THE TADPOLES OF THE HYLID FROGS (ANURA: HYLIDAE: *HYPSIBOAS* AND *OSTEOPILUS*) OF HISPANIOLA

Luis M. Díaz[1], Sixto J. Incháustegui[2], Cristian Marte[3] and Agustín Chong[4]

[1]Museo Nacional de Historia Natural de Cuba. Obispo #61, esquina Oficios, Plaza de Armas, Habana Vieja, CP 10100, Cuba. luisfromcuba@yahoo.es
[2]Grupo Jaragua. El Vergel #33, El Vergel, Santo Domingo, República Dominicana. sixtojinchaustegui@yahoo.com
[3]Museo Nacional de Historia Natural "Prof. Eugenio de Jesús Marcano". Calle César Nicolás Penson, Plaza de la Cultura, Santo Domingo, República Dominicana. c.marte@mnhn.gov.do.
[4]Departamento de Anatomía Patológica, Hospital Hermanos Ameijeiras, La Habana, Cuba. avchong@infomed.sld.cu

ABSTRACT

Hispaniolan hylid frogs are represented by four endemic species: *Hypsiboas heilprini*, *Osteopilus dominicensis*, *O. pulchrilineatus* and *O. vastus*. There are two tadpole ecomorphs represented in the hylid frogs of Hispaniola: lentic (*O. dominicensis* and *O. pulchrilineatus*) and lotic (*H. heilprini* and *O. vastus*). Tadpoles of the four species may be found sympatrically, but in different microhabitats. Hispaniolan hylid tadpoles reach a moderate size (up to 57 mm in total length is recorded in *H. heilprini*), and differ from those of *Peltophryne*, *Rhinella*, *Leptodactylus* and *Lithobates* (the other genera with free-living larvae present on the island), by having the oral discs not emarginated and, from the first three taxa, by a dextral vent opening. Oral deformities observed in most tadpoles of *H. heilprini* from Ébano Verde, Cordillera Central, were caused by the chytrid fungus *Batrachochytrium dendrobatidis*. An identification key is also provided.

Keywords: West Indies, Caribbean, amphibians, tree frogs, larvae, ecomorphs, guilds, deformities, chytrid fungus.

Título: Las larvas de las ranas hílidas (Anura: Hylidae: *Hypsiboas* y *Osteopilus*) de La Hispaniola.

RESUMEN

Las ranas hílidas de La Hispaniola están representadas por cuatro especies endémicas: *Hypsiboas heilprini*, *Osteopilus dominicensis*, *O. pulchrilineatus* y *O. vastus*. Existen dos ecomorfos larvales representados en estos hílidos: el léntico (*O. dominicensis* y *O. pulchrilineatus*) y el lótico (*H. heilprini* y *O. vastus*). Las larvas de estas cuatro especies pueden hallarse en simpatría, pero ocupando microhábitats diferentes. Los renacuajos hílidos de La Hispaniola alcanzan un tamaño moderado (hasta 57 mm de longitud total en *H. heilprini*). Se diferencian de las larvas de *Peltophryne*, *Rhinella*, *Leptodactylus* y *Lithobates* (los otros géneros con larvas en la isla) por tener el disco oral no emarginado y, de los primeros tres géneros, por la posición dextral de la abertura cloacal. Las deformidades orales observadas en la mayoría de las larvas de *H. heilprini* de Ébano Verde, Cordillera Central, se debieron a la presencia del hongo quitridiomiceto *Batrachochytrium dendrobatidis*. Se ofrece una clave para la identificación de las larvas.

Palabras clave: Antillas Mayores, Caribe, anfibios, larvas, ecomorfos, deformidades, hongo quítrido.

INTRODUCTION

The two native frog families with aquatic free living larvae in Hispaniola are Hylidae (genera *Hypsiboas* and *Osteopilus*), and Bufonidae (genus *Peltophryne*). The four hylid frog species: *Hypsiboas heilprini*, *Osteopilus dominicensis*, *O. pulchrilineatus* and *O. vastus* (Fig. 1), are widely distributed in Haiti and Dominican Republic (Schwartz and Henderson, 1991). Noble (1927) made the first reference to the tadpoles of *O. dominicensis*, *O. vastus* and *H. heilprini* along a stream at Los Bracitos (Duarte Province). This author commented that larvae "were all segregated into particular parts of the stream according to their ability to withstand the current". He noted that the tadpoles of *O. dominicensis* were similar to North American pond breeding species, with round bodies and small numbers of teeth rows, whereas larvae of *O. vastus* and *H. heilprini* had large mouths, greater numbers of tooth rows, thicker tail muscles, and a streamlined body. In the same contribution, oral discs and tadpoles (in dorsal view) of these three species were illustrated. Mertens (1939) provided some additional information about colouration of larvae and metamorphs, and mentioned that tadpoles of *O. vastus* use the oral disc to maintain their position in fast-flowing waters. Díaz *et al*. (2014) briefly described and illustrated the tadpoles, eggs, and development of *Osteopilus pulchrilineatus*.

A version of this manuscript was sent to Zootaxa in December 2013 but after one year of delay by the editing process, a similar contribution was published by Galvis *et al*. (2014) and therefore our contribution was rejected. These authors made an excellent revision of the tadpoles of Hispaniolan hylid frogs based on captive raised larvae from a single locality (Cotuí, Sánchez-Ramírez Province). However, we still consider that our contribution complement and even support big part of the information provided by Galvis *et al*. (2014) for a number of reasons: (1) species were sampled in the wild (not captive reared) in several localities and different habitats, (2) variation is shown for larvae from different localities, (3) we offer additional morphological data, and the state of some character is different to descriptions by Galvis *et al*. (2014) in artificially reared tadpoles, and (4) the effect of chytridiomycosis on the oral morphology of tadpoles is reported for the first time.

OBJECTIVES

- This contribution is intended to provide morphological descriptions and comparisons of tadpoles as well as ecological information on them.

MATERIALS AND METHODS

Tadpole morphological terminology and measurements basically follow Altig and McDiarmid (1999), except that: (1) the interorbital distance was measured as the space between inner margins of eyes, instead of centers of the pupils, and (2) the internarial distance was measured in the same way. For most of the other measurements we follow Kolenc *et al*. (2008). The dorsum-spiracle distance was taken from the dorsal outline to the upper border of the spiracle opening. Some morphological traits used for the tadpole descriptions and comparisons, are illustrated in Figure 2. All measurements were taken with a caliper (0.01 mm accuracy) and an ocular micrometer in a dissecting microscope Swift M27LED. The following abbreviations are used: TL, total length; BL, body length; TaL, tail length; MTH, maximum tail height; DFH, dorsal fin height; VFH, ventral fin height; CMH, caudal muscle height; CMW, caudal muscle width; IND, internarial-distance; TMH, tail muscle height; BMW, body maximum width; BMH, body maximum height; DSD, dorsum-spiracle distance; SSD, snout-spiracle distance; SND, snout-naris distance; NED, naris-eye distance; N, nostril major axis; E, eye diameter; IO, interorbital distance; IN, internarial distance. LTRF is the abbreviation for labial tooth

row formula (Altig and McDiarmid, 1999). Not all the studied tadpoles were measured, and those with evidently regenerated tails (usually shorter in length) or with improper shape and consistency were avoided even though they were used for observations of qualitative characters. Tadpole developmental stages were determined according to Gosner (1960). Ecomorphological guilds, based on morphology, feeding behavior, and ecology (habitat) are those defined by Altig and Johnston (1989). For all the species, some of the wild caught tadpoles in Gosner´s developmental stages over 30 were artificially reared in small plastic aquaria up to the end of the metamorphosis to confirm species identity.

Diagnosis of chytridiomycosis based on histological examination was made following Berger *et al.* (1999, 2005). Oral discs with anomalies of two tadpoles in stage 29, from Ébano Verde, Cordillera Central, were removed and processed with standard histological protocols using a tissue processor Sakura Tissue Tek II and a microtome Sakura Accu-Cut SRM. Tissue cuts were stained (separately) with hematoxylin and eosin (H&E), periodic acid-Schiff (PAS), and Grocott's silver-methenamine. Two tadpoles (stages 29 and 32, respectively) from Loma La Canela, Duarte Province, that showed normal oral morphology, were processed in the same way for comparisons. The term "deformity" is used for those anomalies in the tadpole mouthparts like the lack of teeth rows and jaw sheaths that were caused by the chytrid fungus *Batrachochytrium dendrobatidis* as described by Altig (2007).

Tadpoles were photographed in the field, at the time of capture, with a Nikon D300 digital camera, and Micro Nikkor 105 mm lens, using the SB-R200 wireless twin light flash system. Larvae were anesthetized with MS222 (McDiarmid and Altig, 1999) prior to being photographed, and then positioned under water on a clean Petri dish. Photos of preserved specimens were done in a similar way. Line drawings were made either from digital photos with Corel Draw 12, or with a lucid camera K400 attached to a MoticK, dissecting microscope. Oral discs used for illustrations were removed from tadpoles, stained with iodine tincture (Roldan Lab., S.A), then expanded and mounted on a glass slide. Tadpoles preserved in 10% formalin were stored as lots, but individual voucher specimens were examined (Appendix I) and deposited in the collection of the Museo Nacional de Historia Natural "Prof. Eugenio de Jesús Marcano", Dominican Republic (MNHNSD), catalogued with field numbers of the project "*Anfibios Amenazados y Cambio Climático en República Dominicana*" (Endangered Amphibians and Climate Change in Dominican Republic), abbreviated as "*Proyecto Rana RD*" (PRRD).

Figure 1, A-D. Tree frogs (Hylidae) of Hispaniola. A, *Hypsiboas heilprini*, adult male (PRRD 491), Loma Quita Espuela, Duarte Province. B, *Osteopilus dominicensis*, adult male (PRRD 394), Aceitillar, Sierra de Bahoruco, Barahona Province. C, *O. pulchrilineatus*, adult male (PRRD 501), Loma La Canela, Duarte Province. D, *O. vastus*, adult male (PRRD 655), Río Limpio, Parque Nacional Nalga de Maco, Elías Piña Province. Scale bars=1cm. Photos: Luis M. Díaz.

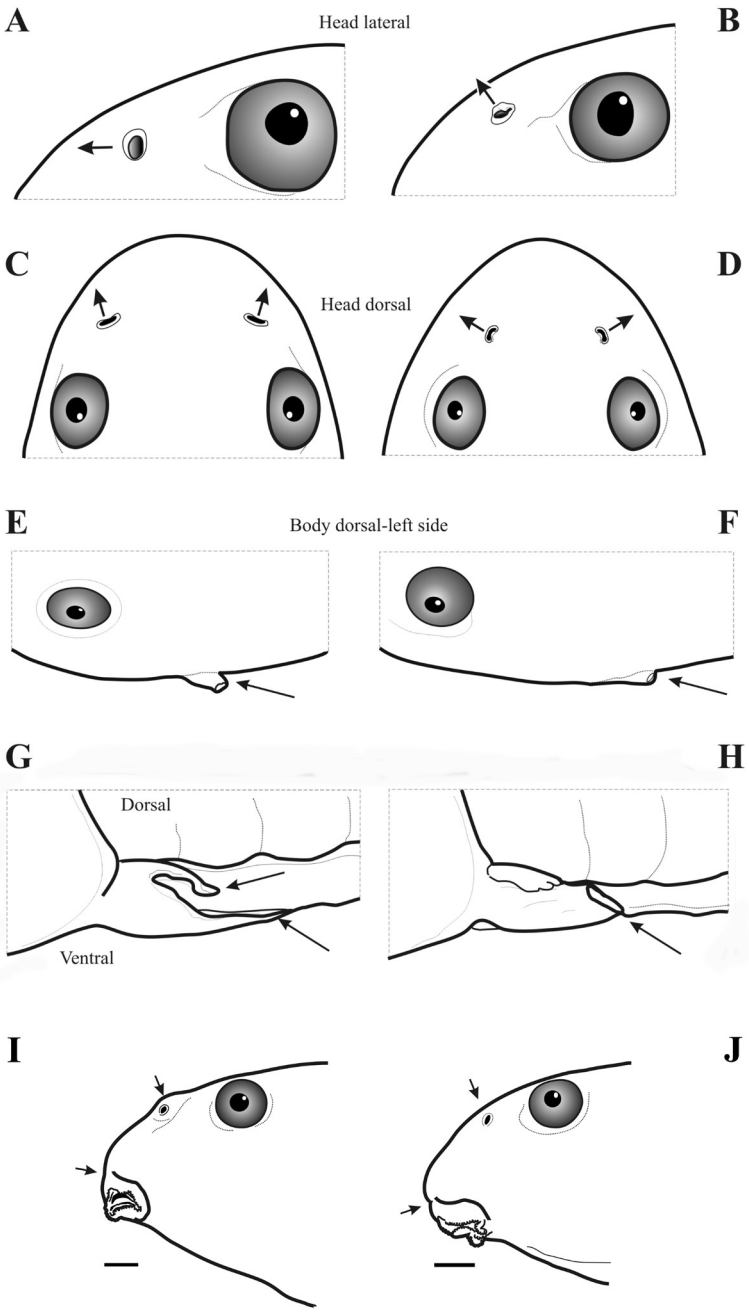

Figure 2, A-J. State of morphological characters as used in species descriptions and comparisons. A and C, nares round, with a weak rim, facing anterolaterally (illustrated tadpole: *Osteopilus vastus*, the same state of character is present in the other Hispaniolan members of the genus). B and D, nares facing dorsolaterally, with a rounded projection in the medial margin which gives them a reniform aspect in dorsal view (*Hypsiboas heilprini*). E, spiracle with the distal part of the inner wall free from body (a condition present in *H. heilprini* and *O. vastus*). F, spiracle with the distal part of the inner wall present as a slight ridge (as occur in *O. dominicensis* and *O. pulchrilineatus*; illustrated species: *O. pulchrilineatus*). G, vent tube with the right wall displaced dorsally and anteriorly (*H. heilprini*). H, vent tube medial with dextral displacement (*O. vastus* and other species in the genus). I, swollen upper narial profile of *O. dominicensis* (upper arrow), and lack of groove in the snout tip transition to oral disc (lower arrow). J, snout gradually slopping (upper arrow), defining a slight groove in the transition to the oral disc (lower arrow). Illustrations: Luis M. Díaz.

