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First record of the genus *Aristelliger* (Squamata: Sphaerodactylidae) in Cuba, with the description of a new species

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Abstract

The genus *Aristelliger* comprises seven species of which six inhabit the West Indies, and one occurs in Central America and satellite islands. For the first time, the genus is reported from Cuba, and a new species (*Aristelliger reyesi* **sp. n.**) is described from that island. The new taxon has affinities with the smaller species of the genus (subgenus *Aristelligella*): A. *expectatus*, A. *cochranae*, and A. *barbouri*. It differs from them in color pattern and other morphological characters.

Key words: Reptiles, *Aristelligella*, West Indies, Península de Hicacos, Varadero

Introduction

The genus *Aristelliger* has seven species, of which only one (*A. georgeensis* Bocourt) occurs in Central America and satellite islands. Two species (*A. expectatus* Cochran, and *A. lar* Cope), inhabit Hispaniola; one species occurs on Navassa Island (*A. cochranae* Grant); two species (*A. barbouri* Noble and Klingel, and *A. hechti* Schwartz and Crombie) are found in the Bahamas; and one species (*A. praesignis* Barbour) occurs in Jamaica, surrounding cays, Cayman Islands, and Swan Islands (Schwartz and Henderson, 1991; Bauer and Russell, 1993a-f; Lynxwiler and Parmerlee, 1993). Additional species are in the process of being described (S. B. Hedges, in prep.). The genus has not previously been recorded from Cuba.

The following combination of characters (among others) are present in *Aristelliger*: 1) small granular scales on most of the body surface; 2) fragile skin; 3) a supraciliar scale modified as a tiny spine; 4) all digits clawed; 5) subdigital lamellae undivided; 6) "friction pads" (*sensu* Cochran, 1933) on three fingers and two outer toes, or only in one digit of each extremity, depending on the species group (see below); 7) eyes with vertical pupil; 8) one egg per clutch; 9) presence of hemipenial bones (Kluge, 1982); 10) presence of parafrontal bones (Bauer and Rusell, 1989; Gamble *et al.*, 2008); and 11) croaking calls. Gamble *et al.* (2008) found strong support for a close relationship between *Aristelliger* and the North African genus *Quedenfeldtia*, and suggested its inclusion in the family Sphaerodactylidae.

There are two recognized groups of species, defined as subgenera by Hecht (1952). The smaller species: *A. cochranae*, *A. barbouri*, and *A. expectatus* (subgenus *Aristelligella*), are 46–63 mm SVL, have lateral postmentals in contact with the median line of mental scale, and friction pads on three fingers and two outer toes. A second group contains the larger members: *A. georgeensis*, *A. hechti*, *A. lar*, and *A. praesignis* (subgenus *Aristelliger*). They are 83–135 mm SVL and have 1–3 median postmentals and friction pads on one finger and one toe (Schwartz and Henderson, 1991).

On 30 May 2007 the senior author identified some reptiles photographed by Ernesto Reyes at the Nature Preserve of Varahicacos, Península de Hicacos, Western Cuba. Surprisingly, some of his photos depicted what, undoubtedly, was a gecko of the genus *Aristelliger*. Soon thereafter several specimens were collected at

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the same locality, confirming not only the presence of the genus in Cuba, but also the existence of a new species that will be herein described.

Materials and methods

Measurements were taken with calipers (0.05 mm accuracy). Head length was measured from the tip of snout to the anterior ear opening margin. Supralabials and infralabials were counted to the center of the eye. Numbers of fourth toe digital lamellae are either reported for individual digits (right/left) or as total fourth toe lamellae by summing those from both feet. We also counted the number of dorsal scales (on middorsum) and ventral scales (on midventer) in the distance from the tip of snout to the center of eye, following Cochran (1933, 1941). Dorsal scales of snout were counted in midline behind the rostral scale to the level of anterior margin of eyes. Terminology for the hemipenis morphology follows Rösler and Böhme (2006). Multivariate statistical analysis was performed with the software STATISTICA 6.0. Specimens examined for comparisons are listed in Appendix I. Codes for measurements and institutional collections: SVL, snout-vent length; MNHNCu, Museo Nacional de Historia Natural de Cuba; BWMC, Bobby Witcher Memorial Collection, Avila University; KU, Museum of Natural History of the University of Kansas; USNM, United States National Museum of Natural History.

Aristelliger reyesi, new species

Figure 1

Holotype. MNHNCu 4665, an adult male collected by Luis M. Díaz, Ernesto Reyes, and Ariatna Linares along the trail Los Musulmanes (23°11'37''N, 81°09'26''W), Reserva Ecológica Varahicacos, sea level, Península de Hicacos, Matanzas Province, on 5 June 2007.

Paratypes (N=15). **Males** (8): MNHNCu 4666–67, from Cueva Ambrosio, Reserva Ecológica Varahicacos (23°11'34''N; 081°09'47''W), Península de Hicacos, Matanzas Province, on 4–5 June 2007, by same collectors; MNHNCu 4668–69, from wooden buildings at Estación Ecológica de Varahicacos (23°11'39''N; 081°09'11''W), collected by Luis M. Díaz on 4 June 2007; MNHNCu 4670–73, same data as the holotype. **Females** (6): MNHNCu 4674–4676, from wooden buildings at Estación Ecológica de Varahicacos, collected by Luis M. Díaz on 4 June 2007; MNHNCu 4677–79, same data as the holotype. **Embryo**: MNHNCu 4680, from an egg laid in captivity.

