SUMMARY

Faunal surveys in northern Roraima, Brazil, revealed the presence of 38 species of frogs, 28 of them known to occur on the riverine island of Maracá. The region surveyed is part of the zoogeographical region called Guianan, and its anuran fauna has a complex history and includes many endemic species as well as widespread South American or Amazonian species.

Four bufonids, one dendrobatid, ten hylids, ten leptodactylos, one microhylid and two pseudids were recorded for Maracá. Ten additional species were recorded for other localities less than 130 km from Maracá, and most of them may also occur on the island. The anuran fauna of northern Roraima is poor when compared with other Amazonian regions, probably because of its long dry season.

Most species found in northern Roraima are widespread in the llanos and savanna habitats of the region and of southern and central Venezuela. Considering 30 relatively well-identified species from northern Roraima, 48% of them are widespread in South America, 27% widespread in Amazonia and 23% are endemic to the Guianan region. Patterns of habitat utilization in Maracá are similar to those found in other neotropical regions, except for the paucity of hylids inside the forests.

Maintenance of the Ilha de Maracá as a reserve will ensure the preservation of many species of frogs from northern Roraima, some of them endemic to the Guianan region and absent in other Brazilian regions.

RESUMO

Levantamentos de fauna no norte de Roraima, Brasil, revelaram a presença de 38 espécies de anuros, 28 delas ocorrendo na ilha fluvial de Maracá. A região estudada faz parte da região zoogeográfica chamada de Guiana e sua fauna de anuros possui uma história complexa e inclui várias espécies endêmicas, além de diversas que ocorrem em grande parte da América do Sul ou da Amazônia.

Quatro bufóideos, um dendrobatide, 10 hílios, 10 leptodactilídeos, um microhílio e dois pseudídeos foram encontrados em Maracá. Dez espécies adicionais foram encontradas em outras quatro localidades a menos de 130 km de Maracá e a maioria delas deve ocorrer na ilha. A fauna de anuros do norte de Roraima é pobre se comparada a outras regiões da Amazônia, provavelmente devido à estação seca longa daquele região.

A maioria das espécies encontradas no norte de Roraima são amplamente distribuídas nos llanos e savanas desta região e do centro e sul da Venezuela. Considerando 30 espécies identificadas com segurança razoável para o norte de Roraima, 48% delas ocorrem em grande parte da América do Sul, 27% ocorrem na maior parte de Amazônia e 23% são endêmicas à região das Guianas. Os padrões de utilização de ambiente em
The State of Roraima of northern Brazil is situated in the Guianan region (Hoogmoed, 1979), and its frog fauna includes both endemic members of this region and species that occur throughout Amazonia. Hoogmoed (1979) summarized and characterized the herpetofauna of the Guianan region, stressing the presence of several endemic species (52% of the frogs) and "our scant and fragmentary knowledge" of this group. The frog fauna of the Guianan region has a complex history, which can be summarized as follows:

- Some species are endemic and probably originate from old stocks of the area.
- Some species show relationships to Andean species, indicating common lowland ancestors.
- Some species invaded the region from the southern lowlands, via forests and savannas (Hoogmoed, 1979; see also Lescure, 1975, 1977).

The frog fauna of the Guianan region is relatively well known when compared with other regions in Amazonia. Among the studies which have characterized this fauna are those of Heatwole et al. (1965), Rivero (e.g. 1965, 1971), Lescure (e.g. 1975, 1976, 1977), Staton and Dixon (1977), and Hoogmoed (e.g. 1979; Hoogmoed and Gorzula, 1979).

The Ilha de Maracá's 100,000 hectares are covered almost entirely by forests. O'Shea (1989) provided a detailed description of the island and its various habitats, summarizing the herpetofauna and its associations with the different habitats occurring on the island.

Here I present a checklist of the frog fauna of the Ilha de Maracá, based on my own observations made before the Maracá Rainforest Project began, and those of Mark O'Shea who worked on the project (O'Shea, 1988, 1989 and pers. comm.). Species that occur in localities around Maracá and have yet to be recorded for the island itself, but which probably also occur there, are treated separately. Additional information on the species cited here can be found in the literature dealing with the frogs of the Guianan region (see above).

METHODS

My collections and observations of frogs on the Ilha de Maracá were undertaken between October 1985 and August 1986. During this period my visits to the island
were made every one or two months. Although my work was restricted to the easternmost corner of the island in the vicinity of the Ecological Station (Figure Pr.1, p. xvii), several different habitats were surveyed: the gallery forests of the Furos de Maracá and Santa Rosa; the swampy area below these forests; and the \textit{terra firme} forest inside the island (including creeks and lakes). Additional collections were made at four other localities in Roraima (Figure 14.1) during the same period. The four localities were Boa Vista (130 km from Maracá), Serra Pacaraima (122 km), Surumu (107 km) and Serra Tepequém (55 km).

Frogs were collected at various times of the day, mostly by hand, and processed by the usual methods (Pisani and Villa, 1974). Those collected in Roraima are deposited in the herpetological collections at the Núcleo de Pesquisas de Roraima (INPA, Boa Vista), the Museu de Zoologia da Universidade de São Paulo and the Museu de História Natural da Universidade Estadual de Campinas (São Paulo).