RESULTS

Tadpole accounts

Larvae of the four species are illustrated in Figure 3 and oral discs in Figure 4.

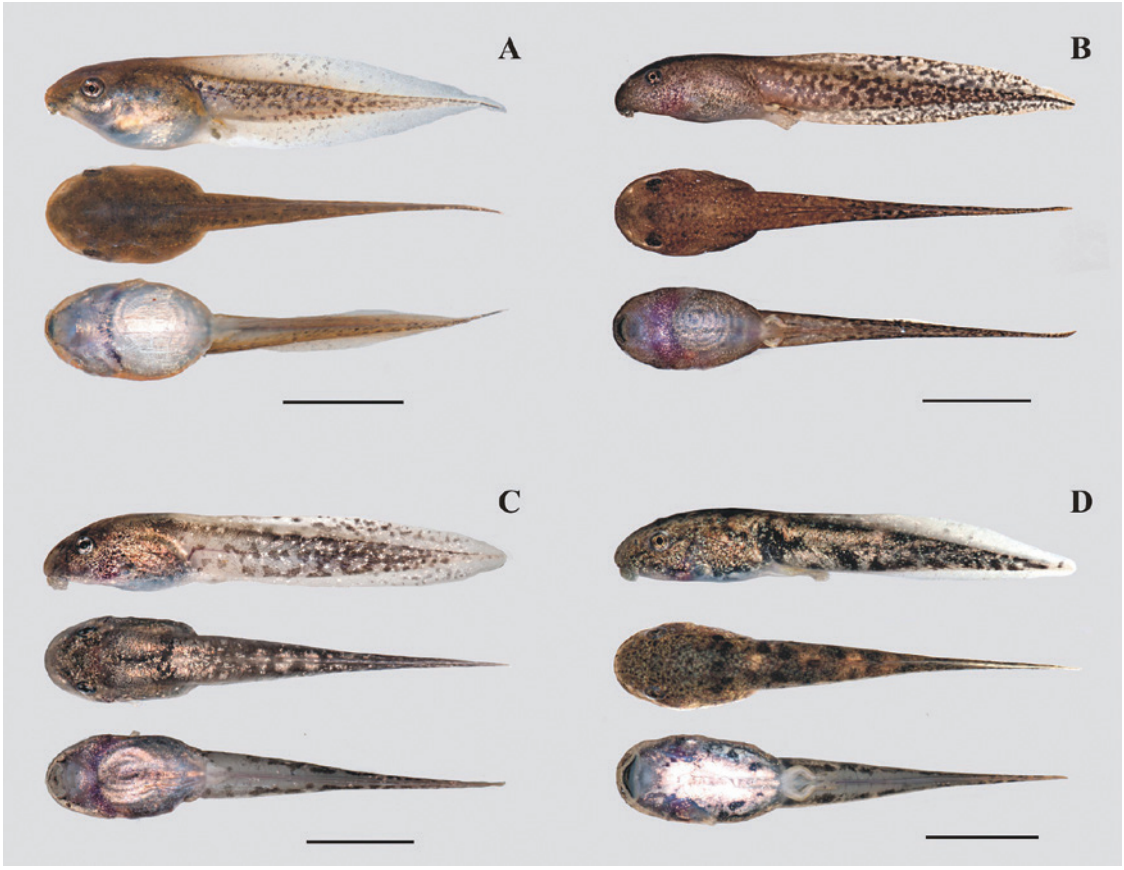

Figure 3, A-D. Tadpoles of the hylid frogs of Hispaniola in lateral, dorsal, and ventral views. All the tadpoles are from Río Limpio, Elías Piña Province, Dominican Republic. Lentic tadpoles: A, *Osteopilus dominicensis* (PRRD 657.8), stage 37; B, *O. pulchrilineatus*, stage 37 (PRRD 654.7). Lotic tadpoles: C, *Hypsiboas heilprini*, stage 32 (PRRD 656.5); D, *O. vastus*, stage 37 (PRRD 651.6). Scale bars=1 cm. Photos: Luis M. Díaz.

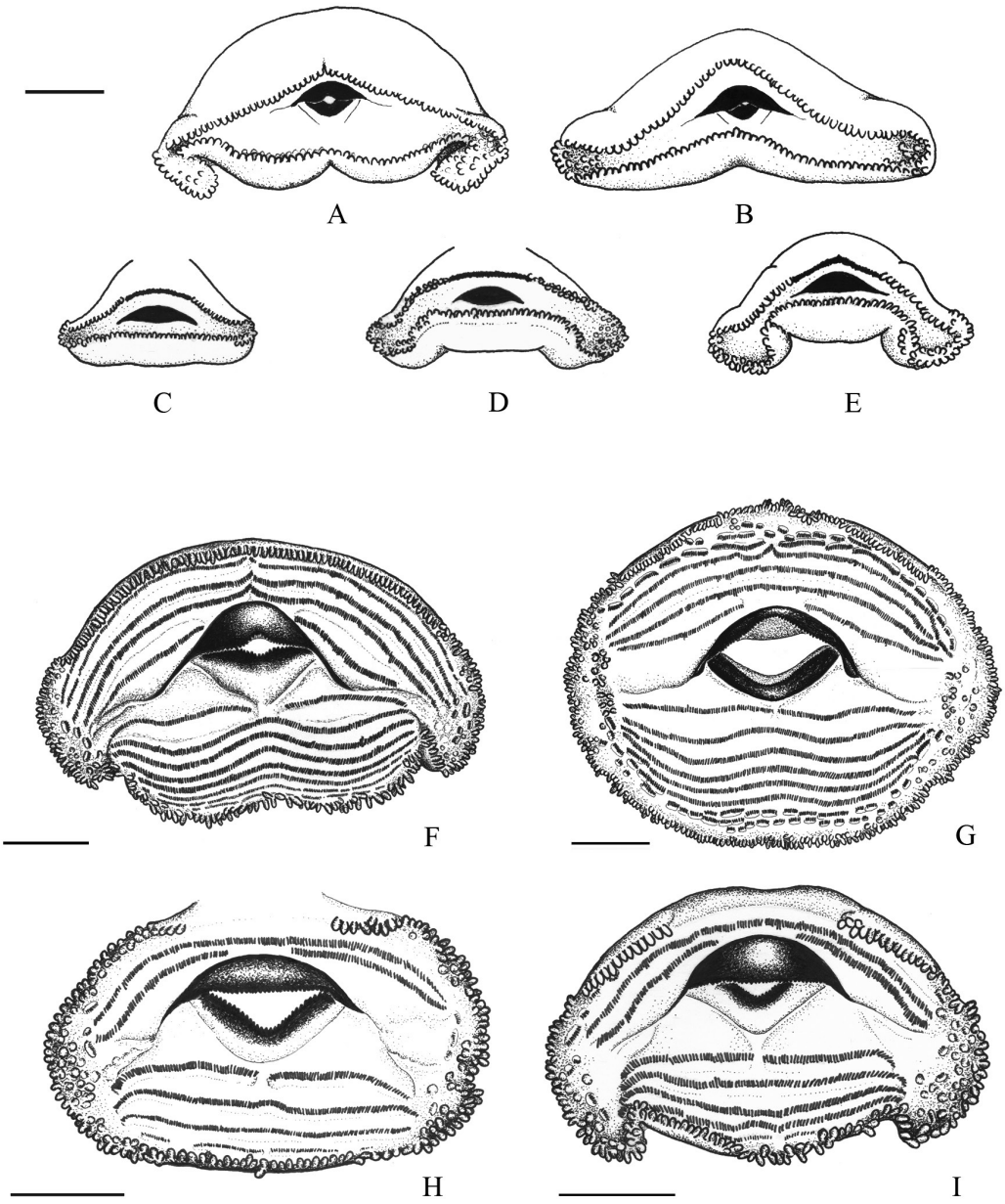

Figure 4, A-I. Oral discs of Hispaniolan hylid tadpoles. Oral disc as they are *in situ*. All tadpoles are in Gosner's stage 36. A, *Hypsiboas heilprini* (PRRD 652.4), note the flexure of the anterior labium, the deep lateral pleats and the medial folding of posterior labium. B, *Osteopilus vastus* (PRRD 661.6), note medial folding of posterior labium. C, *O. dominicensis* (PRRD 657.8), with no folding in the posterior labium. D, *O. dominicensis* (PRRD 309.14), with the posterior labium slightly folded. E, *O. pulchrilineatus* (485.11). Oral discs fully open. All tadpoles are in Gosner's stage 36. F, *H. heilprini* (PRRD 487.31), Gosner's stage 37. G, *O. vastus* (PRRD 661.9), stage 36. H, *O. dominicensis* (PRRD 309.14), stage 36. I, *O. pulchrilineatus* (PRRD 485.3), stage 36. Scale bar= 1 mm in all illustrations. Illustrations: Luis M. Díaz.

Hypsiboas heilprini (Noble, 1923)
Figs. 3C; 4A, F; 5A; 7; 11C-D

Description. Maximum recorded total length 57.2 mm (tadpole PRRD 652.7, in Gosner stage 37, from La Horma, San José de Ocoa Province, Cordillera Central). Body length 33–40% ($\bar{x}$=36%) of the total length; ovoid in dorsal view and ovoid/depressed in lateral view; body height 43–54% ($\bar{x}$=49%) of body length; body width 48–72% ($\bar{x}$=59%) of body length. Snout rounded in dorsal and lateral views. Eyes directed dorsolaterally, each 13–16% ($\bar{x}$=14%) of the body length; the cornea is not included in the dorsal silhouette. Nares small, oval, facing dorsolaterally, rimmed, and usually with a rounded projection in the medial margin which gives them a reniform aspect in dorsal view; the nostril transversal diameter is 3–6% ($\bar{x}$=4%) of body width. Nares slightly closer to eyes than to snout tip. Internarial distance 64–88% ($\bar{x}$=78) of the interorbital distance. Spiracle sinistral, facing posteriorly, and positioned below the middle point of the body side (dorsum-spiracle distance 44–77%, $\bar{x}$=56%, of body height); distal part of the inner wall free from body; snout-spiracle distance 61–63% ($\bar{x}$=66%) of body length. Vent tube dextral, with the right wall displaced dorsally and anteriorly; vent aperture long, 1/2 to 3/4 of the vent tube length. The lateral line system is not very conspicuous, but neuromasts are visible around eyes and on the snout with careful examination. No cumuli of neuromasts were seen in any part of body. Oral disc ventral, completely surrounded by2 to 3 rows of small marginal papillae; the anterior labium is folded and wider than the posterior one; its diameter is 37–63% ($\bar{x}$=48%) of body width. Oral disc lateral margins with numerous submarginal papillae. The oral disc has two deep posterior pleats, and is moderately folded in the middle. Marginal papillae digitiform, twice longer than width. Labial tooth row formula modally 5(5)/8(1), less often 4(4)/7(1), 5(5)/7(1) or 6(6)/9(1); variation occurs even in the same population independently of the developmental stage; first three rows subequal in length, but remaining rows gradually decreasing in length in successive order; A-4, A-5or A-6 (depending on teeth row number) interrupted medially by a gap approximately 1/2 to 3/4 the length of each labial teeth row. Tooth rows on anterior labium forms a medial angle caused by a flexure; in most tadpoles tooth bridges on anterior labium are somewhat notched medially, which gives the appearance of very narrow gaps. P-1 is medially interrupted by a gap 6–7% of the total length of each teeth row; tooth density per millimeter in the middle of row A-3: 55–70 ($\bar{x}$=62%), in P-2: 42–63 ($\bar{x}$=50). Labial teeth dark, directed toward the oral opening. Short accessory teeth rows are variably present on enlarged submarginal papillae or as somewhat lighter coloured and interrupted teeth rows. Jaw sheaths darkly pigmented. Upper jaw sheath medially notched; the lateral processes are 1/2of the upper jaw sheath length or slightly longer. Lower jaw sheath V-shaped; individual serrations small, blunt, 33–50/mm ($\bar{x}$=39). Caudal muscle height 60–91% ($\bar{x}$=74%) of maximum tail height. Dorsal fin very low, originating distal to the body terminus, 28–37% ($\bar{x}$=32%) of tail maximum height; ventral fin narrower than dorsal fin at the mid portion of tail, its height 15–24% ($\bar{x}$=19%). Tail tip acutely rounded. Rectus abdominis muscle very evident through the belly skin. Abdominal parietal peritoneum with a layer of melanophores not densely grouped. Measurements of tadpoles from three localities are shown in Table I.

