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John, R.R., E.J. Bentz, M.J. Rivera Rodríguez, A.M. Bauer, and R. Powell. 2012. *Bachia heteropa*.

Bachia heteropa (Lichtenstein and von Martens) Earless Worm Lizard

Chalcides heteropus Lichtenstein and von Martens *in* Lichtenstein 1856:17. Type-locality, "La Guayra [= La Guaira, Distrito Federal], Venezuela." Lectotype, Zoologisches Museum Berlin (ZMB) 1173 (designated by Bauer and Günther 1994), an adult collected by J. Gollmer, sex and date of collection unknown (examined by AMB). See **Remarks**.
Bachia heteropus: Garman 1892:97.
Bachia heteropa: Beebe 1944:14.
Bachia heretopa: Ávila Pires 2005:32. *Lapsus*.

• **CONTENT**. Five subspecies are currently recognized: *Bachia h. heteropa, B. h. alleni, B. h. lineata, B. h. marcelae*, and *B. h. trinitatis*. Hailey and Cazabon-Mannette (2011) suggested that the population on Tobago might represent an endemic subspecies. Galis et al. (2010) and Kohlsdorf et al. (2010) both presented phylogenies suggesting that *B. heteropa* as currently defined is polyphyletic. See also **Remarks**.

• **DEFINITION**. *Bachia heteropa* is a small member of the genus *Bachia* (maximum known SVL 64 mm). Body and tail are elongated, limbs are reduced with 4 toes on forelimbs and 2–4 toes on hindlimbs (varying by subspecies), external ears are absent, eye size is reduced, and lower eyelids bear an unsegmented window. Dorsal scales are smooth, hexagonal, and imbricate, in 5–12 longitudinal rows; lateral and ventral scales are smooth, quadrangular, and juxtaposed, in 16–22 longitudinal rows; tail scales are mostly hexagonal (Dixon 1973). Dorsal scales number 37–41 from occiput to vent, scale rows around midbody (SAB) are 25–31, gulars 5–8, ventrals 25–29, supraoculars 2–3, superciliaries 3, supralabials and infralabials usually 6/6 or 6/5, labials and parietals not in contact, interparietal, frontonasal, nasals,

FIGURE 1. *Bachia heteropa alleni* from Friendship Bay, Bequia, St. Vincent and the Grenadines. Photograph by S. Blair Hedges.

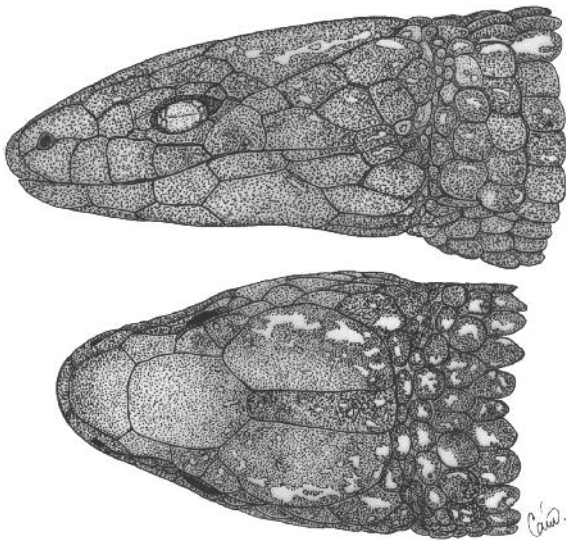


FIGURE 2. *Bachia heteropa heteropa* (MHNLS 9207) from El Guacuco, San Juan de Las Galdonas, Península de Paria, Sucre, Venezuela. Drawing by Osvaldo Villareal (courtesy of Gilson Rivas).