I recorded habitat, microhabitat and data on reproduction for most of the individual frogs collected. For each species listed below, I present the number of specimens collected at each locality (with the number of specimens collected by O'Shea given in parentheses when appropriate), its apparent abundance on Maracá, a short description giving characteristic features to facilitate identification, habitat occupied, reproduction, distribution and remarks on taxonomy, indicating some papers which refer to the species. Specific names follow Frost (1985) and recent revisions (indicated in each account). I use the genus \textit{Hyla} conservatively instead of \textit{Oloolygon} for those species related to \textit{Hyla rubra}, following suggestions by Almeida and Cardoso (1985) and A. Cardoso (pers. comm.). Frog sizes are presented as snout–vent length (SVL).
DISCUSSION

SPECIES RICHNESS

The complex history and high diversity of topography and climate of South America have produced an extraordinarily rich and diverse herpetofauna (see review in Duellman, 1979). South America has almost 1000 anuran species (belonging to approximately 100 genera and 11 families), nearly 95% of them endemic to the continent (Duellman, 1979) and almost half of them in tropical and subtropical forests (Lynch, 1979). Local anuran faunas within Amazonia are very rich, with up to 50–80 species (see for example Appendix 2 in Duellman, 1989). However, local faunas of the savannas and northern forests of the Guianan region (cf. Hoogmoed, 1979) are relatively species-poor when compared with Amazonia, although several of their species may be present in considerable abundance. Lescure (1976), for instance, found 70 anuran species throughout French Guiana, and Heatwole et al. (1965) and Hoogmoed and Gorzula (1979) found 22 and 26 species respectively at different localities in southeastern Bolivar State, Venezuela. Staton and Dixon (1977) found 16 species at two localities in the central llanos of Venezuela, and their paper lists 38 species for several localities within northeastern Roraima.

What are the factors responsible for this relatively low anuran richness in the Guianan region? Vegetational heterogeneity and climatic stability are evidently determinant factors for local anuran richness (Duellman, 1989). The vegetational structure on Maraca is, at least at first sight, similar to most Amazonian localities I know. It can therefore be supposed that climate is the crucial factor for the low anuran diversity in Roraima. Annual amounts of rainfall per se do not explain these differences: 1751 mm were recorded for Boa Vista versus 2075 mm for the Manaus region, Amazonas (RADAMBRASIL, 1975, 1978), and in the latter area I found approximately 70 anuran species. However, at Boa Vista the rains are concentrated in three months (May to July) whereas around Manaus they tend to fall over a period of eight months (October to May). The environmental stability of a relatively uniform climate allows specialization amongst animal groups (see Duellman, 1989), and it is expected that the contrary is also true. In conclusion, the low anuran richness of Maraca and Roraima may be a consequence of the strong seasonality of the region, which constrains specialization.

FAUNAL COMPARISONS AND DISTRIBUTION PATTERNS

The frog fauna of the savannas of Roraima and the llanos and Gran Sabana of Venezuela is very constant throughout the region. Of the 38 species listed here for northeastern Roraima, Heatwole et al. (1965) and Hoogmoed and Gorzula (1979) found 20 (out of a total of 26) and 17 (out of 22) respectively, for two localities in Estado Bolivar, and Staton and Dixon (1977) found 14 (out of 16) at two localities in the central llanos of Venezuela (see also Table 1 in Hoogmoed and Gorzula, 1979).

Considering the 38 species identified below, 48% are widespread in South America, 27% are widespread in Amazonia, 23% are endemic to the Guianan region (cf.
Figure 14.2. Schematic profiles of forest (a) and an open area (b) on Maracá, showing water bodies and associated anuran species. See species accounts for details of each species. AH = Adenomera hylaedactyla; BG = Bufo guttatas; BM = B. marinus; BR = B. granulosus; BS = Bufo sp.; DL = Dendrobates leucomelas; EO = Elachistocleis ovalis; HB = Hyla bosemani; HC = H. crepitans; HF = H. fuscomarginata; HG = H. geographic; HM = H. microcephala; HR = H. rubra; HS = Hyla sp.; HW = H. wawrini; LA = Leptodactylus macrosternum; LB = L. bolivianus; LF = L. fuscus; LK = L. knudseni; LL = Lithodytes lineatus; LM = Leptodactylus mystaceus; LS = Leptodactylus sp.; LY = Lysapsus limellus; PB = Pseudopaludicola boliviana; PE = Physalaemus ephippifer; PP = Pseudis paradoxa; PV = Phrynohyas venulosa

Hoogmoed, 1979), and 10% are widespread in the northern extremes of South America. As observed by Hoogmoed and Gorzula (1979) for El Manteco, the anuran fauna of northeastern Roraima is a composite of species typical of the llanos and savannas and those widespread in Amazonia and South America. Thus, the recurrence of a combination of widespread and Guianan endemic species is responsible for the found similarities discussed above.

COMMUNITY STRUCTURE

The structure of anuran communities on Maracá must be analysed separately by habitats (Figure 14.2). In forests and forest borders, nine species (seven lepto-
dactylids and two bufonids) were found within or below leaf-litter (each of them associated with lakes, rivers and/or streams), four hylids were found on the vegetation of swamps and streams, and one dendrobatid was associated with rocky habitats (Figure 14.2a). In open savanna areas, one leptodactylid, one bufonid, and one microhyliid used temporary ponds, whereas five hylids, four leptodactylids, two bufonids, two pseudids, and one microhyliid were found in permanent lakes (Figure 14.2b). Three hylids perched on plants at margins, two pseudids and one hylid were found on or within floating vegetation, and all others were found on or below the ground.

