

Morphological variation in the tropical anole, *Anolis casildae* (Squamata: Polychrotidae)

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Abstract: We describe morphological variation (scalation and coloration) observed among eight individuals of the Panamanian lizard species *Anolis casildae*. This variation was not observed in the holotype and aids in identification of this recently described species (originally described on the basis of a single, male specimen). This species occurs only in the Reserva Forestal Fortuna (Chiriquí Province) and the adjacent Bosque Protector Palo Seco (Bocas del Toro Province) in western Panama. *Anolis casildae* can be distinguished from all other Panamanian anole species via six features: (1) two enlarged superciliary scales (the first larger than the second); (2) an anterior nasal scale in contact with the rostral scale or separated from the rostral by one scale; (3) 6–8 sublabial scales to the center of the eye; (4) 3–4 scales between the supraorbital semicircles; (5) unique coloration (4–6 oblique brown bands interspersed by blue-outlined yellow patches; dewlap is a dirty cream color with broad yellow scale rows irregularly interspersed with smaller emerald green scales) and (6) *A. casildae* occurs from 1 050 to 1 400 m in the Cordillera Central. We also compare our natural history observations of *A. casildae* to a similar large anole, *A. frenatus*, a species which we believe *A. casildae* to be closely related.

Key words: Squamata, Polychrotidae, *Anolis*, *A. casildae*, morphology, natural history.

Since the description of *Anolis casildae* in 1991 (Arosemena *et al.*), we have collected and observed additional individuals providing information not previously reported for the species. This western Panamanian species was described on the basis of a single male (Museo de Vertebrados, Universidad de Panamá, MVUP-755) captured in the Reserva Forestal Fortuna in the Cordillera Central, Provincia de Chiriquí. Recently, we examined several females and additional males revealing variation in scalation within the species, the existence of two female color morphs, and sexual dimorphism in several characters. In this

paper we describe morphological variation in *A. casildae*, review comparisons of this species to other known *A. latifrons* group species, and provide brief ecological and distributional notes for *A. casildae*.

MORPHOLOGICAL VARIATION

Eight specimens (Natural History Museum of Los Angeles County, LACM 146192-146197, Los Angeles, California, USA; Smithsonian Tropical Research Institute, STRI 0113, Panama; Naturhistorisches Museum Bern,

NMBE 1049173-1049174, Switzerland) of *A. casilda* were collected, some of which exhibit variation in one to several characters not previously reported for the species. Characters that differ from those found in the holotype are described below with the holotype's features noted in parentheses. In addition, RID reexamined the holotype, finding a few discrepancies from the original description, noted within the parentheses. Characters are described following the external feature characterizations of Williams *et al.* (1995) and the format of Arosemena *et al.* (1991).

Head: 11-15 scales between the second canthals (11); 5-8 canthal scales (7) enlarged, keeled; 6-10 postrostral scales (7); most individuals possess a single anterior nasal either in contact with the rostral or separated from the rostral by one scale, but one individual (STRI-0113) possesses an inferior nasal in contact with the rostral scale; 6-8 rows of loreals (5, but reexamination showed 6) with 47-65 loreals (not given, but reexamination showed 47), loreals subequal in size and slightly keeled to rugose (slightly keeled); 6-8 supralabials to the center of eye (7); 3-4 scales between the supraorbital semicircles (3); supraocular disk contains 8-18 enlarged scales (10); interparietal separated from supraorbital semicircles by 3-4 scales (3); one keeled, elongate superciliary scale extending approximately half the length of the eye, followed by one keeled scale 1/3 this length, and rarely an even smaller third scale, then a series of granular scales (one keeled and elongate superciliary followed by a subgranular series, but reexamination showed up to 2 superciliaries followed by a series of small granular series; 3-4 scales between interparietal and nape scales (3, but reexamination showed 4); 6-9 postmental scales (7); 1-3 sublabials (3) in contact with first two infralabials. One feature, not noted for the holotype, is the presence of several dark punctations on the tympanum of all other individuals examined.

Trunk: Dorsal scalation consists of approximately 2-6 rows of keeled, imbricate mid-dorsal scales that are larger than nuchal scales (2-3 rows); mid-dorsal scales grade

smoothly to conical, granular flank scales as in holotype; flank scales in most specimens are juxtaposed (not given, but reexamination showed juxtaposed to slightly imbricate); ventral scales larger than mid-dorsal and flank scales, smooth, and can be juxtaposed or imbricate (identical for holotype).

