Three new species of the genus *Adelophryne* (Amphibia: Anura: Leptodactylidae) from northeastern Brazil, with remarks on the other species of the genus

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Key words: *Adelophryne*; South America; Brazil; Atlantic forest; new species.
In the present paper three new species of the genus *Adelophryne* from the coastal Atlantic forest in Brazil are described. The species are separated from the two species formerly known from the Amazon forest by caatinga vegetation and a distance of at least 1600 km. *A. pachydactylus* from Bahia has a reduced number of phalanges in the fourth finger, and large subdigital pads under fingers and toes. *A. baturitensis* has distinct subarticular tubercles under the toes and a relatively large size. *A. maranguapensis* has large discs on fingers and toes and is boldly patterned.
During fieldwork in Amapá two specimens of *A. gutturosa* were collected and based on them additional data are provided and some concepts from the original description are revised. Literature data on this genus are incorporated and a key to the known species is provided.

Introduction

The genus *Adelophryne* was recognized and named by Hoogmoed & Lescure (1984) to accommodate some minute leptodactylid frogs from the Amazon area. Since its description few additional specimens were reported (Ayarzaguena, 1985; Lynch, 1986) in the literature. Fieldwork by the authors in both the Amazon area (Hoogmoed in collaboration with T.C.S. de Avila-Pires), in Bahia (Hoogmoed) and in Ceará (Borges and Cascon) yielded several new specimens, partly in large series. When subjected to closer study the material turned out to contain three new species and additional material of *Adelophryne gutturosa*. The new species are here described and additional data on *A. gutturosa* are provided.

Acronyms used in the lists of material have the following signification: UFC = herpetological collection of the Universidad Federal do Ceará, Fortaleza, Brazil; MPEG = Museu Paraense Emilio Goeldi, Belém, Brazil; RMNH = Nationaal Natuurhistorisch Museum (formerly Rijksmuseum van Natuurlijke Historie), Leiden, The Netherlands; MSH = fieldseries M.S. Hoogmoed; TCAP = fieldseries T.C.S. de Avila-Pires.

Systematic part
Species accounts

Adelophryne adiastola Hoogmoed & Lescure, 1984 (fig. 17)

Phyzelaphryne miriamae Heyer, 1977: 154 (partly).
Adelophryne adiastola Hoogmoed & Lescure, 1984: 95; Frost, 1985: 258; Lynch, 1986:424.

Lynch (1986) reported a female of this species from Leticia, Amazonas, Colombia. He could not find any trace of vomerine teeth or odontophores and provided a detailed description of the colour pattern.

Adelophryne gutturosa Hoogmoed & Lescure, 1984 (figs.1, 2, 17)

Euparkerella sp. "A" Hoogmoed, 1979: 269.
Adelophryne gutturosa Hoogmoed & Lescure, 1984: 101; Ayarzaguena, 1985: 159; Frost, 1985: 258.

Material.— **Brazil**. AMAPA. Serra do Navio: 1♂, MPEG 4046 (TCAP 854), 1♀, RMNH 26343 (MSH 4874), 9.xi.1988, leg. M.S. Hoogmoed & T.C.S. de Avila-Pires.

Remarks.— The new, freshly collected material provided an opportunity to make comparisons with the original description. Some variation was noticeable.

The snout-vent length of the male is 12.6 mm, that of the female 12.4 mm (fig. 1). The distance between the eye and the nostril in the present specimens is equal to or slightly larger than the distance between nostril and tip of snout. The glandular ridge from tympanum to the base of the forelimb as mentioned in the description in the recent material is not very distinct, but barely discernible. It runs from the middle of the tympanum to the insertion of the forelimb in a straight line. The vocal sac of the male seems to be as extensive as that of the holotype, it is indicated only by two longitudinal folds on the lateral part of the throat and a curved fold in front of the insertion of the forelimbs. Prevomerine processes present, but the number of teeth could not be counted. In the original description large subarticular tubercles are described. With this fresh material in hand it is possible to give a better description of these structures. Actually it would be better to describe them as subdigital pads, because they are not located under the articulations, but under the phalanges themselves. Each finger has a large subdigital pad under its first phalange, only the third finger shows a second, smaller and less distinct pad. Palm of the hand at the base of fingers II, III and IV swollen, but no distinct pads are formed (fig. 2). Fingers in RMNH 26343: I<IV<II<III, in MPEG 4046 I<II=IV<III. Phalangeal formula (based on X-ray photographs) 2-2-3-3, the second phalange in the fourth finger a short rectangle. Terminal phalanges bluntly knobbed. For the toes the same as for the fingers is true (fig. 2). The structures described as subarticular tubercles should be described as subdigital pads. Each toe has a rather prominent subdigital pad at its base, toes III and V each have one additional, less distict swollen area more distally, whereas toe IV has two such areas. The tips of toes I-IV are dilated and slightly swollen into

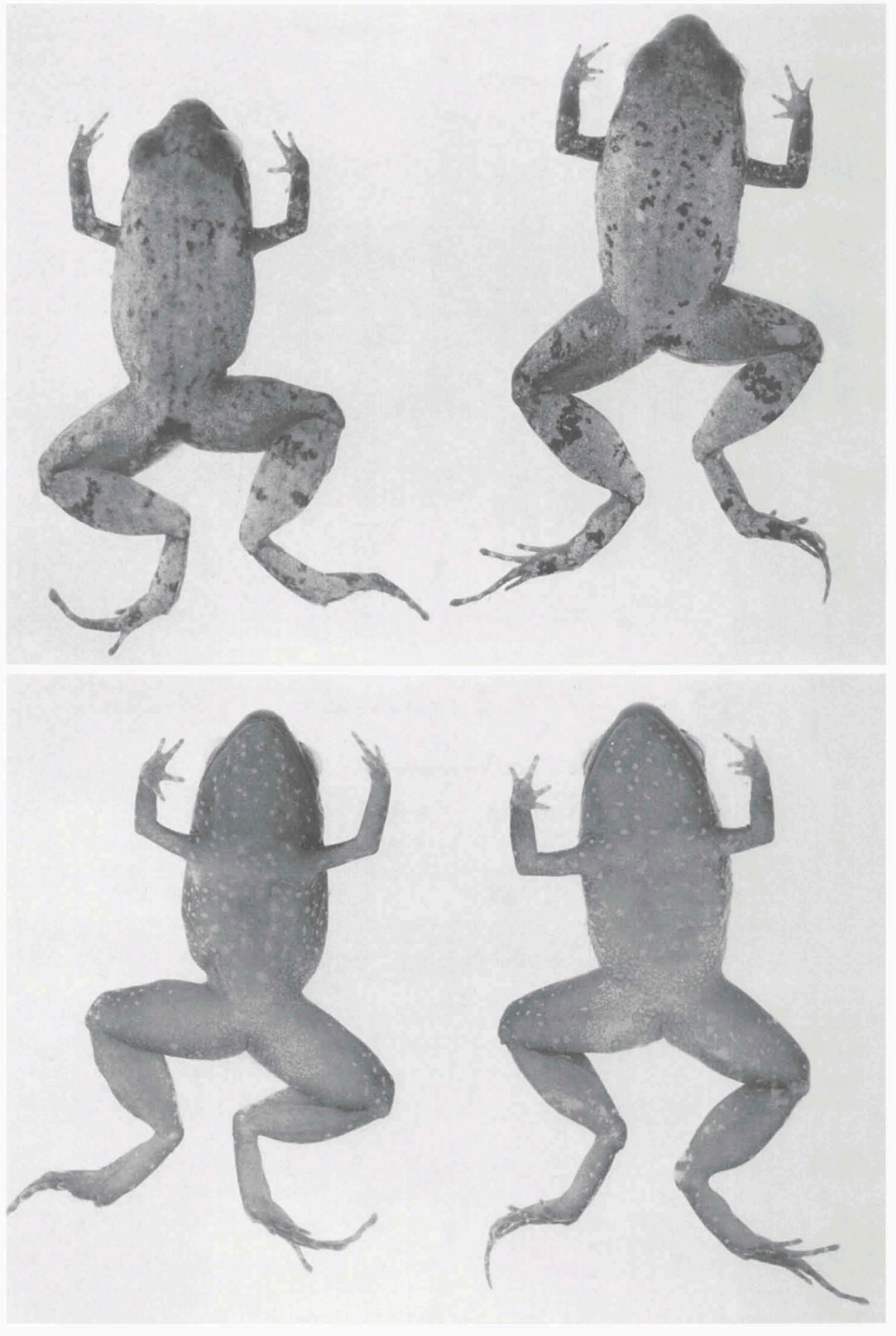


Fig. 1. *Adelophryne gutturosa*, left column dorsal and ventral aspect of ♀ RMNH 26343 (svl 12.4 mm), right column, dorsal en ventral aspect of ♂ MPEG 4046 (svl 12.6mm),

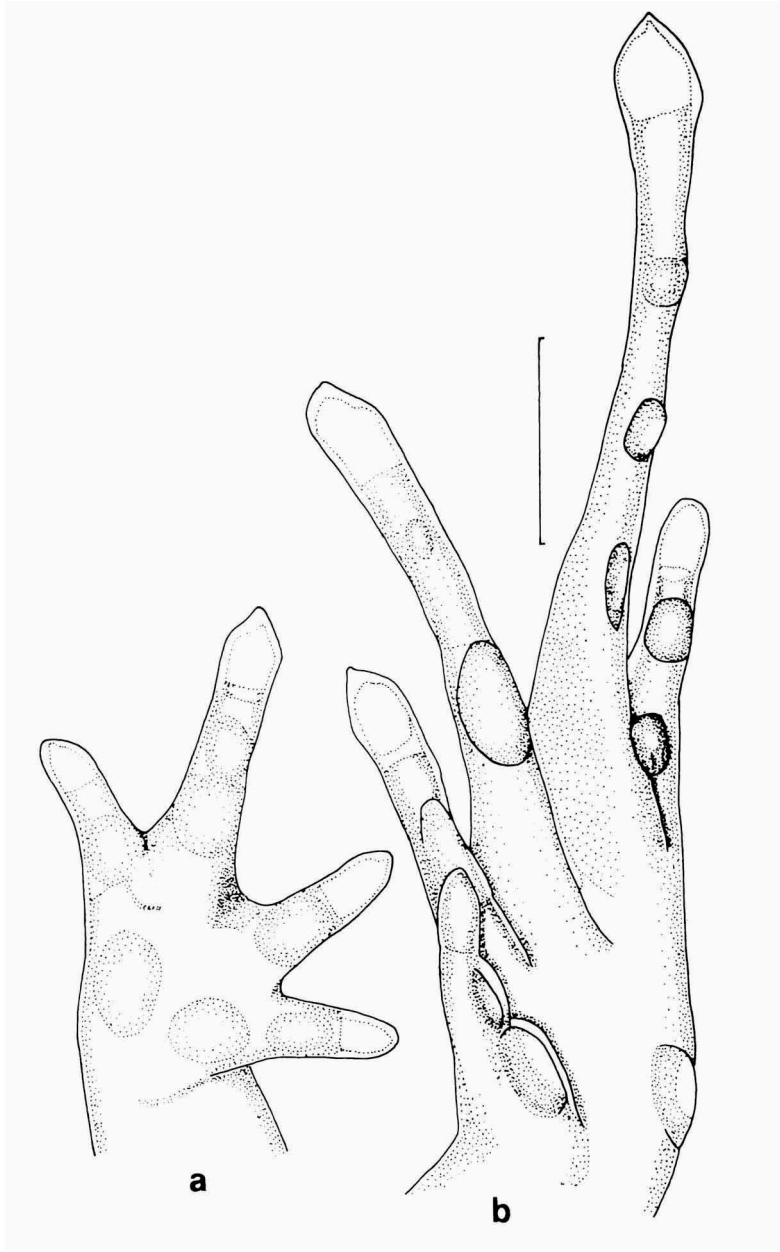


Fig. 2. *Adelophryne gutturosa* (RMNH 26343), a. plantar view of right hand, b. solar view of left foot. Scale bar 1 mm.

small, narrow discs, slightly wider than the adjacent part of the toe, ending in an asymmetrically pointed tip. The tip of toe V is not or hardly dilated and does not have the asymmetrically pointed tip or only shows an indication of it (MPEG 4046), generally it is rounded.

Unfortunately when these specimens were collected it was not realised in the field which species they were and no detailed description of colour in life was made, as they were assumed to be small *Adenomera* Fitzinger, 1867. The only fieldnotes read: Back light brown, flanks black.