Colour. Dark brown with irregular small dark patches and scattered bronze tones that give a heterogeneous appearance. Tail paler than body, with a variable pattern of large dark brown blotches or speckling (Fig. 7). Dorsally, the base of tail has a very evident dark saddle. Nares are surrounded by a dark brown patch. Belly pale, somewhat transparent; the coiled intestine can be seen through the skin. Metamorphs (Fig. 4A) turn gradually into a vivid yellow-green colouration (Fig. 5A), usually having a dark spotted dorsum, and orange coloured hands and feet.

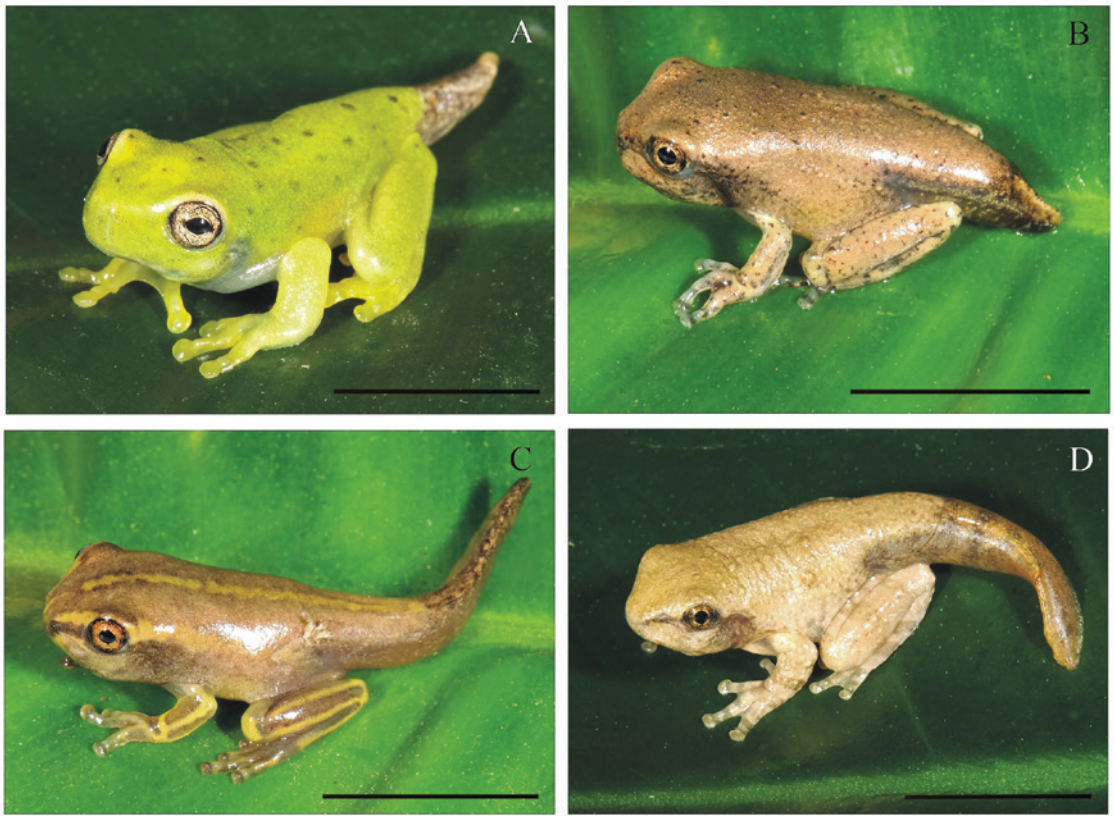

Figure 5, A-D. Metamorphs of the four species of Hispaniolan hylid frogs (no voucher specimens). A, *Hypsiboas heilprini*, La Horma, San José de Ocoa Province, Cordillera Central. B, *Osteopilus dominicensis*, Loma La Canela, Duarte Province, Cordillera Central. C, *O. pulchrilineatus*; same locality. D, *O. vastus*, Arroyo La Vuelta, Santo Domingo. Scale bars=1 cm. Photos: Luis M. Díaz.

Table I. Measurements (in millimeters) of tadpoles of *Hypsiboas heilprini* from three localities. Data are reported as the range plus the mean value ($\bar{x}$) in parentheses.

Locality:	Loma La Canela, Duarte (n=19)						Ébano Verde, La Vega (n=3)			La Horma, San José de Ocoa (n=9)			
Gosner's stages:	34[1] (n=3)	35[2] (n=6)	37[3] (n=4)	38[4] (n=3)	39[5] (n=2)	41[6] (n=1)	28[7] (n=1)	30[8] (n=1)	38[9] (n=1)	36[10] (n=2)	37[11] (n=3)	38[12] (n=2)	41[13] (n=2)
Characters:													
TL	42.2–49.3 (45.1)	39.2–43.9 (41.4)	41.3–47.9 (44.0)	41.4–44.8 (42.9)	43.4–45.8	46.8	50.6	51.4	54.3	54.8–56.5	54.4–57.2 (55.5)	56.4–57.1	49.4–50.8
BL	16.2–16.9 (16.5)	15.5–16.2 (15.8)	15.1–16.7 (15.9)	15.7–16.7 (16.2)	16.7–17.6	16.2	17.2	18.0	18.5	18.9–19.3	19.0–19.6 (19.4)	18.8–19.2	18.3–18.5
BMW	8.2–10.3 (9.4)	7.4–9.4 (8.8)	8.0–9.2 (8.7)	8.8–9.6 (9.1)	9.3–9.8 (9.6)	10.0	11.0	12.0	13.3	11.5–12.6	12.2–13.1 (12.6)	11.9–12.4	12.2
BMH	7.3–8.9 (8.2)	7.1–8.5 (7.8)	7.7–8.2 (7.9)	7.8–8.0 (7.9)	8.1–8.5 (8.3)	7.0	9.0	9.3	9.4	9.8–10.5	9.4–10.2 (9.9)	9.2–9.6	8.6–9.2
TaL	25.9–32.4 (28.5)	23.4–27.8 (25.6)	25.4–31.2 (28.1)	25.2–28.1 (26.8)	25.8–29.1 (27.5)	30.6	33.4	33.4	35.9	35.8–37.2	35.3–37.8 (36.2)	37.6–37.9	30.9–32.6
MTH	6.7–7.6 (7.2)	6.4–7.4 (6.8)	6.7–7.4 (7.0)	6.2–7.7 (7.2)	6.7–8.2 (7.5)	6.6	8.6	8.8	8.9	10.3–10.5	10.2–10.4 (10.3)	9.9–10.1	9.2–9.3
DFH	2.1–2.5 (2.3)	1.8–2.3 (2.0)	1.9–2.5 (2.2)	1.8–2.6 (2.3)	2.1–2.8 (2.5)	2.3	2.3	2.5	2.8	3.5	3.4–3.5 (3.5)	3.2–3.4	3.3–3.5
VFH	1.2–1.5 (1.3)	1.2–1.6 (1.4)	1.3–1.5 (1.4)	1.1–1.4 (1.3)	1.0–1.6 (1.3)	1.2	1.7	1.4	1.6	2.4–2.6	2.2–2.4 (2.3)	1.7–2.4	2.0–2.2
CMH	5.8–6.1 (5.9)	4.9–6.0 (5.5)	5.2–5.7 (5.5)	5.4–6.4 (5.9)	5.0–5.4 (5.2)	5.3	7.0	7.4	6.9	6.5–6.8	6.4–6.7 (6.5)	6.2	5.6
CMW	5.1–5.4 (5.2)	4.5–5.4 (5.0)	4.8–5.0 (4.8)	4.1–5.6 (4.7)	5.2–5.3 (5.2)	4.6	5.7	6.2	6.7	6.2–6.5	5.9–6.7 (6.3)	5.6–6.2	5.6
DSD	4.0–4.4 (4.2)	3.9–4.9 (4.4)	3.5–5.0 (4.1)	4.0–5.0 (4.4)	5.3–5.9 (5.6)	5.5	5.8	5.5	6.5	5.2	5.1–5.7 (5.3)	4.8–5.8	5.6–5.8
SSD	10.3–10.5 (10.4)	10.1–10.6 (10.4)	10.0–11.0 (10.6)	9.8–10.6 (10.3)	10.3–11.7 (10.9)	10.2	11.0	11.0	12.6	13.2–13.6	13.2–13.3 (13.2)	12.6–13.2	13.2–13.3
N	0.4–0.5 (0.4)	0.4–0.5 (0.4)	0.4–0.5 (0.4)	0.4–0.5 (0.4)	0.4–0.5 (0.4)	0.4	0.5	0.3	0.5	0.5	0.5	0.5	0.3
IN	2.8–3.1 (2.9)	2.7–3.0 (2.9)	2.8–3.0 (2.9)	2.5–3.2 (2.9)	2.4–2.7 (2.5)	1.9	2.6	3.0	2.9	3.4–3.6	3.3–3.5 (3.4)	3.2–3.4	2.5–2.6
SND	2.3–2.4 (2.4)	2.1–2.8 (2.5)	2.3–2.5 (2.4)	2.0–2.2 (2.1)	2.2–2.3 (2.2)	1.6	2.0	2.0	2.1	2.6–2.9	2.7–2.9 (2.8)	2.6	1.5–2.1
NED	1.3–1.6 (1.4)	1.2–1.6 (1.3)	1.3–1.5 (1.4)	1.2–1.4 (1.3)	1.5	1.3	1.5	1,5	1.7	1.6–1.7	1.5–1.7 (1.6)	1.6–1.7	1.7
E	2.2–2.3 (2.2)	2.1–2.5 (2.2)	2.3–2.5 (2.4)	2.3–2.5 (2.4)	2.5–2.6 (2.6)	2.5	2.1	2,6	2.8	2.6–2.8	2.6–2.8 (2.7)	2.6–2.8	2.7–2.8
IO	3.7–4.0 (3.8)	3.5–4.0 (3.8)	3.4–4.3 (3.7)	3.8–4.2 (4.0)	2.9–3.7 (3.6)	2.9	3.9	4.0	3.9	4.3–4.4	3.9–4.1 (4.0)	3.8–4.2	3.9–4.0

Voucher specimens: [1]PPRD 487.10; 487.17, 487.23; [2]486.22, 487.6, 487.9, 487.30, 487.34, 487.43; [3]487.13, 487.31, 487.32, 487.37; [4]486.12, 487.1, 487.5; [5]487.35, 487.39; [6]487.21; [7]507.3; [8]507.9; [9]507.34; [10]652.1, 652.2; [11]652.3, 652.4, 652.5; [12]652.6, 652.7; [13]652.8, 652.9.

Deformities. Different anomalies in the keratinized mouthparts were found in most tadpoles from Ébano Verde, Cordillera Central, and to a lesser degree in specimens from other localities. These deformities made it difficult to study the tadpole´s oral morphology. Smaller larvae (stage 25) from Ébano Verde, 30–33 mm in total length, had complete tooth rows and jaw sheaths, but the largest tadpoles lacked keratinized mouthparts. The histological examination of these specimens evidenced infection with the chytrid fungus *Batrachochytrium dendrobatidis*. Figure 6 shows the presence of many sporangia, skin hyperkeratosis and hyperplasia in an infected larva.

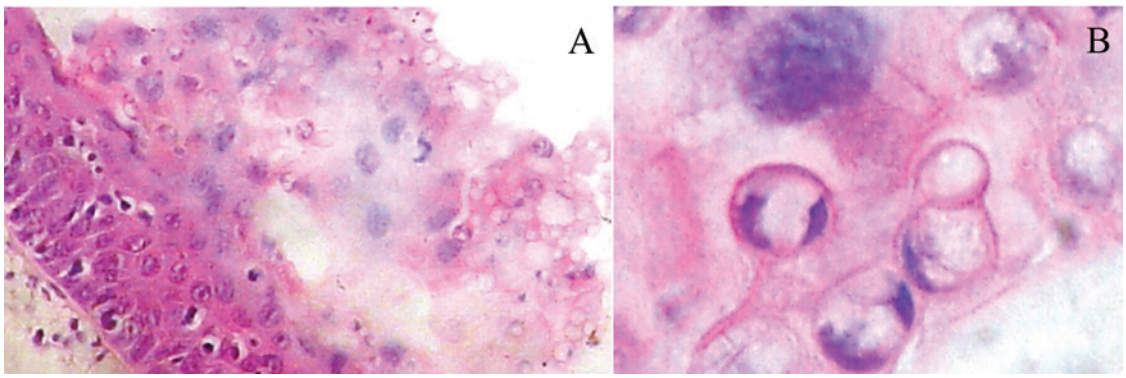

Figure 6, A-B. Histological skin sample (A) stained with hematoxylin and eosin (H&E), from tadpole mouth parts of *Hypsiboas heilprini* from Ébano Verde, Cordillera Central. Arrows show sporangia of *Batrachochytrium dendrobatidis* in different stages of development (A, B). Photos: Agustín Chong.

Habitat and behavior. Cool, fast and turbulent streams (Fig. 8), typically in gallery forests. Larvae are more concentrated in stream pools. Tadpoles rest on the bottom, either exposed on different surfaces or hidden among submerged vegetation debris and rocks. In very fast moving streams (i.e., after heavy rains), tadpoles were seen strongly adhered to rock surfaces via their oral discs. Tadpoles are found in water depths from less than 5 cm to about 1 m.