Dewlap: Male dewlap as in holotype, large, extending to anterior third of venter, with broad scale rows 2-3 scales wide interspersed with smaller, single scales, scale rows separated by skin; female dewlap present, small, extending to anterior edge of shoulder, scale rows as in males (see coloration).

Limbs and digits: 21-26 lamellae under phalanges ii and iii of fourth hind toe (23, but reexamination showed 22); hind limbs as in holotype, long, with tip of fourth toe reaching anteriorly between eye and rostral scales. Forelimb extends anteriorly beyond snout level and posteriorly to thigh articulation.

Tail: Weakly compressed (subcylindrical, but reexamination showed weakly compressed); males possess two enlarged postanal scales, females lack enlarged postanal scales; tail length 2.1 to 3.0 times body length; mean tail length/snout-vent length of males slightly higher than that of females (male mean = 2.8; female mean = 2.5).

Color: Male color, with some additions, as in holotype: dorsal ground color emerald green with approximately 4-6 oblique brown bands; yellow patches that are frequently outlined by light blue present between brown bands; limbs green with alternating brown bands; venter green to yellow green with gray spots, or mottled yellow and green; dewlap of males dirty cream with broad yellow scale rows irregularly interspersed with smaller emerald green scales; female body coloration can be as in males, or displays a second morphotype of solid forest green ground color with a broad, dark brown, mid-dorsal stripe extending from the nape scales to the proximal portion of the tail. Female dewlap is either similarly colored as male dewlap, or is green with yellow scale rows irregularly interspersed with blue spots. Iris is tan-green.

Sexual Dimorphism: Discrete differences between the sexes include dewlap size (male dewlap large, extending to the sternum; female dewlap small, extending only to anterior edge of shoulder), mid-dorsal crest (present in males extending from nuchal area; absent in females), and enlarged postanal scales (present in males; absent in females). Some females exhibit the mid-dorsal brown stripe, a pattern observed in several *Anolis* species, however not all females possess this stripe. There is no sexual size dimorphism in SVL or mass for captures of *A. casildae* (Fig. 1).

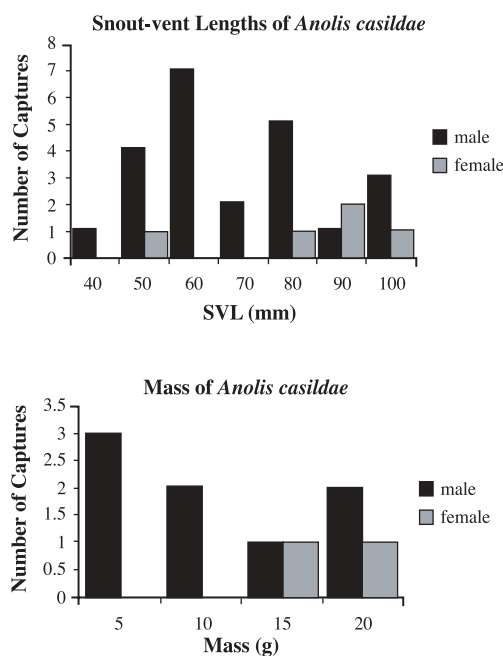


Fig. 1. Snout-vent lengths (SVL) and masses of male and female *Anolis casildae* captured by KRL during transect surveys between 1993 - 1999.

Distribution: The holotype of *A. casildae* was collected along the margins Quebrada Frank in the Reserva Forestal Fortuna, Chiriquí Province, western Panama. All observations of sleeping *A. casildae* by KRL were within 20 m of a stream, although KEN found animals in areas away from streams. The Reserva Forestal Fortuna contains the headwaters of the Río

Chiriquí, so most parts of the reserve are within several hundred meters of a stream. Additional specimens have been collected or observed throughout the Reserva Forestal Fortuna, between approximately 1 050 and 1 400 m elevation, and within the adjacent primary forest of the Bosque Protector Palo Seco at 1 400 m elevation, Bocas del Toro Province. The specimens (NMBE 1049173-1049174) from the Bosque Protector Palo Seco represent a range extension for the species, from the Pacific to the Atlantic versant of the Cordillera Central. All localities are within cloud forest (*sensu* Myers 1969).