In preservative the middle of the back is greyish brown with minute dark brown dots and larger irregularly shaped spots. A wide, grey dorso-lateral area present from eye to groin, not sharply demarcated, widest in the middle, with fewer dark brown dots. Side of head dark brown below the canthus rostralis and the upper eyelid. Flanks dark brown with white spots. Upper parts of hindlimbs as middle of back (thigh only with a narrow longitudinal band), with distinct dark brown transverse bands on the shank, the tarsus and the foot (one each). Anterior and posterior surface of thighs brown with few white spots. Forelimbs dark brown with white spots. Dark brown spot over and around cloaca. Throat, belly, and underside of forelimbs pale brown with white spots. Underside of hindlimbs brown with few white spots. The male and the female agree in most aspects, but the male has brown spots on the back arranged to form an indication of a vertebral stripe. The shank in the male has two incomplete dark brown transverse bands and the throat is slightly darker brown than the belly.

Natural history.— The two specimens here reported were collected in daytime (14.00 - 16.00 h) in terra firme forest on a hill side at an altitude of 110 m. They were in leaf litter on the forest floor. One of the specimens was at the base of a tree. The specimens were collected in November, which in Amapá is the beginning of the rainy season. Ayarzagüena (1985) reported a specimen of this species from La Escalera, carretera El Dorado - Sta. Elena, km 120, Edo. Bolívar, Venezuela, that was found in the stomach of a juvenile specimen of the snake *Chironius fuscus* (L.). The specimen is a female that contained two large (diameter 2 mm) eggs. On the basis of this observation Ayarzaguena reached the conclusion that the species probably has direct development. The specimen was collected in April and Ayarzaguena comes to the conclusion that deposition of eggs takes place at the beginning of the rainy season. In the light of data from one of the new species here described we can only support this opinion.

New species

While doing herpetological research in the coastal region of Brazil Hoogmoed in Bahia and Borges and Cascon in Ceará found specimens of minute frogs apparently belonging to the genus *Adelophryne* as evidenced by the peculiar shape of the tips of their toes. Upon closer examination these specimens proved to belong to three new species which are here described.

While working in the (former) Atlantic forest of Bahia, now largely replaced by cacao farms, MSH in June 1985 found a single specimen of frog that turned out to be new.

Adelophryne pachydactyla spec. nov.
(figs. 3-5, 17)

Holotype.— **Brasil.** BAHIA. Fazenda Luzitania, Rio Almada, 2.4 km E of bridge in BR-101 over Rio Almada, bridge 600 m N of km 487 and 4.5 km N of branch road to Itajuipe, NW of Ilheus: 1♂, MPEG 5711 (MSH 4090), 2.vi.1985, leg. M.S.Hoogmoed.

Diagnosis.— A minute (snout-vent length 11.1 mm) frog, with reduced fourth finger only having two phalanges. Fingers and toes depressed, fingers with swollen subdigital pads. Tips of fingers without discs, bluntly pointed or with an asymmetrically pointed tip (third only). Tips of toes expanded into small discs with asymmetrically pointed tips. Terminal phalanges with a blunt tip. Skin of back smooth. Adult male with subgular vocal sac.

Description.— Snout-vent length of an adult male 11.1 mm. Head slightly longer than wide, as wide as the adjacent part of the body; its depth 56% of the width. Snout rounded in dorsal and lateral profile (fig.4). Distance between tip of snout and eye slightly more than the diameter of the eye. Distance between eye and nostril about half the internarial distance, marginally less than the distance between nostril and tip of snout, about $^1/_3$ of distance between eye and tip of snout. Canthus rostralis indistinct, rounded, slightly concave; loreal region sloping steeply to the upper lips. Lips not flaring. Nostrils inferolateral of the canthus rostralis, not projecting, forming a vertical opening, directed laterally. Internarial distance slightly less than interorbital space. Eye with horizontally oval pupil. Interorbital space 1.5 times as wide as an upper eyelid, slightly convex. Temporal region vertical, tympanum small, but distinct, round, $^1/_3$ diameter eye, surrounded by a distinct, incomplete tympanic annulus, which is obscured by skin in its upper part; distance between tympanum and eye slightly more than half the tympanum diameter. No supratympanic fold. A series of low glandules from the mouth to the insertion of the forelimbs, passing below the tympanum.

Choanae small, round, placed very laterally; prevomerine processes small, transverse, at some distance posteriorly of the choanae (it could not be established whether they bore teeth). Tongue ribbon-like with slightly expanded posterior part, not notched behind, completely free, except its anterior margin. Male with long, slightly curved vocal slits, flanking the tongue, and a subgular vocal sac that does not extend onto the chest.

Skin of back and venter smooth, that of throat also smooth, but with lateral, longitudinal folds (indicating the vocal sac). Skin of limbs smooth, but posteroventral aspect of thighs coarsely areolate. Flanks areolate. Discoidal folds absent. Cloacal opening slightly below the level of the dorsal surface of the thighs, directed posteriorly.

Hand (fig. 5) with a large, undivided, irregularly shaped, flat outer and a smaller, oval inner metacarpal tubercle. Underside of fingers with large, flat padded areas separated by furrows under the articulations, no pads under the ultimate phalanges. At base of fingers II and III a large, flat pad. Fingers depressed, short, wide, free of web. Tips of fingers I, II and IV bluntly pointed, finger III with an asymmetrically pointed tip, no discs, no circumferential groove. Fingers: I<IV<II<III, fourth finger short, free part about half the free part of the third finger. Phalangeal formula 2-2-3-2,

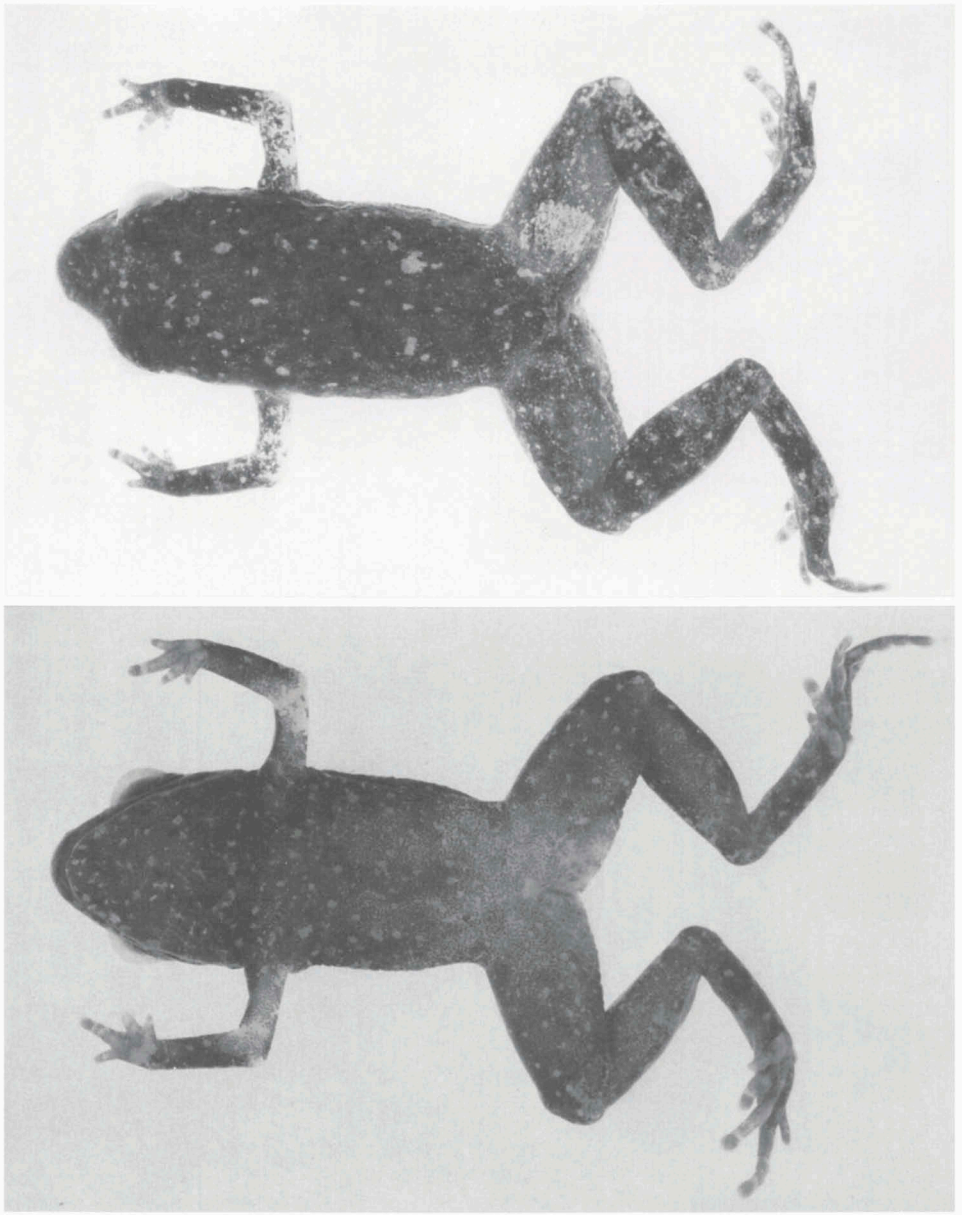


Fig. 3. *Adelophryne pachydactyla* (MPEG 5711), holotype, above dorsal, below ventral view (svl 11.1 mm).

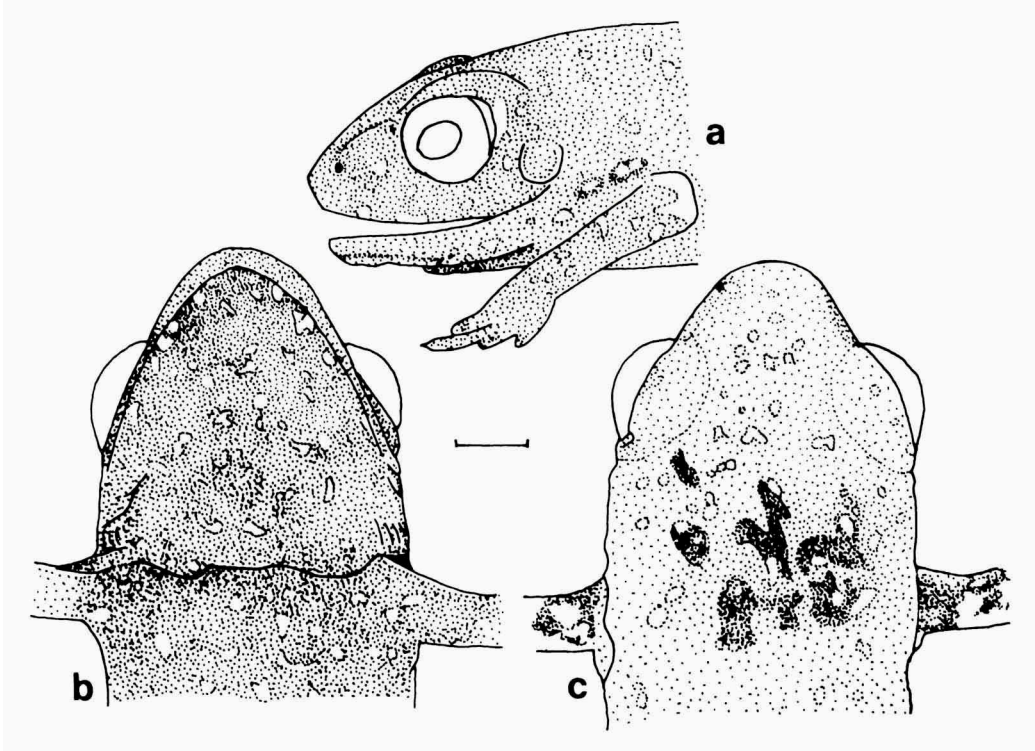


Fig. 4. *Adelophryne pachydactyla* (MPEG 5711), head of holotype, a. lateral, b. ventral, c. dorsal view. Scale bar 1 mm.

thus the number of phalanges in the fourth finger is reduced. Terminal phalanges seem to have a blunt tip. Fingers and palm surrounded by a narrow transparent rim of skin (the muscular mass of fingers and palm is coloured, the surrounding skin is transparent, thus causing a look through effect), the rim thus is not to be interpreted as a flat lateral fringe as may occur in some frogs.

