



Synonyms for some species of Mexican anoles (Squamata: Dactyloidae)

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Abstract

We studied type material and freshly collected topotypical specimens to assess the taxonomic status of five names associated with species of Mexican *Anolis*. We find *A. schmidti* to be a junior synonym of *A. nebulosus*, *A. breedlovei* to be a junior synonym of *A. cuprinus*, *A. polyrhachis* to be a junior synonym of *A. rubiginosus*, *A. simmonsii* to be a junior synonym of *A. nebuloides*, and *A. adleri* to be a junior synonym of *A. liogaster*.

Key words: *Anolis*, Mexico, synonyms, taxonomy

Introduction

Despite decades of progress by Hobart Smith, Jonathan Campbell, Henry Fitch, Carl Lieb and others, the anole fauna of Mexico remains poorly known and muddled by taxonomic confusion. Lieb's (1981, 2001) important work summarized the states of knowledge at those times and directed attention to many outstanding problems. Some of these problems have been addressed (e.g., Nieto-Montes de Oca, 1994, 2001; on *schiedii* group *Anolis*), but many others remain unresolved.

In this paper we address five taxonomic issues in Mexican anoles. All of these issues have been discussed by previous workers who proposed or suggested appropriate taxonomic changes. Fitch (1978) reviewed the taxonomic status of *A. simmonsii* and suggested that it may represent a synonym of *A. nebuloides*. Lieb (1981) performed the only systematic study available of the anole species groups in western Mexico. Therein, he synonymized *Anolis adleri* with *A. liogaster* and suggested that *A. schmidti* might be a synonym of *A. nebulosus*. He did not provide further clarification on the taxonomic status of *A. simmonsii*, and 20 years later he continued to include both *A. schmidti* and *A. simmonsii* in the Mexican anole fauna (Lieb, 2001). Similarly, Nieto-Montes de Oca (1994) synonymized *A. breedlovei* with *A. cuprinus* and *A. polyrhachis* with *A. rubiginosus*.

All of these proposed or suggested changes have remained in need of corroboration and formal publication. Our recent fieldwork has allowed the collection of several forms at their type localities. We also have had the opportunity to examine several type specimens of the aforementioned taxa. This work forms the basis for the taxonomic changes that we propose below.

Methods

We adopt the evolutionary species concept (Simpson, 1961; Wiley, 1978), and apply this concept by identifying species based on consistent differences between populations. That is, we hypothesize that populations that are

diagnosable by major differences in the frequencies of traits are distinct evolutionary lineages, or species (see Wiens and Servedio 2000).

We compared museum material, including type specimens, to our recently collected specimens (Appendix 1). Scale terminology follows Williams *et al.* (1995). Measurements were made with digital calipers to the nearest 0.1 mm and are given in mm throughout the paper. We measured snout to vent length (SVL) from tip of snout to anterior of cloaca; head length (HL) from tip of snout to anterior of ear; head width (HW) at the posteroventral corners of the jugal; femoral length (FL) from longitudinal midline of body laterally to knee, with limb bent at a 90 degree angle; ear height (EH) vertically on the ear.

Systematics

***Anolis schmidti* Smith = *Anolis nebulosus* Wiegmann.** Smith (1939) described *Anolis schmidti* from a single male from Manzanillo, Colima (FMNH 1667) based on his review of the collections of the Field Museum in Chicago, Illinois, USA. Its range is thought to be restricted to the tropical dry forest lowlands in Colima and adjoining western Michoacán (Lieb, 1981) and encompassed by the range of *A. nebulosus* (Lieb, 2001).

Smith (1939) distinguished *A. schmidti* from *A. nebulosus* (and *A. nebuloides*) based on a condition of the ventral scales, namely, "ventrals not distinctly larger than dorsals, curiously protuberant (not flat), weakly keeled." Lieb (1981) did not examine the type of *A. schmidti* or the other few specimens assigned to this taxon at the time. However, he suggested that *A. schmidti* and *A. nebulosus* were conspecific based on the description of *A. schmidti* and his examination of numerous specimens of *A. nebulosus* from throughout its range.