The patterns above are similar to those found in other neotropical localities (see for example Hoogmoed and Gorzula, 1979; Cardoso et al., 1989; Duellman, 1989) except for the extremely low proportion of hylids inside the forests. Hylids are generally abundant in forests because of their ability to explore the vertical space (see Cardoso et al., 1989). Historical factors may be responsible for the paucity of hylids in forests on Maracá: the ancestral stocks that gave rise to the local fauna may have been poor in forest-dwelling hylids.

CONSERVATION

Considering its situation and size, the Ilha de Maracá as a reserve is very important for the preservation of the anuran fauna of northern Roraima. This fauna, although poor when compared to central Amazonia, includes some species endemic to the Guianan region, most of which are absent from other Brazilian regions. However, the Ilha de Maracá is almost entirely covered by forests, and consequently its maintenance as a reserve will primarily preserve those species associated with forests. Thus, to preserve the entire or most of the anuran fauna of northern Roraima, additional reserves including extensive areas of savannas and tepuis must be created.

SPECIES ACCOUNTS

(numbers in parentheses refer to the records of Mark O'Shea)

FAMILY BUFONIDAE

The family Bufonidae is cosmopolitan in tropical and temperate parts of the world, except for Oceanic, Australo-Papuan, and Madagascan regions (Frost, 1985). The family includes 25 genera, three of which occur in northern South America and are represented by several species (Frost, 1985). Only the genus Bufo was observed on Maracá.

*Bufo granulosus* (Spix 1824)

*Material* – Maracá, 12 (6); Boa Vista, 3; Surumu, 15.

*Abundance* – Common.
**Bufo granulosus** (Gallardo 1965)

**Material** – Maracá, 1; Surumu, 1.

**Abundance** – Rare.

**Diagnosis** – A medium-sized *Bufo* (♂♂ 43–51 mm, ♀ 80 mm) of the granulosus group; dorsum greyish-tan with scattered darker marks; skin of the dorsum, flanks, and limbs with pointed tubercles; venter light brown with darker blotches in the gular region in males; skin of the dorsum granulated.

**Habitat** – This species was observed at night in small temporary lakes and ponds in the savanna regions of Maracá, Boa Vista and Surumu.

**Reproduction** – Males of *B. granulosus* were heard calling on rainy nights from late February through mid-August; they call from shallows and from the margins of lakes and ponds.

**Distribution** – Northern South America to Argentina and southeastern Brazil (Frost, 1985).

**Remarks** – *Bufo granulosus* as recognized today may be a composite of many subspecies and/or species (see Gallardo, 1965; Frost, 1985). The population from Maracá is certainly the same described as *B. g. humboldti* by Gallardo (1965), based on specimens from São Marcos, Rio Uraricoera (see also Bokermann, 1967).

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**Bufo guttatus** (Schneider 1799)

**Material** – Maracá, 1; Surumu, 1.

**Abundance** – Rare.

**Diagnosis** – A large *Bufo* (♂ 80–100 mm) of the guttatus group; dorsum light brown; flanks and sides of head black; limbs dark brown above; venter dark brown with small yellow spots irregularly distributed.

**Habitat** – This species was observed at night in gallery and terra firme forests at Surumu, and was collected in terra firme forest at the western end of the Ilha de Maracá by O'Shea.

**Reproduction** – Young of various sizes were collected in December. In Venezuela, *B. guttatus* breeds at the beginning of the rainy season (Hoogmoed and Gorzula, 1979).

**Distribution** – Widespread in Amazonia (Frost, 1985).

**Remarks** – Rivero (1965) and Cochran and Goin (1970) analysed the distribution of *Bufo guttatus* in Venezuela and Colombia respectively.

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**Bufo marinus** (Linnaeus 1758)

**Material** – Maracá, 6; Boa Vista, 1; Pacaraima, 1; Surumu, 6.

**Abundance** – Extremely common.

**Diagnosis** – A large *Bufo* (c. 100–150 mm) of the marinus group; dorsum brown to brownish-tan sometimes with scattered darker spots; skin at the dorsum with several scattered tubercles; large triangular parotid glands; venter cream with brown marbling; skin of the dorsum granulated.

**Habitat** – This species was observed at night in lakes in the savannas and forests of Maracá, Boa Vista, Pacaraima and Surumu.

**Reproduction** – At Boa Vista, *B. marinus* began to breed with the first rains in February and March, and resumed in early June, with a peak in early May. Recently
metamorphosed juveniles were found from mid-March through mid-June. The clutch consists of a string of thousands of eggs. Tadpoles are black and form shoals that feed in shallows.

**Distribution** – Southern Texas to southern Amazonia in Brazil (Frost, 1985).

**Remarks** – Cei (1972) reviewed the South American *Bufo*, and Zug and Zug (1979) summarized the natural history of *B. marinus*.

**Bufo sp.**

**Material** – Maracá, (4).

**Abundance** – Unknown.

**Diagnosis** – O'Shea found only young of this *Bufo* of the *typhonius* group on Maracá. In preservative the specimens appear as follows: dorsum brown with lighter and/or darker irregular spots; a row of pointed tubercles from the eyes through the groin, separating the dorsum from the flanks; venter cream with dark brown marbling on the belly and sometimes also in the gular region.

**Habitat** – Young of this species were collected by O'Shea in damp leaf-litter in forest close to the Cachoeira da Onça, and on a sandy beach at the Corredeira de Fumaça on the Ilha de Maracá. On both occasions they were encountered in the morning.

