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Ecological and Taxonomic Notes on Nicaraguan Anoles

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Abstract. Fourteen species of *Anolis* are here recorded from Nicaragua, with first definite records for *A. carpenteri*, *A. laevis*, and *A. sminthus*. *A. cupreus* is rare in the Pacific versant, but is commoner in montane areas of the Caribbean versant, where it is darker and more arboreal in habits. This Caribbean population of *A. cupreus* is described as a new subspecies. Species most characteristic of the wet Caribbean lowlands, but occurring also in the central mountain ranges, include *A. carpenteri*, *A. humilis*, and *A. limifrons*.

The anole fauna of Central America is remarkably abundant and diverse. Many recent publications have dealt with the anoles of southern México and Costa Rica, but there has been relatively little study of those in Nicaragua since the original descriptions of several species by Hallowell (1860) and Cope (1861) over a century ago. Nicaragua, hence, constitutes a hiatus of sorts in the known distribution and relationships of various anole species. The present study was undertaken with the hope that some of these relationships could be clarified. Our findings are based upon field work in four seasons (1976, 1981, 1982, 1983) and on material in the University of Kansas Natural History Museum, some 239 specimens of 14 species from 35 localities representing all parts of the country. Recent publications listing or discussing Nicaraguan anoles include Fitch and Henderson (1976), Peters and Donoso-Barros (1970) and Villa (1983).

We are indebted to Sr. Reynaldo Arosteguí for scientific collecting permits and for transportation and other facilities provided by *Instituto de Recursos Naturales y Ambiente* in Nicaragua. Eduardo Almendárez, Juan Arellano, Robert W. Henderson, Mirasol Sánchez, and Miryam Zeledón helped with collecting. Wm. E. Duellman kindly made available facilities of the University of Kansas Museum of Natural History. Jaime Villa read our manuscript and contributed valuable suggestions and a summary in Spanish. This research was supported in part by Department of Energy contract DE-Ac09-75R00819 with the University of Georgia Institute of Ecology (SREL).

BIOGEOGRAPHY

The tropical climate of Nicaragua, ranging from wet on the Caribbean coast to extremely dry on the Pacific Coast, is also influenced by the two large lakes, Xolotlán (Managua) and Cocibolca (Nicaragua) on the west and by several sizable mountain ranges, especially in the northwestern quadrant. There the Cordillera Isabelia and Cordillera Dariense join, tending to entrap moisture-laden, westward moving, Caribbean air, resulting in extremely high precipitation on eastern slopes of the mountains at medium and high altitudes. Whereas much of Nicaragua consists of flat or rolling lowlands, mountain ranges of the north continue into even higher areas in southern Honduras, northern El Salvador and Guatemala. This mountain mass, extending throughout northern Central America, separates faunas of the humid Caribbean lowlands from the xeric Pacific lowlands, and has provided a migration route for montane animals. The generally high temperature and xeric character of the west coast region is moderated locally in areas of somewhat higher elevation, the Cordillera los Maribios northwest of Lago Xolotlán and the Meseta de los Pueblos south of this lake.

Anolis sericeus is the only species found in xeric west coast habitats. It also occurs in the central mountain ranges, the Caribbean lowlands, and on Isla de Maíz Grande off the Caribbean coast, hence, it has by far the broadest ecological distribution of any anole in Nicaragua although it is here near the southern limit of its range, and there are few records for Costa Rica.

Anolis biporcatus and *A. cupreus* both occur in west coast Nicaragua but are confined to mesic situations, including the lakeside, the Meseta de los Pueblos, and the slopes of Volcán Mombacho. *A. biporcatus* occurs also in the eastern lowlands, and *A. cupreus* in the central mountain ranges. The latter species is replaced by the closely related, endemic *A. villai* on Isla de Maíz Grande. *Anolis capito*, *A. humilis*, *A. limifrons*, and *A. oxylophus* occur both in the central mountain ranges and the eastern lowlands, whereas *A. carpenteri*, *A. laeiventrtris*, *A. sminthus* and *A. tropidonotus* have been recorded only in the central mountain ranges and *A. lemurinus* and *A. pentaprion* only in the humid eastern lowlands.