Tarsus smooth without tarsal ridge or tubercle. A large, distinct, oval, flat inner and a smaller, round, conical outer metatarsal tubercle, approximately $^1/_3$ the size of the inner one (fig. 5). Subdigital pads distinct, large, flat (1-1-2-3 resp. under toes I-IV; two small, indistinct ones under toe V). No supernumerary pads. Toes depressed, relatively short and wide, free of web. Tip of toes I-IV dilated into small, narrow discs, slightly wider than the toes, ending in an asymmetrically pointed tip. Disc of toe V hardly expanded, bluntly pointed, no asymmetrical tip. Discs with a circumferential groove, which is narrowly interrupted at the tip. Toes: I<II<V<III<IV. Phalangeal formula 2-2-3-4-3; terminal phalanges T-shaped. Toes and sole surrounded by a narrow transparent rim of skin (see hand).

Limbs short. Heel of the adpressed hindlimb reaches the eye. When the hindlimbs are flexed at right angles to the sagittal plane , the heels do not touch. Tibia 44% of the snout-vent length.

In preservative the back is variegated brown and dark brown with small whitish spots. Flanks as back, with an indication of an oblique row of light spots from shoul-

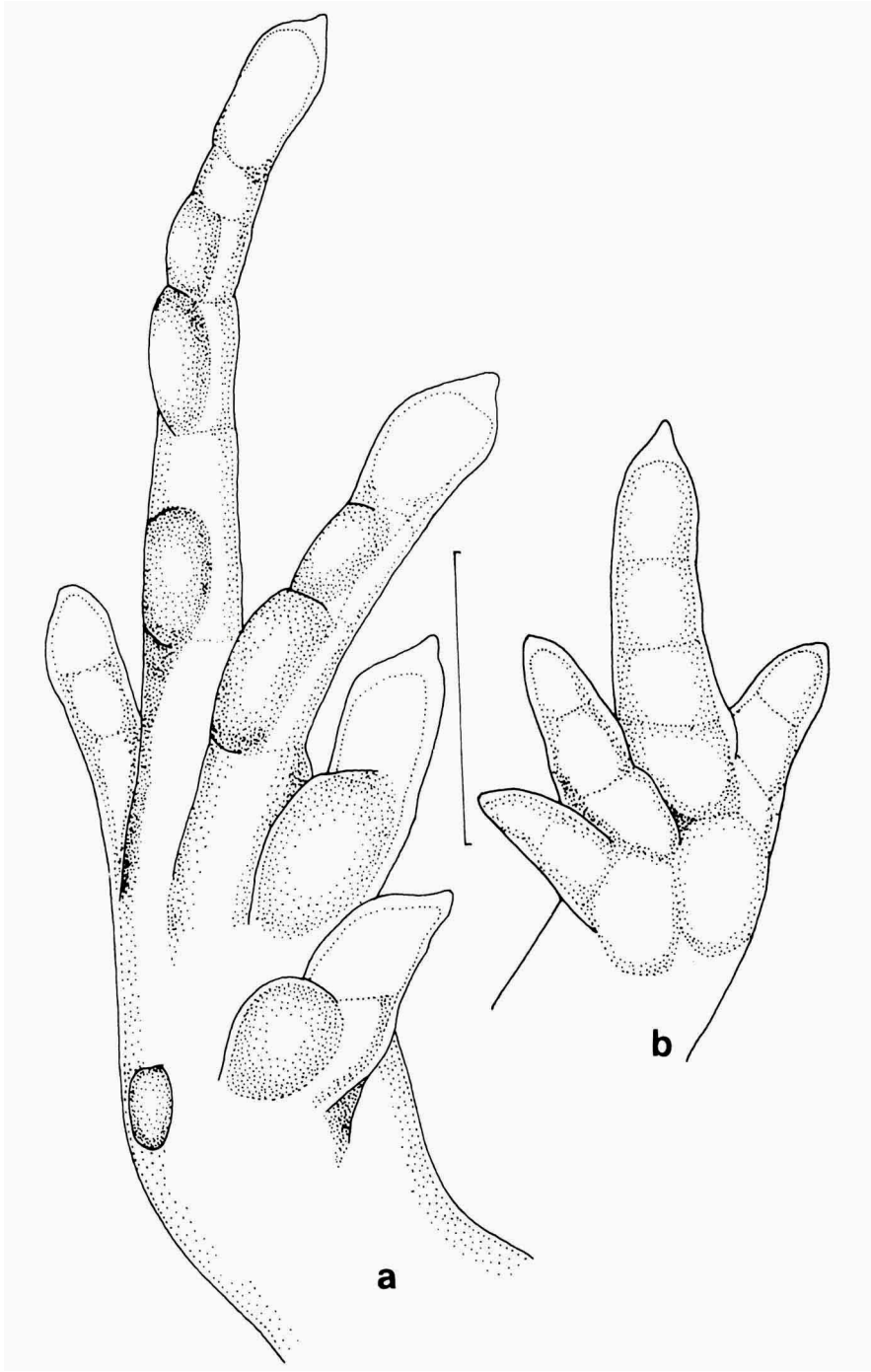


Fig. 5. *Adelophryne pachydactyla* (MPEG 5711), holotype, a. solar view of right foot, b. plantar view of left hand. Scale bar 1 mm.

der to groin. Nostrils in white areas. Posterior and ventral part upper arms whitish. Lower arms as back. Fingers with a transverse, light line above the articulation between the ultimate and the penultimate phalange. An indication of four narrow, transverse dark brown bands on shank. Throat dark brown, with white spots, belly and underside of limbs brown with white spots. Palms transparently white, soles grey. Tips of toes and fingers white.

Colour in life: Back blackish brown with grey spots. Underside black. Iris reddish brown.

Natural history.— The single specimen was collected in June in a cacao farm with mainly cacao trees, some larger, emergent shade trees, and bananas. It was on the forest floor at night, among leaflitter near a small creek.

Distribution.— Only known from the type locality in the coastal area of Bahia, Brazil (fig. 17). The species may be distributed in the cacao forests and the few remaining original rainforests in the general area.

Etymology.— From the Greek *pachys*, thick, and *daktylos*, finger, in reference to the thick, short, swollen fingers of this species.

Remarks.— In accordance with the regulations as laid down in Portaria 55 of the Ministério da Ciência e Tecnologia of 14 March 1990, paragraph 42 a) the holotype has been deposited in a Brazilian collection, viz., the herpetological collection of the Department of Zoology of the Museu Paraense Emilio Goeldi.

Between July 1988 and April 1990 DMB and PC executed intensive fieldwork in the Maciço de Baturité in Ceará to study the local herpetofauna. In the course of this study they collected a number of minute frogs that turned out to belong to a new species here described.

Adelophryne baturitensis spec. nov.
(figs. 6-11, 17, 18)

Holotype.— **Brazil**. CEARÁ. Serra de Baturité, Povoado de Santana, Município de Pacoti, S 4°14'02.8" W 38°53'09.1", 800 m: 1 ♂, UFC 2655, 5.iv.1990, leg. D.M.Borges. Paratypes.— **Brazil**. CEARÁ. Serra de Baturité, Município de Pacoti. Sítio Floresta, S 4°13'41.9" W 38°52'45.5", 800 m: 5 ♀, 2 ♂, UFC 2657-62, RMNH 26663 (formerly UFC 2663), 17.ii.1990, leg. D.M.Borges. Sítio Barbosa: 1 ♀, RMNH 26662 (formerly UCF 2656), 4.iv.1990, D.M.Borges. Sítio Timbaúba e Sítio São Pedro: 2 ♀, 2 ♂, 1 juv., UFC 2666-67, 2669, RMNH 26664-65, (formerly UFC 2668 and 2670), 4.iv.1990, leg. D.M.Borges. Sítio São Luís: 1 ♀, 1 ♂, MPEG 5948-49 (formerly UFC 2664- 65), 5.iv.1990, leg. D.M.Borges. Serra de Baturité, Município de Guaramiranga. Sítio Monte Belo: 1 ♀, UFC 2671, 8.viii.1989, leg. D.M.Borges. Mata do Remanso: 1 ♀, UFC 2364, 12.iii.1989, 2 ♀, UFC 2396- 97, 26/27.iv.1989, 1 ♀, 1♂, UFC 2413-14, 1.v.1989, 1 ♀, UFC 2469, 5.v.1990, all leg. P.Cascon. Sítio Riacho Fundo: 2 ♀, UFC 2440-41, 29/30.vi.1989, leg. P.Cascon, C.L.F.Bezerra & S. Castelo.

Diagnosis.— A minute (snout-vent length to 16.3 mm) frog, with small fourth finger having three phalanges. Fingers depressed, slender with small subdigital pads. Tips of fingers I and II without discs, bluntly pointed, those of fingers III and IV with small discs and an asymmetrically pointed tip (fourth only sometimes). Tips of toes expanded into small discs with asymmetrically pointed tips. Toes with distinct subarticular tubercles. Terminal phalanges T-shaped. Skin of back smooth. Adult male with subgular vocal sac.

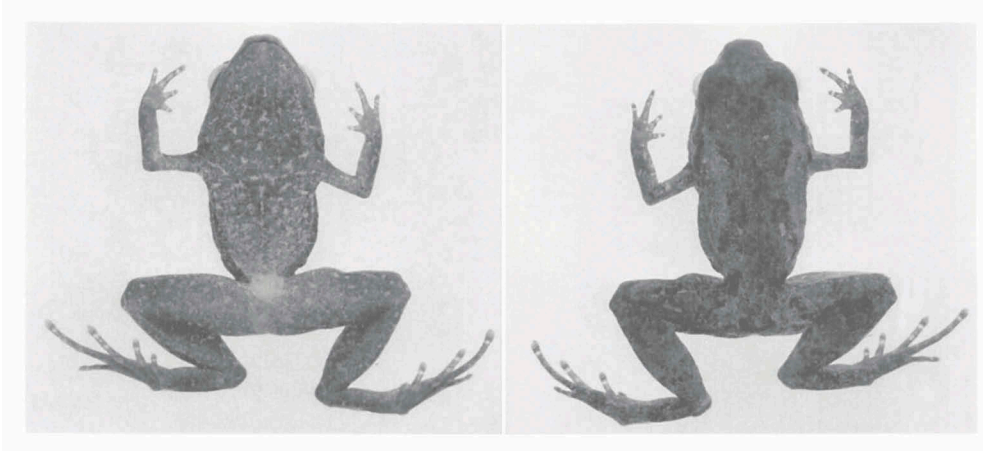


Fig. 6. *Adelophryne baturitensis* (UFC 2655), holotype, left ventral, right dorsal view (svl 13.4 mm).

Description.— Snout-vent length of adult males 11.8-13.4 mm (12.6 ± 0.6, n=7) (holotype 13.4 mm), of adult females 12.2-16.3 mm (13.9 ± 1.3, n=17) (figs. 6, 9-11). Head distinctly longer than wide, as wide as the adjacent part of the body; its depth (45) 51-60 (63)% of the width. Snout truncate in dorsal and rounded in lateral profile (fig. 7). Distance between tip of snout and eye distinctly more than the diameter of the eye. Distance between eye and nostril 60-87% (68.9 ± 21.8, n=48) of the internarial distance, generally distinctly more [(0.8) 1.0-1.4 (1.12 ± 0.5, n=48)] than the distance between nostril and tip of snout, about 60% (42-65, 56.3 ± 4.8, n=48) of the distance between eye and tip of snout. Canthus rostralis indistinct, rounded, straight; loreal region sloping steeply to the upper lips. Lips not flaring. Nostrils inferolateral of the canthus rostralis, not projecting, forming a vertical opening, directed laterally. Internarial distance slightly less than, to equal to, the interorbital distance (75-100%, 87.9 ± 8.5, n=24). Eye with horizontally oval pupil. Interorbital space 1.1-2.0 (1.4 ± 0.2, n=48) times as wide as an upper eyelid, flat to slightly convex. Temporal region vertical, tympanum small, but distinct, round, 29-55% (43 ± 6.7, n=48) of the diameter of the eye, surrounded by a distinct, incomplete tympanic annulus, which is obscured by skin in its upper part, most distinct in its antero-ventral part; distance between tympanum and eye slightly more than half to $^2/_3$ (sometimes equal to) the tympanum diameter. No supratympanic fold. A few low glandules (sometimes not very prominent) from the mouth to the insertion of the forelimbs, passing below the tympanum. Temporal area and flanks with scattered, round yellow 'pores' (= subcutaneous yellow spots). Very few of them on the belly, absent on the back. In the subtympanic glands these 'pores' are more concentrated, also in the area above the insertion of the forelimbs. These pores are more evident in some specimens than in others.