Comparisons. Tadpoles of *H. heilprini* are unique among the hylid frogs of Hispaniola in having reniform nares in dorsal view. Larvae of *Osteopilus vastus* (Fig. 3D) are also stream-lined, with large oral discs, and high numbers of tooth rows, but the nares face anterolaterally; the posterior labium is only slightly foldedin the middle;the belly has a pure white medial zone; the upper jaw sheath lateral processes are short in *O. vastus* (~17% of the upper jaw sheath length); the colour pattern is also different, with *O. vastus* having large, often fused blotches on the tail muscle that gives a banded or saddled appearance when tadpoles are viewed dorsally; neuromasts in *O. vastus* are easily evident and are dark-bordered (see Fig. 11 for comparisons), and the snout tends to be longer in tadpoles of *O. vastus*, 25–35% ($\bar{x}$=31%) of body length.

Figure 7, A-F. Variation in preserved tadpoles of *Hypsiboas heilprini*. A, PRRD 652.4 and B, PRRD 652.5: stage 37, La Horma, Cordillera Central. C, PRRD 507.4, stage 38, Ébano Verde, Cordillera Central. D, PRRD 507.8, stage 26, same locality. E, PRRD 487.32, stage 37, Loma La Canela, Cordillera Central. F, PRRD 660.7, stage 32, Rancho Arriba, Sierra de Ocoa. Scale bars=1 cm. Photos: Luis M. Díaz.

Osteopilus dominicensis (Tschudi, 1838)
Figs. 3A; 4C, D, H; 5B; 9

Description. Maximum recorded total length 49.1 mm (two tadpoles in stages 36 and 38, PRRD 489.18 and 489.6, respectively, both from Sierra de Neyba). Body length 31–39% ($\bar{x}$=35%) of the total length; ovoid in dorsal and lateral views; body height 57–66% ($\bar{x}$=62%) of body length; body width 60–75% ($\bar{x}$=69%) of body length. Snout rounded in dorsal view and somewhat subacuminate in lateral view, not defining a groove in its transition to the oral disc. Eyes directed laterally, each 11–16% ($\bar{x}$=13%) of the body length; the cornea is included or not in the dorsal silhouette. Nostril small, round shaped, facing anterolaterally (oriented ~25º with the sagittal plane), with a weak rim; the nostril diameter is 2–6% ($\bar{x}$=4%) of body width. Nares slightly closer to eyes than to snout tip. Upper narial area visibly swollen. Internarial distance 65–84% ($\bar{x}$=74%) of the interorbital distance. Spiracle sinistral, facing posteriorly, and positioned under the middle point of the body side (dorsum-spiracle distance 55–80%, $\bar{x}$=67%, of body height); inner wall present as slight ridge; snout-spiracle distance 47–72% ($\bar{x}$=65%) of body length. Vent tube dextral, with the right wall slightly displaced anteriorly. The lateral line system has highlighted neuromasts, and is very evident around eyes, snout, body and tail. Oral disc anteroventral, forming 45–51° with body, incompletely surrounded by small marginal

papillae; oral disc diameter 29–37% ($\bar{x}$=33%) of body width; the gap of anterior labium is 1/4 to 1/2 of the oral disc width; marginal papillae in double rows, less often in one row on the anterior labium. Oral disc lateral margins with submarginal papillae. Posterior labium unfolded to slightly fold. Marginal papillae digitiform, twice longer than width. Labial tooth row formula modally 2(2)/4(1), less frequently 2(2)/5(1) or 2(2)/6(1); tooth rows gradually decreasing in length in successive order; A-2 interrupted medially by a gap 1/16–1/2 the length of each labial teeth row. P-1 is medially interrupted by a narrow gap, which is vaguely defined (tooth rows almost overlapping) or comprises 5–9% of the total length of each teeth row; tooth density in the middle of row A-1: 43–86 ($\bar{x}$=62). Labial teeth dark, directed toward the oral opening. Short accessory teeth rows are variably present on enlarged submarginal papillae or as somewhat pale coloured interrupted teeth rows. Jaw sheaths darkly pigmented; the upper sheath is a wide arch; lower sheath V-shaped; individual serrations very small, blunt, 38–50/mm ($\bar{x}$=44). Caudal muscle height 43–66% ($\bar{x}$=52%) of maximum tail height. Dorsal fin deep, 31–39% ($\bar{x}$=36%) of tail height, originating at the level of body terminus or slightly before it; ventral fin 30–36% ($\bar{x}$=33%) of tail height. Tail tip rounded to very narrow, in some cases almost defining a flagellum. Rectus abdominis muscle slightly evident through the belly skin. Usually, the abdominal parietal peritoneum has a compact layer of melanophores. Main measurements of tadpoles from four localities are shown in Table II.

Colour. Brown, ocherous brown, to olive brown with golden flecks and patches on operculum and body sides. Belly pearl white to golden white. The body is usually plain coloured, but tail varies from translucent and pattern-less to speckled, with isolated blotches, or with a dense dark mottling that gives an almost solid black appearance in some individuals (Fig. 9). Metamorphs bronze green, usually with dark dots, or definitely spotted, with dark blotches or bars evident on limbs; the loreal and labial area somewhat lighter and delimited by a dark brown canthal stripe (Fig. 5B).

Habitat and behavior. Tadpoles occur in temporary ditches and ponds, man-made containers, and slow moving margins of rivers (Fig. 8). They occurs in water depths from less than one inch to almost 1 m. Tadpoles are on the bottom, or moving actively in the water column, grasping on vegetation, ascending for breathing, or feeding in the water surface film. Larvae also eat submerged fruits, dead animals, or are cannibals. Water temperature in tadpole habitats is very variable, according to localities, from less than 16°C to more than 36°C.

Comparisons. Tadpoles of *Osteopilus pulchrilineatus* (Fig. 3B) have a less robust and somewhat depressed body; the mouth is more ventrally oriented (24–39°) than in *O. dominicensis*, and the oral disc tends to be wider in proportion to body width (oral disc width 37–43% of body width); the middle of teeth row A-1 is angled (not so in *O. dominicensis*); the posterior labium is more conspicuously folded; the snout profile is gradually sloped (not swollen above the nares), and the snout transition to the oral disc defines a slight groove; despite overlapping, there is a strong tendency to have proportionally larger internarial distance in this species than in *O. dominicensis*: 78–117% ($\bar{x}$=93%) of the interorbital distance; very often, the dorsal fin originates after body terminus; in most of the sampled localities of *O. pulchrilineatus* the overall colouration is reddish brown, without gold patches and flecks, and with speckled to vermiculated tails; ventral colouration is not very different from that of dorsum, and the abdominal parietal peritoneum is translucent.

Figure 8, A-G. Representative frog breeding habitats where tadpoles were found in the Dominican Republic. A, Mountain stream at La Canela, Duarte Province (~1–1.5 m wide; 10–30 cm deep): tadpoles of *Hypsiboas heilprini*. B, River at Río Limpio, Elías Piña Province: *H. heilprini*, *Osteopilus dominicensis*, *O. pulchrilineatus* and *O. vastus* (~8 m wide; 10–70 cm deep). C, Rain-formed pond inside a forest at La Canela (~20 m long; 10–60 cm deep): *O. dominicensis* and *O. pulchrilineatus*. D, Small pool in an intermittent stream in the forest at La Canela (~80 cm in diameter; 50 cm deep): *O. pulchrilineatus*. E, Temporary pool on a trail, at Río Limpio (~3.5 m wide; <10 cm deep): *O. dominicensis*. F, Small puddle (~60 cm in diameter; <15 cm deep) in a valley that is often used for rice plantation, Río Limpio: *O. pulchrilineatus*. G, Small lagoon with hebaceous vegetation at Juana Vicenta, Samaná Province (~ 100 m long; 10 cm to more than 1m deep): *O. dominicensis* and *O. pulchrilineatus* (also tadpoles of *Lithobates catesbeianus* and *Rhinella marina*). Photos: A, C, D and F by Luis M. Díaz; B, E and G by Nils Navarro.

Table II. Measurements (in millimeters) of tadpoles of *Osteopilus dominicensis* from four localities. Data are reported as the range plus the mean value ($\bar{x}$) in parentheses.

Locality:	Sierra de Neyba, Independencia (n=11)					Santana, Higüey (n=7)				Río Limpio, Elías Piña (n=6)						Aceitillar, Barahona (n=4)			
Gosner´s stages:	28[1] (n=1)	33[2] (n=1)	36[3] (n=4)	38[4] (n=2)	35[5] (n=3)	28[6] (n=1)	35[7] (n=4)	36[8] (n=1)	37[9] (n=1)	34[10] (n=1)	35[11] (n=1)	36[12] (n=1)	37[13] (n=1)	38[14] (n=1)	39[15] (n=1)	27[16] (n=1)	35[17] (n=1)	36[18] (n=1)	38[19] (n=1)
Characters:																			
TL	37.9	42.5	43.7–49.1 (47.1)	47.2–49.1	37.8–43.8 (40.5)	35.0	37.8–43.8 (40.5)	47.2	37.5	35.4	38.2	41.3	40.4	40.4	39.8	34.3	45.3	41.0	42.7
BL	14.2	14.6	16.1–16.5 (16.3)	16.9–17.2	13.9–15.6 (14.8)	13.3	13.9–15.6 (14.8)	16.5	14.9	11.3	12.7	13.2	13.1	13.2	13.4	12.2	14.2	14.6	14.5
BMW	10.7	10.2	9.7–11.8 (11.2)	12.3–12.5	10.1–10.6 (10.3)	9.3	10.1–10.6 (10.3)	12.2	11.1	7.3	8.6	8.9	9.3	9.6	8.8	8.1	9.5	9.6	10.7
BMH	9.4	8.9	9.7–10.5 (10.1)	10.9–11.1	8.9–9.8 (9.4)	8.2	8.9–9.8 (9.4)	10.6	9.4	6.6	8.2	7.9	8.2	8.5	8.4	7.4	8.7	9.1	8.9
TaL	23.4	27.8	27.6–32.8 (30.8)	30.0–32.2	23.0–28.2 (25.5)	21.7	23.0–28.2 (25.5)	30.7	22.6	24.1	25.4	28.1	27.2	27.2	26.4	22.0	31.2	26.4	28.2
MTH	10.4	10.4	10.7–11.5 (11.1)	11.7–11.8	9.1–10.2 (9.5)	8.7	9.1–10.2 (9.5)	11.4	10.3	7.2	9.1	10.0	9.4	9.2	8.8	8.4	10.6	8.0	9.4
DFH	3.6	3.4	3.6–4.3 (4.0)	3.9–4.1	3.2–3.7 (3.5)	3.4	3.2–3.7 (3.5)	4.3	4.1	2.3	3.3	3.4	3.5	3.4	3.4	3.1	4.1	2.8	3.4
VFH	3.3	3.4	3.4–3.9 (3.6)	3.7–3.8	2.9–3.5 (3.1)	3.1	2.9–3.5 (3.1)	3.6	3.5	2.4	3.2	3.3	3.3	3.2	2.8	2.8	3.3	2.6	2.9
CMH	4.8	4.5	5.2–7.4 (5.9)	5.6–6.9	4.9–5.4 (5.2)	4.1	4.9–5.5 (5.2)	5.3	5.3	3.9	5.0	4.8	5.3	5.1	4.1	4.3	5.9	5.2	5.1
CMW	3.6	3.3	3.1–6.3 (4.4)	2.7–3.4	2.6–3.5 (3.1)	2.3	2.6–3.5 (3.1)	3.2	3.6	2.7	2.9	2.9	3.0	2.8	2.4	2.5	3.4	3.2	3.2
DSD	6.7	6.2	6.3–7.9 (6.7)	7.6–7.8	5.5–6.4 (5.9)	6.0	5.5–6.4 (5.9)	6.6	6.1	4.2	5.5	5.3	5.6	5.6	5.2	5.3	6.2	5.8	6.1
SSD	9.2	9.6	10.5–11.7 (10.9)	11.0–11.1	9.1–9.4 (9.3)	8.4	9.1–9.4 (9.3)	10.3	9.1	7.7	6.0	9.4	8.7	8.9	8.9	8.4	9.8	9.3	10.2
N	0.5	0.4	0.4–0.5 (0.5)	0.4–0.5	0.4–0.5 (0.5)	0.3	0.4–0.6 (0.5)	0.5	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.5
IN	4.6	4.3	4.4–4.6 (4.5)	4.3–4.6	3.7–4.2 (3.9)	3.3	3.7–4.1 (3.9)	4.9	3.9	3.7	4.2	4.2	4.0	4.3	3.9	3.6	4.6	4.1	4.2
SND	2.2	2.8	2.6–3.3 (2.9)	2.5–3.1	2.2–2.4 (2.3)	1.9	2.2–2.4 (2.3)	2.8	2.4	2.1	1.8	1.8	1.8	2.2	1.9	2.3	2.6	2.7	2.3
NED	1.7	1.9	2.1–2.2 (2.2)	1.8–2.1	1.9–2.0 (2.0)	1.5	1.9–2.0 (1.9)	2.2	1.8	1.5	1.5	1.5	1.7	1.8	1.6	1.5	2.0	1.8	1.7
E	1.5	2.0	1.9–2.2 (2.0)	2.2–2.3	1.7–1.9 (1.8)	1.5	1.7–1.9 (1.8)	2.1	1.9	1.6	1.7	1.7	2.1	2.1	2.2	1.6	2.2	2.1	2.0
IO	5.6	5.8	5.9–6.3 (6.1)	4.3–4.6	5.3–6.4 (5.7)	4.9	5.3–6.4 (5.7)	6.9	5.7	4.4	5.2	5.2	5.2	5.4	5.2	4.8	5.7	5.3	5.4

Voucher specimens:[1]PRRD 489.15; [2]489.17; [3]489.9, 489.11, 489.13, 489.18; [4]489.3, 489.6; [5]489.2, 489.8, 489.14; [6]309.9; [7]309.3, 309.7, 309.11, 309.14; [8]309.8; [9]309.12; [10]650.3; [11]650.1; [12]650.2; [13]650.4; [14]650.5; [15]650.6; [16]488.6; [17]488.11; [18]488.9; [19]488.10.

