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Two new species of *Cnemidophorus* (Squamata: Teiidae) of the *C. ocellifer* group, from Bahia, Brazil

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Abstract

Two new species of *Cnemidophorus* are described from the right bank of the São Francisco river, in the northwestern part of state of Bahia, Brazil. Both species are assigned to the *Cnemidophorus ocellifer* group and are distinguished from all other congeners on the basis of lepidosis and color pattern. One of them, *Cnemidophorus cyanurus*, shares with the species of the subgroup of *C. littoralis* (*C. abaetensis*, *C. littoralis* and *C. venetacaudus*), a bluish green tail, spurs on the heels of males, 6–7 supraciliaries, a high number of femoral pores (27–45), a row of enlarged scales in the dorsal part of the humerus, and 8 to 10 rows of ventral scales. The second species, *Cnemidophorus nigrigula*, shares with the *C. ocellifer* subgroup (composed of *C. ocellifer*, *C. mumbuca*, *C. jalapensis* and *C. confusionibus*) a low number of femoral pores (14–21), enlarged scales in the temporal region posterior to the third subocular, 5 supraciliaries, 6 to 8 rows of ventral scales, and a brown tail color. It is also characterized by males being conspicuously larger than females and by females retaining the juvenile color pattern, which is lost in adult males. The latter characteristic has not been reported in any species of the *C. ocellifer* group before now. The two new species occur sympatrically at Santo Inácio.

Key words: *Cnemidophorus*, *Cnemidophorus ocellifer* group, São Francisco river, Bahia, new species, taxonomy

Resumen

Se describen dos nuevas especies de *Cnemidophorus* del margen derecho del río São Francisco, noroeste del estado de Bahía, Brasil. Ambas especies presentan los caracteres diagnósticos del grupo de *Cnemidophorus ocellifer*, por lo que son asignadas al mismo, pero a su vez muestran importante variación en el patrón de coloración y en la lepidosis, que las distinguen del resto de las especies. Una de ellas, *Cnemidophorus cyanurus*, presenta las características del subgrupo de *C. littoralis* (*C. abaetensis*, *C. littoralis* y *C. venetacaudus*) caracterizado por presentar cola verde azulada, espinas en los talones de los machos, 6–7 supraciliares, un elevado número de poros femorales (27–45), una hilera de escamas agrandadas en la región dorsal del húmero y 8–10 hileras de escamas ventrales. La segunda especie descripta, *Cnemidophorus nigrigula*, muestra las características del subgrupo de *C. ocellifer*, integrado por *C. ocellifer*, *C. mumbuca*, *C. jalapensis* y *C. confusionibus*, como un bajo número de poros femorales (14–21), escamas agrandadas en la región temporal (posterior a la 3ª subocular), 5 supraciliares, 6 a 8 hileras de escamas ventrales y cola castaña. Esta especie presenta también un evidente dimorfismo sexual en tamaño corporal (machos mayores) y en el patrón de coloración: las hembras retienen la coloración de los juveniles y los machos la pierden totalmente, una característica aún no reportada para las especies del grupo *C. ocellifer*. Las dos nuevas especies son simpátricas en Santo Inácio.

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Introduction

At the moment, the lizard genus *Cnemidophorus* includes 27 species distributed in South America, from the Lesser Antilles in the Caribbean Sea to the province of Río Negro in Argentina. They occur in a diversity of habitats, throughout highly diverse ecosystems like the Amazonia, Caatinga, Cerrado, Chaco, and the region of "montes" in Argentina (Arias *et al*., 2011).

Cnemidophorus is presently arranged into four species groups: *C. lemniscatus*, *C. lacertoides*, *C. longicauda*, and *C. ocellifer*. The *C. lemniscatus* group is composed of eleven species that occur in Northern South America, from the Lesser Antilles to open areas in the Amazon basin. Two parthenogenetic species are known among its members (Cole and Dessauer, 1993). The group is highly complex and needs more investigation in order to further subdivide the complex of species still hindered under the name *C. lemniscatus* (Markezich *et al*., 1997; Ugueto *et al*., 2009; Arias, unpublished data).

The *Cnemidophorus lacertoides* group (Cei, 1993) comprises five species that occur in southern Brazil, Uruguay, and northern Argentina (Peters and Donoso-Barros, 1970). One of them, *C. charrua*, from the Atlantic coast of Uruguay, is considered extinct (Cabrera and Carreira, 2009).

The *Cnemidophorus longicauda* group comprises two species: *C. longicauda*, which is known from the Monte Desert region in western Argentina (Cei, 1993), and *C. tergolaevigatus* from northwest Argentina (Cabrera, 2004).

Presently, the *Cnemidophorus ocellifer* group comprises seven species (Arias *et al*., 2011), distinguished by the presence of granules in the supraorbital semicircles, a low number of femoral pores (less than 40), and the absence of preanal spurs (Rocha *et al*., 2000, Colli *et al*., 2003b). These species are distributed from northern Brazil (south of the Amazon River) to northern Argentina. The group includes *C. ocellifer*, a widespread and artificially defined species, that occurs in very distinct landscape physiognomies, such as the Caatinga (Vanzolini, 1974; Vanzolini *et al*., 1980; Vitt, 1983, 1995, Menezes *et al*., 2011), Cerrado (Vitt, 1991), "restingas" (Menezes and Rocha, 2011), and the paraguayan and argentinian Chaco (Cei, 1993, Williams and Tedesco, 1985). Except for *C. ocellifer*, the other seven Brazilian species of the group were described in recent years (Rocha *et al*., 1997; Rocha *et al*., 2000; Dias *et al*., 2002; Colli *et al*., 2003a; Colli *et al*., 2003b; Colli *et al*., 2009; Arias *et al*., 2011). Although the description of these new species contributed substantially to improve our knowledge on the taxonomy of the *Cnemidophorus ocellifer* group, much remains to be done.

In a recent contribution, Arias *et al*. (2011) subdivided the *Cnemidophorus ocellifer* group in two subgroups, based on morphological evidence, as follows: one subgroup composed by *C. abaetensis*, *C. littoralis*, and *C. venetacaudus* (herein referred to of the *C. littoralis* subgroup) and sharing the presence of spurs on the heels of males, six supraciliary scales, a high number of femoral pores (from 21–45), a row of enlarged scales in the dorsal region of the arm, 8 –10 rows of ventral scales, and a bright bluish-green tail; a second subgroup composed of *C. ocellifer*, *C. mumbuca*, *C. jalapensis*, and *C. confusionibus* (herein referred to as of the *C. ocellifer* subgroup) and sharing a low number of femoral pores (no more of 20), enlarged scales in the temporal region (posterior to third subocular), five supraciliary scales, 6–8 rows of ventral scales, and a tail with a brown color pattern (never approaching the bluish tail of the other species). We further clarified the complex taxonomic status of the *Cnemidophorus ocellifer* group by removing *C. parecis* and *C. nativo*, two species that lack the diagnostic features of the group. *Cnemidophorus parecis* differs from members of the *C. ocellifer* group by the incomplete series of granules in the supraorbital semicircles, causing the third supraocular to contact the frontoparietal. Furthermore, the tongue of *C. parecis* is posteriorly rounded and covered by the lingual sheath, a character known for the genus *Ameiva* (Presch, 1971). Along with this conspicuous diagnostic feature of *Ameiva*, *C. parecis* also presents several osteological features characteristic of the latter genus (Arias, unpublished data), suggesting that the species may belong to *Ameiva* instead of *Cnemidophorus*. *Cnemidophorus nativo* shows an intermediate condition in the number of femoral pores, temporal, and ventral scales, and for this reason cannot be allocated in neither subgroups of the *C. ocellifer* group. Dias *et al.* (2002) suggest that *C. nativo* is a clonal species that originated from a hybrid between *C. ocellifer* and *C. abaetensis*.

Since 1980, one of us (MTR) has been conducting extensive fieldwork in the fossil dunes of the São Francisco River and adjacent areas of the northern region of the Serra do Espinhaço, in the Caatingas of the state of Bahia. These surveys resulted in the discovery of an unsuspected diversity, comprising several new genera and species of lizards, snakes, and amphisbaenians (Rodrigues, 1986, 1991a, b, c, d, 1996, 2002, 2003; Vanzolini, 1991a, b). Among the lizards are two very conspicuous new species of *Cnemidophorus* of the *C. ocellifer* group that occur

syntopically at Santo Inácio, near the banks of the Rio São Francisco. One of them, presenting a distinctive bluish tail, was also obtained at Morro do Chapéu, about 170 km away. Here, we described these two new species.

Material and methods

Specimens were collected with the aid of rubber bands, and pitfall traps with drift fences, between 1980 and 2006. The following characters were taken from each specimen: supraocular scales on right side; supraciliary scales on right side; femoral pores on both sides; longitudinal rows of ventral scales; transverse rows of ventral scales, scales from gular fold to anterior margin of hindlimbs; subdigital lamellae under fourth finger; subdigital lamellae under fourth toe; longitudinal rows of enlarged scales in the dorsal region of the arm; scales around midbody, counted midway between fore- and hindlimbs (excluding ventrals); enlarged scales of preanal plate; scales around tail, counted on fourth transverse row, and dorsal scales, counted along the midline, from occiput to first transverse row of scales around tail. In addition, we recorded the presence or absence of enlarged scales in the temporal region, posterior to third subocular; and spurs on heels of the males.

The following measurements were taken in mm: snout–vent length (SVL); head length (HL); head height (HH), head width (HW), trunk length (TrL), tail length (TL), humeral length (HuL), forelimbs length (FL), tibia length (TiL), femur length (FeL), and hindlimbs length (HiL). Scale observation and measurements were taken using a digital caliper to the nearest 0.02 mm, under a stereomicroscope (10–40x).