Key to the Species of Nicaraguan Anoles

1. Ventral scales perfectly smooth 2
- 1'. Ventral scales keeled 4
2. Size large, S-V exceeding 65 mm; ground color pale olive; tail compressed, and relatively short averaging 1.3 times S-V; hind limb short, extending forward to middle of neck; ear opening small (twice diameter of nostril) .. *pentaprion*
- 2'. Size small or medium, S-V less than 65 mm; tail round, about twice S-V; ear opening much larger than nostril 3
3. Size medium, S-V usually 45-55 mm; ground color dark brown; hind limb extending forward to eye *villai*
- 3'. Size small, S-V not exceeding 42 mm; ground color pale green; hind limb extending forward to ear *carpenteri*
4. Size large, S-V exceeding 70 mm 5
- 4'. Size medium or small, S-V less than 70 mm 6
5. Head shorter than tibia; hind limb long, often extending to tip of snout or beyond; dorsal color olive with dark blotches *capito*
- 5'. Head longer than tibia; hind limb short, extending forward to ear; dorsal color often green in life (turning brown in preservative) *biporcatus*
6. Dorsal scales larger than ventrals 7
- 6'. Dorsal scales smaller than ventrals 9
7. Extremely slender; tail more than twice S-V; male dewlap orange with central indigo spot *sericeus*
- 7'. Relatively robust; tail length less than twice S-V; male dewlap lacks indigo spot 8
8. Small, S-V 42 mm or less; ventral surface dusky; male dewlap red with yellow margin; head longer than tibia *humilis*
- 8'. Medium, S-V to 55 mm; ventral surface white; male dewlap red or orange with a dark streak; head equal to tibia or shorter *tropidonotus*
9. Tail compressed; a white or cream-colored lateral stripe extends from eye to groin; loreal scales in about nine rows *oxylophus*
- 9'. Tail round in cross-section; no pale lateral stripe; loreal scales in fewer than nine horizontal rows 10
10. Supraorbital semicircles broadly in contact on midline; tail relatively short, 1.5 to 1.7 times S-V; limbs short, hind limb extended forward fails to reach eye; male dewlap dull white *laeiventrtris*
- 10'. Supraorbital semicircles separated by one to three scales; tail usually more than 1.7 times S-V; limbs long, hind limbs usually extending forward at least to eye; male dewlap variable, with yellow, orange, or red 11
11. Scalation fine and granular with mid-dorsal body scales scarcely larger than laterals; supraorbital semicircles usually separated by three rows of scales;

- extended hind limb reaches beyond eye; male dewlap dull white with yellow basally *limifrons*
- 11'. Dorsal scales somewhat enlarged; semicircles usually separated by one or two rows of scales; extended hind limb usually does not reach beyond eye; male dewlap predominantly red 12
12. Supraorbital semicircles separated by one row of scales; size medium, often 55-56 mm; extended hind limb does not reach beyond ear; pattern of large middorsal dark blotches on body; dewlap small *lemurinus*
- 12'. Semicircles usually separated by two scale rows; size small, S-V usually less than 50 mm; extended hind limb reaches about to eye; no middorsal dark blotches 13
13. Ventrals heavily keeled; tail usually less than twice S-V; male dewlap extends posteriorly well beyond axilla; no enlarged postanals *cupreus*
- 13'. Ventrals faintly keeled; tail usually more than twice S-V; male dewlap extends posteriorly little beyond axilla; enlarged postanals in male *sminthus*

ACCOUNTS OF SPECIES

In the following species accounts, locations of occurrence are listed under the Nicaraguan departments in their alphabetical order, and individual specimens are cited by number (University of Kansas Natural History Museum, unless otherwise indicated). Noteworthy facts concerning taxonomic status, distribution overall and within Nicaragua, habitats and characters are included in these accounts. Figure 1b is a map of Nicaragua showing specific localities where anoles have been collected, and identifying them with the localities in the species accounts.

Anolis biporcatus. Granada: Finca Santa Cecilia 6.5 km SE Guanacaste, 101863; Managua: 1 km E Finca Las Nubes, Casa Colorada, 174041-174046; Rivas: Río Javillo 3 km N and 4 km W Sapoá, 85628-85635; Zelaya: Bonanza, 85636, 101389, 101390. All the specimens are adults; ten males average 87.0 ± 1.76 mm (78-94) S-V and eight females average 84.1 ± 3.24 (72-93). It is surprising that all but three of the specimens came from western Nicaragua, as elsewhere *A. biporcatus* is usually found in lowland evergreen forest, and in Costa Rica, for instance, is confined to the eastern parts of the country (Savage, 1973). Gaige, *et al.* (1937) recorded this species (as *A. copei*) from Río Siquia, department of Zelaya.

Anolis capito. Matagalpa: 2 km N and 6 km E Esquipulas, 960 m, 124988; Río San Juan: El Castillo, Finca Juan Zavalla, 174047. Both specimens are adult females, 72 and 81 mm in length S-V, respectively. Gaige, *et al.* (1937) recorded the species from Río Mico, department of Zelaya. The species occurs from Tabasco to Panamá in lowland rainforest (Peters and Donoso-Barros, 1970), so doubtless it will be found in many other places in the eastern half of Nicaragua.

Anolis carpenteri. Matagalpa: Finca Tepeyac 10.5 km N and 9 km E Matagalpa, 960 m, 85722, adult female; Finca La Perla, Quebrada Las Brisas, 12 km NE Matagalpa, 1100 m, adult female 195056. The Finca Tepeyac specimen was mentioned in the original description (Echelle *et al.*, 1971), but the identification was tentative. The Finca La Perla specimen, collected by us in 1983 only a few kilometers from Finca Tepeyac, in similar habitat, confirms the species' occurrence in the mountains of central Nicaragua, extending the known range some 400 km northwest from Costa Rican localities.

The Finca La Perla specimen (195056 S-V 40 mm, tail 52 mm, weight 0.70 g) was taken in deep shade where streamside rocks were covered with a dense mat of lichens 5 cm or more in thickness. The stream was clear and swift with a rocky bed and steep banks. Native forest trees, some large, with buttressed roots grew along the stream, and vegetation was of a mesic type, much like that at the lowland localities where *A. carpenteri* has been found, but coffee groves grew on nearby slopes. *A. carpenteri*, like *A. humilis*, *A. limifrons*, and *A. oxylophus*, is primarily a lowland rainforest species; occurrence of all four together in the montane habitat of the Matagalpa region is noteworthy.