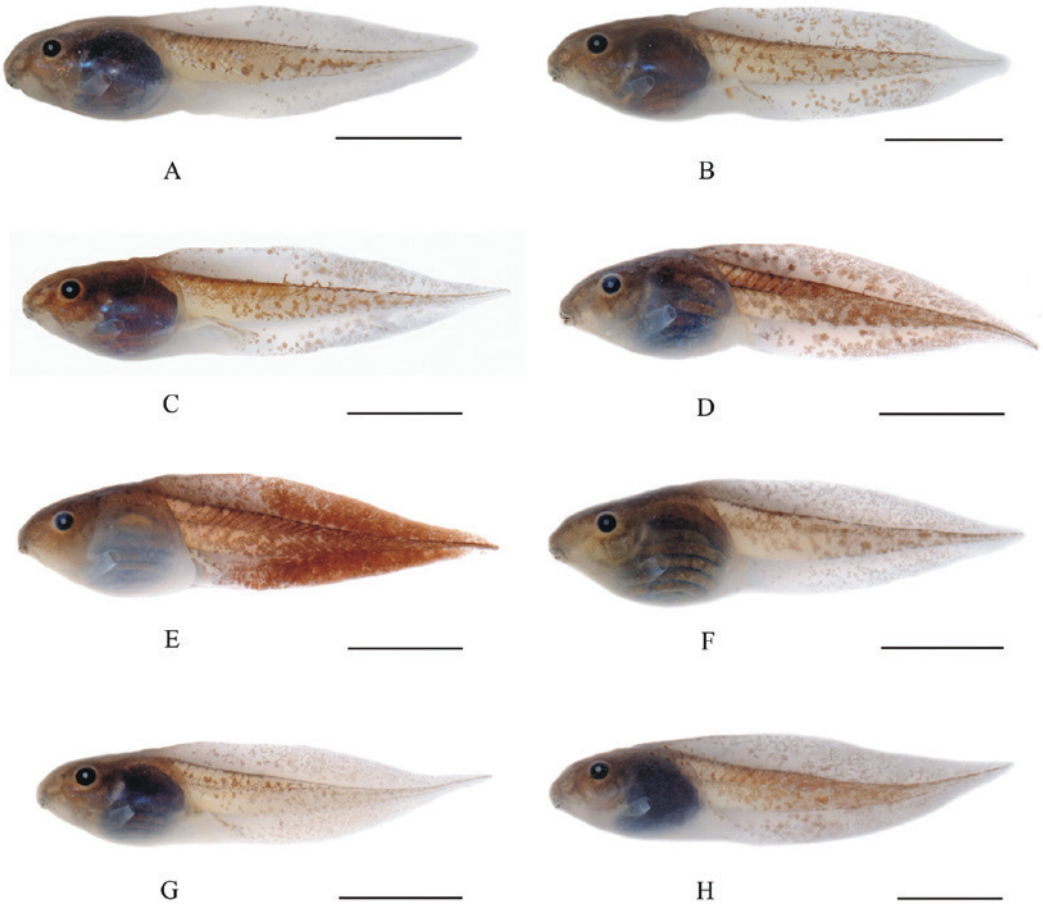

Figure 9, A-H. Variation in preserved tadpoles of *Osteopilus dominicensis*. A, PRRD 489.2, stage 35, Sierra de Neyba. B, PRRD 489.14, stage 35, same locality. C, PRRD 489.18, stage 36, same locality. D, PRRD 309.22, stage 36, Santana, Higüey. E, PRRD 309.8, stage 36, same locality. F, PRRD 309.18, stage 38, same locality. G, PRRD 650.5, stage 38, Río Limpio, Elías Piña. H, PRRD 488.9, stage 35, Aceitillar, Sierra de Bahoruco. Scale bars=1cm. Photos: Luis M. Díaz.

Osteopilus pulchrilineatus (Cope, 1869)

Figs. 3B; 4E, I; 5C; 10

Description. Maximum recorded total length 48.4 mm for a captive reared tadpole in Gosner stage 41 (no voucher), parents from Juana Vicenta, Samaná (female) and Loma La Canela, Duarte (male); maximum size recorded for a wild-caught tadpole: 45.6 mm of total length, stage 38, PRRD 485.12, from Loma La Canela, Duarte. Body 31–38% ($\bar{x}$=34%) of total length, ovoid in dorsal view and ovoid/depressed in lateral view; body height 40–63% ($\bar{x}$=56%) of body length; body width 57–76% ($\bar{x}$=66%) of body length. Snout rounded in dorsal and lateral views, defining a slight groove in its transition to the oral disc. Eyes directed dorsolaterally, each 9–14% ($\bar{x}$=13%) of body length; the cornea is not included in the dorsal silhouette. Nostril small, rounded, facing anterolaterally (oriented ~30º with the sagittal plane), with a weak rim that is more evident and pigmented in the upper half of the narial opening; the nostril diameter is 3–6% ($\bar{x}$=4%) of body width. Nares slightly closer to eyes than to snout tip. Internarial distance 78–117% ($\bar{x}$=93%) of the interorbital distance. Spiracle sinistral, facing laterally, and positioned slightly under the middle point of the body side (dorsum-spiracle distance 39–67%, $\bar{x}$=53%, of body height); inner wall present as slight ridge; snout-spiracle distance 62–70% ($\bar{x}$=66%) of body length. Vent tube dextral, with the right wall slightly displaced anteriorly. The lateral line system is visible on head, midbody and tail. Oral disc anteroventral, forming an angle of 24–39° with body, not emarginate, with a wide anterior gap that is 1/2 (or slightly over) of the oral disc width; oral disc diameter 37–43% ($\bar{x}$=41%) of body width. Marginal papillae twice longer than width, in single or double rows, and digitiforms; submarginal papillae numerous on lateral sides of posterior labium. Labial tooth row formula 2(2)/6(1) or 2(2)/5(1); tooth rows gradually decreasing in length; A-2 interrupted medially by a gap 12–35% of each labial tooth row; P-1 interrupted medially by a gap about 6–14% of the total length of each tooth row of P-1; tooth density per millimeter in the middle of row A-1: 47–100 ($\bar{x}$=66). Short accessory teeth rows are variably present on enlarged submarginal papillae. Jaw sheaths darkly pigmented; upper sheath awide arch; lower sheath V-shaped; individual serrations very small, blunt, 39–41/mm ($\bar{x}$=38). Caudal muscle height 47–71% ($\bar{x}$=54%) of maximum tail height. Dorsal fin originating distal to the body terminus, 34–43% ($\bar{x}$=38%) of tail height; ventral fin 25–32% ($\bar{x}$=29%) of tail height. Tail tip rounded (defining an angle of 24–40º). Rectus abdominis muscle barely evident through the belly skin. Abdominal parietal peritoneum translucent, with only scattered melanophores. Main measurements of tadpoles from Loma La Canela, Duarte Province, are shown in Table III.

Colour. Overall colouration is reddish brown, with scattered iridocites. Tail dark brown vermiculated, speckled or with small blotches. Belly purple-gray to brown, not very contrasted to the dorsal colouration. Tadpoles from the same clutch obtained in captivity and raised in spartan aquaria were gray to greyish-brown with vermiculated tail, and those maintained in naturalistic conditions, with a gravel bottom, were more similar to wild caught larvae. Tadpoles with enlarged hind-legs (Fig. 10) show the typical pattern of yellow stripes of juvenile and adult frogs (see Figs. 1C and 5C).

Habitat and behavior. Lentic habitats like lagoons, ponds, puddles, rice fields, small pools along intermittent streams, and rivers (Fig. 8). Tadpoles are usually hidden among submerged vegetation and debris either in transparent or turbid waters. In rivers, tadpoles occur in the slow moving shallow margins, below the layer of submerged leaves.

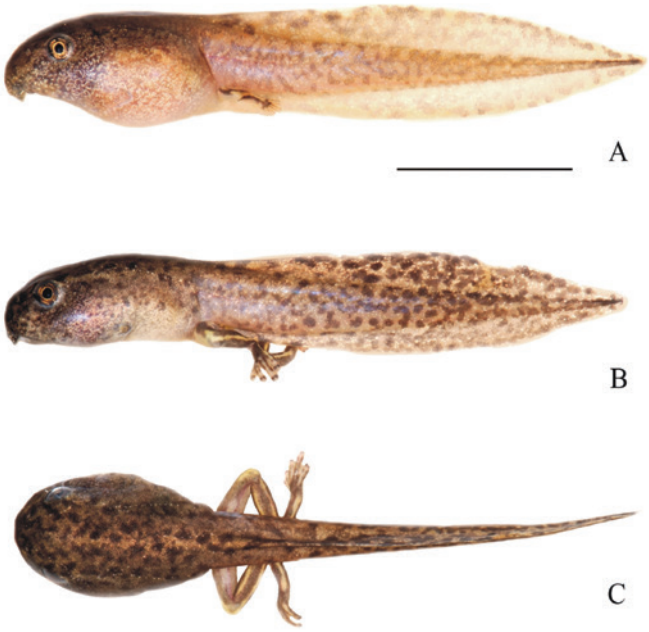

Figure 10, A-C. Wild tadpoles of *Osteopilus pulchrilineatus* from La Canela, Duarte, Cordillera Central, showing yellow striping on developing hind-legs as is typical of species. A, tadpole in stage 37. B and C, tadpole in stage 40, in lateral and dorsal views. In C it is also possible to see a middorsal, still diffuse, longitudinal paler zone that will give way to the vertebral stripe of juvenile and adult frogs. Also note different tail pattern, from sparsely and not very conspicuously mottled or vermiculated (A) to heavily mottled (C). Scale bar=1 cm. Photos: Luis M. Díaz.

Comparisons. Tadpoles of *Osteopilus dominicensis* (Fig. 3A) have a more robust and taller body; the oral disc defines an angle of 45−51° with body, and tends to be smaller in proportion to body width (oral disc width 29–37% of body width); A-1 is widely curved, not angled; the posterior labium is unfolded to only slightly folded; snout with a swollen profile above nares; snout transition to oral disc does not defines any groove; despite overlapping, there is strong tendency to have proportionally smaller internarial distance in this species than in *O. pulchrilineatus*, 65–84% ($\bar{x}$=74%) of the internarial distance; very often, tail originates slightly before the body terminus; overall colouration is brown to olive brown, generally with gold and silver patches on sides and ventral surface; the abdominal parietal peritoneum is often black.

Osteopilus vastus (Cope, 1871)
Figs. 3D; 4B, G; 5D; 11A-B; 12

Description. Maximum recorded total length 50.3 mm (PRRD 651.6; Gosner stage 41). Body 31–43% ($\bar{x}$=35) of total length; ovoid in dorsal view and ovoid/depressed in lateral view; body height 43–59% ($\bar{x}$=51%) of body length; body width 53–68% ($\bar{x}$=62%) of body length. Snout rounded in dorsal and lateral views. Eyes directed dorsolaterally, each 13–19% ($\bar{x}$=16%) of the body width at the level of eyes; the cornea is not included in the dorsal silhouette. Nostril small, rounded, with a weak rim, facing anterolaterally (oriented ~35º with the sagittal plane);

the nostril transversal diameter is 3–6% ($\bar{x}$=5%) of body width. Nares closer to eyes than to snout tip. Internarial distance 63–100% ($\bar{x}$=84%) of the interorbital distance. Spiracle sinistral, facing posteriorly, and positioned under the middle point of the body side (dorsum-spiracle distance 54–79%, $\bar{x}$=65%, of body height); distal part of the inner wall free from body; snout-spiracle distance 63–78% ($\bar{x}$=69%) of body length. Vent tube medial with dextral displacement. Neuromasts are evident and margined in black (Fig. 11, A-B). Oral disc ventral, not emarginate, completely surrounded with a double row of small marginal papillae, its diameter 45–63% ($\bar{x}$=55%) of body width at the level of mouth. Oral disc lateral margins with submarginal papillae. Posterior labium typically with moderate medial folding. Marginal papillae digitiform, two times longer than wide. Labial tooth row formula modally 4(4)/5(1), less often 5(5)/8(1), 4(4)/7(1) or 5(5)/7(1); variation occurs even in the same population, independently of development stages; first three rows subequal in length, but remaining rows gradually decreasing in length in sucesive order; A-4 or A-5 (depending on tooth row number) interrupted medially by a gap approximately 1/2 to 3/4 of the length of each labial tooth row. P-1 is medially interrupted by a gap 1/16 of the total length of each tooth row; tooth density per millimeter in the middle of row A-3: 45–60 ($\bar{x}$=51), in P-2: 42–62 ($\bar{x}$=52). Labial teeth dark, directed toward the oral opening. Short accessory tooth rows are variably present on enlarged submarginal papillae, very often forming many interrupted rows. Jaw sheaths darkly pigmented; upper sheath slightly notched and the lower V-shaped; individual serrations very small, blunt, 47–50/mm ($\bar{x}$=48). Caudal muscle height 59–89% ($\bar{x}$=77%) of maximum tail height. Dorsal fin low, originating after body terminus, 30–43% ($\bar{x}$=37%) of tail height; ventral fin 19–30% ($\bar{x}$=26%) of tail height. Tail tip rounded. Rectus abdominis muscle very evident through the ventral skin. Main measurements of tadpoles from three localities are shown in Table IV.