Comparisons with other Panamanian

***Anolis*:** Arosemena *et al.* (1991) discussed the relationships of *A. casildae* to other anoles based on their similarities, but variation in characters presented here warrants a revised review and clarification. *Anolis casildae* is allied with the *A. latifrons* group (according to Arosemena *et al.* 1991) because it possesses the characteristic features of the group: these are giant (snout-vent length > 100 mm) mainland alpha anoles (Etheridge 1959; *Dactyloa* of Guyer and Savage 1986, 1992) that possess wide toe lamellae under phalanges ii and iii, have moderately-sized head scales, lack enlarged mid-dorsal scales relative to their flank scales, and lack a proboscis and axillary pockets (Williams 1976, 1988). *Anolis casildae* is distinguished from other *A. latifrons* group anoles (*A. apollinaris*, *A. danieli*, *A. fraseri*, *A. insignis*, *A. microtus* and *A. propinquus*) by possessing longer hind limbs (Arosemena *et al.* 1991).

Anolis casildae was reported previously to possess a single, keeled and elongate superciliary scale extending the length of the eye followed by a series of subgranular scales, and this feature was used to distinguish it from a number of other species. Individuals examined and discussed in this paper differ in having a second enlarged superciliary scale behind the first, and sometimes even a third small superciliary scale. The second superciliary scale varies among individuals in its shape and extent of elongation, but it is never as long as the first enlarged superciliary scale. A small granular

series follows the posterior - most superciliary scale. This condition distinguishes *A. casildae* from *A. latifrons* which has a series of swollen and rugose superciliaries, and from *A. squamulatus* which has approximately four short superciliary scales followed by a subgranular series. However, the superciliary condition of *A. casildae* is similar to that of *A. frenatus*, *A. princeps*, and *A. purpurescens*.

The holotype of *A. casildae* was reported as having as a diagnostic feature an anterior nasal scale in contact with the rostral scale (distinguishing it from *A. princeps* and *A. purpurescens* and in part from *A. frenatus*). However, we found that *A. casildae* exhibits variation in this character such that the anterior nasal scale may be in contact with the rostral or separated from the rostral by one scale. Thus, this character does not distinguish *A. casildae* from *A. princeps*, *A. purpurescens* or *A. frenatus*, but other characters may be used. *Anolis princeps* has a greater number of sublabials to the center of the eye than does *A. casildae* (9-12 for *A. princeps*; 6-8 for *A. casildae*). *A. purpurescens*, still known only from the holotype, possesses two scales between the nasal and rostral (*A. casildae* has 0-1 scale intervening), has 2 scales between the supraorbital semicircles (*A. casildae* has 3-4), and the dorsal scales are not keeled (see above for dorsal condition of *A. casildae*).

On the basis of overall similarity, *A. casildae* seems most closely related to *A. frenatus* as evidenced by the nearly complete overlap in meristic characters; they seem to differ only in coloration and in geographic range. The dorsum of *A. frenatus* is covered with several dark green ocelli (most outlined with yellow) that are closely arranged and form dark oblique bands and has a dull, cream-colored dewlap (occasionally with black shading) that appears somewhat translucent. In contrast, *A. casildae* has approximately 4-6 oblique brown bands (not formed of adjacent ocelli) interspersed by blue-outlined yellow patches, and a dewlap of dirty cream color with broad yellow scale rows irregularly interspersed with smaller emerald green scales. *Anolis frenatus* is primarily a lowland inhabitant (up to approximately 800 m

elevation) ranging from Costa Rica southward to Colombia, whereas *A. casildae* has been reported only from 1 050 to 1 400 m in the Cordillera Central in the highlands of Chiriquí and Bocas del Toro Provinces, western Panama.

DISCUSSION

Anolis casildae was regularly seen during herpetofaunal surveys at Fortuna. KRL made 34 observations of *A. casildae* individuals during surveys (n=174) of stream and terrestrial transects between 1993 and 1999. The annual average of *A. casildae* captures per transect was $0.27 + 0.34$ (range = 0 - 0.30, n = 7 visits), annual average of captures/minute was $0.0014 + 0.0012$ (range = 0 - 0.0031, n = 6 visits), and annual average of captures/km surveyed was $0.39 + 0.53$ (range = 0 - 1.45, n = 6). During one collecting trip targeting anoles, KEN observed 9 individuals over 32 daytime collecting hours along two transects (0.00468 captures/minute).