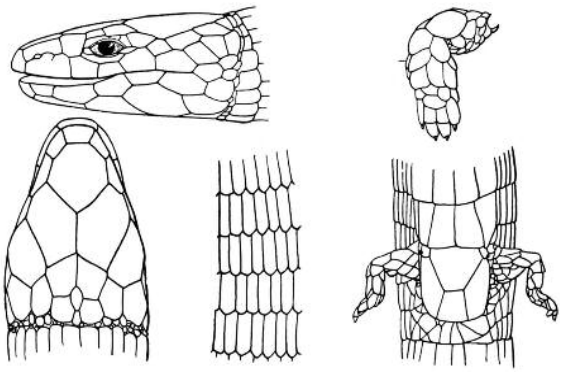
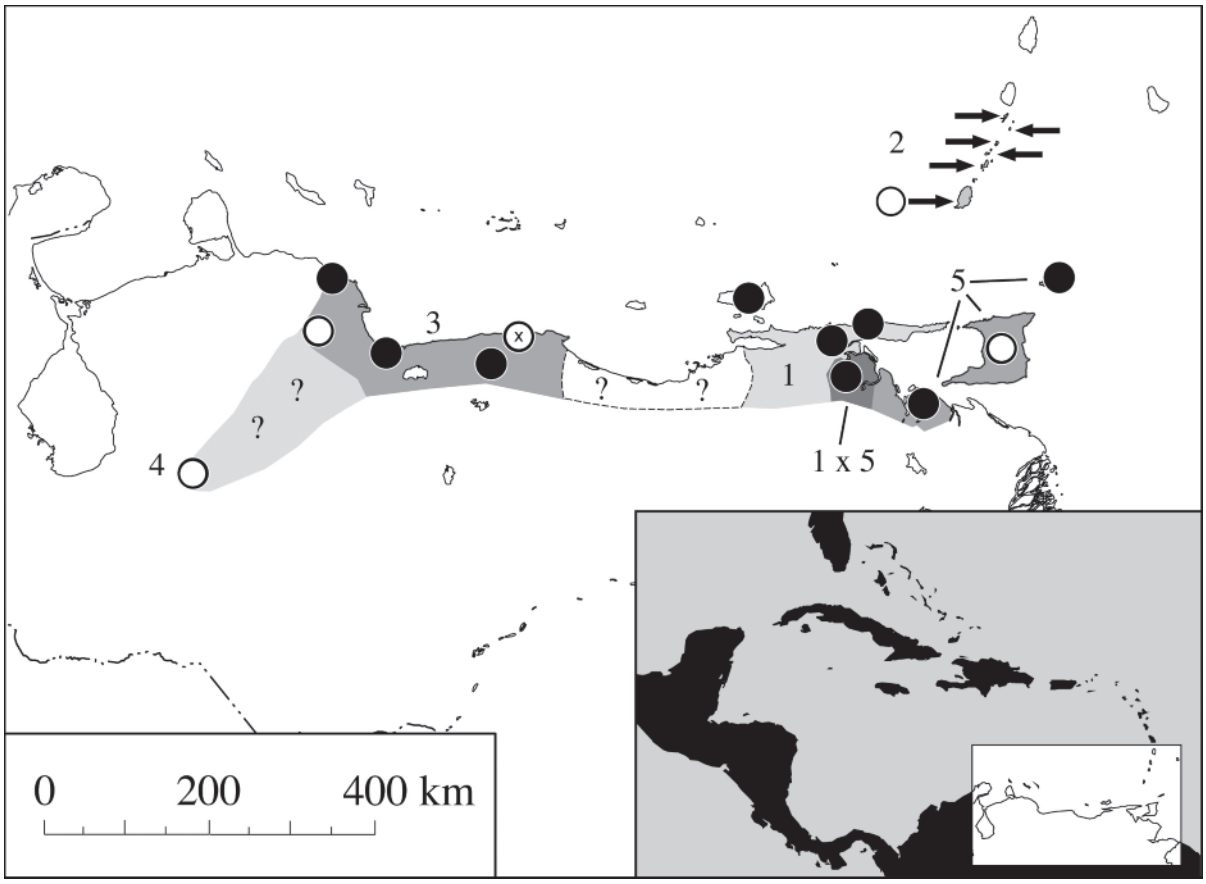


FIGURE 3. *Bachia anomala* (= *B. heteropa lineata*) (from Brongersma 1946).

and parietals present, prefrontals absent or present in median contact, second pair of chin shields not usually in medial contact and do not typically reach the oral border, males usually with 2/2 preanal pores (absent in females), and preanal shields usually 4, but 3–5 occurring once in 80 specimens (Dixon 1973; Schwartz and Henderson 1991).

Coloration varies slightly between subspecies, but all have a basic pattern of 3 longitudinal dorsal dark lines alternating with 4 wider, light interspaces extending from the parietals onto the tail. The sides of the body are dark brown to blackish and the venter is light brown to yellowish tan. The upper edge of the lateral dark stripe tends to be darker than the stripe In all subspecies, giving an illusion of 5 dark stripes on the body (Dixon 1973).

