

STUDIES ON THE FAUNA OF CURAÇAO AND OTHER  
CARIBBEAN ISLANDS: No. 108.

**THE AMPHIBIA OF TRINIDAD**

by

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## INTRODUCTION

Compared with the other vertebrate groups the Amphibia of the island of Trinidad are relatively poorly known. There have been four surveys of the group, one in the last century and the others in the earlier part of the present. The earliest is that of MOLE & URICH (1894) in which twelve species are listed and a brief account given of the breeding habits of one species, and another species listed later in the same source. Approximately thirty years later ROUX (1926) examined a collection made by KUGLER and reported fourteen species. A year later LUTZ (1927) visited the island and made a collection listing fourteen species giving brief notes on their distribution. Apart from these references, which are essentially nothing more than lists of species, there has been only one comprehensive study of the group, that of PARKER (1933) which was based on collections made by URICH and VESEY-FITZGERALD, in which twenty-three species are listed and in which a key to identification is presented. A year later PARKER (1934) reviewed a minor taxonomic problem and described a new species of *Gastrotheca* from the island. There are, of course, scattered references to Trinidad amphibia in the literature falling generally into two groups, those dealing with limited collections or particular aspects of life histories of individual species and those in which particular groups of species are being reviewed. In the former category are the papers of BEEBE (1952), DITMARS (1941), GANS (1956), KENNY (1956 and 1966) and in the latter those of DUELLMAN (1956), DUNN (1949), FUNKHOUSER (1957), GALLARDO (1961 and 1965), PARKER (1937) and RIVERO (1961).

There is no doubt that there is need for a general study and review of the Amphibia of the island. Since PARKER's study was published, the names of nine of the twenty-three species have been altered in one way or another, some even at the generic level, while two hitherto unrecorded species have been found. Apart from this, however, there has been surprisingly little recorded on general life histories of the Trinidad species or of mainland representatives of these species. Admittedly some species are comparatively well known but these are mostly forms with peculiar life histories or habits, for example *Pipa pipa*, *Pseudis paradoxus* and possibly *Bufo marinus*, which would attract the attention of herpetologists. Never-

theless, the bulk of the species remain nothing more than names in taxonomic reviews. While the adult forms may be fairly well known taxonomically, most of the tadpoles are still unknown. A search of the literature, both of Trinidad forms as well as mainland forms has revealed descriptions only of three forms.

The paper presented here represents the results of a survey of Amphibia of Trinidad carried out between 1955 and 1961 and between 1963 and 1965. This survey was conducted largely along the lines of a general investigation of life histories both of adult and larval amphibia with particular reference to distribution and habitat preference, and to the natural history of the tadpoles. While it has been comparatively easy to work out life histories of most of the twenty-five species, a few of the species remain poorly known, largely on account either of scarcity of material or of difficulties in making extended field observations of forms occurring in inaccessible habitats. For example *Rana palmipes* is known only from five specimens, while spawning of the bromeliad dwelling *Amphodus auratus* is yet to be observed. It is hoped, however, that in spite of the many gaps in the knowledge of these animals, the results of this survey will be of use not only to zoologists and naturalists on the island, but to the many herpetologists studying South American Amphibia.

I am particularly indebted to Dr. J. L. PRICE and Dr. V. C. QUESNEL who accompanied me on many field trips and to Miss A. GRANDISON of the British Museum (Natural History) for identifying some of the material, for reading the manuscript and for drawing my attention to several papers on Trinidad amphibia. I must also thank Dr. P. WAGENAAR HUMMELINCK who suggested this study in the course of one of his visits to the West Indies.

## TOPOGRAPHY, CLIMATE AND VEGETATION

The island of Trinidad is roughly rectangular in shape and measures approximately 35 miles by 48 miles (Figure 1). Two peninsulars extend westwards from the north-western and south-western corners to within 8 miles of the coast of Venezuela. Three mountain ranges traverse the island in an east-west direction. Of these the Northern Range is the most prominent with two of its peaks rising above 3000 feet. This range of mountains is about 12 miles wide at its widest point and is criss-crossed by a series of valleys running north to

south. Most of the Northern range is either under cocoa cultivation or is Crown forest reserve but, in the western portion of this range which is nearer the more densely populated area of the island, the hills are very badly denuded of forest cover.

The Central Range consists of a series of low limestone hills running from just north of Pointe-a-Pierre on the west side of the island to Manzanilla on the east coast. The highest elevation is at Mount Tamana, 1009 feet. Most of the Central Range is under cocoa cultivation but there are extensive forest reserves in the eastern portion of this range.

The Southern Range consists of a series of low rolling hills extending along the south coast from about Erin to Guayaguayare. Most of the hills in this range are only perhaps 200 to 300 feet high

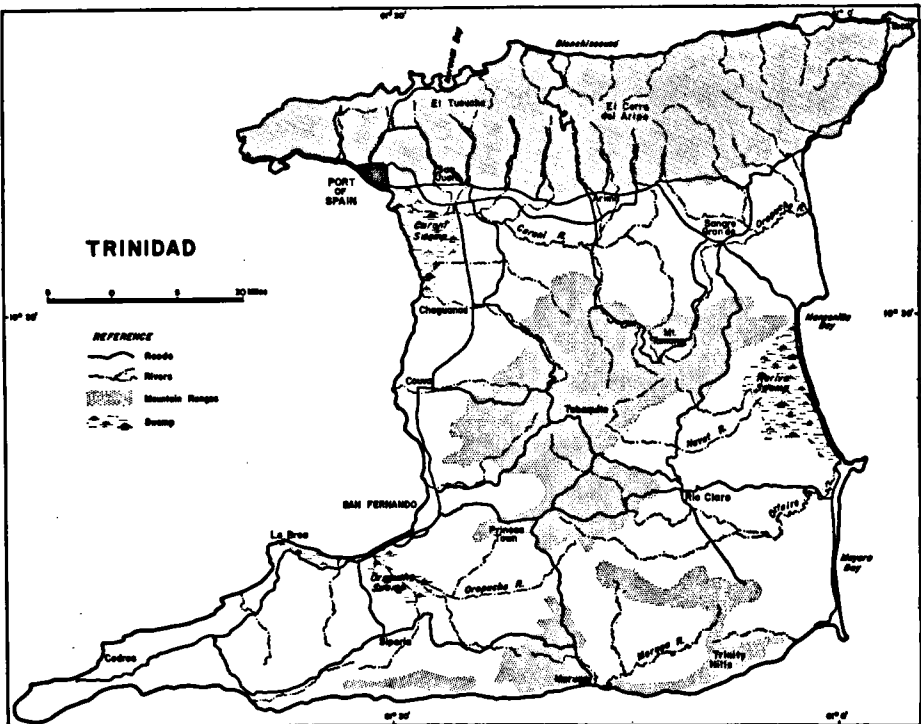


FIGURE 1. The island of Trinidad: topography.



but in its eastern portion, the Trinity Hills rise to 997 feet. The vegetation in the Southern Range varies from coconut, citrus and cocoa cultivations to natural forest.

Between these three ranges of hills there are two fairly extensive plains which are cultivated with a wide variety of crops which include sugarcane, rice, coconuts, cocoa, coffee, citrus and vegetables. On the west side of the island there are two large brackish water swamps, the Caroni and the Southern Oropouche, and on the east two fresh water swamps, the North Manzanilla and the large Nariva Swamp.

Rainfall (Figure 3) ranges from about 280 cm per year in the eastern portions of the Northern Range and the Central Range to about 130 cm per year on the extreme western portions of the island. There are usually two seasons per year, a dry season extending from January to May, and a rainy season from May to December. Maximum temperatures in any year run up to about 95 degrees Fahrenheit, and minimum to about 60 degrees. During both seasons there is usually a pronounced drop in temperature after dusk.

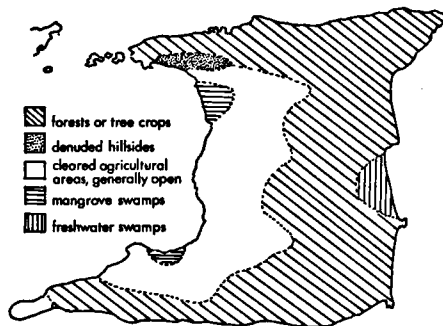


FIGURE 2. The island of Trinidad: vegetation.

Trinidad has approximately 2000 miles of drivable roads. As the population density is rather higher in the west of the island, there are naturally more roads there but the east of the island is relatively well served, although there are two large blocks of country in the north east and southeast to which the only access is by trails. All

roads are marked with mile posts every quarter mile and all culverts and bridges are numbered, greatly facilitating accurate record of localities.

## METHODS AND LOCALITIES

Between 1954 and 1960, 204 separate field trips were made throughout the island and 562 localities visited (Figure 4). Most of these trips were made at night, and in the rainy season, and collections were made either by direct search with the aid of a head-light or by stalking. Some field trips were made during the day for diurnal species such as *Pseudis* and *Phyllobates*, and some were made during the dry seasons of 1958, 1959 and 1960, particularly for dry season spawning forms such as *Hyla maxima* and *Hyla geographica*. Tadpoles were collected simply by dipnetting, but some study was also made of tadpoles raised from eggs collected in the field and hatched at the writer's residence.

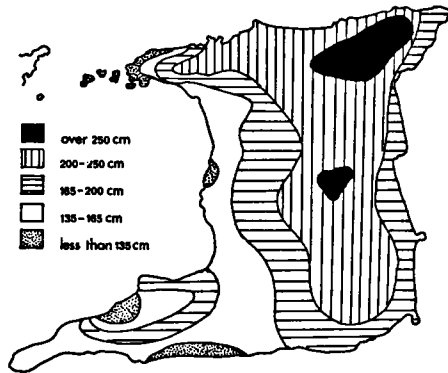


FIGURE 3. The island of Trinidad: rainfall.

In addition to the general collections, which were used largely for distribution records, seven areas were selected for intensive study involving repeat visits to specific localities. Studies on habitat preference of individual species referred to later were based on observations made in these localities. The areas selected (Figure 4) included:

### Area 1: SUMMIT OF EL TUCUCHE.

This area also includes the adjacent peak of Naranjo, the divide between these peaks, the southern face of El Tucuche, all above an elevation of 2000 feet. This area is characterized by steep virgin rain forest, some patches of cloud forest, and is within the range of maximum rainfall in Trinidad (280 cm per year). Owing, however, to steep slopes, there are relatively few pools but numerous small streams.

### Area 2: MARACAS VALLEY

This area includes the Government Land Settlement lying at the base of El Tucuche, the village of Maracas, the lower portion of the Maracas Waterfalls Trail, the Maracas River, and El Chorro Road. This area contained possibly the widest range of habitats of any of the areas studied. On the Waterfalls trail and along the Waterfalls river, there is both rain forest and old abandoned cocoa cultivations. In the flatter portion of the area, particularly in the village of Maracas and to the north of it, could be found open savannah, citrus orchards, cocoa and coffee cultivations, second growth scrub forest, rivers, small patches of swampy ground and numerous

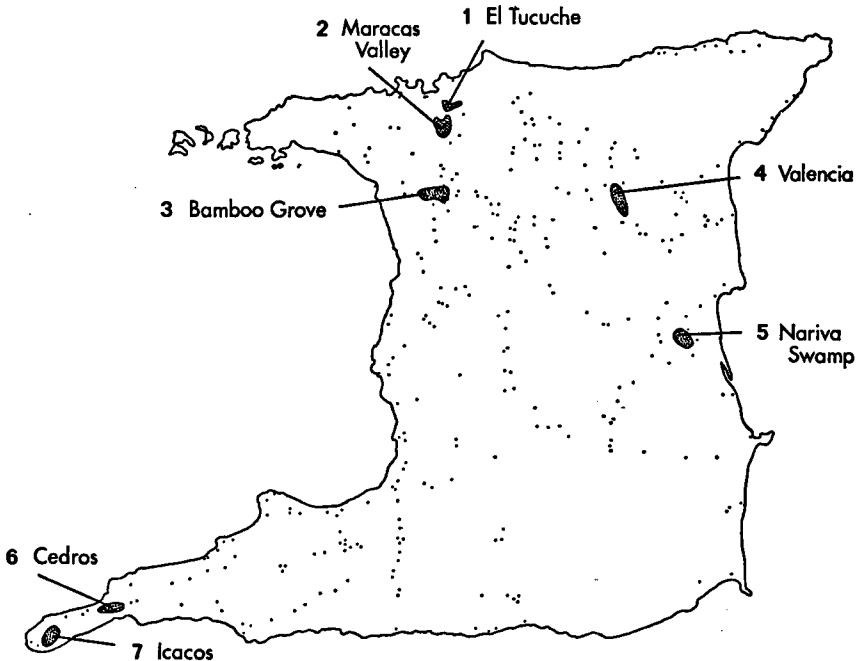


FIGURE 4. Localities visited in Trinidad between 1955–1961, and areas of special study.

small temporary ponds. Three places often visited in this area were a small swampy ravine at El Chorro, a concrete tank lying near stables on the Land Settlement and the Maracas River at the Waterfalls bridge.

### Area 3: BAMBOO GROVE

This area includes the fish farm at Bamboo Grove and the land for about a mile on either side of the Churchill Roosevelt Highway as far west as El Socorro. In the early part of this survey, most of this area consisted of cane fields and citrus orchards to the north, coconuts to the east, extensive bamboo stands to the south, and rice fields and market gardens to the west. Since 1956, however, the bamboo stands to the south have been cleared for land settlement purposes, while more recently the land to the north and east has been cleared for high-priced housing, and some of the land to the west has been used for the erection of a factory. The St. Joseph river runs alongside the fish farm and at one time flowed throughout the year. Excessive clearing of the Maracas Valley, with consequent faster run off, has resulted in the river drying up for three or four months each year. The fish farm itself consists of a series of shallow ponds of varying sizes up to about  $1\frac{1}{2}$  acres and covers a total area of 10 acres. The banks between the ponds are planted with fruit and ornamental trees. The fish farm itself always has some permanent water in storage ponds. During the rainy season, there are countless temporary ponds and small pools which attract amphibians. This area is quite flat and only about 15 to 20 feet above sea level. Rainfall is about 200 cm per year.

### Area 4: VALENCIA FOREST

This area extends on either side of the Eastern main road near Valencia between miles 21 and 25. This area is mainly flat, densely forested and contains numerous roadside ditches some of which are almost permanent, and countless small temporary pools in the forest. This area has an annual rainfall in excess of 230 cm per year.

### Area 5: NARIVA SWAMP

The Nariva Swamp is an extensive fresh water swamp on the eastern side of the island. Unfortunately, the swamp is only easily accessible from a few points. This area refers to a portion of the swamp near the village of Plum Mitán. Access is through Caltoo Trace which runs firstly through an area developed for rice cultivation and which ends at a canal running north and south between the Petit Poole cut and the Jagroma River. On either side of the Caltoo Trace there are rice fields and open swamp savannah; to the north there is an extensive palm forest, while to the east there is some elevated land forming islands of dense forest. Most of the land in this area is just barely above sea level. There are numerous canals beside the trails which lead from Caltoo Trace, as well as two along Caltoo Trace itself. During the rainy season the entire area with the exception of the traces is inundated. During the dry season the entire area except for some of the canals is dry and much of it is burnt and planted with dry season crops. Rainfall is about 200 cm per year.

### Area 6: CEDROS

This area includes a fairly narrow strip on either side of the Southern Main Road between miles 65 and 72, just outside the village of Bonasse. This area provides a wide range of habitats from rice fields, forested swamps, forests, drainage canals, cocoa cultivations, coconut cultivations and second growth scrub forest. Although rainfall is comparatively low (120 cm per year), during the rainy season numerous temporary pools can be found which will attract amphibia.

### Area 7: ICACOS SWAMP

This area is on either side of the Southern Main Road between miles 77 to 80. Most of it is either open swamp savannah or coconut cultivation. Although the rainfall is low (less than 100 cm per year), during the rainy season the open savannah is inundated and numerous small pools and roadside ditches can be found. Parts of this area are slightly brackish but nevertheless support certain species.

Apart from the keys to identification of adults and tadpoles and a discussion of habitat preference and distribution, which are considered separately, the general treatment which has been adopted here is to present accounts of each species in the form of an annotated list with separate headings for descriptions of adults and tadpoles, voice, habitat, distribution, spawning and natural history of tadpoles. In the descriptions of adults, the measurements given are mean figures of ten specimens of both males and females taken from a single locality, except in the cases of *Pipa* and *Rana* of which fewer examples were available. With regard to the tadpoles, most of the descriptions are of stage X tadpoles, the staging used being that of TAYLOR & KOLROSS (1946) and the lengths given being a mean of ten examples.

No attempt has been made to include complete synonymies of the species in the annotated list. Instead, under each species heading is given the name applied by different authors as they appear in the literature dealing with Trinidad forms.

## KEY TO ADULT AMPHIBIANS OF TRINIDAD

PARKER (1933) gives a key for the identification of the species found in Trinidad. While this key is reasonably workable, it is to a certain extent based on characters which are found in preserved

animals which cannot be discerned easily in living or freshly killed material. For example, it will be noted that in the case of *Hyla crepitans*, one of the key characters is the presence of vertical black bars on the flanks; in fact, these bars are bright orange in life. Again, in the case of *Hyla minuta*, one character is the presence of a short white line above the vent; some specimens of *H. minuta*, particularly the more lightly coloured forms, do not always show this when alive although the line may appear after fixation. In other cases where single characters are used, they may be quite misleading; *Leptodactylus podicipinus petersi* is one such case where the key states that the back of the animal is perfectly smooth. In life, this species is very variable and may occasionally have a very rough back.

The key which is here presented has been based as much as possible on morphological features such as absence or presence of digital discs and webbing, shape of tongue, shape of pupil, length of toes, presence of bony ridges, dermal folds and warts. Every effort has been made to refrain from using markings or colours and every character used can be observed in live or preserved animals.

#### KEY TO ADULT AMPHIBIANS OF TRINIDAD

1. Fingers and toes, or fingers with digital discs. . . . . 2  
     Fingers and toes lacking digital discs . . . . . 16
2. Fingers with star-shaped discs, tongue lacking . . . . .  
     . . . . . *Pipa pipa* (Linnaeus)  
     Fingers with rounded discs, tongue present. . . . . 3
3. Webbing entirely lacking . . . . . 4  
     Webbing present between toes, or toes and fingers . . . 6
4. Upper surface of discs with pair of scale-like scutes . . . . .  
     . . . . . *Phylllobates trinitatis* Garman  
     Upper surfaces of discs smooth . . . . . 5
5. First toe longer than second and opposable . . . . .  
     . . . . . *Phyllomedusa trinitatis* Mertens  
     First toe shorter than second and unopposable . . . . .  
     . . . . . *Eleutherodactylus urichi* (Boettger)

6. Webbing in toes only . . . . . 7  
 Webbing in both fingers and toes . . . . . 9
7. Lower jaw with series of fine tooth-like serrations. . . . .  
     . . . . . *Amphodus auratus* Boulenger  
 Lower jaw lacking tooth-like serrations . . . . . 8
8. Discs wider than long, tongue notched posteriorly. . . . .  
     . . . . . *Hyla rubra* Daudin  
 Discs as wide as long, tongue entire . . . . .  
     . . . . . *Nototheca fitzgeraldi* (Parker)
9. Webbing lacking between first and second fingers. . . . 10  
 Webbing present between first and second fingers. . . . 12
10. Pupil a horizontal rhomboid . . . . .  
     . . . . . *Hyla geographica geographica* Spix  
 Pupil a horizontal ellipse . . . . . 11
11. Tongue notched posteriorly . . . . . *Hyla crepitans* Wied  
 Tongue entire. . . . . *Hyla punctata* (Schneider)
12. Tongue notched posteriorly . . . . . 13  
 Tongue entire . . . . . 14
13. Canthus rostralis distinct and angular . . *Hyla misera* Werner  
 Canthus rostralis indistinct and rounded. *Hyla minuta* Peters
14. Fingers fringed laterally. . . . . *Hyla maxima* (Laurenti)  
 Fingers not fringed laterally . . . . . 15
15. Snout pointed, mouth inferior . . . . .  
     . . . . . *Hyla orophila* Lutz & Lutz  
 Snout rounded, mouth terminal . . *Phrynohyas zonata* Spix
16. Toes with webbing . . . . . 17  
 Toes lacking webbing . . . . . 21
17. Skin warty . . . . . 18  
 Skin either smooth or rough . . . . . 20
18. Bony ridges on head and orbit . . . . . 19  
 Bony ridges lacking on head and orbit . . . . .  
     . . . . . *Eupemphix pustulosus trinitatis* Boulenger

19. Warts in uniform closely-set pattern, snout projecting beyond mouth . . . . . *Bufo granulosus beebei* Gallardo  
Warts scattered irregularly, snout not projecting beyond mouth  
. . . . . *Bufo marinus* (Linnaeus)
20. Dermal fold running from eye posteriorly . . . . .  
. . . . . *Rana palmipes* Spix  
Dermal fold lacking . . *Pseudis paradoxus caribensis* Gallardo
21. Teeth lacking, head small . . . . . 22  
Teeth present, head large . . . . . 23
22. No white line down back, bright orange blotch in groin, belly yellow with brown marbling . . . . .  
. . . . . *Elachistocleis surinamensis* (Daudin)  
White line on back, no orange markings in groin, belly white or stippled grey . . . . . *Elachistocleis ovalis* (Schneider)
23. Six dermal folds along back and flanks . . . . .  
. . . . . *Leptodactylus sibilatrix* (Weid)  
Dermal folds fewer than six or lacking. . . . . 24
24. Single dermal fold on either side, males with prominent horny spur at base of first finger . . . . .  
. . . . . *Leptodactylus pentadactylus pentadactylus* (Laurenti)  
Dermal folds lacking, males lacking horny spur on first finger .  
. . . . . *Leptodactylus podicipinus petersi* (Steindachner)

### KEY TO LARVAL AMPHIBIANS OF TRINIDAD

Any attempt to construct a key to larval anurans must necessarily be a compromise, for there is such a wide range of structural variation between a freshly hatched tadpole and one which is undergoing metamorphosis. However, there is some argument for erection of such a key because many tadpoles are relatively long lived and, in each species, there is some fairly extended period where there will be no basic change in structure. The key which is here presented is based on examination of live and freshly killed material and is workable from that stage where the limb bud becomes differentiated into a distinct foot paddle to that stage prior to emergence of the fore limb, that is from stage VI to stage XVII, TAYLOR & KOLROSS.