All KRL sightings occurred at night along streams when lizards were found sleeping on large-leafed plants (e.g., tree ferns, palms, aroids) along stream courses. This species was usually observed at a height of 1 m or more in trees or vegetation adjacent to or within 100 m of a stream. Sleeping females were captured at $1.50 + 0.43$ m height (range = 1 - 1.75 m, n = 3 individuals), while males were captured at a height of $1.62 + 0.95$ m (range = 0 - 4 m, n = 17 individuals). Adults were captured at $1.58 + 0.698$ m (range = 1 - 3 m, n = 10 individuals), while juveniles were captured at $1.79 + 1.22$ m (range = 0 - 4 m, n = 13 individuals). There were no significant differences between male or female or between adult and juvenile capture heights (Mann-Whitney U one tailed tests because adult > juvenile and male > female is expected; Losos *et al.* 1991).

During the day individuals were usually observed on tree trunks at 2 m or less in height in the characteristic head down posture of *Anolis*, but were occasionally observed on trunks in a head up position. Individual *A. casildae* were captured easily by hand and

allowed close approach showing only mild wariness. If wary when approached, they moved to a position on the trunk opposite the captor as other anole species do when attempting to "hide". KEN observed one large male capturing a katydid from the ground and then quickly leaping to a trunk perch approximately 0.5 m in height to consume the prey (Nicholson 1999). It is unknown whether this species regularly forages on the ground.

Anolis casildae shares some similarities to another large Panamanian anole, *Anolis frenatus*. Both have been observed to assume a head-down posture when perched during daytime, and are known to forage on the ground (pers.obs., KEN). While females of both species were captured at the same height (Losos *et al.* 1991), male *A. frenatus* were found one meter higher on average than those of *A. casildae* (Losos *et al.* 1991). Little work has been done on either species, but they have been captured with varying frequencies at different sites (*A. casildae*: Fortuna: 0.00468/min by KEN, 0.00140/min by KRL; *A. frenatus*: "Lutz" in Barro Colorado Island: 0.00329/min by Losos *et al.* 1991; "AVA" in Barro Colorado Island: 0.00033/min by Losos *et al.* 1991; several sites in Barro Colorado Island: 0.00076/min by Losos *et al.* 1991; six sites in the lowlands of central Panama: 0.00002/min by Ibáñez *et al.* "1995"[1997]). Thus, these species may both appear to occur at low densities, or are seen less frequently than other species due to cryptic coloration or more common associations higher in the trees.

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RESUMEN

Nosotros describimos la variación morfológica (escamación y coloración) observada entre ocho individuos de la especie de lagartija panameña *Anolis casildae*. Esta variación no fue observada en el holotipo y ayuda en la identificación de esta especie recientemente descrita (originalmente descrita con base en un único espécimen macho). Esta especie ocurre solo en la Reserva Forestal Fortuna (Provincia de Chiriquí) y en el Bosque Protector Palo Seco (Provincia de Bocas del Toro) adyacente, en el oeste de Panamá. *Anolis casildae* se puede distinguir de las demás especies panameñas de *Anolis* por seis características: (1) dos escamas superciliares agrandadas (la primera más grande que la segunda); (2) una escama nasal anterior en contacto con la escama rostral o separada de ésta por una escama; (3) seis-ocho escamas sublabiales hacia el centro del ojo; (4) tres-cuatro escamas entre los semicírculos supraorbitales; (5) coloración única (cuatro-seis bandas café oblicuas interespaciadas por parches amarillos bordeados de azul; la papada es de color crema sucio con filamentos anchas de escamas amarillas interespaciadas irregularmente con escamas verde esmeralda más pequeñas) y (6) *A. casildae* ocurre de 1 050 a 1 400 m en la Cordillera Central. Nosotros también comparamos nuestras observaciones de historia natural de *A. casildae* con un *Anolis* similar grande, *A. frenatus*, una especie a la que nosotros creemos está *A. casildae* cercanamente relacionada.

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