Anolis cupreus. Hallowell (1860) named *A. cupreus*, with the type locality given as merely "Nicaragua". The species is best known from northwestern Costa Rica where it is abundant (Guanacaste, Puntarenas, San José and Cartago provinces) but it is also known from southeastern Guatemala (Stuart, 1955) and El Salvador (Mertens, 1952). In Honduras the species has been collected at eight localities in the departments of El Paraiso, Olancho and Colon (Meyer and Wilson, 1973) all in the Atlantic versant, and one of these localities, Trujillo, Colon, is on the Caribbean coast. In Costa Rica, the climate becomes progressively drier to the northwest, and *A. cupreus*, abundant in the relatively mesic areas along streams of Guanacaste, becomes scarce in the severely xeric climate of western Nicaragua. The range in Nicaragua is discontinuous and is chiefly on the Caribbean versant, in humid mostly montane situations.

In the southwestern corner of Nicaragua, resident *A. cupreus* seem similar to those in adjacent Guanacaste in northwestern Costa Rica, but in the central mountain ranges there is change to more mesic habitat, a darker (chocolate colored) dewlap, darker ground color, and more arboreal habits.

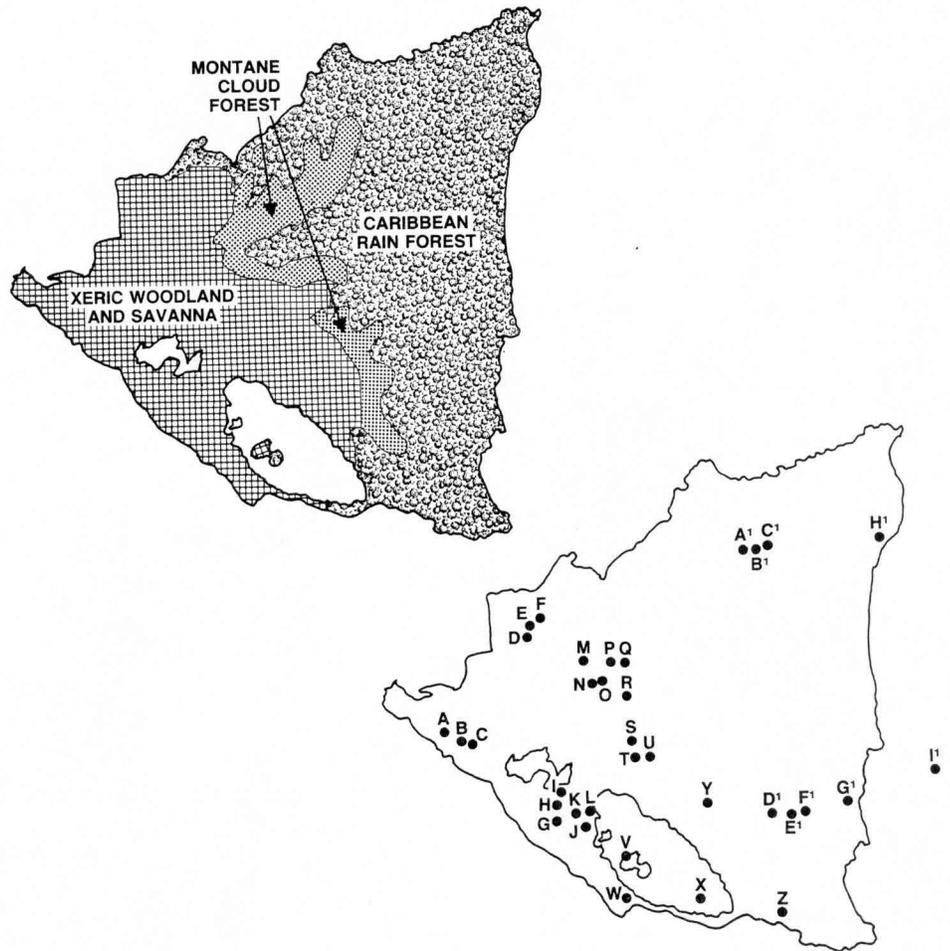
In the brief original description of *A. cupreus* (Hallowell, 1860), the notation "throat orange" indicates that the type specimen originated from the southwestern part of the country, from the Rivas or Managua area, not from the central mountain ranges where dewlaps are much darker. The darker dewlap, in combination with several other distinctive characters, justifies the recognition of a subspecies in central Nicaragua distinct from typical *Anolis cupreus*.

Anolis cupreus cupreus Hallowell

Type. — The 14 syntypes include U.S. Nat. Mus. 12211 (11), Harvard Mus. Comp. Zool. 17631 and 17632, and U. of Illinois Mus. Nat. Hist. 40733, all labelled merely "Nicaragua" (*vide* Stuart, 1963; not seen by present authors).

Diagnosis. — Color usually nondescript pale brown, lacking well-defined pattern or with series of chevron-like middorsal black marks in both sexes; male dewlap with amber-orange inner area and pinkish rose outer area; 8-9 widened lamellae under fourth toe; scale rows around mid-body average about 122 in males (N=72) and 117 in females (N=45), based on a series from Costa Rica.