• **DIAGNOSIS**. *Bachia heteropa* can be distinguished from sympatric South American congeners by scale pattern. Dorsal scales in the *B. heteropa* group (*B. heteropa* and *B. pallidiceps*) are hexagonal, smooth, and imbricate, and lateral and ventral scales



MAP. Distribution of *Bachia heteropa*; circles mark type-localities and dots indicate other known locality records. Note the type-locality of *Chalcides heteropus* (La Guayra [= La Guaira, Distrito Federal], Venezuela), marked with a circle and an "x," falls within the range of *B. heteropa lineata* according to the ranges shown by Dixon (1973). However, some authors (e.g., Rivas Funemayor et al. 2005) called into question the validity of the various subspecies, citing clinal variation across the range of the species. Gollmer's collections were probably derived from a wider area within Venezuela that just La Guaira, and that locality may merely indicate the point from which the specimens were shipped. Lichtenstein was notorious for taking collectors' detailed data and replacing them with broad geographic reference points. Uncertain records from Colombia are not shown (see **Remarks** and **Comment**).

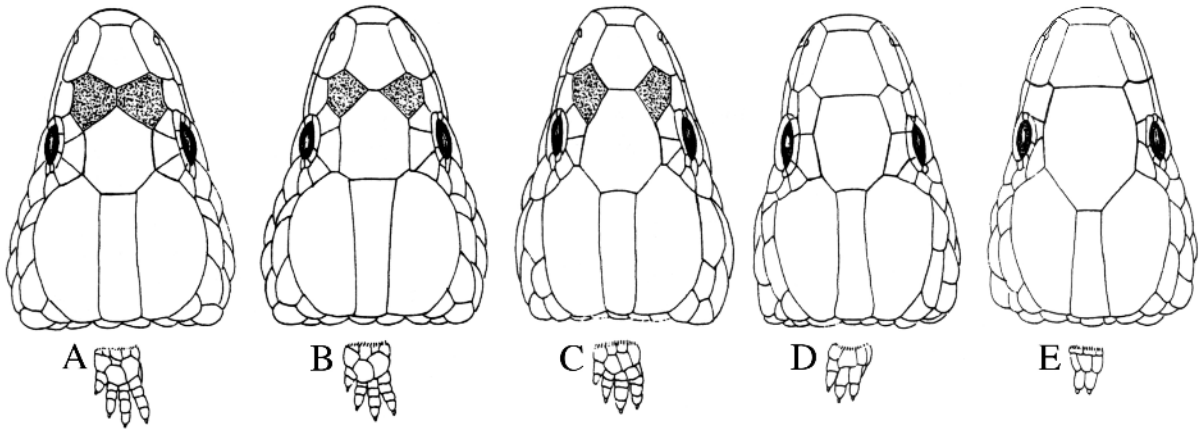


FIGURE 4. Progressive reduction in size and loss of prefrontal scales and hindlimb toes in *Bachia heteropa* from more mesic habitats in the eastern portion of the species' distribution to increasingly xeric habitats in the west: (A) *B. h. alleni*, (B) *B. h. trinitatis* from Trinidad, (C) *B. h. trinitatis* from the mainland, (D) *B. h. heteropa*, and (E) *B. h. lineata* (from Dixon 1973).

are quadrangular, smooth and juxtaposed; species in the *B. bresslaui* group have keeled hexagonal scales dorsally as well as laterally; species in the *B. dorbignyi* group also have hexagonal scales dorsally and laterally, but these are smooth; species in the *B. flavescens* group have quadrangular scales all over the body (no hexagonal scales). *Bachia heteropa* can be distinguished from *B. pallidiceps* in having 3 supercilliaries and 24+ (mean 28.4) midbody scale rows, whereas *B. pallideceps* has 2 supercilliaries and ≤24

(mean 22.9) midbody scale rows (Dixon 1973). *Bachia heteropa* can be distinguished from all sympatric Lesser Antillean lizards by the following combination of characters (Schwartz and Henderson 1985): large, square, ventral plates, fewer than 2 pairs of scales between the rostral and the first unpaired median head scale, ventral plates larger than dorsal scales, anterior nasals separated by rostral and frontonasal, and the lack of an ear opening.