Diagnosis. A small species (maximum SVL: 63.6 mm) of the subgenus *Aristelligella* (Fig. 1) according to size, and by the arrangement of friction pads and lateral postmentals. Both sexes have a dark stripe (almost black) that extends laterally through the head and over shoulders, fading from there as dorsolateral bifurcated brown zones that reach the tail base. From *Aristelliger barbouri* it differs in having a conspicuous pattern of longitudinal zones (*vs*. a more faded coloration in *A. barbouri*, with lateral stripes only reaching shoulders), and a higher number of total fourth toe lamellae (21–29, *vs*. 18–19 in *A. barbouri*). In *A. cochranae*, dark lateral zones similar to those found in *A. reyesi* are conspicuous in juveniles and subadults, but less evident or absent in adults, where they are substituted by many pale dots and blotches (Fig. 1); the number of loreal scales is lower in *A. reyesi* than in *A. cochranae* (11–15 *vs*. 15–16, respectively), the snout-to-center of eye distance averages shorter with respect to SVL (13.0–14.4%, x=13.8; *vs*. 14.2–15.8%, x=15.2%, in *A. cochranae*) and the ratio of the ear opening longest diameter/ SVL is smaller (1.7–2.9, x=2.3; *vs*. 2.9–4.2, x=3.4). *Aristelliger reyesi* requires closer comparison with *A. expectatus*. The new species is longer than *A. expectatus* (63.6 mm maximum SVL in *A. reyesi*, *vs*. 55 mm in *A. expectatus*), and has a more robust body. Typically, *A. expectatus* has a more distinctive dorsal "ladder" pattern than *A. reyesi*, because the lateral darker zones (if defined) are connected to each other by bridges, "saddles" or bands (only pairs of middorsal dots or small chevrons are present in *A. reyesi*) (Fig. 2); the hemipenes of *A. reyesi* have two prominent horn-like

asulcal papillae, which are absent in *A. expectatus* (Fig. 3); the number of total fourth toe lamellae is 22–29 (x=24) in *A. reyesi*, *vs*. 16–22 (x=19) in *A. expectatus*; the dorsal scales of snout are smaller (and higher in number) in *A. reyesi* (16–19, x=18) than in *A. expectatus* (14–16, x=15); the ear opening is rounded in *A. reyesi* and narrow in *A. expectatus* (horizontal diameter 47.6–112.5%, x= 76.5%, of longest diameter in *A. reyesi*, *vs*. 18.7–39.3%, x= 28.8%, in *A. expectatus*) (Fig. 4).