Range. — *A. c. cupreus* occurs in Puntarenas and Guanacaste provinces, Costa Rica, north into southwestern Nicaragua. We associate this kind of anole with the name *A. c. cupreus* chiefly on the basis of Hallowell's notation "throat orange". University of Kansas Museum of Natural History specimens are from Rivas: Río Javillo 3 km N and 4 km W Sapoa, 40 m, 85717, 85638-85640; Isla Ometepe 2 km S Moyagalpa in Lago Cocibolca, 85720. Managua: 2 km N Sabana Grande, 85637; Río Jesús 4 km N Masachapa (juvenile captured but not preserved). Granada: Volcán Mombacho, HSF 2908-2911.



Upper: Map of Nicaragua showing main vegetation types, a simplified version from Terán and Incer Barquero (1964). Tropical Savanna and Deciduous Forest are mixed in the more xeric western regions. Caribbean Rain Forest includes extensive upland pine forest and lowland evergreen forest, and a coastal fringe of mangrove forest.

Lower: Map of Nicaragua showing localities where anoles were collected, as listed in species accounts. A. Finca San Isidro 10 km S Chinandega. B. 4 km N and 2 km W Chichigalpa. C. San Antonio. D. 5 km N and 4 km E Condega. E. 5 km N and 10 km E Condega. F. Finca Venecia 7 km N and 16 km E Condega. G. 1 km E Finca Las Nubes, Casa Colorada. H. 5 km S Managua. I. 2 km S Sabana Grande. J. Volcán Mombacho. K. Finca Santa Cecilia 6.5 km SE Guanacaste. L. 5 km W and 7 km S Granada. M. 2 km SE Jinotega. N. 10 km N Matagalpa, 1500 m. O. 5 km N Matagalpa, 1000 m. P. Finca Tepeyac 10.5 km N and 9 km E Matagalpa. Q. Finca La Perla. R. 2 km N and 6 km E Esquipulas, 960 m. S. Puente C. F. Amador between Boaco and Camoapa. T. 7 km N Camoapa. U. 1 km N Camoapa. V. Isla Ometepe 3 km N Moyagalpa, 40 m. W. Río Javillo 3 km N and 4 km W Sapoa. X. Islas de Solentiname. Y. 1 km N and 2.5 km W Villa Sandino, 520 m. Z. Finca Juan Zavalla, El Castillo. A¹. Bonanza. B¹. 1 km E Bonanza. C¹. Río Tunkey 4 km E Bonanza. D¹. Río Escondido, Cara de Mono. E¹. El Recreo, 25 m. F¹. Río Escondido 10 km E Rama. G¹. 3-4 km W Bluefields, 30 m. H¹. 3-4 km NNW Puerto Cabeza 30 m. I¹. Isla de Maíz Grande.

By departamentos — A, B and C are in Chinandega; D, E and F in Estelí; G, H and I in Managua; J, K and L in Granada; M in Jinotega; N, O, P, Q and R in Matagalpa; S, T and U in Boaco; V and W in Rivas; X and Z in Río San Juan; and A¹ to I¹ in Zelaya.

Anolis cupreus dariense new subspecies

Holotype. — Adult male, UKNHM 195081, collected 2 March 1982 at Puente Carlos Fonseca Amador on W side of divide between Boaco and Camoapa, Departamento de Boaco, Nicaragua, by H.S. Fitch and R.A. Seigel.

Diagnosis. — A Caribbean-montane population of *A. cupreus* characterized by: darkened, chocolate-colored dewlap; dark brown color; fine, granular dorsal scalation with average of 160 scales around mid-body; fourth hind toe with average of about 10 widened lamellae; habits more arboreal than in other subspecies.

Description of the holotype. — Weight 2.5 grams, length S-V 48 mm, tail 93, head length 12.6, head width 7.3, extended hind limb reaches to front of eye; front limb extends back to groin and for length of distal phalanx beyond snout; scales around mid-body approximately 155, with about 26 enlarged ventrals and four somewhat enlarged vertebrales; supraocular disks consist of three much enlarged plates in an inner row (middle one largest and posterior one next largest) and an outer row of six plates less than half as large as inner three, and numerous granular scales; supraorbital semicircles separated by one scale and separated from occipital by two or three scales; loreals in six rows on each side; supralabials 8-8; dewlap extends posteriorly about one-third of distance from axilla to thigh; dewlap dark reddish brown or chocolate colored with whitish scales; ventral surface dull white; dorsal surface dark brown with no distinct markings; limbs, fingers, toes and tail marked with faint dusky bands; each fourth toe with 10 widened lamellae.

Variation. — Some scale characters of *A. c. dariense* vary as follows: scales around mid-body in males 161.44 ± 2.76 (138-179) N=18, in females 158.44 ± 2.98 (146-168) N=8; widened lamellae on fourth toe 9.73 ± 0.08 (9-11) N=29 anoles, 56 counts; rows of loreals 6.21 ± 0.08 (5-7) N=53 counts; supralabials 6.94 ± 0.09 (6-8) N=51 counts; scales separating supraorbital semicircles 2 in 75.0%, 1 in 21.4% and 3 in 3.6% (N=28). Among 19 males, nine were dark brown, nondescript, lacking definite pattern, 4 had black shoulder spots, 3 had a series of middorsal spots, 3 had pairs of dorsal spots, one had a dark vertebral stripe, and one had a pale stripe. Of 11 females, 3 were nondescript, 3 had a vertebral stripe and diamond shaped dorsal markings, 2 had a vertebral stripe combined with spots, one had a vertebral stripe edged with black, another vertebral stripe was brown and one female had dorsal blotches. Undamaged tails averaged 183% (174-195) of snout-vent length in seven males and 179% (173-184) in 3 females. Eleven adult males averaged 46.27 ± 0.89 (41-53) mm (SVL) and 6 adult females averaged 42.17 ± 2.04 (38-53).