# CHARACTERS USED IN KEY (Figure 5)

(a) Spiracle. In most tadpoles, the spiracle is sinistral in position and deflected upward on the side of the body. In Trinidad

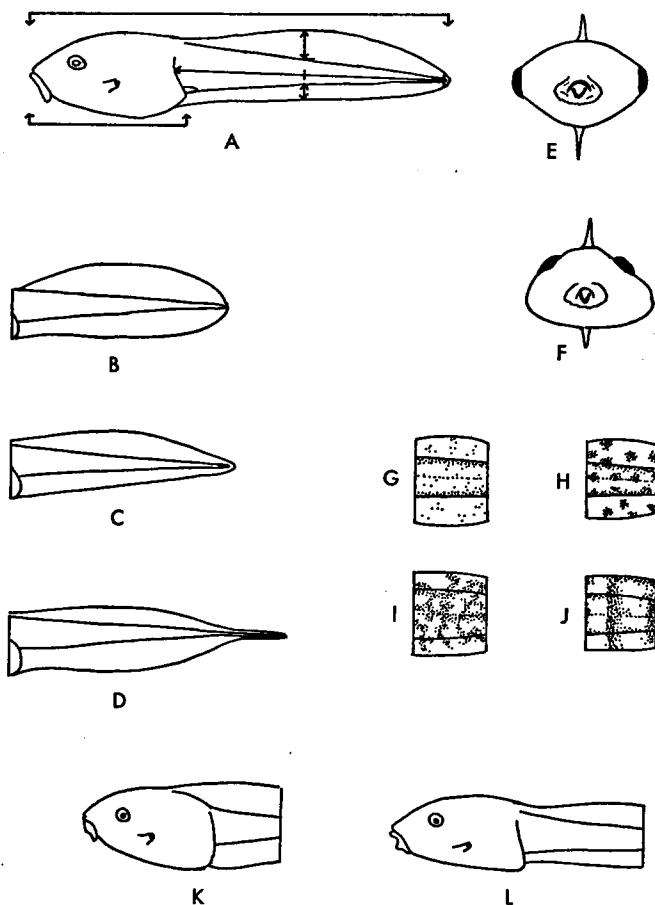


FIGURE 5. Some characters used in the Key to the tadpoles of Trinidad.

A. Body proportions. B. Rounded tail. C. Tapered tail. D. Tapered tail with filament. E. Lateral eyes. F. Dorso-lateral eyes. G. Diffuse pigment of tail. H. Spotted tail. I. Marbled tail. J. Barred tail. K. Origin of dorsal fin: from back. L. Origin of dorsal fin: from tail.

tadpoles, there are three atypical conditions. In *Phyllomedusa*, the spiracle is slightly to the left of a midventral position. In *Nototheca*, it is midventral but lasting only for a few days. In both species of *Elachistocleis* it is rectal in position.

(b) Labial teeth. These are horny teeth borne in rows on the upper and lower halves of the oral disc, and clearly one of the most useful characters in identification of tadpoles. The teeth are borne on ridges and may be either continuous, where the ridge extends from one side of the oral disc to the other, or broken into right and left sides.

In the description of the tadpoles the numbers 1 and 2, in the dental formula, refer respectively to continuous and discontinuous tooth rows. For example, in *Phyllobates trinitatis* the dental formula is 1 : 2/1 : 1 : 1.

(c) Lips. The oral disc is formed of the upper and lower lips and, frequently, there is no sharp demarcation between the structures. Both lips may bear rows of papillae.

(d) Jaws. In tadpoles, the larval jaws are horny, beaklike structures with serrated edges, supported by the rostral cartilages, with the lower jaw elevating within the upper.

(e) Fin width. Provided that measurements are confined to a point halfway along the length of the tail, the ratio of dorsal fin width to ventral fin width is a reliable character. However, it must be emphasized that the ratio is variable at different points along the tail.

(f) Position of eyes. Eyes may be either dorsolateral or lateral. This may be determined readily by viewing the animal from below. If the eyes can be seen, they are lateral.

(g) Tail shape. Tails may be either rounded, tapered, or tapered with a filamentous tip. In preserved material, it is possible that the tapered and tapered with a filamentous tip characters may not be readily separated. However, in living material, there is no problem for the filament can be seen beating independently of the rest of the tail.

(h) Origin of dorsal fin. The dorsal fin may extend onto the back or it may originate from the tail itself.

(i) Nares. Nares may be simple holes, or may have raised rims

with flaps partially occluding them, or there may be some other modification specifically referred to in the key.

(j) **Pigmentation.** The only pigmentation referred to in the key is that which persists after fixation of the tadpole in formalin, or formalin-containing fixatives, and only tail and fin pigmentation is used. Pigment may be diffuse, in the form of spots, marbled or barred.

#### KEY TO THE TADPOLES OF TRINIDAD

1. Spiracle sinistral . . . . . 4  
Spiracle not sinistral . . . . . 2
2. Spiracle ventral . . . . . 3  
Spiracle rectal, margin of oral disc smooth . . . . .  
. . . . . *Elachistocleis ovalis*  
Spiracle rectal, margin of oral disc denticulate . . . . .  
. . . . . *Elachistocleis surinamensis*
3. Labial teeth present . . . . . *Phyllomedusa trinitatis*  
Labial teeth absent . . . . . *Nototheca fitzgeraldi*
4. Upper lip with single tooth row . . . . . 5  
Upper lip with more than one tooth row . . . . . 6
5. Lips lacking papillae, mouth tubelike . . . . . *Hyla misera*  
Lips with papillae, mouth funnel-like . . . . . *Hyla minuta*
6. Upper lip with two tooth rows . . . . . 7  
Upper lip with more than two tooth rows . . . . . 8
7. Lower lip with three tooth rows . . . . . 11  
Lower lip with four tooth rows . . . . . 9
8. Upper lip with three tooth rows . . . . . *Phrynohyas zonata*  
Upper lip with four tooth rows . . . . . *Rana palmipes*
9. Dorsal fin twice as wide as ventral fin . . . . . 10  
Dorsal fin same width as ventral . . . . . *Hyla g. geographica*
10. Horny jaws typical, body rounded . . . . . *Hyla crepitans*  
Horny jaws with deep serrations at lateral ends, body flattened  
. . . . . *Amphodus auratus*

11. Eyes lateral . . . . .	12
Eyes dorsolateral . . . . .	14
12. Tail terminating in filament . . . . .	13
Tail not terminating in filament <i>Pseudis paradoxus caribensis</i>	
13. Nares with prominent U-shaped rim, tail irregularly barred . . . . .	<i>Hyla orophila</i>
Nares without prominent rim, tail spotted. . . . .	<i>Hyla rubra</i>
14. Tail rounded . . . . .	15
Tail tapered . . . . .	16
15. Width of dorsal fin to width of ventral fin 1:1, mid-ventral part of lip without papillae . . . . .	<i>Bufo granulosus beebeyi</i>
Width of dorsal fin to width of ventral fin 1½:1, mid-ventral part of lip with papillae. . . . .	<i>Bufo marinus</i>
16. Width of dorsal fin to width of ventral fin 1:1 . . . . .	17
Width of dorsal fin to width of ventral fin not 1:1 . . . . .	19
17. Tail with prominent spotting . . . . .	<i>Phyllobates trinitatis</i>
Tail unspotted, with diffuse pigment . . . . .	18
18. Second upper tooth row broken mesially. . . . .	<i>Leptodactylus podicipinus petersi</i>
Second upper tooth row continuous . . . . .	<i>Leptodactylus p. pentadactylus</i>
19. Dorsal fin originating from back . . . . .	20
Dorsal fin originating from tail . . . . .	21
20. Tail prominently spotted . . . . .	<i>Leptodactylus sibilatrix</i>
Tail unspotted . . . . .	<i>Hyla punctata</i>
21. Dorsal fin twice width of ventral fin . . . . .	<i>Hyla maxima</i>
Dorsal fin 1½ times width of ventral fin . . . . .	<i>Eupemphix pustulosus trinitatis</i>

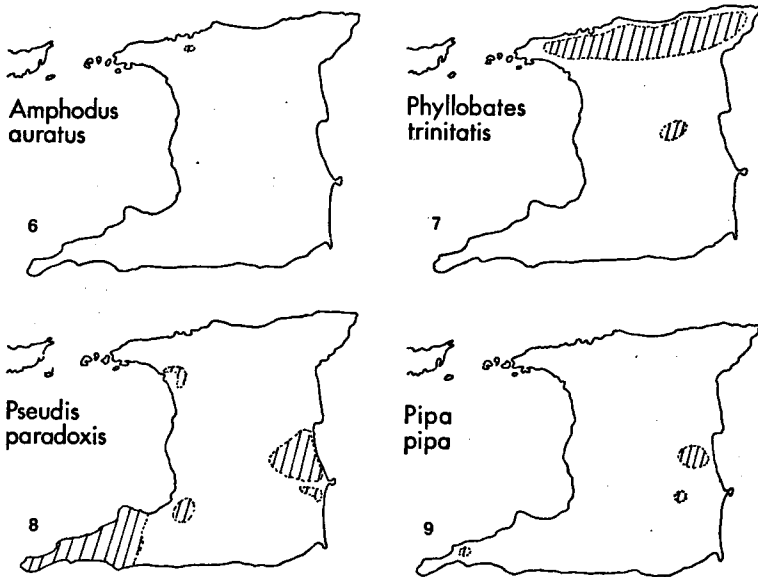
## DISTRIBUTION AND HABITAT PREFERENCE

With the exception of a few species, Trinidad amphibians do not show any peculiar distribution pattern and can be taken throughout the island, provided suitable habitat is available. Those which show

unusual distributions are the ones which display narrowest habitat preference.

Probably the most selective of habitats is *Amphodus auratus*, which has so far only been found in epiphytic bromeliads, particularly *Glomeropitcairnia* spp., on the summit of El Tucuche. It is tentatively suggested that this species is restricted to this area (Figure 6) at elevations of from 2000 feet upward to the summit. Why this species is restricted to this area must remain problematical, for there is considerable negative evidence for its non-occurrence on adjacent peaks Naranjo, Piedra Blanca, and other peaks farther east such as Morne Bleu and Aripo, all of which are of similar elevation, and all of which have a suitable bromeliad flora.

Another species equally selective of habitat but of much wider distribution is *Phyllobates trinitatis*. This species is one of the few diurnal ones and is terrestrial, and its typical habitat is damp ground



FIGURES 6-9. Distribution of *Amphodus auratus*, *Phyllobates trinitatis*, *Pseudis paradoxus*, and *Pipa pipa*.

or rocks at the edges of streams in heavily forested areas. It is also found occasionally in caves. Its range includes most of the Northern Range, wherever there is suitable habitat, as well as the Central Range (Figure 7).

By nature of their aquatic habitats, *Pipa pipa* and *Pseudis paradoxus* have peculiar distributions in the island, and are restricted to those areas where reasonably permanent water is available.

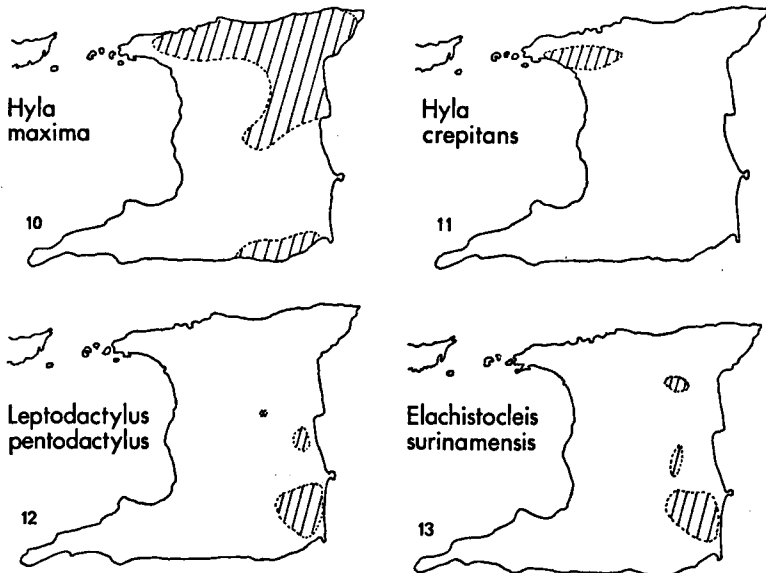
Distribution of *Pseudis* is much clearer than that of *Pipa*, simply because *Pseudis* is vocal, has a particularly loud call, and can readily be recorded simply by its call. Its distribution (Figure 8) is throughout the Nariva Swamp on the east, extending in a broad band to the south and west as far as Icacos. It is particularly common in oilfield reservoirs. Up until 1957, this species had not been recorded in the Caroni drainage although there were available extensive areas of suitable habitat around the edges of the Caroni Swamp. Some two dozen individuals were introduced accidentally into the fish ponds at Bamboo Grove in 1957 and have since spread into the area around the Caroni Swamp.

Distribution of *Pipa* is probably similar to that of *Pseudis* but this remains pure speculation. Owing to the softness of the call, and the fact that it is made under water, only few vocal records are available. However, specimens have been taken in the Cedros area and in the Nariva Swamp, and at Rio Claro.

Of the Hylidae, with the exception of *Amphodus* already discussed two species show unusual distribution. One of them, *Hyla maxima*, shows a fairly narrow range of habitat preference, being found always near rivers, dwelling in trees and bamboos at the water's edge. Its distribution is throughout the Northern Range, from the sea coast to elevations up to 1200 feet, and in the Central Range, and the eastern portion of the Southern Range, wherever there is suitable habitat (Figure 10). *Hyla crepitans* on the other hand, which shows no particular habitat preference, appears to be confined to the lower reaches of valleys of the western half of the Northern Range, extending as far east as the Arima valley, but not out onto the Caroni Plain (Figure 11). There appears to be no rational explanation for this distribution. Most of the other Hylidae are distributed throughout the island at lower elevations on the plains, but also extending into the valleys of each mountain range, provided that suitable

preferred habitat is available. Thus, at the edge of a forest, may be found *Hyla misera* and within a few yards, *Hyla minuta*. *Nototheca* appears to be the only hylid with really wide distribution, extending well up into the mountains, and this may be because of its peculiar breeding habits with attenuated larval life.

Buonids do not show any special distribution, except as related to habitat preference, and both species are confined to lower elevations. Of the three species of Leptodactylidae, two are found throughout the island at lower elevations, and in a wide range of habitats. *Leptodactylus sibilatrix* is more commonly found in open



FIGURES 10-13. Distribution of *Hyla maxima*, *Hyla crepitans*, *Leptodactylus pentadactylus*, and *Elachistocleis surinamensis*.

cleared areas, while *L. podicipinus petersi* is found usually in heavily shaded conditions. *L. p. pentadactylus* was only very recently re-discovered in Trinidad at five separate locations in the Mayaro area, and is assumed to be confined to this area (Figure 12). The two microhylids also show a similar habitat preference and distribution (Figure 13) to that of *L. sibilatrix* and *L. p. pentadactylus*. *Elachistocleis*

*surinamensis* is found in the same general area as *L. p. pentadactylus*, while *E. ovalis* is a frog of open country, being commonly heard or found with *L. sibilatrix*. Nothing definite can be said about the single ranid species, *Rana palmipes*, for it has been collected only at three localities, two in the Mayaro area and one in the Tamana Caves in the Central Range.

TABLE 1 is a summary of the records of species collected or observed in the seven areas studied. In areas 2, 3, 4, 5 and 6, it will be noted that from 13 to 16 of the 25 species have been recorded and that unrecorded species are largely those with narrow habitat preference. Each of these areas is in itself basically quite different from the others with regard to topography, rainfall and availability of habitat and yet each supports the majority of species. Areas 1 and 7 represent extremes. Area 1 is a typically forested mountain top with little or no standing water, while area 7 is a weakly brackish water swamp area with occasional freshwater pools in the rainy season, so that suitable conditions for typical spawning do not obtain. It is significant that in area 1 the four species found all have special spawning habits. *Amphodus* lays its eggs in the water collected in the leaf bases of bromeliads, while *Nototheca* incubates its eggs in a brood pouch on its back and releases its tadpoles at an advanced state of metamorphosis also into water in bromeliads. Both *Phylllobates* and *Eleutherodactylus* lay their eggs on the ground. In the former species, the larvae are transported on the backs of males to streams or temporary pools while in the latter, the egg develops directly into a froglet.

In areas 2 to 6, it was also possible to determine minor preferences within any one habitat. As a general rule, in the case of the Hylidae, larger species such as *Hyla maxima*, *H. crepitans*, and *Phrynohyas zonata* are tree-dwelling forms which only come down onto the ground to spawn. Smaller forms, including *H. misera*, *H. minuta*, *H. orophila*, *H. rubra* and *Nototheca*, are all bush-dwelling forms remaining close to their spawning sites. Two exceptions are found in the Hylidae; *Phyllomedusa trinitatis* and *Hyla g. geographica* are both moderately large tree frogs which normally dwell in bushes, the former in bushes near temporary ponds, and the latter in bushes near the edges of streams.



TABLE 1

Species	Areas						
	1	2	3	4	5	6	7
<i>Hyla maxima</i>	—	x	x	x	x	—	—
<i>Hyla minuta</i>	—	x	—	x	x	x	x
<i>Hyla misera</i>	—	x	x	x	x	x	x
<i>Hyla rubra</i>	—	x	x	x	x	x	x
<i>Hyla punctata</i>	—	x	—	x	x	—	—
<i>Hyla g. geographica</i>	—	x	x	x	—	x	—
<i>Hyla crepitans</i>	—	x	x	—	—	—	—
<i>Hyla orophila</i>	—	—	—	—	x	x	—
<i>Phrynohyas zonata</i>	—	x	x	x	x	x	x
<i>Phyllomedusa trinitatis</i>	—	x	—	x	x	x	x
<i>Amphodius auratus</i>	x	—	—	—	—	—	—
<i>Nototheca fitzgeraldi</i>	x	—	—	—	—	—	—
<i>Eleutherodactylus urichi</i>	x	x	—	x	x	x	—
<i>Pseudis paradoxus caribensis</i>	—	—	x	—	x	x	x
<i>Phyllobates trinitatis</i>	x	x	—	—	—	—	—
<i>Leptodactylus sibilatrix</i>	—	x	x	x	x	x	x
<i>Leptodactylus podicipinus petersi</i>	—	x	x	x	x	x	x
<i>Leptodactylus p. pentadactylus</i>	—	—	—	—	x	—	—
<i>Bufo marinus</i>	—	x	x	x	x	x	x
<i>Bufo granulosis beebei</i>	—	—	x	—	—	—	—
<i>Eupemphix pustulosus trinitatis</i>	—	x	x	x	x	x	x
<i>Pipa pipa</i>	—	—	—	—	x	x	—
<i>Rana palmipes</i>	—	—	—	—	—	—	—
<i>Elachistocleis ovalis</i>	—	—	x	x	x	x	—
<i>Elachistocleis surinamensis</i>	—	—	—	x	—	—	—

**Pipa pipa** (Linnaeus)

Pl. IIa

*Pipa pipa*: PARKER 1933.

