rican and Panamanian salamanders, we found that the holotype of *Bolitoglossa palustris* bore a remarkable similarity to salamanders assigned by us to *B. lignicolor*. This discovery prompted a thorough investigation into the status of the two taxa. It is now apparent that only a single species is represented, and it is rediagnosed and redescribed below. In addition, information concerning intraspecific variation and ideas concerning relationships of *B. lignicolor* and its allies are presented.

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Bolitoglossa lignicolor (Peters)

Spelerpes (*Oedipus*) *lignicolor* Peters, 1873. Monatsb. König. Preuss. Akad. Wiss. Berlin, 1873: 617.

Oedipus ahli Unterstein, 1930. Zool. Anz., 57. (9/10): 272.
Bolitoglossa lignicolor Taylor, 1944. Univ. Kansas Sci. Bull., 30, Pt. 1 (12): 219.
Bolitoglossa palustris Taylor, 1949. Univ. Kansas Sci. Bull., 33, Pt. 1 (6): 283.

Holotype: ZMB 7736, Chiriquí, Panamá.

Material examined: Panamá, ANSP 22875–77, UMMZ 58489–90, 58492–95, USNM 118784, Boquete, 4,000 feet (1,220 meters), Provincia de Chiriquí; UMMZ 58496–98, Progresso, 100 ft (30 m), Prov. Chiriquí; ANSP 21639–42, Puerto Armeulles, near sea level, Prov. de Chiriquí; ZMB 31801 (2 specimens, syntypes of *Oedipus ahli*), "Val de Pilaton, Cordillera" = Chiriquí, Prov. Chiriquí, fide Dunn (1940); ANSP 22480–95, Cerro Mangillo, 2,800 ft (850 m), Peninsula de Azuero, Prov. Los Santos; ANSP 22549–50, Tiger Ridge Camp, 2,600 ft (800 m), Peninsula de Azuero, Prov. Los Santos. Costa Rica: UMMZ 123196, Río Rincon, 164 ft (circa 50 m), Peninsula de Osa, Prov. Puntarenas; KUMNH 23817 (holotype of *B. palustris*), 34924, San Isidro del General, 2,400 ft (730 m), Prov. San José; KUMNH 66164, east of Isla Bonita, 3,040 ft (925 m), Prov. Heredia; AMNH 11725, Sarapiquí, 300 ft (92 m), Prov. Heredia; and holotype.

Diagnosis: A large species of *Bolitoglossa* (11 adult males: 47.3–67.7, mean 59.2 mm, standard length; 10 adult females: 47.9–81.2, mean 66.8 mm) with moderate numbers of maxillary teeth (21 adults: 23–60, mean 35) and fully webbed hands and feet distinguished from *B. alvaradoi* by fewer maxillary teeth and banded rather than patched light dorsal coloration; from *B. arborescandens* by more robust habitus, fewer maxillary teeth, and tendency for light dorsal pigmentation; from *B. borburata* by larger size and fewer maxillary teeth; from *B. striatula* by larger size, more robust habitus, darker ground color, and solid rather than striated color ventrally; from *B. yucatana* by slightly broader head, less robust tail, and tendency for broad dorsal band of light color rather than paired dorsolateral light stripes.

Description: *B. lignicolor* is a large, robust species with a moderately long and broadly rounded to subtruncate snout. As is typical of the genus, females are larger than males. The nostril is small. Labial protuberances are moderately developed in adult males, but poorly developed in females and young. Mental hedonic glands are present in adult males but are only faintly indicated. Heads are moderately broad, but head width is variable (standard length 5.6 to 7.1 times head width, mean 6.3 in males; 6.3 to 7.2, mean 6.6 in females). A relatively deep, slightly curved groove about the same length as the eye opening is found just below the eye, but it does not communicate with the lip. The eyes are moderate in size, and are but slightly protuberant. A poorly defined postorbital groove extends posteriorly from the eye as a shallow, irregular depression. At the posterior end of the mandible the groove proceeds sharply ventrally and extends across the throat anterior to the gular fold