Comparisons. — *A. c. dariense* is the only one of the *cupreus* subspecies that has its main range in the Caribbean drainage; unlike the other subspecies which are often found in leaf litter, on stems of low bushes, or in grass, it is nearly always found in trees, and perches farther above ground. It differs from all the others in having a greater number of toe lamellae (mean almost 10 vs less than 9), darker ground color and finer scalation with more scales around mid-body, mean approximately 160, from 138 to 179, contrasted with means of 135.3 in *A. c. spilomelas*, 126.7 in *A. c. macrophallus*, 119.4 in *A. c. cupreus*, and 108.3 in *A. c. hoffmanni* (Fitch et al., 1972).

A. villai of Isla de Maíz Grande, in the Caribbean 65 km off the coast of southeastern Nicaragua, is evidently a near relative of *A. cupreus*, and in some characters *dariense* constitutes a link between *villai* and the Pacific Coast populations of *cupreus*. However, *villai* is larger (S-V 51.5 mm in males, 46.0 in females vs 46 and 42 in *dariense*) and has finer scalation (mean 169 rows around body vs 160 in *dariense*). *A. villai* is

mostly dark olive brown dorsally with a pale oblique streak extending upward and backward from the forelimb, and is stippled with gray ventrally; *cupreus* often has black spots, dots or chevrons on the dorsal surface and has the ventral surface immaculate white. The ventral scales are smooth in *villai* but keeled in *dariense* and other subspecies of *A. cupreus*.

Etymology. — *A. c. dariense* is named for the Cordillera Dariense where this subspecies occurs.

Range. — This subspecies occurs in central and north-central Nicaragua, and probably extends north into Honduras, judged from records published by Meyer and Wilson (1973). Specific Nicaraguan localities are the following. Boaco: W side of divide between Camoapa and Boaco 195082-195088; 1 km N Camoapa 195060; 7 km N Camoapa 195061-195063; Chontales: 1 km N and 2.5 km W Villa Sandino, 320 m, 112985-112987; Estelí: 7 km N and 17 km E Condega, Finca Venecia, 1200 m 85645; Jinotega: 3 km SSE Jinotega 195057-195059; Matagalpa: 2 km N and 6 km E Esquipulas, 960 m 124989, 124990; Finca Tepeyac, 10.5 km N and 9 km E Matagalpa, 960 m 84645-84649; Finca La Perla, 12 km NE Matagalpa, 1100 m 195064-195067; Zelaya: Bonanza, 260 m, 101396.

Anolis humilis. Matagalpa: Finca Tepeyac 10.5 km N and 9 km E Matagalpa, 960 m, 85642-85644; Finca La Perla, Quebrada Las Brisas 12 km NE Matagalpa, 1100 m 195068-195071; Zelaya: Río Escondido, Cara de Mono, 50 m, 112984, 113013; Río Escondido 10 km E Rama, 101864; 1 km E Bonanza, 240 m, 101391. Gaige *et al.* (1937) recorded this species from Río Mico, department of Zelaya.

A. humilis is a forest-floor species, chiefly in lowland rainforest. It was formerly thought to occur from Chiapas south through Panamá (Peters and Donoso-Barros, 1970). However, Meyer and Wilson (1971) concluded that two separate species were represented, *A. uniformis* of southern México and Guatemala, and *A. humilis* of southern Central America. Echelle *et al.* (1978) confirmed the validity of this separation on the basis of display behavior. Meyer and Wilson (1971) indicated the northernmost record of typical *humilis* to be 40 km E Catamacas, just north of the Nicaraguan border. The geographic ranges of *A. uniformis* and *A. humilis* are widely separated, and the intervening area is occupied by the larger but ecologically similar *A. tropidonotus*. Savage (1973) recorded *A. humilis* from the northeast, southeast and Talamanca regions of Costa Rica. Montane occurrences in Costa Rica are north of San José and at Monteverde.

Anolis laeiventrís. Jinotega: 2 km SE Jinotega, 1100 m, 195072-195076. Two are hatchlings, the remaining three are partly-grown females. Some pertinent characters are: hind limb extends forward to a point between ear and eye; front limb extended backward reaches two-thirds of distance to thigh; plates on top of head flat and smooth; supraorbital semicircles broadly in contact on midline; large scales of supraocular disks and supraorbital semicircles partly in contact; scale counts around midbody 123, 124, and 129 (in the three largest); loreal rows four or five; ventrals heavily keeled; ear opening small and round, smaller than occipital; a middorsal white band 16 scale rows wide.

