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A New Species of Green Anole (Reptilia, Sauria) from the North Coast of Veraguas, Panama

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ABSTRACT

Anolis procellaris is described from lowland forest on the Atlantic coast of western Panama. The new species is a small, slender lizard of uncertain relationships. It is superficially similar to *Anolis chloris* Boulenger, an allopatric species that is found from eastern Panama to northwestern Ecuador, but osteological evidence and different kinds of green pigmentation indicate that the two species belong in different sections of the genus *Anolis*. A key is provided for determining the species of green anoles that occur in Panama, and photographs from life are presented of the following species: *Anolis biporcatus*, *A. chloris*, *A. chocorum*, *A. frenatus*, *A. latifrons*, and *A. procellaris*. *Anolis aquaticus* is incidentally recorded from Panama for the first time; the known geographic range of *Anolis chocorum* is extended southward to the Río San Juan in western Colombia, and a specimen from a disjunct population in extreme western Panama is tentatively assigned to this species.

INTRODUCTION

West of the Canal Zone, one may sail along the north coast of Panama for well over 200 kilometers before finding all-weather anchorage. The frequency of strong winds and heavy surf makes landings seasonally irregular and sometimes hazardous on this section of coast, which is

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accessible only by boat and by airplane at one or two tiny landing strips. Foothills of the Serranía del Tabasará come close to the ocean, thus interrupting prevailing northerlies and causing abundant rainfall; the human population is low and the lush evergreen forest is virtually unbroken. Because of the climate and travel difficulties, therefore, the lands bordering on the Golfo de los Mosquitos are little known, although biogeographically important. While investigating the distributional limits of certain amphibians and reptiles in this region, I found one specimen of an attractive green lizard of a heretofore unknown species. The name I propose for it is derived from the Latin *procella* (a strong wind or storm) plus the adjectival suffix *-avis* (pertaining to), in allusion to this windy coast and to a near misfortune, when the only specimen was almost lost at sea the day after capture.

***Anolis procellaris*, new species**

Figures 2A; 3A, B

HOLOTYPE: KU¹ 113452 (Field No. CWM 7377), an adult female caught by Charles W. Myers on October 25, 1966, in forest near the mouth of the Río Concepción, 1-10 meters elevation, Province of Veraguas, Republic of Panama (fig. 1).

DEFINITION AND DIAGNOSIS: A small, slender, green forest anole of the beta group, having transverse processes on some of the autotomous caudal vertebrae. No color repertory, green in life and death, but fading to pale yellowish brown (not blue) in alcohol; throat lining not pigmented. Head scales small, keeled on snout and in supraorbital disks; small granules in shallow frontal depression; frontal and canthal ridges weak; elongated supraciliary scale present; interparietal large relative to other scales. Trunk with tiny, smooth granules, largest on venter. About 15 lamellae on phalanges ii and iii of fourth toe.

The precise relationships of *Anolis procellaris* are unknown. Among green anoles in lower Central America, it is most likely to be confused in life with *A. chloris* (compare fig. 2A and B). The latter, however, is not closely related, as is shown by apparently basic differences in its caudal vertebrae (no transverse processes on autotomic vertebrae) and in its pigmentation (turns blue in perservative). Specimens are easily distinguished by a feature of head scutellation: *Anolis procellaris* has small granules in the frontal depression and noticeable enlargement of some scales in the supraorbital disks, whereas in *A. chloris* the scales in the frontal depression are

¹Museum abbreviations used in this paper are: AMNH, the American Museum of Natural History; KU, the University of Kansas Museum of Natural History, Lawrence.

as large as, or even larger than, the non-enlarged scales in the supra-orbital disks. *Anolis chloris* also differs in having keeled ventrals; see also section on comparisons, page 10.