We compared our new species with *Cnemidophorus abaetensis*, *C. littoralis*, *C. venetacaudus*, *C. confusionibus*, *C. mumbuca*, *C. jalapensis*, *C. ocellifer* (only from Salvador, Bahia, the type locality), and *C. nativo*. Specimens examined are deposited in the herpetological collections of the Museu de Zoologia da Universidade de São Paulo (MZUSP) and Museu Nacional do Rio de Janeiro (MNRJ) (Appendix 1).

We also added to our comparisons data taken from the original descriptions of *C. jalapensis* (Colli *et al*., 2009) and *C. littoralis* (Rocha *et al*., 2000). Color pattern terminology for *Cnemidophorus* follows Walker *et al*. (1997).

Results

Cnemidophorus nigrigula sp. nov.

(Fig. 1, 2)

Holotype. MZUSP 93721 (field number MRT 3313), adult male, from Santo Inácio (10°39'S, 42°37'W), state of Bahia, Brazil, elevation 520 m, collected by Miguel T. Rodrigues *et al.*, on 5 May 2000.

Paratypes. MZUSP 93735 to 93750 (field number, respectively MRT 3378 to 3393), collected by Miguel Trefaut Rodrigues from 4–7 May 2000, and MZUSP 93807, 93819 (field number, respectively MRT 3105, 3274), collected by Miguel T. Rodrigues, on 5 May 2000; same locality data as for the holotype. Male adults: MZUSP 93737, 93740, 93741, 93742, 93743, 93744, 93748, 93749, 93807 and 93819. Female adults: MZUSP 93735, 93736, 93738, 93739, 93745, 93746, 93747 and 93750.

Diagnosis. *Cnemidophorus nigrigula* is a member of the *C. ocellifer* group with which it shares the presence of granules in the supraorbital semicircles and the absence of anal spurs in males. The species differs from all other members of the group by having a gular and occasionally the sublabial region dark black, ontogenetic changes in male color pattern, sexual dimorphism in size, and a pronounced sexual dichromatism. Furthermore, *Cnemidophorus nigrigula* differs from *C. jalapensis* by having 15–20 (x= 17) femoral pores (11– 16, x= 13.3 in *C. jalapensis*), 27–32 (x= 30) scales around tail (19–26, x= 22.7), 190–220 (x= 208.6) dorsal scales (200–250, x= 225.9), lateral spots present (lateral spots absent), and a larger body size (smaller, SVL= 53.45 mm). *Cnemidophorus nigrigula* differs from *C. mumbuca* by having 27–32 (x= 30) scales around tail (19–27, x= 22.6 in *C. mumbuca*), dorsal stripes absent in adult males (present), row of bright turquoise ocelli on lower lateral fields (bluish white ocelli, only males). *Cnemidophorus nigrigula* differs from *C. ocellifer* by having 15–20 (x= 17) femoral pores (14–17, x= 16 in *C. ocellifer*), 190–220 (x= 208.6) dorsal scales (172–188, x= 181), and dorsal stripes absent in adult males (present). *Cnemidophorus nigrigula* differs from *C. confusionibus* by having 27–32 (x= 30) scales around tail (22–28, x= 24.9 in *C. confusionibus*), 190–220 (x= 208.6) dorsal scales (188–211, x= 201.6), and lateral spots turquoise

(yellow). *Cnemidophorus nigrigula* differs from all members of the littoralis subgroup (*C. littoralis*, *C. abaetensis* and *C. venetacaudus*) by having enlarged scales in temporal region, posterior to third subocular (absent), 2–3 rows of enlarged scales in dorsal part of arm (one row), 5 supraciliaries (6–7), 8 longitudinal rows of ventral scales (8–10), 26–29 (x= 27) transverse ventral scale rows (29–38), 15–20 (x= 17.5) femoral pores (21–45), and a brown tail (bluish green). Furthermore, it differs from *C. littoralis* and *C. abaetensis* by the absence of a mid-dorsal stripe (present in both species), and absence of a stripe on the tail (present in both species). *Cnemidophorus nigrigula* differs from *C. venetacaudus* by having lateral ocelli on flanks (absent), and from *C. cyanurus* sp. nov. (see below) by having 15–20 (x= 17.5) femoral pores (31–38, x= 34.5 in *C. cyanurus*), 8 longitudinal rows of ventrals (8–10), 87–105 (x= 95) scales around midbody (110–126, x= 118.2), 5 superciliaries (6–7), mid-dorsal stripe absent (present), lateral spots on flanks (absent), and a brown tail (bright blue-green).

Description of holotype. Measurements: snout-vent-length (SVL) 81.11 mm, trunk length 34.19 mm, head length 20.71 mm, head width 12.99 mm, head height 11.49 mm, tail length 174.97 mm (2.16 times longer than SVL), humerus length 7.43 mm, femur length 14.76 mm, tibia length 11.1mm, foot length 25.92 mm, and arm length 51.78 mm.

Snout moderately pointed. Rostral large, wider than high, visible from above, separated from frontonasal by the midline contact between nasals. Anterior and posterior nasal in broad contact by an oblique suture. Nostril rounded, in lower part of suture. Frontonasal sub-hexagonal, contacting nasals and prefrontals. Prefrontals roughly trapezoidal, pentagonal, in broad contact along midline; contacting laterally nasal, loreal and first supraocular. Frontal approximately pentagonal, longer than wide, and wide anteriorly, separated from second, third and fourth supraoculars by a row of granules. Two frontoparietals, approximately pentagonal, separated from supraoculars by a row of granules. Five parietals, external ones smaller; interparietal sub-pentagonal, longer and wider than others, bordered at each side by parietals. Occipital scales irregular and variable in size. Four supraoculars on each side, second and third largest, first in contact with loreal, prefrontal, frontal and first supraciliary. Five supraciliaries on each side, first and second largest, others small, sub-equal, only first supraciliary in contact with first supraocular, all others separated from supraoculars by a row of granules. Loreal single, large, in contact with nasal, prefrontal, first supraocular, first supraciliary, preocular, first subocular, and third and fourth supralabials. Preocular narrow, higher than wide, in contact with first subocular, loreal, and small scales in ocular region. Three suboculars on each side, anteriormost subocular keeled, approximately pentagonal, in contact with fourth and fifth supralabial; second subocular keeled, longer than anterior, approximately rectangular, in contact with fifth, sixth and seventh supralabials; third subocular smooth, approximately round. A continuous keel runs from preocular to second subocular. Seven supralabials on each side. Temporal region with irregular scales, granular centrally, enlarged ventrally. A supratemporal row with moderately large scales, decreasing in size posteriorly. Ear opening large, round, higher than wide with smooth margins. All dorsal and lateral head scales juxtaposed, smooth (except for keeled preoculars and suboculars). Symphysal anteriorly ellipsoid, posteriorly in contact with first infralabials and postsymphysal, forming two wide angles. Postsymphysal single, pentagonal, in contact with first and second infralabials; followed by five pairs of enlarged chinshields. First pair of chinshields in broad contact along midline, in contact with second and third infralabials; longer than others. The second, third and fourth pairs of chinshields separated from infralabials by a row of small granules. Seven infralabials on each side; followed posteriorly by a series of small scales extending to commissure of mouth; first infralabials the smallest. Gular region divided in two areas: anterior region with enlarged, round scales, in transverse rows, delimited posteriorly by a line uniting lower margin of ear openings; posterior region covered with granules, in transverse rows, bordered posteriorly by the antegular fold. Gular and antegular folds marked by granules; three enlarged scale rows between the two folds. Scales on nape and sides of neck similar to dorsals. Dorsals and scales on flanks granular, rounded, smooth, sub-imbricate; 200 scales along a middorsal line from nape to base of tail; 99 scales around mid-body (excluding ventrals), 32 scales around tail. Ventral scales large, smooth, rectangular (wider than long), imbricate, in 29 longitudinal rows; 8 ventral scales in transverse rows across mid-body. Ventral scales separated from scales on flanks by row of moderately large scales. Preanal plate with three enlarged scales, one central surrounded laterally by small scales and two on posterior region. Femoral pores in a continuous row along each thigh, medially with a short gap; 9 pores on right side, 8 pores on left side. Scales on base of tail rectangular, smaller than ventrals, in transverse rows; keeled and slightly mucronate dorsal and laterally, smooth ventrally, imbricate. Tail scales becoming gradually longer and narrower from the base to tip; subcaudal scales becoming keeled distally. Limbs with large, smooth, imbricate scales on dorsal aspect of upper arms, antero-dorsal aspect of forearms, antero-ventral aspect of thighs, and ventral aspect of

lower legs; elsewhere scales small, granular. Larger scales on upper arms in longitudinal rows. Forearms with one row of enlarged scales, wider than long. Anterior scales on thigh decreasing in size proximally, with three rows of enlarged scales. Lower legs with two rows of enlarged, hexagonal scales. Patch of scales modified in form on shin small on the heel. Ventral aspect of hands and feet granular; one enlarged tubercle at base of pollex. Sub-digital lamellae single; lamellae under left and right fourth finger 16; under left and right fourth toe 30.