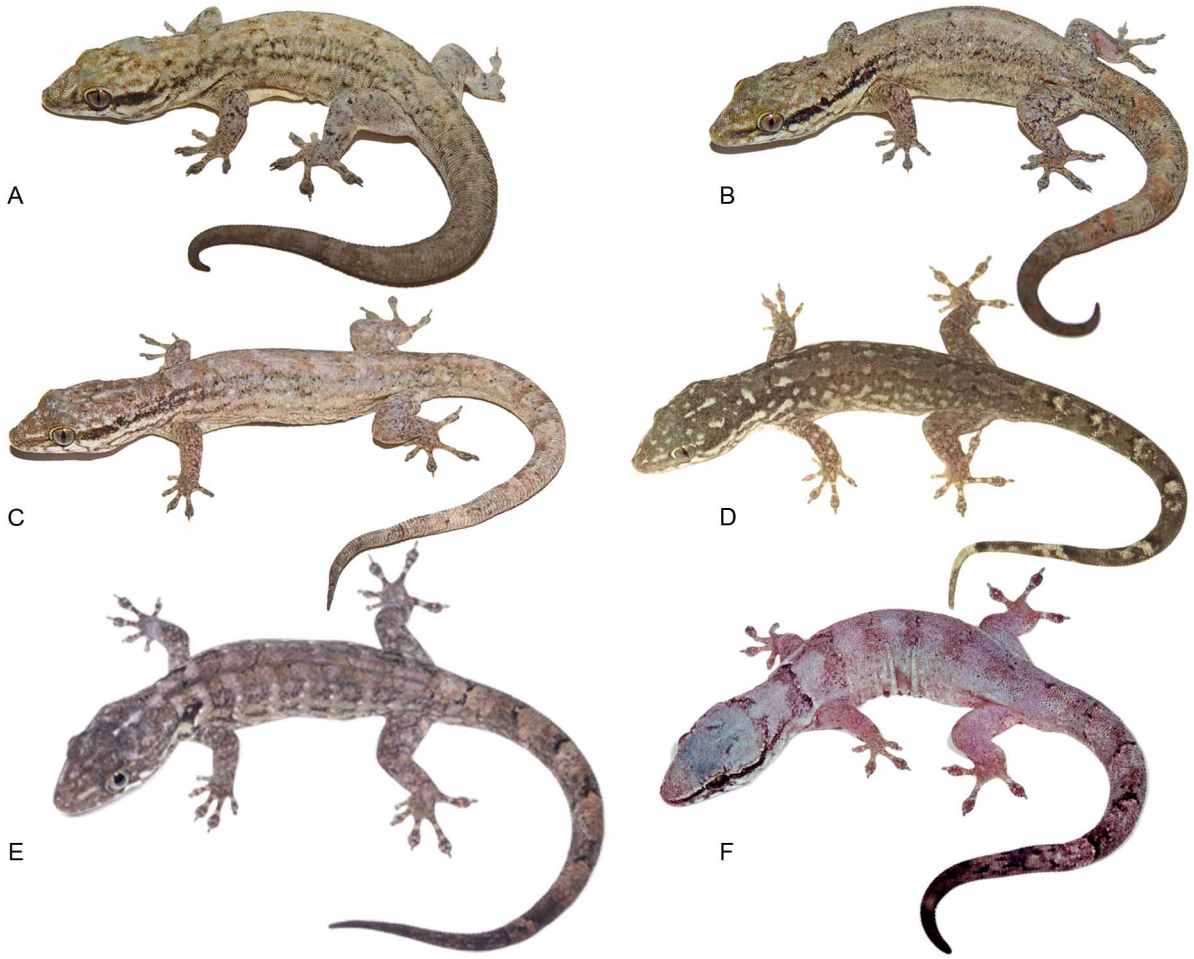

FIGURE 1. West Indian species of the subgenus *Aristelligella*, genus *Aristelliger*: (A) *A. reyesi* n. sp., paratype adult male (MNHNCu 4670), from type locality; (B) adult female of *A. reyesi* (died in captivity), from the same locality; (C) young female of *A. reyesi* (paratype MNHNCu 4674), from Estación Ecológica Varahicacos; (D) *A. cochranae*, adult male from Lulu Bay, Navassa Island; (E) *A. expectatus*, adult male (USNM 328909), from Dept du Sud, 10.3 km NW Port Salut, Haiti; (F) *A. barbouri*, adult male from 1.2 km E John Gray Hill, Great Inagua, Bahamas. Photographs A, B, and C, by Rolando Fernández de Arcila; D, E, and F, by S. B. Hedges.

Description. Males, maximum SVL 63.6 mm; females, 55.1 mm. Head length 23–24% of SVL. Ear opening rounded or oval, with the upper margin slightly folded; the columella is well visible. Fourth toe lamellae modally 10–15; fourth finger lamellae 9–15. Supralabials modally 7; infralabials modally 6. Two enlarged lateral postmentals in median contact behind the mental. Dorsal scales small, granular, and swollen. Ventral scales semicircular, smooth, and partially imbricated. One or two internasal scales (mode 1). Two postnasal scales. Subcaudal scales transversally enlarged. Males are more bulky-headed than females, appearing more robust. Metric and meristic data are shown in Table 1 (by sexes), compared with those of other species of the subgenus *Aristelligella*.

Color in life: Overall coloration mostly olive-green with yellowish shades; grayish on legs and some dorsal areas. Females somewhat more grayish colored than males. Supralabial scales white colored in both

sexes. Usually, lower body flanks more yellow in males than in females. Males and females with a dark brown (almost black) stripe that runs along head sides and neck, from which it becomes a less conspicuous and bifurcate dorsolateral zone that reach the tail base. Another brown stripe is on lower flanks. Middorsum almost plain colored, with either vertebral series of small, chevron like patterns, pairs of brown spots, or small papilionaceus figures. Parietal area of head with a chevron like or an X-shaped brown pattern weakly evident, followed by a pair of dark spots near the occiput. Legs with small brown spots or reticulations. The belly is gray or tan. Tail dorsally unpatterned, or with a pale series of rhombs slightly evident. Adult males tend to have a dark brown tail on the ventral surface, with some pinkish patches. Frequently, males also exhibit regenerated areas of skin on body (probably from territorial encounters), which appear as grey patches (see the head of male in Fig. 1). These geckoes may turn into a dark brown color.

TABLE 1. Metric and meristic data on the four species in the subgenus *Aristelligella*, genus *Aristelliger*. All measurements are in mm. Values are the mean (x) and the range (in parentheses). Fourth toe lamellae are reported for right/left digits.

