

Distribution extension for *Anolis pseudokemptoni* Köhler, Ponce, Sunyer & Batista, 2007 (Reptilia: Squamata: Dactyloidae), a microendemic species in the Serranía de Tabasará of the Comarca Ngöbe-Buglé of western Panama

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ABSTRACT: We report new localities for *Anolis pseudokemptoni* Köhler, Ponce, Sunyer & Batista, 2007, along the Serranía de Tabasará in the Comarca Ngöbe-Buglé of western Panama. These records extend the known geographic distribution of this lizard about 6 km eastward and 9 km northwestward, as well as the known vertical distribution approximately 470 m lower and 380 m higher. We also provide photos of specimens from different localities and comment on their morphology. No population of this Panamanian microendemic species, which is classifiable as Critically Endangered, lives inside a protected area.

Köhler *et al.* (2007) described *Anolis pseudokemptoni* on the basis of three specimens from “La Nevera, 8°29'45" N, 81°46'35" W, 1,600 m elevation, Serranía de Tabasará, Comarca Ngöbe Bugle, Distrito de Nole Düima, Corregimiento de Jadeberi, Panama.” Their slightly erroneous coordinates, also applied to the type localities of *A. datzorum* Köhler, Ponce, Sunyer & Batista, 2007 and *A. pseudopachypus* Köhler, Ponce, Sunyer & Batista, 2007, were later corrected to 8°30' N, 81°46'20" W (Lotzkat *et al.* 2010a). The type locality (Figure 1, locality 1; Figure 2E and F) is situated on the continental divide of the Serranía de Tabasará, which constitutes the eastern continuous (unbroken above 1,000 m) portion of the Cordillera Central of western Panama. Ponce and Köhler (2008), at the time of their morphological revision of the Panamanian highland anoles related to *A. kemptoni* Dunn, 1940, still had only the type series of *A. pseudokemptoni* available. During recent field work in the highlands of western Panama, we collected 20 additional specimens of *A. pseudokemptoni* from several localities east and west of the type locality, which considerably improve our knowledge of the distribution and morphological variation of this little-known species.

All specimens were encountered during opportunistic searches performed primarily at night, captured by hand, and preserved the day after capture. The collecting permits SE/A-30-08, SC/A-8-09, SC/A-28-09, and SC/A-21-10, as well as the corresponding exportation permits, were issued by the Dirección de Áreas Protegidas y Vida Silvestre of the Autoridad Nacional del Ambiente (ANAM), Panama City, Panama. Our specimens have been deposited in the collection of the Senckenberg Forschungsinstitut Frankfurt (SMF) and in the Museo Herpetológico de Chiriquí (MHCH) of the Universidad Autónoma de Chiriquí, David, Chiriquí,

Panama. Species identification was carried out employing the keys, figures, and descriptions provided by Köhler *et al.* (2007), Köhler (2008), and Ponce and Köhler (2008), and by comparison with the type series (SMF 85420–22). All specimens strongly resemble the type specimens of *Anolis pseudokemptoni* and match the descriptions in Köhler *et al.* (2007) and Ponce and Köhler (2008) in terms of external morphology and dewlap coloration. Adult specimens were sexed according to dewlap size and coloration, by eversion of hemipenes in males, and by presence or absence of enlarged postcloacal scales, the last also applicable to juveniles. Characters of external morphology were recorded according to the methodology described by Köhler *et al.* (2007) and Ponce and Köhler (2008). Snout-vent length (SVL) and tail length (TL) were measured using a ruler. Head length (HL), Head width (HW), snout length, and shank length measurements were made using calipers. Measurements and scale counts are summarized in Table 1. Colors and color codes (the latter in parentheses) follow Smithe (1975–1981). Coordinates and elevation were recorded using Garmin GPS receivers with built-in altimeters. All coordinates are in WGS 1984 datum; elevations are rounded to the nearest 10 m. Within the Comarca Ngöbe-Buglé, place names typically are in Ngäbere, the indigenous language of the Ngöbe people for which different spellings are available and used. For these names, we follow the spelling used on the Mapa General de la República de Panamá and in the Atlas Nacional de la República de Panamá (IGNTG 2000; 2008).