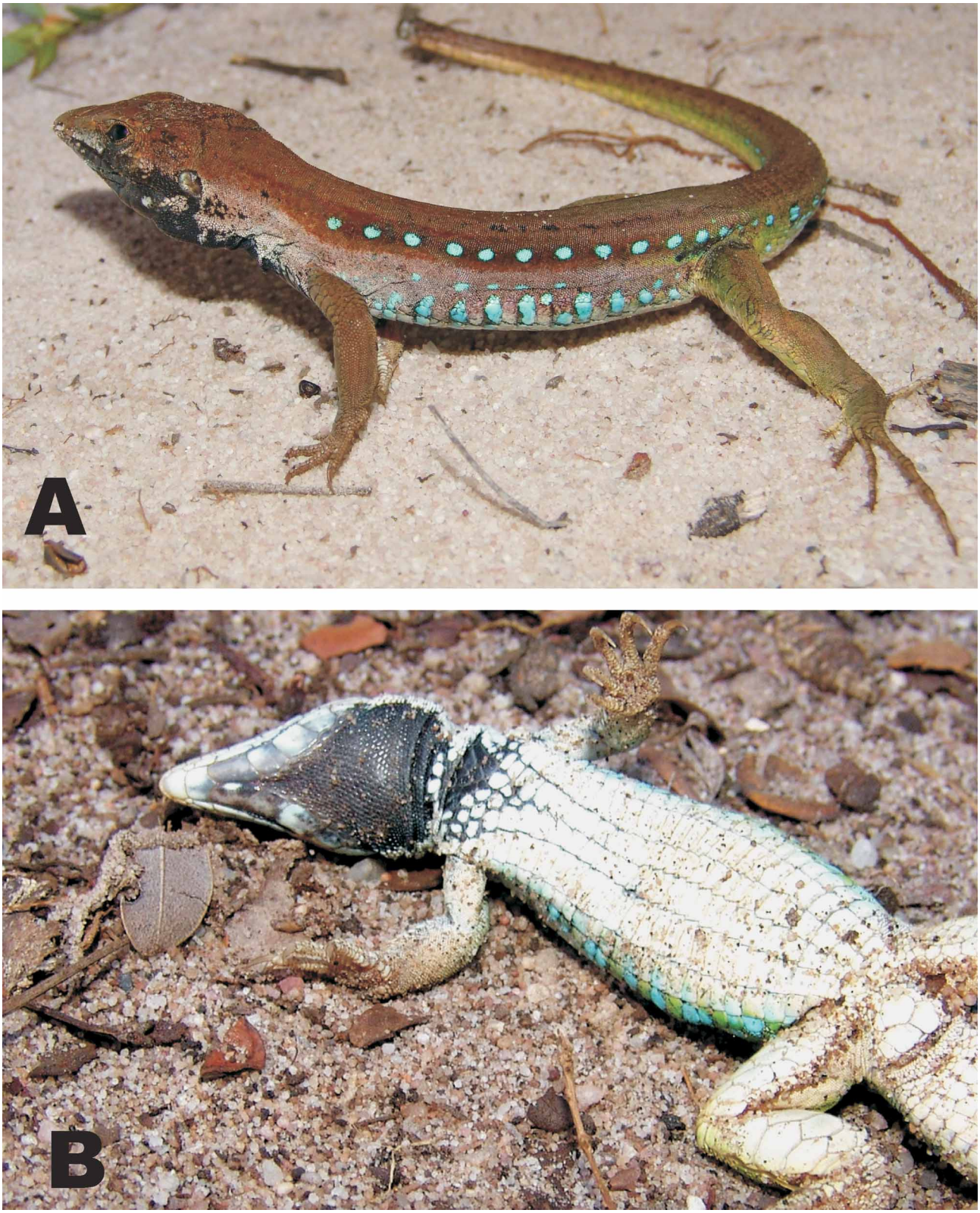

FIGURE 1. *Cnemidophorus nigrigula* from Santo Inácio, Bahia state, Brazil. A) Dorsal view of an adult male. B) Ventral view of an adult male. Photo: Miguel Rodrigues.

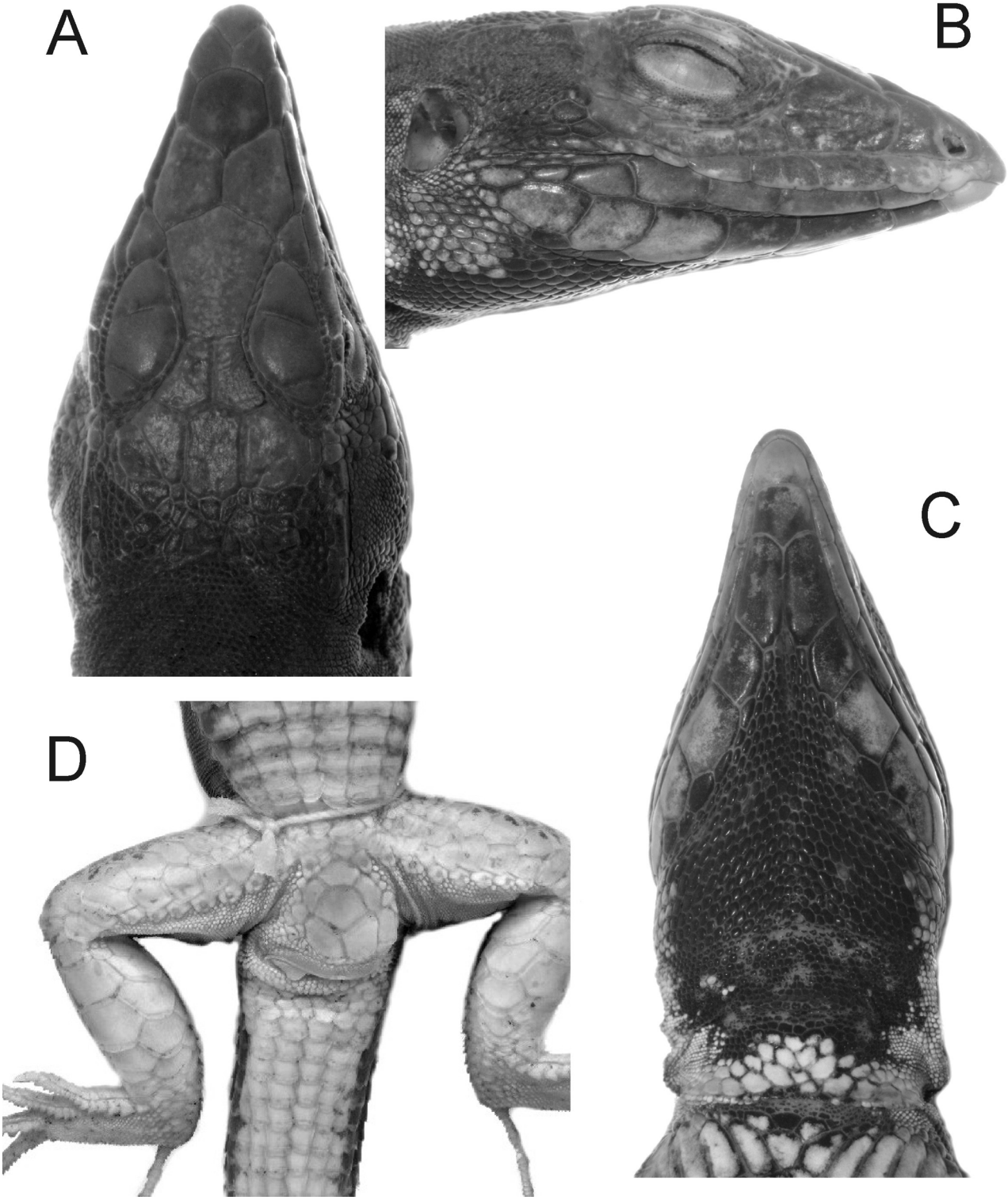

FIGURE 2. *Cnemidophorus nigrigula*, holotype, MZUSP 93721, adult male. A) Dorsolateral view of the head; B) lateral view of head; C) ventral view of the head; D) preanal plate and femoral pores. Photo: J.C. Arredondo.

Color in life. (Fig. 1) Dorsal and dorso-lateral surfaces of the head, body, limbs and tail light brown, Lateral surface of the neck and flanks light gray. Dorso-lateral surface of the body ornamented with a row of regularly spaced bright turquoise ocelli that extends from the level of the forelimbs to the anterior third of the tail. Light gray area of the flanks between limbs with irregular bright turquoise ocelli. Throat and, occasionally labial region, black. Belly and ventral surface of limbs and tail white. Lateral surface of tail greenish white.

Variation in females and juveniles. Sexual dichromatism (Fig. 3) and size dimorphism are evident (Table 1). In females, the dorsum of head, limbs and tail are brown. The anterior half of body is light brown, while the posterior half is bright green. There are three dorsolateral diffuse stripes on each side of the body. The paravertebral stripe extends from the neck to the base of the tail, while the dorsolateral stripe runs from the supraciliaries to the first third of the tail, and the ventrolateral originate on the subocular region, cross the ear, the body and extend through the hindlimbs to reach the feet. Irregular dark spots are disposed between the paravertebral and dorsolateral stripes, while a row of regularly spaced turquoise ocelli is present between the dorsolateral and ventrolateral stripes, from the forelimbs to the hindlimbs. Below this series of ocelli, there are irregular bluish spots that reach the margin of the ventrolateral scales. The lateral surface of the head is light gray, while the throat is dark black. The belly and the ventral surface of the limbs and tail are light white.

TABLE 1. Sexual variation in *Cnemidophorus nigrigula*. Mean and range (in parenthesis).