Adult: A large aquatic frog, measuring up to about 200 mm from snout to vent. Snout in profile flat and truncate, from above broadly pointed with rounded tip, canthus rostralis quite indistinct, head very flat and much wider than long, skin only very loosely attached to cranium, eyes very small and set widely apart, tympanum obscured, body about four times as broad as thick, hind limbs flattened and massive, mouth wide with dermal tassles at angles of jaw and one just below upper jaw. Upper surfaces with uniformly arranged pattern of fine tubercles, and with slightly larger warts

arranged in four vague lines down back. Belly smoother but with similar pattern of fine tubercles. Fingers long and terminated by star-shaped sensory discs, toes fully webbed. Colour of upper surfaces pale brown with darker brown mottling, ventral surfaces brownish gray with some irregular cream blotches and with numerous small brown or black flecks. Tongue lacking.

**Voice:** A loud click made under water. Will call in response to a whistle of a fixed frequency.

**Habitat:** Water, in forests and swamps.

**Distribution:** Common in the Nariva Swamp but also recorded from Rio Claro, Mayaro and Cedros (Figure 9). Because of its habits, this species is not readily taken and it is possible and likely that it is more widely ranging than records suggest.

**Spawning:** Several specimens have been maintained in captivity but actual spawning or hatching has not been observed. RABB e.a. 1960a, 1960b and 1963 has given a thorough account, however, of breeding.

### **Phyllobates trinitatis** Garman

Pl. IIb

*Prostherapis trinitatis*: MOLE & URICH 1894.

*Phyllobates trinitatis*: ROUX 1926; LUTZ 1927; PARKER 1933; BEEBE 1952.

**Adult:** A small ground dwelling frog, males measuring 25 mm, females 28 mm from snout to vent. Snout in profile rounded, from above pointed, mouth slightly inferior, canthus rostralis distinct, eyes large but not particularly prominent, tympanum small, about one-third diameter of eye, both dorsum and ventrum smooth, webbing lacking in both hands and feet, digital discs present on fingers and toes, discs much wider than long, each disc with a pair of scale-like scutes on upper surface, colour of black brown with irregular brown markings or blotches anteriorly and medially, a dark brown to black stripe running from snout, through eye, to break into two

stripes in the flanks, the upper of which runs to the vent and upper surfaces of thigh, the lower of which runs to the groin and may be continuous with an irregular stripe in the anterior surface of the thigh. Dorsal surfaces of limbs pale brown with dark brown blotches or bars. Under parts pale cream to white except below jaws, skin below jaws of males black, females bright yellow. Pupil horizontal, iris black. Tongue narrow, thick, pear-shaped and free posteriorly.

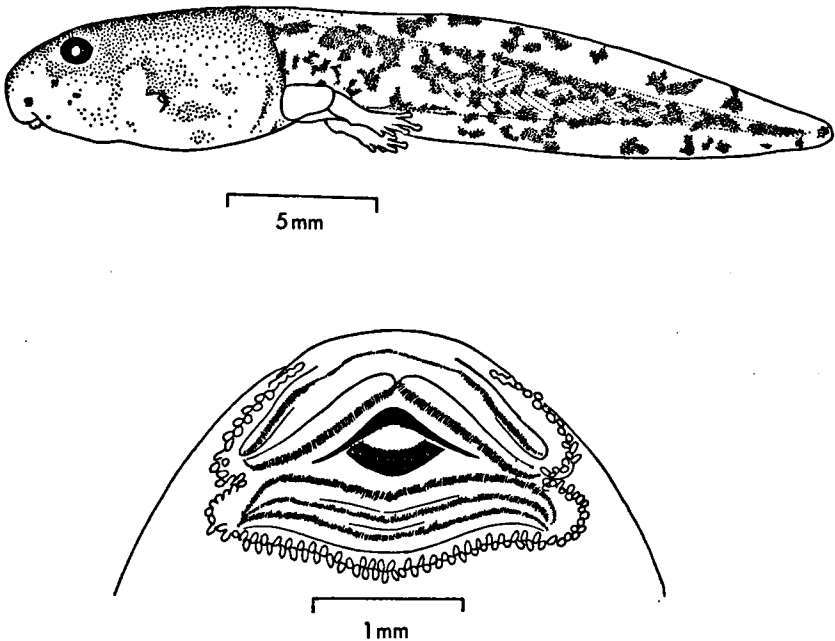


FIGURE 14. *Phyllobates trinitatis* Garman.

**Tadpole:** Maximum length 35 mm. Body length to total length 1:3.5. Body wider than deep with a flattened belly. Dorsal fin originating from tail. Width of dorsal fin to ventral fin 1:1. Tail tapered. Nares simple with unpigmented rim, opening laterally and lacking flap. Spiracle sinistral. Stirn organ obscure. Eyes dorsolateral. Oral disc simple, with double row of papillae. Dental formula 1 : 2/1 : 1 : 1.

Jaws typical. Colour variable shades of brown, lighter on the belly. Tail with irregular brown or black spotting. Lateral line system obscure.

**Voice:** A sustained peep-peep-peep -. This species is diurnal.

**Habitat:** Somewhat variable, from damp forest floor to rocks at edges of small mountain streams, always in heavily shaded areas. Common at the mouths of caves, and particularly common at Tamana Caves.

**Distribution:** Found throughout the Northern Range (Figure 7) from sea level to the highest elevations. Owing to severe denudation of the southern slopes of the Northern Range between St. Joseph and Diego Martin, this species is found only in isolated pockets where adequate habitat still obtains.

**Spawning:** Spawning has not actually been observed but enough observations have been made to reconstruct the essential features. Breeding takes place throughout the year provided that water is available in the habitat. Males change from their normal colouration to jet black and call repeatedly from small prominences such as rocks or logs. On the approach of a ripe female, the male performs an elaborate series of movements about her leading her to some accustomed crevice where actual mating probably takes place. Eggs are laid on the underside of leaves or in crevices and there may be up to 12, measuring 3.5 mm in diameter. Males stay with the eggs until they hatch, about three weeks after which the tadpoles mount the back of the male and are transported to water. Males also display to other males and occupy territories.

**Natural history of tadpoles:** Under natural conditions, tadpoles dwell always in running water but they can be raised easily in aquaria. Diet varies with the environment. In mountain streams where there is virtually little or no organic matter in suspension, tadpoles may subsist on organic matter on the substratum or rocks. In the Tamana Caves, densities of several thousand per square meter subsist in water hardly able to cover them on a diet of bacteria and any organic material washed out of the guano in the caves. Pigmentation of the tail tends to be extremely variable. Tadpoles from the caves have more prominent spotting than those from exposed streams. Under aquarium conditions, tadpoles emerge in eight weeks.

**Phyllomedusa trinitatis** Mertens

Pl. IIIa

*Phyllomedusa burmeisteri*: MOLE & URICH 1894; PARKER 1933; BEEBE 1952.*Phyllomedusa trinitatis*: MERTENS 1926; FUNKHOUSER 1957; KENNY 1966.

**Adult:** A large bush dwelling tree frog, males measuring 79 mm, females 90 mm from snout to vent. Snout in profile sloping, from above acuminate, canthus rostralis distinct and angular, eyes large and prominent, tympanum small, about one-third diameter of eye. Parotid gland present but indistinct and forming a narrow elongate rounded ridge dorso-laterally behind eyes, dorsum generally smooth but with a few scattered tubercles, belly and ventral surfaces of forearm and thigh roughly granular, palm of hand and sole of foot tubercular, chest smooth, skin under chin granular, webbing absent in hands and feet, discs on fingers and toes roughly oval in shape, discs on third and fourth fingers slightly larger than discs on fourth and fifth toes. First toe longer than second and third and opposable, neither fingers nor toes fringed. Dorsum and upper surfaces of limbs bright grass green, belly dirty white to pinkish white on limbs, a white diamond-shaped blotch on chest. Green colour of dorsum extends downwards as irregular bars or blotches on flanks. Pupil a verticle ellipse, iris black with irregular orange gold flecks. Tongue thick and pear-shaped, entire, and free on sides and posteriorly. Buccal cavity white.

**Tadpole:** Maximum length 65 mm. Body length to total length 1:3.5. Body as deep as wide. Dorsal fin originating from tail. Width of dorsal fin to width of ventral fin 1:3. Tail tapered and terminating in a slender filament. Nares simple, unpigmented, lacking flap and opening anteriorly. Spiracle to left of mid-ventral position. Stirn organ prominent, particularly in early stages. Eyes lateral in position and with prominent gold flecks. Oral disc typical with double row of papillae, and with triangular-shaped papillae in angles of lips. Some papillae bearing teeth. Dental formula 1 : 2/2:1:1. Jaws typical. Colour pale olive with silverish sides and belly. Ventral fin with prominent cluster of black spots which expand in the dark to form a black bar across the tail. Lateral line prominent.

**Voice:** A soft "puck" repeated at intervals of up to about 15 minutes. Males also have a special mating call which is made on the ground, consisting of a much softer "huh-huh-huh—" repeated at intervals of a few seconds. Both sexes are vocal but the female's voice is much softer and higher pitched.

**Habitat:** A bush dwelling frog commonly found in slender bushes at the edges of ponds at lower elevations, generally in fairly open country, but also in forests.

**Distribution:** This species is found throughout Trinidad except in the mountains, wherever its habitat is available.

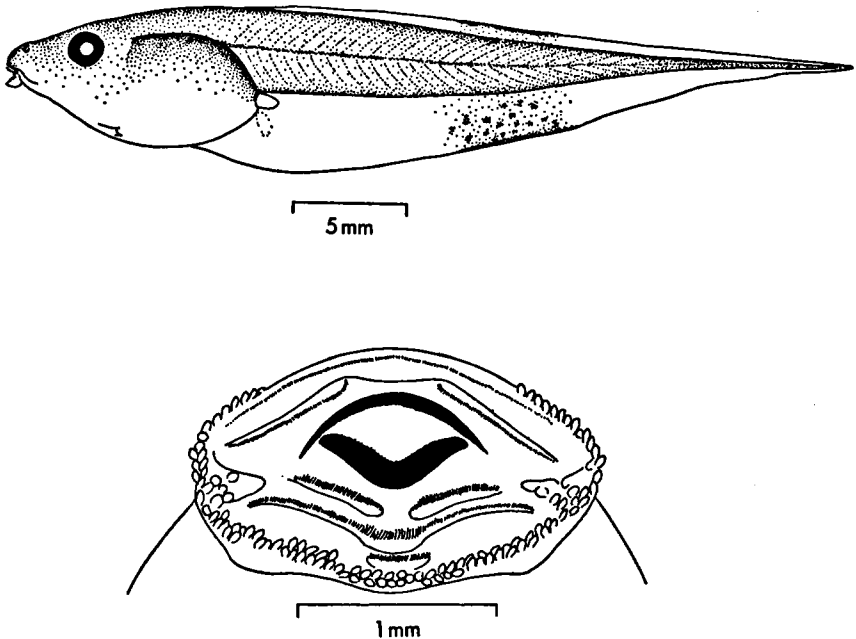


FIGURE 15. *Phyllomedusa trinitatis* Mertens.

**Spawning:** Spawning takes place from May to December and occasionally into the dry season. Amplexus usually takes place on

the ground after which the pair move onto suitable bushes overhanging water. Leaves are folded into a tube into which the eggs are laid. Up to 600 eggs, measuring 3 mm are laid. Larvae hatch in 7 to 8 days and fall into the water below. A complete account of nest building is given by KENNY (1966).

**Natural history of tadpoles:** Larvae usually live in midwater where they filter feed on the phytoplankton. Of particular interest is the use of the tail filament which is beaten continuously to maintain the tadpole in a head up position. Under ideal aquarium conditions, froglets emerge in 12 weeks. When froglets first emerge, they are a dull olive colour, somewhat darker than the tadpoles, but after a few days this changes to a rich plum colour with black bordered orange discs or blotches on the flanks. There is a diurnal change of colour from this at night to olive green during the day, lasting for about five weeks, after which the adult colouration develops and persists.

### **Eleutherodactylus urichi (Boettger) Pl. IIIb**

*Hylodes urichi*: BOETTGER 1894; MOLE & URICH 1894; LUTZ 1927.

*Eleutherodactylus urichi*: PARKER 1933; BEEBE 1952.

**Adult:** A very small bush dwelling, tree frog. Males measuring 21 mm, females 23 mm snout to vent. Head comparatively large, snout in profile rounded, from above pointed, canthus rostralis a sharp ridge, eyes large and prominent, tympanum relatively small, about one-third diameter of eye, skin on back rough, on belly granular, webbing lacking in both hands and feet, discs on fingers wider than long, discs on toes roughly circular, fifth toe longer than third, colour very variable, from pinkish white to dark brown, occasionally brick red, occasionally also with dark brown stripe down back, with pale flanks and upper limb surfaces, belly finely mottled with brown and white, limbs and flanks sometimes with brown bars, anterior and posterior surfaces of thighs bright carmine red. Pupil a horizontal ellipse, iris black, upper portion a bright electric blue. Tongue relatively narrow but thick and heart-shaped with a notch posteriorly, and extensively free.

**Voice:** A short high pitched "peep", rather like the noise produced by hitting a bottle with a spoon, sometimes interspersed with an urgent 'click'.

**Habitat:** Bushes or on ground in forest usually, but occasionally in bushes in open country.

**Distribution:** Throughout Trinidad from sea level to the highest elevations. Probably the most ubiquitous of Trinidad amphibians.

**Spawning:** Not observed. Eggs are laid on the ground and develop directly into a froglet.

***Amphodus auratus* Boulenger**

Pl. IVa

*Amphodus auratus*: PARKER 1933.

**Adult:** A small bromeliad-dwelling tree frog, males measuring 29 mm, females 35 mm from snout to vent. Snout in profile sloping slightly, snout from above pointed with blunt tip, canthus rostralis distinct, eyes not particularly large nor very prominent, tympanum small, less than one-third diameter of eye, body very flattened, dorsum smooth, belly and ventral surfaces of thighs granular, webbing lacking in hands, present but very much reduced between toes, discs on fingers roughly circular and larger than discs on toes which are oval-shaped and longer than wide. Colour of back dark brown with two iridescent yellow green stripes which originate on the head and which run backwards to fade slightly in front of the vent on either side. On the head these stripes are irregular and widen behind the eyes enclosing an irregular brown blotch. Flanks and upper surfaces of limbs cream with fine brown flecks, belly and other parts pale cream, overall translucency. Pupil horizontal ellipse, iris metallic green and black. Tongue large, flat and entire, roughly heart-shaped, not very free laterally or posteriorly. Lower jaw with series of fine bony tooth-like serrations. A single subgular vocal pouch.

**Tadpole:** Maximum length 40 mm. Body length to total length 1:2.5. Body very much flattened, belly flat. Dorsal fin originating from tail. Width of dorsal fin to width of ventral fin 2:1. Tail tapered with ventral fin reduced anteriorly. Nares opening anteriorly with pigmented rims. Stirn organ obscured. Spiracle sinistral but directed



posteriorly. Eyes dorso-lateral, black and overlaid with silver and pink flecks. Oral disc large and suctional, not folded laterally. Papillae in double row at edge of lip, and multiple laterally. Dental formula  $1 : 1/1:1:1:1$ , but with irregular patches of teeth below fourth lower tooth row. Jaws atypical, lateral parts of upper jaw with coarser serrations. Colour generally pale pinkish brown above and pale cream below. No prominent markings on tail. In later stage of the tadpole, adult markings in the form of two iridescent green stripes appear on the back.

Voice: Unknown.

Habitat: Only collected from bromeliads, particularly *Glomero-pitcairnia*.

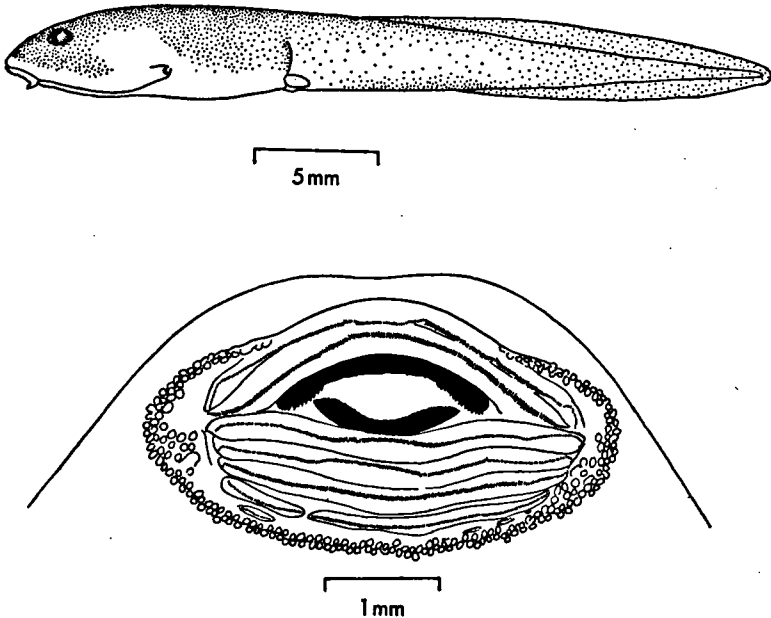


FIGURE 16. *Amphodius auratus* Boulenger.

Distribution: Recorded only from El Tucuche between elevations of 2000 feet to 3072 feet (Figure 6). Extensive examinations

of bromeliads from adjacent peaks of the same approximate elevations have not yielded a single specimen.

**Spawning:** Virtually nothing is known of spawning or general natural history of this animal. Both frogs and tadpoles have been collected all year round suggesting that spawning may take place throughout the year; however, the maximum number of tadpoles collected at one time from a bromeliad was only 5, and each of them was at a different stage of development. Perhaps few eggs are laid at a time. Both tadpoles and frogs can be maintained without difficulty at lower elevations but all attempts to induce spawning or calling have been unsuccessful.

**Natural history of tadpoles:** Tadpoles live, as the frogs do, in the water which collects in the leaf bases of bromeliads, and presumably have a diet of organic matter accumulating there. The fact that tadpoles will take meat or bits of earthworm, and the atypical jaws, might suggest that they are carnivorous. This is probably not so, however, for the gut is typical of anuran larvae.

***Nototheca fitzgeraldi* (Parker)**

Pl. Vb

*Gastrotheca fitzgeraldi*: PARKER 1934; BEEBE 1952.

**Adult:** Males 21 mm, females 25 mm from snout to vent. Snout short and in profile rounded. Snout from above rounded. Head three times width of eye. Canthus rostralis obtuse. Eyes large and prominent with horizontal elliptical pupil. Iris predominantly gold or brassy with black patches anteriorly and posteriorly, continuous with an irregular black streak running from the canthus rostralis through the eye onto the flanks. Tympanum small, about one-third the diameter of the eye. Back and upper surfaces of limbs generally smooth. Belly and postero-ventral surfaces of thigh granular. Fingers entirely free, first finger longer than second and same length as third and fourth. Webbing in toes reduced or lacking. Discs large and slightly wider than long. Disc on fourth toe as large as that on fourth finger. Tongue small, round and entire, and only slightly free on sides and posteriorly. Vocal sac small, sub-gular, smooth and unpigmented. Colour generally light brown on upper surfaces, whitish and translucent below, with a prominent but irregular black streak

running along canthus rostralis through the eye and spreading onto the flanks, and with irregular dark brown spots or marblings on the upper surfaces. Females with a dorsal brood pouch consisting of two folds of skin originating on either side of the back about midway along the back, and extending posteriorly toward but not as far as the rump.