We tentatively follow Meyer and Wilson (1971) in relegating to the synonymy of *A. laeiventrís* (type locality Jalapa, Veracruz, México) the supposed Central American species *A. nannodes* and *A. intermedius*. Anoles of this group are montane, at medium altitudes, and have a highly discontinuous distribution. Stuart (1955), recognizing three distinct species, stated that the head scales were keeled or rugose in *laeiventrís*, less so in *nannodes* and smooth in *intermedius*, and that dorsal scalation

was finer in *nannodes*. Meyer and Wilson (1971) stated that there were no consistent geographical differences. They stated that three specimens from Honduras provided the only records between central Guatemala and northwestern Costa Rica. If *A. intermedius* should eventually prove to be a valid taxon, our material would probably be referable to it both on geographical grounds and on the basis of the smooth head plates.

Anolis lemurinus. Zelaya: 3-4 km W Bluefields, 30 m, 101396. The Bluefields specimen is an immature male (S-V 43 mm, tail 69 mm). *A. lemurinus* is known to occur from Veracruz, México, to South America (Peters and Donoso-Barros, 1970). In Costa Rica the species is known from the southeast, northeast and southwest (Savage, 1973), chiefly from lowland rainforest. Gaige *et al.* (1937) recorded one from Río Siquia, department of Zelaya.

Anolis limifrons. Matagalpa: Finca Tepeyac, 10.5 km N and 9 km E Matagalpa, 900 m, 85675; Finca La Perla, Quebrada Las Brisas, 12 km NE Matagalpa, 1100 m, 195077-195078; Río San Juan: Islas de Solentiname, Lago Cocibolca, 174048-174050; Zelaya: Bonanza, 101397-101400; El Recreo, 25 m, 101865-101867. Most are adults. Five males average 36.2 (35-38) mm, and 11 females average 38.5 (35-42). *A. limifrons* is known to occur from México to Panamá, chiefly in lowland rainforest (Peters and Donoso-Barros, 1970). Savage (1973) recorded it from Costa Rica in the southeast, southwest and northeast. Although the species occurs chiefly in lowland rainforest and at its edge, some recorded occurrences are at medium elevations (Taylor, 1956; Fitch, 1973). Gaige *et al.* (1937) recorded a total of 30 specimens from Río Mico 16 km upstream from Recreo; and from Río Siquia at Rama and 11 km upstream from Rama, department of Zelaya.

Anolis oxylophus. Matagalpa: Finca Tepeyac, 10.5 km N and 9 km E Matagalpa, 960 m, 85658-85674; Zelaya: Bonanza, 260 m, 85676, Río Tunkey 4 km E Bonanza, 200 m, 101405; El Recreo, 25 m, 112992. Six adult males from Finca Tepeyac averaged 65.6 (64-70) mm S-V, and five adult females averaged 65.0 (58-69). This semi-aquatic anole resembles the more southern *A. lionotus*. It probably does not occur farther north than Nicaragua. It is found in both dry and wet climates in Costa Rica; in Nicaragua records are from the Caribbean lowlands and the central mountain ranges. Gaige *et al.* (1937) recorded this species (as *A. lionotus*) from the Río Mico upstream from Recreo.

Anolis pentaprion. Zelaya: Bonanza, 260 m, 85677. The specimen is an immature male, S-V 46 mm, tail 56. This large, highly arboreal species occurs from Chiapas, México, to Colombia (Peters and Donoso-Barros, 1970). Its habitat is lowland forest, in both xeric and humid areas. Eventually, it will probably be found to have a much wider distribution in Nicaragua.

Anolis sericeus. Chinandega: 4 km N and 2 km W Chichigalpa, 85678; Finca San Isidro, 10 km S Chinandega, 85707-85715; San Antonio, 85679-85706; Estelí: 5 km N and 10 km E Condega, 440 m, 85716; Granada: 5 km W and 7 km S Granada, 280 m, 85719; Managua: 5 km S Managua, 42270, 42271; Rivas: Isla Ometepe, Lago Cocibolca, 3 km N Moyagalpa, 40 m, 85718; Zelaya: 3.4 km NNW Puerto Cabezas, 30 m, 101410; Isla de Maíz Grande 159642-159645. This anole has an unusually large geographic range, from northeastern México south and east to northern Costa Rica. It is unusually tolerant of xeric conditions but also occurs in wet climates.

Anolis sminthus. Matagalpa: Finca La Fundadora, 5 km N Matagalpa, 1000 m, 195089-195090; 10 km N Matagalpa, 1400 m, 195080. These specimens represent a southward extension of the known range, from Honduras into Nicaragua. Heretofore, the species had been known only from seven localities in the mountains of southern

Honduras (Meyer and Wilson, 1973). A hiatus of about 185 km intervenes between the nearest known Honduran locality, San Juancito, Departamento de Francisco Morazán (type locality of *A. sminthus*), and our Nicaraguan records. Habitat is probably discontinuous, but with relatively minor gaps, as the intervening area is mostly mountainous.