**Reproduction** – Young were collected in August.

**Distribution** – Unknown.

**Remarks** – This species was listed by O'Shea (1988) as *Dendrophryniscus* sp. While awaiting a revision of the *Bufo typhonius* group by M.S. Hoogmoed, I prefer to give no name to this species.

**FAMILY DENDROBATIDAE**

The family Dendrobatidae is essentially neotropical, occurring from Nicaragua to southeastern Brazil (Frost, 1985). The five genera included in this family occur in northern South America (Myers, 1987; Martins and Sazima, 1989). Only one genus was found on Maracá.

**Dendrobates leucomelas** (Steindachner 1864)

**Material** – Maracá, (1); Tepequém, 5.

**Abundance** – Rare.

**Diagnosis** – A medium-sized *Dendrobates* (c. 35 mm) of the *histrionicus* group; dorsum bright yellow with two deep black transversal bars and small deep black spots that also occur on the limbs; venter deep black with variable-sized yellow spots.

**Habitat** – This species was found by day in rocky habitats at the Cachoeiras de Fumaça and Purumame on the Ilha de Maracá (O'Shea, 1989), and on Serra Tepequém.
**Reproduction** – At Serra Tepequém I found males of *D. leucomelas* amongst rocks in July 1986, and at creek margins in May 1987. Local people say that this species congregates at creek margins at the beginning of the rainy season. O'Shea (1989) heard this species calling in the afternoon from horizontal fissures in large rock slabs.

**Distribution** – *Dendrobates leucomelas* is endemic to the Guianan region, where it occurs from eastern Venezuela to the Guianas (Frost, 1985).

**Remarks** – Hoogmoed and Gorzula (1979), Daly *et al.* (1987) and Zimmermann and Zimmermann (1988) provide valuable information on this species.

**FAMILY HYLIDAE**

The family Hylidae occurs in the Americas, Australia, Tasmania, New Guinea and the Solomon Islands (Frost, 1985). Of nearly 40 genera included in this family, some 15 of them occur in northern South America, and are represented by many species. Three genera of hylids were found on Maracá.

**Hyla boesemani** (Goin 1966)

**Material** – Maracá, 2.

**Abundance** – Rare.

**Diagnosis** – A medium-sized *Hyla* (c. 30–40 mm) of the *x-signata* group; dorsum greenish to yellowish brown, sometimes with small lighter spots; canthus rostralis with a dark brown stripe that extends from the snout to the tympanum; venter yellowish cream; snout round in dorsal and lateral views.

**Habitat** – *Hyla boesemani* was found at night in swamps and ponds in savannas on Maracá.

**Reproduction** – I heard males of *H. boesemani* calling from water hyacinths (*Eichhornia* sp.) in a swamp in July.

**Distribution** – Guyana, Surinam, southern Venezuela and Amazonas, Pará (Frost, 1985) and Roraima, Brazil.

**Remarks** – Information on this species is found in Hödl (1977).

**Hyla crepitans** (Wied 1824)

**Material** – Maracá, 2 (3); Pacaraima, 13.

**Abundance** – Common.

**Diagnosis** – A medium-sized *Hyla* (c. 50–60 mm) related to the *circundata* and *boans* groups; dorsum generally brown by night and green by day; venter cream; iris golden with a blue stripe externally; prepollical spines in males.

**Habitat** – This species was found at night in small to large temporary or permanent ponds in the savannas and forest borders of Maracá and Serra Pacaraima.
Reproduction – Males of *H. crepitans* were heard calling from May to August. They called from the ground, or perched at low levels on plants at pond margins. The clutch consists of a roughly round monolayer film of eggs deposited on the water surface.

Distribution – Central America through northeastern Brazil (Frost, 1985).

Remarks – Kluge (1979) reviewed the ‘gladiator frogs’ of Middle America and Colombia, including *H. crepitans*.

### *Hyla fuscomarginata* (A. Lutz 1925)

**Material** – Maracá, 1 (a male whose calls were recorded); Boa Vista, 1.

**Abundance** – Common.

**Diagnosis** – A small *Hyla* (♂ 19–23 mm) of the *staufferi* group; snout acuminate; dorsum yellowish tan with longitudinal brown stripes; venter whitish cream.

**Habitat** – This species was found at night in temporary and permanent ponds in the savannas of Maracá and Boa Vista.

**Reproduction** – Males of *H. fuscomarginata* were heard from May through August. They called from low heights on plants at pond margins.

**Distribution** – Southern Venezuela through southeastern Brazil (Frost, 1985; pers. obs.).

**Remarks** – Individuals of this species from Venezuela were described as *Oloolygon trilineata* by Hoogmoed and Gorzula (1979).

### *Hyla geographica* (Spix 1824)

**Material** – Maracá, (10).

**Abundance** – Rare.

**Diagnosis** – A medium to large *Hyla* (♂ 44–48 mm, ♀ 54–56 mm) of the *geographica* group; dorsum reddish brown sometimes with darker irregular shaped blotches, and/or a mid-dorsal longitudinal stripe, and/or small white spots; flanks black speckled with white; transversal dark brown stripes on the posterior limbs; venter yellowish cream; bones green.

**Habitat** – This species was found at night in forest streams on Maracá (O'Shea, 1988).

**Reproduction** – No data available.

**Distribution** – Tropical South America east of the Andes (Frost, 1985).

**Remarks** – Duellman (1973) reviewed the *Hyla geographica* group.

### *Hyla microcephala* (Cope 1886)

**Material** – Maracá, 29 (10); Pacaraima, 4; Tepequém, 9.

**Abundance** – Very common.
Diagnosis — A small Hyla (♂♂ 19 mm, ♀ 25 mm) of the microcephala group; dorsum reddish brown to red; limbs orange–yellow; venter cream; vocal sac light green.