We have not examined type material of *A. nebulosus*, but we have examined the type specimen of *A. schmidti* and have collected *A. nebulosus* from throughout its range, including areas north and south of Manzanillo and the inferred type locality of Mazatlán, Sinaloa (Smith and Taylor, 1950). We are unable to discern anything unusual about the ventral scales of *A. schmidti* relative to *A. nebulosus*. Further, we are unable to distinguish the type specimen of *A. schmidti* from topotypical *A. nebulosus* using other characters (Table 1). Based on this evidence, we consider *A. schmidti* to be a junior synonym of *A. nebulosus*.

We note two complicating factors in this decision. First, our photos of the dewlaps of topotypical *A. nebulosus* and *A. schmidti* are not identical. The dewlap of "*A. schmidti*" includes a white distal edge that is not present in our photo of topotypical *A. nebulosus* (Fig. 1). We do not consider this difference to constitute evidence of separate species because we have observed that the amount of white at the dewlap edge varies within northern populations of *A. nebulosus*. Second, because there is some variation in dewlap color among southern populations of *A. nebulosus* that is likely to be indicative of separate species (pers. obs. of all authors), we suspect that additional analyses may determine *A. nebulosus* to be a complex of species. However, our morphological observations suggest that northern (i.e., Colima and Sinaloa) populations are conspecific, and therefore consider *A. schmidti* a junior synonym of *A. nebulosus*.

***Anolis breedlovei* Smith and Paulson = *Anolis cuprinus* Smith.** *Anolis breedlovei* was described by Smith and Paulson (1968) from "Cerro Azul, about 30 km SE Santa María Chimalapa, Oaxaca" shortly after Smith (1964) described *A. cuprinus* from "Zanatepec, Oaxaca." Both of these type specimens were collected by Thomas MacDougall, at "perhaps 91.5 m below the 1586 m peak of Cerro Azul" and 1525 m, respectively. Smith considered *A. cuprinus* a member of the *A. cupreus* group and diagnosed it only relative to *A. cupreus*, whereas Smith and Paulson considered *A. breedlovei* as a member of the *A. schiedii* group and compared it only to other members of this group. That is, Smith and Paulson compared their new form only to other Mexican and Guatemalan species that display small size, weakly keeled ventral body scales and strongly keeled dorsal head scales.

We have examined the type specimens of *A. cuprinus* (UIMNH 52959) and *A. breedlovei* (UIMNH 48671) and we find these to be nearly identical, and to both possess typical *schiedii*-group characters (Table 2). Thus, we agree with Nieto-Montes de Oca (1994) and tentatively consider *A. breedlovei* to be a junior synonym of *A. cuprinus*. However, we note one reservation concerning this decision. Nieto-Montes de Oca (1994) noticed that among all of the specimens that he assigned to *A. cuprinus* ($n = 34$), only the holotype of *A. breedlovei* and two specimens from the Cerro Baúl region exhibited smooth or very faintly keeled ventral scales, whereas the holotype of *A. cuprinus*,

TABLE 1. Comparison of *A. nebulosus* and *A. schmidtii*. SVL = snout to vent length; snsc = scales across the snout between the second canthal scales; sosc = scales between supraorbital semicircles.