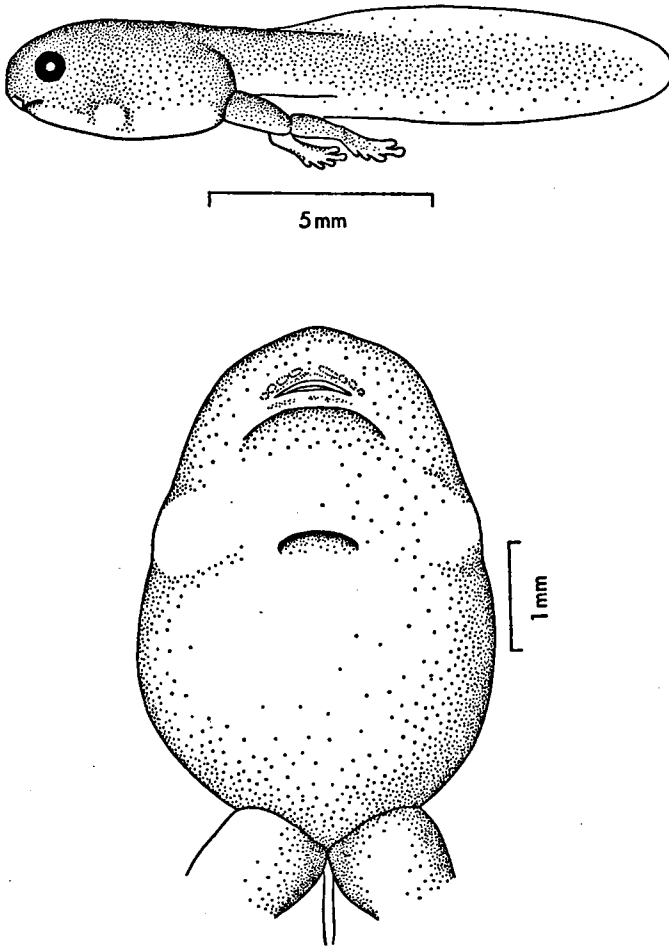


FIGURE 18. *Nototheca fitzgeraldi* (Parker).

**Tadpole:** Maximum length 15 mm. Body length to total length 1:3. Body wider than deep and somewhat flattened ventrally. Dorsal fin originating from tail. Width of dorsal fin to width of ventral fin 1:1. Tail rounded. Nares obscured. Spiracle mid-ventral, consisting of a simple slit without a spout. Eyes lateral, iris black ringed with gold. Oral disc lacking, mouth consisting of a simple inferior and transverse slit surrounded by small tubercles. Labial teeth lacking. Jaws present at some stages but never horny. Body generally brown on back with cream or white belly. Tail and fins unpigmented. Tadpoles normally "hatch" at an advanced stage of metamorphosis when the hind limbs are well developed and the forelimbs appear as prominent bulges on either side of the body behind and beneath the eyes.

**Voice:** A soft click or chirp repeated at frequent intervals, and usually only within the first hour after sunset. Calls throughout the year.

**Habitat:** Bush dwelling, particularly in leaf bases of bromeliads and aroids, and mostly forest dwelling.

**Distribution:** Presumed to be throughout Trinidad from sea level to the summit of the highest peaks. Recorded from several places in Northern Range including the summits of El Tucuche, Naranjo and Aripo, Aripo valley, the mouth of Grand Riviere River, Matelot, Rio Claro, Mayaro and from Tamana Hill in the Central Range where it is particularly common.

**Spawning:** Not observed. PARKER claims that females lay two large eggs measuring about 4 mm in diameter. A female with six eggs was collected in the present survey, and delivered six tadpoles ten days after capture. After the tadpoles leave the female, the brood pouch rapidly regresses to the pair of skin folds described above.

**Natural history of tadpoles:** Free tadpole life is short, metamorphosis being completed within five days of leaving the parent. When "hatched" the tadpoles are still heavily yolked and do not feed. As tadpoles do not feed, they can tolerate severe crowding. At Tamana, 26 tadpoles were collected from the leaf bases of one giant aroid, *Xanthosoma*, in a volume of water of about 200 ml.

**Hyla rubra** (Daudin)

Pl. IVb

*Hyla rubra*: PARKER 1933; BEEBE 1952.

**Adult:** A small bush dwelling tree frog, males measuring 31 mm, females 39 mm from snout to vent. Snout long and in profile rounded. Snout from above pointed with rounded tip. Interorbital space  $1\frac{1}{2}$  times diameter of eye. Canthus rostralis angular. Eyes prominent and about  $\frac{1}{4}$  width of head, and with horizontal pupil. Iris brown with network of fine gold flecks, with the upper margin of pupil predominantly gold, and with a black bar running horizontally through it continuous with a black stripe running along side of body. Tympanum about  $\frac{1}{2}$  diameter of eye. Back and upper surfaces of limbs smooth to finely granular. Vocal sac, belly and postero-ventral surface of thigh coarsely granular. Fingers mostly free but occasionally with some webbing. Toes moderately webbed but with the two phalanges of first and fourth toes free. Discs on fingers and toes wider than long. Disc on fourth finger slightly larger than that on fourth toe. Tongue large, flat, rounded with a notch posteriorly, and extensively free laterally and posteriorly. Vocal sac sub-gular and yellowish white. Upper surfaces of males yellowish brown. Upper surfaces of females brown. In both sexes two brown streaks running backward from each eye enclosing a lighter brown streak. Belly white to yellowish white, with groin, anterior and postero-dorsal surfaces of thighs and calves yellow with thin dark brown mottling or marbling.

**Tadpole:** Maximum length 40 mm. Body length to total length 1:3.5. Body deeper than wide. Dorsal fin originating from back. Width of dorsal fin to width of ventral fin 1:1. Tail tapered and with filament. Nares simple, without flap, opening dorsally and with pigmented rim. Stirn organ obscured. Spiracle sinistral. Eyes lateral, black with fine gold, bronze or occasionally reddish flecks. Oral disc large, with single row of papillae dorsally and ventrally and with multiple rows laterally. Dental formula 1 : 2/1:1:1. Horny jaws typical. Head and body dark brown above and silverish on sides and below. Prominent black stripe running along snout on either side through eye and along base of tail in lateral line. Fins and tail with

prominent dark brown to black spots. Lateral line system not prominent. Density of all pigmentation variable with environment.

**Voice:** A soft "eh-eh" repeated at intervals of a few seconds, occasionally interspersed with a softer and more abbreviated "chuck chuck-chuck". Calls throughout the year, but large choruses are only typical of the rainy season.

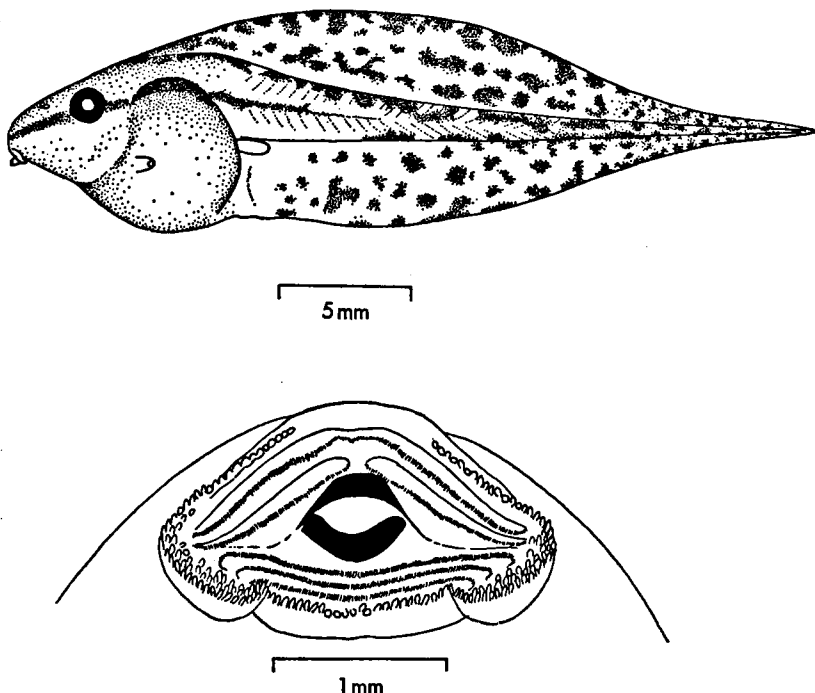


FIGURE 17. *Hyla rubra* (Daudin).

**Habitat:** Bush dwelling, usually in open country and near standing water. Occasionally in second growth forests but rarely in dense forest.

**Distribution:** Throughout Trinidad where habitat available. One of the more common of Trinidad Hylidae.

**Spawning:** Amplexus takes place usually on the ground or low bushes at the edge of shallow temporary ponds or ditches, or rice fields, usually within the first few hours of darkness. Eggs are black and white, about 1 to 1.5 mm in diameter, and are deposited in a mass of jelly which usually floats and is adhesive. Eggs are more frequently deposited at the edge of water among bushes where the mass adheres. Development is rapid; tadpoles hatch and are free-swimming within 24 hours. Spawning has been observed throughout the rainy season and as late as the end of January.

**Natural history of tadpoles:** Tadpoles normally browse on substratum but are capable of mid-water suspension feeding, and of surface feeding. Unlike other hylid species with tail filaments, the filament is not beaten continuously. Duration of larval life under laboratory conditions is about 6 weeks.

### ***Hyla geographica geographica* Spix      Pl. Va**

*Hyla spectrum*: LUTZ 1927.

*Hyla punctatissima*: PARKER 1933.

**Adult:** A bush dwelling tree frog, males measuring 58 mm, females 67 mm snout to vent. Snout long and in profile somewhat rounded at its tip. Snout from above pointed. Interorbital width about  $1\frac{1}{4}$  times diameter of eye. Canthus rostralis indistinct except near eye where it becomes slightly angular. Eyes large and prominent, pupil a horizontal rhomboid. Iris greyish brown. Lower eyelid transparent but with fine meshwork of mostly parallel running gold lines. Free edge of lower eyelid a solid gold line. Tympanum slightly wider than  $\frac{1}{2}$  diameter of eye. Upper surfaces generally granular. Ventral surfaces coarsely granular. Webbing in hand slightly reduced and only between second, third and fourth fingers. Webbing in toes complete. Discs on fingers roughly circular and about  $1\frac{1}{2}$  times the diameter of discs on corresponding toes. Discs on toes somewhat elongate. Tongue entire, free laterally and posteriorly, roughly bell shaped, and bright yellow. Vocal sac reduced. Colour variable. Frequently bright yellow or brownish yellow, occasionally dull reddish brown. Sometimes with a brown saddle across sacral region, or with narrow brown bands across entire back. Belly usually yellow with fine white spots mesially, and with irregular black roset-

tes merging into black marbling on the flanks. Vocal sac in males orange yellow. Anterior and postero-dorsal surfaces of thigh with scattered tubercles, and with dark brown to black marbling. Webbing in hands and feet almost always deep orange.

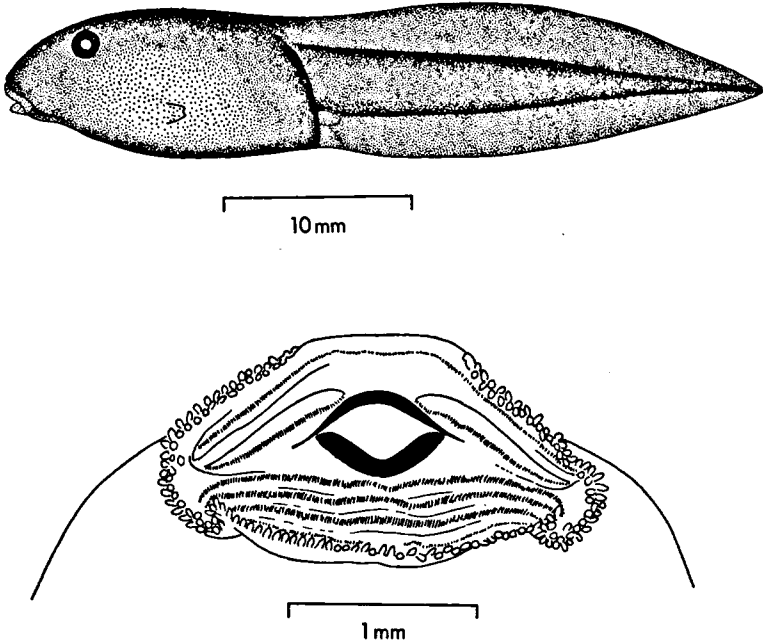


FIGURE 19. *Hyla geographica geographica* Spix.

**Tadpole:** Maximum length up to 75 mm. Body length to total length 1:2.5. Body wider than deep. Dorsal fin originating from back. Width of dorsal fin to width of ventral fin 1:1. Tail tapered. Nares simple, unpigmented and opening laterally. Stirn organ visible, particularly in smaller specimens. Spiracle sinistral. Eyes dorso-lateral, black with network of fine gold flecks. Oral disc large, typical, and with a double row of papillae. Dental formula 1 : 2/1 : 1 : 1 : 1. The fourth lower tooth row appears later in larval life. Horny jaws typical. Body, tail and fins uniformly black. At hatching, only the body and tail are pigmented, and the fins become



pigmented as the tadpole grows. Frequently, tadpoles have a bluish cast to the underside of the body. BOKERMANN (1963) figures *H. geographica* from Brazil.

**Voice:** A low pitched and very much muted rattle.

**Habitat:** Somewhat variable. Most frequently found in low bushes at edges of mountain streams at lower elevations. Occasionally found in small concentrations in swampy areas, or at the mouths of rivers and streams in slightly brackish conditions.

**Distribution:** Recorded from Maracas, Santa Cruz, Guanapo and Arima valleys, Tabaquite, Centeno, El Socorro, Valencia and Las Cuevas beach. It has not been recorded in the Southern Range but this area has not been collected as thoroughly.

**Spawning:** Natural amplexus was not observed but enough information is available from both field and laboratory observations to deduce the main features of spawning. Spawning takes place during the dry season. One large floating and adhesive jelly mass is deposited at the edges of streams, particularly in little backwaters, and frequently in amongst partially submerged vegetation. Eggs are about 2 mm in diameter and each is enclosed in a typical capsule of jelly, and are typically black and white. Development is rapid, the tadpoles hatching within 48 hours.

**Natural history of tadpoles:** Tadpoles show one peculiar behavioural pattern. They form dense schools in which there may frequently be a range of sizes of individuals, presumably from different spawnings. Typically they can be seen as a compact black mass floating at the surface, at irregular intervals breaking up and moving horizontally or vertically before reforming into another mass. The mass itself is constantly in motion with the peripherally placed individuals exhibiting vigorous swimming movements. The schooling behaviour usually persists through metamorphosis and the young froglets emerge onto vegetation in a mass. At first the tadpoles are completely black but within three or four days, change to golden brown to pinkish brown colour with a pattern of black spots on their backs, and with black webbing in the hands and feet. This colour pattern is gradually replaced over the next few weeks by the typical adult colouration.

**Hyla crepitans** Wied

Pl. XV

*Hyla crepitans*: MOLE & URICH 1894; ROUX 1926; LUTZ 1927; PARKER 1933; BEEBE 1952.

**Adult:** A medium sized tree frog, males measuring 61 mm, females 73 mm snout to vent. Snout in profile rounded, from above rounded, canthus rostralis distinct but rounded, eyes prominent, tympanum about two thirds diameter of eye, dorsum smooth, skin on abdomen and postero-ventral surfaces of thigh coarsely granular, skin under chin granular, webbing on hand between second and fourth fingers but very much reduced, webbing between toes reduced, third and fourth fingers and toes with slight lateral fringes, discs on fingers and toes circular, discs on fourth toes only slightly smaller than discs on second and third and on fourth fingers. Colour varies from greyish through pinkish white to golden brown on dorsum and upper parts of limbs, belly bright orange with orange bars running dorsally on flanks, a distinct brown cross on back. Pupil a horizontal ellipse, iris pale yellowish green with black outer margin. Tongue large, flat and notched posteriorly, tongue and interior of mouth cavity pale yellowish pink.

**Tadpole:** Maximum length 55 mm. Body length to total length approximately 2:3. Body wider than deep and belly flattened. Dorsal fin originating from tail. Width of dorsal fin to width of ventral fin 2:1. Tail tapered. Nares large, opening upward, lacking flap but with papillae mesially, and with pigmented rim. Stirn organ obscure. Spiracle sinistral. Eyes dorso-lateral and gold pigmented. Oral disc simple with single row of papillae, and much folded laterally. Dental formula 2 : 2/2 : 1 : 1 : 1, and with isolated patches of teeth on papillae in angles of labial funnel. Jaws typical. Colour olive brown on back, and dark mottled brown on flanks, belly spotted anteriorly, pale silver posteriorly. Prominent black line running along snout to eye. Tail bearing two dark stripes along upper margin of musculature and along lateral line. Tail and fins with diffuse and irregular spotting.

**Voice:** A loud low-pitched croaking rattle.

**Habitat:** Extremely variable. Commonly found on the ground, in bushes and in trees, always in fairly open country, rarely in thick forest. Extremely common in gardens around the University of the West Indies Campus and will frequently enter houses.

**Distribution:** This species, for reasons unknown, appears to be confined to the foothills and valleys of the southern slopes of the Northern Range from Diego Martin to Arima (Figure 11).

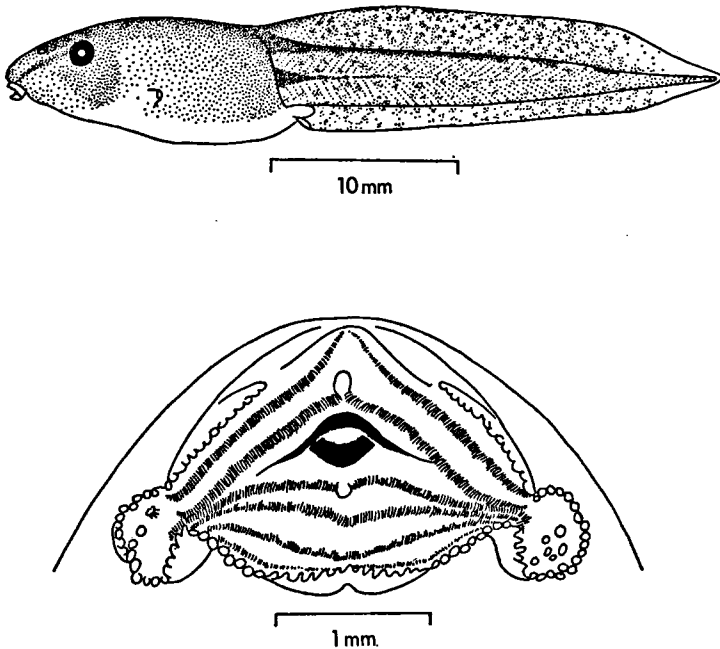


FIGURE 20. *Hyla crepitans* Wied.

**Spawning:** Spawning takes place throughout the year, provided standing water is available. Amplexus takes place on the ground or in water. The egg mass is free floating at the start and is non-adhesive. After about 24 hours, however, the eggs sink. Eggs measure about 2 mm and development is typical.

**Natural history of tadpoles:** Larvae are bottom dwelling, feeding on a diet of filamentous algae and organic matter. Under aquarium conditions, metamorphosis takes place in about 3 months.

**Note:** Distinctive features of *H. crepitans* are the remarkable colour change which it undergoes diurnally and its resistance to dessication even in direct sunlight. During the day the normal colouration changes to a very pale greyish white, and frogs may be seen lying exposed to the sun on walls or garden plants.

### ***Hyla punctata* (Schneider)**

Pl. VIB

*Hyla punctata*: PARKER 1933.

**Adult:** A small tree frog, males measuring 30 mm, females 35 mm snout to vent. Snout short, in profile truncate. Snout from above broadly rounded. Interorbital space only slighter greater than diameter of eye. Canthus rostralis distinct and angular. Eyes large and prominent with a horizontal pupil. Iris brown with fine gold reticulations, and with darker brown stripe running horizontally through it. Tympanum large, almost two thirds diameter of eye. All upper surfaces finely granular, belly and postero-ventral surfaces of thighs granular, with patches of larger tubercles. Webbing in forelimbs reduced, webbing in feet reduced, extending only to proximal end of last phalange but to the discs on the other toes. Discs slightly longer than wide, discs on fingers larger than discs on toes. Tongue flat and entire, roughly triangular in shape with rounded corners, wider than long, and extensively free laterally and posteriorly. Vocal sac subgular and pale whitish green. Dorsum pale translucent green with a red line, bordered by a yellowish streak, running posteriorly from the snout along the canthus rostralis, through the eye, and along the flanks. Back and upper surfaces with fine red spots and with clusters of fine red spots. At night the entire back becomes bright red.

**Tadpole:** Maximum length 40 mm. Body length to total length variable, from 1:3 to 1:4. Body somewhat wider than deep and flattened ventrally. Dorsal fin originating from tail. Width of dorsal fin to width of ventral fin  $1\frac{1}{2}$ :1. Tail tapered. Nares with prominent rim and with flap. Spiracle sinistral. Eyes dorsolateral, iris mainly gold. Stirn organ faintly visible. Oral disc typical with papillae arranged in a single row. Dental formula 1 : 2/1:1:1. Horny jaws

typical. Body dark greenish brown becoming lighter ventrally, tail uniformly translucent cream to pale orange. No prominent markings.