Habitat — This species was found at night in temporary and permanent water bodies with emergent sedges and grasses on Maracá, and at Pacaraima and Serra Tepequém. Reproduction — Males of Hyla microcephala called throughout the rainy season (May to September). Calling males perched low (up to 1 m) on sedges and grasses. Distribution — Southern Mexico throughout Central America and South America east of the Andes to southeastern Brazil (Frost, 1985).


Hyla rubra (Laurenti 1768)

Material — Maracá, 14 (12); Boa Vista, 11; Surumu, 1.

Abundance — Very common.

Diagnosis — A small to medium-sized Hyla (♂♂ 35–38 mm, ♀ 37–40 mm) of the rubra group; dorsum highly variable, generally brownish tan with irregular darker blotches; venter white with gular region light red in males; limbs reddish cream below; posterior surfaces of thighs dark brown to black with yellow spots.

Habitat — Hyla rubra was found at night in temporary and permanent ponds and lakes in the savannas of Maracá, Boa Vista and Surumu.

Reproduction — Males of H. rubra were heard calling throughout the rainy season (May to September). Males called from the ground or, rarely, from low heights on plants at pond and lake margins. Eggs were deposited as a monolayer film on the water surface in shallows. The first tadpoles were observed in late May and recently metamorphosed juveniles in July and August.

Distribution — Trinidad, St Lucia and Panama throughout Amazonia to eastern Brazil (Frost, 1985).

Remarks — Hyla rubra as known today is possibly a composite of many species (Frost, 1985).

Hyla wavrini (Parker 1936)

Material — Maracá, (2).

Abundance — Apparently rare.

Diagnosis — A large Hyla of the boans group (♂♂ 89–113 mm, ♀♀ 75–81 mm, Hoogmoed, 1990); dorsum greyish to greenish tan, sometimes bearing a reddish brown vertebral line and/or irregular darker spots or stripes; flanks cream with transverse dark brown bars; venter cream, gular region greyish brown with dark lines or spots.

Habitat — This species was found at night by O’Shea in riverine forest around Maracá.

Reproduction — No reproductive activity was observed. However, H. wavrini seems to reproduce throughout the year in several Amazonian localities (Martins and Moreira, in press).
**Distribution** – Amazonian Brazil and Venezuela (Hoogmoed, 1990; Martins and Moreira, in press).

**Remarks** – *H. wavrini* has been considered a synonym of *H. boans* until recently.

**Hyla sp.**

**Material** – Maracá, (3).

**Abundance** – Apparently rare.

**Diagnosis** – A medium-sized *Hyla* (♂♂ 39–41 mm) related to *H. marmorata*; in preservative the dorsum is brown with irregularly distributed dark brown spots and bars; upper surface of thighs with three dark brown bars and spots; chin white, bordered by brown reticulations; belly and chest cream with scattered brown reticulations.

**Habitat** – O’Shea found this species at night in a baixada (damp depression in the forest) close to the Cachoeira da Onça on the Ilha de Maracá, where it was sitting on leaves up to 2 m above the ground.

**Reproduction** – No reproductive activity was observed.

**Distribution** – Unknown (see remarks).

**Remarks** – This species is similar to *H. marginata* in dorsal pattern and size. However, it differs from the latter and related species in several other characteristics, indicating that it may be an undescribed species.

**Phrynohyas venulosa** (Laurenti 1786)

**Material** – Maracá, 6 (3).

**Abundance** – Common (see Reproduction).

**Diagnosis** – A large *Phrynohyas* (♂♂ 65–74 mm); paired lateral vocal sacs; dorsum brownish tan with irregular darker marks; flanks and anterior surfaces of limbs cream reticulated with brown; venter cream.

**Habitat** – This species was found at night on Maracá in swamps, ponds, lakes and streams in forests, or savannas close to forests.

**Reproduction** – *Phrynohyas venulosa* is an explosive breeder; males were heard only on 9–11 May 1986. Hundreds of males congregated in a swamp during these three days. Males called from the ground or from the vegetation up to 3 m.

**Distribution** – Mexico to southern Brazil including Trinidad and Tobago (Frost, 1985).

**Remarks** – Duellman (1971) reviewed the South American species of the genus *Phrynohyas*.

**Phyllomedusa hypocondrialis** (Daudin 1802)

**Material** – Maracá, (1, photographed by W. Milliken); Pacaraima, 9; Tepequém, 5.

**Abundance** – Apparently rare.
FROGS

Diagnosis - A medium-sized Phyllomedusa (♂ 48 mm) of the hypocondrialis group; dorsum green; anterior and posterior surfaces of thighs with dark transversal bars; venter cream.

Habitat - On Pacaraima and Tepequém, P. hypocondrialis was found in permanent and temporary pools on mountain slopes. The habitat in which it was found on Maracá was not recorded.

Reproduction - Males were heard calling in July on both Pacaraima and Tepequém. They called from low (1-2 m) in the marginal vegetation. Pyburn and Glidewell (1971) provided information on the reproductive biology of this species in Colombia.

Distribution - South America east of the Andes, from the Guianas to Paraguay, Argentina and southeastern Brazil (Frost, 1985).