Preserved specimens conceivably might be confused with the sympatric *Anolis limifrons* or with the possibly sympatric *A. fuscoauratus*, both of which

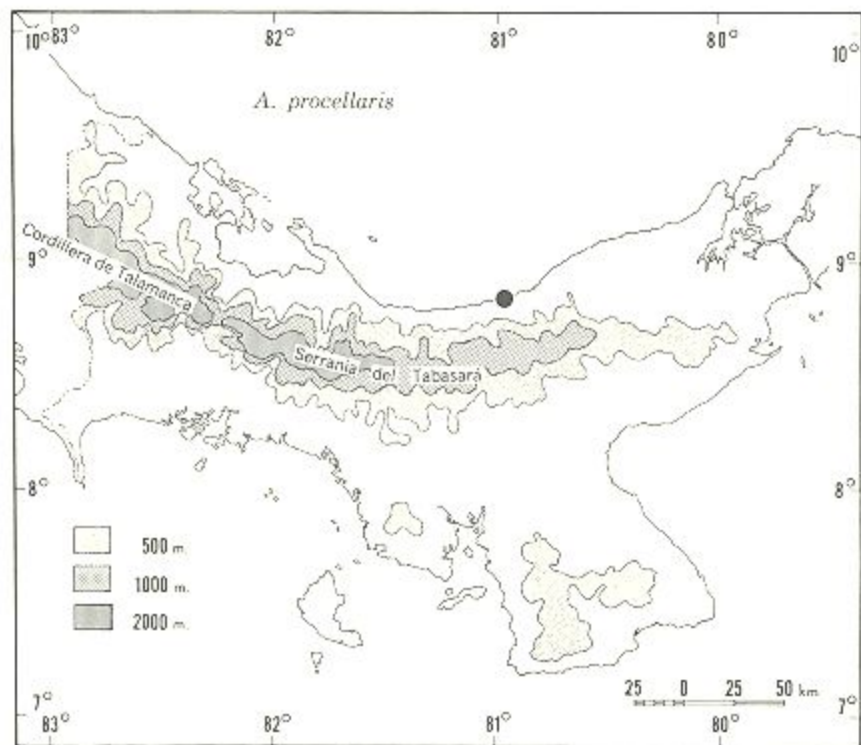


FIG. 1. Western Panama, showing the type locality of *Anolis procellaris*, new species.

are brown in life, but *procellaris* fades to a much paler brown. *Anolis procellaris* also has a much less conspicuously banded tail than *A. limifrons* and lacks an oblique pale line across the top of the shank, and it has longer legs than *A. fuscoauratus*, in which the appressed hindlimbs usually fail to reach the eye. Other comparisons must await a study of *Anolis limifrons* and its relatives in Panama.

DESCRIPTION OF HOLOTYPE: Snout to vent length 46 mm., total length 129 mm.; limbs moderate, longest toe of appressed hindlimb reaching rear edge of eye, longest finger of extended forelimb reaching nostril;