Choanae small, round, placed very laterally; prevomerine processes small, transverse, at some distance posteriorly of the choanae (with 3-8 teeth). Tongue long and narrow, slightly expanding posteriorly, expanded posterior part not notched behind; completely free, except its anterior margin. Males with long, slightly curved vocal slits, flanking the tongue, and a subgular vocal sac that does extend onto the anterior part of the chest.

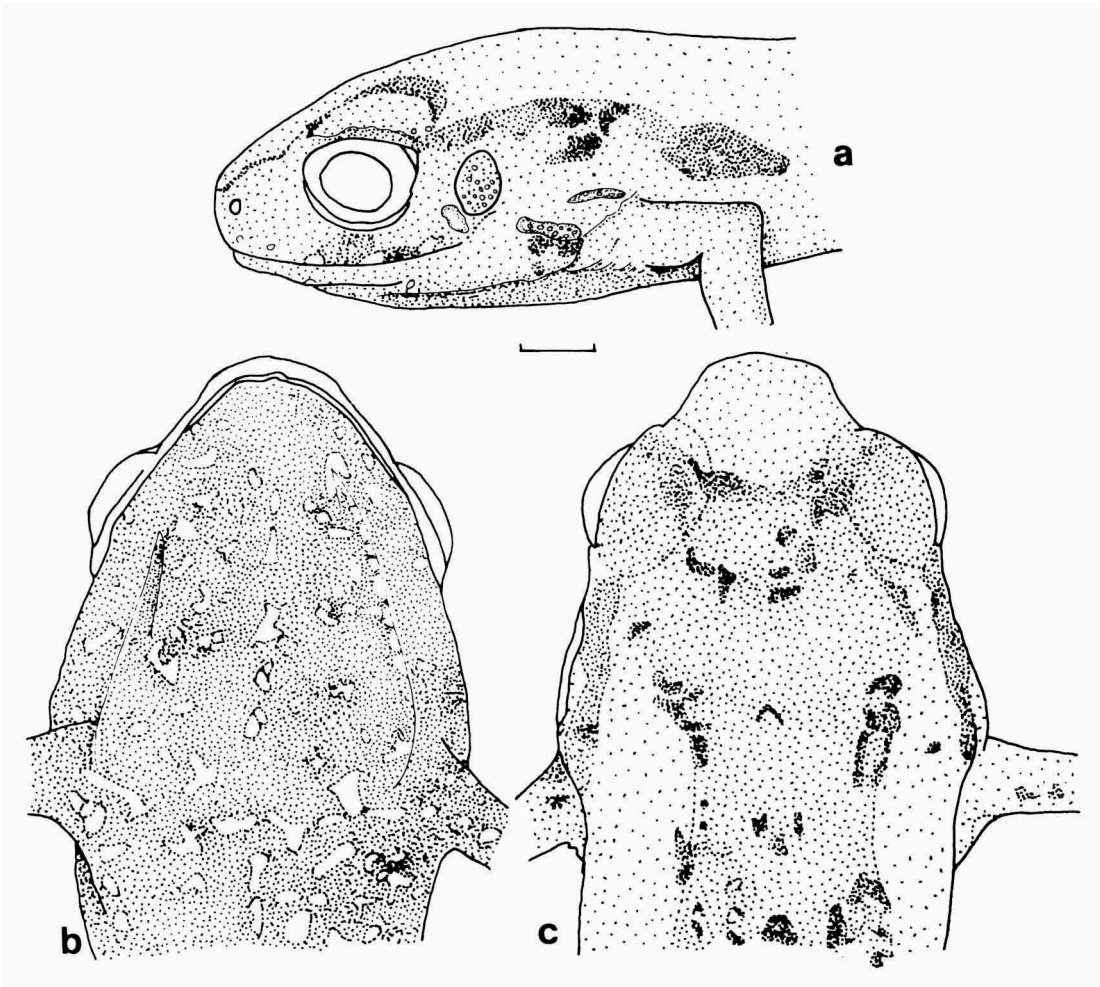


Fig. 7. *Adelophryne baturitensis* (UFC 2655), head of holotype, a. lateral, b. ventral, c. dorsal view. Scale bar 1 mm.

Skin of back, venter, throat and limbs smooth. Throat of males with lateral, longitudinal folds (indicating the vocal sac). Skin of limbs smooth, but posteroventral aspect of thighs coarsely areolate. Flanks smooth to slightly pustulous. Discoidal folds absent. Cloacal opening at mid height of the thighs, no dorsal flap, directed posteriorly.

Hand (fig. 8) with a large, undivided, irregularly shaped, flat outer and a smaller, oval inner metacarpal tubercle. Underside of fingers with small, flat padded areas (1-1-2-2), no pads under the ultimate phalanges. Pads under the proximal phalanges higher than distal ones. On palm at base of fingers II and III a large, flat pad each. Fingers depressed, free of web. Tips of fingers I and II bluntly pointed, of IV mostly so, finger III and sometimes IV with an asymmetrically pointed tip. Fingers I and II without discs, no circumferential groove; fingers III and IV with small discs not wider than the adjacent phalange and a circumferential groove interrupted at the

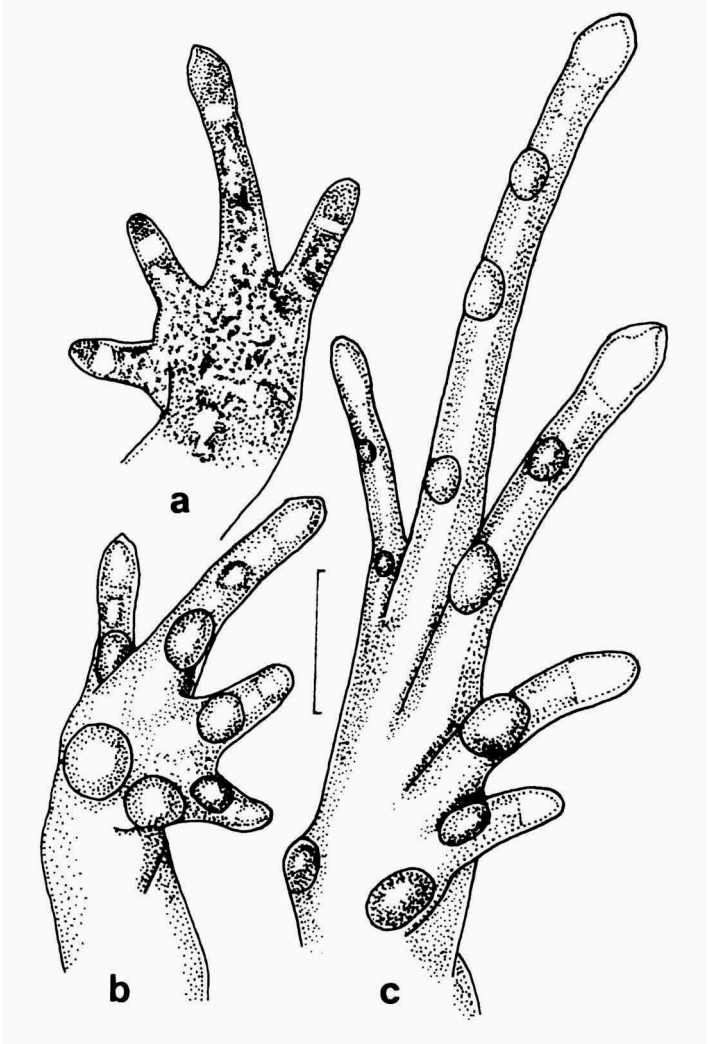


Fig. 8. *Adelophryne baturitensis* (UFC 2655), holotype, a. dorsal view of right hand, b. plantar view of right hand, c. solar view of right foot. Scale bar 1 mm.

asymmetrically pointed tip. Fingers: I<II≤IV<III, fourth finger relatively long, free part more than half the free part of the third finger. Phalangeal formula 2-2-3-3, thus the number of phalanges in the fourth finger is not reduced. Terminal phalanges T-shaped. Fingers and palm surrounded by a narrow transparent rim of skin (the muscular mass of fingers and palm is coloured, the surrounding skin is transparent, thus causing a look through effect), the rim thus is not to be interpreted as a flat lateral fringe as may occur in some frogs.

Tarsus smooth without tarsal ridge or tubercle (fig. 8). A distinct, oval, inner and a slightly smaller, round, conical outer metatarsal tubercle. No subdigital pads. Subarticular tubercles distinct, round, protruding, present under all but the ultimate arti-

Fig. 9. Upper picture *Adelophryne baturitensis* , UFC 2469 (svl 14.4 mm); *Adelophryne maranguapensis*, lower left UFC 2672 (svl 12.6 mm), lower right UFC 2673 (svl unknown).

culation. No supernumerary tubercles under toes or sole. Toes depressed, relatively short and wide, free of web. Tip of toes II-IV dilated into small, narrow discs, slightly wider than the toes, ending in an asymmetrically pointed tip. Discs of toes I and V hardly expanded, bluntly pointed, the tip may be asymmetrically pointed or rounded. Discs with a circumferential groove, which is narrowly interrupted at the tip. In some specimens the groove is continuous dorsally of the tip. Toes: I<II<V<III<IV. Phalangeal formula 2-2-3-4-3; terminal phalanges T-shaped. Toes and sole surrounded by a narrow transparent rim of skin (see hand).

Heel of the adpressed hindlimb reaches between the eye and the tip of the snout. When the hindlimbs are flexed at right angles to the sagittal plane, the heels do overlap slightly. Tibia 45-56% (50.3 ± 2.7, n=49) of the snout-vent length.

In preservative the middle of the back with a large brown area, with scattered

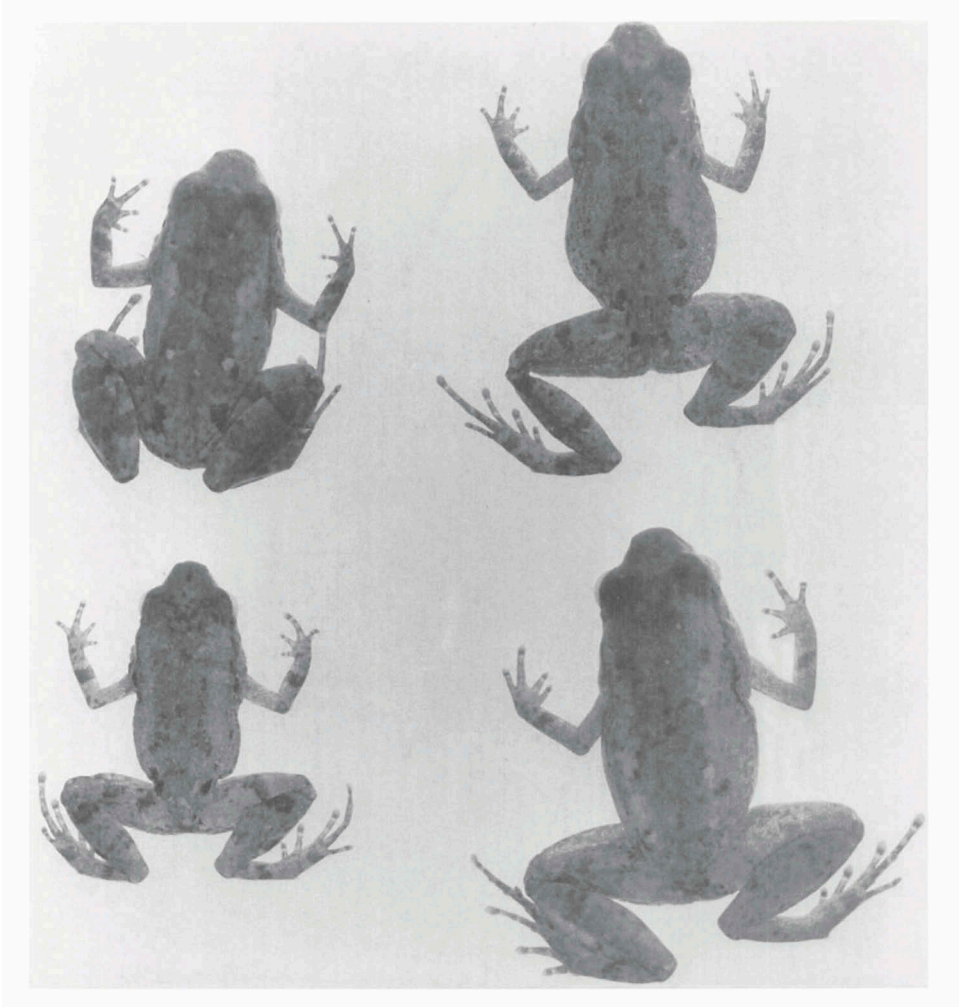


Fig. 10. *Adelophryne baturitensis*, dorsal aspect of UFC 2469 (upper left, svl 14.4 mm), RMNH 26665 (upper right, svl 15.1 mm), RMNH 26664 (lower left, svl 11.8 mm), and RMNH 26662 (lower right, svl 16.3 mm).