FAMILY LEPTODACTYLIDAE

The family Leptodactylidae is neotropical, occurring from southern North America to southern South America, including the West Indies (Frost, 1985). Of the 51 genera of leptodactylids, some 20 occur in northern South America with hundreds of species (Frost, 1985). Five leptodactylid genera were found on Maracá.

Adenomera sp.

Material - Maracá, 1.
Abundance - Moderately common.

Diagnosis - A small Adenomera (♂ 23 mm); dorsum greyish brown with darker small spots; transversal dark brown stripes on the limbs; venter cream.

Habitat - Adenomera sp. was found by day within the leaf-litter in forests on Maracá.

Reproduction - No data available.

Distribution - Unknown (see Remarks).

Remarks - This species could not be assigned to any known species of Adenomera, reviewed by Heyer (1973).

Leptodactylus bolivianus (Boulenger 1898)

Material - Maracá, 16 (12); Boa Vista, 2; Pacaraima, 2.

Abundance - Common.

Diagnosis - A large Leptodactylus (♂♂ 71–73 mm, ♀♀ 74–81 mm) related to the ocellatus group; two longitudinal glandular folds on the dorsum; dorsum brown with dark brown folds; venter cream with brown reticulation in the gular region; dark brown transversal bars on thighs and tibia; males with robust forelimbs and two pairs of black spines in each hand.

Habitat - This species was found at night in lakes in savannas close to forests on Maracá, and at Boa Vista and Serra Pacaraima. O'Shea (1988) also observed this species in terra firme forest and riverine habitats.
Reproduction – *Leptodactylus bolivianus* probably breeds from July to September, when males congregate at lake margins.

Distribution – South America south of Colombia, including the Guianas and Trinidad (Hoogmoed and Gorzula, 1979; Frost, 1985).

Remarks – Gallardo (1964) reviewed *L. bolivianus*.

*Leptodactylus fuscus* (Schneider 1799)

Material – Maracá, 9 (3); Boa Vista, 15; Surumu, 10.

Abundance – Very common.

Diagnosis – A small *Leptodactylus* (♂ 36–40 mm, ♀ 37–43 mm) of the *fuscus* group; six longitudinal glandular folds on the dorsum; dorsum greyish brown with darker blotches, sometimes with a lighter mid-dorsal longitudinal stripe (polymorphic); venter white; gular region with dark reticulations at each side in males.

Habitat – This species was found at night in ponds and lakes in the savannas of Maracá, Boa Vista and Surumu.

Reproduction – Males of *L. fuscus* were heard from the first rains in February and March through to mid-June, but clutches were found only from early May to mid-June. Males called in groups of three to five individuals on the ground at pond and lake margins. Clutches consist of eggs embedded in white foam and are deposited in subterranean nests dug by males at pond margins. Heavy rains or pond water flood these nests, allowing tadpoles to reach the pond. Tadpole development lasts nearly three weeks. A detailed description of the reproductive biology of *L. fuscus* is found in Martins (1988).

Distribution – Panama throughout South America east of the Andes to southern Brazil (Frost, 1985).

Remarks – Heyer (1978) reviewed the *fuscus* group of the genus *Leptodactylus*.

*Leptodactylus knudseni* (Heyer 1972)

Material – Maracá, 2 (1).

Abundance – Rare.

Diagnosis – A large *Leptodactylus* (♂ 127 mm) of the *pentadactylus* group; dorsum reddish brown sometimes with small darker blotches; triangular dark brown bars on the lips; males with a spine in each hand; venter cream with irregular brown reticulations.

Habitat – This species was found at night in the leaf-litter in forests on Maracá.

Reproduction – A male *L. knudseni* was heard in May; it called from a hole within roots in the forest floor.

Distribution – Amazon basin, Colombia, Venezuela and the Guianas (Frost, 1985).

Remarks – Heyer (1979) reviewed the *L. pentadactylus* group, including *L. knudseni*, and Hero and Gallati (1990) provided the characteristics that distinguish the latter species from *L. pentadactylus*. 
**Leptodactylus macrosternum** (Miranda Ribeiro 1926)

*Material* – Maracá, 22 (2); Boa Vista, 30; Surumu, 7.

*Abundance* – Common.

*Diagnosis* – A large *Leptodactylus* (♂♂ 74–80 mm, ♀♀ 76–83 mm) of the *ocellatus* group; ten longitudinal glandular folds on the dorsum, the second pair sometimes indistinct; dorsum greyish brown with darker blotches; venter cream with brown reticulations below the thighs and ventrolateral and gular regions; males with robust forelimbs and a pair of spines in each hand.

*Habitat* – This species was found at night in temporary and permanent lakes in the savannas of Maracá, Boa Vista and Surumu.

*Reproduction* – Males of *L. macrosternum* were heard in June and July. Males called from shallows, and eggs were embedded in white foam and deposited over the shallow waters. Tadpoles formed shoals that were guarded by their mothers during the initial stages of development.

*Distribution* – Amazonia to southern Brazil (Frost, 1985).

*Remarks* – Gallardo (1964) reviewed the species related to *L. ocellatus*, including *L. macrosternum*.

**Leptodactylus mystaceus** (Spix 1824)

*Material* – Maracá, 8 (6).

*Abundance* – Moderately common.

*Diagnosis* – A medium-sized *Leptodactylus* (♂♂ 43–47 mm) of the *fuscus* group; dorsum reddish brown sometimes with darker blotches; transversal darker bars on the thighs, tibia, and feet; white supralabial stripe; canthus rostralis with a black stripe extending from the tip of the snout to the tympanum; venter cream with dark brown reticulation in the gular region of males.