Measurements (mm)	males (n= 28)	females (n= 22)
snout–vent length (SVL)	84.44 (81.11–90.07)	64.1 (56.15–72.35)
Tail length (TL)	182.88 (174.97–190.79)	137.06 (128.59–145.52)
TL/SVL	2.25 (2.16–2.35)	2.31 (2.29–2.33)
Trunk length (TrL)	38.86 (34.19–43.19)	33.16 (27.91–37.7)
TrL/SVL	0.46 (0.42–0.48)	0.52 (0.5–0.54)
Head larger (HL)	21.94 (20.6–23.63)	15.56 (13.8–17.31)
HL/SVL	0.26 (0.25–0.27)	0.25 (0.24–0.25)
Head wide	14.53 (12.99–15.32)	9.57 (8.76–10.75)
Forearm length	27.22 (26.51–28.63)	20.69 (18.39–22.57)
Foot length	27.84 (25.92–28.92)	22.6 (19.52–25.46)
Forelimbs length	55.24 (51.78–58.73)	43.63 (38.79–49.83)

TABLE 2. Character variation (given as means, range in parentheses) for five members of the *Cnemidophorus ocellifer* subgroup. Supraocular scales (SO); supraciliary scales (SC); fourth finger lamellae (FFL): fourth toe lamellae (FTL); number of granules around midbody (SAM); number of scales around tail (SAT); number of dorsal granules (D); longitudinal rows of enlarged scales in dorsal part of arm (RH); longitudinal rows of ventral scales (VL); transverse rows of ventral scales (VT); total number of femoral pores (FP); enlarged scales in temporal region posterior to third subocular (EST).

Character	*C. nigrigula* **sp nov.** (n= 83)	*C. jalapensis* (n= 2)	*C. confusionibus* (n= 19)	*C. mumbuca* (n= 11)	*C. ocellifer* (n= 52)
SO	4 (4–4)	4 (4)	4 (4-4)	3.9 (3–5)	4 (4-4)
SC	5 (5)	5 (5)	5 (5)	5 (5)	5 (5)
TV	27.4 (26–29)	25.5 (25–26)	28.2 (27–29)	27 (24–29)	27.2 (26–28)
LV	8 (8)	7 (6–8)	8 (8)	8 (6–8)	8 (8)
FP	17 (15–20)	13 (12–14)	17.5 (16–21)	16.7 (14–20)	16 (14–17)
FFL	17 (16–18)	15.5 (15–16)	15.6 (15–17)	16.3 (13–19)	16 (15–17)
FTL	31.3 (30–32)	27 (26–28)	30.4 (29–35)	27.4 (24–32)	30 (28–31)
RH	2 (2)	3 (3)	3 (3)	3 (3)	3 (3)
SAM	99.8 (97–105)	96.5 (91–102)	95 (87–105)	101.0 (91–117)	94.6 (92–100)
SAT	30 (27–32)	24 (22–26)	24.9 (22–28)	22.6 (19–27)	28 (25–30)
D	208.6 (190–220)	206 (200–212)	201.6 (188–211)	229.6 (194–271)	181 (172–188)
EST	present	present	present	present	present

Males exhibit ontogenetic changes in color pattern (Fig. 4). In juveniles (Fig. 5A), the coloration is similar to that of females, with the distinction that stripes are bright white and dorsolateral bands are dark. In subadult males (Fig. 5B), the anterior half of the body is brown, and stripes are lost, while the posterior half of the body is bright

green and stripes becoming diffuse. On the flanks, large regular turquoise-blue ocelli extend from the forelimbs to the first third of the tail. Bluish spots that reach the venter are irregularly disposed below the larger ocelli. Adult males (Fig. 5C) show the characteristic coloration of the holotype.

Color in preservative. Dorsal parts of head, body, limbs, and tail dark. Lateral region of the body with a series of regularly spaced turquoise-blue ocelli, from the forelimbs to first third of the tail. The lateral surface of the head and flanks (between the limbs) is light grey, with irregular turquoise-blue ocelli. Throat dark black. Belly and ventral region of limbs and tail white.

FIGURE 3. Sexual dichromatism in *Cnemidophorus nigrigula*. A) Dorsal view of an adult female. B) Dorsal view of an adult male. Both specimens from Santo Inácio, Bahia state, Brazil.

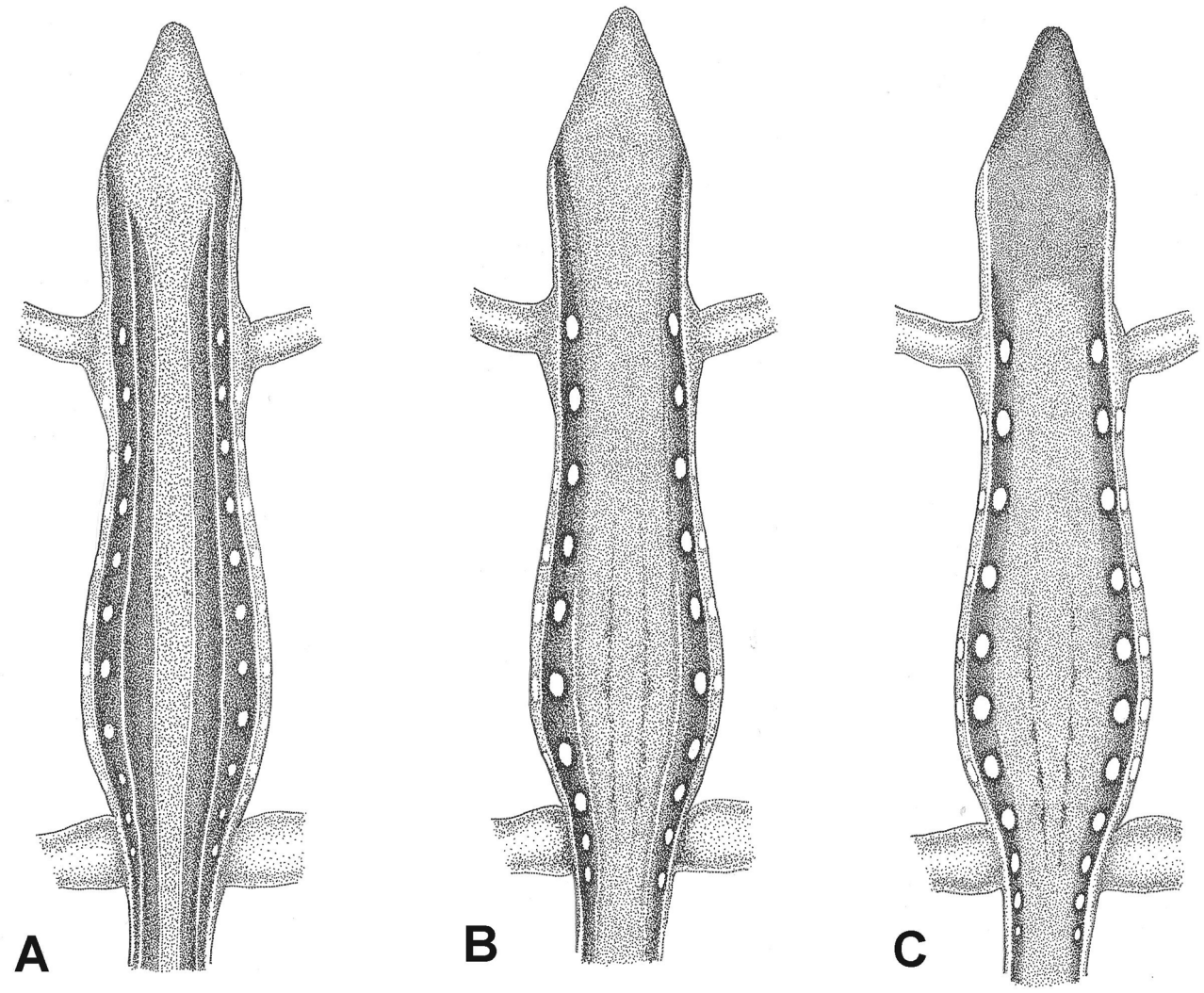

FIGURE 4. Ontogenetic change in color pattern in males of *Cnemidophorus nigrigula*. A) Juvenile. B) Sub adult. C) Adult.

Variation. Variation in meristic characters is summarized in Table 1, while variation in measurements is given in Table 2.

Etymology. The specific epithet, *nigri*, is a Latin adjective meaning ‘‘black,’’ and *gula*, a Latin noun in apposition, meaning throat, in allusion to the characteristic black coloration of the throat in this species.

***Cnemidophorus cyanurus* sp. nov.**
(Fig. 6, 7)

Holotype. MZUSP 65781, adult male from Morro do Chapéu (11°33´10´´ S, 41°09´02´´ W), state of Bahia, Brazil, elevation 995 m, collected by Miguel T. Rodrigues, on 16 September 1984.

Paratypes. MZUSP 56115 to 56127, collected by Miguel T. Rodrigues on 30 November 1980; MZUSP 62801 to 62810, and MZUSP 65780, MZUSP 65782 to 65784, collected by Miguel T. Rodrigues from 16–18 September 1984; MZUSP 74179, MZUSP 74215 to 74222, collected by Miguel T. Rodrigues from 3–5 October 1990, all from Morro do Chapéu, state of Bahia, Brazil. MZUSP 56287, collected by Miguel T. Rodrigues on 3 December 1980 and MZUSP 72420 and 72421, collected by Miguel T. Rodrigues on 22 August 1988, from Santo Inácio (11 06’S, 42 43’ W), state of Bahia, Brazil, elevation 500–800 m. Male adults: MZUSP 56115, 56117, 56120, 56124, 56125, 56126, 56287, 62801, 62802, 62805, 62808, 62809, 62810, 65783, 65784, 72421, 74215, 74216, 74218, 74221 and 74222. Undetermined sex MZUSP 56127. Female adults: MZUSP 56116, 56118, 56119, 56121, 56122, 56123, 62803, 62804, 62806, 62807, 65780, 72420, 65782, 74179, 74217, 74219 and 74220.