Figure 1 shows the type locality of *Anolis pseudokemptoni* and the localities reported herein. Exact locality information for all collected specimens is provided in the Appendix. From west to east, we provide the following new records for *A. pseudokemptoni*: On the southeastern

slopes of Cerro Saguí (also known as Cerro Ratón), between 2 and 2.5 km north of the settlement Ratón, we collected one individual along the banks of Quebrada Juglí (Figure 1, locality 2), and three more ascending the ridge E of this river (localities 3 and 4). Descending the trail leading from the continental divide N to Río Cricamola and Kankintú, we collected several specimens at Terminal de Hacha on the continental divide (locality 5), at the upper limit of the village of Hacha, also known as Río Hacha or Quebrada de Hacha (locality 6), and along Río Flor that is also known as Río Flores (locality 7), observing many more between these points (unnumbered localities). On the western slopes of Cerro Santiago near the type locality La Nevera, we collected individuals on the continental divide (locality 8) and adjacent Caribbean slopes (locality 9). Two specimens were collected east of Cerro Santiago in the Pacific drainage, about 3 km north of Buabidí, on the trail leading from Río Rey to the continental divide (localities 10 and 11).

The localities reported herein extend the known geographic and elevational range of *Anolis pseudokemptoni*. The records from Cerro Saguí, approximately 9 km northwest of the type locality, now constitute the westernmost records for the species, and raise the upper elevational limit to 2,010 m. The individuals from Hacha at 1,130 m set the lower elevational limit for *A. pseudokemptoni*. The trail ascending the southeastern slopes of Cerro Santiago above Río Rey, approximately 6 km east of the type locality, now constitutes the easternmost locality reported for the species, and the only locality situated below the continental divide on the Pacific slopes of the Serranía de Tabasará.

Selected specimens are shown in Figure 3. The examination of our additional specimens allows for a more comprehensive assessment of the variation in external

morphology. Most notably, the minimum number of loreal scales is lowered to 56 arranged in 6 loreal rows, revealing an overlap in these characters with *Anolis fortunensis* Arosemena & Ibañez, 1994, *A. kemptoni*, and *A. gruuo* Köhler, Ponce, Sunyer & Batista, 2007 (Ponce and Köhler 2008; Lotzkat et al. 2012a). Consequently, the high number of loreal scales and rows considered unique among these four closely related species by Ponce and Köhler (2008) loses its value as a non-overlapping diagnostic character. However, animals with 70 or more loreal scales are still highly likely to be representatives of *A. pseudokemptoni*. The species remains readily distinguishable from *A. gruuo* by the red male dewlap (orange in *A. gruuo*), and from *A. fortunensis* and *A. kemptoni* by the large bilobed hemipenis bulging the base of the tail in adult males (smaller and unilobed in the other two species). In Table 1, we provide an updated version of the table of Ponce and Köhler (2008) for selected morphological characteristics of *A. pseudokemptoni*, based on all known specimens except MHCH 1335 (n=22).

As typical for anoles, the coloration among our specimens is rather variable. Especially noteworthy is that a conspicuously contrasting dark and pale banding of the tail, stated as a diagnostic character for *Anolis gruuo* (Köhler et al. 2007, Köhler 2008, Ponce and Köhler 2008) and reported to not occur in all specimens of that species by Lotzkat et al. (2012a), is also present in some specimens of *A. pseudokemptoni* (Figure 3A and B). Since we also observed this banding among other beta-anoles in western Panama, it should not be relied upon for species identification. Furthermore, we observed variation in female dewlap coloration ranging from almost white over the typical yellow shown by most females to orange (Figure 3K–N). The coloration in life of the male SMF 89515 (Figure 3A and G) was recorded as follows:

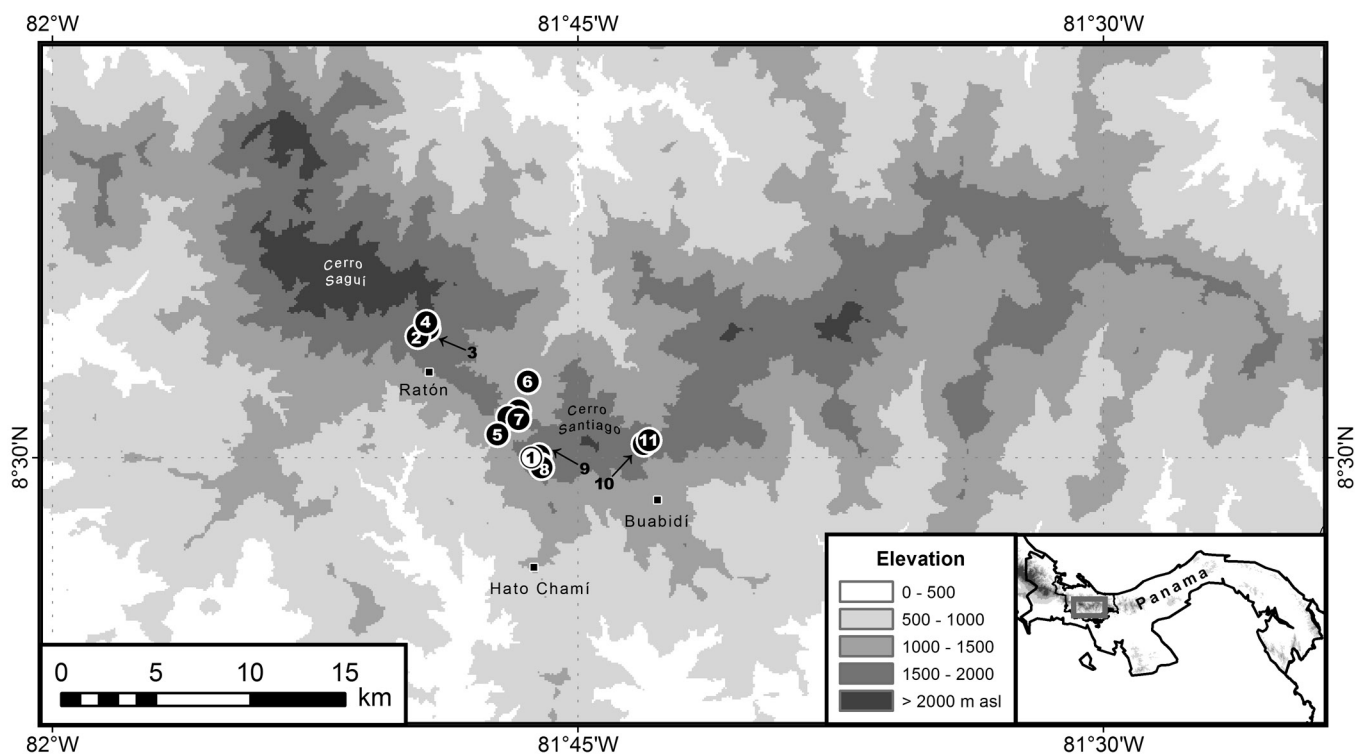


FIGURE 1. Distribution map showing the known localities for *Anolis pseudokemptoni* in the central Serranía de Tabasará, Comarca Ngöbe Buglé (outlined in the overview map), western Panama: The white circle (1) represents the type locality, black circles the localities reported herein.

Dorsal and lateral ground color Drab-Gray (119D), with Vandyke Brown (121) mottling forming transverse bands on body, limbs and base of tail; mid-dorsum with a faint suggestion of Dark Drab (119B); dorsal surface of head Sepia (219); lips and ventral surface of head dirty white

with a suggestion of Pale Horn Color (92); ventral surfaces of body and hind limbs dirty white with a suggestion of Pearl Gray (81) with fine Fawn Color (25) mottling; ventral surface of front limbs as well as soles of hands and feet Light Drab (119C); ventral surfaces of body and tail as well