• **DESCRIPTIONS**. In addition to original descriptions, detailed descriptions were provided by Burt and Burt (1931), Thomas (1965), Dixon (1973), Schwartz and Henderson (1991), and Vanzolini (1961a).

• **ILLUSTRATIONS.** Color photographs are in Powell et al. (1996), Murphy (1997), La Marca and Sori-ano (2004), Quinn et al. (2010), Hedges (2011), and Sánchez Muñoz (2011, including an image of an egg). Black-and-white photographs are in Ditmars (1928, 1933), Boos (1979), and Daudin and de Silva (2007, 2011). Line drawings are in Barbour (1914; dorsal, lateral, and ventral views of the head and views of the hand and foot), Beebe (1944; whole body, lateral view of head and forebody, and hindlimb), Brongersma (1946; lateral and ventral views of the head, forelimb, dorsal scales, and anal region of *B. anomala* [= *B. heteropa lineata*]), Vanzolini (1961a; 3 views of the head plus fore- and hindlimbs), Donoso-Barros and Garrido (1964; dorsal, lateral, and ventral views of the head, anal plates, dorsal and ventral scales, anterior and posterior limbs), Dixon (1973; prefrontal scales and hindlimb toes in the *B. heteropa* group in Venezuela), Cei (2007; supraocular region); Thomas (1965), and Murphy (1997). Both of the latter illustrated dorsal head views of *B. h. alleni* and *B. h. trinitatis*. John et al. (2011) provided line drawings showing the use of the head in burrowing. Kohlsdorf and Wagner (2006) diagrammed digital loss in *B. h. trinitatis* and Galis et al. (2010) provided diagrammatic illustrations of gestalt and fore- and hindlimb morphology of *B. h. lineata* and reproduced the figure showing prefrontal scales and hindlimb toes in Dixon (1973). Presch (1975) illustrated fore- and hindlimb osteology, and the former was reproduced in Shapiro and Carl (2001) and Shapiro (2002). Ugeto and Rivas (2010) provided a color illustration of the entire animal, diagrammatic views of dorsal head squamation showing variation, and a color photograph of two preserved specimens.

• **DISTRIBUTION.** *Bachia heteropa* is found on the Grenada Bank (Bequia, Battowia, Mustique, Cannouan, Union, Grenada, and possibly Petit St. Vincent), Trinidad and satellites, Tobago, and through northern Venezuela (see also **Comment**). *Bachia heteropa* is mesophilic, at least semi-fossorial, and found in habitats with an abundance of ground litter (Barbour 1914; Dixon 1973; Ugeto and Rivas 2010). The distribution was previously illustrated by Dixon (1973). The West Indian range was illustrated in Schwartz and Henderson (1991), that for Isla de Margarita was mapped by Ugeto and Rivas (2010), and distribution maps for *B. h. alleni* (Tobago) and *B. h. trinitatis* (Trinidad) are in Murphy (1992).

• **FOSSIL RECORD.** None.

• **PERTINENT LITERATURE.** The following literature citations pertaining to *B. heteropa* are arranged by topic: **behavior** (Donoso-Barros and Garrido 1964; John et al. 2011; Johnson 1946), **comparative morphology** (including limb loss) (Bergmann 2008; Cei 2007; Dixon 1973; Galis et al. 2010; Kearney 2002; Kizirian and McDiarmid 1998; Kohlsdorf and Wagner 2006; Kohlsdorf et al. 2010; Lande 1978; MacLean 1974; Parker 1933; Presch 1975, 1980; Seligmann et al. 2003), **desiccation** (water loss rates) (Bentz et al. 2011), **diet** (Parker 1935), **distribution and zoogeography** (Daudin and de Silva 2007; Dixon 1973; Esqueda and La Marca 1999; Henderson and Powell 2006; Hoogmoed and Dixon 1977; Schwartz 1967), **geographic origin** (Hedges 1996; Murphy 1996), **key to subspecies** (Dixon 1973), **locomotion** (Beebe 1944; Donoso-Barros and Garrido 1964), **natural history** (Bentz et al. 2011; Boos 1979; Henderson and Powell 2009; Murphy 1997; Schwartz and Henderson 1991), **phylogenetics and systematics** (Dixon 1973; Galis et al. 2010; Kizirian and McDiarmid 1998; Kohlsdorf and Wagner 2006; Kohlsdorf et al. 2010), **predation** (Brongersma 1956; Murphy 1997; Ugeto and Rivas 2010), **tail autotomy** (Beebe 1944; Donoso-Barros and Garrido 1964), and **taxonomic history** (Brongersma 1946; Censky and Kaiser 1999; Peracca 1896; Thomas 1965).