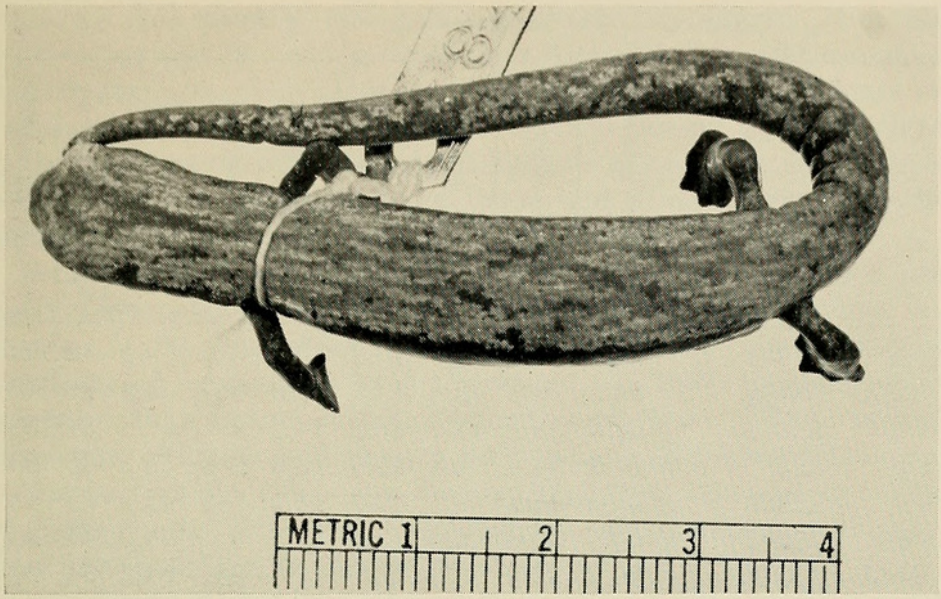

FIG. 1. Dorsal view of *Bolitoglossa lignicolor*, UMMZ 58498, adult female, from Progresso, Provincia de Chiriquí, Panamá.

as a moderately to poorly defined depression. Vomerine teeth range from 18 to 40 (mean 28) in adult males, and from 24 to 38 (mean 32) in adult females. Vomerine teeth increase in number with size, in general, and the larger number in females is probably a reflection of their larger size. The teeth are either in patches or single series and always extend beyond the medial border, and sometimes extend beyond the lateral border of the internal nares. Maxillary teeth extend to about the center of the eyes and range from 23 to 43 (mean 34) in adult males, and from 24 to 60 (mean 36) in adult females. Premaxillary teeth are few in number (0–6), and pierce the lip of adult males. Many slightly enlarged and pigmented glandules cover the dorsal surface of the head, trunk, and tail. The trunk and tail are robust. Tails are almost round in cross section and are moderately constricted at their bases. Light gray postiliac glands are usually present. Limbs are robust and of moderate length. Limb interval (costal folds between appressed limbs) varies from 2½ to 3½ (mean 3) in males; 2½ to 4½ (mean 3½) in females. Hands and feet are relatively large, and are extensively and virtually completely webbed. Digits are well demarcated by grooves in the webbing between them. Tips of the longer digits protrude from the webbed pad as broadly rounded points. The longest digit has a more pointed tip than the other digits. Webbing between the digits is very thickened and the digits are not greatly flattened as in certain other *Bolitoglossa* (e.g., *striatula*, *colonnea*). Subterminal pads are not evident. The fingers are in order of decreasing length: 3, 2, 4, 1; toes in order of decreasing length: 3, 4, 2, 5, 1. Pertinent counts and measurements of material studied by us are found in Table 1.