Character	<i>A. schmidtii</i> holotype FMNH 1667 (male)	Topotypical <i>A.</i> <i>schmidtii</i> (1 male)	Topotypical <i>A. schmidtii</i> (2 females)	Topotypical <i>A.</i> <i>nebulosus</i> (males)	Topotypical <i>A. nebulosus</i> (female, 2 juveniles)
SVL	45	36	29.6	34.6	27.5
Femoral length/SVL	.27	.29	.26	.27	.25
Head length/SVL	.26	.29	.30	.28	.30
Head width/SVL	.16	.19	.19	.18	.20
Toe length/SVL	.15	.16	.17	.17	.18
Height of ear/SVL	.020	.017	.020	.018	.020
Length of interparietal/SVL	.042	.053	.049	.039	.045
Length of interparietal/ lateral scale	3.2	2.7	2.5	2.5	2.6
Length of tail/SVL	Broken	Broken	Broken, regrown	1.96	1.96
# longitudinal dorsals in 5% SVL	7–8	6	6	5–7	4–6
# longitudinal ventrals in 5% SVL	8	6	4–5	5–6	4–5
# lamellae	15–16	15	14–15	13–14	13–14
# snsc	5	5	6	5–6	5–6
# scales separating sosc	0	0	0	0	0
# scales from interparietal to sosc	1	1	2	2	2
# postrostrals	5	7	4–5	4–5	5
# postmentals	4	4	4	4	4–5
# supraciliaries	1–2	2	2	2	2
# loreal rows	5	5	5	4–5	4–5
# supralabials to center of eye	7	7	7	6–8	6–7
Subocular row	In contact with supralabial row	In contact with supralabial row	In contact with supralabial row	In contact with supralabial row	In contact with supralabial row
Naris	Elongate anterior nasal scale from naris to sulcus between rostral and supralabial	Elongate anterior nasal scale from naris to sulcus between rostral and supralabial	Elongate anterior nasal scale from naris to sulcus between rostral and supralabial	Elongate anterior nasal scale from naris to sulcus between rostral and supralabial	Elongate anterior nasal scale from naris to sulcus between rostral and supralabial
Ventral body scales	Keeled, in diagonal and transverse rows	Keeled, in diagonal rows	Keeled, in diagonal rows	Keeled, in diagonal rows	Keeled, in diagonal and transverse rows
Dorsal body scales	Keeled, approximately 10–12 middorsal rows slightly and gradually enlarged relative to flank scales	Keeled, approximately six middorsal rows slightly and gradually enlarged relative to flank scales	Keeled, approximately nine middorsal rows slightly and gradually enlarged relative to flank scales	Keeled, approximately 12 middorsal rows slightly and gradually enlarged relative to flank scales	Keeled, approximately nine middorsal rows slightly and gradually enlarged relative to flank scales

