

Hispaniolan Giant *Diploglossus* (Sauria: Anguidae): Description of a New Species and Notes on the Ecology of *D. warreni*

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Abstract. A third giant species of *Diploglossus*, *D. carraui*, is described from north-central República Dominicana. Comparisons between this species and *D. warreni* from Haiti and *D. anelpistus* from south-central República Dominicana are made. The taxonomic status of the three named populations is discussed, and alternative arrangements are noted.

Diploglossus warreni is viviparous, and gives birth in July-August (wet season). Number of young (8-27) is positively correlated with female body size, but mean size of young is not correlated with litter size. *D. warreni* takes a wide variety of prey species (including other lizards) but, in terms of prey volume, centipedes (*Scolopendra*) and millipedes (Rhinocricidae) predominate.

The genus *Diploglossus* Wiegmann (sensu Strahm & Schwartz, 1977) was only recently discovered (1968) to occur on Hispaniola, even though there had been a specimen in the National Museum of Natural History, Washington, D.C., U.S.A., collected in northern Haiti in 1917. The northern Haitian population, which also occurs on Ile de la Tortue, was named *D. warreni* by Schwartz (1970). A second giant species was discovered in San Cristóbal Province, República Dominicana and was named *D. anelpistus* by Schwartz, Graham, and Duval (1979). These two species, although similar in many ways, are distinctly different in coloration and pattern, and to some extent in scutellation. The two species are separated by a distance of about 300 km, and their known ranges are separated by the Dominican Cordillera Central and its Haitian affiliate, the Massif du Nord. It has seemed likely, with the discovery of the isolated population of *D. anelpistus*, that other populations of *Diploglossus* would be discovered. In fact, Schwartz et al. (1979) noted a specimen of the genus from Comedero, Puerto Plata Province, República Dominicana, some 200 km NNE of the known range of *D. anelpistus*, but they did not assign it to the latter taxon.

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Since that time, two additional specimens from the northern República Dominicana have been brought to the Museo Nacional de Historia Natural in Santo Domingo; thus, there are now three adults (all males) from three different northern Dominican localities. These differ from both Haitian *D. warreni* and southern Dominican *D. anelpistus*, and represent still another taxon. We name it here as a full species, although acknowledging that it is intermediate in some ways between the two previously named species, in honor of Dr. José Antonio Carrau who took the first specimen, as

Diploglossus carraui sp. n.

Holotype. National Museum of Natural History (USNM) 197369, an adult male, from Comedero, La Isabela, Puerto Plata Province, República Dominicana, May 1978, collected by Niño Gómez and presented by José Antonio Carrau.

Paratypes. Museo Nacional de Historia Natural de Santo Domingo (MNHNSD), between Salcedo and Tenares, Salcedo Province, República Dominicana, brought to museum by Bienvenido López Dulance and collected by Plinio, on 5 May 1980; MNHNSD, Pozo Prieto, Valverde Province, República Dominicana, 8 May 1980, collected by native.

Definition. A species of *Diploglossus* characterized by: 1) large size (snout-vent length to 283 mm in males; females unknown); 2) throat and venter pale creamy with scattered dark brown markings, either toward the centers of ventral scales or along their edges, the markings randomly placed in each individual; 3) head scales not outlined in black; 4) nuchal scales posterior to enlarged head scales without dark pigment along median sutures so that neck region is not obviously lineate; 5) supralabial intercalated scales absent.

Description of holotype. An adult male with a snout-vent length of 270 mm and tail length (apparently not regenerated) of 225 mm; dorsum (as preserved) pale creamy tan with random dark brown smudges extending as far as the occiput; neck more or less solid dark brown and without lineate pattern; dorsum medium brown; a series of 15 dark brown bands, each about 4 scales wide, from just behind the auricular opening to the groin, plus two additional bands postsacrally, these bands extending ventrally and maintaining their integrity along the sides to an imaginary line between the lower edges of the fore- and hindlimb insertions, the ground color of the sides paler tan so that the lateral “bars” (= lateral extensions of the dorsal crossbands) are more prominent than the dorsal crossbars but are also narrower, usually involving 2 scales; entire venter cream and blotched with very dark brown, giving a more or less semi-lineate effect but not comparable to the completely dark brown venter in *D. anelpistus*; scales of anal flap almost completely dark brown; chin and throat similar to venter except that the dark markings are smaller and somewhat more closely placed to give an almost

speckled appearance; tail dark brown both dorsally and ventrally, without markings; limbs medium brown with darker brown blotching, the ground color paler below and comparable to the ventral ground color; 95 scales between mental and vent; 40 scales around midbody; angular subocular scale between supralabials 6 and 7 on one side, intermediate on other side; medium brown dorsal band width 17 scales; 18 fourth toe lamellae; 11 chin shields; arm length 48 mm; head length 59.6 mm, head width 50.5 mm; head width/head length ratio $\times 100$ 84.7.