Ground color of the lateral and ventral surfaces is very dark and

TABLE 1.—Data on *Bolitoglossa lignicolor*

MUSEUM NUMBER			SNOUT–VENT LENGTH	AXILLA–GROIN	HEAD WIDTH	HIND LIMB LENGTH	SNOUT–GULAR FOLD	LIMB INTERVAL	TAIL LENGTH	MAXILLARY TEETH	VOMERINE TEETH
ANSP	22877	♂	67.7	37.4	10.7	16.3	15.0	3	70.2	40	34
UMMZ	58489	♂	64.3	36.2	9.8	14.0	13.8	3½	54.2	28	40
ANSP	22876	♂	62.3	33.7	11.1	16.2	14.9	2	60.8	31	30
ANSP	22480	♂	61.3	34.1	9.8	13.5	13.6	2½	50.2	45	28
ANSP	22482	♂	60.9	33.8	9.5	13.8	13.0	2½	47.1	35	18
ANSP	22481	♂	60.5	33.6	9.6	13.2	13.2	3	54.2	41	23
UMMZ	123196	♂	59.2	32.8	8.3	13.9	13.3	2½	64.2	31	21
ANSP	22875	♂	59.1	32.7	9.6	13.3	13.2	2½	55.8	33	34
ANSP	22484	♂	54.9	31.2	9.2	12.0	12.4	3	47.1	43	23
UMMZ	58497	♂	53.3	28.1	8.1	12.0	12.8	3½	53.5	25	28
UMMZ	58493	♂	47.3	25.5	7.9	10.4	10.8	3	41.2	23	24
UMMZ	58495	♀	81.2	46.9	11.3	17.0	17.2	4	67.0	48	26
KUMNH	66164	♀	78.6	45.5	12.3	18.0	17.0	4	80.2	60	42
KUMNH	34924	♀	76.4	44.7	10.6	16.3	16.8	4½	77.8	40	24
AMNH	11725	♀	73.0	42.1	10.9	—	16.8	—	—	—	19*
UMMZ	58490	♀	71.5	40.9	10.7	15.8	15.0	4	—	32	28
ANSP	22549	♀	64.6	35.9	10.1	14.2	14.1	4	45.2	48	29
UMMZ	58498	♀	63.1	36.6	10.0	14.6	14.0	4	64.0	44	34
UMMZ	58494	♀	61.6	33.7	9.8	13.3	14.1	3½	—	33	38
ANSP	21639	♀	49.8	27.3	7.8	12.0	10.9	3	—	33	29
KUMNH	23817	♀	47.9	27.0	7.6	11.2	11.1	4	33.0	24	28
ANSP	21642	♀	45.5	25.7	7.4	10.8	10.8	2½	30.4	27	22
ANSP	22550		44.5	22.8	7.5	10.8	10.4	3	35.0	23	19
UMMZ	58491		44.5	23.4	7.4	9.9	10.2	3	37.4	13	25
ANSP	21641		43.2	24.2	7.1	10.2	10.6	3	39.3	25	23
UMMZ	58492		39.5	21.9	6.5	8.9	8.8	3	28.4	18	22
UMMZ	58496		29.7	15.6	4.8	6.8	7.8	3	21.7	4	16

* Vomerine teeth counted on one side only.

ranges in preservative from lead gray to gray to gray-brown. Broad dorsal bands of cream to light tan with slight pinkish tints are present in most individuals. The band is often streaked or washed with darker coloration and the amount of dark dorsal coloration is rather variable. Some have only a few spots of dark color dorsally, most have a central irregular dark streak that expands on the head, and some are very dark dorsally with only a few streaks of light coloration. One specimen is

uniformly dark dorsally. The dark ventral coloration appears to undergo some ontogenetic change. In smaller specimens the dark color is arranged in punctate melanophores, but with increasing size the melanophores fuse to form dense reticula. The ventral surface of the tail is colored similar to the trunk venter. Tiny white guanophores are common on all ventral surfaces and on the dark-colored limbs, and some striations of white pigment are found on the throats of many individuals.

Remarks: Taylor (1949) described a new species of salamander, *Bolitoglossa palustris* (KUMNH 23817), which he considered to be a member of the *Bolitoglossa rufescens* group. He did not mention the possibility of relationship to *B. lignicolor*. In 1952, however, Taylor compared *B. palustris* with *B. lignicolor* and stated: "The two chief characters, which seem to separate *Bolitoglossa palustris* from this species is that each of the ridges has the vomerine teeth arranged in a patch or multiple series, rather than in a single line, and the tail is much shorter than head–body length (approximately 0.7)."

The characters used by Taylor to separate *B. palustris* and *B. lignicolor* are not consistent. Nineteen of 22 specimens of *B. lignicolor* with unregenerated tails have tails that are shorter than their standard lengths, including eight that have tails 10 mm or more shorter than their standard lengths. Two individuals have body–tail dimensions very closely approximating the holotype of *B. palustris*. As a taxonomic character, tail length in salamanders is hazardous, and in the case under consideration the character appears to be valueless.