The two Finca La Fundadora specimens were found on different days within 10 m of each other, the hatchling on the ground on a little used dirt road, the adult male about 1.5 m up on a vertical stem in a roadside thicket in a pine grove. The adult female was found in different habitat from the other two specimens, on a fence post in open grassland, and at higher altitude near the divide between Matagalpa and Jinotega. This female differs in various details from the other two specimens, and her association with them and with the species *sminthus* thus remains subject to some doubt. Our Nicaraguan specimens have in common with *A. sminthus* and its near relatives the following characters: the male has a pair of enlarged postanal scales; the male dewlap is small, red with scales white, and lacking marginal scales, its gorgetal scales slender and elongate with black stippling; there are 8 to 12 dorsal body scale rows that are much enlarged (especially the 4 middle rows), heavily keeled, and irregular, with smaller, crowded scales frequently interrupting the uniformity of each row; lateral scale rows are small and granular but with occasional isolated scales among them that are 2 to 4 times the diameter of others; ventrals large, often weakly keeled on chest and sides of abdomen, smooth on mid-abdomen; supraorbital semicircles separated by one scale on midline (usually separated by 2 scales); 3 scales between either semicircle and interparietal; ear opening small, circular (its area markedly less than that of interparietal scale); a prominent frontal depression.

Meyer and Wilson (1971) indicated affinities between *Anolis sminthus* and species of the "anisolepis" group of Mexican and Central American anoles: *A. crassulus*, *A. haguei*, and *A. anisolepis* (if indeed all these are valid species). They also compared *A. sminthus* with *A. heteropholidotus* of the Metapan Mountains in northwestern El Salvador, and concluded tentatively that *Anolis heteropholidotus* (Mertens, 1952) is a junior synonym of *Anolis sminthus* (Dunn and Emlen, 1932).

Our comparison of topotypical series of *A. sminthus* (193100-193101, 193103-193105, 193111-193116, 194288, 194291, 194298-194300) and *A. heteropholidotus* (62027-62034, 66867-66875) suggests that there are minor differences between the two. Perhaps subspecific status for *heteropholidotus* will eventually prove to be necessary. We cannot at present offer any final solution to this problem. Table 1 compares characters of our two adult Nicaraguan *sminthus* with the KU series of *sminthus* and *heteropholidotus*.

Anolis tropidonotus. Estelí: 5 km N and 4 km E Condega, 910 m, 85721. This medium-sized, ground-living anole occurs from Veracruz southeast to northern Nicaragua in lowland rainforest and montane forest, but seems not to occur farther south. It is abundant in the pine forests of Honduras. Our only specimen, an immature female, has the characteristic appearance and lepidosis of the species.

Anolis villai. Zelaya: Isla de Maíz Grande, 85723-85729; 159646 (holotype); 159647-159716. *A. villai* is confined to Great Corn Island and was described by Fitch and Henderson (1976) from a large series collected in February, 1976. Obviously its affinities are with *A. cupreus* of the mainland. Characters which seemed to emphasize the specific distinctness of *villai* were its relatively large size, dark color, and darkened, chocolate colored male dewlap and more arboreal habits. However, at the time

Table 1. Comparison of Characters in Supposed *Anolis sminthus* from Nicaragua, Honduras and El Salvador

	Nicaraguan ♂ Finca La Fundadora	Nicaraguan ♀	Honduran <i>sminthus</i> (means)	El Salvadoran “ <i>heterophilidotus</i> ” (means)
Color	pale brown	pale olive gray	dark brown	dark brown
Length S-V in mm	52	52	44(♂♂) 47(♀♀)	47(♂♂) 52(♀♀)
Proportions				
Tail/S-V ratio	225%	221%	200%(186-210)	237%(193-278)
Reach of hind limb	mid-eye	mid-eye	behind ear to mid-eye	behind eye to mid-eye
Reach of front limb	<u>tip of snout</u> groin	past snout by <u>finger length</u> groin	<u>tip of snout</u> short of groin	<u>tip of snout or past</u> slightly past groin
Level reached by rear end of dewlap	shoulder	—	axilla or a little beyond	forelimb diameter beyond axilla
Scalation of body and limbs				
Scales around mid-body	108	112	111	120
Middorsals, axilla to groin	43	50	49	41(31-51)
Mid-ventrals, axilla to groin	41	43	40	40
Lamellae of 4th toe	11-11	12-12	11-11	12+ -12+
Scalation of head				
Surface of head scales	smooth and flat	slightly rugose	rough, bulging	rugose, uncarinate
Loreal rows	4	5	usually 4	usually 4 (or 5)
Suboculars	smooth	faintly keeled	keeled	keeled

the description was made, *cupreus* material was not available from central Nicaragua for comparison. The series from departamentos Chontales, Matagalpa and Zelaya, partially bridge the gap between typical *cupreus* and *villai*, some having dewlaps almost as dark as those of *villai*, and resembling it also in arboreal tendencies.

PROBLEMATIC RECORDS

Anolis longicauda was named by Hallowell (1860) from a single specimen, purportedly from Nicaragua, but with no more specific locality. In the ensuing 124 years, no additional specimens have been reported. A striking and unusual distinguishing feature mentioned in the description, which ought to prevent confusion with other species, was the dewlap — orange with an indigo lateral stripe on each side. Color was stated to be green (but farther on in the description is the statement, “bluish, probably green in life”). The ventral surface was described as light blue. Ventrals were stated to be keeled, median dorsals enlarged, S-V 40 mm, tail 97.4 mm.