Colour. Body and tail musculature brown to olive brown with multiple iridophores and yellowish patches. Tail paler than body, with a pattern of large, dark brown blotches, often connected to each other; blotches often defining saddles when the tail is seen in dorsal view (Fig. 12). Fins are generally translucent or with scattered melanophores. Most individuals with a white longitudinal zone along the belly (Fig. 3D). Metamorphs are brown to tan coloured, usually with scattered pale orange or yellowish warts on dorsum and dark bars on fore- and hind limbs; pupil is rhomboidal; tarsal and feet folds (which are well developed in adult frogs) are already defined (Fig. 5D).

Habitat and behavior. Larvae occur in fast and turbulent streams where they hold to rocks via oral disc. The streams are usually covered with gallery forests but also run throughout open areas. At Río Limpio, tadpoles were found in the middle of the current, on a bottom of fine gravel, pebbles and scattered rocks. In Río La Isabela, tadpoles were found in a similar situation in the river, but also in a secondary intermittent stream where they also occurs in pools. It was easier to collect tadpoles at night instead of during the day, because they were exposed and quickly detected. At Arroyo La Vuelta, very close to the city of Santo Domingo, metamorphs were found along the margins of the river, very often in small shallow side-pools where they hide among rocks, leaves and vegetal debris. Even small tadpoles in this locality were seen holding themselves to the rocks in the fast moving waters. Larvae have been collected at depths from 2 to 15 cm.

Comparisons. Larvae of *Hypsiboas heilprini* (Fig. 3C) are also stream-lined, but differ by having reniform nares in dorsal view; the oral disc is conspicuously folded, laterally and medially; the lateral processes of the upper jaw are longer, about 1/2 of the jaw length; the vent tube has the right wall displaced dorsally and anteriorly; neuromasts are difficult to see because they are not highlighted (Fig. 11C-D); the snout tends to be shorter, 17–26% ($\bar{x}$=22%) of body length. Both species differ in the tail colour pattern (compare Figs. 7 and 12).

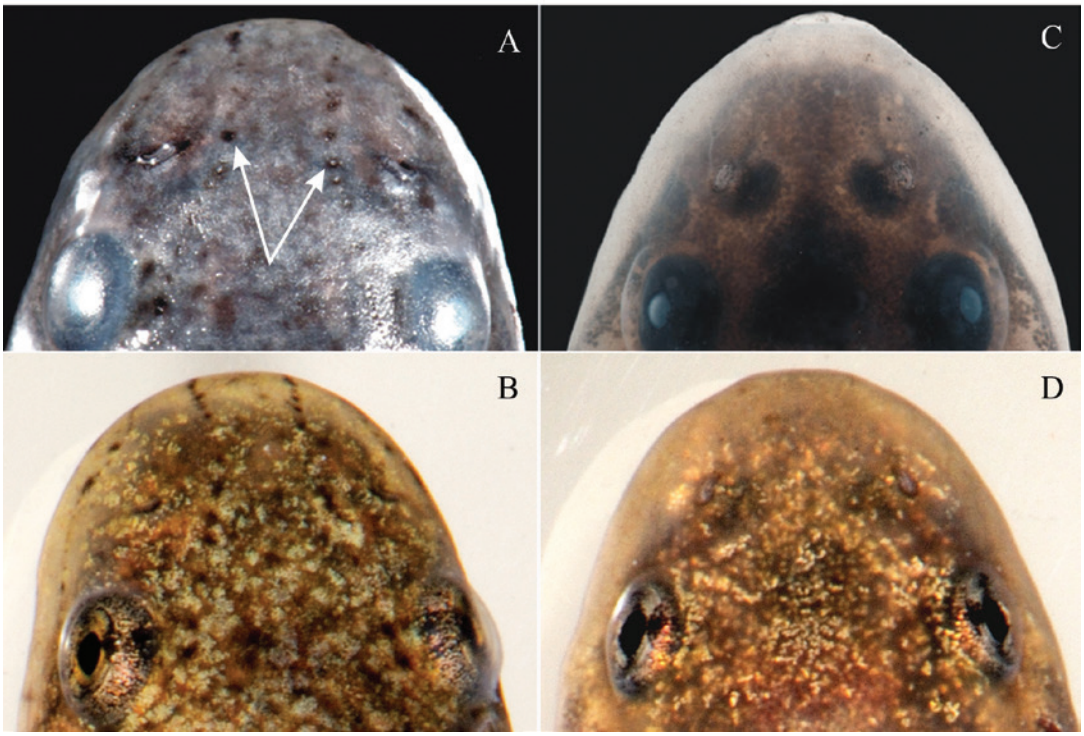

Figure 11, A-D. Neuromasts in two hylid tadpoles. A-B, *Osteopilus vastus* has very evident, dark-bordered neuromasts (arrows); preserved specimen (A) and live individual (B). C-D, In *Hypsiboas heilprini*, neuromasts are more scattered and difficult to see because they are not highlighted (C: preserved tadpole; D: live individual below). Photos: Luis M. Díaz.

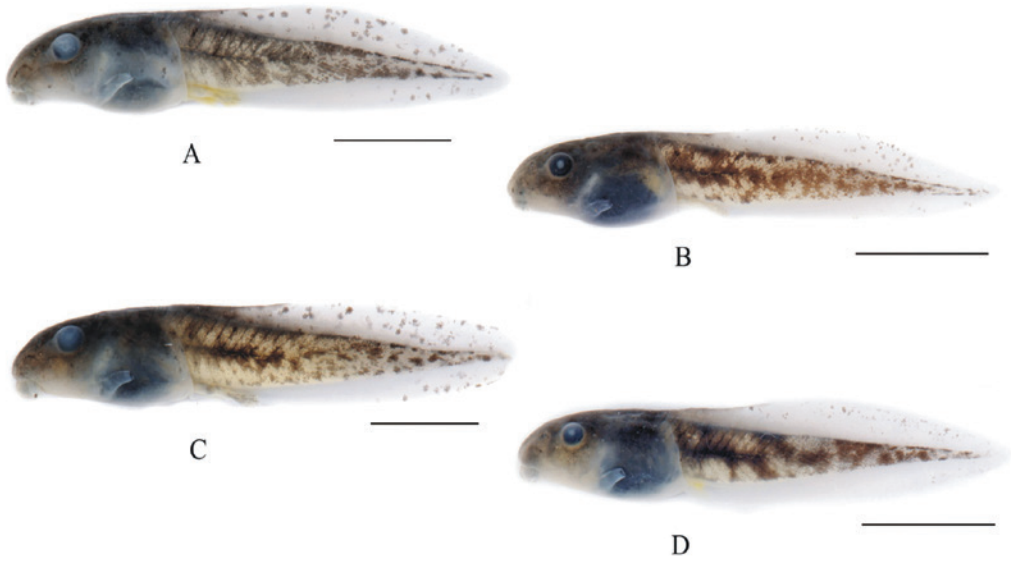

Figure 12, A-D. Variation in preserved tadpoles of *Osteopilus vastus*. A, PRRD 661.15, stage 39, Río Isabela, Santo Domingo. B, PRRD 658.6, stage 32, Arroyo La Vuelta, Santo Domingo. C, PRRD 661.6, stage 39, Río Isabela, Santo Domingo. D, PRRD 661.5, stage 31, same locality. Scale bars=1 cm. Photos: Luis M. Díaz.

Table III. Measurements (in millimeters) of tadpoles of *Osteopilus pulchrilineatus* from Loma La Canela, Duarte Province. Data are reported as the range plus the mean value ($\bar{x}$) in parentheses.

Gosner´s stages:	26[1] (n=1)	28[2] (n=1)	31[3] (n=1)	35[4] (n=5)	36[5] (n=2)	38[6] (n=5)
Characters:						
TL	28.5	25.5	33.6	33.7–41.8 (37.4)	37.4–39.1	37.5–45.6 (40.9)
BL	10.1	9.2	11.4	12.4–13.7 (12.9)	12.8–13.5	12.6–15.2 (13.5)
BMW	6.2	5.8	6.8	8.1–9.4 (8.7)	8.5–8.8	8.4–10.1 (9.2)
BMH	5.6	4.6	6.1	6.9–7.9 (7.6)	7.3–7.4	7.4–8.5 (7.8)
TaL	18.4	16.3	22.2	20.8–28.1 (24.5)	24.6–25.6	24.6–30.4 (27.4)
MTH	5.4	5.5	5.7	6.9–8.5 (7.4)	7.2–7.3	7.3–9.2 (7.8)
DFH	2.2	2.1	2.1	2.4–3.3 (2.8)	2.8–2.9	2.7–3.9 (3.0)
VFH	1.4	1.6	1.7	1.9–2.6 (2.2)	2.3	1.9–2.8 (2.2)
CMH	2.9	2.8	2.9	3.6–4.4 (4.1)	3.7–3.9	3.7–4.9 (4.2)
CMW	2.2	2.1	2.5	3.0–3.5 (3.3)	3.3	3.3–4.5 (3.7)
DSD	2.9	2.5	3.3	1.4–1.8 (1.6)	3.6–4.7	2.9–5.2 (4.1)
SSD	6.6	6.2	7.5	8.0–8.6 (8.3)	8.4–8.7	8.4–9.9 (9.1)
N	0.4	0.3	0.4	0.4–0.5 (0.4)	0.4	0.4–0.5
IN	2.7	3.2	2.9	2.9–3.8 (3.5)	3.3–3.5	2.8–3.7 (3.3)
SND	1.6	1.4	1.1	1.4–1.8 (1.6)	1.4–2.0	1.4–2.2 (1.6)
NED	0.7	0.8	0.9	1.0–1.2 (1.1)	1.0–1.2	1.0–1.2 (1.1)
E	1.1	1.1	1.3	1.4–1.8 (1.6)	1.6–1.8	1.6–2.0 (1.7)
IO	2.7	2.7	2.9	3.3–4.2 (3.7)	3.6–3.8	3.4–4.0 (3.6)

Voucher specimens: [1]PRRD 485.36; [2] 485.24; [3]485.7; [4]485.25, 485.32, 485.41, 485.44; [5]485.11, 485.17; [6]485.6, 485.12, 485.18, 485.19, 485.40.

Table IV. Measurements (in millimeters) of tadpoles of *Osteopilus vastus* from three localities. Data are reported as the range plus the mean value ($\bar{x}$) in parentheses.