Taylor's statement concerning the arrangement of vomerine teeth in *B. lignicolor* does not hold. The numbers and arrangement of vomerine teeth are subject to clinal variation, and range from low numbers arranged in single rows in central Panamá to high numbers arranged predominantly in patches in Costa Rica (Table 2).

In 1954, Taylor reported finding a specimen of *B. lignicolor* from the type locality of *B. palustris*. The vomerine teeth are arranged in two rows (patched) somewhat like *B. palustris*, and the tail is but 1 mm longer than the standard length. Taylor therefore revised his analysis

TABLE 2.—Clinal arrangement of vomerine teeth organization in *Bolitoglossa lignicolor*

AREAS	PATCH	INTERMEDIATE	SINGLE
Northeastern and Central Costa Rica	2	0	1
Southern Costa Rica and Far-western Panamá	7	6	4
Central Panamá	1	2	8
TOTAL	10	8	13

of distinguishing characters for separating *B. palustris* from *B. lignicolor* as follows: "Vomerine teeth forming an irregular patch on strongly elevated ridges (low in *lignicolor*), the domelike character of the palate (much less so in *lignicolor*), the choanae of the type actually larger than those of this specimen of *lignicolor* (KUMNH 34924), more than double its size, the tail compressed, higher than wide, the color different . . . ." Examination of a series of *B. lignicolor* reveals that these characters are highly variable. The majority of *B. lignicolor* which have vomerine teeth arranged in patches have an irregular arrangement like that of the holotype of *B. palustris*. Elevation of the vomerine ridges shows considerable variation as does the relative choanal size. Curvature of the palate ranges widely in shape from dome shape to gentler curves, and is at least partially influenced by preservation. Degree of tail compression in many of the specimens of *B. lignicolor* matches that of *B. palustris*, and the color of *B. palustris* agrees with the coloration of several small individuals of *B. lignicolor*.

In addition to the above similarities, *B. palustris* falls within the range of variation for *B. lignicolor* in regard to the following characters (proportional to standard length): numbers of vomerine and maxillary teeth,