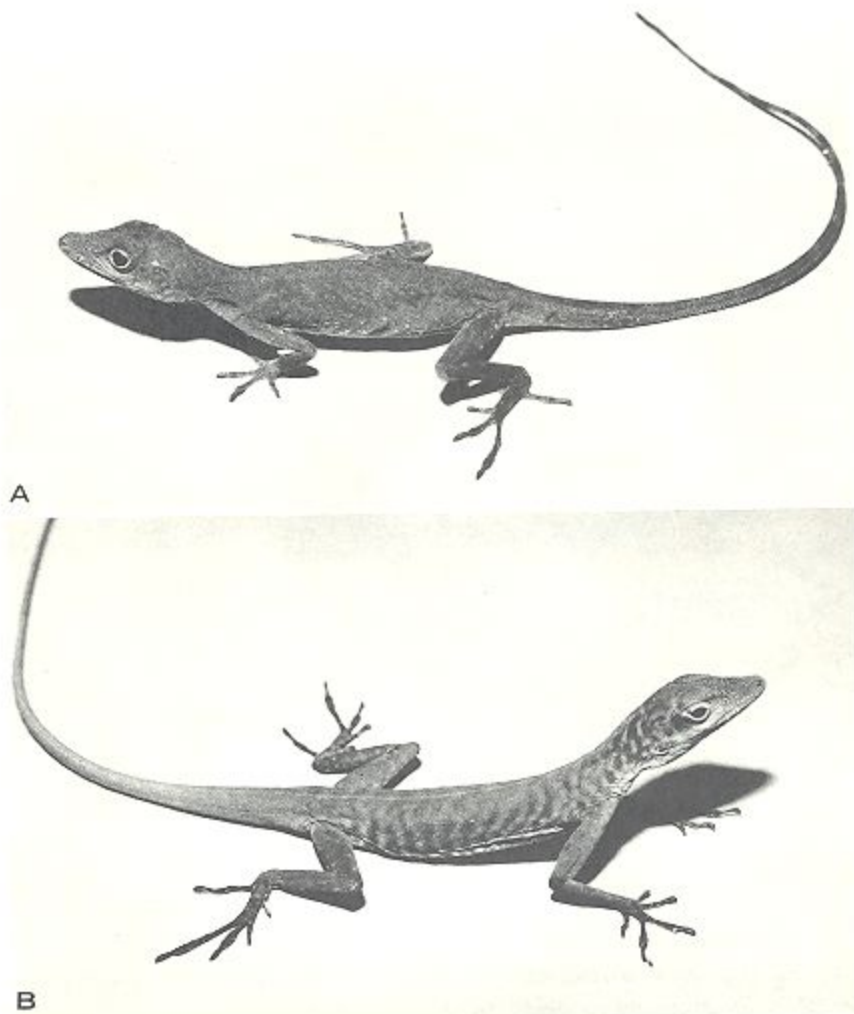


FIG. 2. A. *Anolis procellaris*, holotype, photographed in life. B. *Anolis chloris* Boulenger, KU 113109, from the Río Jaqué, Darién Province, eastern Panama; lateral dark markings may be absent on other individuals and are not diagnostic of *A. chloris*. Both approximately $\times 1.2$.

humerus 7.1 mm., ulna 4.7 mm., femur 12.0 mm., and tibia 9.8 mm. (bones measured from radiograph); lower leg between outer limits of knee and heel 12.2 mm., fourth toe 7.9 mm.; head length 12.0 mm. from snout to front edge of ear; head width between corners of mouth 6.8 mm., head height 5.3 mm. Specimen an adult female, as determined by