	A. reyesi n. sp.		A. cochranae	A. expectatus	A. barbouri
Characters	Males (N=9)	Females (N=6)	N[1]= 20	N[2]=9	N[3]=5
Snout-vent length	56.5 (42.8–63.6)	50.6 (47.1–55.1)	47.6 (41–59.9)	43.2 (37–54.2)	43.5 (35–47.2)
Head length	13.6 (12.2–14.8)	12.1 (11.3–13.1)	12.2 (10.3–14.9)	10.5 (9.7–11.4)	10.2 (8.4–11.0)
Head width	11.4 (10.0–13.1)	9.7 (8.9–10.6)	9.5 (8.1–11.6)	8.4 (7.7–9.4)	8.4 (6.8–9.5)
Loreal scales	13 (11–14)	13 (11–15)	15 (15–16)	13 (12–14)	15 (14–16)
Supralabial scales	7 (7–9)	8 (7–8)	8 (7–9)	7 (6–9)	9 (8–10)
Infralabial scales	7 (5–9)	6 (6–7)	8 (7–9)	6 (5–8)	8 (7–8)
Dorsal granules in the snout-to-center of eye distance	28 (26–30)	30 (26–35)	35 (31–40)	26 (24–30)	26 (24–30)
Ventral scales in the snout-to-center of eye distance	14 (11–16)	14 (13–16)	15 (13–19)	15 (12–18)	14 (12–18)
Fourth toe lamellae (right/ left digits)	12 (11–14)/ 12 (10–15)	11 (11–12)/ 11 (11–12)	12 (11–13)/ 12 (11–13)	11 (8–11)/ 10 (8–11)	9 (8–10)/ 9 (8–10)
Ear longest diameter/ SVL (%)	2.5 (2.1–2.9)	2.1 (1.7–2.4)	3.4 (2.9–4.2)	3.6 (2.5–3.9)	2.4 (2.0–2.5)
Snout-to-center of eye distance/ SVL (%)	13.7 (13–14.4)	13.9 (13.3–14.3)	15.2 (14.2–15.9)	14.5 (12.9–16.8)	13.4 (13.1–14.2)

N (males/females): [1]10/10; [2]5/4; [3] 3/2.

Color in alcohol: General pattern remains essentially intact, but coloration becomes gradually gray or grayish brown.

Discriminant function analysis (DFA). The analysis of nine variables (SVL, total fourth toe lamellae, number of dorsal scales, number of ventral scales, number of loreal scales, supralabials scales, infralabials scales, snout to eye distance/SVL, and ear longest diameter/SVL) provided a 97.9% of total correct classification (Wilks' Lambda 0.013, approx. F (27, 105) = 14.23, p<0.00). Only one specimen in the sample of *Aristelliger expectatus* was not discriminated from *A. cochranae*, for a 91.7% of classification success (see Table 2). The remaining species were 100% correctly assigned. The model suggests that the combination of those characters has a strong diagnostic value as expressed by the representation of the two first canonical functions (Fig. 5). The four characters with the highest discriminant value were (in the following order): SVL, loreal scales, total fourth toe lamellae, and number of dorsal scales.

Etymology. We are pleased to name this new gecko after Ernesto Reyes, who provided the first evidence of its existence.

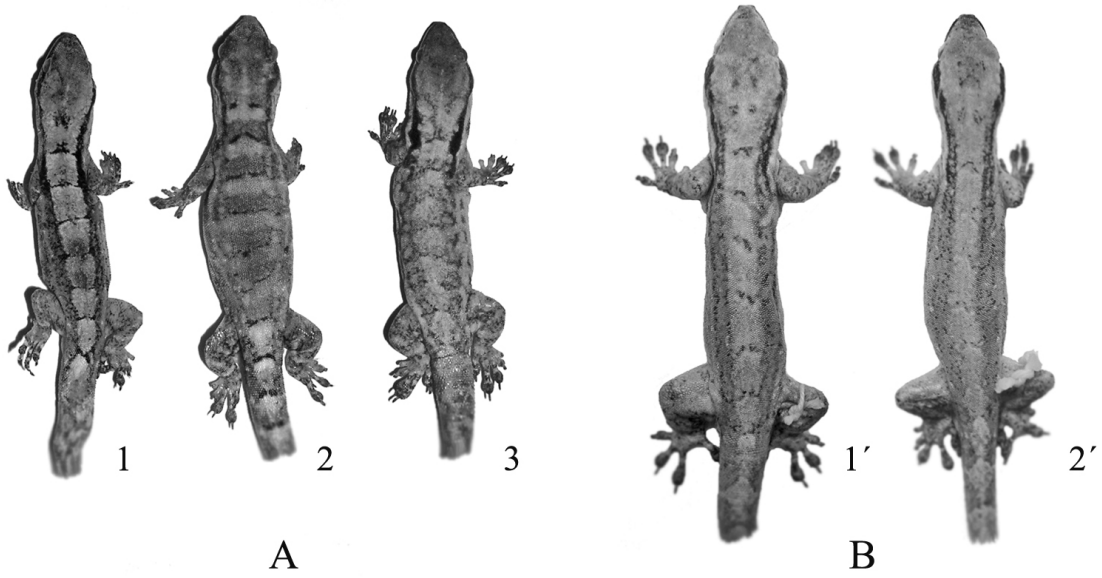

FIGURE 2. Pattern variation in preserved specimens of two closely related species of the subgenus *Aristelligella*, genus *Aristelliger*: [A] *Aristelliger expectatus*: (1) adult male MNHNCu 4691, from Oviedo, Península de Barahona, República Dominicana, showing a dorsal "ladder" pattern, (2) adult male MNHNCu 4692, same locality, with dorsal bands, and (3) male MNHNCu 4685, from Puerto Escondido, NW slope of Sierra de Bahoruco, República Dominicana, showing dorsal "saddles"; [B] *A. reyesi* **sp. n.**, holotype male (1′) and paratype female (2″) (MNHNCu 4674), with typical patterns. Photographs by L. M. Díaz.