The species was included under various synonyms in the following **checklists, keys, faunal accounts, or general works** (some include brief descriptions): Ayala (1986), Barbour (1914, 1930, 1935, 1937), Barbour and Loveridge (1929), Barros and Rincón (1999), Beebe (1952), Boos (1984a,b), Brygoo (1989), Burt and Burt (1933), Censky and Kaiser (1999), Cochran (1934), Cordero (1987), Corke (1992), Crother (1999), Daan and Hillenius (1966), Daudin and de Silva (2007), Donoso-Barros (1968), Esqueda et al. (2001), Evans (2008), Garman (1887), Germano et al. (2003), Gorzula and Señaris (1999), Groome (1970), Hailey and Cazabon-Mannette (2011), Hardy (1982), Henderson and Berg (2006, 2011), Henderson and Breuil (2012), Kramer (1979), La Marca and Soriano (2004), Lescure (1987), Lynn (1959), MacLean et al. (1977), Mahler and Kearney (2006), Malhotra and Thorpe (1999), Marcuzzi (1950), Markezich (2002), Mijares- Urrutia and Arends (1999, 2000), Mole and Urich (1894), Murphy (2004), Parker (1933, 1935), Pefaur (1992), Peters and Donoso-Barros (1970), Powell and Henderson (2005), Powell et al. (1996), Quinn et al. (2010), Rivas Fuenmayor et al. (2005), Romero Moreno and Romero Moreno (1989), Roux (1926), Ruthven (1925), Sánchez et al. (1995), Schwartz (1978), Schwartz and Henderson (1985, 1988), Schwartz and Thomas (1975), Shreve (1947), Ugeto and Rivas (2010), Underwood (1962), van Tuijl (1995), Vanzolini (1978, 1986), Werner (1900), and Wrobel (2005). Court (1858) mentioned “a curious little animal

resembling an amphisbaena, but having four limbs; it is probably a ceps."

• **REMARKS.** Bauer and Günther (1994) noted that the original description mentioned 4 specimens, although measurements were given for only one. The ZMB catalogue lists 4 specimens under 3 consecutive numbers. All are apparently types. ZMB 1173, originally represented by 2 specimens listed as having been lost during World War II, is present, although only 1 specimen remains. The other members of the type-series originated from outside the currently construed range of *B. heteropa* (Dixon 1973), and their allocation to species should be further investigated. Authorship of *Chalcides heteropus* and other taxa first published in the "Nomenclator reptilium et amphibiorum Musei Zoologici Berolinensis" is here credited to Lichtenstein and von Martens. Although Lichtenstein alone is often given credit for names in this work, the preface clearly states that most of this work, including the descriptions, was due to von Martens (see Harris and Kluge 1984; Ulber 2003). David Weinland might also have played a role in the publication. Dixon (1973), Schwartz and Thomas (1975), Schwartz and Henderson (1988, 1991), and Powell et al. (1996) erroneously listed Natur-Museum Senckenberg (SMF) 39900 as the holotype. That specimen is the type of *Herpetochalcis heteropus* Boettger 1883 [*Bachia boettgeri* Boulenger 1885)] (Mertens 1967). Smith and Taylor (1950) erroneously assumed that Boettger's species was a synonym of *Chalcides heteropus*.

Lichtenstein (1856) indicated that the name was derived from a Wiegmann manuscript, explaining why Powell et al. (1996) listed the taxonomic authority as "Wiegmann in Lichtenstein." However, as we are uncertain if Wiegmann also provided the description, authorship is most appropriately attributed to Lichtenstein and von Martens.

Dixon (1973), based on size and development of the limbs and toes, suggested that *B. h. lineata* and *B. h. marcelae* are predominately fossorial, *B. h. heteropa* is partially fossorial, and *B. h. alleni* and *B. h. trinitatis* are supraterranean leaf-litter inhabitants. Rivas Funemayor et al. (2005) called into question the validity of the various subspecies, citing clinal variation across the range of the species.