Voice: Like the noise produced by stroking a comb, very much amplified. Calls repeated frequently. In a chorus, a range of pitch of call can be heard. Both sexes vocal. This species has been recorded calling throughout the year.

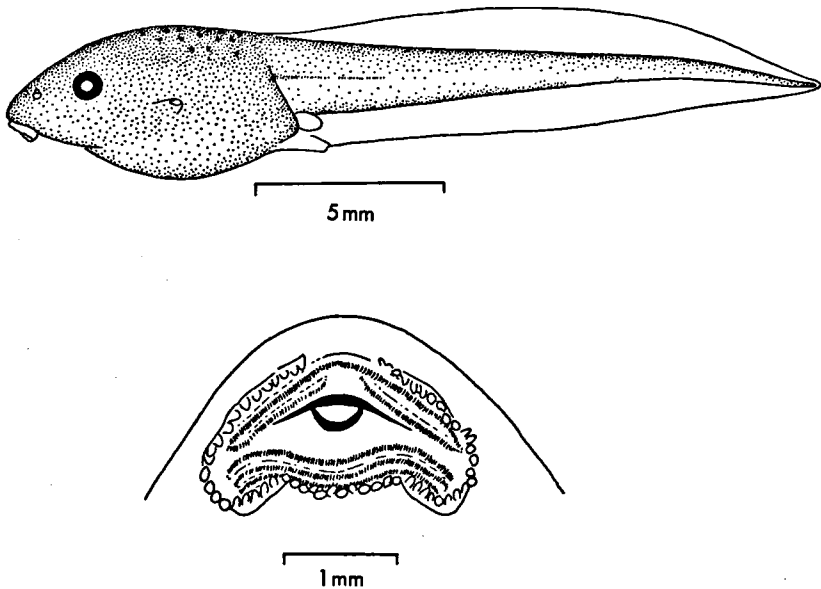


FIGURE 21. *Hyla punctata* (Schneider).

Habitat: Usually in grasses or bushes, and almost always over slowly moving water as may be found in choked ditches or rivers. Generally found in fairly open country and at low elevations.

Distribution: Presumed to be throughout Trinidad, but tending to be found in small isolated pockets where its typical habitat obtains.

Spawning: No direct observations were made on spawning.

Eggs measure about 1.5 mm, are typically black and white, and are deposited in a single mass of floating and adhesive jelly. Development comparatively rapid, tadpoles hatching within 48 hours. No definite information is available on spawning seasons but one pair was spawned in captivity in January of one year after most other hylids had ceased spawning. At one locality, tadpoles were found in March and April in the middle of the dry season.

**Natural history of tadpoles:** Not well known. Under certain circumstances, tadpoles can be seen lying in shallow water in the typical habitat of the adult. Under laboratory conditions, tadpoles behave as bottom feeders.

### ***Hyla misera* Werner**

Pl. VIa

*Hyla goughi*: BOULENGER 1911; PARKER 1933.

*Hyla misera*: LUTZ 1927; RIVERO 1961.

*Hyla misera* is one of the problem frogs of Trinidad. LUTZ (1927) included it in his list of Trinidad species, suggesting that it was conspecific with a common Trinidad species *Hyla goughi*, and while PARKER (1933) did not include it in his list, he agreed that these two species may be conspecific. The only other reference to *H. misera* from Trinidad is that of RIVERO (1961) based on M.C.Z. specimens. GRANDISON (personal communication) has, however, pointed out some differences between these two species; the type of *H. goughi* lacks a tarsal fold which is clearly found in *H. misera*, slight differences in degree of webbing are displayed, and the sizes of mature individuals are different, 26.8 mm ♀ and 22.6 mm ♂ in the case of *H. goughi* and 24.4 mm ♀ and 20.7 ♂ in the case of *H. misera*. In June 1965 it was possible to make a collection of *H. misera* at San Filipe, Estada Yracuy, Venezuela and to make observations of the species in the field. GRANDISON has confirmed the identification of this material, which agrees fairly closely with Trinidad *H. goughi*, except for the differences listed above. Colour, markings, habitat preference and general habits agree closely while voice is virtually identical in the two species. Perhaps the most striking similarity is in the tadpoles of the two species which have the same colour, markings, size range, body form and peculiar mouth parts. The question remains; are these species conspecific? The differences in webbing and size are

in this writer's opinion trivial and well within the range of variation which one might expect in a species of wide distribution. The only real difference between the two forms would therefore be the absence or presence of a tarsal fold. For the present this single difference is not considered sufficient grounds for retaining *H. goughi* as a separate species.

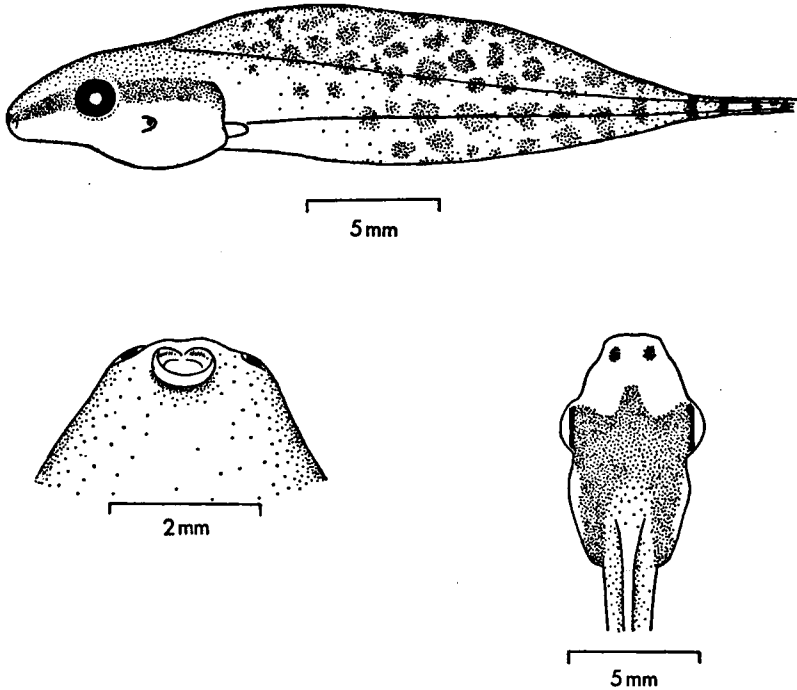


FIGURE 22. *Hyla misera* Werner.

Adult: A small bush dwelling tree frog, males measuring 20 mm, females 25 mm snout to vent. Snout in profile rounded with a distinct canthus rostralis, eyes prominent, tympanum small, about one third diameter of eye, dorsum smooth, belly and ventral surface of thigh granular, rest of underparts smooth, webbing present in both hands and feet, in hands reduced but extending to discs of second, third and fourth fingers, in feet to discs of all toes, discs

relatively small and roughly circular in shape, those on the third toe being roughly the same size as those on the second and third fingers. Dorsum pale yellow to orange with variable brown lines sometimes forming an irregular "H" shaped marking, a whitish line bordered ventrally by a brown streak running posteriorly from tip of snout through the eye to about the lateral borders of the sacral crest. When viewed from above, these two white lines form a very distinct V along the canthral ridges and upper eyelids. Upper surfaces of shank and forearm as well as back very finely flecked with brown. Pupil a horizontal ellipse, iris golden brown with minute gold flecks. Tongue flat, roughly heart-shaped extensively free both on sides and posteriorly.

**Tadpole:** Maximum length 35 mm. Body length to total length 1:3. Body wider than deep. Dorsal fin originating from back. Width of dorsal fin to width of ventral fin 1.5:1. Tail tapered and with terminal filament. Nares simple, lacking pigmented rims or flaps but directed anteriorly. Stirn organ visible but obscured in later stages. Spiracle sinistral. Eyes lateral, black, with gold flecks dorsally, silver ventrally, and with iris ringed with orange gold flecks. Oral disc in form of simple eversible tube, entirely lacking papillae. Labial teeth reduced, in form of single dorsal row, with teeth very much reduced in number. Jaws typical. Back and snout mottled brown, with clusters of fine gold flecks, belly silver, and with a band of black running from snout through eye to flank. Tail and fin marbled. Tail filament prominently banded.

**Voice:** A loud metallic squeak repeated at short intervals, changing to a series of rapid buzzing squeaks to the rhythm of "ti-ti-ti...". Calls all year round, provided water is available.

**Habitat:** Grass or small bushes immediately over temporary pools, drains or rice fields, in open country, and only occasionally in shaded areas. *H. misera* may sometimes be found over temporary ponds at the edge of forests, in the same general habitat as *H. minuta* which is typical of forest pools.



**Distribution:** Recorded throughout Trinidad but only at lower elevations.

**Spawning:** Amplexus takes place either on bushes, at the edges of pools, or in water. Eggs are laid in clumps floating on the surface and are often entangled in vegetation. Eggs measure 1.5 mm in diameter and have a thick jelly coat. Development is typical and rapid. Spawn throughout the rainy season, more commonly in large numbers during the first two months of the season.

**Natural history of tadpoles:** The distinctive features of this tadpole are the unusual mouth and the prominent tail filament. Under laboratory conditions, it will filter feed in midwater or at the surface in the same way as *Phyllomedusa* and *H. minuta* but is apparently incapable of active browsing. Tadpoles undergo metamorphosis in six weeks under aquarium conditions.

### ***Hyla minuta* Peters**

Pl. VII

*Hyla minuta*: PARKER 1933; PARKER 1934; BEEBE 1952.

**Adult:** A small bush dwelling tree frog. Males measuring 20 mm, females 25 mm from snout to vent. Snout in profile sloping, from above broadly rounded, canthus rostralis indistinct, eyes large and prominent, tympanum small, about one quarter the diameter of the eye, dorsum smooth, belly and underparts of thigh granular, webbing in both hands and feet, webbing of hand very much reduced but extending to discs on second, third and fourth fingers. Webbing between toes complete and extending to discs of all toes, discs roughly circular in shape. Colour extremely variable from very pale yellow to dark brown on back, with dark brown hourglass shaped marking between eye and middle of back and with brown bar across posterior part of back. Sometimes these markings are fringed with gold or green, or completely obliterated by gold or green spots. Belly usually pale yellowish white while all upper surfaces may be covered with fine brown flecks or spots as in *Hyla misera*. Pupil a horizontal ellipse, iris brown. Tongue a rounded diamond shape with a notch posteriorly, thick in the centre and anteriorly but thinner laterally and posteriorly, and with a pronounced medial groove.

Tadpole: Maximum length 40 mm. Body length to total length 1:3. Body deeper than wide. Dorsal fin originating from back. Width of dorsal fin to width of ventral fin 1:1. Tail tapered with prominent filament. Nares simple, anteriorly directed, and ringed with pigment. Stirn organ obscure. Spiracle sinistral and posteriorly directed. Eyes lateral and gold pigmented. Oral disc typical but somewhat reduced, and with single row of labial papillae. Dental formula 1/1:1. Snout,

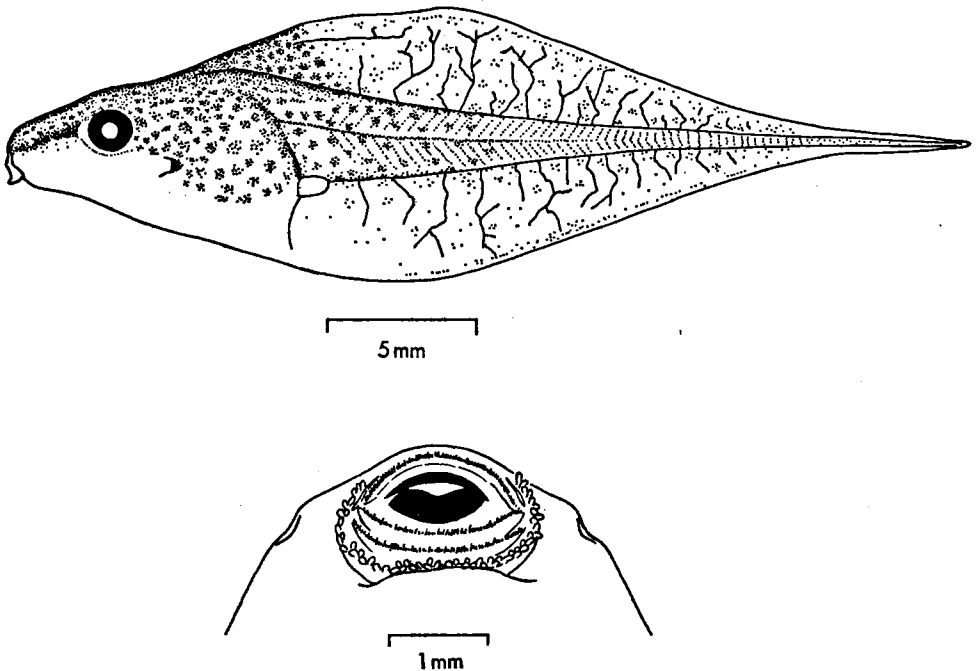


FIGURE 23. *Hyla minuta* Peters.

back and flanks, and anterior base of dorsal fin with fine orange brown mottling, belly yellowish silver. Blood vessels in tail and fin heavily pigmented from elaborate black lacework pattern in tail. BOKERMAN (1963) figures *H. minuta* from Brazil. The dental formula of the Trinidad form does not agree with that of the Brazilian form.

Voice: The voice is very similar to that of *H. misera*, consisting

of a loud metallic squeak, but the call is longer sustained than in *H. misera*. When calling in chorus, the period of the call may be reduced and a running series of short squeaks produced.

**Habitat:** Small bushes over water in forest pools.

**Distribution:** Throughout Trinidad at lower elevations but more common on the eastern and south eastern parts of the island. This may be simply because of its preference for forested areas.

**Spawning:** Spawning takes place throughout the rainy season but, as in the case of *H. misera*, there is usually one or more massive spawnings at the commencement of the heavy rains in May or June. Eggs measure 1.5 mm, with a thin jelly coat, and are laid in adhesive strings or clumps on submerged leaves or debris. Eggs may be readily identified simply by their colour. Unlike most of the other hylids which have black pigmented animal hemispheres and white vegetal hemispheres, in *H. minuta* the hemispheres are brown and cream respectively. Development is typical and rapid and larvae hatch and attain a late tail bud stage within 36 hours.

**Natural history of tadpoles:** In life, tadpoles are suspended in mid-water inclined at about 60–70 degrees to the vertical, and are maintained in this position by constant beating of the tail filament, in much the same way as *Phyllomedusa*. Its diet, as determined from examination of stomach contents, consists largely of unicellular algae in suspension, as well as some zooplankton organisms. It is of particular interest to note that while both this species and *H. misera* show adaptations to mid-water feeding in the form of the tail filament, *H. minuta* is typically an open water tadpole while *H. misera* is usually found in dense submerged vegetation at the edges of ponds. Under laboratory conditions, *H. minuta* will not surface or bottom feed, and tadpoles undergo metamorphosis in 8 weeks.

### ***Hyla maxima* (Laurenti)**

Pl. IXa

*Hyla maxima*: MOLE & URICH 1894; ROUX 1926; LUTZ 1927; PARKER 1933; BEEBE 1952.

**Adult:** A large tree frog, males measuring 100 mm, females 115 mm from snout to vent. Snout truncate, canthus rostralis distinct but rounded, tympanum about half diameter of eye. Eye pale gold with horizontal rhomboidal pupil. Dorsum smooth, skin on ab-

domen and posterior ventral surfaces of thigh granular, webbing on both hands and feet, fingers fringed laterally, discs on fingers large and rounded, discs on toes smaller and roughly oval in shape, toes not fringed. Colour varies from reddish brown to olive brown on back and upper parts of limbs, belly and chin white, whitish or yellowish reticulations on flanks and hind limbs.

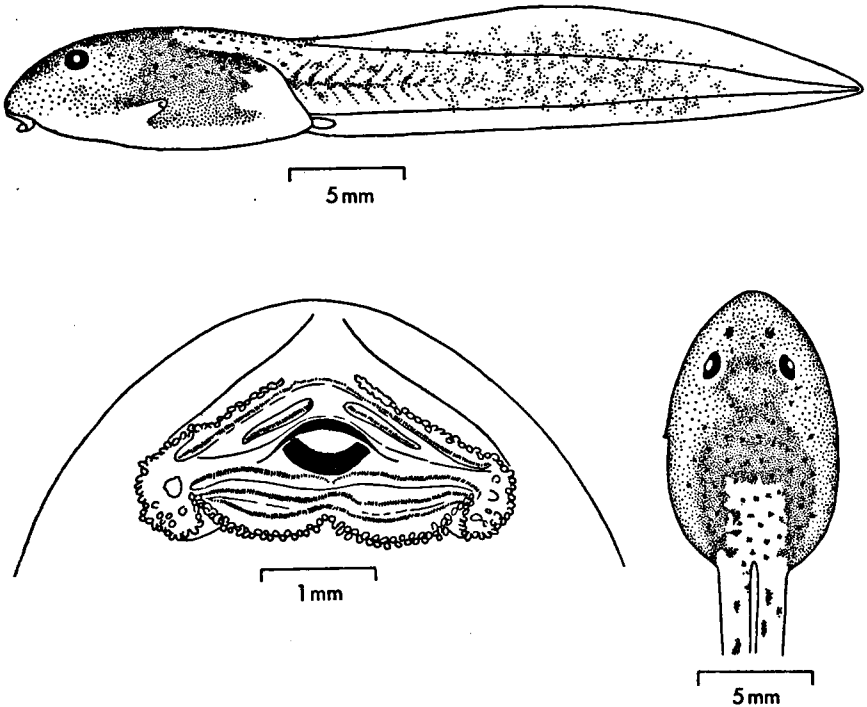


FIGURE 24. *Hyla maxima* (Laurenti).

**Tadpole:** Maximum length 42 mm. Body length to total length 1:3. Body wider than deep and very much flattened. Dorsal fin originating from tail. Width of dorsal fin to width of ventral fin 2:1. Tail tapered. Nares simple, but opening laterally, and with a mesial projection. Stirn organ visible but not prominent. Spiracle sinistral. Eyes dorsolateral and pigmented with gold flecks. Oral disc typical, with a double row of papillae in the lower lip and with supernumer-

ary rows laterally. Dental formula 1 : 2/2:1:1 and with a fourth lower row developing occasionally in later stages. Jaws typical. Body and tail generally cream or pale pink, with distinctive brown saddle on the back extending on to the flanks. Back covered with black spots. Tail and fin with diffuse and pale marbling.

**Voice:** A raucous "wark-wark" repeated at intervals of a few seconds, sustained over periods of up to an hour. Calls throughout the night.

**Habitat:** Tall trees or bamboo always at the edges of rivers in forested areas, and extending from sea level to elevations of 1500 feet.

**Distribution:** Throughout the valleys of the Northern Range and Central Range, but generally more common on the eastern half of the island (Figure 10). Its distribution appears to be determined largely by its narrow habitat preference.

**Spawning:** Spawning takes place in the dry season from December to April, when individuals descend from trees and congregate in shallow running water. After amplexus, the female excavates a depression measuring up to 18 inches in diameter and 6 inches deep, on the bank in gravel or sand at the edge of the stream. Spawn, which is floating and non-adhesive, is deposited in the water in the depression. Eggs are large, up to 3.5 mm, have a thick jelly coat, and develop comparatively slowly, when compared with other hylidae. Tadpoles hatch in 72 hours. It is not clear how tadpoles leave the depression and enter the stream. It may be simply following natural rise or fall of the stream, or they may be able to work their way through the spaces in the gravel.

**Natural history of tadpoles:** Tadpoles, although they show no special adaptive features, select moving water at the edges of streams, where they feed on encrusting algae on stones. They may, however, be raised in aquaria in still water, and undergo metamorphosis in 8 weeks. Tadpoles of *H. maxima* appear to be able to tolerate low salinities at river mouths.

**Hyla orophila** Lutz & Lutz

Pl. VIII

This species has not previously been recorded for Trinidad and has been identified by SHREVE from specimens collected by MILLER (1960, personal communication). GOIN (1957, 1961) has included this species in *Sphoerophyla* and *Dryomelictes*, divisions of the genus *Hyla*.

**Adult:** A small bush dwelling tree frog, males measuring 32 mm, females 40 mm from snout to vent. Snout in profile pointed, from above pointed, mouth inferior, canthus rostralis distinct and angular, eyes relatively small and not as prominent as in most hylidae, skin on back smooth, skin on belly granular, skin on ventral surfaces of thigh granular and continuous with a pair of granular pads on either side of vent, webbing on both hands and feet, hands large with reduced webbing which, however, extends to bases of discs, extensive webbing of toes to bases of discs, discs on fingers and toes circular. Colour a pale translucent green dorsally fading to whitish green ventrally, a yellow line running backwards along the canthus rostralis through the eyes and along the flanks disappearing posteriorly. Pupil a horizontal ellipse, iris greyish gold. Tongue large, thick medially, roughly rhomboid in shape with rounded corners, entire and free laterally and posteriorly.