dark brown spots and often delimited laterally by dark brown lines forming a)(shaped figure, anteriorly it is delimited by a dark brown transverse line (not always very distinct) between the eyes, posteriorly there is a pair of dark brown inguinal spots, apparently more distinct in males than in females. Dorsolateral area light grey, delimited laterally by a dark brown line extending horizontally and posteriorly from the eye to above the insertion of the forelimb, where it curves ventrally and continues obliquely to the groin. Snout grey to brown. Sides of head brown, flanks below the lateral line light grey with brown spots. Forearm with a transverse dark brown band. A dark brown spot on the anterior aspect of the upper arm near the insertion. Two more or less distinct transverse dark brown bands each on thigh and shank, continued on tarsus and foot. Transverse white lines over the ultimate articulations of the fin-

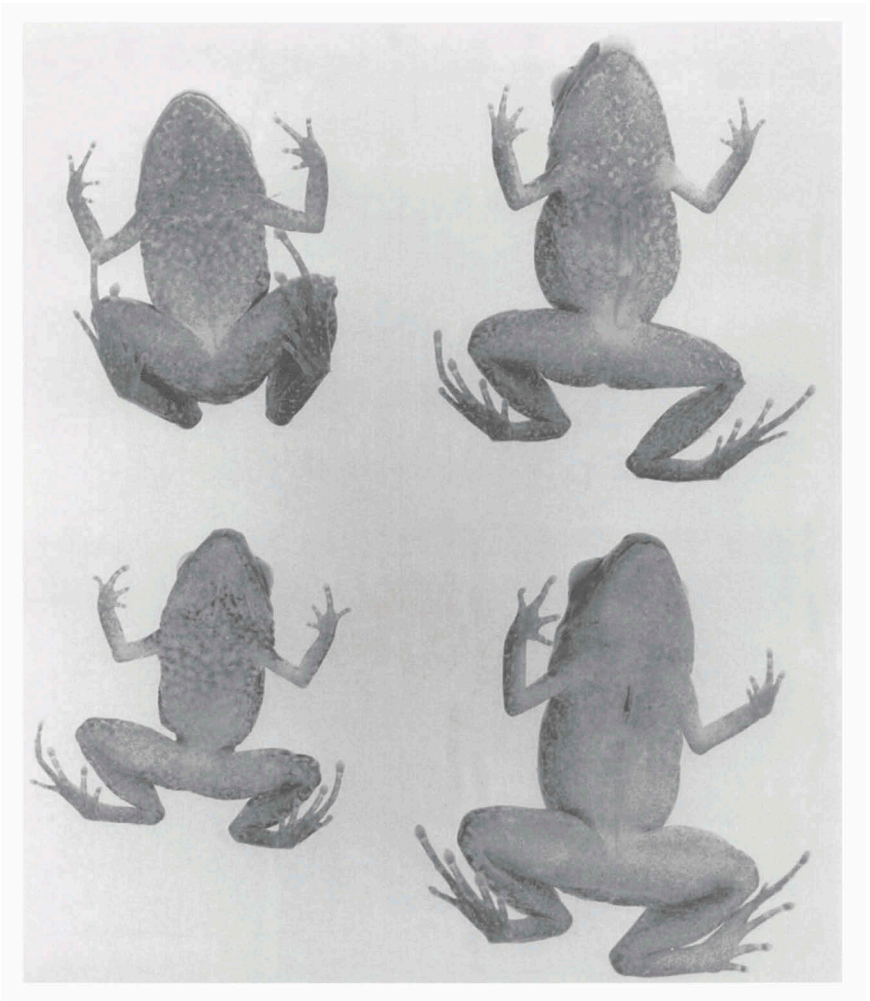


Fig. 11. *Adelophryne baturitensis*, ventral aspect of UFC 2469 (upper left, svl 14.4 mm), RMNH 26665 (upper right, svl 15.1 mm), RMNH 26664 (lower left, svl 11.8 mm), and RMNH 26662 (lower right, svl 16.3 mm).

gers and over all articulations of the toes. Throat and chest brown with whitish spots anteriorly, posteriorly the brown decreases and changes into a reticulum on a white background. Underside of limbs as the belly.

Colour in life (based on colour photographs of UFC 2469 and 2661/2): Back with a large brown figure, from between the eyes to the sacral area. Snout and dorsolateral area light brown. Sides of snout and flanks with a dark brown band, tapering towards the groin. Limbs with brown and light brown transverse bands. Iris gold coloured(fig. 9).

Distribution.— So far the species is only known from several localities in the Maciço or Serra de Baturité, Ceará, Brazil (figs. 17, 18), an isolated, humid and forested mountain range (altitudes generally varying between 300 m and 800 m, the highest

point reaching 1114 m above sea level) in the relatively dry coastal area of Ceará.

Natural history.— The Maçico de Baturité is situated at 70 km SW of Fortaleza, and has a general direction from NNE to SSW (4°00'-4°30'S and 38°45'-39°15'W) (Nascimento & Lima Verde, 1989) and measures 55 × 30 km (Cunha et al., 1992). Several factors, like for instance the altitude (maximum 1114 m, Pico Alto) and the position in relation to the humid winds, favour the conservation of forested areas with their own physiognomic and climatic characteristics, which are very different from those of the surrounding caatingas. The vegetational cover normally present in these humid northeastern mountain ranges is forest, which was separately classified by Andrade-Lima (1966) and named Floresta Tropical Plúvio-Nebular Perenifólia and Floresta Tropical Plúvio-Nebular Sub-perenifólia. These closed forests consist of trees of 15-20 m high, with straight stems and the branching high above the ground, with an undergrowth of smaller trees with many epiphytes, and are encountered between 500 and 800 m. The area is characterised by only two seasons: rainy (with highest rainfall in the months of February to April) and dry (lowest rainfall in the months of August to October). The mean temperature in the highest localities like Pacoti and Guaramiranga is about 21°C. At the moment the Maçico de Baturité, like all other humid mountain ranges is unrelentingly deforested. Exploration for wood takes place and thanks to the good soil and climate agricultural activities (principally coffee, bananas and vegetables) are developing. Because of this, the closed humid forests are constantly being pressed back to the highest mountain tops which are difficult to reach. During a short visit to the Maciço de Baturité on August 15, 1993 by MSH and DMB, the localities Santana and Sitio Floresta were visited. Santana is a hamlet surrounded by plantations of sugarcane, banana, xuxu (*Sechium edule* Sw.) and coffee, with remains of the original forest on the mountaintops. The holotype was collected in the main street of the hamlet, which is paved with cobblestones and bordered by houses, gardens and some banana plantations. No original vegetation remains nearby. The forest at Sitio Floresta is situated on a very steep part of a slope, near the crest of the mountain ridge. The forest is low (approximately 10-15 m) and consists of rather small trees, with a well developed undergrowth of young trees that made walking through it difficult. To MSH this forest made the impression of being secondary. The trees were covered with large bromelias. The forest floor was covered with crisp, dry leaves. The only standing water in the area was to be found in the bromeliads. No creeks were present in the area either. Another patch of *Adelophryne* habitat nearby was situated on a more horizontal stretch of ground. The undergrowth here mainly consisted of a small species of bamboo. No specimens of *Adelophryne* were found during this visit, but this may be related to the fact that no rain had fallen in the area for the past two years, and specimens probably were hidden deep in the soil. Bromelias investigated did not yield any herpetological specimens.

Generally specimens were collected in dry or moist leaf litter on the ground in reasonably well preserved closed forests. Some specimens were collected at ground-level in places protected by superficial roots of trees. However, normally specimens were seen jumping on the dry leafs on the floor, resembling crickets. This is a diurnal frog of which most specimens were collected in the daytime between 10.00 and 15.00 h, only UFC 2469 was collected at night between 21.30 and 24.00 h. The holotype was collected in a street in a hamlet (see above) on an overcast and rainy afternoon. UFC

2413-14 were collected close to the margin of a small creek in the forest, UFC 2441 was in a waterhole in a creek without running water at the time of collecting, RMNH 26662 (formerly UFC 2656) was in forest leaf litter under a terrestrial bromeliad containig water. UFC 2657-62 were collected in a moist area far away from sources of running or standing water. In the area frog calls were heard, but no calling frogs were actually observed. In the same locale specimens of the frog *Eleutherodactylus* sp. (an endemic species) and the terrestrial dwarf gecko *Coleodactylus meridionalis* Boulenger were collected. Because of this, and because none of the males was ever seen calling, it is difficult to decide whether the call of *Adelophryne baturitensis* was ever heard.

The proportion of females in the sample is astonishingly high: 17 females against 7 males. Normally in frogs this ratio is more skewed in favour of males, which are more obvious because of their calling behaviour. However, in *Adelophryne* there is a distinct (*A. baturitensis*) or a slight (of *A. adiastola* and *A. gutturosa* three females and two males are known for each, only one male known for *A. pachydactylus*) preponderance of females in the material known sofar. Either this reflects that collecting is done in a rather unbiassed way, and that specimens are collected whenever they are chanced upon and not specifically sought out for their call, and that there is a real preponderance of females. Or it means that the (smaller) males remain more hidden in fissures in the ground (Hoogmoed & Lescure, 1984) than females, which possibly expose themselves more when they are searching for suitable places to deposit eggs.

A number of females contain large (diameter up to 2 mm in UFC 2659) eggs with a relatively large amount of vitellin, which seems to indicate that eggs are deposited in wet spots and have direct development (Ayarzaguëna, 1985). The number of large eggs ranges from two to five. Females containing large eggs were collected in February and in early April, a period which coincides with the rainy season in the Maciço de Baturité. Some females collected in the middle of March (UFC 2364) and in early April (UFC 2665, 2669) only contained small ovules. In UFC 2670 (collected on April 4) apart from the 5 large eggs about 15 ovules of different sizes can be seen; in UFC 2656 there are 2 large eggs and a number of small ovules. The rainy season in the Maçico de Baturité falls between February and June, with maximum rainfall in March and April, and thus it seems the reproductive season entirely falls within this season. However, it should be remarked that hardly any material has been collected outside the rainy season, so this remark should be treated as preliminary. Borges (1991) provides more details on the conditions in the area and about the herpetofauna in general. Cunha et al. (1992) provide a general description of the Maçico de Baturité as well, especially of the type locality of a new genus and species of teiid lizard (*Colobosauroides cearensis* Cunha, Lima-Verde & Lima).

Remarks.— Although the forests of the Maçico de Baturité at the moment are isolated and surrounded by dry caatinga, they likely were in contact with the Amazonian and Atlantic forest during humid Quaternary (and earlier) periods (Vanzolini, 1981). The herpetofauna of the Maçico de Baturité is of mixed origin and has elements in common with the surrounding caatinga, with the Atlantic forest, with the Amazonian forest, with both forested regions, with all three habitats mentioned and also contains a number of endemics (e.g. *Colobosauroides cearensis* mentioned above). Among the shade-loving species the Atlantic forest elements dominate, although the

Amazonian element also is present, but to a lesser degree (Borges, 1991).

The present species seems to be endemic to the Maçico de Baturité and is separated by considerable distances from most other members of the genus. An exception is formed by the specimens of *Adelophryne* found recently in the Serra de Maranguape, which is located between the Maçico de Baturité and Fortaleza, at a distance of some tens of kilometers.