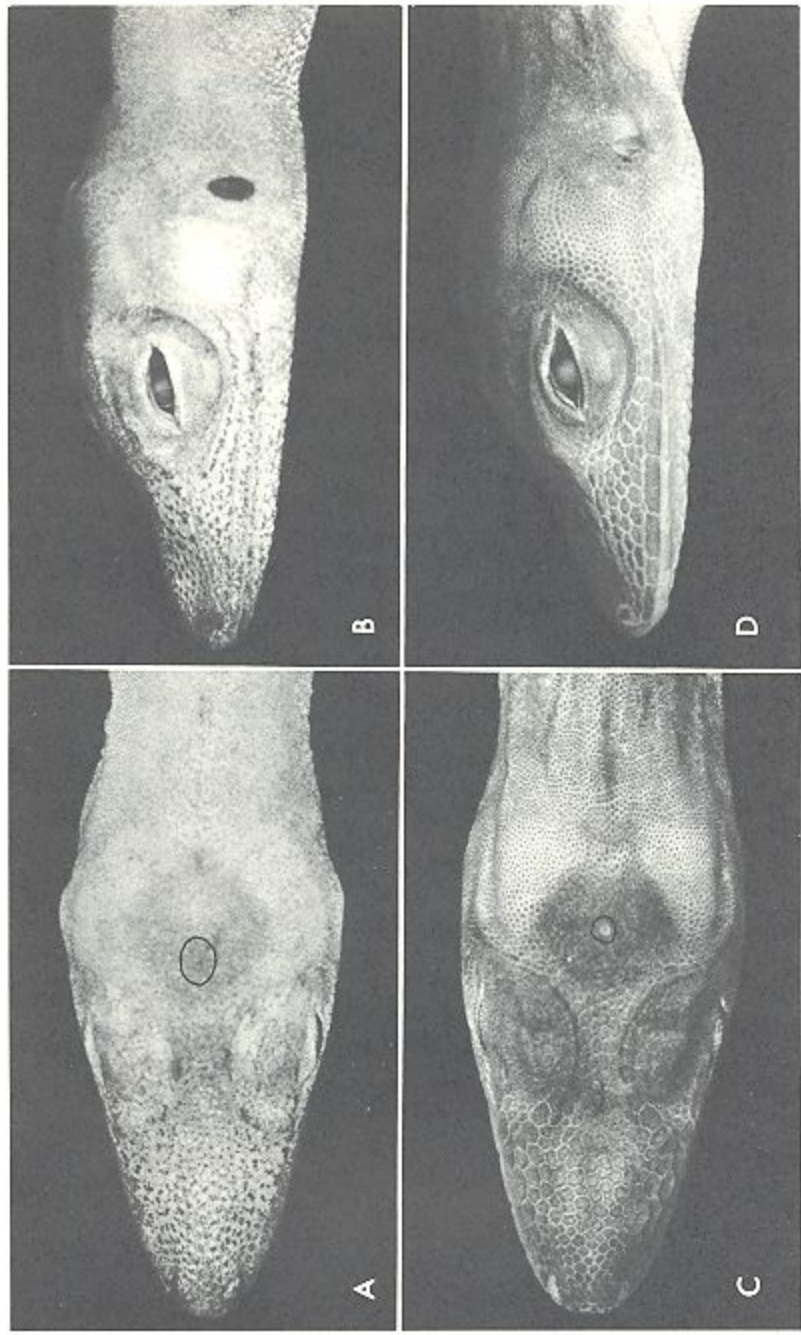


FIG. 3. A, B. Head of *Anolis punctularis* (holotype). C, D. Head of *Anolis chloris* Boulenger (KC 113109). The interparietal scale is outlined in black.

presence of shelled oviductal egg (8.7 mm. long, measured from radiograph).

Green in life and death (before preservation). All dorsal surfaces light green, with pale, inconspicuous blue dots along sides of body and on limbs; faint darker green banding on tail. Venter white, turning greenish flesh under limbs and base of tail. Vestigial dewlap pale gray with closely spaced white scales; iris brown; no pigmentation to tongue or to mouth and throat lining. In alcohol, faded to pale yellowish brown above, with a dusting of melanophores; these pigment cells forming dense punctations on top and sides of snout; vague tail bands now light brown, about 15 in number; venter yellowish white, turning pale yellow under limbs and slightly gray under chin; ventral side neither sharply demarcated from dorsal surfaces nor much paler.

Head scales small, those on tip of snout, loreal region, and in supra-orbital disks keeled, those in frontal depression smaller and granular. Rostral tipped forward, with dorsal edge slightly projected and forming a transverse keel; seven postrostral scales, lowermost one separating rostral from circumnasal scale. Frontal ridges very weak; shallow frontal depression containing both convex and conical granules only half the size of small carinate scales in internarial region. Canthus rostralis weakly keeled, nearly rounded, containing nine scales posteriorly increasing in size, with the ultimate scale being much largest and tipped abruptly upward. Ten carinate scales across top of snout between circumnasals; about 15 scales across snout posterior to nasal region, between third canthals; about 17 scales, including a count of 10 granules in frontal depression, between ultimate canthals. Three scales between supraorbital semicircles; one or two granules between semicircle and scales of supra-orbital disk; about seven enlarged, single-keeled scales in each disk; four indistinct lines of granules between disk and supraciliary margin, this being posteriorly composed of undifferentiated granules and anteriorly of a long, keeled supraciliary scale.

Roughly 45-50 keeled loreal scales on left side, disposed in maximum of six horizontal rows; subocular scales in single row, anteriorly forming two rows of smaller scales indistinguishable in shape and size from loreals; 10 supralabials to center of eye on each side of head.

Temporal region and upper, rear part of head with minute, convex granules grading to a few larger, flat granules around interparietal scale. Interparietal the largest scale on head, somewhat larger than ear opening, and separated from supraorbital semicircles by four granules.

Mental wider than rostral, almost completely divided in middle. Ten

infralabials to a point beneath center of eye, on both sides; sublabials poorly differentiated, small, smooth, in several rows medial to infralabials; throat granules smaller, convex, becoming clustered and smaller still on vestigial dewlap.

Dorsum and sides of trunk pebbled with tiny, convexly smooth, subequal granules, vaguely disposed obliquely. Ventral granules small, but distinctly larger than dorsals, with slightly raised, smooth surfaces. About 85 dorsolateral granules and 50 ventral granules in one head-length.

No pocket in axilla. Limbs covered with tiny scales, smooth and juxtaposed on upper parts of limbs, tending to become keeled and imbricate distally. Supradigital scales with multiple ridges. Digital pads weakly dilated; distal phalanx distinctly narrower than, and raised from, the dilated pad; 15 lamellae under second and third phalanges of fourth toe.

Tail rounded, basally with granules like those on trunk, but most of length with strongly keeled, imbricate scales; ventral caudal scales largest and most heavily carinate; middorsals slightly enlarged but not forming median crest or ridge; verticils poorly defined, containing about 5-8 lateral scales in length.