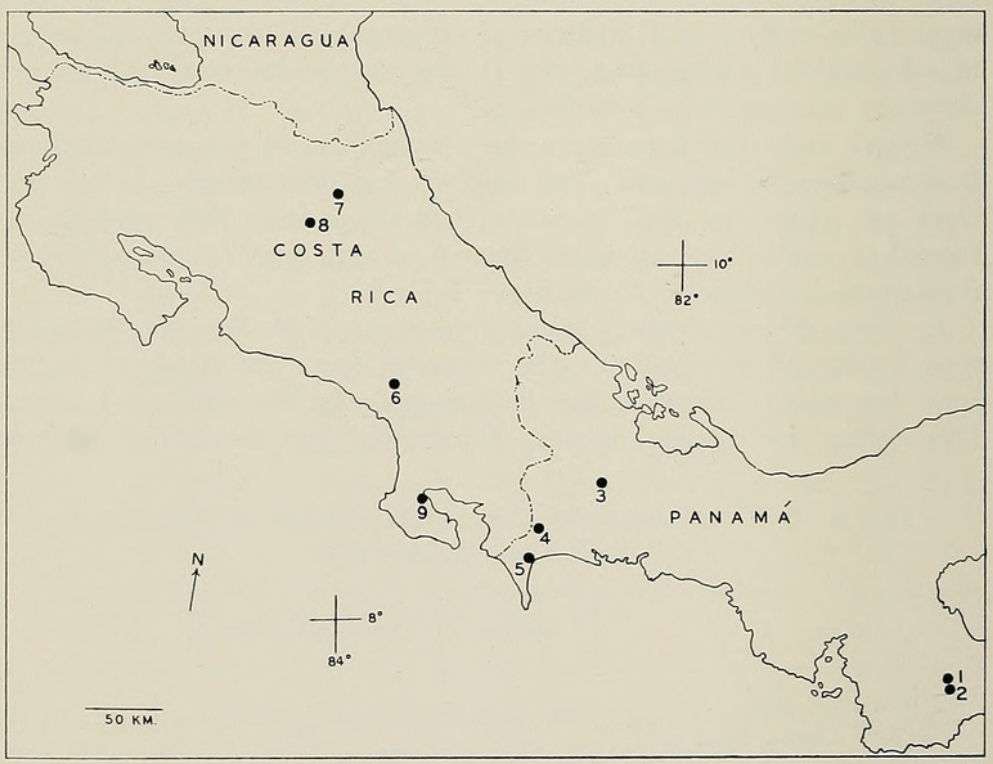

Fig. 2. Range of *Bolitoglossa lignicolor* with localities indicated by black dots; 1—Cerro Mangillo, Peninsula de Azuero, Provincia de Los Santos; 2—Tiger Ridge Camp, same region as locality 1; 3—Boquete, Prov. Chiriquí; 4—Progresso, Prov. Chiriquí; 5—Puerto Armeulles, Prov. Chiriquí; 6—San Isidro del General, Prov. San José; 7—Sarapiquí, Prov. Heredia; 8—east of Isla Bonita, Prov. Heredia; 9—Río Rincon, Peninsula de Osa, Prov. Puntarenas.

head width, head length, and hind limb length (see Table 1). The taxon is left without distinguishing characters, and it seems apparent that *B. palustris* should be considered a subjective junior synonym of *B. lignicolor.*

The senior author recently examined the two syntypes of *Oedipus ahli* Unterstein in the Berlin Museum, and concurs with Dunn (1940) in considering this name to be a subjective junior synonym of *B. lignicolor.*

The closest relative of *B. lignicolor* is apparently *B. yucatana.* Dunn (1926) first pointed out this close relationship and Taylor (1952) concurred. The two species resemble each other very closely in size, proportions, and numbers of teeth. *B. yucatana* tends to have a slightly narrower head than *B. lignicolor.* The tail of adult *B. yucatana* is extremely robust, and is much larger than that of *B. lignicolor.* The broad, light dorsal band of *B. lignicolor* is replaced in *B. yucatana* by paired dorsolateral light stripes. *B. lignicolor* is a little less closely related to *B. mexicana, B. flaviventris, B. salvinii,* and *B. platydactyla* from which it differs in being more robust, in shape of hands and feet, and in coloration. It resembles *B. alvaradoi* in size, proportions, and shape of hands and feet but differs in lacking spots or patches of light coloration dorsally, and in having fewer maxillary teeth. It is probably more closely related to *B. alvaradoi* than to any other southern Central American species. There is some indication of a relationship between *B. lignicolor* and *B. borburata* of Venezuela, especially in coloration. *B. lignicolor* is larger, however, and has far fewer maxillary teeth, and differently shaped hands and feet.

Range: Central Panamá to northeastern Costa Rica (Fig. 2).

Literature Cited

Dunn, E. R. 1926. The salamanders of the family Plethodontidae. Smith College 50th Anniversary Publ., Northampton, Mass., 1926: viii + 441, illus.

———. 1940. New and noteworthy herpetological material from Panama. Proc. Acad. Nat. Sci. Philadelphia, 92: 105–22, pl. 2.

Peters, W. 1873. Über eine neue Schildkrötenart *Cinosternon Effeldtii* und andere neue oder weniger bekannte Amphibien. Monatsb. König. Akad. Wiss. Berlin, 1873: 607–18, 1 pl. (figs. 1–3).

Taylor, E. H. 1944. The genera of plethodont salamanders in Mexico, Pt. I. Univ. Kansas Sci. Bull., 30, pt. 1 (12): 189–232, figs. 1–2, pls. 12–15.

———. 1949. New salamanders from Costa Rica. Univ. Kansas Sci. Bull., 33, pt. 1 (6): 279–88.

———. 1952. The salamanders and caecilians of Costa Rica. Univ. Kansas Sci. Bull., 34, pt. 2 (12): 695–791, figs. 1–14, pls. 76–88.

———. 1954. Additions to the known herpetological fauna of Costa Rica with comments on other species. No. I. Univ. Kansas Sci. Bull., 36, pt. 1 (9): 597–639, figs. 1–12.

UNTERSTEIN, W. 1930. Beschreibung zwier neuer Molche der gattung *Oedipus*. Zool. Anz., 87 (9/10): 270–272.