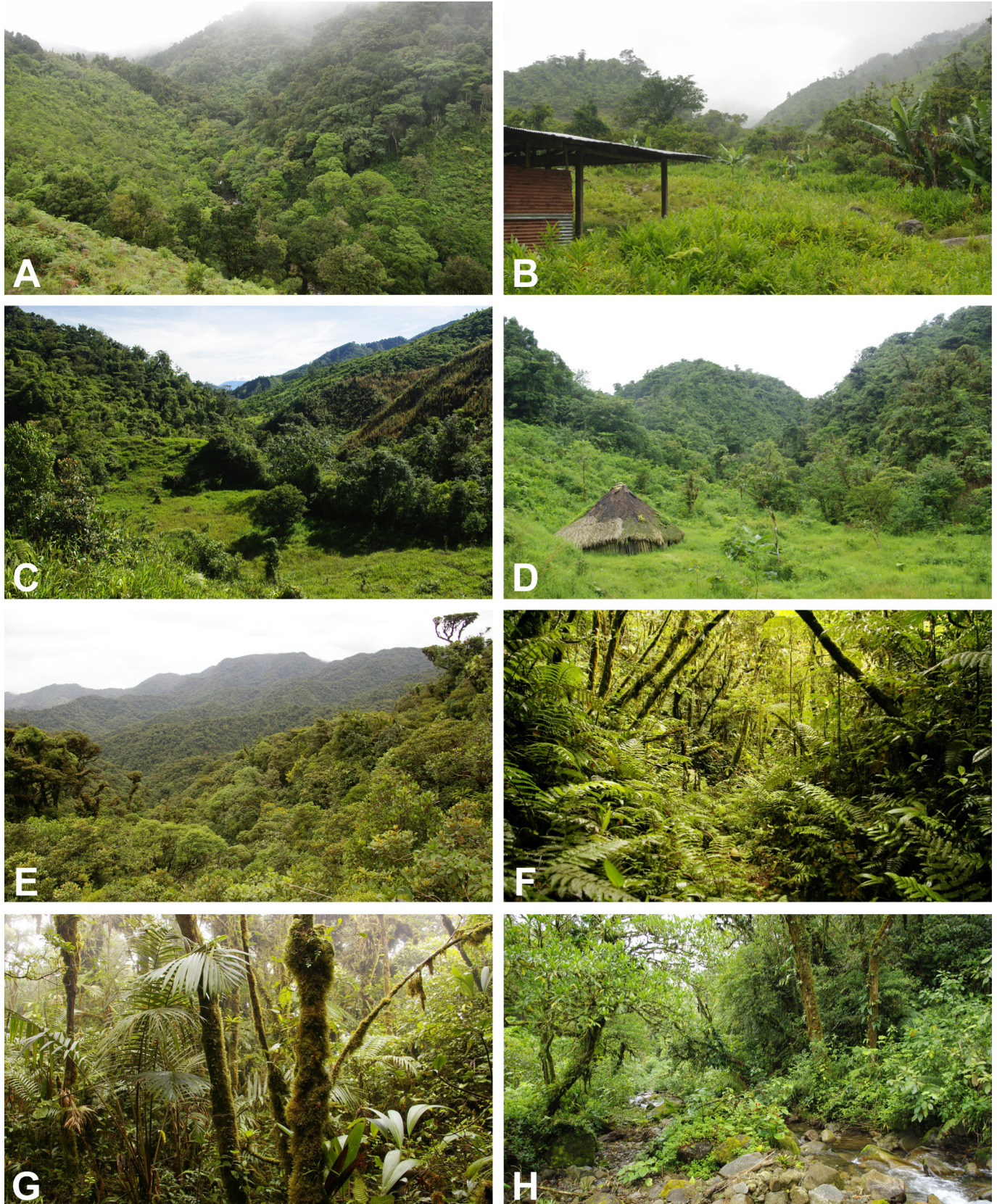


FIGURE 2. Habitats of *Anolis pseudokemptoni* along the Serranía de Tabasará in western Panama: (A) Cerro Saguí, looking north into the valley of Quebrada Juglí from approximately 1,800 m; (B) upper limit of Hacha, looking south towards junction of Río Flor and Río Hacha, 1,130 m; (C) valley of Río Flor 2.6 km north-northwest of type locality, 1,220 m; (D) valley of Río Flor 1 km north-northeast of type locality, 1,500 m; (E) looking east-northeast from the continental divide at La Nevera, 1,700 m, across the type locality towards Cerro Santiago; (F) type locality at La Nevera, cloud forest streambed at approximately 1,600 m; (G) continental divide near La Nevera, elfin forest at 1,810 m; (H) crossing Río Rey on trail to continental divide, 1,550 m.