Eight basal, non-autotomic postsacral vertebrae, with transverse processes changing from posterolateral orientation in first seven vertebrae to lateral in eighth. Postsacral vertebrae 9-18 autotomous and with tiny transverse processes of strong anterolateral orientation; processes situated posterior to fracture plane. Transverse processes absent on other caudal vertebrae (19-49), but autotomy septa present on many.

FIELD NOTES

The holotype of *Anolis procellaris* was found in a dense river-swamp forest that is dominated by an understory of large palms (fig. 4). The ground surface is nearly flat and is drained by small clear streams flowing sluggishly over mud; water stands on the surface after rains and the forest is probably subject to extensive flooding. There is the possibility, however, that the specimen was a stray, inasmuch as it was found near the base of a low ridge that led to higher, better drained rain forest.

The lizard was in a tangle of vines about 3 meters above the ground when I first sighted it, and it eluded capture for several frantic minutes before being finally knocked down with a pole. The specimen was kept alive for a few days, during which time it proved capable of passing through only a few shades of light green.

Only the one specimen of *Anolis procellaris* was found in three days of collecting on the lower Río Concepción. The area harbors a rich anoline

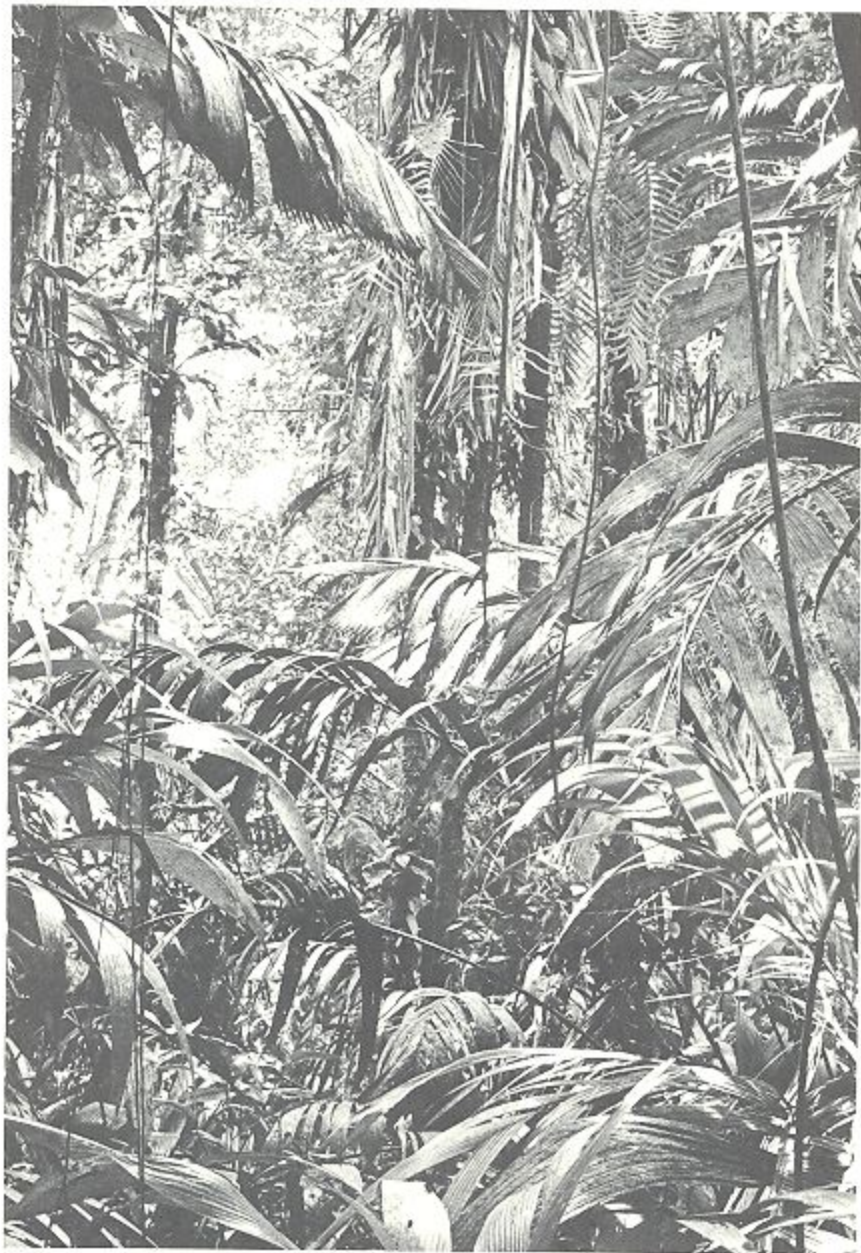


FIG. 4. The type locality of *Anolis procellaris*: River-swamp forest near the mouth of the Rio Concepción, 1-10 meters elevation, Veraguas, Panama (October 25, 1966).

fauna, as the following six species were also taken in this short time, and others doubtlessly occur: *Anolis biporcatus*, *A. frenatus*, *A. humilis*, *A. lemurinus*, *A. limifrons*, and *A. lionotus*.