It seems premature to speculate extensively on the history of this group, because necessary immunological and DNA data are lacking. These data could tell us something about the time of separation of the different species. Vanzolini (1981), discussing the relationships of the reptiles inhabiting mesic forest enclaves in northeastern Brazil (the Cariri) came to the conclusion that "they are not samples of the primitive forests, but definite entities with a context very much of their own, involving altered population densities, interaction with forms from the open formations, and random reduction of the number of species". We are of the opinion that a similar conclusion can be drawn for frogs in these enclaves. Vanzolini (1981) also confirms that Ceará was included in the forest bridge uniting the Hylaea to the Atlantic forest, and he suggests that further study of e.g. the Serra de Baturité would yield useful data. The recent study of one of us (Borges, 1991) has proved Vanzolini's assumption to be right. Although Vanzolini (1981) based himself on incomplete data because his samples had been obtained in a short period only, his conclusions in general are upheld by the findings of Borges (1991). Vanzolini (1986) repeats his former opinion on the identity of the fauna of the forest isolates in northeastern Brazil. Nascimento & Lima Verde (1989) studying some forest inhabiting snakes from the Maçico de Baturité, also come to the conclusion (first formulated by Vanzolini, 1981, 1986) that the forest isolates in Ceará have their own peculiar fauna, among others depending on the time of isolation of each of them. It has now become clear that each brejo (forest enclave) has its own characteristic fauna, including a number of endemics.

Etymology.— Named after the type locality, the Maciço de Baturité, an isolated mountain range close to the litoral of Ceará.

Recently some *Adelophryne* became available from the Serra de Maranguape. They show differences with the specimens from the Maçico de Baturité, although specimens in the sample are rather variable in several characters. We want to name this species

Adelophryne maranguapensis spec. nov.
(figs. 12-18)

Holotype.— **Brasil**. CEARÁ. Municipio de Maranguape. Serra de Maranguape, Pico da Rajada, 890 m: 1 ♂, UFC 2672, 10.xi.1992, leg. P. Cascon. Paratypes.— Same locality as holotype: 1 ♀, 1 ♂, 2 ex., 1 juv., UFC 2674-75, 2680-81, RMNH 26666 (formerly UFC 2676), 10.i.1993, leg. W. Franklin-Júnior & N. Salgado. Same data as holotype: 1 ex., UFC 2673 (slightly desiccated). Excluded specimen.— **Brasil**. CEARÁ. Municipio de Maranguape. Serra de Maranguape, trilha do Cascatinha/Pico da Rajada:1 ♂, UFC 2677, 10.i.1993, Leg. W. Franklin-Júnior & N. Salgado.

Diagnosis.— A minute (snout-vent length to 17.4 mm) frog, with small fourth finger with three phalanges. Fingers depressed, slender with indistinct subdigital

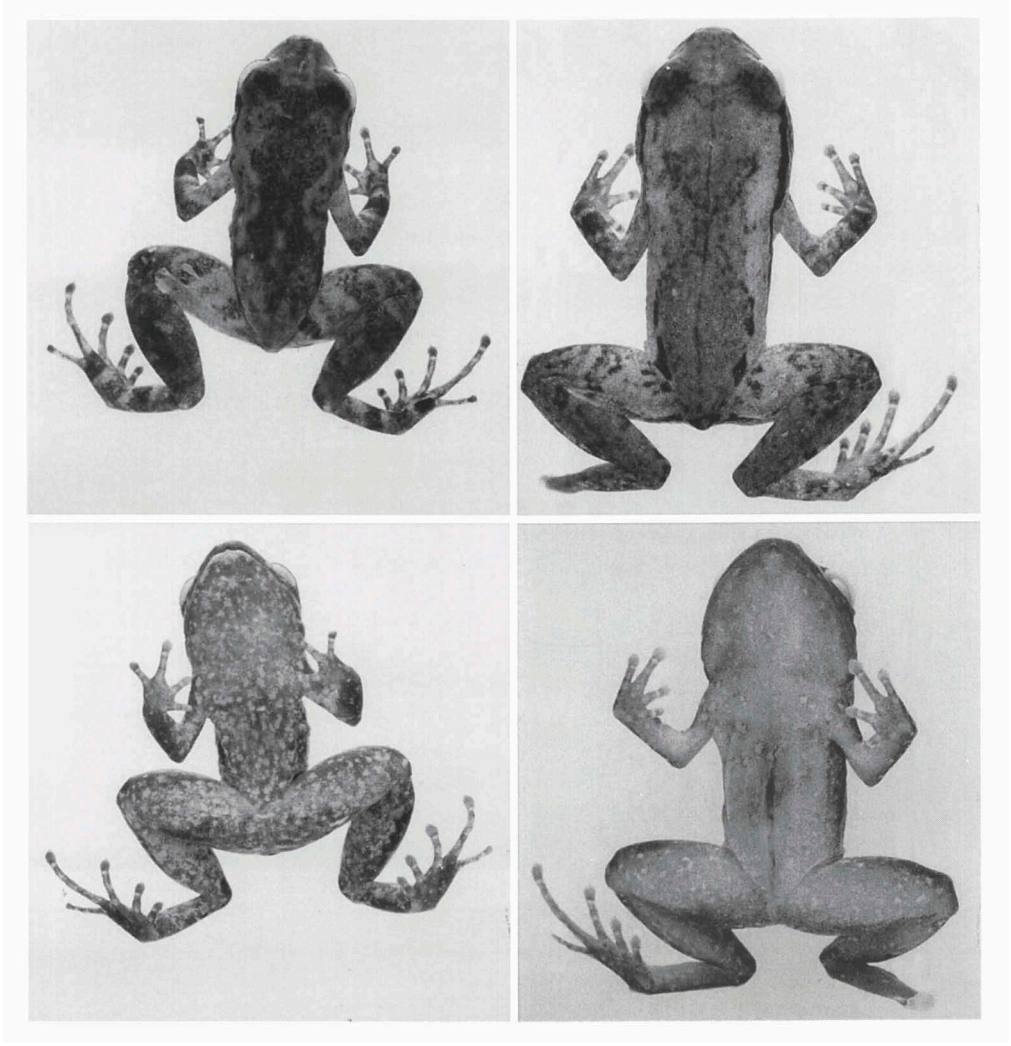


Fig. 12. *Adelophryne maranguapensis*, habitus, left column dorsal and ventral view of holotype, ♂ UFC 2672 (svl 12.6 mm), right column dorsal and ventral view of ♀ UFC 2674 (svl 17.4 mm).

pads. Tip of finger I with small disc, those of fingers II, III and IV with larger discs, all with an asymmetrically pointed tip. Tips of toes expanded into distinct discs with asymmetrically pointed tips. No distinct subarticular tubercles under the toes. Terminal phalanges T-shaped. Skin of back smooth. Adult male with subgular vocal sac.

Description.— Snout vent length of adult males 11.9-12.6 mm (12.3 ± 0.5, n=2) (holotype 12.6 mm), of adult female 17.4 mm. Head distinctly longer than wide, as wide as or slightly wider than the adjacent part of the body; its depth 43-56% (49.6 ± 4.7, n=5) of the width. Snout truncate in dorsal view and pointed, slightly projecting beyond the mouth (UFC 2674, 2675) to rounded (UFC 2672, 2680, RMNH 26666) in lateral profile. Distance between eye and nostril 64-90% (79.4 ± 9.7, n=10) of the inter-

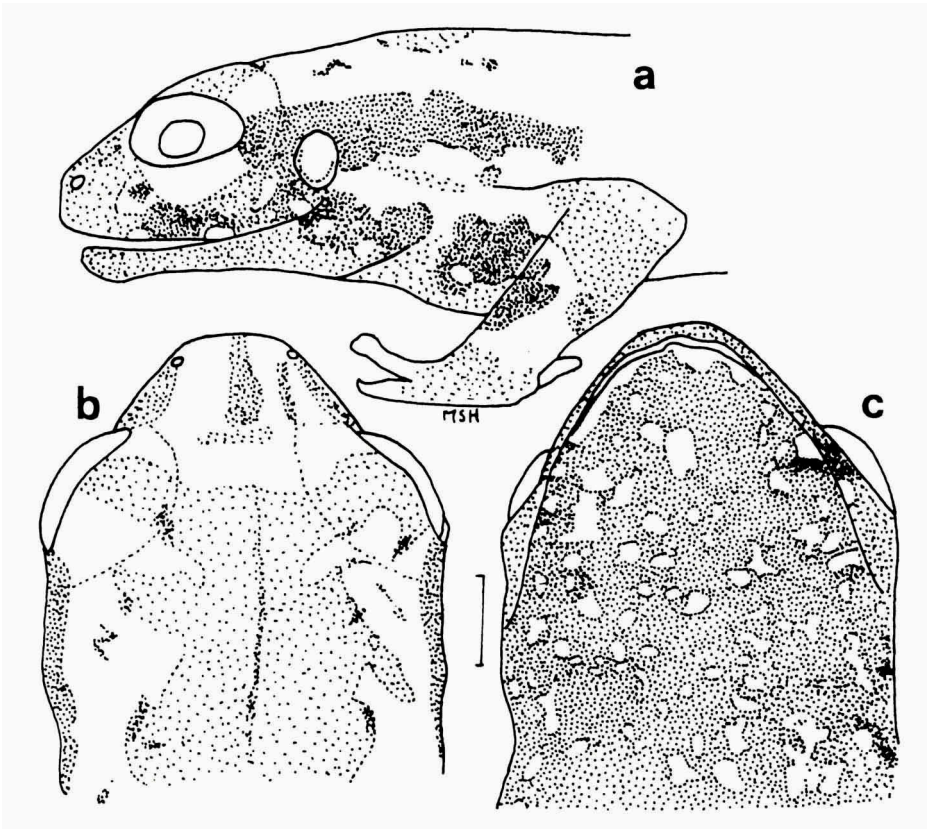


Fig. 13. *Adelophryne maranguapensis* (UFC 2672), head of ♂ holotype, a. lateral, b. dorsal, c. ventral view. Scale bar 1 mm.

narial distance, distinctly more (1.1-1.5, 1.3 ± 0.12, n=10) than the distance between nostril and tip of snout, about half (46-57%, 53.4 ± 3.5, n=10) the distance between eye and tip of snout. Canthus rostralis indistinct, rounded, straight; loreal region sloping steeply to the upper lips. Lips not flaring. Nostrils inferolateral of canthus rostralis, not projecting, forming a vertically oval opening, directed laterally. Internarial distance slightly less than, or equal to, the interorbital distance (83-102%, 91.2 ± 9.0, n=5). Eye with horizontally oval pupil. Interorbital space 1.2-1.5 (1.3 ± 0.4, n=10) times as wide as an upper eyelid, flat to slightly convex. Temporal region vertical, tympanum small, in most specimens distinct, in UFC 2676 indistinct, 31-38% (32 ± 11.3, n=10) of the diameter of the eye, surrounded by a tympanic annulus, obscured by skin in its upper part, most distinct in antero-ventral part; distance between tympanum and eye equalling the tympanum length or (slightly) more, resulting in the tympanum being placed far from the eye. No supratympanic fold. A few indistinct glandules between tympanum and the insertion of the forearm. No yellow 'pores' (cf. description of *A. baturitensis*) could be found.

Choanae relatively large, round, placed very laterally; prevomerine processes large, transverse, at some distance posterior of the choanae, with a row of 4-8 teeth.

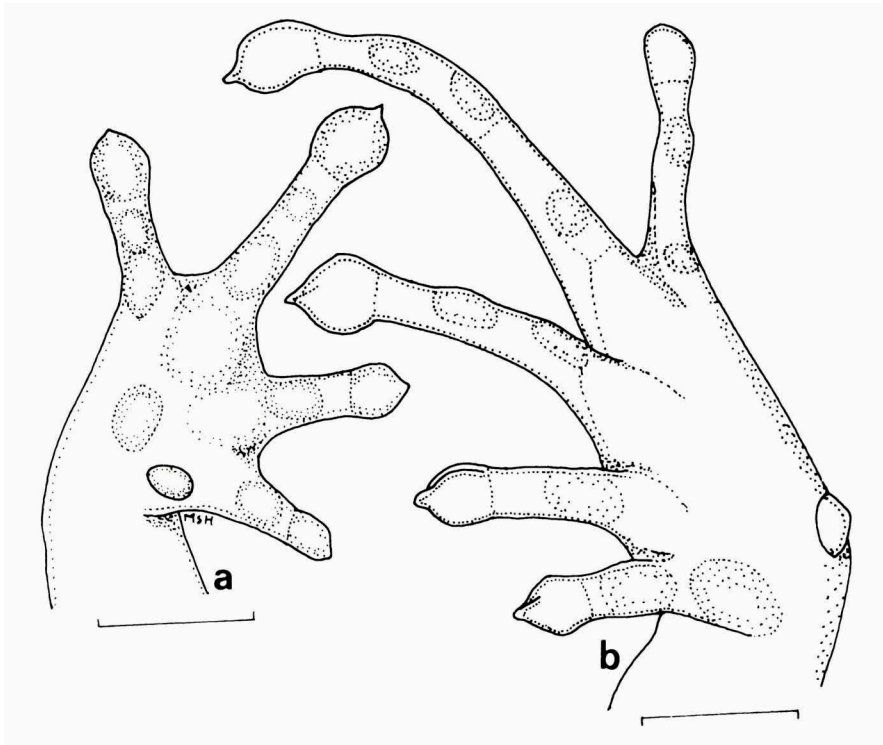


Fig. 14. *Adelophryne maranguapensis* (UFC 2672), holotype, a. plantar view of right hand, b. solar view of left foot. Scale bar 1 mm.