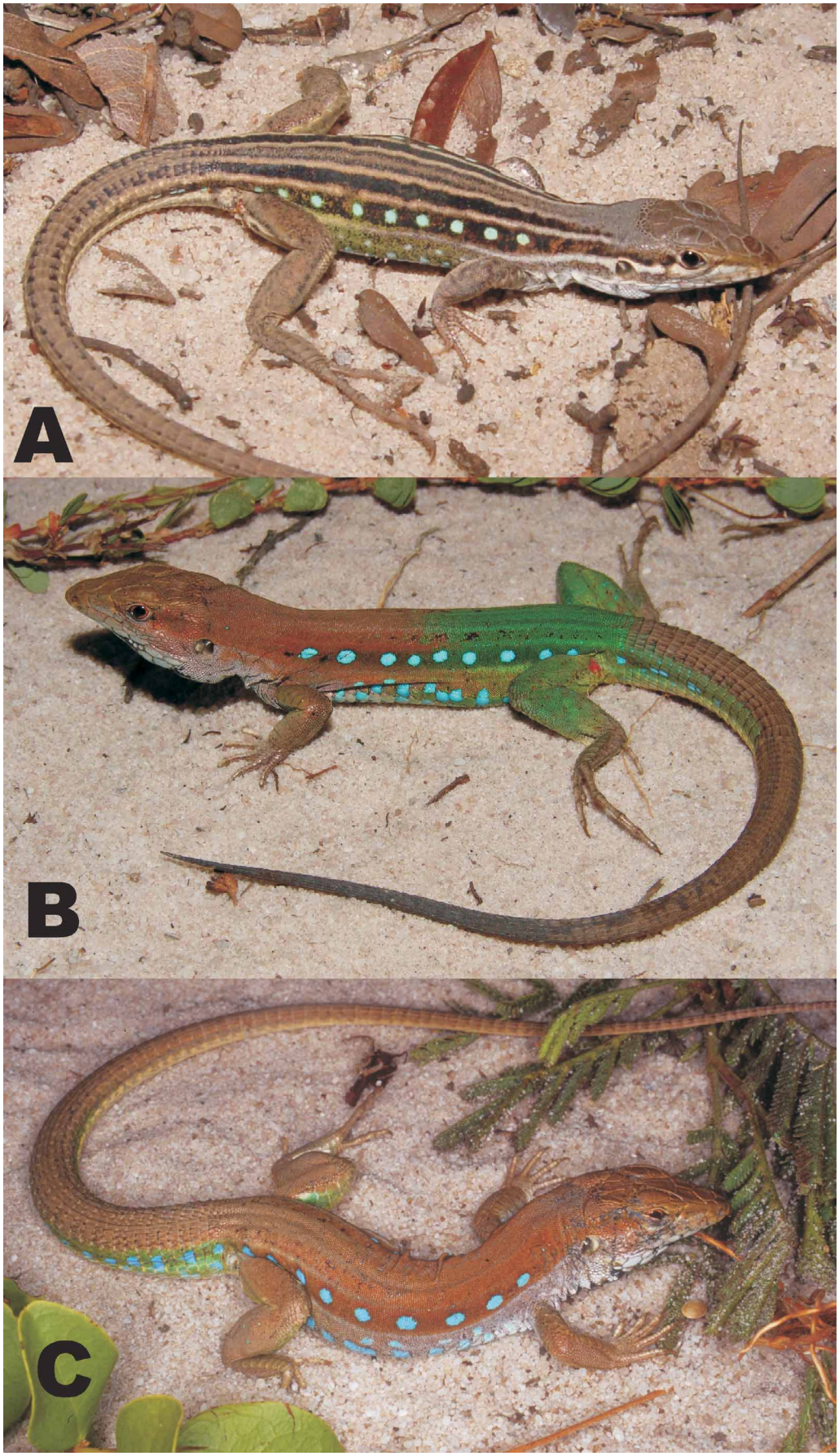

FIGURE 5. Photo in life of *Cnemidophorus nigrigula*, showing color variation in males. A) Juvenile. B) Sub adult. C) Adult.

FIGURE 6. *Cnemidophorus cyanurus* from Morro do Chapéu, Bahia state, Brazil. Photo: Miguel Rodrigues.

Diagnosis. A species of the *Cnemidophorus ocellifer* group with granules in the supraorbital semicircles, and no anal spurs in males. *Cnemidophorus cyanurus* differs from *C. ocellifer*, *C. mumbuca*, *C. jalapensis*, and *C. confusionibus* by having 31–38 (x= 34.5) femoral pores (a maximum of 20 in all other species); 8–10 longitudinal rows of ventral scales (6–8), 29–33(x= 30.4) transverse rows of ventrals (a maximum of 29 in all other species), 6–7 superciliaries (always 5), 1–2 row of spurs in the heel in males (absent), one row of distinctive enlarged scales in the arm (2–4, never enlarged), no enlarged scales in temporal region posterior to third subocular (present), vertebral stripe present (absent), lateral spots absent (present), and bluish-green tail (brown tail). *C. cyanurus* differs from *C. abaetensis* by having 31–38 (x= 34.5) femoral pores (27–31, x= 24), 190–215 (x= 201.8) dorsal scales (210–240, x= 221.8), second supraocular totally separated from frontal by supraocular granules (second supraocular contacts frontal), four supraoculars (usually 3), stripe on the tail absent (present). *Cnemidophorus cyanurus* differs from *C. littoralis* by having 31–38 (x= 34.5) femoral pores (28–36, x= 32.6 in *C. littoralis*), 190–215 (x= 201.8) dorsal scales (168–191, x= 174.9), frontonasal never divided (35.6 % of individuals with a divided frontonasal, according to Rocha *et al*., 2000), second supraocular separated from frontal by supraocular granules (second supraocular contacts frontal), and tail stripe absent (present). *Cnemidophorus cyanurus* differs from *C. venetacaudus* by having 31–38 (x= 34.5) femoral pores (34–45, x= 38 in *C. venetacaudus*), 26–31 (x= 28.6) fourth toe lamellae (30–35, x= 33), vertebral and lateral stripes present (absent), and body color blue gray (brown).

Description of holotype. Measurements: snout-vent-length 76.6 mm; trunk length 39.39 mm; head length 18.2 mm; head width 10.31 mm; head height 8.39 mm; tail length 137.87 mm (regenerated); femur length 12.53 mm; tibia length 10.48 mm; foot length 24.33 mm; hindlimb 47.34 mm; humerus length 5.24 mm, and arm length 22.9 mm. Snout pointed. Rostral large, wider than high, visible from above, separated from frontonasal by contact between anterior nasals. Anterior and posterior nasals in broad contact at midline through an oblique suture. Nostril rounded in lower part of suture. Frontonasal roughly hexagonal, with almost rounded vertices, contacting posterior nasals and prefrontals. Prefrontals roughly trapezoidal, pentagonal, in broad and straight contact along midline, contacting laterally posterior nasal, loreal and first supraocular. Frontal approximately pentagonal, longer than wide, wider anteriorly, contacting only partially first supraocular and separated from the second and third supraoculars by a row of granules. Two frontoparietals, longer than wide, separated from supraoculars by a row of gran-

ules. A small scale between the frontoparietals, anteriorly in contact with the frontal. Five parietals, interparietal longer than wide, sub-hexagonal, bordered at each side by larger parietals. External parietals, smaller, slightly larger than interparietal and diagonally disposed. Occipital scales irregular and variable in size, larger than dorsals. Four supraoculars on each side, second and third largest, and first in contact with frontal, prefrontal, and first and second supraciliaries. Seven supraciliaries on each side, third the largest, separated from supraoculars (excepted first and second) by a row of granules. Loreal single, large, in contact with posterior nasal, prefrontal, first supraocular, first supraciliary, preocular, first subocular, and third and fourth supralabials. Preocular keeled, narrow, higher than wide, in contact with first subocular, loreal, and first superciliary. Three suboculars on each side, anteriormost keeled, approximately pentagonal, in contact with fourth supralabial; second subocular keeled, longer than anterior, approximately rectangular, in contact with fifth and sixth supralabials; third subocular smooth, slightly shorter than second one, approximately rectangular. A continuous keel runs from preocular to second subocular. Seven supralabials on each side. Temporal region with irregular scales, granular centrally, sub-equal, enlarging in size towards eye and ear opening. A supratemporal row with moderately large scales, decreasing in size posteriad. Ear opening large, semicircular, higher than wide. All dorsal and lateral head scales juxtaposed, smooth, except for keeled preoculars and suboculars. Symphysal wider than long, concave anteriorly, convex posteriorly, ellipsoid, contacting posteriorly first infralabials and postsymphysal. Postsymphysal single, pentagonal, as long as wide, in contact with first and second infralabials; followed by five pairs of enlarged chinshields. First pair of chinshields the longest, in broad contact along midline, in contact with third infralabials; second, third and fourth pairs separated from infralabials by row of small granules and internally marginated by a series of enlarged scales. Six infralabials on each side, followed posteriorly by series of small scales extending to labial commissure; first infralabials the smallest. Chin scales irregular in size and shape, diagonally disposed, increasing in size posteriorly. Gular region divided in two areas: anterior one with irregularly shaped, roughly elongate, juxtaposed scales, disposed in roughly oblique and transverse rows from first pair of chinshields, to an imaginary line uniting the lower margin of ear openings; lateral scales largest. Posterior gular region with minute granules disposed in transverse rows, identical to those on antegular fold. Gular and antegular folds with diminute granules; a series of enlarged mesoptychial scales between the two folds. Scales on nape and sides of neck similar to dorsals. Dorsal and flank scales granular, rounded, smooth, sub-imbricate; 202 scales along a middorsal line from nape to base of tail; 110 scales around midbody (excluding ventrals), 29 scales around tail. Ventrals large, smooth, wider than long, rectangular, imbricate, in 31 transverse rows; 8 longitudinal rows of ventral scales across midbody. Ventral scales separated from scales on flanks by a row of moderately enlarged scales. Preanal plate with four enlarged scales, the central one largest, contacting one anterior, surrounded laterally by small scales, and two posterior ones that form the lower border of the anal plate. Preanal spurs absent. Thirty five femoral pores in a continuous row with a short gap medially; 18 on right side, 17 on left. Scales at the base of the tail rectangular, smaller than ventrals, in transverse rows; keeled dorsally and laterally, ventrally smooth. Tail scales becoming gradually longer and narrower from the base to tip; subcaudal scales becoming keeled distally, but less markedly than in dorsals. Limbs with large, smooth, imbricate scales on dorsal aspect of upper arms, antero-dorsal aspect of forearms, antero-ventral aspect of thighs, and ventral aspect of lower legs; elsewhere scales small, granular. Larger scales on upper arms, disposed in longitudinal rows. Forearms with one row of distinctively enlarged scales, wider than long. Dorsal surface of arm with one row of enlarged scales. Anterior scales on thigh decreasing in size proximally, with five rows of enlarged scales. Lower legs with two rows of enlarged, hexagonal scales. Ventral aspect of hands and feet granular; one enlarged tubercle at base of pollex. Sub-digital lamellae single; 18 on left and right fourth fingers; 34 on left and 35 on right fourth toe. Heel with one row of spurs.