**Tadpole:** Maximum length 47 mm. Body length to total length 1:3. Body wider than deep. Dorsal fin originating from back. Width of dorsal fin to width of ventral fin 1:1. Tail tapered. Nares opening laterally, "U" shaped with prominent mesial flap. Stirn organ obscured. Spiracle sinistral and dorsally directed. Eyes lateral, with gold bronze pigment. Oral disc typical, but papillae long and pointed and mainly in a single row. Dental formula 1 : 2/2: 1:1. Jaws typical. Colour and markings ornate. Head black spotted, with prominent gold patches on flanks, tail marbled but with a few scattered black spots. Fins with prominent but irregular black bars.

**Voice:** A loud sharp croak repeated at irregular but long intervals. Rarely heard in massive choruses.

**Habitat:** Low bushes over water in permanent or semi-permanent water, at the edges of forest clearings but frequently in open swampy country.

**Distribution:** Throughout Trinidad at lower elevations and always near fairly permanent water. Although found in a wide range of localities, in every drainage system, this species is not really common and tends to be found in isolated pockets.

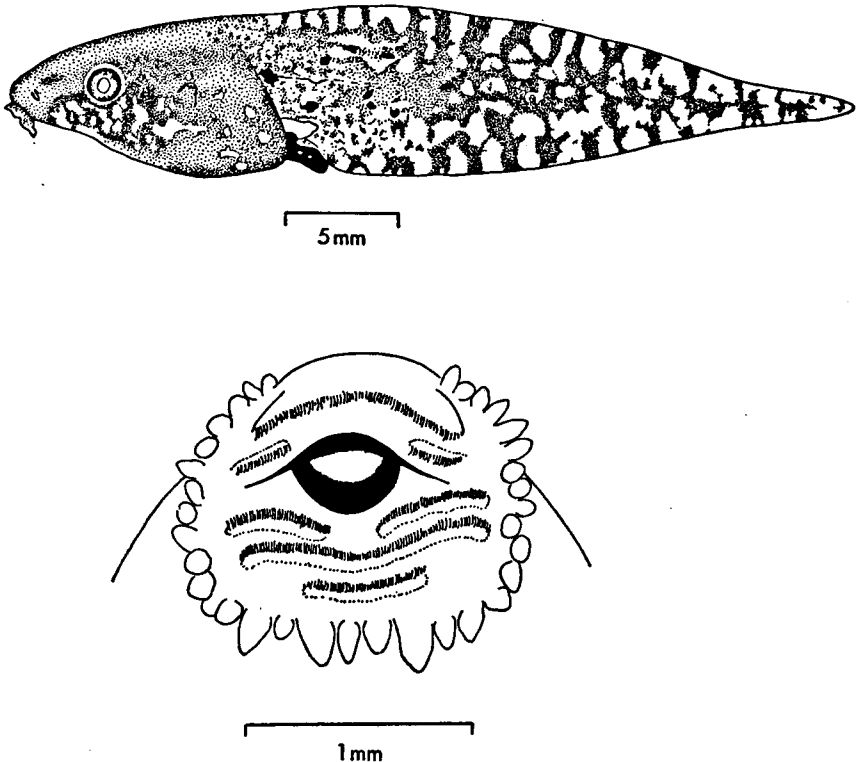


FIGURE 25. *Hyla orophila* Lutz & Lutz.

**Spawning:** Spawning has not been observed but it is claimed that eggs are deposited on leaves at the edge of water.

**Natural history of tadpoles:** Comparatively few tadpoles were collected so little is known about the species. While the tail does not display a typical filament structurally, in life the tip beats independently of the rest of the tail and the animal is capable of maintaining itself in mid-water. The specimens collected were all collected from the same general type of aquatic habitat; dense submerged aquatic vegetation. Diet consists largely of algae

### **Phrynohyas zonata** Spix

Pl. IXb

*Hyla coriacea*: MOLE & URICH 1894.

*Hyla venulosa*: ROUX 1926; LUTZ 1927; PARKER 1933; BEEBE 1952.

*Phrynohyas zonata*: DUELLMAN 1956.

**Adult:** A large bush and tree dwelling tree frog, males measuring 75 mm, females 90 mm snout to vent. Snout short and in profile rounded. Snout from above rounded. Head at least four times as wide as diameter of eye. Canthus rostralis angular. Eyes large and prominent, with horizontal elliptical pupil. Iris black, flecked with gold, and with irregular but conspicuous black patches running horizontally and vertically through eye forming a rough cross in iris. Tympanum in male about one half the diameter of the eye. Upper surface of head and back rough with scattered tubercles. Upper surface of thigh smooth. Knee, heel and forearms rough. Throat, belly and posterior surfaces of thigh coarsely granular. Webbing between first and second fingers very much reduced or lacking, webbing between second and fourth fingers reduced. Webbing on feet complete and extending to bases of discs. Discs on fingers large, slightly broader than long, discs on toes somewhat smaller and oval shaped. Tongue entire, rounded, and free laterally and posteriorly. Vocal sac paired in male, forming pouches extending backward from angles of jaws. Colour variable from reddish brown to olive brown on upper surfaces, white to yellowish white on undersurfaces, with irregular brown cross bars on limbs, and with irregular brown marbling on limbs and occasionally on upper surfaces. Toes, fingers, webbing, and sometimes the undersides of the extremities turquoise blue.

**Tadpole:** Maximum length 45 mm. Body length to total length 1:3.5, body slightly wider than deep. Dorsal fin originating from back. Width of dorsal fin to width of ventral fin 1:1. Tail tapered.



Nares simple, unpigmented, opening laterally. Spiracle sinistral. Eyes lateral. Oral disc large, with single row of papillae, some of which bear teeth. Tooth rows variable and irregular, dental formula  $2:1:2/2:2:2:1:1$ . Horny jaws typical. Mottled brown dorsally and pinkish silver on flanks and belly. Body and tail with two stripes, one extending from eye backward along back and onto upper edge of epaxial musculature, and the other running in lateral line on tail, meeting upper stripe about midway along tail. Fins generally without melanophores, except in older specimens which develop a few diffuse clusters in both fins posteriorly, and along leading edge of dorsal fin. Lateral line organ particular prominent.

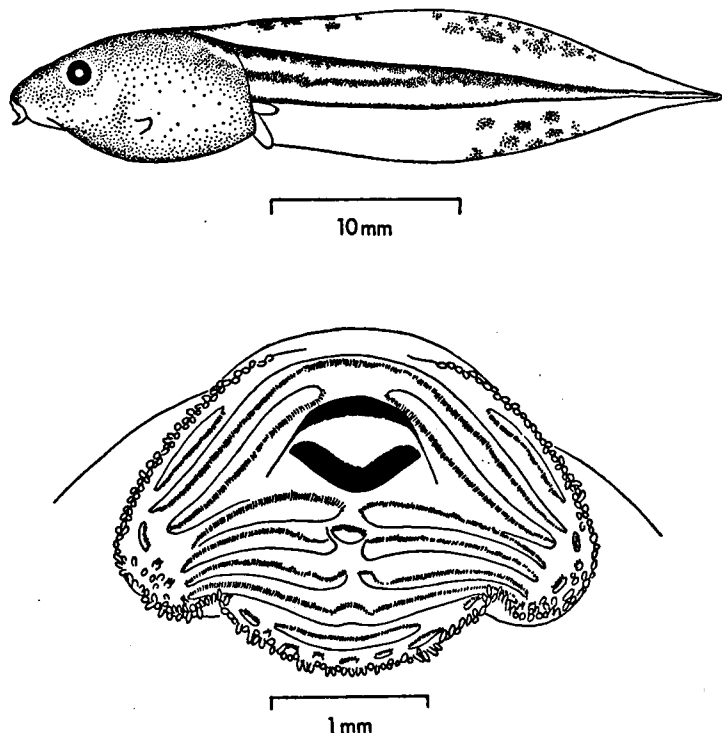


FIGURE 26. *Phrynohyas zonata* Spix.

**Voice:** An extremely loud low pitched sawing noise repeated at short intervals. In wet weather it is fairly common to hear a single

individual calling in the early part of the night, but mating choruses are usually only heard after unusually heavy rains between June and December.

**Habitat:** Arboreal, in forests, second growth forests, citrus orchards, cocoa plantations.

**Distribution:** Presumed to be throughout Trinidad, except at higher elevations in the Northern Range. Recorded from Maracas valley, U.W.I. campus, Valencia forests, Nariva Swamp, and Point Fortin.

**Spawning:** Amplexus takes place usually in temporary pools overgrown with bushes, and usually within the early part of the night. Eggs are relatively large, 2.5 to 3 mm, with a heavy coat of jelly, and are held together in a mass of adhesive jelly which may be either in strings attached to submerged vegetation, or a diffuse sheet lying entangled in floating vegetation. The eggs in life are black and cream. Development is rapid; larvae hatch and are free swimming within 24 hours.

**Natural history of tadpoles:** Tadpoles normally suspend themselves almost vertically either in midwater, or at the surface, and feed on a diet of algae and decaying organic matter. Under laboratory conditions, froglets emerge in six weeks.

### ***Eupemphix pustulosus trinitatis* Boulenger Pl. XII**

*Eupemphix trinitatis*: MOLE & URICH 1894; NETTING 1930.

*Eupemphix pustulosus*: LUTZ 1927.

*Eupemphix pustulosus trinitatis*: PARKER 1933; BEEBE 1952.

**Adult:** A small ground dwelling toad, males measuring 28 mm, females 32 mm from snout to vent. Snout in profile sloping backwards, mouth inferior, head small, canthus rostralis distinct but rounded, eyes small and not very prominent, tympanum small and not distinct, less than half diameter of eye, back rough and warty with warts either arranged in vague lines down back or in rough diamond shaped pattern behind head, upper parts of limbs rough

and warty, ventral surfaces rough, postero-ventral surfaces of thigh very granular. Third finger long, fourth longer than second, webbing and digital discs lacking on fingers, toes lacking discs but slightly webbed, three small spurs on foot. Colour of back and upper parts of limbs varying shades of brown, occasionally with a broad darker brown stripe down the middle of the back, occasionally also with very pale brown upper arms, usually a dark brown or black spot on back on either side over pelvic girdle, and similar bars on thigh and shank, which all fuse when the hind limbs are held at rest, also a thin whitish line running from about the middle of the back to the vent. Flanks stippled black or dark brown, undersides dirty white with brown stippling. Skin under vocal sac in males stippled dark brown or black, but with a thin whitish stripe medially to tip of lower jaw. Tongue very small, entire and free posteriorly, much longer than wide. Pupil a horizontal ellipse, iris brown with gold flecks.

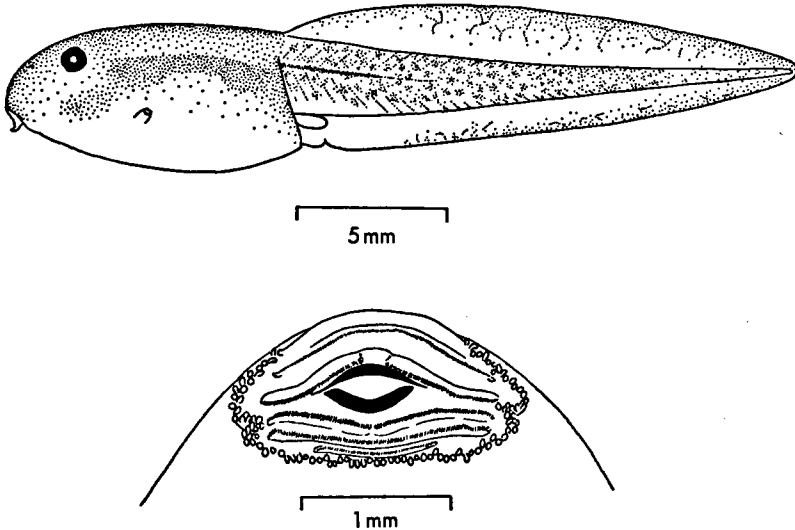


FIGURE 27. *Eupemphix pustulosus trinitatis* Boulenger.

Tadpole: Maximum length 30 mm. Body length to total length 1:3. Body wider than deep. Dorsal fin originating from tail. Width of dorsal fin to width of ventral fin  $1\frac{1}{2}$ :1. Tail tapered. Nares simple,

opening dorsolaterally, and with unpigmented rim. Stirn organ obscure. Spiracle sinistral. Eyes dorsolateral and black pigmented, overlaid with gold flecks. Oral disc typical, with single row of papillae on lower lip and multiple rows laterally. Dental formula 1 : 2/2:1:1. Jaws typical. Body generally creamish brown with darker brown patches on flanks, belly transparent. Tail with diffuse pale spotting. Fins transparent but blood vessels frequently pigmented.

**Voice:** A loud "Pung-dit" repeated at intervals of a few seconds. In chorus, either the first or second note of the call may be doubled. Sometimes can be heard calling during the day.

**Habitat:** Ground dwelling in open country at lower elevations, but occasionally also on forest floor.

**Distribution:** Throughout Trinidad at lower elevations.

**Spawning:** Spawns throughout the Rainy Season. Males set up chorus in ponds and ditches to which females are attracted. Amplexus takes place in the water during the first two hours of darkness but it is only very much later that egg laying takes place. In egg laying, at first an oviducal secretion is exuded, sometimes including a few eggs, and this secretion is beaten into a foam by the action of the hind legs of the female. More secretion with clumps of eggs continue to be produced during the course of about an hour and this is worked into a foam. The eggs are pale cream and hatch in the foam in 72 hours, but remain in the foam for a further but varying period of up to 7 days. Frequently, in ponds may be found several foam nests coalesced into one mass measuring up to 30 cm × 5 cm high.

**Natural history of tadpoles:** Tadpoles are typical bottom feeders, but because of the wide range of habitat may feed on a diet ranging from filamentous algae to organic matter. A distinctive feature of their behaviour is the constant vertical movement every few minutes. An individual feeding on the bottom of a pond will stop feeding abruptly, swim quickly to the surface, break surface and gulp air, and return to the bottom. Tadpoles undergo metamorphosis in 6 weeks under aquarium conditions.

**Bufo granulosus beebei** Gallardo

Pl. I

*Bufo granulosus*: PARKER 1933; BEEBE 1952.*Bufo granulosus beebei*: GALLARDO 1965.

**Adult:** A small toad, males measuring 43 mm, females 50 mm from snout to vent. Snout pointed in profile and projecting beyond the jaws, viewed from above elongate and somewhat pointed, head small, canthus rostralis distinct, eyes relatively large and prominent, tympanum large, about one half diameter of eye, bony ridges on head and about orbits, parotid glands large, skin on back and upper surfaces of limbs rough and with uniform and closely set warts, belly and ventral surfaces of limbs coarsely granular, webbing and discs lacking in fingers but slight webbing between toes, single horny pad and short spur on wrist. Colour of back and upper surfaces light brown with darker brown mottling, forming irregular bars or lines on back. Pupil a horizontal ellipse, iris black with gold flecks. Tongue small, thick and entire, twice as long as wide, roughly oval shaped, and free posteriorly.

**Tadpole:** Maximum length 17 mm. Body length to total length 1:2.5. Body wider than deep, belly rounded. Dorsal fin originating from tail. Width of dorsal fin to width of ventral fin 1.5:1. Tail rounded. Nares simple, unpigmented, opening dorsally, and with a small mesial projection. Stirn organ obscure. Spiracle sinistral. Eyes dorsolateral, black with gold flecks. Oral disc atypical, having a separate median flap bearing a row of teeth, single row of papillae only on lateral margins of disc. Dental formula 1 : 2/1:1:1. Jaws typical. Back and tail black pigmented, belly transparent or silverish. Ventral margin of tail pale cream. Fins transparent except for black line between tail musculature and dorsal fin, and pigmented blood vessels in dorsal fin.

**Voice:** A sustained tremulous low pitched whistle.

**Habitat:** PARKER (1933) records this species as coming from bromeliads from the summit of El Tucuche. This is clearly incorrect for typical habitat is the ground in open country such as cane fields

or other agricultural workings, always at low elevations. It is likely that the error may have been a result of mis-labelling of VESEY-FITZGERALD's material from Trinidad. BEEBE (1952) records this species from the Arima valley but this does not seem likely.

**Distribution:** Throughout Trinidad but not extending into the valleys of the Northern Range. Particularly common in the Caroni drainage.

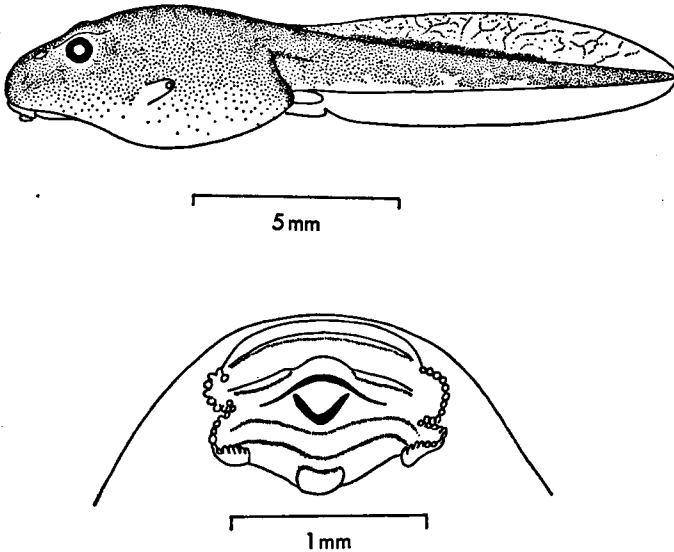


FIGURE 28. *Bufo granulatus beebbei* Gallardo.

**Spawning:** Spawning takes place in temporary pools, or rice fields, throughout the rainy season, but there appears, at least in area 3, to be two massive spawnings, one at the start of the rainy season in June and another in August to September. Spawn is typical but can be readily distinguished from that of *Bufo marinus*, partly by the smaller number of eggs, and partly by the curious wrinkled appearance of the jelly strings. Development is rapid and tadpoles hatch within 24 hours.

**Natural history of tadpoles:** Unlike tadpoles of *Bufo marinus*, which may feed either on the bottom, in midwater, or at the surface, those of *B. granulosus* feed only at the bottom, on encrusting algae or submerged vegetation. Metamorphosis takes place in 4 weeks.

### ***Bufo marinus* (Linnaeus)**

Pl. Xb

*Bufo marinus*: MOLE & URICH 1894; ROUX 1926; LUTZ 1927; PARKER 1933; BEEBE 1952.

**Adult:** A large toad. Males measuring 140 mm, females 205 mm from snout to vent. Snout in profile truncate and not projecting much past the jaws, from above rounded, head with bony ridges particularly about orbits, eyes fairly large and prominent, tympanum about one third the diameter of the eye, massive parotid glands, covered by smooth skin behind eyes and tympanum, canthus rostralis distinct and angular, skin on back and upper surfaces of limbs rough and leathery with numerous irregularly scattered warts, larger warts situated medially on back, often in vague lines, ventral surfaces covered with very fine warts, except postero-ventral surfaces of thighs which are wrinkled. No digital discs or webbing on fingers, two horny pads on palm of hand and numerous smaller horny tubercles. Toes partially webbed, a fringe on the medial side of the tarsae, two spurs on the end of the tarsae on either side. Colour of back and upper surfaces pale dirty brown or olive brown with large irregular chocolate brown patches on back (females) or a general orange brown tinge over entire back (males). Belly and underparts pale brownish to olive grey. Parotids and bony ridges on head tinged with orange brown in both sexes. Pupil horizontal, iris black with large golden flecks. Tongue large, thick, entire and extensively free posteriorly.

**Tadpole:** Maximum length 23 mm. Body length to total length 1:2.5. Body slightly wider than deep and rounded. Dorsal fin originating from tail. Width of dorsal fin to width of ventral fin 1:1. Tail rounded. Nares simple, opening dorsally, with pigmented inner rim, and with a small mesial projection of the rim. Stirn organ visible. Spiracle sinistral and posteriorly directed. Eyes dorsolateral, black

with gold flecks. Oral disc atypical, papillae only on lateral edges of disc. Dental formula  $1 : 2/1 : 1 : 1$ . Jaws typical. Body and most of tail black, pale cream stripe along lower part of tail. Fins unpigmented and transparent.

Voice: A low pitched staccato drumming, sustained for up to 30 seconds, then repeated at varying intervals.