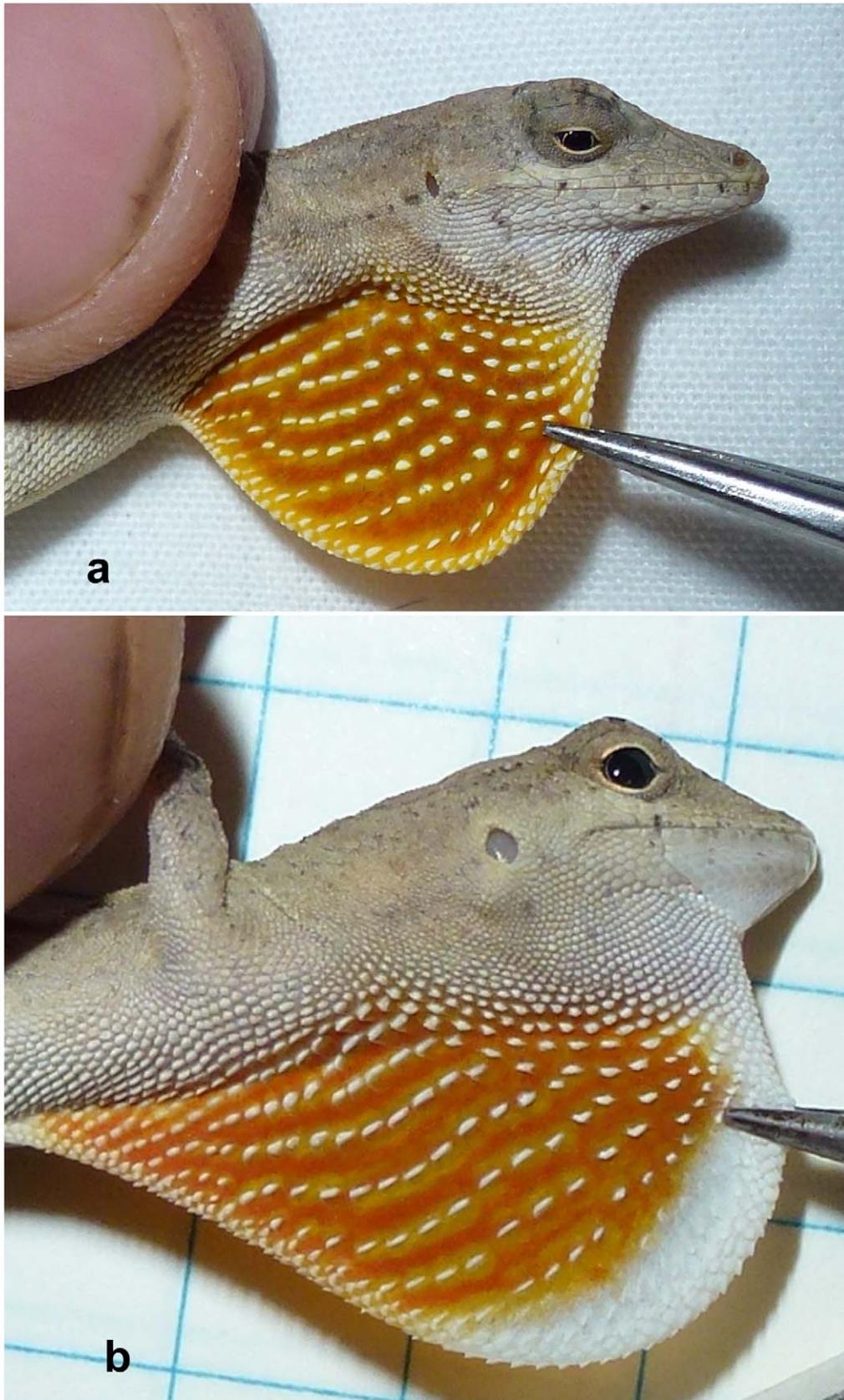


FIGURE 1. *Anolis nebulosus* from a) the type locality of *A. nebulosus*, b) the type locality of *A. schmidtii*.

all of specimens from the Sierra Madre north of Zanatepec, and the remaining specimens from the Cerro Baúl region exhibited weakly, yet more distinctly keeled ventral scales. No other specimens are known from the type locality of *A. breedlovei*, and the dewlap color in its holotype was not recorded in life. The type localities of *A. breedlovei* and *A. cuprinus* are only about 25 km from each other (by air). However, the cloud forest in the Sierra Madre appears to be restricted to its highest elevations, where it forms ecological islands separated by the lower canyons of small rivers (MacDougall, 1971).

TABLE 2. Comparison of holotype specimens for *Anolis cuprinus* and *A. breedlovei*. See table 1 and text for abbreviations.

Character	<i>A. cuprinus</i> holotype UIMNH 52959	<i>A. breedlovei</i> holotype UIMNH 48671
SVL	54	49
Femoral length/SVL	.30	.30
Head length/SVL	.25	.26
Head width/SVL	.17	.18
Toe length/SVL	.22	.22
Height of ear/SVL	.035	.034
Length of interparietal/SVL	.029	.032
Length of interparietal/lateral scale	1.60	1.78
Length of tail/SVL	broken	1.50
# dorsals in 5% SVL	6	7
# ventrals in 5% SVL	8	6
# lamellae	17	15
# snsc	7	8
# scales separating sosc	2	2
# scales from interparietal to sosc	2	3
# postrostrals	8	7
# postmentals	5	5
# supraciliaries	2	3
# loreal rows	6	6
# supralabials to center of eye	6	6–7
Subocular row	Separated from supralabial scales by interrupted row of intervening scales	Separated from supralabial scales by interrupted or complete row of intervening scales
Naris	naris separated from rostral by one scale	naris separated from rostral by one scale
Ventral body scales	Very weakly keeled, overlapping, in transverse and diagonal rows	Weakly keeled, overlapping, in transverse and diagonal rows
Dorsal body scales	Keeled, very gradually increasing in size superiorly from upper flanks to middorsum	Keeled, very gradually increasing in size superiorly from upper flanks to middorsum

The type locality provided in the description of *A. cuprinus* (“Zanatepec”) is problematic. The description states that the type was collected at 5000 feet, but Zanatepec is located on the coastal plain of extreme eastern Oaxaca on the east side of the Isthmus of Tehuantepec at an elevation of ~240 m. We and others (especially Fitch and associates; see Nieto-Montes de Oca, 1994 for references to their publications) have collected extensively in these lowlands and found numerous *A. unilobatus* and *A. isthmicus*, but no species that could be assigned to the *A. schiedii* group. The habitat in this area (arid tropical thornscrub) is not suitable for *A. schiedii*-group species, most of which are found in cloud forest and associated habitat. In contrast, the elevation at the collecting locality of the type of *A. cuprinus* is typical for *A. schiedii*-group species and consistent with all known localities for *A. cuprinus*, which has only been taken in the montane cloud forest of the Sierra Madre north of Zanatepec (Nieto-Montes de

Oca, 1994, 2001). Thus, we believe the type locality of Zanatepec to be in error (or perhaps an oversimplified description of the general area), with the actual type locality to be in cloud forest at ~1525 m above Zanatepec (Niето-Montes de Oca, 1994; Lieb, 2001).