COMPARISONS

The large distribution and size of the genus *Anolis*, and my ignorance, preclude exhaustive evaluation of the affinities of *A. procellaris* at this time. For the present, it will be compared only with other green species of lower Central America.

The anoline fauna of the region is large—I personally have collected more than two dozen species in Panama alone—but green species make up less than a quarter of the total. The green species known to me to occur in Panama are separable by the key below; I am not aware of any additional green anoles in lower Central America that do not reach Panama, but that country has four such species that are unknown to the north.

KEY TO GREEN PANAMANIAN *Anolis*

1. Ventrals keeled (magnification may be needed to distinguish keels on small specimens) 2
 Ventrals smooth 4
2. A pale lateral line and dark crossbands on body; dorsal trunk scales distinctly larger than lateral granules *A. aquaticus*¹
 Never a horizontal pale line on body; crossbands absent or very vague; no conspicuous enlargement of dorsal scales 3
3. Small, slender species less than 60 mm. snout to vent; head length (snout to ear) about equal to tibial length; throat lining white *A. chloris*
 Larger, more robust lizards; head much longer than tibia; throat lining black *A. biporcatus*
4. Small species, no more than about 50 mm. snout to vent; almost uniformly colored, without darker markings on body; granules in frontal depression about half the size of scales in internarial region *A. procellaris*
 Larger species; oblique rows of spots or stripes on body (except in some specimens of *chocorum*); scales in frontal depression larger than, or about the same size as, those of internarial region 5
5. Moderate-size species to about 80 mm. snout to vent; ear opening small, about equal in size to interparietal scale; lining of throat black
 *A. chocorum*
 Giant species, exceeding 100 mm. snout to vent; ear opening large, twice the size of interparietal scale; throat lining white 6

¹ *Anolis aquaticus* Taylor is not strictly a green anole, but young specimens at least may have extensive areas of green on the body. The species has not been previously reported from Panama, but it occurs along forested streams in the highlands of Chiriquí Province, as represented by AMNH 73345 and specimens in the University of Kansas collection.

6. Keeled, elongated supraciliary scale present anteriorly, but only undifferentiated granules present on posterior half of supraciliary margin, which remains soft and flexible throughout life *A. frenatus*
 Enlarged, keeled scales on entire length of supraciliary margin, which in adults is projected out over eye to form a bony ridge *A. latifrons*

Anolis procellaris will not be confused with any of the larger, invariably well-patterned species, namely *A. aquaticus* Taylor, *A. frenatus* Cope, and *A. latifrons* Berthold. Also, *Anolis chocorum* Williams and Duellman¹ often has a distinct pattern of obliquely arranged dark markings on the body; those that do not can be distinguished from *procellaris* by the larger scales in the frontal depression, larger size of adults, presence of a large dewlap in females, and by a black throat lining.

Anolis biporcatus (Wiegmann) often is uniform green, but aside from being a larger, more robust lizard with keeled ventrals, it differs from *A. procellaris* in having a color repertory (green to brown) and a black throat lining.

The only green anole in lower Central America that at first seems to warrant detailed comparison is *Anolis chloris* Boulenger, which occurs from extreme eastern Panama southward through the Pacific lowlands to northwestern Ecuador. In life *Anolis chloris* is quite similar to *A. procellaris* in color, size, and habitus as indicated by comparison of figure 2A and B. But close inspection reveals differences which leave no doubt that two distinct species are involved. Differences that seem especially significant are the following:

Anolis chloris
 Ventrals keeled

Anolis procellaris
 Ventrals smooth

¹ *Anolis chocorum* has a larger distribution than previously reported. I recently collected specimens (AMNH 105883, 105884) that extend the range to the upper Río San Juan, Departamento Chocó, a distance about 200 kilometers south of the only previous Colombian locality in the Río Atrato drainage; an older record for the Río San Juan (Boulenger, 1913), under the name "*Anolis fasciatus*," might also be based on specimens of *chocorum*. But, of greater interest is a lizard (AMNH 103778) obtained by James Duke on the Río Teribe, Bocas del Toro Province, extreme western Panama (not far from the Costa Rican border). This specimen was donated to the American Museum of Natural History by Howard Campbell, and it extends the known range by more than 550 kilometers from the nearest locality in eastern Panama. If there has been no mix-up of locality data, the population represented by the specimen is almost certainly a disjunct remnant of some former distribution. The specimen is an adult female having a fairly large and characteristically pigmented dewlap, and it agrees well with previously known specimens of *chocorum* except in having a few more internarial scales and in having solid stripes on the flanks rather than rows of spots. The identification must nonetheless be considered tentative pending fresh material and further study.

No conspicuously enlarged scales in supraorbital disks	Enlarged scales present
Scales in frontal depression as large as those between nares and often larger than those in supraorbital disks	Small granules in frontal depression, only half as large as internarial scales and very tiny compared with supra-orbitals
Interparietal not enlarged, smaller than many other head scales	Interparietal the largest scale on head
Hindlimbs relatively shorter (usually not reaching eye) and forelimb relatively longer (extending past tip of snout)	Appressed hindlimb to eye, extended forelimb to nostril
Green color turns blue in preservative	Green color turns pale yellowish brown in preservative
No anterolaterally directed transverse processes and no autotomy septa on caudal vertebrae	Anterolaterally directed transverse processes present on some of the autotomy vertebrae

The last two characteristics are indicative of more than mere species distinction and suggest that the gross similarities of *chloris* and *procellaris* are due to convergence rather than close relationship. Although both species are light green in life, as documented by my field notes and color transparencies, there must be a basic difference in their pigmentary systems. My specimens were all preserved in the same manner (fixed and initially stored in formalin, and transferred to ethanol after a few weeks to a month), but the holotype of *procellaris* bleached to a pale yellowish brown and the *chloris* became blue. This is reminiscent of the diagnostic color changes undergone in preservative by representatives of different species-groups of centrolenid frogs. Considerable taxonomic weight evidently can be given to osteological differences between *procellaris* and *chloris*: Richard Etheridge, in an unpublished doctoral dissertation (not seen), divided *Anolis* into alpha and beta sections, and, according to Williams (1965, p. 10), placed *chloris* in the South American alpha group. A Panamanian specimen of *chloris* (KU 113109) lacks autotomy septa and has transverse processes only on the basal caudal vertebrae, and consequently does not agree with the alpha group as briefly defined by Etheridge (1967, pp. 705, 717) in a general account of lizard caudal vertebrae. The holotype of *Anolis procellaris*, in contrast, has anterolaterally directed processes on some of the anterior autotomy vertebrae. *Anolis procellaris* thus agrees most closely with the beta section as defined by Etheridge in his 1967 paper, and its relatives are presumably not to be sought among alpha-group species, which include most of the green anoles in lower Central America. *Anolis biporcatus* is said by Etheridge (*vide* Williams, 1966, p. 2) to be a beta anole, but this species is too different (see above) to be suggested as a very close