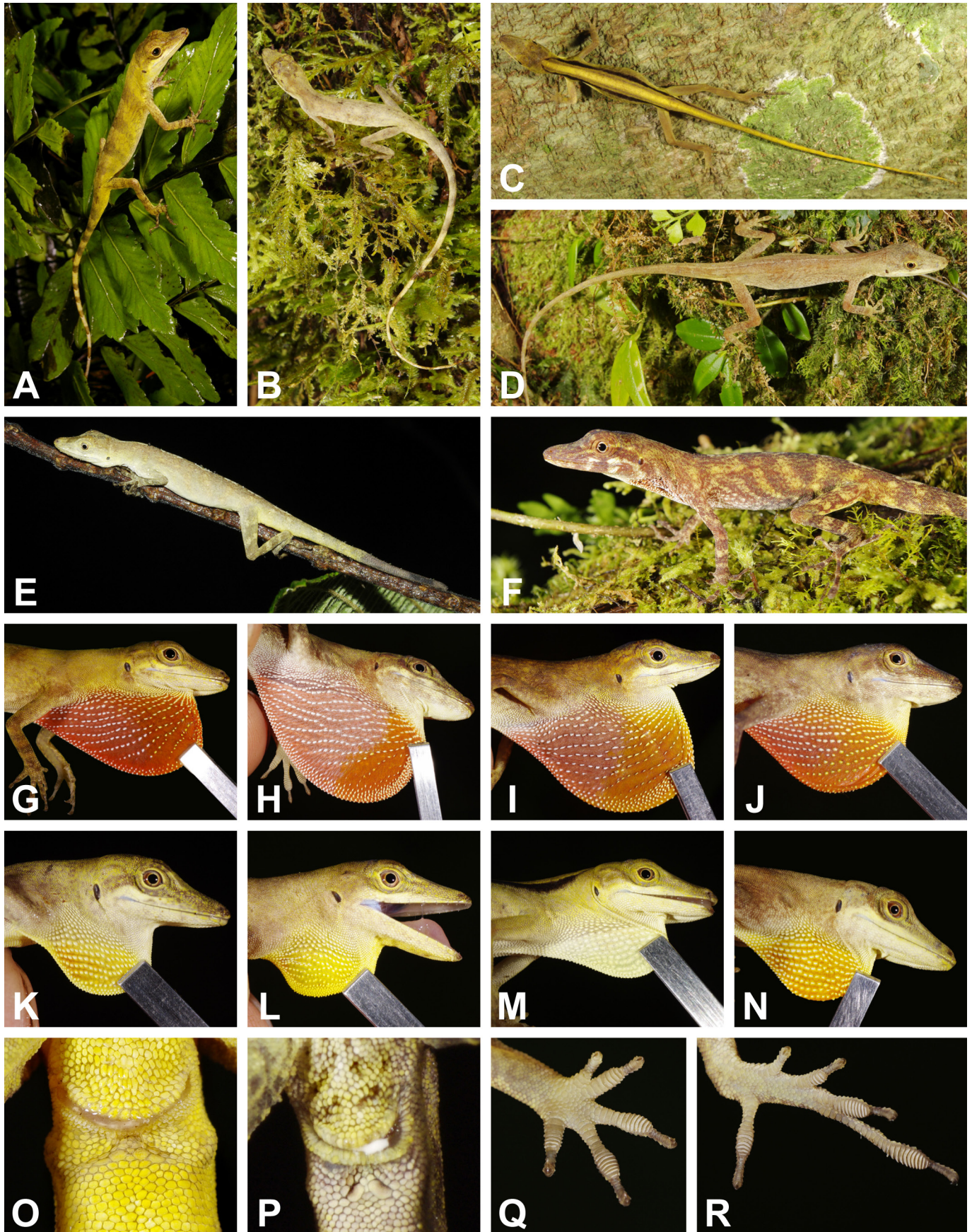


FIGURE 3. Individuals of *A. pseudokemptoni* from different localities: (A) male SMF 89515 and (B) female SMF 90154 from La Nevera; (C) female SMF 91519 from Terminal de Hacha; (D) female SMF 89750 from above Río Rey; (E) male SMF 90156 from La Nevera in sleeping position and (F) the next day; (G)–(J) male dewlaps, width of forceps 3 mm: (G) SMF 89515; (H) SMF 90156; (I) MHCH 2271 from Río Flor; (J) SMF 91516 from Cerro Sagui; (K)–(N) female dewlaps: (K) SMF 90154; (L) SMF 91515 from Cerro Sagui; (M) SMF 91519; (N) SMF 89750; (O)–(P) cloacal region showing enlarged postcloacal scales of (O) adult male SMF 90156 with swollen base of tail, and (P) juvenile male MHCH 2267; (Q) left hand and (R) left foot of MHCH 2268 in ventral view (not to same scale).

as cloacal region Tawny Olive (223C); posterior portion of tail Pearl Gray (81) with a suggestion of Pale Horn Color (92), with Dark Brownish Olive (129) transverse bars grading into Grayish Horn Color (91) ventrally; iris True Cinnamon (139); dewlap Spinel Red (108B) with a suggestion of Poppy Red (108A) posteriorly, Spectrum Red (11) anteriorly, with a Burnt Orange (116) anterior border and dirty white scales, bordered by Dark Neutral Gray (83) except for the marginals.