Variation. The holotype and the two paratypes are all males. Snout-vent length varies between 265 mm and 283 mm. Ventral scales between mental and vent vary between 89 and 96 ($\bar{x} = 93.3$); midbody scales 38-40 (39.0); fourth toe lamellae 14-18 (16.0); number of dorsal bands 14-15 (14.7); chin shields 10 (2 specimens), 11 (1); dorsal band width 17 scales in all specimens; head width/head length ratio $\times 100$ 79.4-84.7 (2 specimens).

The two paratypes are very similar to the holotype in color (as preserved) and pattern. Dorsally, the paratypes have a pair (not multilineate) of broad nuchal lines which blend into the first crossbar, but these lines are not prominent. The venters of the paratypes are slightly less pigmented with dark blotches than the holotype, but the general effect is identical. The ventrolateral extension of the dorsal crossbars as lateral bars occurs in all three specimens; there is no sharp color demarcation between the lateral and ventral colors, and the lateral bars on their pale ground simply blend gradually into the ventral color and blotched pattern. No specimen has intercalated scales between the supralabials.

Comparisons. The most simple comparison between the three Hispaniolan species of *Diploglossus* involves their ventral colors and patterns: in *D. warreni*, the venter is unmarked orange of some shade, in *D. anelpistus* the venter is heavily marked with dark brown along the centers of the ventral scales to give an almost totally dark venter or at least a darkly lineate one, whereas in *D. carraui* the venter is cream with randomly placed dark brown blotches or smudges. That this condition in *D. carraui* is not an ontogenetic one is shown by the fact that the largest male *D. carraui* (283 mm) is almost as large as the largest *D. anelpistus* (285 mm); both are larger than the largest (of 15) male *D. warreni* which has a snout-vent length of 279. All three species reach about the same adult size (at least in males). The neck is multilineate in *D. anelpistus*, non-lineate in *D. warreni*, and non-lineate or with two broad vague lines in *D. carraui*. The head shields are regularly outlined in black in *D. anelpistus*, but this is not the case in *D. warreni* or *D. carraui*. Pale sides with clear lateral bars are the rule in *D. warreni* and *D. carraui*, but not in *D. anelpistus* where the sides are dark; in the latter species, the lateral bars are lost in the dark lateral coloration, whereas they remain prominent in *D. warreni* and *D. carraui*.

As far as scutellation is concerned, there is strong overlap in all counts; it should be recalled that there are only 3 *D. carraui* and 15 *D. anelpistus* known, whereas *D. warreni* is now represented by 41 specimens. Schwartz et al. (1979) included a table comparing