***Anolis polyrhachis* Smith = *Anolis rubiginosus* Bocourt.** Bocourt (1873) described *Anolis rubiginosus* on the basis of a single adult female from the "Province of Oaxaca, Mexico" (MHNH 2636). Smith and Taylor (1950) placed *A. rubiginosus* in the synonymy of *A. rodriguezi* Bocourt, although they did not examine the type of *A. rubiginosus*. Later, Smith (1968) described *A. polyrhachis* on the basis of an adult female from 6.2 mi S Vista Hermosa, Oaxaca (UIMNH 57548).

Nieto-Montes de Oca (1994) examined the type of *A. rubiginosus* and 47 specimens referable to *A. polyrhachis* from the region of its type locality in the Sierra de Juárez and the adjacent Sierra Mixe, Oaxaca, and observed that all of the characters exhibited by the type of *A. rubiginosus* were also present in his sample of *A. polyrhachis*. In particular, both the type of *A. rubiginosus* and all of the specimens of *A. polyrhachis* exhibited numerous multicarinate scales on most of the dorsal surfaces of the head, body, limbs, and tail, a character unique among the species in the *A. schiedii* group that served as the basis for the name *polyrhachis*. We have now examined the holotype specimen of *A. polyrhachis* and corroborated Nieto-Montes de Oca's (1994) finding that *A. polyrhachis* is a junior synonym of *A. rubiginosus*.

***Anolis simmonsii* Holman = *Anolis nebuloides* Bocourt.** *Anolis simmonsii* was described by Holman (1964) based on two specimens from "Rio Canoa, 16.25 mi west of Pinotepa Nacional, Oaxaca, Mexico." Despite the mention in the same work of three specimens of *A. nebuloides* from eight km west of the type locality of *A. simmonsii* and the obvious similarity between these two taxa, Holman diagnosed *A. simmonsii* relative only to *A. pygmaeus*, a poorly known species with distinctive dorsal scalation that has been collected at isolated mid-elevation localities in Chiapas and Oaxaca. Later, Smith (1968) noted a third specimen of *A. simmonsii* from approximately 160 km east of the type locality (32 km southeast of Juchatengo). Despite additional effort and an easily-visited type locality (Fitch, 1978; and see below), to our knowledge these three specimens are the only individuals that have been authoritatively identified as *A. simmonsii*, although Smith's (1968) specimen differed from the type in several important characters (Fitch, 1978).

Fitch (1978) noted the similarity of the type specimen of *A. simmonsii* (UIMNH 52899) to individuals of *A. nebuloides*. We have examined the type specimen of *A. simmonsii* and compared it to topotypical specimens of *A. nebuloides* (Table 3). We agree with Fitch (1978) that all of the characters in the types of *A. simmonsii* apply to *A. nebuloides* and thus consider these forms conspecific.

We note that we have observed variation in dewlap color (and mitochondrial DNA, pers. obs. ANMO) among populations of putative *A. nebuloides*, and we suspect that *A. nebuloides* as currently recognized is a complex of species. However, our current results suggest that populations associated with *A. simmonsii* are likely to be closely related to the topotypical population of *A. nebuloides*.

Fresh topotypical material of *A. simmonsii* would be helpful in assessing the taxonomic status of this population. However, the type locality of *A. simmonsii* and the surrounding area is now pasture. We and others (e.g., Fitch, 1978) have searched at this site and found large numbers of *A. subocularis*, *A. nebulosus*, and *A. unilobatus* but no *A. nebuloides*. It is our experience that *A. nebuloides* requires less disturbed habitat than the former three species, and we suspect that the razing of previous habitat may have reduced the abundance of *A. nebuloides/simmonsii* in this area. It may be difficult to procure true topotypical specimens of *A. simmonsii*.

***Anolis adleri* Smith = *Anolis liogaster* Boulenger.** *Anolis adleri* was described by Smith (1972) from "2.2 km W of Patio de Aviación, Guerrero." In his key that accompanies the description, Smith separates *A. adleri* from *A. liogaster* based on the degree of contact of the supraorbital semicircles (strong in *A. adleri*, weak or absent in *A. liogaster*), the appearance of a medial light stripe (present in *A. liogaster*, absent in *A. adleri*), and the color of the male dewlap ("pink" in *A. liogaster*, "pale purple" in *A. adleri*).