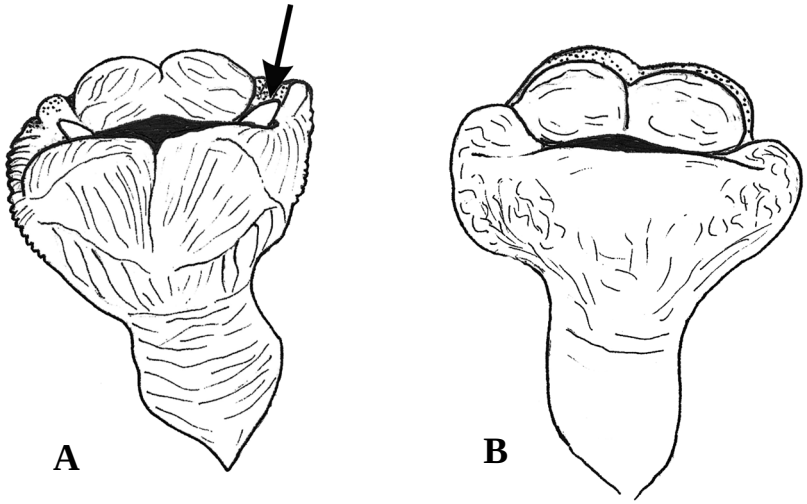

FIGURE 3. Asulcal view of the right hemipenis of (A) *Aristelliger reyesi* **sp. n.** (paratype male MNHNCu 4667) and (B) *A. expectatus* (MNHNCu 4690). Note the two horn-like papillae (signaled by the arrow) in the new species. Drawings by L. M. Díaz.

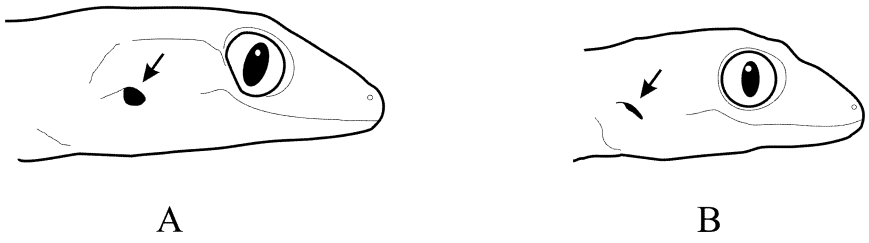

FIGURE 4. Ear opening shape in (A) *Aristelliger reyesi* **sp. n.** (holotype male), and (B) *A. expectatus* (male MNHNCu 4691). Drawings by L. M. Díaz.

TABLE 2. Classification matrix obtained from the Discriminant Function Analysis of nine variables in four species of *Aristelliger.*

	Percent correct	*A. barbouri* p=0.104	*A. expectatus* p=0.250	*A. cochranae* p=0.416	*A. reyesi* **sp. n.** p=0.229
A. barbouri	100	5	0	0	0
A. expectatus	91.66	0	11	1	0
A. cochranae	100	0	0	20	0
A. reyesi **sp. n.**	100	0	0	0	11
Total	97.91	5	11	21	11