Locality:	Río Limpio, Elías Piña (n=5)				Villa Altagracia, San Cristóbal (n=10)					Río La Isabela, Santo Domingo (n=17)				
Gosner´s stages:	32[1] (n=2)	35[2] (n=1)	38[3] (n=1)	39[4] (n=1)	29[5] (n=1)	31[6] (n=2)	34[7] (n=3)	35[8] (n=2)	36[9] (n=2)	31[10] (n=3)	32[11] (n=3)	35[12] (n=4)	36[13] (n=3)	39[14] (n=4)
Characters:														
TL	32.6–36.4	39.7	41.8	43.4	34.9	34.1–39.4	36.7–39.5 (38.1)	35.9–41.8	42.9–44.0	33.8–37.6 (36.1)	36.5–43.7 (39.3)	39.2–41.7 (40.1)	40.2–43.5 (41.4)	40.1–45.1 (42.0)
BL	13.8–13.9	14.7	14.9	15.9	12.4	12.2–12.6	12.2–13.5 (12.9)	13.1–13.4	13.8–15.3	12.1–13.4 (12.7)	12.8–13.5 (13.2)	13.7–14.3 (13.9)	13.9–15.2 (14.4)	13.7–15.6 (14.4)
BMW	7.5–7.9	7.9	8.0	8.4	7.3	7.6–7.8	6.9–8.3 (7.8)	6.9–9.1	8.6–9.4	7.6–8.0 (7.7)	7.5–8.4 (8.1)	8.4–9.5 (9.1)	8.8–9.7 (9.3)	9.0–9.6 (9.3)
BMH	6.7–7.1	7.4	7.7	7.8	6.0	5.4–5.8	6.2–6.6 (6.4)	5.6–6.6	6.9–8.1	6.1–6.2 (6.2)	6.6–7.2 (6.9)	6.8–8.2 (7.6)	7.4–8.3 (7.7)	6.8–7.6 (7.2)
TaL	18.7–22.6	25.0	26.4	27.5	22.6	21.8–26.7	24.5–25.9 (25.1)	22.8–28.4	28.7–29.1	21.7–24.3 (23.4)	23.2–30.1 (26.1)	24.9–27.9 (26.9)	26.1–28.3 (26.9)	26.2–29.5 (27.6)
MTH	6.5–6.6	7.1	8.1	8.7	6.3	5.9–6.2	6.3–6.6 (6.4)	5.9–7.1	6.7–8.1	5.8–7.1 (6.4)	6.4–7.1 (6.7)	7.3–7.6 (7.4)	7.3–8.3 (7.7)	6.7–7.9 (7.4)
DFH	2.3–2.5	2.5	3.2	3.4	2.2	1.8–2.6	1.9–2.6 (2.3)	2.1–2.5	2.3–3.5	2.2–2.4 (2.3)	2.5–2.6 (2.5)	2.7–3.0 (2.8)	2.8	2.5–3.2 (2.7)
VFH	1.5	1.6	1.6	1.9	1.6	1.5–1.8	1.6–1.8 (1.7)	1.4–1.9	1.6–1.9	1.6–1.7 (1.6)	1.8–2.0 (1.9)	1.8–2.3 (2.1)	2.1–2.3 (2.2)	1.7–2.3 (2.0)
CMH	4.3–4.9	5.6	4.8	6.1	5.3	4.6–4.8	5.3–5.5 (5.4)	4.8–5.9	5.9–6.0	4.2–5.1 (4.7)	5.1–5.9 (5.4)	5.3–6.2 (5.8)	5.5–6.4 (6.0)	5.3–5.8 (5.6)
CMW	4.0–4.2	4.8	4.8	5.2	3.9	3.4–3.8	3.5–3.8 (3.7)	3.6–3.9	4.2–4.8	3.9–4.3 (4.1)	4.2–5.4 (4.8)	4.4–5.5 (5.1)	4.9–5.4 (5.2)	4.6–5.5 (5.1)
DSD	4.2–4.8	5.1	4.6	5.2	3.8	3.7–3.9	4.4–4.6 (4.5)	3.7–4.8	4.7–5.5	3.8–4.1 (4.0)	4.2–4.9 (4.5)	4.8–5.2 (5.1)	4.6–5.3 (4.9)	4.1–4.4 (4.3)
SSD	9.0–9.3	9.8	10.0	11.2	8.4	8.1–9.0	8.4–9.1 (8.8)	8.3–9.3	9.7–10.7	8.8–9.0 (8.9)	9.0–9.6 (9.3)	9.5–10.4 (9.8)	10.0–10.1 (10.1)	9.6–10.7 (10.1)
N	0.3–0.4	0.5	0.5	0.5	0.3	0.3–0.4	0.4	0.3–0.4	0.3	0.3–0.4 (0.3)	0.3–0.5 (0.4)	0.3–0.5 (0.4)	0.4–0.5 (0.5)	0.3–0.5 (0.4)
IN	3.6–3.9	4.0	4.0	3.7	3.6	3.5–3.9	3.7–3.8 (3.7)	3.4–4.0	3.8–4.6	3.5	3.4–3.9 (3.7)	3.7–3.8 (3.7)	3.7–4.1 (3.8)	3.5–3.8 (3.7)
SND	2.9	3.3	2.8	3.3	2.5	2.3–2.8	2.2–3.0 (2.6)	2.4–3.1	3.1–3.5	2.4–2.7 (2.5)	2.5–2.9 (2.7)	2.6–3.3 (2.9)	2.7–2.9 (2.8)	2.4–3.0 (2.8)
NED	1.3–1.4	1.5	1.7	1.8	1.4	1.2–1.5	1.4–1.6 (1.4)	1.4–1.6	1.5–1.6	1.2–1.3 (1.3)	1.1–1.3 (1.2)	1.2–1.4 (1.3)	1.3–1.7 (1.5)	1.1–1.5 (1.3)
E	2.2	2.7	2.4	3.0	1.6	1.8–2.2	1.8–1.9 (1.9)	1.9–2.1	2.1–2.2	1.8–2.0 (1.9)	2.1–2.3 (2.2)	2.0–2.4 (2.2)	2.2–2.6 (2.4)	2.2–2.4 (2.3)
IO	4.1–4.3	4.8	5.0	5.4	4.1	4.1–4.5	3.7–4.5 (4.2)	4.3–5.0	4.9–5.2	3.8–4.4 (4.2)	3.9–4.4 (4.2)	4.3–4.8 (4.7)	3.8–5.2 (4.4)	3.9–5.1 (4.6)

Voucher specimens: [1]PRRD 651.1, 651.5; [2]651.2; [3]651.3; [4]651.4; [5]659.8; [6]659.1, 659.10; [7]659.4, 659.5, 659.9; [8]659.2, 659.6; [9]659.3, 659.7; [10]661.1, 661.3, 661.5; [11]661.4, 661.661.10, 661.14; [12]661.8, 661.12, 661.13, 661.18; [13]661.7, 661.9, 661.19; [14]661.6, 661.11, 661.15, 661.20.

A KEY TO THE HYLID FROG TADPOLES OF HISPANIOLA

1A. Oral disc fully surrounded with papillae; upper jaw notched; anterior labium with more than two tooth rows[1]; lotic morphology 2
1B. Oral disc with anterior gap; upper jaw not notched; two tooth rows on anterior labium; lentic morphology 3

2A. The anterior labium is wider than the posterior one; oral disc conspicuously folded posteriorly, with two deep postero-lateral pleats; neuromasts hard to see, not highlighted; vent tube with the inner wall quite displaced dorsally and anteriorly; nares reniform, with a medial papilla, and directed dorsolaterally ..... *Hypsiboas heilprini*
2B. Anterior labium about the same width as the posterior one; posterior labium with only a weak medial fold; neuromasts very evident, and contrasted with black pigment; vent tube medial with dextral displacement; nares rounded, without any papilla, and directed anterolaterally .... *Osteopilus vastus*

3A. Snout over nares distinctively swollen; oral disc forming an angle of 45–51° with body; snout transition to the oral disc not defining any groove; A-1 widely curved; posterior margin of oral disc unfolded to slightly folded; overall coloration brown to olive brown dorsally, typically with golden or silver areas on belly and flanks ……..... *Osteopilus dominicensis*
3B. Snout over nares not distinctively swollen; oral disc more ventrally directed, forming an angle of 24–39° with body; snout transition to the oral disc defining a slight groove; A-1 defining angle; posterior margin of oral disc with distinctive lateral folding; overall coloration brown to reddish brown; ventral and dorsal coloration not conspicuously different .... *Osteopilus pulchrilineatus*

[1]Chytrid fungus may destroy the keratinized oral structures.

CLAVE PARA LA IDENTIFICACIÓN DE LOS RENACUAJOS HÍLIDOS DE LA HISPANIOLA

1A. Disco oral completamente rodeado por papilas; placa mandibular anterior escotada; labio anterior con más de dos hileras de dientes[1]; morfología lótica 2
1B. Las papilas dejan una diastema en el margen anterior del labio anterior; placa mandibular anterior sin escote; dos hileras de dientes en el labio anterior; morfología léntica 3

2A. El labio anterior es más ancho que el posterior; disco oral con dos profundos pliegues posterolaterales; neuromastos difíciles de apreciar, poco resaltados; tubo cloacal con la pared

interna desplazada dorsal y anteriormente; narinas reniformes, con una papila media y dirigidas dorsolateralmente ..... *Hypsiboas heilprini*

2B. Labio anterior aproximadamente del mismo ancho que el posterior; labio posterior con un moderado pliegue medio; neuromastos muy evidentes y resaltados con pigmento oscuro; tubo cloacal medial, con la abertura desplazada hacia la derecha; narinas redondeadas, sin ninguna papila, y dirigidas hacia adelante ……..…….… *Osteopilus vastus*

3A. Parte del hocico por encima de las narinas distintivamente abultado; disco oral formando un ángulo de 45–51° con el cuerpo; la transición entre hocico y el margen anterior del disco oral no define un surco; serie A-1 ampliamente curvada; margen posterior del disco oral sin plegamiento o muy ligeramente plegado; color general marrón a marrón oliváceo, generalmente con zonas doradas y plateadas sobre el vientre y los flancos..... *Osteopilus dominicensis*

3B. Parte del hocico por encima de las narinas no distintivamente abultado; disco oral formando un ángulo de 24–39°con el cuerpo; la transición entre el hocico y el margen anterior del disco oral define un surco ligero; serie A-1 definiendo un ángulo; margen posterior del disco oral con pliegues laterales distintivos; color general marrón a marrón rojizo; la coloración ventral y dorsal no es marcadamente diferente ..... *Osteopilus pulchrilineatus*

[1]El hongo quítrido puede destruir las estructuras córneas.

DISCUSSION

West Indian hylid frogs have radiated into different tadpole ecomorphs (*sensu* Altig and Johnston, 1989) and reproductive modes as first noted by Noble (1927). Jamaican species of the genus *Osteopilus* have arboreal larvae that develop in phytotelmata (Dunn, 1926; Trueb and Tyler, 1974; Lannoo *et al*., 1987; Vogel, 2000). Tadpoles of these species differs from the other member in the genus by having elongate bodies, pale colouration, low fins, sacculate stomach, reduced gill filters and gill filaments, an enlarged and anteriorly directed glottis, reduced teeth rows and a general appearance of the oral disc according to oophagy (Lanoo *et al*., 1987). In *Osteopilus brunneus* tadpoles are fed by the mother with fertilized and unfertilized eggs (Lannoo *et al*., 1987; Thompson, 1996). The larvae of the only known Cuban hylid species, *Osteopilus septentrionalis*, are found in both lotic and lentic habitats and show extreme morphologies according to the particularities of their ecology (Díaz and Cádiz, 2008). This intraspecific tadpole diversity is so accentuated that it might suggest the existence of more than one species. However, recent genetic data by Heinicke *et al*. (2011) demonstrated that Cuban populations (with lotic and lentic tadpole ecomorphs) are represented by a single taxon; therefore, tadpole variation is likely caused by adaptive plasticity of this very successful species to opportunistically breed in a wide diversity of aquatic habitats. By contrast, the four hylid frogs of Hispaniola may occur sympatrically at some localities, but the tadpoles develop in lentic and lotic microhabitats depending on the species. In this case, larvae are more ecologically restricted and the external morphology tends to be distinctive for each species. In the classification of the ecomorphological guilds of Altig and Johnston (1989), tadpoles of *Hypsiboas heilprini* and *Osteopilus vastus* agree with the lotic guild: suctorial condition of the exotrophic larvae because they have a LTRF >2/3, the marginal row of papillae is complete, the oral disc is larger and ventrally positioned, they occurs in very fast and turbulent waters where position is continuously

kept via the oral disc, the tail musculature is thick, and the body is depressed. Tadpoles of *Osteopilus dominicensis* and *O. pulchrilineatus* agree with typical lentic ecomorphs, having the oral disc smaller and positioned anteroventrally with interrupted rows of papillae, less massive tail musculature, and taller bodies. These two species also occur syntopically at many localities. An adult frog collected at Río Limpio, Elías Piña, Cordillera Central, showed an intermediate appearance between *Osteopilus dominicensis* and *O. pulchrilineatus* suggesting hybridization, but there is no information about tadpoles with shared characteristics.

Febles (2002) made a preliminary morphological study of the tadpoles of some Cuban populations of *O. septentrionalis* including lentic and lotic forms. We compared her data with those of *O. dominicensis* and found strong overlapping in most characters and measurements of the lentic larvae that makes difficult a good diagnosis with the available information. The extreme lotic: suctorial morphology reported for tadpoles of *O. septentrionalis* (see Díaz and Cádiz, 2008) have been never observed in *O. dominicensis*. Adult morphology and ecology of both species is somewhat similar, but a diagnosis based on external and osteological data is available in Trueb and Tyler (1974) and the phylogenetic relationship with other members of the genus was analyzed by Faivovich *et al*. (2005), giving support for the specific identity of these taxa. Trueb and Tyler (1974) also mentioned that tadpoles of both species were very similar but in *O. dominicensis* the LTRF was 2/5 versus 2/4 in *O. septentrionalis*. However, Díaz and Cádiz (2008) showed a more variable LTRF in *O. septentrionalis*: 2/4, 2/5, 3/4, 3/5, 3/6, 4/5 and 4/6, which suggest no diagnostic value of this character. There are no additional studies comparing the tadpoles of these two species, and a new attempt for this is necessary. *Osteopilus pulchrilineatus* only requires additional comparisons with *O. septentrionalis* from which it differs essentially in the same way we discussed for *O. dominicensis*, considering the similarities between these two species. The larvae of *O. vastus* are unique within the genus in having the distal half of the spiracle free from the body. Within the tribe Lophiohylini (*sensu* Faivovich *et al*., 2005), this character is also known in lotic larvae of some casque-headed species of the genus *Osteocephalus* (i.e., Ron *et al*., 2010) and it likely represents a case of morphological convergence. *Hypsiboas heilprini* was included in the *H. albopunctatus* species group by Faivovich *et al*. (2005). A comprehensive review of the tadpoles of *Hypsiboas* was made by Kolenc *et al*. (2008) who stated that *H. heilprini* is the species with the largest LTRF in its genus, also having double rows of papillae completely surrounding the oral disc and lateral flaps with teeth (based on the description by Noble, 1927). Tadpoles of other species in this group commonly have LTRF 2/3–2/4, either single or double rows of marginal papillae and usually few submarginal papillae (Kolenc *et al*., 2008). Like other species of the *H. albopunctatus* group (i.e., *H. albopunctatus, H. fasciatus* and *H. raniceps*) tadpoles of *H. heilprini* have the mediodistal portion of the internal wall of the spiracle separated from the body wall (Kolenc *et al*., 2008). Reniform nares are typical of the tribe Cophomantini (*sensu* Faivovich *et al*., 2005), compared with the condition of the other Hispaniolan hylid species that belong to Lophiohylini. The *H. albopunctatus* group is not basal within the genus *Hypsiboas*, and tadpole characteristics of the oral disc of *H. heilprini* are more likely attributable to adaptations for development in lotic habitats than to a phylogenetic position. The existence of unpigmented eggs in this species is another reproductive character that has evolved independently from other species groups within the genus (Nali *et al*., 2014).