All individuals were encountered at night, sleeping on vegetation between 1 and 4 m above ground. The collection sites encompass different habitats (compare photographs in Figure 3A–H) ranging from roadsides, riverbanks, pastures, plantations, and secondary forest to apparently pristine premontane and lower montane moist or wet forest, including cloud forest. While we found the species as low as 1,130 m on the Caribbean (*i.e.*, northern) slopes, and down to 1,390 m atop the continental divide, our only two records from the Pacific (*i.e.*, southern) slopes are much higher at 1,560 and 1,660 m, respectively, while still very close to the continental divide. At lower elevations on the Pacific slope, we found *A. gruuo* instead of *A. pseudokemptoni* (Lotzkat et al. 2012a). The parapatric distribution of our collection sites of these two species suggests that they do not occur in syntopy with each other. Rather, *A. gruuo* seems to be a species of the Pacific drainage, living at premontane elevations up to around 1,530 m, whereas *A. pseudokemptoni* appears to occupy the continental divide and adjacent Caribbean slopes, only descending onto the Pacific slopes down to somewhere near the upper elevational limit of *A. gruuo*.

The documented range of *Anolis pseudokemptoni* stretches over only 13 airline km, or 16 km along the course of the continental divide, from about 81°49'30" W to 81°43' W at premontane and lower montane elevations of 1,130–2,010 m of the Serranía de Tabasará, Cordillera Central, in western Panama. Future fieldwork most probably will expand these range limits, but we are convinced that this expansion will be minor and mostly extend the current limits vertically as well as further to the east in the Comarca Ngöbe-Buglé, following our reasoning for *A. gruuo* in this regard (Lotzkat et al. 2012a) and considering the fact that we did not find *A. pseudokemptoni* during our extensive surveys around Santa Fé, Veraguas.

Accordingly, while *Anolis gruuo* ranges east into Veraguas province (Lotzkat et al. 2012a), *A. pseudopachypus* is distributed westerly to the Fortuna area in Chiriquí province (Lotzkat et al. 2010b), and *A. datzorum* has been reported from Costa Rica (Köhler and Vargas 2010), *A. pseudokemptoni* is the only of the four species described from the central Tabasará range by Köhler et al. (2007) that remains known only from near its type locality in the Comarca Ngöbe-Buglé. Our findings suggest that *A. pseudokemptoni* is a true microendemic species restricted to the central Serranía de Tabasará around the region known as Cerro Colorado. Its extent of occurrence of only 32.35 km² and the continuing deforestation (resulting in a decline of the obviously preferred forest habitats) we observed in the region qualify *A. pseudokemptoni* for the IUCN category “Critically Endangered” (CR), according to criterion B1b (IUCN 2001). A similar, yet even smaller range is documented for the recently discovered rainfrog

TABLE 1. Selected measurements, proportions, and scale characters of 11 males and 11 females of *Anolis pseudokemptoni*. Range is followed by mean value and standard deviation in parentheses. For abbreviations see text.

CHARACTER	SEX	VALUE
Maximum SVL	males	54.5 mm
	females	55 mm
TL / SVL	males (n=7)	1.80–1.98 (1.89 ± 0.07)
	females (n=9)	1.64–1.91 (1.77 ± 0.09)
Tail diameter vertical / horizontal	males	1.08–1.33 (1.21 ± 0.09)
	females	1.08–1.29 (1.16 ± 0.07)
Axilla-groin distance / SVL	males	0.41–0.46 (0.43 ± 0.02)
	females	0.42–0.48 (0.45 ± 0.02)
HL / SVL	males	0.26–0.28 (0.26 ± 0.01)
	females	0.23–0.27 (0.25 ± 0.01)
HL / HW	males	1.52–1.86 (1.75 ± 0.11)
	females	1.69–1.86 (1.75 ± 0.04)
Snout length / SVL	males	0.12–0.13 (0.12 ± 0.00)
	females	0.10–0.13 (0.12 ± 0.01)
Snout length / HL	males	0.45–0.51 (0.47 ± 0.02)
	females	0.44–0.5 (0.48 ± 0.01)
Shank length / SVL	males	0.21–0.23 (0.22 ± 0.01)
	females	0.20–0.23 (0.21 ± 0.01)
Shank length / HL	males	0.77–0.86 (0.82 ± 0.03)
	females	0.79–0.87 (0.83 ± 0.03)
Subdigital lamellae under phalanges II–IV of 4 th toe		23–28 (25.77 ± 1.48)
Number of scales between supraocular semicircles		1–2 (1.45 ± 0.51)
Number of scales between interparietal and supraocular semicircles		1–4 (2.77 ± 0.69)
Number of scales between suboculars and supralabials		0
Number of supralabials to level below center of eye		6–9 (7.27 ± 0.77)
Number of infralabials to level below center of eye		7–9 (8.18 ± 0.85)
Total number of loreals		56–100 (76.23 ± 12.49)
Number of horizontal loreal scale rows		6–8 (7.05 ± 0.65)
Number of postrostrals		7–10 (7.91 ± 0.97)
Number of postmentals		4–8 (6.05 ± 1.05)
Number of scales between nasals		6–9 (8.0 ± 0.82)
Number of scales between 2 nd canthals		8–12 (10.32 ± 1.13)
Number of scales between posterior canthals		8–15 (11.68 ± 1.89)
Number of medial dorsal scales in one HL		50–80 (60.27 ± 7.72)
Number of medial ventral scales in one HL		35–61 (47.91 ± 6.49)