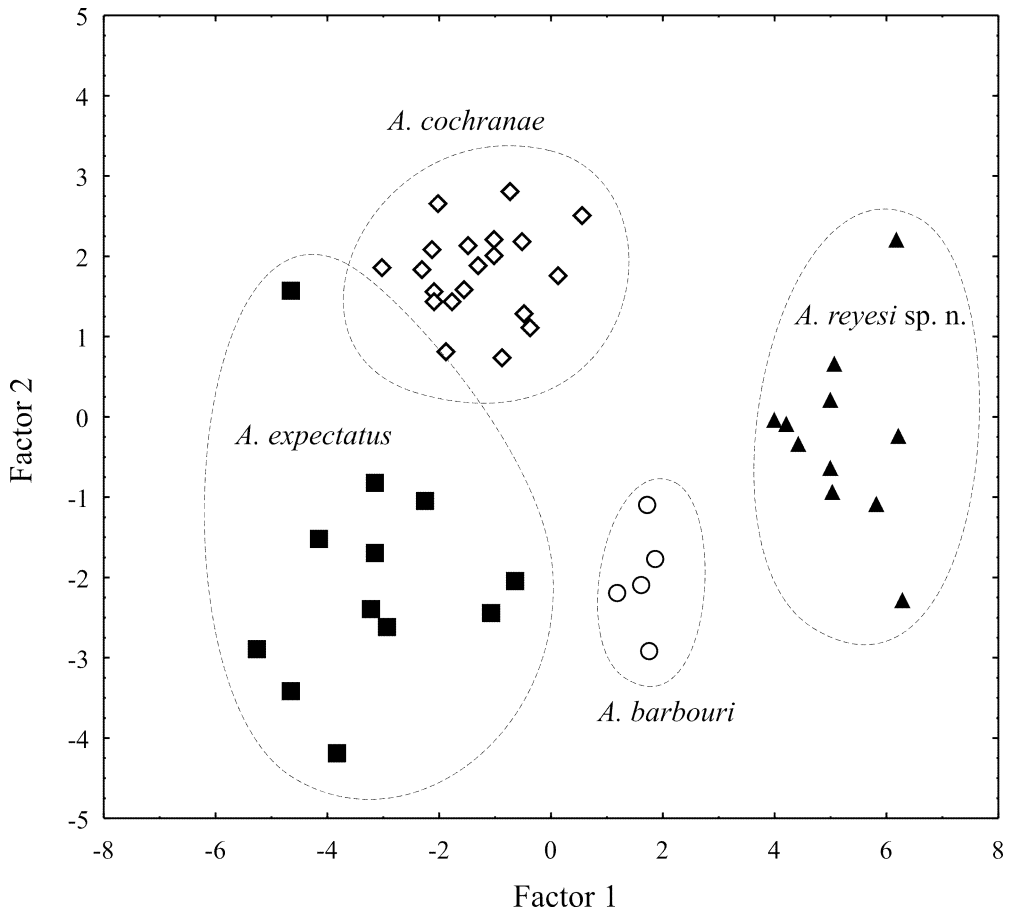

FIGURE 5. Representation of the two first canonical functions after discriminant analysis of four species of the subgenus *Aristelligella*, genus *Aristelliger.*

Distribution. Only known from the Península de Hicacos (Fig. 6), Matanzas Province, Western Cuba. The type series was collected between Cueva de Ambrosio and the Estación Ecológica de Varahicacos, which are separated by approximately 800 m; however, a single male was seen (not collected) during the day climbing the rustic roof of a restaurant in a populated village about 20 km SW from the type locality.

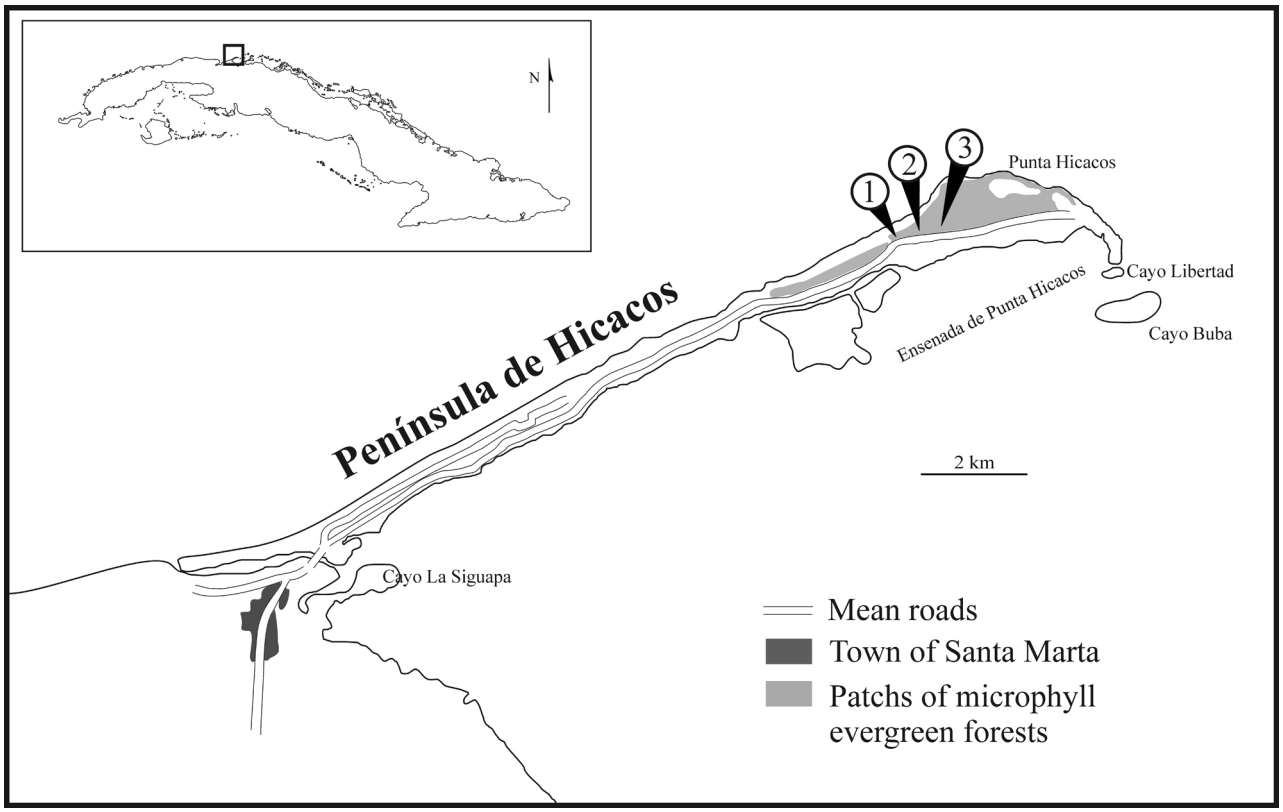

FIGURE 6. Distribution of *Aristelliger reyesi* **sp. n.** in Península de Hicacos, Matanzas Province, Western Cuba. Numbered localities: (1) Cueva Ambrosio, (2) Sendero Los Musulmanes, and (3) Estación Ecológica de Varahicacos.

Ecological notes. Individuals of *Aristelliger reyesi* were relatively easy to find in several habitats, both during the day and at night, suggesting the existence of a large population. Lizards were detected on limestone outcrops, cliffs, caves entrances, rocky shelters, sinkholes, rustic wooden houses roofed with "*guano*" (palm fronds), tree cactus (*Dendrocereus nudiflorus*), and on fig (*Ficus* sp.) root tangles (Fig. 7). At some places, we collected or observed 4–5 of these geckoes within an area of less than five meters. The limestone rock at the type locality was mostly covered by a microphyll evergreen forest.