• **ETYMOLOGY.** The specific epithet is presumably from the Greek *heteros* (= different) and *pous* (= foot), almost certainly in reference to the variable size and number of hindlimb toes. The name *alleni* is a patronym honoring the collector of the holotype; *lineata* is from the Latin, presumably a reference to the striped pattern; the meaning of *marcelae* is unknown; and *trinitata* is derived from the type-locality (Trinidad) of this subspecies.

• **COMMENT.** *Chalcides Cuvieri* (Duméril and Bibron 1839) is included in synonymies of various subspecies of *B. heteropa* (e.g., Brongersma 1946, Dixon 1973). However, Brygoo (1989) clarified that the specimens cited in Duméril and Bibron (1839) were from the banks of the Orinoco River and from Colombia, and are not attributable to *B. heteropa* (see also **Remarks**).

The Reptile Database (www.reptile-database.org) quoted F. Castro (pers. comm.) that the species has been found in Colombia. Ayala (1986) included *B. heteropa* in his list of Colombian lizards, based on a specimen from Norte de Santander in the Museo de Historia Natural, Instituto La Salle, Bogotá. Sánchez et al. (1995) listed Norte de Santander and Orinoquía as states of occurrence in Colombia.

1. *Bachia heteropa heteropa* (Lichtenstein and von Martens)

Chalcides heteropus Lichtenstein and von Martens 1856:17. See species synonymy.
Bachia heteropus: Garman 1892:97.
Bachia heteropa heteropa: Peters and Donoso-Barros 1970:80.

• **DEFINITION.** This subspecies is characterized (Dixon 1973) by tail squamation similar to body scales, prefrontals absent, supraoculars usually 2 (but sometimes 3 in intergrades between *B. h. heteropa* and *B. h. trinitatis*), 3 toes on hindlimbs, 7 rows of gular scales, 28–30 (mean 29.3) scales around midbody, 45–47 (mean 45.3) dorsal scale rows, and 27–30 (mean 28.3) ventral scale rows. One specimen examined by Dixon (1973) intermediate between *B. h. heteropa* and *B. h. trinitatis* had the second pair of chin shields in medial contact.

The 3 dorsal dark lines are usually evident, occasionally irregular, with the light interspatial stripes lightly freckled or mottled (Dixon 1973).

2. *Bachia heteropa alleni* (Barbour)

Scolecosaurus cuvieri: Boulenger 1885:416 (part).
Scolecosarus alleni Barbour 1914:315. Type-locality, "St. George's, Grenada." Holotype, Museum of Comparative Zoology (MCZ) 7793, an adult, sex unknown, collected by G.M. Allen, date of collection unknown (not examined by authors). *Lapsus*.
Scolecosaurus alleni alleni: Barbour 1933:76.
Scolecosaurus alleni parviceps Barbour 1933:77. Type-locality, "Cannouan, The Grenadine Islands, B.W.I." Holotype, Museum of Comparative Zoology (MCZ) 32345. an adult, sex unknown, collected by D. Fairchild and H.F. Loomis on 6 February 1932 (not examined by authors).
[*Bachia*] *alleni*: Vanzolini 1961b:204.
Scolecosaurus trinitatis: Underwood 1962:94 (part).
Scolecosaurus trinitatis parviceps: Underwood 1962: 94.
Bachia alleni alleni: Thomas 1965:145.
Scolecosaurus sp.: Groome 1970:36.
Bachia heteropa alleni: Dixon 1973:32.
Bachia heteropus alleni: Schwartz and Thomas 1975: 109.
B[achia]. (*Scolecosaurus*) *alleni*: Obst, Richter, and Jacob 1984:91.

• **DEFINITION.** This subspecies is characterized (Dixon 1973) by tail squamation mostly hexagonal, prefrontals present and in contact medially, 3 supraoculars, 4 toes on hindlimbs, 8 rows, of gular scales, 27–31 (mean 29.0) scale rows around midbody, 39–45 (mean 40.9) dorsal scale rows, and 24–29 (mean 26.4) ventral scale rows.

Coloration varies slightly from the basic pattern by tending towards an obscure median dark line and paravertebral dark lines broken into a series of dashes or spots with the light interspaces heavily mottled or freckled with dark brown (Dixon 1973).