Color in preservative. Dorsum and dorsal parts of limbs light blue. A white vertebral stripe extends from neck to the anterior quarter of the tail. A dark-blue, dorsolateral band edged inferiorly by a wider light gray band extends on the lower flanks from nostril to groin. Belly, and ventral region of tail bluish white. Head color follows dorsal and lateral body patterns: light brown dorsally and light gray laterally, separated by the dark lateral stripe. Ventral aspect of head bluish white. Ventral aspect of fore and hind limbs brownish white. Dorsal and lateral aspects of tail blue.

Variation. The following is based on 39 paratypes. Head longer (16.13–22.1mm; x= 18.89 mm), than wide (8.27–17.67 mm; x= 11.85 mm). Head height 7.88–10.32 mm (x= 9.21mm). Snout-vent length 65.56–81.93 mm (x= 75.71mm). Tail length 126.3–191.7 mm, (x= 152.99 mm), 2.05 times longer than SVL. Humeral length 4.35–7.1mm, (x= 5.75 mm). Fore limb length 21.75–27.4 mm, (x= 24.5 mm). Tibia length 9.37– 13 mm, (x= 11.43 mm).

Thigh length 11.52–15.44 mm, (x= 13.88). Foot length 23.21–27.24 mm, (x= 25.64 mm). Hind limb twice longer than foot. Hind limb length 44.1–55.24 mm, (x= 50.95 mm).

There is no sexual dichromatism in adult pattern. In juveniles, tail color is bright blue, which becomes bright bluish-green in adults (Fig. 8 A, B). Males have spurs on heel. MZUSP 65781, 65780 and 65782 have seven supraciliaries. Only the male MZUSP 56126 has small scale between the frontoparietals, as the holotype. Variation in other meristic characters is summarized in Table 3.

TABLE 3. Character variation (given as means, range in parentheses) for four members of the *Cnemidophorus littoralis* subgroup. Supraocular scales (SO); supraciliary scales (SC); fourth finger lamellae (FFL): fourth toe lamellae (FTL); number of granules around midbody (SAM); number of scales around tail (SAT); number of dorsal granules (D); longitudinal rows of enlarged scales in dorsal part of arm (RH); longitudinal rows of ventral scales (VL); transverse rows of ventral scales (VT); total number of femoral pores (FP); spurs on heel of males (HSPUR).

Character	*C. cyanurus* **sp nov.** (n= 43)	*C. abaetensis* (n= 37)	*C. littoralis* (n= 19)	*C. venetacaudus* (n= 13)
SO	4 (4)	3.2 (3–4)	4 (4)	4 (4)
SC	6.6 (6–7)	6.2 (6–7)	6.2 (6–7)	6.2 (6–7)
TV	30.38 (29–33)	32 (30–35)	34.9 (32–38)	31.2 (30–32)
LV	8.25 (8–10)	8.7 (8–10)	8.6 (8–10)	10 (10)
FP	34.5 (31–38)	24 (27–31)	32.6 (28–36)	38 (34–45)
FFL	15.8 (14–18)	18 (16–21)	18.8 (16–24)	17.3 (16–18)
FTL	28.6 (26–31)	33 (29–38)	32.8 (29–37)	33 (30–35)
RH	1 (1)	1 (1)	1 (1)	1 (1)
SAM	108.1 (104–112)	140.4 (127–148)	109.9 (96–123)	119.5 (114–129)
SAT	31.18 (26–35)	32.6 (30–35)	28.7 (25–34)	31.7 (31–34)
D	199.64 (185–215)	221.8 (210–240)	174.9 (168–191)	204.8 (190–218)
HSPUR	present	present	present	present

Color in life. (Fig. 6). Dorsal surface of head brown grayish; body and limbs dark brown. A dark-gray dorsolateral band runs from the nostril, crosses the eye, to reach the hindlimbs. Below it, a light gray area that darkens towards the posterior region covers all the lateral surface of the head and flanks. A creamy white and narrow vertebral stripe extends from the neck to the base of the tail. Below it, a pair of parallel wide dark brown paravertebral stripes, separated from the dorsolateral band by a narrower creamy white stripe. The paravertebral stripe runs from the supraciliary region to the base of tail, the dorsolateral one from the subocular region to the hindlimb.. The belly and ventral region of the head and tail are light blue. The ventral aspect of the fore- to hindlimbs is brownish white. The dorsal aspect of the tail is bright bluish-green, while the lateral aspect is predominantly bluish green (Fig. 6).

Etymology. The specific epithet, *cyan*, is a Latin adjective meaning ‘‘bluish,’’ and the Latin superlative suffix *urus*, means ‘‘tail’’ in allusion to the characteristic ‘‘bluish tail’’ in members of this species.

Distribution and natural history. Both type localities are in the Serra do Espinhaço, a prominent mountain ridge that reaches up to 2000 m and stretches (in a southeastern-northestern direction) along approximately 1100 km in the states of Minas Gerais and Bahia. Its northern portion, characterized by extensive and discontinuous flat plateaus, is usually referred to as the Chapada Diamantina (Fig. 9). Santo Inácio is situated at 480 m, in the northern portion of the Chapada Diamantina where a contact zone is created between the dissected mountains and the alluvial plain of the São Francisco river, the latter being situated around 430 m of elevation. The Santo Inácio area is characterized by extensive and highly eroded quartzitic and conglomerate rock outcrops, separated by coarse-grained white sandy soils that result from rock intemperism (Fig. 10). The Caatinga is the dominant vegetation in both rocky and sandy areas, with abundance of Bromeliaceae, Cactaceae, Euphorbiaceae, and Leguminoseae. The area dominated by rock outcrops is covered by a thorny vegetation, with small and deciduous leaves, with some scattered Cerrado trees diagnosed by their leathery leaves and thickened bark. In the alluvial plain of the Rio São Francisco, rocks are absent and the region is completely dominated by a typical Caatinga vegetation, with scattered *Copernicia* palms that grow on eolic yellowish sandy soils sometimes built in small dunes. Further data on the area is given by Rodrigues (1996). *Cnemidophorus nigrigula* is one of the most abundant lizards in the area, occurring

in the alluvial plain and sandy soils around rocky areas, from the base of mountains to about 800 m of elevation. It is active from early morning to the end of the day, and is frequently seen foraging on the ground between and within vegetation tickets. *Cnemidophorus cyanurus* is much less abundant and was exclusively found in the white sandy soils of the rocky area in Santo Inácio, where it is syntopic with *C. nigrigula*. Other lizards that occur at Santo Inácio are: *Ameiva ameiva, Tupinambis teguixin, Iguana iguana, Tropidurus amathites, Tropidurus erythrocephalus, Tropidurus hispidus, Tropidurus pinima, Mabuya heathi, Acratosaura mentalis, Calyptommatus sinebrachiatus, Psilophthalmus paeminosus, Hemidactylus mabouia, Phyllopezus pollicaris, Lygodactylus klugei, and Polychrus acutirostris* (Rodrigues, 1996).