Diasporus igneus Batista, Ponce & Hertz, 2012 that is only known from La Nevera and near Río Rey (Batista *et al.* 2012). Both species are presumed to be primarily forest-dwellers and thus susceptible to habitat degradation, while deforestation occurs at an alarming pace within the Comarca (ANAM 2009). Moreover, its mountains' enormous mineral deposits and high suitability for hydroelectric dams pose major threats to the Comarca's natural environments. If, for example, the exploitation of the Cerro Colorado copper deposit eventually was undertaken (Nakoneczny and Whysner 2010), both species easily might be driven to extinction. Apart from the taxa already recounted by Lotzkat *et al.* (2012a), other more recently described endemic species of the Tabasará range like *Diasporus citrinobapheus* Hertz, Hauenschild, Lotzkat & Köhler, 2012, *D. igneus*, and *Sibon noalamina* Lotzkat, Hertz & Köhler, 2012 are facing the same threats (Hertz *et al.* 2012b; Batista *et al.* 2012; Lotzkat *et al.* 2012b). All these taxa, most of them discovered only during the last years, remain very poorly known, while many more unknown organisms can be expected confidently to await discovery. If the survival of the vital forest environments along the Serranía de Tabasará is not seriously pursued soon, we might never come to know their true diversity. The establishment of a reasonably sized and properly enforced protected area comprising the Cerro Colorado area including Cerro Saguí and Cerro Santiago, as suggested by Hertz *et al.* (2012a), would be a first step in this direction.

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APPENDIX. Exact localities for the 20 specimens of *Anolis pseudokemptoni* reported herein from the Comarca Ngöbe-Buglé, western Panama.

Distrito de Kankintú, Corregimiento de Piedra Roja: locality 2: Cerro Saguí, Quebrada Juglí, 8°33'27" N, 81°49'34" W, 1,710 m: MHCH 2268; locality 3: Cerro Saguí, above Quebrada Juglí, 8°33'49" N, 81°49'18" W, 1,930–1,960 m: MHCH 2269, SMF 91515; locality 4: Cerro Saguí, above Quebrada Juglí, 8°33'51" N, 81°49'20" W, 2,010 m: SMF 91516; locality 5: Terminal de Hacha, 8°30'39" N, 81°47'18" W, 1,390 m: SMF 91519; locality 6: Hacha, 8°32'10" N, 81°46'26" W, 1,130 m: MHCH 2272, SMF 91512–14; locality 7: Río Flor, 8°31'15" N, 81°46'42" W, 1,220 m: MHCH 2270, 2271, SMF 91517, 91518; locality 8: western slope Cerro Santiago near La Nevera, 8°29'43" N, 81°46'02" W, 1,810 m: SMF 90155; 8°29'46" N, 81°46'04" W, 1,730 m: SMF 90156; locality 9: western slope Cerro Santiago near La Nevera, 8°30'03" N, 81°46'06" W, 1,640 m: MHCH 2267, SMF 89515, 90154. *Distrito de Müna, Corregimiento de Peña Blanca:* locality 10: near Río Rey, 8°30'23" N, 81°43'07" W, 1,560 m: MHCH 1335; locality 11: just below continental divide above Río Rey, 8°30'30" N, 81°42'58" W, 1,660 m: SMF 89750.