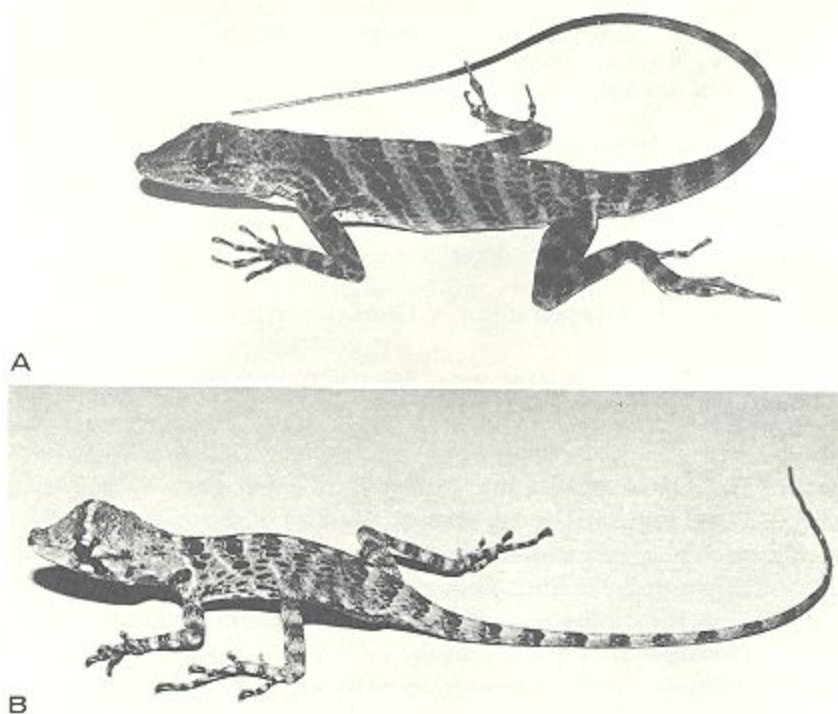


FIG. 5. Green anoles from Panama, photographed in life: A. *Anolis frenatus* Cope, KU 113117, from the mouth of the Rio Cahuita, Bocas del Toro. B. *Anolis latifrons* Berthold, KU 113180, a juvenile specimen from the upper Rio Jaqué, Darién. Not to same scale.

relative. *Anolis procellaris* might well receive attention in any future investigation of the relationships of *Anolis fuscoauratus* D'Orbigny and *A. limifrons* Cope, two widely distributed brown lizards that share with *procellaris* certain features of squamation and habitus. The restriction to green species in the present paper has been pragmatic, for I certainly do not insist that the closest relatives of *Anolis procellaris* might not be some color other than green.

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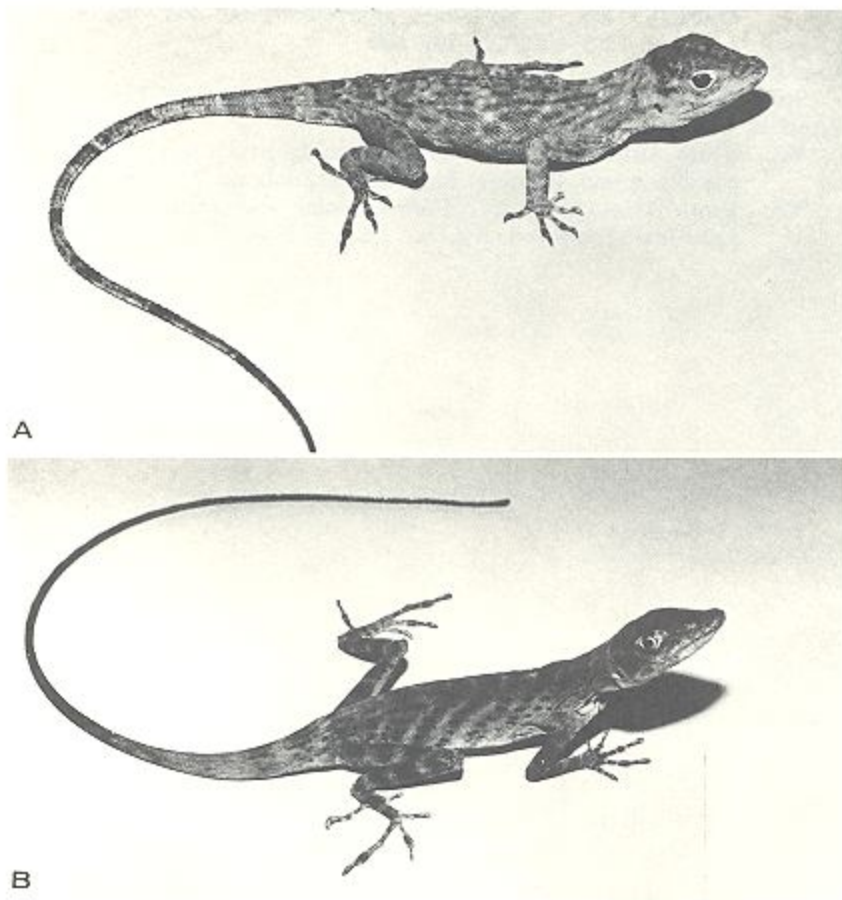


FIG. 6. Green anoles from Panama, photographed in life: A. *Anolis biporcatus* (Wiegmann), KU 108004, from the mouth of the Rio Concepción, Veraguas. B. *Anolis choconum* Williams and Duellman, KU 113110, from Cerro Sapo, Darién. Not to same scale.

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