Two males were seen fighting during the midday on fig roots at Cueva Ambrosio. One of these males (MNHNCu 4666) easily lost pieces of head skin when handled during the collection. Most of the individuals exposed on limestone surfaces were always very close to small holes that serve as refuge, or were partially hidden within them. When collected, some males produced croaking distress calls. Many females were gravid, with a single egg easily seen trough the ventral skin. Three of them laid white, oval eggs in isolated terraria, all firmly attached to the inner surfaces of bamboo tubes offered as shelters (Fig. 8). Two of those eggs measured 10.6 x 8.4 mm and 10.8 x 9.1 mm, respectively. The absence of juveniles during the field work suggested us that the breeding season was probably starting.

Geckos were detected at heights of one to three meters above the ground. The following ingested items were found in lizard feces: ants (including several winged females of *Camponotus* sp.), adult neuropterans, beetles, shed skin, and small stones. Other reptiles observed at the surroundings of the type locality were: *Sphaerodactylus intermedius*, *S. e. elegans* (Sphaerodactylidae), *Tarentola a. americana* (Gekkonidae), *Anolis allisoni*, *A. a. angusticeps*, *A. equestris buidei*, *A. p. porcatus*, *A. pumilus*, *A. s. sagrei*, *A. h. homolechis*,

Leiocephalus c. carinatus, *L. c. cubensis*, *L. raviceps klinikowskii* (Iguanidae), *Ameiva auberi abducta* (Teiidae), *Tropidophis m. melanurus* (Tropidophiidae), *Arrhyton dolichurus* (new locality record), *Antillophis a. andreai*, and *Alsophis c. cantherigerus* (Dipsadidae).