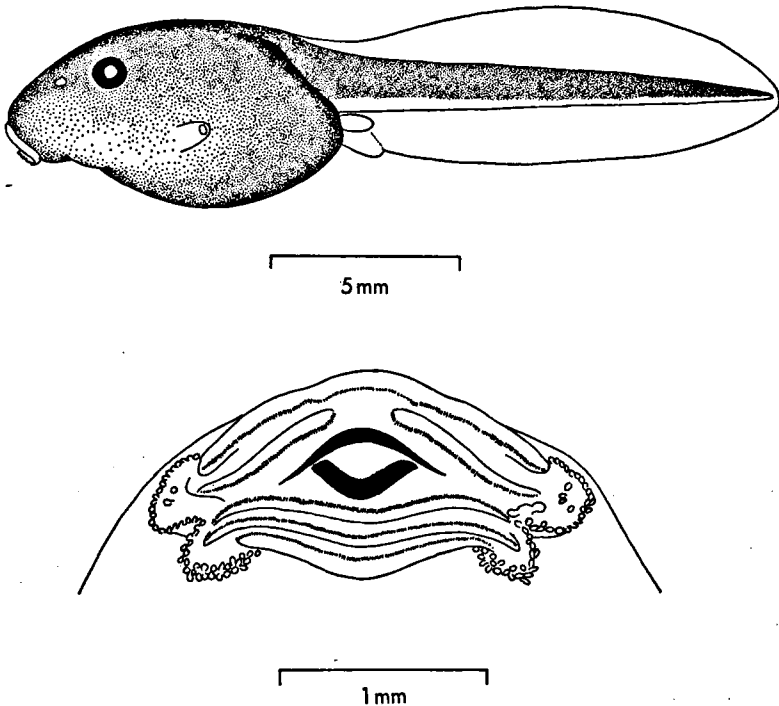


FIGURE 29. *Bufo marinus* (Linnaeus).

Habitat: Generally the ground in open cleared areas, particularly in agricultural lands and gardens, but also in caves and in forests.

Distribution: Throughout Trinidad at lower elevations.



**Spawning:** Spawning takes place throughout the year in temporary pools, permanent ponds, and in rivers. There appears, however, to be two peaks of spawning, one in the early part of the rainy season, and another in March at the height of the dry season. River spawning is typical of the dry season peak, while the temporary pond spawning is typical of the rainy season peak. After amplexus, vast strings of eggs, measuring up to 2 mm, are laid, which hatch within 36 hours.

**Natural history of tadpoles:** Tadpoles feed either on the bottom, in mid-water, or at the surface, and when surface or midwater feeding, particularly in permanent ponds, they form vast black shoals displaying a primitive schooling behaviour. Diet varies with the type of feeding, and will range from organic matter to sessile algae and phytoplankton. Metamorphosis takes place in 6 weeks.

When living in streams, tadpoles are confined to slowly moving parts of stream and show no special adaptations to living in moving water.

### ***Rana palmipes* Spix**

Pl. Xa

*Rana palmipes*: ROUX 1926; LUTZ 1927; PARKER 1933; BEEBE 1952.

**Adult:** A large ground dwelling or semi-aquatic frog measuring up to about 100 mm from snout to vent. Snout in profile pointed, from above pointed, canthus rostralis distinct and angular, head large, eyes large and prominent, tympanum large, more than three-quarters diameter of eye, body and hind limbs stout, back and upper surfaces generally rough, dorsal surfaces of shank with a series of fine tubercular ridges, ventral surfaces smooth, dorso-lateral ridges running back on either side from the eye. Fingers lacking webbing or digital discs. First and third fingers longer than second and fourth. Toes long and fully webbed. Back olive brown, dermal ridges yellowish brown, flanks pale olive brown fading to cream ventrally, upper surfaces of limbs yellowish brown with irregular spots and bars, groin and upper anterior regions of thigh yellowish with dark brown blotches, belly and other underparts cream white with scattered brown spots. Pupil a rounded vertical ellipse, with two tiny fissures dorsally and ventrally, iris brown with minute gold flecks, except for upper portion which is gold.

**Tadpole:** Maximum length 95 mm. Body length to total length

1:3. Body flattened, wider than deep. Dorsal fin originating from back. Width of dorsal fin to width of ventral fin 1:1. Tail tapered. Nares simple, lacking projection or flaps. Stirn organ prominent. Spiracle sinistral, and slightly more than halfway along body. Eyes dorsolateral. Oral disc typical and extensive, with papillae in multiple rows, particularly laterally. Dental formula 1:2:2:2/2:1:1:1. Jaws typical. Preserved material light brown with darker brown spots on body, tail and fin.

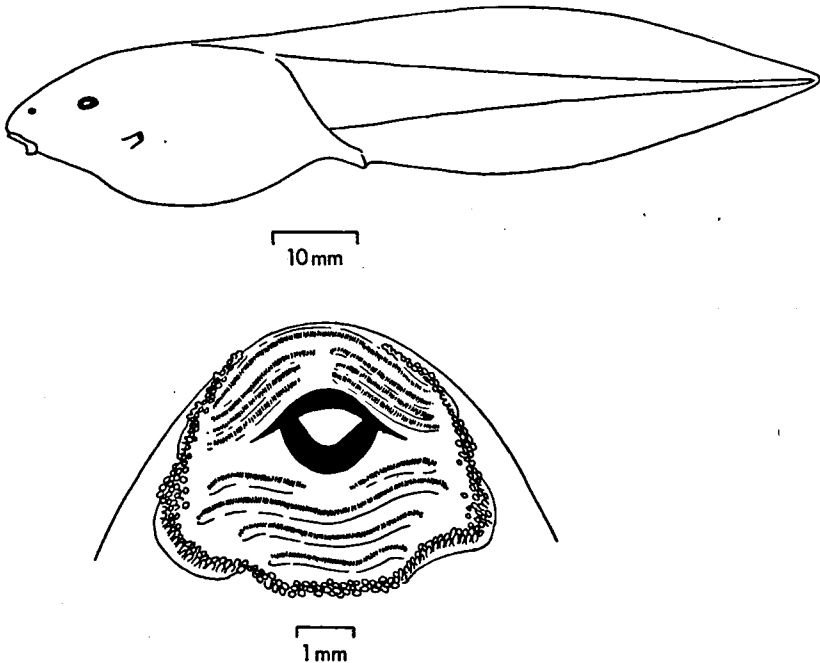


FIGURE 30. *Rana palmides* Spix.

As no tadpole material of this species was collected, descriptions are from the original Urich collection from Mayaro, kindly lent by the British Museum.

Voice: Not recorded so far in Trinidad, although the author is familiar with that of the Venezuelan forms.

Habitat: Insufficient records do not permit any definite state-

ment, but all specimens found so far have been from forested areas.

**Distribution:** Five specimens have been collected, three from the Mayaro area and two from within the Tamana Caves. This species must be regarded as being uncommon in Trinidad and possibly restricted to the southeast corner of the island. BEEBE (1952) however records it from Arima valley.

***Pseudis paradoxus caribensis* Gallardo Pl. XIVa**

*Pseudis paradoxa*: PARKER 1933; PARKER 1934; DITMARS 1941; GANS 1956; KENNY 1956.

*Pseudis paradoxus caribensis*: GALLARDO 1961.

**Adult:** A medium sized aquatic frog, males measuring 65 mm, females 73 mm from snout to vent. Snout pointed both in profile and from above, canthus rostralis quite distinct, eyes fairly large and prominent, tympanum large but indistinct, and about three-quarters diameter of eye, body and hind limbs stout, back relatively smooth but with fine tubercles posteriorly, upper surfaces of hind limbs also with fine widely spaces tubercles, belly uniformly smooth. Fore limbs stout, fingers lacking webbing. First finger opposable, second much reduced, toes with very full webbing, spur at base of toe. Head and back usually bright green or brown, upper surfaces of hind limbs brown, dark brown stripe on posterior surface of fore limb, dark brown stripe on anterior surface of hind limb running onto flank where it becomes diffuse, ventral surfaces of thigh with irregular brown stripes and spots, webbing in toes with large brown blotches, underparts generally cream white with widely scattered brown spots, chin of male orange. Pupil a horizontal ellipse, pupil black with fine gold flecks. Tongue flat and heart-shaped with notch posteriorly, and fairly free laterally and posteriorly.

**Tadpole:** Tadpole large, maximum length 230 mm. Body length to total length 1:3. Body deeper than wide. Dorsal fin originating from back extending anteriorly to in front of eyes. Width of dorsal fin to width of ventral fin 1:1. Tail tapered. Nares simple but with prominent rounded rim, with concentration of pigment above it. Stirn organ obscure. Spiracle sinistral. Eyes lateral and gold

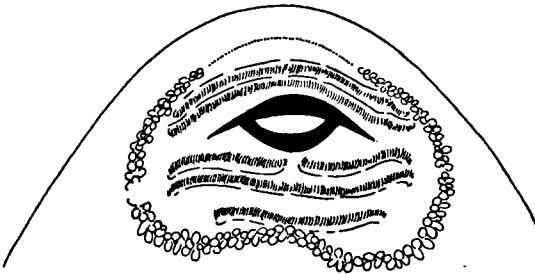
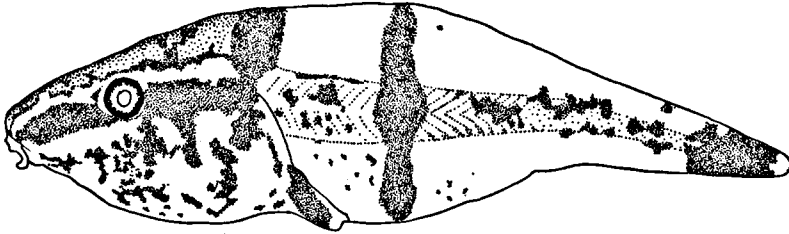
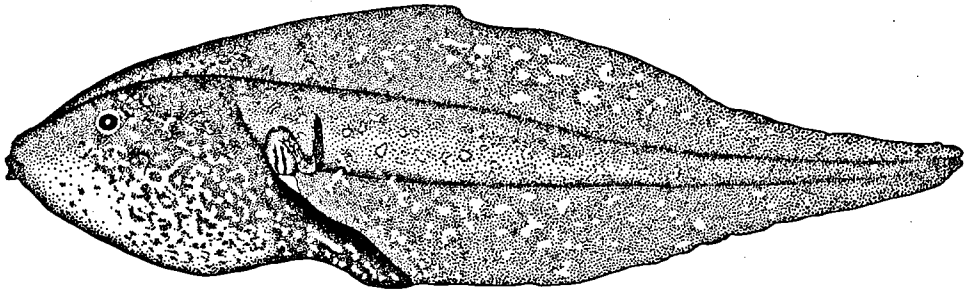


FIGURE 31. *Pseudis paradoxus caribensis* Gallardo.

pigmented. Oral disc typical, papillae small but in multiple rows around edge of funnel. Dental formula  $1:1/2:1:1$ . Jaws typical. Two distinct colour phases apparent, juvenile and mature.

**Juvenile:** Head with prominent black stripe bordered by light stripes through eye. Flank bronze with black patches. Back spotted. Two vertical black bars through base of tail, and at about one-third of tail, and a prominent black spot at the tip of the tail.

**Mature:** Uniformly dark brown, with bluish rosette-like spotting on back, flanks and tail. Body lighter ventrally.

**Voice:** A single sharp croak, repeated at irregular intervals, made both by night and day throughout the rainy season. Calls in chorus several times during any 24 hour period at commencement of spawning season.

**Habitat:** Aquatic, in vegetation at the edges of ponds, swamps, reservoirs, or rice fields, frequently in mildly brackish water.

**Distribution:** Throughout a broad band extending south from Nariva Swamp and to the west as far as Icos (Figure 8). In 1957, in the course of the survey, 24 individuals were introduced into a concrete tank at the Fish Farm, Bamboo Grove, from which they subsequently escaped, and spread via the St. Joseph river into the Caroni drainage. During the next ten years they spread through most of the available habitat around the edge of the swamp, and are commonly heard calling.

**Spawning:** No actual spawning was observed, but from observations at the Bamboo Grove station, it appears that there is a single massive spawning in June or July.

**Natural history of tadpoles:** In the early stages, tadpoles live in submerged vegetation at the edges of ponds, and grow surprisingly rapidly. At the end of four weeks measure 55–65 mm, and at the end of 16 weeks, 220 mm. As they increase in size, they move out into open water and feed either at the surface or in midwater, largely on plankton, but occasionally can be found browsing on encrusting algae on vegetation at the edges of ponds. Metamorphosis takes place in December

and January, but tadpoles may occasionally be found in February and March. While the fins are resorbed completely within three or four days, the massive myotomes persist for up to two weeks.

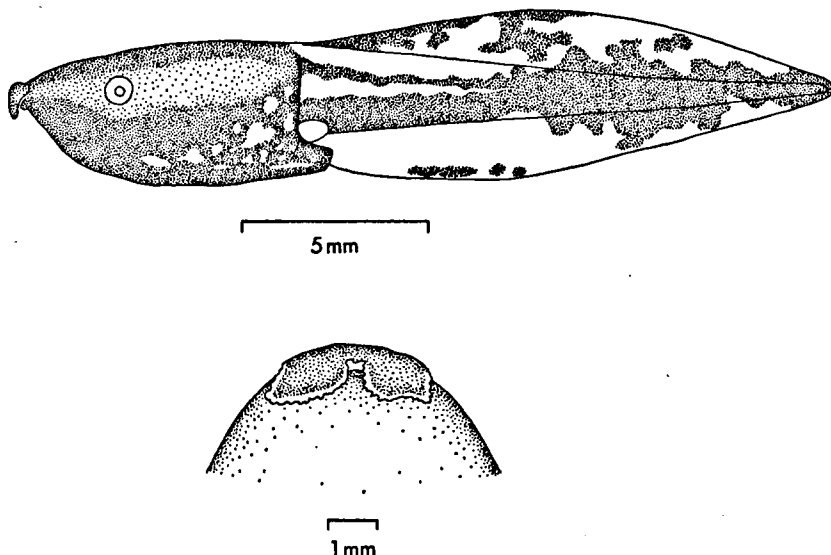


FIGURE 32. *Elachistocleis surinamensis* (Daudin).

***Elachistocleis surinamensis* (Daudin) Pl. XIIIa**

This species is apparently a new record for Trinidad. DUNN (1949) recognized three species of *Elachistocleis* (*bicolor*, *ovalis* and *pearsei*) on the basis of the colour of the venter, femoral stripes and inguinal spots. The first two species have immaculate venters and femoral stripes but lack inguinal spots. GRANDISON (personal communication) has compared Trinidad *E. surinamensis* with a paratype of *E. pearsei* and reports no morphological or other differences. Although DAUDIN's type was not seen the Trinidad form agrees reasonably well with his description, particularly with regard to the pronounced spotting and reticulations of the venter, the femoral stripes and the spots behind the knee and in the inguinal region. As DAUDIN's *E. surinamensis* antedates RUTHVEN's *E. pearsei* it is applied to the Trinidad form.

**Adult:** A small ground dwelling frog, males measuring 35 mm,

females 48 mm from snout to vent. Snout pointed in profile and from above, head very small, canthus rostralis indistinct, eyes small and not prominent, tympanum indistinct, both dorsal and ventral surfaces smooth, fingers and toes relatively short and tapered, webbing entirely lacking. Back and other upper surfaces dark mottled grey on a lighter grey background, a very thin black vertebral line running from snout to vent, a bright orange stripe, sometimes broken into blotches, on postero-dorsal surface of thigh, irregular bright orange blotches on upper part of calf behind knee, a large bright orange patch in groin extending to anterior surface of thigh and on flank. Belly and underparts deep yellow with brown marbling, mottling or reticulations, with these brown markings enclosing yellow spots irregularly on flanks and ventral surfaces of limbs, and which fade into the colour of the dorsal surfaces. Males with black skin below vocal sac. Pupil round, iris brown to black. Tongue large and entire, much longer than wide, thick anteriorly, roughly oval shaped, and free laterally and posteriorly.

**Tadpole:** Maximum length 25 mm. Body length to total length 1:3. Body wider than deep. Dorsal fin originating from tail. Width of dorsal fin to width of ventral fin 1:1. Nares obscured. Stirn organ obscured. Spiracle rectal in position and to the left of midventral, beside anal tube. Eyes lateral and gold bronze pigmented. Oral disc atypical, papillae lacking except along edges of labial flaps. Oral disc consisting of two ventral projecting flaps notched medially, and with a ventral, forward projecting, conical process. Edges of labial flaps denticulate. Labial teeth lacking. Jaws lacking. Colour generally black, with light stripe through eyes along tail, and with irregular silverish spots on belly and rectal spout. Ventral half of tail black. Fins irregularly spotted, and tip of tail black.

**Voice:** A sustained buzz rather like that of a cicada, ending abruptly, repeated at intervals of a few seconds, and always given while in water. Sometimes will give a muted clucking buried in litter at the edge of the pond.

**Habitat:** Litter in forest floor at low elevations, never in open country.

**Distribution:** Found so far only in the Mayaro forests, the Valencia forests, and the Charuma forests (Figure 13). It is possible, however, that this species may also extend to the west from Mayaro.

**Spawning:** Spawning has been observed throughout the first three months of the Rainy Season. Amplexus takes place in water in temporary ponds and pools, and floating non-adhesive eggs, measuring 1.5 mm, are laid in clumps. The jelly capsules are in the form of flat lens shaped envelopes. Development is moderately rapid and tadpoles hatch within 48 hours.

**Natural history of tadpoles:** When seen under natural conditions, tadpoles are never particularly active and remain suspended motionless at the surface where they are presumably filter feeding. They will, however, feed off the bottom in organic matter and adopt a characteristic head down position. Metamorphosis takes place in eight weeks under laboratory conditions.

**Elachistocleis ovalis** (Schneider) Pl. XIIIb

*Engystoma ovale*: MOLE & URICH 1894.

*Elachistocleis ovale*: PARKER 1933.

**Adult:** A small ground dwelling frog. Males measuring 32 mm, females 35 mm from snout to vent. Snout pointed in profile and from above, head very small, canthus rostralis indistinct, mouth inferior, eyes small and not prominent, tympanum almost as large as eye but only barely discernible, both dorsal and ventral surfaces smooth, fingers and toes relatively short and tapered, webbing entirely lacking, back and other upper surfaces dark brownish grey mottling, with fine white line running back from snout to vent, yellowish line on postero-dorsal surface of thigh from vent to back of knee joint where it becomes diffuse and is continuous with a similar line on the calf. Belly and ventral surfaces of thigh and shank usually dirty white, sometimes with faint brownish marbling or reticulations, males with black skin below vocal sac. Pupil round, iris brown to black. Tongue large and entire, much longer than wide, thick anteriorly, roughly oval shaped, and free posteriorly.

**Tadpole:** Maximum length 25 mm. Body length to total length



1:3. Body wider than deep. Dorsal fin originating from tail. Width of dorsal fin to width of ventral fin 1:1. Tail tapered. Nares and stirn organ obscured. Spiracle rectal in position and to left of anal

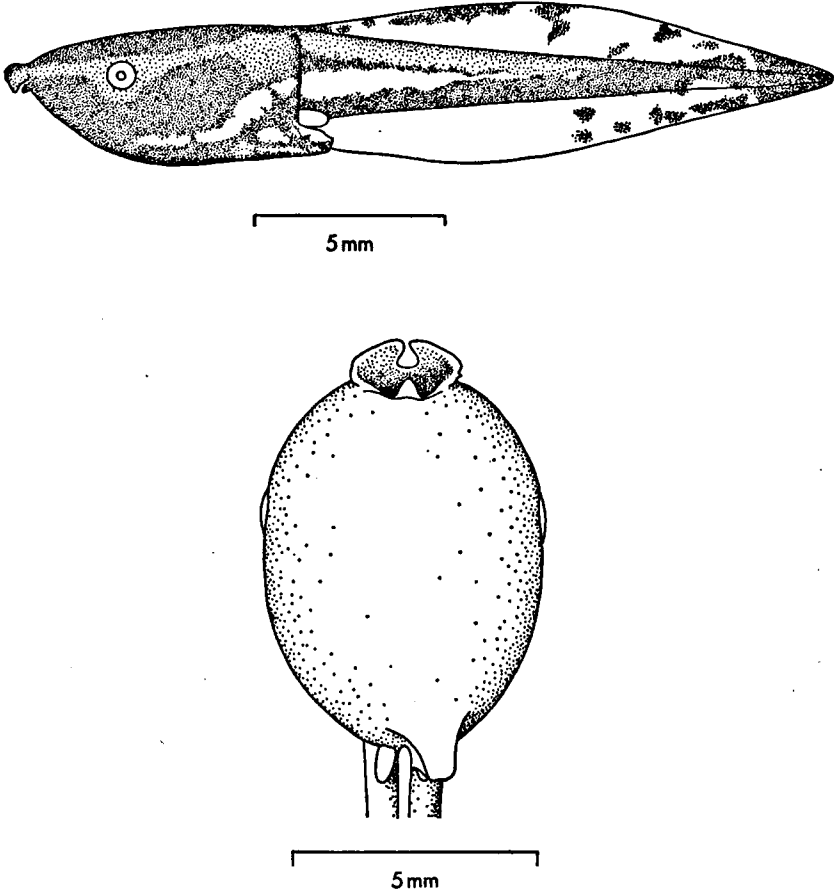


FIGURE 33. *Elachistocleis ovalis* (Schneider).

tube. Eyes lateral, black overlaid with gold pigment. Oral disc atypical and in form of two ventral projecting flaps notched medially. Edges of labial flaps smooth. Papillae lacking except for a forward projecting conical papilla ventrally. Teeth lacking. Jaws

lacking. Colour generally the same as in *E. surinamensis* except that pigmentation of fins is not as dense, and the belly is paler.