northern Haitian mainland and Ile de la Tortue *D. warreni*, and *D. anelpistus* scale counts. From the data included in this paper a similar set of data can be made for *D. carraui*. Using the same categories (mainland *D. warreni*, Tortue *D. warreni*, *D. anelpistus*), the following scale comparisons can be made. *Diploglossus carraui* has the highest mean of ventral scales (93.3), with other means varying between 87.5 (Tortue *warreni*) and 92.3 (*anelpistus*), but counts overlap broadly. *Diploglossus carraui* also has the highest mean of ventral scales (39.0) with other means of 35.6 (Tortue *warreni*) to 37.4 (Haitian *warreni*). Position of the angular subocular, although variable (between 5 and 6 to between 7 and 8), is modally between 6 and 7 in all samples. Fourth toe lamellae mean is highest in *D. anelpistus* (16.9), and lowest in Tortue *D. warreni* (14.2), but the counts overlap broadly. Dorsal band width is 17 in all *D. carraui*, varies between 14 and 18 (\bar{x} = 16.0) in *D. anelpistus*, between 12 and 20 in Haitian *D. warreni* (\bar{x} = 16.6), and between 12 and 15 (\bar{x} = 13.9) in Tortue *D. warreni*. Intercalated scales occur only in *D. anelpistus*. Number of dorsal crossbars is 14 or 15 (\bar{x} = 14.7) in *D. carraui*, 14–18 (16.2) in *D. anelpistus*, 15–19 (16.6) in Haitian *D. warreni*, and 14–17 (15.9) in Tortue *D. warreni*. Overlap of this count between *D. carraui* and Haitian *D. warreni* is thus minimal, and the same condition seems to apply to *D. carraui* and *D. anelpistus*, although there is some overlap in counts. The crossbands in *D. carraui* seem broader but more widely spaced and thus fewer in number, merely upon inspection, in *D. carraui* as compared with the other taxa. Finally, the head width/head length ratio $\times 100$ varies between 79.4 and 84.7 in *D. carraui*, is 72.0 in the single adult male *D. anelpistus*, varies between 71.3 and 80.0 in male *D. warreni* from northern Haiti, and is 78.5 in the single male Tortue *D. warreni*. Thus, the highest ratio occurs in *D. carraui*; although there is very slight overlap between *D. carraui* and *D. warreni*, the latter seems to be a much slimmer headed lizard.

Remarks. Apparently *D. carraui* occupies a variety of habitats. The holotype was recorded as having been taken “in bosque seco en base de cambarones, pedregoso, arido” on the north side of the Cordillera Septentrional. The specimen from Pozo Prieto is from the western portion of the arid Valle de Cibao, on the southern side of the same cordillera. The third specimen is from a mesic region, at an elevation between about 200 and 300 m, in a cacaotal. The localities whence *D. warreni* have been taken are almost invariably forested and mesic, with the exception of the single specimen from an oasis near Terre Sonnain in Haiti, and even this locality is forested and relatively mesic in an otherwise xeric region. The locality for *D. anelpistus* was at least forested and presumably relatively mesic. No Hispaniolan *Diploglossus* is known from an elevation higher than about 350 m (*D. warreni*).

The three specimens of *D. carraui* are from localities about 90 km apart (Pozo Prieto—between Salcedo and Tenares), and about 25 km north of this west-east line at the type-locality. The nearest locality for *D. warreni* (Limbé, Dépt. du Nord, Haiti) is about 165 km west of the westernmost *D. carraui* locality (Pozo Prieto); the minimal distance between the ranges of *D. anelpistus* (Ingenio Catarey, San Cristóbal Province)

and *D. carraui* (between Salcedo and Tenares) is about 80 km. We repeat that there seems little question that other populations of *Diploglossus* will be found scattered over Hispaniola.

Discussion

If the scenario proposed by Strahm and Schwartz (1977) is correct—namely, that *Diploglossus* has been out-competed by later-arriving *Celestus* (a genus which on Hispaniola has many species, is widespread over the island, and occurs at both high and low elevations), then one may confidently expect a fractionalization of the basic *Diploglossus* stock into a variety of species. There now seems little doubt that this has indeed been the case. But the question continues to arise as to the status of these (apparently) isolated populations. Would it be more appropriate to consider *warreni*, *anelpistus*, and *carraui* as subspecies of *D. warreni*, or as distinct species? Some (but not all) of the characters of *D. carraui* do indeed suggest that such a nomenclatural arrangement might be appropriate. Another possibility is that *D. carraui* is intermediate (or intergradient?) between *D. warreni* and *D. anelpistus*, but again, although some characteristics are intermediate (such as the ventral pattern), the population differs in ways which are not so. It should be recalled that, on Hispaniola, such eminently distinct diploglossine species as *Celestus stenurus* Cope and *Celestus costatus* Cope were long considered identical (Cochran, 1941), since there are no striking differences between them in scutellation and often in pattern (both have several subspecies which at times are somewhat convergent). Thus, we cannot become unduly concerned with the lack of scutellar differences between the three Hispaniolan populations of *Diploglossus*. Color and pattern differences are striking between them, and we are here placing more emphasis on these differences (as well as the apparently widely scattered distribution of the three populations) in regarding them as full species.