*Habitat* – This species was found at night in stream valleys in *terra firme* forests and gallery forests on Maracá.

*Reproduction* – Males of *L. mystaceus* were heard from May to July. Males called from small constructed nests below leaf-litter.

*Distribution* – Amazonia through northern Paraguay (Frost, 1985).

*Remarks* – O’Shea (1989) cited *L. mystaceus* and *L. amazonicus* for Maracá, but these are synonymous (see Heyer, 1983). Heyer (1978) reviewed the *L. fuscus* group, including *L. mystaceus*.

**Leptodactylus sp.**

*Material* – Maracá, 4 (10).

*Abundance* – Common.

*Diagnosis* – A small to medium-sized *Leptodactylus* (♂♂ 32–34 mm, ♀♀ 37–39 mm) of the *melanonotus* group; interrupted glandular folds on the dorsum;
dorsum dark brown with a triangular darker spot between and behind the eyes; narrow cream bars on the lips; venter cream with brown reticulation; males with a pair of spines in each hand.

*Habitat* – *Leptodactylus* sp. was found at night in streams and swampy areas in forests on Maracá. 

*Reproduction* – Males of this *Leptodactylus* sp. were heard in October 1985 and August and September 1986. 

*Distribution* – Unknown (see Remarks). 

*Remarks* – O'Shea (1989) assigned this species to the *Leptodactylus wagneri* complex, and also cited *L. podicipinus* (the name I have used for this species in previous lists). However, while awaiting a revision of the *L. wagneri* complex by W.R. Heyer, I prefer to give no name to this species. Heyer (O'Shea, pers. comm.) suspects that there are (at least) two species of the *L. wagneri* complex in the material which he examined from Maracá. However, when examining some of the same specimens I could not distinguish more than one species.

*Lithodytes lineatus* (Schneider 1799) 

*Material* – Maracá, 1 (I). 

*Abundance* – Extremely rare. 

*Diagnosis* – A medium-sized frog (♂ c. 40 mm) of the monotypic genus *Lithodytes*; dorsum and flanks black with a cream dorsolateral stripe extending from the tip of the snout to the groin; iris reddish brown; upper surface of limbs light brown with irregular black spots; bright red flash-marks in the inguinal region; venter greyish brown with cream spots laterally. 

*Habitat* – This species was found by day in a nest of *Atta* ants in *terra firme* forest on Maracá, and O'Shea recorded it by night in a swamp in the forest. 

*Reproduction* – A male *L. lineatus* was heard calling from a nest of *Atta* ants in the morning of 6 July 1986. 

*Distribution* – Amazonia, Venezuela and the Guianas (Frost, 1985). 

*Remarks* – Schlüter and Regös (1981) and Regös and Schlüter (1984) provided valuable information on *L. lineatus*. 

*Physalaemus ephippifer* (Steindachner 1864) 

*Material* – Maracá, 32 (45). 

*Abundance* – Very common. 

*Diagnosis* – A small *Physalaemus* (♂♂ 26–28 mm) of the *cuvieri* group; dorsum brown with darker spots; flanks dark brown from loreal to inguinal regions; transversal dark brown bars on the upper surface of limbs; venter cream with brown reticulations in the pectoral and gular regions. 

*Habitat* – This species was found by day in the leaf-litter, and by night in lakes in the forests of Maracá and Pacaraima. 

*Reproduction* – Males of *P. ephippifer* were heard calling from the shallows of a lake in May.
Distribution – Lower Amazonian region and the Guianas (Frost, 1985).
Remarks – O’Shea (1989) called this species ‘Physalaemus sp.’. Hoogmoed and Gorzula (1979) listed some specimens probably of this species as *P. enesefae* Heatwole, Solano & Heatwole, 1965, but, based on the original descriptions, *P. enesefae* is probably a synonym of *P. ephippifer* (see also Frost, 1985).

**Pseudopaludicola boliviana** (Parker 1927)

*Material* – Maracá, 39 (23); Surumu, 25.

*Abundance* – Very common.

*Diagnosis* – A diminutive species of *Pseudopaludicola* (♂♂ 13–15 mm); dorsum dark brown with either small darker spots or a mid-dorsal longitudinal cream to reddish brown stripe (polymorphic); transversal dark bars on the lips and upper surfaces of thighs and feet; venter cream with pale reticulations at the gular region and below the thighs; large conical tubercle on the heel.

*Habitat* – This species was observed at night in ponds, lakes and swamps in the savannas of Maracá, Boa Vista and Surumu, and by day in the gallery forests.

*Reproduction* – At Boa Vista, males of *P. boliviana* were heard calling in June and July. They called from the ground within the marginal vegetation of water bodies.

*Distribution* – Guyana, Surinam, Brazil (Roraima), Venezuela, Colombia, Bolivia and Paraguay (Frost, 1985; pers. obs.).

Remarks – O’Shea (1989) called this species *Pseudopaludicola pusillus* (following an identification made by W.R. Heyer), and cited another species of this genus (*Pseudopaludicola* sp.). However, considering the extensive polymorphism observed in this species, I suspect that there is only one species of *Pseudopaludicola* on Maracá. Lynch (1989) reviewed the species of *Pseudopaludicola* that occur in northern South America.

**FAMILY MICROHYLIDAE**

The family Microhylidae is nearly cosmopolitan in tropical and temperate regions, except for the Palearctic region and the West Indies (Frost, 1985). Of the 61 known genera eight occur in northern South America, represented by several species. Only one genus was found on Maracá.