Tongue rather short, narrow anteriorly, expanded posteriorly, not notched behind; completely free, except its anterior margin. Males with vocal slits near corner of mouth, and with a subgular vocal sac which is not very evident in any one of the males.

Skin of flanks, venter, throat and limbs, including the posteroventral aspect of the thighs, smooth. Throat in males without longitudinal folds. Skin of back (especially dorsolateral area) slightly pustulous. Discoidal folds absent. Cloacal opening at level of upper half or third of thighs, with a transverse dorsal flap, opening directed ventrally.

Hand with an undivided, round, flat outer and a slightly smaller, round inner metacarpal tubercle. Underside of fingers with small padded areas (1-1-2-2), no pads under ultimate phalanges. Fingers depressed, free of web. Tip of finger I with small disc, slightly wider than adjacent phalange, tips of fingers II-IV with larger discs, largest on finger III, distinctly wider than adjacent phalange. Discs with circumferential groove, narrowly interrupted at the asymmetrical tip. Tips of discs sharply pointed to nearly rounded. Fingers: I<II<IV<III. Fourth finger relatively long, free part more than half the length of the free part of third finger. Phalangeal formula: 2-2-3-3. Terminal phalanges T-shaped.

Tarsus smooth without tarsal ridge or tubercle. A distinct, oval, flat inner, and a smaller, round, conical outer metatarsal tubercle. Flat subdigital pads (1-1-2-3-2), no

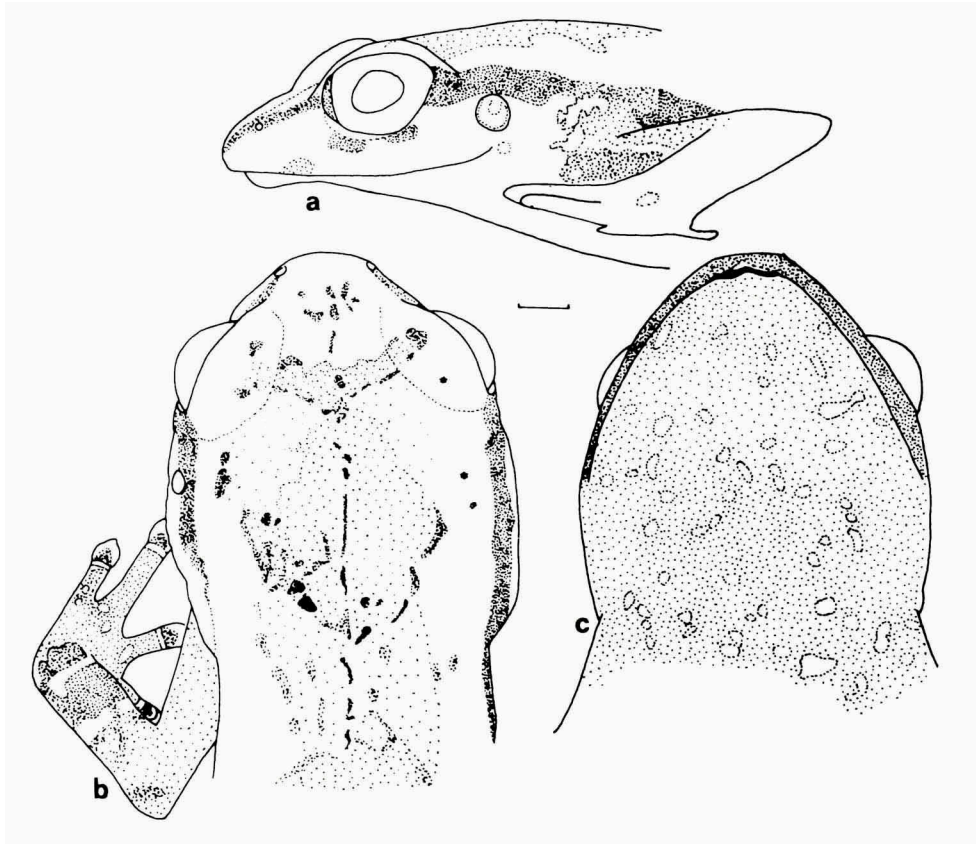


Fig. 15. *Adelophryne maranguapensis* (UFC 2674), head of ♀, a. lateral, b. dorsal, c. ventral view. Scale bar 1 mm.

subarticular tubercles. Toes proximally cylindrical, distally depressed, free of web. Tips of toes I- IV dilated into distinct, rounded discs, much wider than the adjacent phalanges, ending in an asymmetrically pointed tip. Tip of toe V dilated into a small disc with pointed or rounded tip. Discs with a circumferential groove which is narrowly interrupted at the tip. Toes: I<II<V<III<IV. Phalangeal formula: 2-2-3-4-3. Terminal phalanges T- shaped.

Heel of adpressed hindlimb reaches the eye or to between eye and tip of snout. When the hindlimbs are flexed at right angles to the sagittal plane, the heels touch. Tibia 45-52% (48.8 ± 2.4, n=10) of the snout-vent length.

In preservative the middle of the back has a large, hourglass-shaped or X-shaped (RMNH 26666) brown figure, often with darker brown spots along its margin. A pair of dark brown inguinal spots, continuous with a band on the thigh. A crescent- or V-shaped dark band between the eyes. Dorsolateral and upper lateral area of back light, ventrally bordered by a distinctly demarcated dark brown lateral band starting at the eye, passing over the tympanum, continuing as an oblique stripe on the flanks and ending in the groin. An indistinct dark brown canthal stripe. Sides of head brown, variegated with lighter areas. Flanks below the dark lateral band as belly.

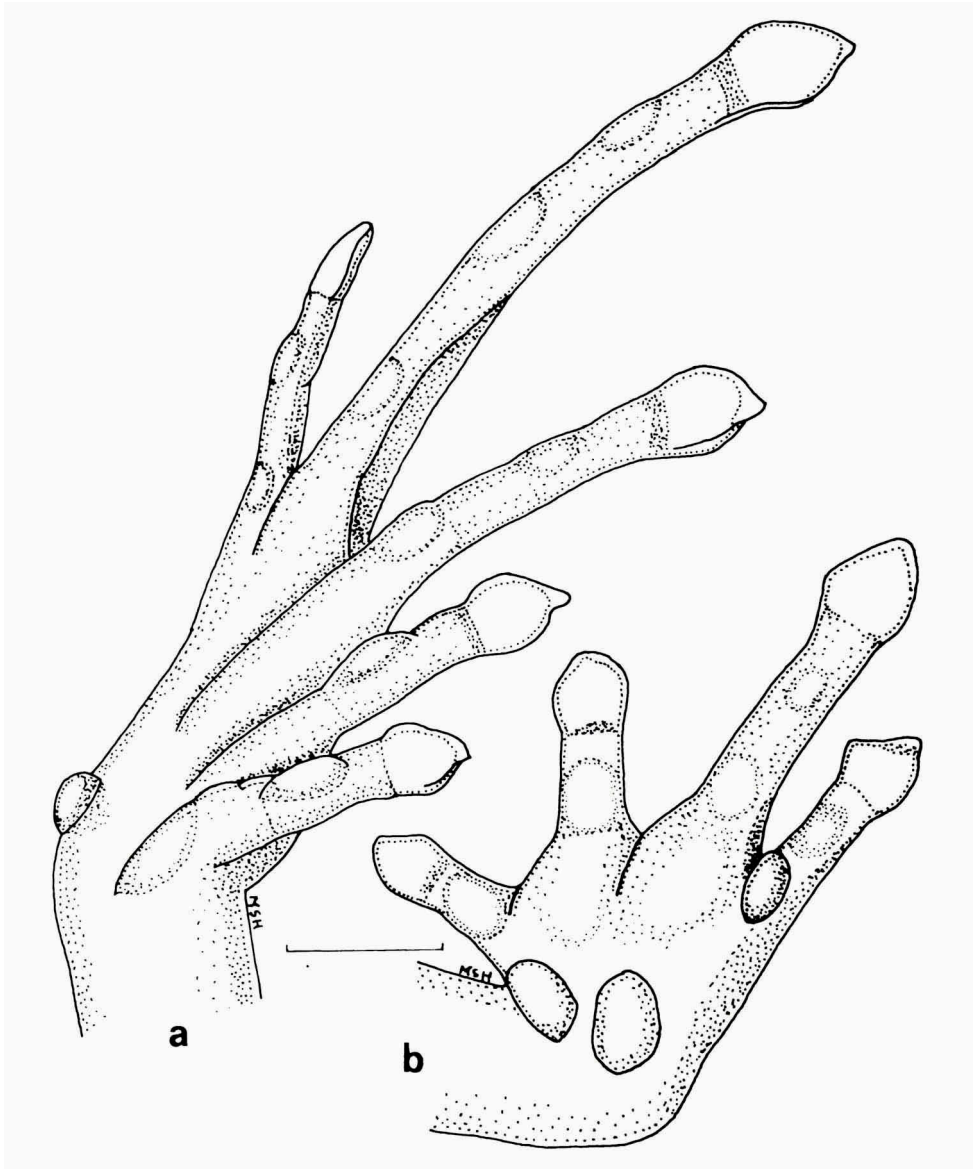
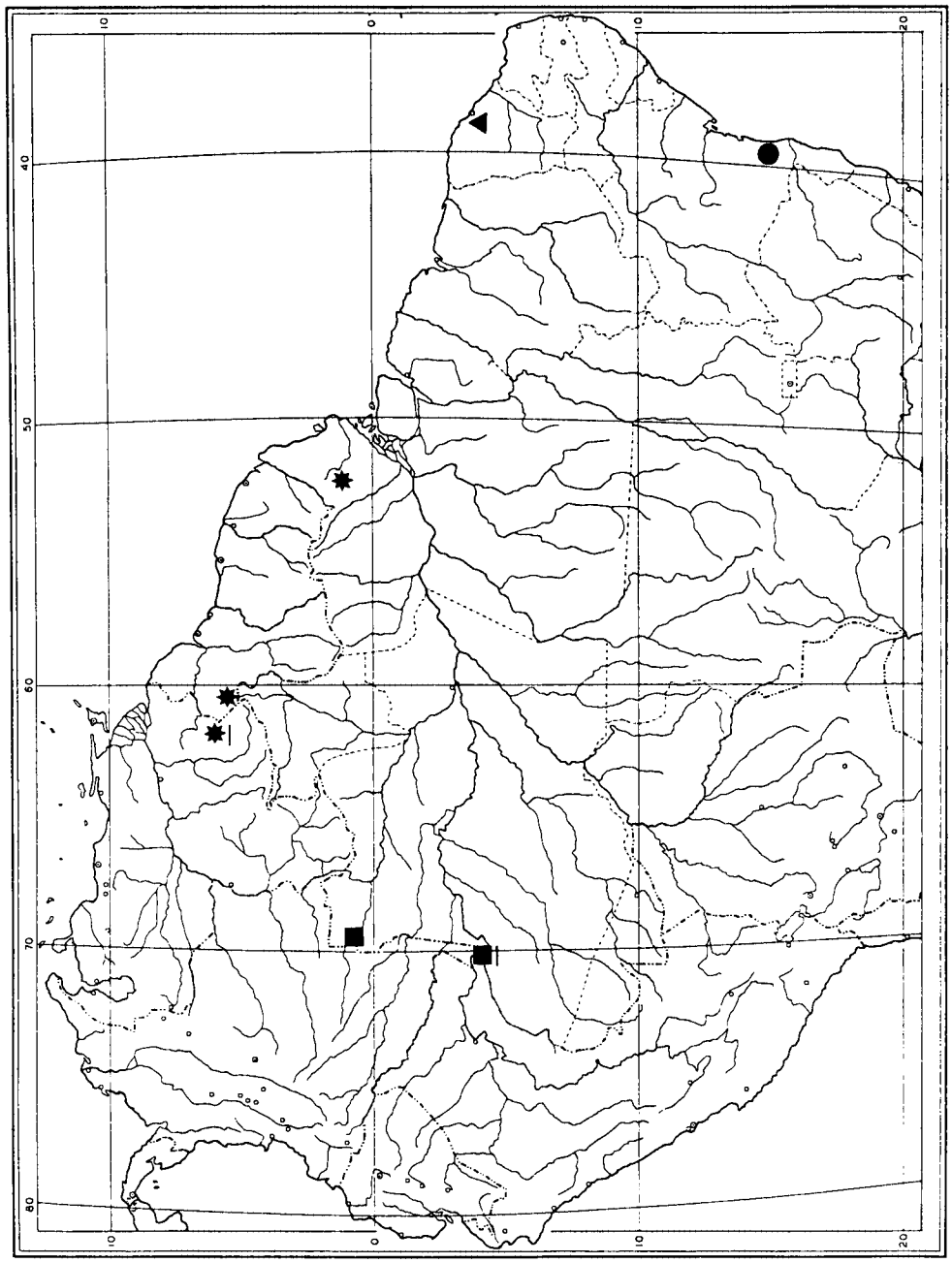


Fig. 16. *Adelophryne maranguapensis* (UFC 2674), ♀, a. plantar view of right hand, b. solar view of left foot. Scale bar 1 mm.