Notes on the Ecology of *Diploglossus warreni*

Diploglossus warreni was the first of the three known giant Hispaniolan diploglossines to be described (Schwartz 1970), and is known from many more specimens than either of the other two species. Most of the specimens are in the Albert Schwartz Field Series (ASFS). *D. warreni* in the ASFS ($n = 36$) were measured (SVL and head width) and dissected. Stomachs were removed and their contents examined. The unborn young of pregnant females were removed, counted and measured (SVL). Individual prey items were counted, identified to a variety of taxonomic levels, and, if possible, had their volumes determined, in the manner described by Henderson (1982).

Diploglossus warreni is an inhabitant of mesic situations in northern Haiti (including Ile de la Tortue). It is frequently associated with the root systems of large trees, and it has been observed outside burrows during the day, and on asphalt roads at night (J.A. Needham, pers. commun.).

Table 1. Summary of stomach content analysis of *Diploglossus warreni*.

Prey taxon	Volume (cm ³)	Percent of total volume
Gastropoda (slugs)	3.3	2.0
Arachnida		
spiders	15.0	11.0
Amblypygi	1.0	0.7
Chilopoda		
<i>Scolopendra alternans</i>	27.0	21.0
Diplopoda: Spirobolida		
Rhinocricidae	25.5	20.0
Insecta		
Orthoptera	0.3	0.2
Dermoptera	0.1	
Hemiptera	0.1	
Homoptera: Cicadidae		
<i>Diceroprocta</i> (adults and nymphs)	19.3	15.0
Coleoptera (adults and larvae)	10.0	7.0
Lepidoptera (larvae)	1.5	1.0
Reptilia: Sauria		
<i>Anolis</i>	4.0	3.0
<i>Celestus</i>	20.0	15.0
Aves: Icteridae: ? <i>Quiscalus niger</i>		

Like many other anguids, and most diploglossines, *D. warreni* is viviparous (Greer, 1967; Ober, 1968). Ten females had nearly full-term young, and all were collected during the first half of August. The pregnant females were 17.0-27.0 cm SVL, and litter size (8-27) is positively correlated with female SVL ($r = .92$, $P < .01$). Mean SVL per litter ranged from 3.2-4.2 cm; there is no correlation between mean SVL of a litter and litter size ($r = .26$). A 20.7 cm SVL captive female gave birth to 34 young (Lawlor and Norris, 1979).

The stomach content analysis yielded about 45 individual prey items (exclusive of mites and formicid insects (Table 1). In terms of occurrence, millipedes (Rhinocricidae) ($n = 12$) were the most common prey items, followed by cicadas (7) (*Diceroprocta* sp.), centipedes (*Scolopendra alternans*) (5) and gastropods (slugs) (5). Centipedes and millipedes combined account for 41% of the total prey volume. Two lizards were eaten and are 18% of the total volume. The two largest prey items taken were a tarantula (? *Scopelobates*; 13.0 cm³) and an anguid lizard (*Celestus costatus*, 20.0 cm³). Feathers from an icterid bird (probably *Quiscalus niger*) were ingested, but it is not known if any other part of the bird was eaten. There is no correlation between size of the largest prey item found in each of 18 stomachs and lizard SVL ($r = .224$).

All of the prey items, except for the bird, are, like *D. warreni*, leaf litter inhabitants. *D. warreni* is, seemingly, an opportunistic forager, eating most anything that is encountered, including the potentially highly toxic rhinocricid millipedes (Loomis, 1936; Wheeler et al., 1964; R.M. Shelley, in litt.). The bird was most likely found dead, and

D. millepunctatus on Malpelo Island, Colombia is also known to feed on dead birds (Kiester, 1975).

The incidence of old tail injuries in the *D. warreni* sample ($n = 24$) is high (83%), with only 17% of the sample showing no tail injuries. Both sexes suffer tail injuries: of those injured 45% are males and 55% females (total $n = 20$). The mean SVL for those lizards with complete tails is, not unexpectedly, smaller (17.1 ± 2.1 cm) than those for males (24.5 ± 0.8 cm) and females (21.1 ± 1.0 cm) with injured tails. Whether the injuries were inflicted by conspecifics or by potential predators is unknown, but it is unlikely that large (> 25.0 cm) *D. warreni* have many natural enemies. Agonistic behavior has been observed between captive males (Lawler and Norris, 1979), and *D. warreni* is sexually dimorphic for head size, the males having a greatly enlarged temporal region (\bar{x} head width/SVL for 10 largest males = $.151 \pm .002$; for females = $.125 \pm .003$). This may be an adaptation for combative social behavior.

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