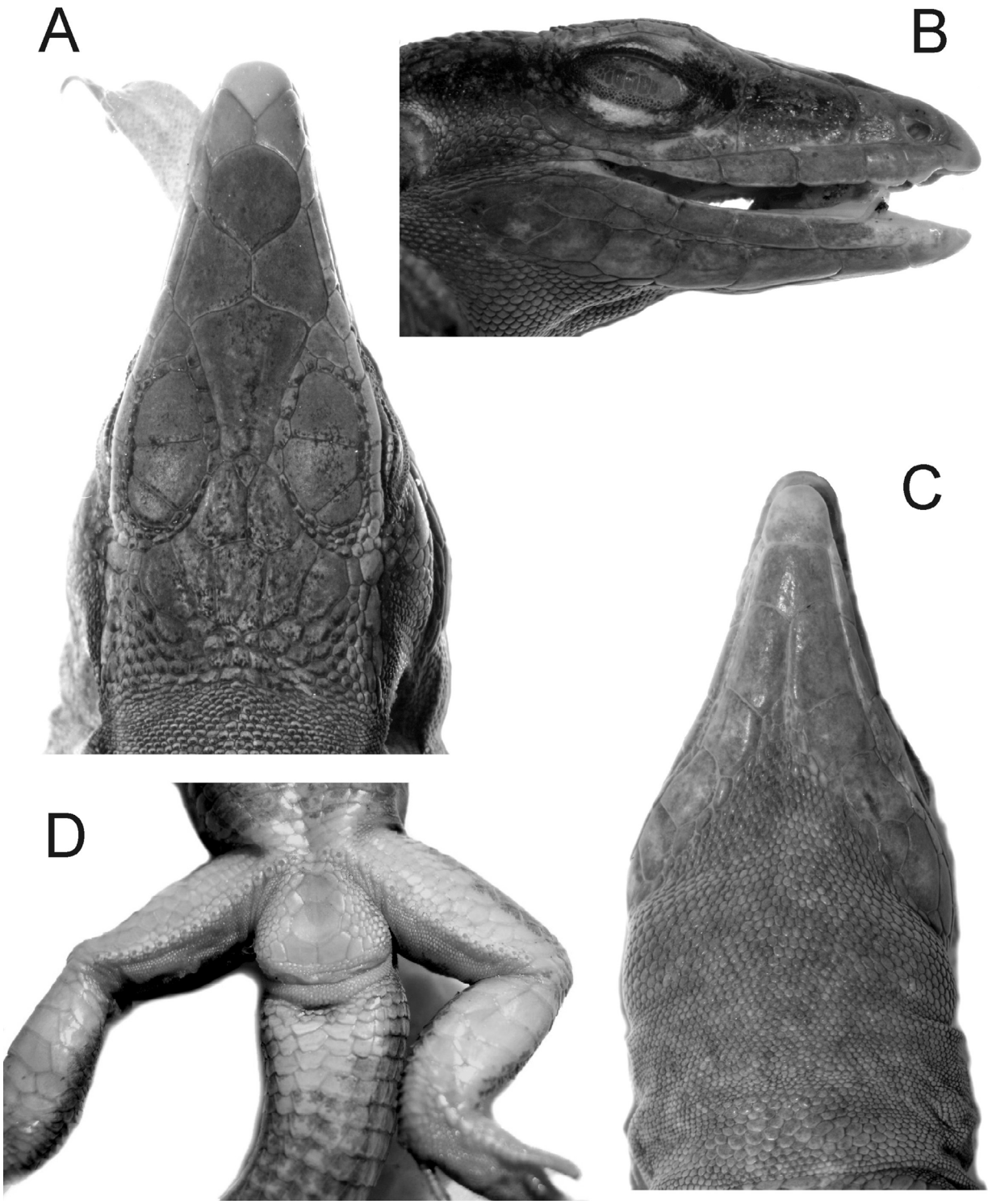

FIGURE 7. *Cnemidophorus cyanurus*, holotype, MZUSP 65781, adult male. A) dorsal view of the head; B) lateral view of head; C) ventral view of the head; D) preanal plate and femoral pores.

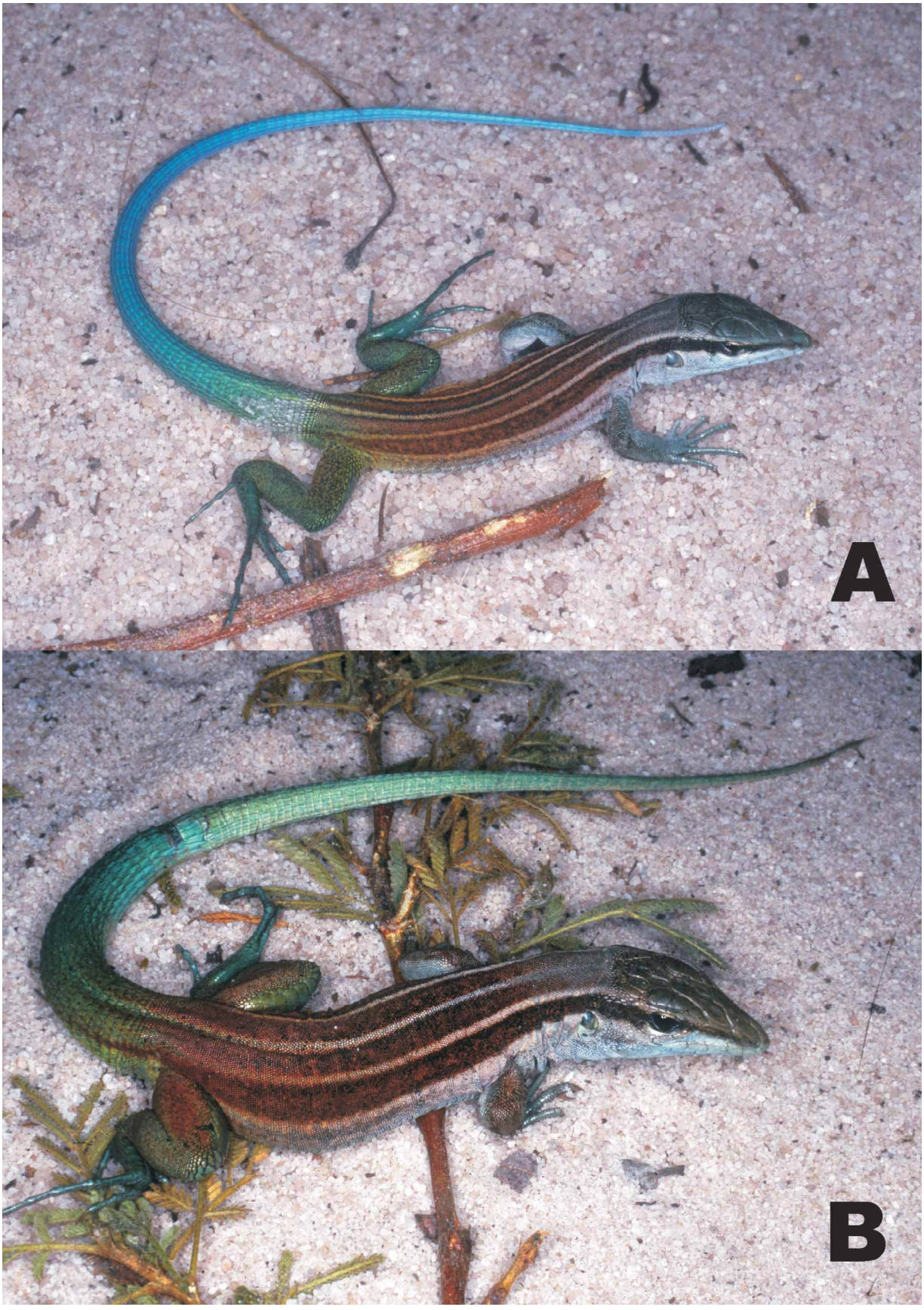

FIGURE 8. *Cnemidophorus cyanurus* from Morro do Chapéu, Bahia state, Brazil. A) Young. B) Adult. Photo: Miguel Rodrigues.