**Elachistocleis ovalis** (Schneider 1799)

*Material* – Maracá, 2 (10); Boa Vista, 2.

*Abundance* – Common.

*Diagnosis* – A small species of the genus *Elachistocleis* (♂♂ 22–24 mm, ♀♀ 25–28 mm); dorsum dark grey with small greyish punctuations scattered throughout, sometimes with a narrow whitish longitudinal stripe; snout acuminate in dorsal and lateral view; orange flash-marks at the inguinal region; venter grey with small yellow spots.
Habitat — *Elachistocleis ovalis* was observed at night in lakes in the savannas of Maracá and Boa Vista, and also in the forest on Maracá.

Reproduction — At Boa Vista, males of *E. ovalis* were heard from May to July. They called from shallows or from the margins. In May a male of this species was found calling from a small pond in a dry stream inside the forest.

Distribution — Panama to southern Argentina (Frost, 1985, but see Remarks).

Remarks — O’Shea (1989) identified this animal to the genus level only (*Elachistocleis* sp.). Following Hoogmoed and Gorzula (1979), who found this species at El Manteco, Venezuela, I tentatively identified it as *Elachistocleis ovalis* pending a revision of the genus.

FAMILY PSEUDIDAE

The family Pseudidae includes four species that occur exclusively in South America (Frost, 1985). Its two genera both occur in northern South America, and both were found on Maracá.

*Lysapsus limellus* (Cope 1862)

Material — Maracá, 1 (7); Boa Vista, 60; Surumu, 5.

Abundance — Extremely common.

Diagnosis — A small pseudid of the genus *Lysapsus* (♂♂ 17–21 mm, ♀♀ 23–27 mm); dorsum green with brown longitudinal stripes; no webbing in the hands; feet fully webbed; eyes facing upward; transversal brown bars on the limbs; venter yellowish green.

Habitat — This species was found both at night and during the day, in lakes and swamps in the savannas of Maracá, Boa Vista and Surumu.

Reproduction — Males of *L. limellus* were heard throughout the year. They called from floating plants and from the margins. Tadpoles were also observed throughout the year.

Distribution — The Guianas south to Paraguay (Frost, 1985).

Remarks — Gallardo (1961) reviewed the species of *Lysapsus*.

*Pseudis paradoxa* (Linnaeus 1758)

Material — Maracá, 1 (2); Boa Vista, 7; Surumu, 1.

Abundance — Very common.

Diagnosis — A medium to large species (♂♂ 42–52 mm, ♀♀ 53–57 mm) of the monotypic genus *Pseudis*; dorsum green with irregular dark brown marks; venter and posterior surfaces of thighs cream with brown reticulations; eyes facing upward; hands without webbing; feet fully webbed.

Habitat — *Pseudis paradoxa* was found both by night and by day in lakes in the savannas of Maracá, Boa Vista and Surumu.
Reproduction – Males of *P. paradoxa* were heard from March to July, with a peak in June and July. They called from everywhere in the water. Tadpoles were found from May to July.

Distribution – Northern South America south to Paraguay (Frost, 1985).

Remarks – Gallardo (1961) reviewed the genus *Pseudis*.

**ADDITIONAL SPECIES FROM RORAIMA**

Besides the 25 species listed above, I observed 10 additional species at Boa Vista, Serra Pacaraima, Serra Tepequém, and Surumu. Most of these species may occur on Maracá, but only additional field surveys would reveal them. Data on these 10 species are summarized in the following paragraphs.

A small unidentified *Colostethus* (♂ 20 mm) was found on the rocks of a small stream on the slopes of Serra Tepequém. Also at Serra Tepequém I found the following hylids: *Hyla minuta* Peters, 1872, a small species (♂♂ 23–25 mm SVL) widespread in South America (Frost, 1985); and *Phyllomedusa bicolor* (Boddaert, 1772), a large species (♂ 110 mm SVL) widespread in Amazonia (Frost, 1985). A medium-sized, unidentified *Eleutherodactylus* (♂ 28 mm SVL) of the *fitzingeri* group was also found at Serra Tepequém.

At Boa Vista, I found two additional hylids in habitats very similar to those found on Maracá: *Hyla nebulosa* Spix, 1824, a medium-sized treefrog (♂ 33 mm SVL) of the *rostrata* group that occurs in the Guianas, eastern Amazonia, and eastern Brazil (Frost, 1985); and *Hyla exigua* (Duellman, 1986), a small species (♂ 19 mm SVL) described from the Gran Sabana of Venezuela (see Duellman, 1986). The leptodactylid *Pleurodema brachyops* (Cope, 1869) was also found in large numbers at temporary and permanent lakes and ponds in the savannas of Boa Vista and Surumu; Martins (1989) described the defensive behaviour of this species from the vicinity of Boa Vista. The large *Rana palmipes* Spix, 1824 (♂ 86 mm, ♀ 103 mm SVL), the only South American ranid, was also found in that area. This species occurs from Mexico to northern South America (Frost, 1985).

Finally, at Serra Pacaraima, I found the hylid *Hyla raniceps* (Cope, 1862), a medium-sized species (♂ 47 mm SVL) of the *albopunctata* group that is widespread in South America, and the leptodactylid *Leptodactylus longirostris* Boulenger, 1882, a medium-sized species (♂ 40 mm SVL) of the *fuscus* group that occurs in Venezuela, the Guianas and Brazilian Amazonia.

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