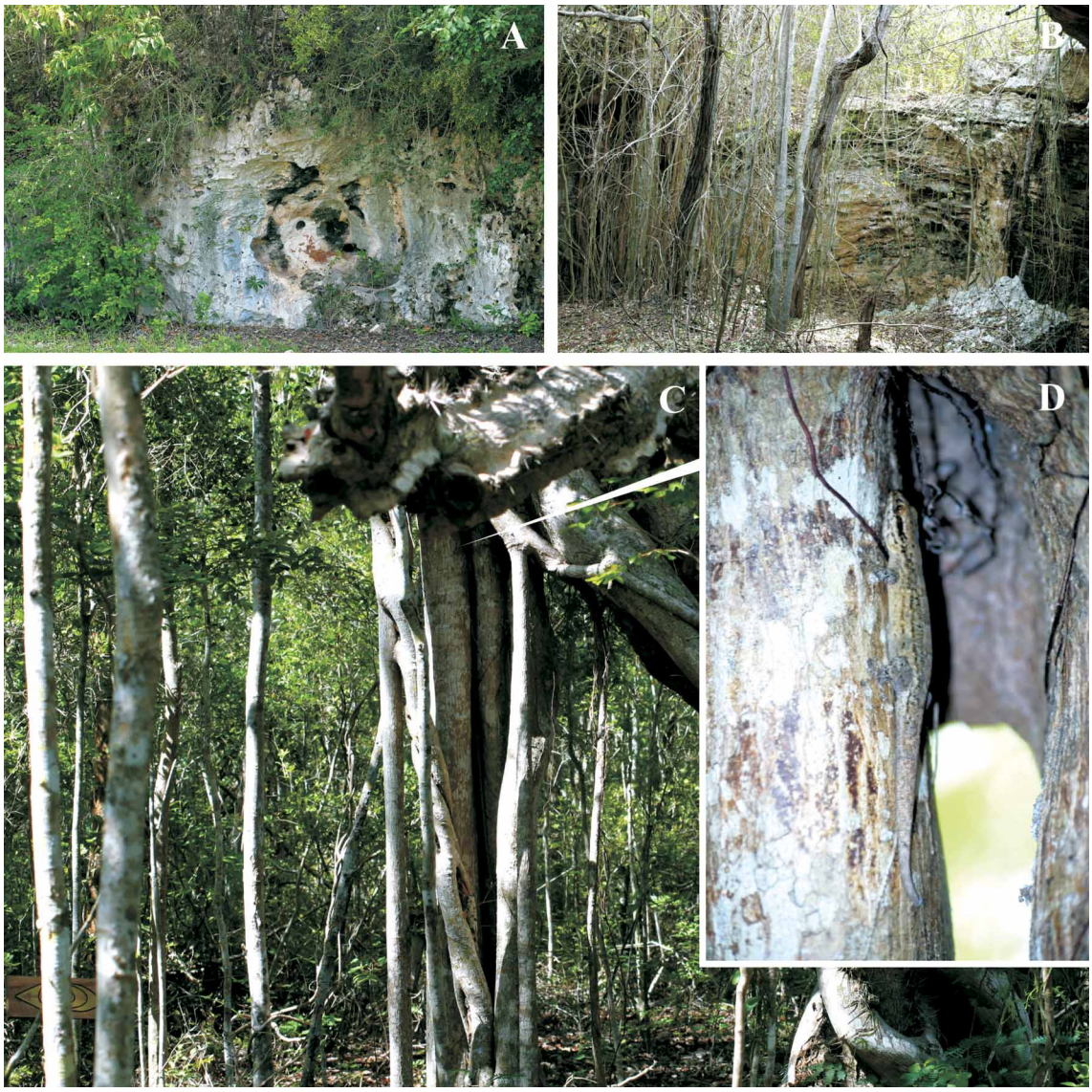

FIGURE 7. Typical habitats of *Aristelliger reyesi* **sp. n.** on the Península de Hicacos: (A) Limestone cliffs near the entrance of Cueva Ambrosio. (B) Sinkhole inside Cueva Ambrosio. (C) A tree cactus (*Dendrocereus nudiflorus*) supporting a strangler fig (*Ficus* sp.). (D) Adult male (MNHNCu 4670) photographed *in situ* on aerial fig roots during the midmorning of 5 June 2007. Photographs by Ernesto Reyes.

Discussion

The discovery of *Aristelliger reyesi* was unexpected, especially because it was found near Varadero beach, one of the most popular tourist locations in Cuba, where this gecko has been unnoticed despite its abundance. This raises the possibility, that we have considered, that this species was introduced by humans from its native habitat elsewhere (e.g., from another part of Cuba or from Hispaniola). Although we cannot completely rule out this possibility, our morphological comparisons show that it is a new species of *Aristelliger* regardless of whether it is native to Cuba or was introduced. Also, analyses of DNA sequences of the 16S and 12S ribosomal RNA genes (~2400 base pairs) from *A. reyesi* and other West Indian species and populations

(S.B.H., unpublished) confirm the assignment (based on morphology) of this species to the subgenus *Aristelligella*, as well as support of its distinction from other species in that subgenus.

FIGURE 8. Egg of *Aristelliger reyesi* **sp. n.** attached to the inner surface of a bamboo tube offered as shelter in captivity.

Aristelliger reyesi reaches a similar maximum SVL as *A. cochranae*. However, in the series examined by us and in the literature (Hecht, 1952; Lynxwiler and Parmerlee, 1993), specimens of *A. cochranae* would appear to be slightly smaller [males 52.3 mm (42–63); females 43.9 mm (41–47)] than those of *A. reyesi*. However, because *A. expectatus* was confused with *A. cochranae* in some of the earlier references, and the specimens examined were not always listed, there remains some ambiguity as to body size differences among *A. cochranae*, *A. expectatus*, and *A. reyesi*. The other member of the subgenus *Aristelligella*, *A. barbouri*, is smaller, with males reaching a maximum SVL of 50 mm.

The adult color pattern of most species in the genus *Aristelliger* develops from a juvenile "ladder" pattern consisting of middorsal rhombs, "saddles", or bands. An embryo of *A. reyesi* (MNHNCu 4680), close to hatching, showed a general pattern similar to that of adults, but with more uniformly-colored lateral zones, and a conspicuous middorsal series of small pairs of dots along body. A somewhat similar juvenile pattern also occurs in *A. cochranae*, but with better defined rhombs and bands as noted by Lynxwiller and Parmerlee (1993) and observed by us in uncataloged specimens of *A. cochranae*. A juvenile of *Aristelliger expectatus* (MNHNCu 4687), from Puerto Escondido (north slope of Sierra de Bahoruco), has a conspicuous pattern of bands and "saddles", somewhat similar to that described by Noble and Klingel (1932:6) for *A. barbouri*. Color changes during ontogeny seem to be more accentuated in the other species of the subgenus *Aristelligella* than in *A. reyesi*, but considering the limited juvenile material available this is only a preliminary observation.

Males of *Aristelliger reyesi* and *A. expectatus* were actively breeding when they were collected, so the presence-absence of the hemipenis papillae reported as diagnostic character in these species is not expected to be associated to different reproductive conditions.

The fragile environment of the Península de Hicacos is presently threatened by rapid development related to tourism. Because the entire known distribution of this newly discovered species—the only representative of its genus in Cuba—is restricted to the peninsula, efforts should be made to protect its habitat.

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Appendix I. Specimens examined for comparisons.

Uncataloged specimens belongs to the research collection of S. Blair Hedges, Pennsylvania State University.

Aristelliger barbouri (N=6).—KU 228566–67, 228571, 228573, 228575, from Great Inagua, Bahamas; and an uncataloged specimen from 1.2 km E John Gray Hill, Great Inagua.

A. cochranae (N=21).—Navassa Island: BWMC 6178–6182, 6186–6188, 6204, 6210–6211, 6216, 6220, and two uncataloged specimens.

A. expectatus (N=13).— USNM 328909 and an uncataloged specimen from Pedernales, Dominican Republic; an uncataloged specimen from Los Pinos, Independencia, Dominican Republic; MNHNCu 4685–87, Puerto Escondido, NW slope of Sierra de Bahoruco, Dominican Republic; MNHNCu 4690–93, Oviedo, Península de Barahona, Dominican Republic; MNHNCu 4688–89, Juan Esteban, Península de Barahona, Dominican Republic; USNM 75908 (holotype), Jacmel, Haiti.