Lee (1983) tentatively included *A. longicauda* in the synonymy of *A. sericeus* following Barbour (1934) but mentioning that subsequent authors had not followed that allocation. Presumably, Hallowell’s original description was based on the speci-

men after preservation, with dewlap contracted and shrivelled; the central round indigo spot of the spread dewlap may have appeared to be a lateral stripe under those conditions. Also, in preservative the normally white undersurface may have been discolored to light blue and the dorsal color, ashy olive in life, may have appeared greenish or bluish. Other diagnostic characters of the type are readily reconciled with the supposition that it is the same as *Anolis sericeus*, e. g., slender form, length S-V 40 mm, tail 243% of S-V, ventrals heavily keeled, dorsal scales, especially those of median rows, enlarged and keeled.

Anolis rhombifer was described by Boulenger (1894) from Departamento Chontales. Some important characters mentioned were: ventrals imbricate, strongly keeled; no enlarged postanals; 7 loreal rows; supraorbital semicircles separated by 1 or 2 rows; 12 to 14 enlarged supraoculars; ear opening large and oval, about size of occipital; dewlap large; hind limb extending forward to anterior edge of eye; tail 1.25 to 1.33 times snout-vent length; digits moderately dilated, with 15 lamellae under second and third phalanges of 4th hind toe; pale greenish golden above with two brown stripes; snout-vent and tail lengths 40 and 50 mm in male, 55 and 73 in female.

The description was based on two specimens in the British Museum of Natural History, not designated by number. The name is here considered synonymous with *A. lemurinus*, because nearly all characters listed correspond well with those of that species. Many of the characters listed correspond also with those of *A. cupreus*, but several others contrast with *cupreus* characters and seemingly eliminate it from consideration, as set forth below. 1) Size. The female of *A. rhombifer*, having a length S-V of 55 mm, is larger than any female *cupreus* yet recorded. 2) Color and pattern. *A. rhombifer* had middorsally on the body "Five large rhomboidal brown spots", a pattern typical for *lemurinus* but not for *cupreus*. Also, *rhombifer* was "Pale greenish golden above, with two brown stripes originating on the nape above and behind the ears . . ." but *cupreus* is dark olive brown. 3) There were "twelve to fourteen enlarged supraoculars" in *rhombifer*, whereas *cupreus* has fewer — an inner row of three or four that are much enlarged and bordering them laterally a row of four or five that are less than half as large.

Enigmatic characters in the description of *A. rhombifer* pertain to its tail length and toe lamellae. The statement "Tail . . . once and one-fourth to once and one-third length of head and body" was almost certainly based on regenerated tails shorter than the originals. The statement "14 or 15 lamellae under phalanges II and III" seems to apply well to *lemurinus* but is not readily comparable with literature statements which indicate either the number of definitely widened lamellae or the total of scales on the toe's undersurface.

Anolis rodriguezi (MCZ 26963) was recorded from Isla de Maíz Grande by Barbour and Loveridge (1929), who also mentioned a second specimen from the Río Escondido on mainland Nicaragua. Actually *A. rodriguezi* is a more northern species of the Yucatán Peninsula and Guatemala. The Isla de Maíz specimen is almost certainly *A. villai* (differing from *rodriguezi* in larger size, dark dewlap, more robust form and arboreal habits). The mainland specimen was probably the closely related *A. limifrons*. In the same publication, Barbour and Loveridge mentioned *A. sallaei* (MCZ 26964-26966) from Isla de Maíz; these are *A. sericeus*, of which *sallaei* is a synonym.

Brattstrom and Howell (1954) recorded five species from Nicaragua: (*capito*, *cras-sulus*, *petersi*, *limifrons*, and *humilis*) but we believe only the last two are acceptable. The three first listed were all recorded from Granada, and all from the same brush pile! For *A. capito* they noted, ". . . the dewlap is orange with a central circular deep

blue spot", but this is a color pattern distinctive of *A. sericeus*, which, in any case, is by far the most likely anole inhabitant of the rather xeric Granada area. *A. petersi* is a giant cloudforest species which would be out of its geographic range and out of its habitat at Granada. For *A. crassulus*, which they also recorded from Granada (LA 6314), the authors described a pattern of a broad white dorsal band narrowly bordered with black, and a middorsal zone of enlarged keeled scales. Since *A. crassulus* is a high montane species, never recorded so far south, and since the description applies equally well to *A. sericeus*, it may be assumed that this specimen too was *A. sericeus*; possibly the supposed *A. petersi* was also. *A. limifrons* was represented by one specimen (LA 6476) from 16 km W Rama and *A. humilis* by five specimens (LA 6440-6444) on the northern border 25 km E Jalapa.

RESUMEN

Se registran 14 especies de lagartijas del género *Anolis* en Nicaragua: *biporcatus*, *capito*, *carpenteri*, *cupreus* (con dos subespecies, *cupreus* y *dariense*, nueva) *humilis*, *laeviventris*, *lemurinus*, *limifrons*, *oxylophus*, *pentaprion*, *sericeus*, *sminthus*, *tropidonotus* y *villai*. Tres de ellas, *carpenteri*, *laeviventris* y *sminthus*, son nuevas para Nicaragua. *A. cupreus* es rara en los departamentos occidentales, siendo más común en las montañas de la vertiente del Caribe donde es más oscura, con papera color chocolate, y de hábitos más arborícolas. Las especies más características de la llanuras húmedas del Caribe, pero que también se encuentran en las montañas centrales, son *carpenteri*, *humilis* y *limifrons*. Se incluye una clave para la identificación de las especies nicaragüenses de *Anolis*.

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