The tadpole size of Hispaniolan hylid frogs is not proportional to the adult size. The total length of fully grown tadpoles of *Hypsiboas heilprini* and *Osteopilus pulchrilineatus* may surpass the snout-vent length (SVL) of adults (maximum SVL 54.3 mm in *H. heilprini*; 43 mm in *O. pulchrilineatus*; Schwartz and Henderson, 1991). Larvae of *O. dominicensis* are up to two times smaller than adult frogs, while in *O. vastus* tadpoles are about three times smaller than the female maximum snout-vent length (SVL 99 mm, in *O. dominicensis*; 141.9 mm in *O. vastus*; Schwartz and Henderson (1991).

The tadpoles of the hylid frogs of Hispaniola very often occur sympatrically with other anuran larvae of different families from which they can be easily differentiated. Larvae of *Peltophryne guentheri* (Incháustegui *et al.*, 2014; see Appendix I) and *Rhinella marina* (Bufonidae) reach smaller sizes (20.6 mm of total length in *P. guentheri*; 25.1 mm in *R. marina*) than hylid tadpoles in equivalent stages, having a laterally emarginate oral disc, row of marginal papillae with anterior and posterior gaps, and a medial vent tube. Tadpoles of *Peltophryne fluviaticus* and *P. fractus* remain unknown, but the above mentioned traits are widespread in the genus (Schwartz and Henderson, 1991; Díaz and Cádiz, 2008). Tadpoles of *Lithobates catesbeianus* (Ranidae) reach a larger size (over 80 mm total length in advanced stages), have a combination of laterally emarginate oral discs, the row of marginal papillae have only an anterior gap, and the vent tube has a dextral aperture. Larvae of *Leptodactylus albilabris* (Leptodactylidae), of which we recorded a maximum total length of 42.9 mm in stage 37, have either subterminal (wild-caught tadpoles from Miches, El Seibo Province) or anteroventral (tadpoles from captive bred frogs collected in the same locality) oral discs that are not emarginate, row of marginal papillae with only an anterior gap, a medial vent tube, and a very dark overall colouration.

Chytrid fungus is now present in many Caribbean islands (Burrowes *et al*. 2004; Henderson and Berg, 2006; Díaz *et al*., 2007; Joglar *et al*., 2007; Malhotra *et al*., 2007). In the Dominican Republic, the chytrid fungus was reported by Joglar *et al*. (2007) from two localities in the Cordillera Central: Ébano Verde and Valle Nuevo. Since that time there were only unpublished references to chytrid infection in different species throughout the country. Infected tadpoles of *Hypsiboas heilprini* collected at Ébano Verde show disease prevalence since 2004. Tadpole oral deformities have been not detected in other species from Hispaniola, but juveniles and adults could be carrying the fungus. *Hypsiboas heilprini* is considered "vulnerable" (VU) by the IUCN Red List (Hedges *et al*., 2004). This frog is still common and widely distributed, from sea level to moderate uplands, but monitoring and research on the species response to the chytrid fungus is advisable to address conservation actions.

ACKNOWLEDGMENTS

Special gratitude to Kenia Ng for the morphological measurements, curatorial work and help with specimen collecting. Also to Eveling Gabot and Marcos Rodríguez for their enthusiastic assistance during field work. We acknowledge Celeste Mir and Carlos Suriel (Museo Nacional de Historia Natural "Prof. Eugenio de Jesús Marcano", Santo Domingo) for their kind support and the work space at the Museum. Nils Navarro assisted in the field work and plate composition. Wolfgang Feichtinger, Francisco Kolenc, Alfonso Silva, Robert Powell, and Blair Hedges, provided literature. We are indebted to Kraig Adler, Ronald Altig, F. Kolenc and Victor G. D. Orrico for reviewing and improving first drafts of the manuscript. This paper is an outcome of the project "*Anfibios Amenazados y Cambio Climático en República Dominicana*" (Endangered Amphibians and Climate Change in Dominican Republic), financed by "Ministerio de Educación Superior, Ciencia y Tecnología, FONDOCYT 2008-1-A-102", of the Dominican Republic. Our gratitude to Grupo Jaragua (Santo Domingo) for the administrative and logistic support for the Project, with especial thanks to Yvonne Arias, Miguel Abreu, and Cristina Nivar. Also to the authorities of Museo Nacional de Historia Natural de Cuba, Agencia de Medio Ambiente (CITMA, Cuba), and Sociedad Cubana de Zoología for supporting the Cuban participants in the Project. L.M.D wishes to express his gratitude to the University of Wuerzburg (particularly to Michael Schmid, Wolfgang Feichtinger, and Claus Steinlein), and the Belgian Focal Point to the Global Taxonomy Initiative (especially to Yves Samyn) for providing the photographic equipment. Histological work for chytrid fungus detection was made in the Hospital Hermanos Ameijeiras, in Havana. Additionally, thanks to Carlos Suriel and *Novitates Caribaea* for making possible the publication of this contribution.

LITERATURE CITED

Altig, R. G. 2007. Comments on the descriptions and evaluations of tadpole mouthparts anomalies. Herpetological Conservation and Biology, 2: 1–4.

Altig, R. & G. F. Johnston. 1989. Guilds of anuran larvae: relationships among developmental modes, morphologies and habitats. Herpetological Monographs, 3: 81–109.

Altig, R. G. & R. W. McDiarmid. 1999. Body plan. Development and morphology. In Tadpoles: The biology of anuran larvae, 24–51. McDiarmid, R.W. & Altig, R. (Eds.). Chicago: The University of Chicago Press.

Berger, L., R. Speare & A. Kent. 1999. Diagnosis of chytridiomycosis in amphibians by histologic examination. Zoos' Print Journal, 15: 184–190.

Berger, L., A. D. Hyatt, R. Speare & J. E. Longcore. 2005. Life cycle stages of the amphibian chytrid *Batrachochytrium dendrobatidis*. Diseases of Aquatic Organisms, 68: 51–63.

Burrowes, P. A., R. L. Joglar & D. E. Green. 2004. Potential causes for amphibian declines in Puerto Rico. Herpetologica, 60: 141–154.

Díaz, L. M. & A. Cádiz. 2008. Guía taxonómica de los anfibios de Cuba. Abc Taxa, vol. 4, 294 pp. + CD (audio).

Díaz, L. M., A. Cádiz, A. Chong & A. Silva. 2007. First report of chytridiomycosis in a dying toad (Anura: Bufonidae) from Cuba: a new conservation challenge for the island. EcoHealth, 4: 172–175.

Díaz, L. M., S. J. Incháustegui & C. Marte. 2014. Preliminary experiences with the husbandry, captive breeding, and development of the Hispaniolan Yellow Tree Frog, *Osteopilus pulchrilineatus* (Amphibia: Anura: Hylidae), with ecological and ethological notes from the wild. Herpetological Review, 45: 52–59.

Dunn, E. R. 1926. The frogs of Jamaica. Proceedings of the Boston Society of Natural History, 38: 111–130.

Faivovich, J., C. F. B. Haddad, P. C. A. García, D. Frost, J. A. Campbell & W. C. Wheeler. 2005. Systematic review of the frog family Hylidae, with special reference to Hylinae: phylogenetic analysis and taxonomic revision. Bulletin of the American Museum of Natural History, 294: 1–240.

Febles, I. 2002. Morfología externa de las larvas de siete especies de anuros cubanos (Amphibia: Anura). Tesis de Diploma. Facultad de Biología, Universidad de La Habana, 44 pp. (Unpublished).

Galvis, P. A., S. J. Sánchez-Pacheco, J. J. Ospina-Sarria, M. Anganoy-Criollo, J. Gil & M. Rada. 2014. Hylid tadpoles from the Caribbean Island of Hispaniola: ontogeny, description and comparison of external morphology. South American Journal of Herpetology, 2: 154–169.

Gosner K. L. 1960. A simplified table for staging anuran embryos and larvae with notes on identification. Herpetologica, 16: 183–190.

Heinicke, M. P., L. M. Díaz & S. B. Hedges. 2011. Origin of invasive Florida frogs traced to Cuba. Biology Letters, 7: 407–410.

Henderson, R.W. & C. S. Berg. 2006. The herpetofauna of Grenada and the Grenada Grenadines: Conservation concerns. Applied Herpetology, 3: 197–213.

Incháustegui, S. J., K. Ng, C. Marte y L. M. Díaz. 2014. The tadpoles of Peltophryne guentheri (Anura: Bufonidae) from Hispaniola. Reptiles & Amphibians, 21(4): 125 – 129.

Joglar, R. L., A. O. Álvarez, T. M. Aide, D. Barber, P. A. Burrowes, M. A. García, A. León-Cardona, A. V. Longo, N. Pérez-Buitrago, A. Puente, N. Rios-López & P. J. Tolson. 2007. Conserving the Puerto Rican herpetofauna. Applied Herpetology, 4: 327–345.

Kolenc, F., C. Borteiro, L. Alcalde, D. Baldo, D. Cardozo & J. Faivovich. 2008. The tadpoles of eight species of *Hypsiboas* Wagler (Amphibia, Anura, Hylidae) from Argentina and Uruguay, with a review of the larvae of this genus. Zootaxa, 1927: 1-66.

Lannoo, M. J., D. S. Townsend & R. J. Wassersug. 1987. Larval life in the leaves: Arboreal tadpole types, with special attention to the morphology, ecology, and behavior of the oophagous *Osteopilus brunneus* (Hylidae) larva. Fieldiana Zoology (New Series), 38: 1–31.

Malhotra, A., R. S. Thorpe, E. Hypolite & A. James. 2007. A report on the status of the herpetofauna of the Commonwealth of Dominica, West Indies. Applied Herpetology, 4: 177–194.

McDiarmid, R.W. & R. G. Altig. 1999. Research: materials and techniques. In Tadpoles: The biology of anuran larvae, 7–23. R. W. McDiarmid & R. Altig (eds.). Chicago: The University of Chicago Press.

Mertens, R. 1939. Herpetologische Ergebnisse einer Reise nach der Insel Hispaniola, Westindien. Abhandlungen der Senckenbergischen Naturforschende Gesellschaft, 471: 1–84.

Nali, R. C., J. Faivovich & C. P. A. Prado. 2014. The occurrence of unpigmented mature oocytes in Hypsiboas (Anura: Hylidae). Salamandra, 50: 53–56.

Noble, G. K. 1927. The value of life history data in the study of the evolution of the Amphibia. Annals of the New York Academy of Sciences, 30: 31–128.

Ron, S. R, E. Toral, P. J. Venegas & Ch. W. Barnes. 2010. Taxonomic revision and phylogenetic position of *Osteocephalus festae* (Anura, Hylidae) with description of its larva. ZooKeys, 70: 67–92.

Schwartz, A. & R. Henderson.1991. *Amphibians and reptiles of the West Indies: descriptions, distributions, and natural history*. University of Florida Press, Gainesville, 720 pp.

Thompson, R. L. 1996. Larval habitat, ecology, and parental investment of *Osteopilus brunneus* (Hylidae). In Contributions to West Indian Herpetology: A tribute to Albert Schwartz, 259–269. Powell R. & Henderson R. (eds.). Contributions to Herpetology, vol. 12. Ithaca, N.Y.: Society for the Study of Amphibians and Reptiles.

Trueb, L. & M. Tyler. 1974. Systematics and evolution of the Greater Antillean hylids frogs. Occasional Papers of the Museum of Natural History, University of Kansas, 27: 1–60.

Vogel, P. 2000. Wirbeltiere (Vertebrata) und Bromelien. Die Bromelie, 2: 32–37.

APPENDIX I

Specimens used for descriptions and comparisons

HYLIDAE

Hypsiboas heilprini (n=123).— Ébano Verde, La Vega Province, Cordillera Central (PRRD 507), n=10; La Horma, San José de Ocoa Province, Cordillera Central (PRRD 652), n=17; Rancho Arriba, Sierra de Ocoa (PRRD 660), (n=17); Río Limpio, Elías Piña Province, Cordillera Central (PRRD 656), n=6; Loma La Canela, Duarte Province, Cordillera Central (PRRD 486-487), n=73.

Osteopilus dominicensis (n=101).— Santana, Higüey, La Altagracia Province (PRRD 309), n=43; Sierra de Neyba, (PRRD 489), n=20; Río Limpio, Elías Piña Province (PRRD 657-650), n=27; Aceitillar, Barahona Province, Sierra de Bahoruco (PRRD 488), n=11.

Osteopilus pulchrilineatus (n=100).— Juana Vicenta, Samaná Province (PRRD 663), n=4; Loma La Canela, Duarte Province (PRRD 485-484), n=67; Río Limpio, Elías Piña Province (PRRD 654), n=6; Cotuí, Sánchez Ramírez Province, Cordillera Central (PRRD 664), n=23.

Osteopilus vastus (n=166).— Cañada de Quilino, Río Limpio, Elías Piña Province (PRRD 651), n=15; Arroyo La Vuelta, Santo Domingo Province (PRRD 658), n=13; Villa Altagracia, San Cristóbal Province (PRRD 659), n=92; Río Isabela, La Isabela, Santo Domingo Province (PRRD 661), n=46.

BUFONIDAE

Peltophryneguentheri (n=45).— Río Gurabo, Santiago Rodríguez Province (PRRD 653).

Rhinella marina (n=100).— Surroundings of Río Gurabo, Santiago Rodríguez Province (PRRD 16); Santana, Higüey, La Altagracia Province (PRRD 304).

LEPTODACTYLIDAE

Leptodactylus albilabris (n=7).— Miches, El Seibo Province (PRRD 322).

[Recibido: 16 de agosto, 2015. Aceptado para publicación: 15 de septiembre, 2015]