Fig. 17. Map showing the presently known distribution of the genus *Adelophryne* in South America. Stars: *A. gutturosa* , squares: *A. adiastola*, triangle: *A. baturitensis* and *A. maranguapensis*, dot: *A. pachydactyla*, underlined symbols represent new data from the literature.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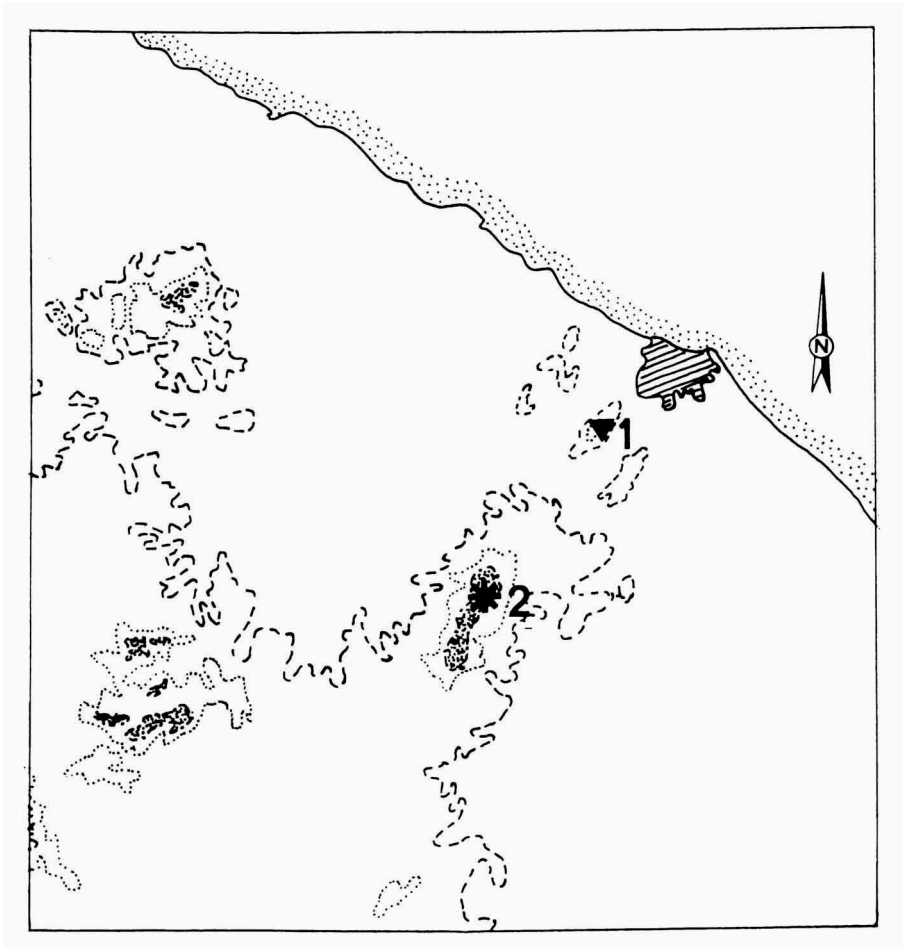

Fig. 18. Surroundings of Fortaleza, northeastern Ceará. 1. Serra de Maranguape, 2. Serra de Baturité. Inverted triangle: *Adelophryne maranguapensis*; star: *A. baturitensis*. Line of dashes: contour line of 200 m, line of dots: contour line of 500 m, densely stippled area: area over 700 m, lightly stippled area: border of Atlantic Ocean. Scale of map 1: 1.000.000.

Forearm with a transverse dark brown band, bordered by two light bands. A dark brown spot on the anterior aspect of the upper arm near the insertion. Two transverse dark brown bands each on thigh and shank, continued on tarsus and foot. Transverse white lines over the ultimate articulation of fingers and toes, and white spots over all articulations of toes. Throat, chest and belly dark brown with white spots. Underside of limbs as rest of venter. In the single female the background colour is less dark than in males.

Colour in life (based on colour photographs of UFC 2672-75, 2680, RMNH 26666): Back mostly with a dark brown to reddish brown hourglass-shaped central figure and light brown to beige dorsolateral area. A dark brown lateral band. Limbs with light and dark transverse bands in the same colours as occur on the back. Throat, chest and belly in UFC 2674 and 2675 purplish with lighter spots. In RMNH 26666

dark chocolate brown with lighter spots. Underside of limbs in UFC 2674 purplish, of UFC 2675 flesh-coloured with purplish smudges and of RMNH 26666 dark brown with lighter spots.

Distribution.— Sofar the species only has been found in one locality within the Serra de Maranguape: Pico da Rajada and along the trail leading to it from the Cascatinha. The Serra de Maranguape (maximum altitude 890 m) is located just W of Fortaleza at 3°54'S 38°43'W., and like the Maçico de Baturité is a humid place with orographic rains, situated close to the coast. Thus, it is covered by forest, which at the moment however, has been extremely devastated. Original vegetation only remains in the highest parts, like around the Pico da Rajada, where access is steep and difficult. On the Pico da Rajada there exists a spring, which probably is mainly responsible for the humidity that exists throughout the year in the area with primary forest.

Natural history.— All specimens were collected in primary forest, but more detailed data are hardly available. UFC 2675 and RMNH 26666 were found in a bromelia a short distance above the ground, UFC 2681, a juvenile, was collected in moss on the ground. The other specimens were found jumping on the ground. The single available female (UFC 2674) contains four large eggs. The humid conditions on the Pico da Rajada probably allow reproduction in the area throughout the year, independent of the seasons. The rainy season in this mountain range is the same as that in Baturité, lasting from February to June.

Remarks.— UFC 2677 is aberrant (and therefore excluded from the type series) by having very small discs on all fingers and toes and in not showing a trace of pointed tips on any of them. A circumferential groove on the discs is present. The tympanum is distinct and separated from the eye by a distance about $^2/_3$ the diameter of the tympanum. The snout in lateral profile is high and truncate. The throat and chest are cream with a pattern of irregular brown spots, the belly is cream with fewer brown spots.

Etymology.— Named after the type locality, the Serra de Maranguape.

Discussion

The finding of these new species of *Adelophryne* in the coastal area of E and NE Brazil comes somewhat as a surprise. The first two species of this genus were described from areas north of the Amazon, and the additional material reported of these species did not essentially change this picture. However, considering the localities from where they were known, we already knew that the genus had an extensive distribution, covering hundreds of thousands of square kilometers. The new species here described are separated from the others not only by a big expanse of Amazonian forest, but also by the Caatinga Domain (Ab'Saber, 1977) separating the Amazonian and Atlantic forest regions. The distance between Serra do Navío and the Maciço de Baturité/Serra de Maranguape is 1600 km, that between Serra do Navío and the area of Ilheus is 2250 km, whereas that between the coastal Brazilian localities in Bahia and Ceará is 1150 km. Distances to the localities of *A. adiastola* are even much larger. These enormous distances between known localities once more highlight the fact that these frogs are still very insufficiently known and that they will most likely be discovered in intervening areas when these are sampled in the right

way. The large distances involved might give rise to the assumption that the specimens from the Atlantic coastal area could belong to a genus distinct from *Adelophryne*, but careful examination of the specimens convinced us that they are congeneric and that we have to accept the great intervening areas as real gaps in the distribution of the genus.

The new species do fall into two groups, as did the original two species: those with a reduced fourth finger and a number of phalanges reduced to two in that finger and those with a reduced fourth finger with the normal complement of three phalanges. Among the three newly described species, that of the Ilheus area (*A. pachydactyla*) is most distinct because of its pudgy, depressed fingers and toes. *A. baturitensis* shows subarticular tubercles and small discs, whereas *A. manguarapensis* has no subarticular tubercles, but has well developed discs. The last species further is remarkable because of variation in the shape of the snout: pointed in some, rounded in some others, and in the expression of the tips of fingers and toes. *A. baturitensis* and *A. manguarapensis*, based on external morphological characters only, seem to be closer related to each other than to any of the other species. Considering the topographical closeness and the probable history of the area, this is not a surprise and we may assume that these two were in contact, or probably forming one interbreeding population until very recently.

Bokermann (1974) described *Eleutherodactylus bilineatus* from between Ilheus and Itabuna in Bahia, close to the type locality of *Adelophryne pachydactyla*. Lynch (1976: 11) made a rather cryptic remark about that species, that only recently was clarified by him to MSH. Lynch (1976) basing himself on the description and the illustrations only, said that the frog was "similar to a frog now under study by M.S.Hoogmoed; if *E. bilineatus* is congeneric with Hoogmoed's frog, it is not a member of the genus *Eleutherodactylus*." During the recent 3rd CLAH in Campinas, Brazil, Lynch explained to Hoogmoed that he had been referring to a specimen of *Adelophryne gutturosa* that Hoogmoed had shown him before. Upon comparing the description of *E. bilineatus* with our material we came to the conclusion that this taxon is not identical with one of the taxa here described. Its general appearance indeed is that of an *Adelophryne*, but it lacks the distinctive pointed discs on fingers and toes. Unfortunately we have not been able to examine the holotype. We therefore prefer not to change the generic allocation of this species until it has been studied.

Key to the species of *Adelophryne*

1. Fourth finger with two phalanges 2
- Fourth finger with three phalanges 3
2. Adult males 11 mm, skin smooth, fingers thick and short, with large subdigital pads, free part of fourth finger about half the length of the free part of the third finger; back and venter with white spots; when hindlimbs are flexed, the heels do not overlap ..... ***A. pachydactyla***
- Adult males 13-13.7 mm, skin shagreened, fingers not thick, subdigital pads not very distinct, free part of fourth finger less than half the free part of the third finger; back variegated with brown, belly white dusted with brown; when hindlimbs are flexed the heels slightly overlap ..... ***A. adiastola***

3. Toes with distinct subarticular tubercles, no subdigital pads; tympanum separated from the eye by a distance half to $^2/_3$ (sometimes equalling) its diameter; adult males 11.8-14.5 mm, adult females 12.2-16.3 mm ..... ***A. baturitensis***
- Toes without subarticular tubercles, subdigital pads present; tympanum separated from the eye by a distance equalling its diameter; adult males 11.9-14.5 mm, adult females 12.4-17.4 mm 4
4. Snout pointed to rounded in lateral profile; discs distinctly wider than adjacent phalanges; transverse flap above the cloaca, which opens ventrally; tympanum separated from the eye by a distance approximately equalling the diameter of the tympanum; adult males 11.9-12.6 mm, adult female 17.4 mm .... ***A. maranguapensis***
- Snout truncate to rounded in lateral profile; discs only slightly wider than adjacent phalanges; no transverse flap above the cloaca, which opens posteriorly; adult males 12.6-14.5 mm, adult females 12.4-13.0 mm ..... ***A. gutturosa***

Acknowledgements

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