3. *Bachia heteropa lineata* (Boulenger)

Bachia lineata Boulenger 1903:432. Type-locality, "Duaca, Venezuela." Holotype, British Museum (Natural History) (BMNH) 1946.8.2.41 (formerly 1902.7.29.90), an adult (sex unknown), collected by Mr. Wayman (purchased from Mr. Rosenberg), date of collection unknown, but registered into the collections on 29 July 1902 (examined by C. McCarthy at the request of the authors).

Bachia anomala Roux 1929:31. Type-locality, "El Mene, Distr. Acosta, Prov. Falcon, Vénezuéla." Holotype, Naturhistorisches Museum, Basel (NMBA) 9912, an adult male (SVL 52 mm), collected by H.G. Kugler and presented to the museum in 1929 (probably collected in the same year; R. Winkler, in litt., 29.XI.2010) (not examined by authors).

Bachia heteropa lineata: Mijares-Urrutia and Arends 1999:115.

• **DEFINITION.** This subspecies is characterized by tail squamation similar to body scales, prefrontals absent, 2 supraoculars, 2 toes on hindlimbs, 7 rows of gular scales, 24–26 (mean 25.3) scales around midbody, 45–49 (mean 47.2) dorsal scale rows, and 24–26 (mean 25.3) ventral scale rows (Dixon 1973).

The 3 dorsal dark lines are usually evident, occasionally irregular, with the light interspatial stripes lightly freckled or mottled (Dixon 1973).

• **REMARKS.** Shreve (1947) suggested that *B. lineata* and *B. anomala* might not be conspecific.

4. *Bachia heteropa marcelae* Donoso-Barros and Garrido

Bachia marcelae Donoso-Barros and Garrido 1964:1. Type-locality, "Bosque tropical La Luz, Edo. Barinas, Venezuela." Holotype, D-B 6312061, collected on 12 December 1963 by R. Donoso-Barros and A. Garrido (not examined by authors).

Bachia lineata marcelae: Donoso-Barros 1968:117.

Bachia heteropa marcelae: Dixon 1973:33.

• **DEFINITION**. This subspecies is characterized by tail squamation similar to body scales, prefrontals absent, 2 supraoculars, 2 toes on hindlimbs, 5 rows of gular scales, 25 (in 3 specimens) scale rows around midbody, and 39–42 (mean 40.7) dorsal scale rows (Dixon 1973).

The 3 dorsal dark lines are usually evident, occasionally irregular, with the light interspatial stripes lightly freckled or mottled (Dixon 1973).

5. *Bachia heteropa trinitatis* (Barbour)

Scolecosaurus cuvieri: Boettger 1893:76.

Scolecosaurus trinitatis Barbour 1914:316. Type-locality, "Caparo, Trinidad." Holotype, Museum of Comparative Zoology (MCZ) 8947, an adult, sex unknown, collected by A.B. Carr, date of collection unknown (not examined by authors).

[*Bachia*] *trinitatis*: Vanzolini 1961b:204.

Bachia alleni trinitatis: Thomas 1965:152.

Bachia heteropa trinitatis: Dixon 1973:32.

Bachia heteropa trinitatus: MacLean, Kellner, and Dennis 1977:45. *Lapsus*.

Bachia trinitatis: Kenny 1979:9.

• **DEFINITION.** This subspecies is characterized (Dixon 1973) by tail squamation mostly hexagonal, prefrontals present (not in contact medially), 3 supraoculars, 4 toes on hindlimb, 7 rows of gular scales in 57.5% of specimens (8 rows of gular scales in the rest), 26–31 (mean 28.5) scales around midbody, and 38–45 (mean 41.3) dorsal scale rows.

The basic color pattern is retained in this subspecies with 3 dark lines, but these can be broken or irregular. The 2 paravertebral light interspatial stripes usually are prickled with dark brown, whereas the 2 dorsolateral light interspatial stripes are uniform tan to yellowish brown (Dixon 1973).

• **ACKNOWLEDGEMENTS.** Colin McCarthy (BMNH), José Rosado (MCZ), and Raffael Winkler (NMBA) examined type-specimens in their care. Adrian Hailey, John C. Murphy, and Gilson Rivas helped locate obscure references. John S. Parmerlee, Jr. prepared the map.

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