Our collections of *A. liogaster* from Omiltemi (the type locality) display both strongly and weakly contacting supraorbital semicircles, and frequently lack a medial light stripe. Further, we believe that the color of the male dewlap of topotypical *A. liogaster* could reasonably be interpreted as either "pink" or "pale purple" (figure 2). These observations corroborate previous work by Lieb (1981).

Smith (1972) suggested that *A. adleri* and *A. liogaster* are sympatric throughout much or all of their ranges. We have collected extensively in areas around the type localities of both of these forms (Omiltemi for *A. liogaster*, Patio de Aviación for *A. adleri*) and have found dozens of anoles but only three morphs: *A. microlepidotus*, *A.*

omiltemanus and one other species that fits the descriptions of *A. liogaster* and *A. adleri*.

In sum, our evidence supports Lieb's (1981) assertion that *A. adleri* should be considered a junior synonym of *A. liogaster*.

TABLE 3. Comparison of type specimen of *A. simmonsii* with topotypical *A. nebuloides*. See table 1 for abbreviations.

Character	<i>A. simmonsii</i> holotype UIMNH 52899 (male)	Topotypical <i>A. nebuloides</i> (males)
SVL	36	46 (maximum)
Femoral length/SVL	.27	.27–.28
Head length/SVL	.27	.26–.27
Head width/SVL	.18	.15–.18
Toe length/SVL	.18	.16–.18
Height of ear/SVL	.038	.02–.03
Length of interparietal/SVL	.043	.036–.044
Length of interparietal/lateral scale	2.7	2.38–3.00
Length of tail/SVL	1.98	no male w/o broken tail, (1.72–1.77 females)
# dorsals in 5% SVL	4	4–5
# ventrals in 5% SVL	5	4–5
# lamellae	16	13–16
# snsc	8	7–9
# scales separating sosc	2	0–2
# scales from interparietal to sosc	3	1–3
# postrostrals	5	5 (5–6)
# postmentals	4	4 (4–6)
# supraciliaries	2	3 (2–3)
# loreal rows	6–7	5 (3–7)
# supralabials to center of eye	6	7 (6–8)
Subocular row	Contacts supralabial row	Contacts supralabial row
Naris	Differentiated anterior nasal from naris to sulcus between rostral and first supralabial	Differentiated anterior nasal from naris to sulcus between rostral and first supralabial
Ventral body scales	Keeled, diagonal, strongly overlapping	Keeled, diagonal
Dorsal body scales	Approximately 10 abruptly enlarged middorsal rows	8–12 abruptly enlarged middorsal rows
Size of ventrals vs. dorsals	Dorsals > ventrals	Dorsals > or = ventrals

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FIGURE 2. *Anolis liogaster* from its type locality.

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APPENDIX 1. Specimens examined.

Anolis cuprinus UIMNH 52959 (holotype): Oaxaca, "Zanatepec"; UIMNH 48671 (*breedlovei* holotype): Oaxaca, Cerro Azul, about 30 km SE Santa María Chimalapa. *Anolis liogaster* POE 3769-80, 3836: Guerrero, Campo de Aviación, 47 km W of intersection of old Mexico 95 and road to Campo de Aviación; 3782: Guerrero, 38 km W of intersection of old Mexico 95 and road to Campo de Aviación; 3801-2: Guerrero, 1 km W of Omilteme; 3806-13: Guerrero, 1 km E of Omilteme. *Anolis nebuloides* UIMNH 52903 (*simmonsii* paratype), 52899 (*simmonsii* holotype): Oaxaca, Rio Canoa, 16.25 mi W of Pinotepa Nacional; POE 3934-3939: Oaxaca, S edge of Putla Villa de Guerrero. *Anolis nebulosus* FMNH 1667 (*schmidti* holotype): Colima, Manzanillo; POE 3992-4003: Sinaloa, 16 km N of Mazatlán; 4004-5: Nayarit, near Acaponeta (along Cuota); 4023-9: Colima, NE edge of Manzanillo (along Cuota). *Anolis polyrhachis* UIMNH 57548 (holotype): Oaxaca, 6.2 mi S of Vista Hermosa. See Nieto Montes de Oca (1994) for additional specimens examined.