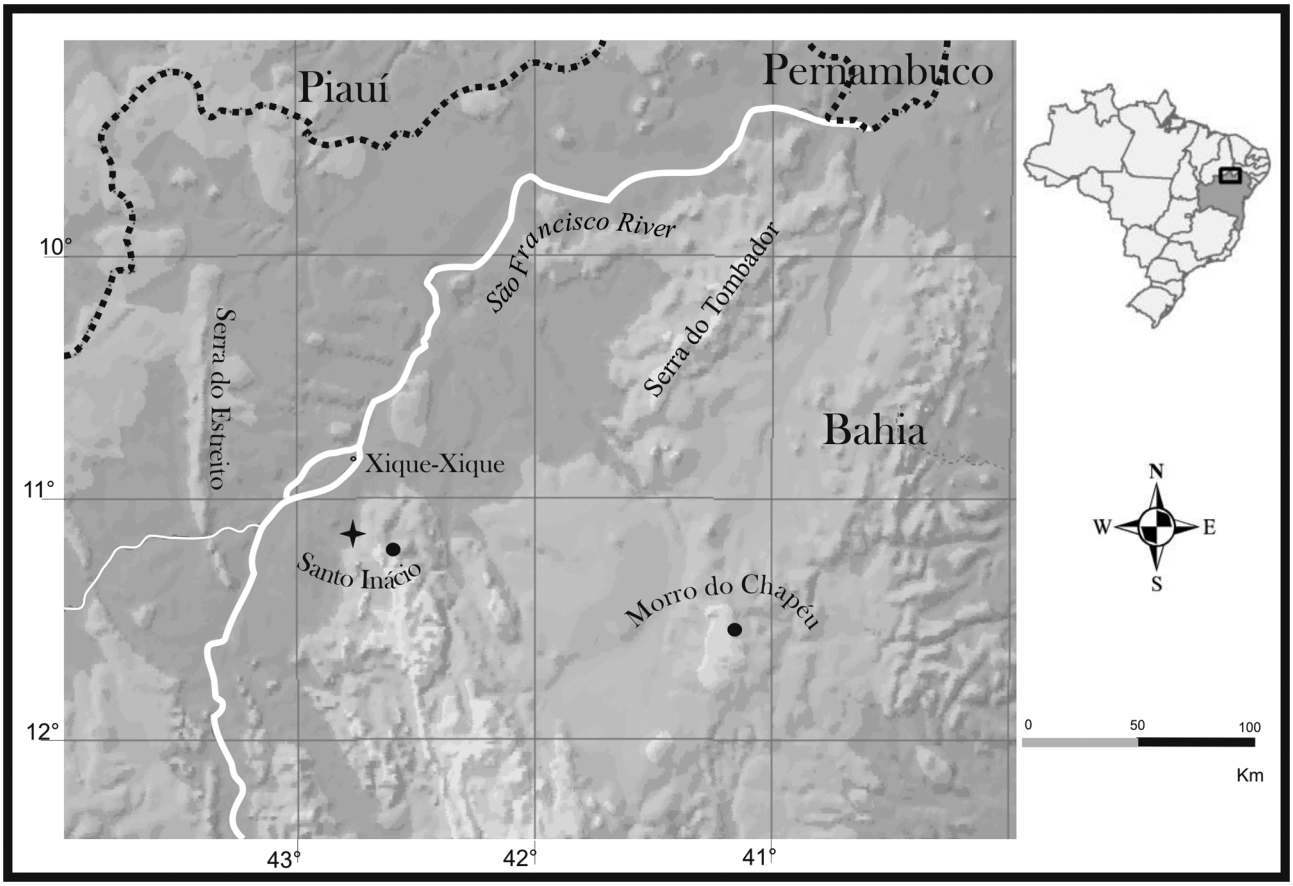

FIGURE 9. Distribution of *Cnemidophorus nigrigula* and *Cnemidophorus cyanurus* in Bahia, Brazil. Black circles= *C. cyanurus*; black star= *C. nigrigula*.

Morro do Chapéu is also located in the northern portion of the Chapada Diamantina, but in a more central position, at about 1000 m of elevation and approximately 180 km southeastern from Santo Inácio. The dominant landscape at Morro do Chapéu is characterized by rocky outcrops of quartzites that are less dissected and eroded than those from Santo Inácio. The area has the characteristic vegetation of the "campos rupestres," recognized by the dominance of plant families adapted to rocky areas, like Velloziaceae, Euriocaulaceae, Xiridaceae and Melastomartaceae, with some influence from the Caatinga vegetation due to its geographical proximity. It is in these sandy areas that *C. cyanurus* is found (Fig. 11). The species is syntopic with *C. ocellifer*, and forages on the ground, where it can be seen in much less abundance than its congener. The conspicuity conferred by the contrast between its bright blue tail and the white sand is astonishing. Other lizards obtained at Morro do Chapéu are: *Ameiva ameiva, Tupinambis teguixin, Iguana iguana,Tropidurus cocorobensis, Tropidurus erythrocephalus, Tropidurus hispidus, Tropidurus semitaeniatus, Mabuya heathi, Gymnodactylus geckoides, Hemidactylus mabouia, Hemidactylus brasilianus, Phyllopezus pollicaris, and Polychrus acutirostris.*

Discussion

The *Cnemidophorus ocellifer* group has been traditionally distinguished from the other groups of *Cnemidophorus* by the presence of granules in the supraorbital semicircles, a lower number of femoral pores (less than 40), and the absence of preanal spurs (Rocha *et al.*, 2000, Colli *et al.*, 2003b). However, this diagnosis is now untenable. Species belonging to the *C. longicauda* group also have granules in the supraorbital semicircles, fewer than 40 femoral pores, and no preanal spurs. Therefore, we redefine the *C. ocellifer* group as follows: presence of granules in the supraorbital semicircles, fewer than 40 femoral pores, absence of preanal spurs, and absence of "opercular ears"- a projection of skin in the anterodorsal margin of the ears (Cabrera, 2004).

FIGURE 10. Habitat of *Cnemidophorus cyanurus* and *C. nigrigula* at Santo Inácio, Bahia, Brazil. Photo: Miguel Rodrigues.

In a recent paper, Arias *et al*. (2011) described two new species of the *Cnemidophorus ocellifer* group from the Parque Nacional da Serra das Confusões, in the Brazilian State of Piauí. We also divided the *C. ocellifer* group into two subgroups. The *C. littoralis* subgroup is composed of very distinctive species (*C. littoralis*, *C. abaetensis*, and *C. venetacaudus*) that share the following features: absence of enlarged scales in temporal region (posterior to third subocular), 6–7 supraciliaries (the first divided), 8–10 longitudinal rows of ventral scales, 29–38 transverse rows of ventral scales, 21–45 femoral pores, one distinctive row of enlarged scales on the dorsal part of arm, 1–2 rows of spurs on heel of the males, and a bright bluish green tail. The *Cnemidophorus ocellifer* subgroup includes *C. mumbuca*, *C. jalapensis*, *C. ocellifer*, and *C. confusionibus*, and is characterized by the following combination of characters: enlarged scales in temporal region (posterior to third subocular), five supraciliaries, 6–8 longitudinal rows of ventral scales, 24–29 transverse rows of ventral scales, and 11–21 femoral pores. *Cnemidophorus cyanurus* fits clearly in the *C. littoralis* subgroup while *C. nigrigula* fits into the *C. ocellifer* subgroup. Comparative character variations for these two assemblages are given in Tables 2 and 3.

Although sexual dimorphism in snout–vent length (SVL) and head length was reported for *C. ocellifer* (Vitt, 1983, 1995; Santana *et al*., 2010), sexual differences are much more pronounced in *C. nigrigula* than in any other species belonging to its subgroup (Table 1). Males have a larger SVL, head length, limbs length, and tail length but the relationship between the trunk length/SVL is larger in females. In addition, males have a patch of the modified scales on the heel, and sexual dichromatism is evident. Females retain much of the juvenile pattern while adult males lose completely the dorsal striped pattern of juveniles. The conspicuous ontogenetic change in color pattern observed in *C. nigrigula* (Figs. 3 and 4) is also known in some species of the *Cnemidophorus lemniscatus* group (such as *C. arenivagus*, Markezich *et al.*, 1997; *C. senectus* and *C. flavissimus*, Ugueto *et al.*, 2009), but have not been reported so far in any other species of the *C. ocellifer* group. Nevertheless, Vanzolini *et al*. (1980) described a similar ontogenetic color pattern variation for a population of *Cnemidophorus* cf. *ocellifer* from Junco do Seridó, in

Paraíba state. Like *C. nigrigula*, females retain the juvenile pattern while males lose their dorsal stripes. Nevertheless, because adult males have most part of the belly red, these specimens should be recognized as a distinctive new species now under study.

In 1987 Rodrigues suggested that the species currently identified as *Cnemidophorus ocellifer* was a species complex. The systematics of the group is passing through a period of important changes, with the description of eight new species in the past 10 years. Despite this prolonged effort, species richness of the group is still far from being well known, with many populations in South America still waiting for a better diagnosis.

FIGURE 11. Habitat of *Cnemidophorus cyanurus* at Morro do Chapéu, Bahía, Brazil. Photo: Miguel Rodrigues.

Material examined

Species names are arranged alphabetically by species, then, by country, province, museum acronym, number and details of the localities.

Cnemidophorus abaetensis: **Brazil**, **Sergipe**: MZUSP 79610, 80982-80983, Barra dos Coqueiros. MZUSP 88104, 88106, 88108, Estação Ecológica Serra de Itabaiana. MZUSP 49385-49387, Santo Amaro das Brotas. **Bahia**: MZUSP 56559-56567, Guarajuba. MZUSP 96847-50, Jandaíra. MNRJ 8618, 8623, 8631, 8640, 8642, 8644, 8645, 8647, 8650, 8658, 8687, 8681, 8685, 9300-9301, Salvador (parátipos).

Cnemidophorus confusionibus: **Brazil**, **Piauí**: MZUSP 100187-100205. Parque Nacional Serra das Confusões, Caracol.

Cnemidophorus cyanurus **sp nov.**: **Brazil, Bahia**: MZUSP 56115-56127, 62801-62810, 65779-65784, 65801, 74215-74222, Morro do Chapéu, MZUSP 56286-56287, 72420-72422, Santo Inácio.

Cnemidophorus jalapensis: **Brazil**, **Tocantins**: MZUSP 100168 and 100169, São Félix do Jalapão.

Cnemidophorus littoralis: **Brazil, Rio de Janeiro**: MNRJ 6555-6556, 6559-6560, 6564-6566, 6578-6579, 6585, 6587, 6592, 6599, 6601, 6603-6604, 6607, 6621, 6665, Barra de Maricá (paratypes).

Cnemidophorus mumbuca: **Brazil, Tocantins**: MZUSP 92547-92548, Mateiros (paratypes); MZUSP 94102-94109, 93415, Mateiros (Estação Ecológica Serra Geral do Tocantins).

Cnemidophorus nativo: **Brazil, Espírito Santo**: MNRJ 39545, 4713, 4715, 4718-4719, 4722, 4724-4725, 4730, 4732, 4734-4738, Linhares (paratypes); MZUSP 95100-95101, Conceição da Barra. **Bahía**: MZUSP 96833-96834, Itacaré.

Cnemidophorus ocellifer: **Brazil, Bahia**: MZUSP 191-196, 201-206, 6149-6152, 6700, 8468, 26827-26859, 65762, Salvador.

Cnemidophorus nigrigula **sp nov.**: **Brazil, Bahia**: MZUSP 93706-93772, 93813-93828, Santo Inácio.

Cnemidophorus parecis: **Brazil, Rondônia**: MZUSP 64470-64473 *BR 364 KM 53-55*; MZUSP 92549-92550, Fazenda Cachoeira (12º32'S, 60º25'W) (paratypes).

Cnemidophorus venetacaudus: **Brazil**, **Piauí**: MZUSP 100115-100119, 100120-100127. Parque Nacional Serra das Confusões. Caracol.

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