The only reliable character which may be used to separate these two species is that in *E. surinamensis* the edges of the labial flaps are irregular, being broken up into denticulate processes, particularly along the inner margins of the flap, while in *E. ovalis* the flaps have unbroken edges.

**Voice:** A very high pitched buzzing whistle sustained for up to about 10 to 15 seconds and repeated after a few seconds rest.

**Habitat:** Terrestrial and open country or agricultural workings, at lower elevations.

**Distribution:** Throughout Trinidad in open cleared areas but particularly common in the Caroni drainage.

**Spawning:** Spawns throughout the rainy season in temporary pools and ditches. Spawning essentially the same as in *E. surinamensis*. Eggs have the same lens shaped envelopes.

**Natural history of tadpoles:** Tadpoles are essentially similar to those of *E. surinamensis* both in general behaviour, feeding, and later development.

### ***Leptodactylus sibilatrix* (Wied) Pl. XIVb**

*Leptodactylus typhoni*: MOLE & URICH 1894; ROUX 1926; LUTZ 1927; PARKER 1933; BEEBE 1952.

**Adult:** A small ground dwelling frog, males measuring 40 mm, females 50 mm from snout to vent. Snout pointed in profile and from above, canthus rostralis distinct, eyes not very large or prominent, tympanum large, about two-thirds diameter of eye, body and hind limbs stout, back rough with six distinct dermal folds running from eyes backwards, occasionally with lines of tubercles or warts between folds, dorsal surfaces of thigh and shank with a few small tubercles, ventral surfaces smooth except for postero-ventral surface of thigh which is rough or granular, webbing and digital discs lacking, fingers long, first and third longer than second and fourth, toe

very long, third longer than fifth. Back olive or olive brown with large dark brown spots or blotches, belly pale cream, chin stippled darkening to almost black near lower jaw, dorsal surfaces of limbs olive or olive brown with brown blotches or bars, postero-dorsal surfaces of thighs with yellow and brown marbling, a cream to yellow stripe bordered on both sides by irregular brownish stripes, running from about vent along posterior margin of thigh. Pupil almost round, iris brown with gold flecks. Tongue thick, narrow, and pear shaped, with a slight notch posteriorly, with two or three grooves on surface and scarcely free posteriorly.

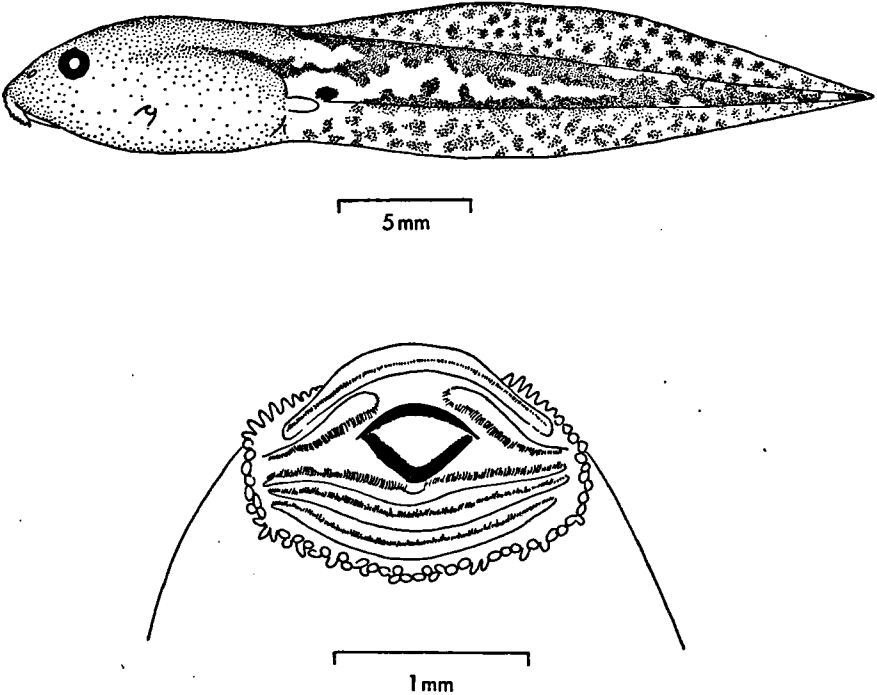


FIGURE 34. *Leptodactylus sibilatrix* (Wied).

Tadpole: Maximum length 35 mm. Body length to total length slightly greater than 1:3. Body wider than deep and belly flattened. Dorsal fin originating from tail. Width of dorsal fin to width of

ventral fin approximately 1:1. Tail tapered. Nares simple, unpigmented and opening dorsally. Stirn organ obscure. Spiracle sinistral. Eyes dorsolateral and pigmented with gold flecks. Oral disc typical, with pointed papillae in single row around edge of disc. Dental formula 1 : 2/2:1:1. Jaws typical. Colour generally uniform brown on back and snout, and with a lighter belly. Tail spotted.

**Voice:** A loud "weep-weep", with an occasional "chuck-chuck—chuck", repeated at intervals of a few seconds. Can be found calling during the rainy season throughout the day and night, but also calls in chorus after dark.

**Habitat:** Terrestrial in open country or savannah, rarely in shaded or forested areas.

**Distribution:** Throughout Trinidad at lower elevations.

**Spawning:** Spawns throughout the rainy season. Females, in amplexus, excavate a cavity, usually beneath stones, logs or vegetation and some distance from water, in which eggs are deposited in a foam mass. The exit hole of the nest is usually plugged. Eggs, which are devoid of pigment, develop comparatively slowly in five days to hatch into the foam. Tadpoles have been kept in foam for up to five weeks where, while they do not apparently feed, they do not appear to suffer any ill effects. Heavy rains wash tadpoles out of their foam nests into standing water.

**Natural history of tadpoles:** Tadpoles may be collected from the smallest and most temporary of pools, including tire ruts or animal tracks in muddy roads. They may, however, also be found in more permanent bodies of water. Diet varies with particular habitat and includes organic matter or encrusting algae on submerged vegetation. Tadpoles normally are bottom feeders, and undergo metamorphosis within six weeks.

### ***Leptodactylus pentadactylus pentadactylus* (Laurenti) Pl. XIb**

*Leptodactylus pentadactylus*: MOLE & URICH 1894; PARKER 1933.

PARKER (1933) included *Leptodactylus pentadactylus* in his list on the basis of the MOLE & URICH record (1894), but suggested that this

species may have been exterminated by the mongoose. The presence of this species can now be confirmed. It was collected in 1965 by the author on the Lizard Springs road, Mayaro, and has subsequently been found at five other localities in the area, and has been recorded, by voice, from the Nariva Swamp.

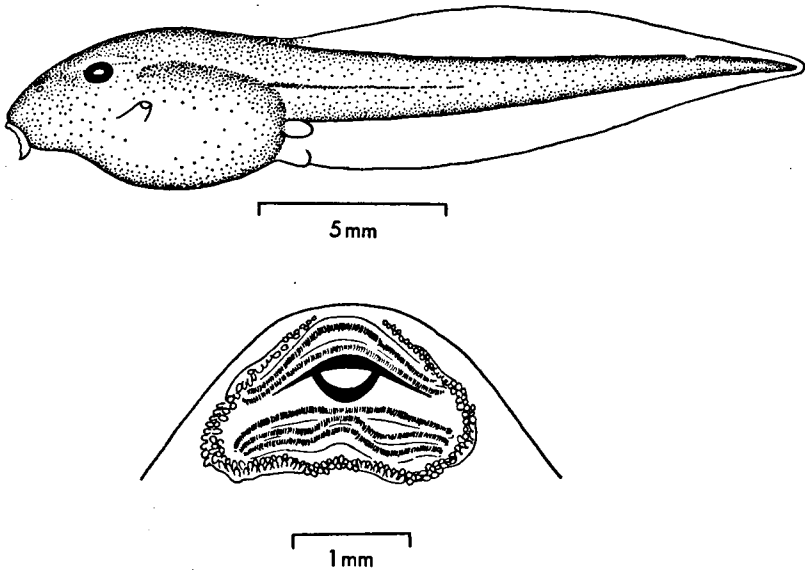


FIGURE 35. *Leptodactylus pentadactylus pentadactylus* (Laurenti).

Adult: A large ground dwelling frog, measuring 90 mm from snout to vent in male, and 115 mm in female. Snout in profile sloping with rounded tip, from above pointed. Canthus rostralis broadly rounded but distinct. Tympanum in male about same diameter as eye. Pupil a horizontal ellipse. Dorsum generally smooth anteriorly but with scattered tubercles over sacral region. Belly and other ventral surfaces smooth. Toes, but not fingers, with very much reduced webbing. Colour in life generally brown on upper surfaces with prominent dark brown or black markings. Black stripe running along snout through eye on either side. Triangular black patch between eyes with apex of triangle extending posteriorly. Two prominent black lines running along dermal folds. Anterior dorsal

surfaces of thighs with 3 to 5 black cross bars, postero-dorsal surfaces brown marbled. Ventral surfaces dirty white and, in males, skin beneath head with fine brown stippling. Males with thickened forearm and with horny spur at base of first finger.

**Tadpole:** Maximum length 30 mm. Body length to total length 1:3. Body wider than deep. Dorsal fin originating from tail. Width of dorsal fin to width of ventral fin 1:1. Tail tapered. Nares simple and unpigmented. Stirn organ visible. Spiracle sinistral. Eyes dorso-lateral, black overlaid with bronze flecks. Oral disc typical. Papillae in single row dorsally, in double row laterally and ventrally. Dental formula 1:1/1:1:1. Jaws typical. Colour generally brown dorsally with diffuse darker brown spotting, belly transparent. Tail light brown, fins transparent. Prominent bronze flash over eye.

**Voice:** Either a simple "bloop" or "bloop bloop". A chorus gives the impression of porridge bubbling.

**Habitat:** Terrestrial, in leaf litter in forested areas at lower elevations.

**Distribution:** So far recorded from five localities in the Mayaro area (Figure 12) and recorded by voice from the Nariva Swamp. It is possible that the species may have a wider distribution to the west of Mayaro where there is adequate habitat.

**Spawning:** Spawns at the commencement of the Rainy Season, in temporary pools or swamps which may or may not be under cover. Amplexus is in the water and eggs are deposited in a vast foam nest measuring up to 30 cm by 6 cm high. Eggs are small, up to about 1.5 mm and unlike *L. sibilatrix* and *L. p. petersi* are heavily pigmented. Development is rapid and eggs hatch in 24 hours, although the tadpoles may not leave the foam for three days. The foam of *L. pentadactylus* is not as stable as that of the other species and breaks down in 3 to 4 days.

**Natural history of tadpoles:** Tadpoles feed either on the bottom or more frequently in midwater where they congregate in shoals and display a simple schooling behaviour. Development of the tadpole is usually rapid, even in aquaria where they undergo metamorphosis in 4 weeks.

**Leptodactylus podicipinus petersi** (Steindachner) Pl. XIa

*Leptodactylus caliginosus*: MOLE & URICH 1894; ROUX 1926; LUTZ 1927.

*Leptodactylus petersi*: PARKER 1933; BEEBE 1952.

**Adult:** A small ground dwelling frog, males measuring 40 mm, females 51 mm from snout to vent. Snout in profile with rounded tip, from above pointed with rounded tip, canthus rostralis indistinct, eyes not very large or prominent, tympanum large, more than two-thirds diameter of eye, body and hind limbs stout, back variable from smooth to rough, belly smooth, postero-ventral and posterior surfaces of thigh rough, webbing and digital discs lacking, first and third fingers same length and longer than second and fourth, fourth toe long, third slightly longer than fifth. Back brown with dark brown triangle between eyes with apex posterior, limbs brown or reddish, fore limbs with brown blotches, hind limb with dark brown bars or blotches on upper surfaces, postero-dorsal surfaces of thighs marbled brown and yellow or cream. Pupil almost round, iris brown with gold flecks. Belly cream or white, chin finely stippled with brown, flanks light brown with small and irregular brown spots. Small specimens occasionally with a cream stripe, bordered dorsally by a dark brown stripe running from eye along flanks.

**Tadpole:** Maximum length 35 mm. Body length to total length 1:3. Body wider than deep, belly somewhat flattened. Dorsal fin originating from base of tail. Width of dorsal fin to width of ventral fin 1:1. Tail tapered. Nares simple, unpigmented and opening dorsally. Stirn organ obscure. Spiracle sinistral. Eyes dorsolateral, black with gold flecks. Oral disc typical, but papillae in lateral lips at least twice as large as those in ventral lip, and in multiple row. Middle portion of ventral lip free of papillae. Dental formula 1:2/1:1:1. Upper surfaces generally light brown changing into pale cream or transparent ventrally, tail and fin with light diffuse brown spotting.

**Voice:** A sharp "ping", rather like the noise produced by striking a bottle with a piece of metal, repeated at intervals of about 1 second, and sustained for up to 15 minutes. Occasionally a soft rattling purr will be made, but this is only typical of a solitary animal and is never heard in a full chorus.

**Habitat:** Terrestrial, in dead leaves or debris, in heavily shaded areas. Found also in caves and dark gullies.

**Distribution:** Throughout Trinidad at lower elevations.

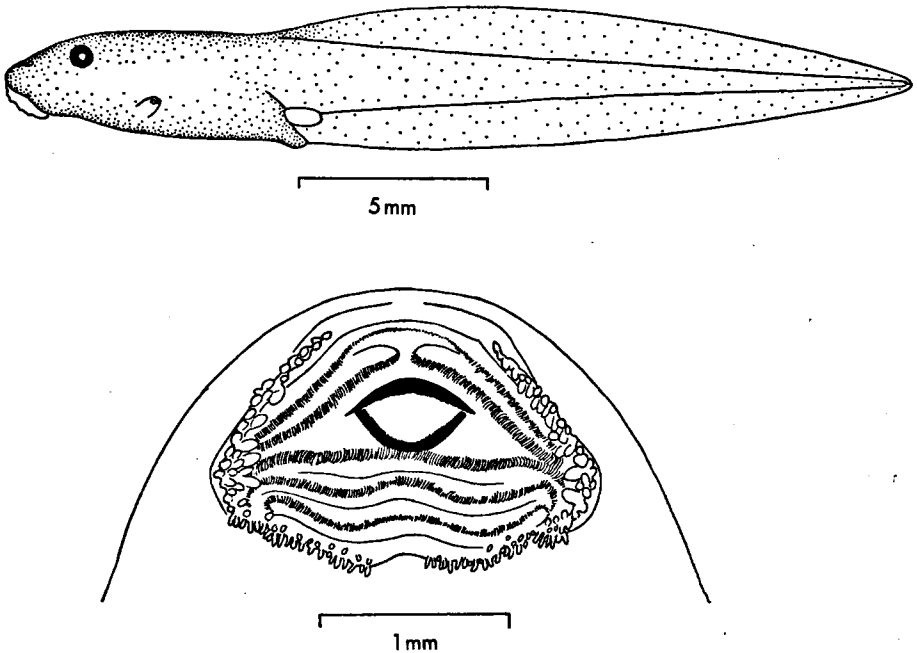


FIGURE 36. *Laptodactylus podicipinus petersi* (Steindachner).

**Spawning:** Spawning takes place throughout the Rainy Season. Eggs are laid in a foam nest produced from an oviducal secretion, and nests are found either free floating on the surface of the pond, or more frequently partially covered with leaves or sticks. Eggs meas-



ure about 2 mm in diameter and are light grey pigmented. Development is similar to that of *L. sibilatrix* but the foam nests are not as stable as in the other species, and the tadpoles enter water within 5 days.

**Natural history of tadpoles:** Tadpoles feed at the surface, in midwater or on the bottom, largely on organic matter because the weak lighting of their normal habitat will not support algae. Metamorphosis takes place in 8 weeks.

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Plate I

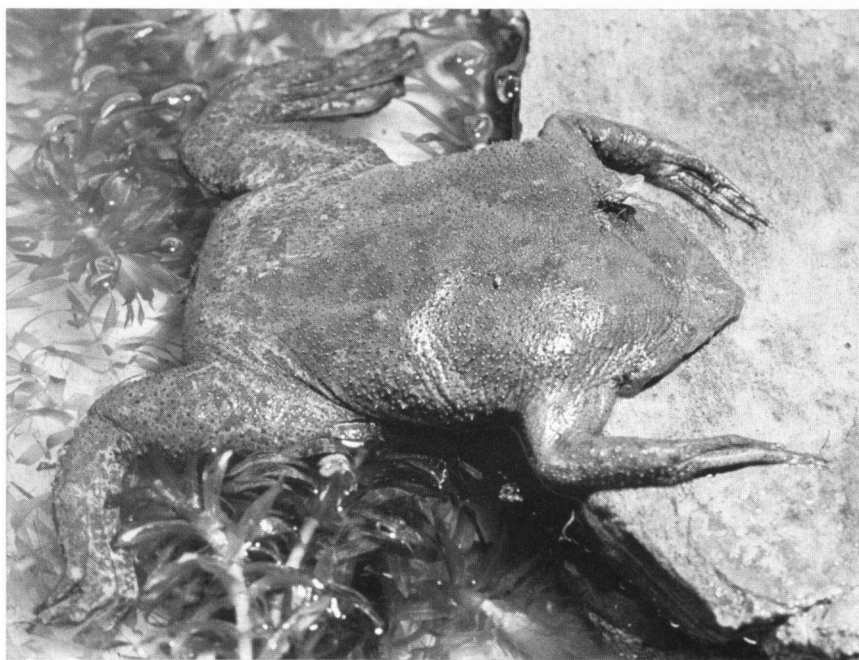


I. *Bufo granulatus beebei* Gallardo

Plate II



IIa. *Pipa pipa* (Linnaeus)



IIb. *Phyllobates trinitatis* Garman

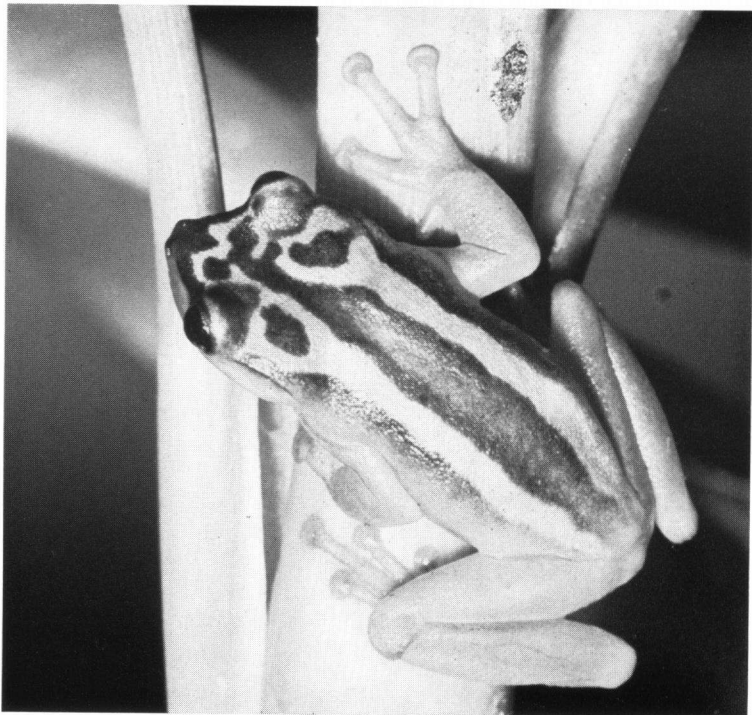


IIIa. *Phyllomedusa trinitatis* Mertens



IIIb. *Eleutherodactylus urichi* (Boettger)

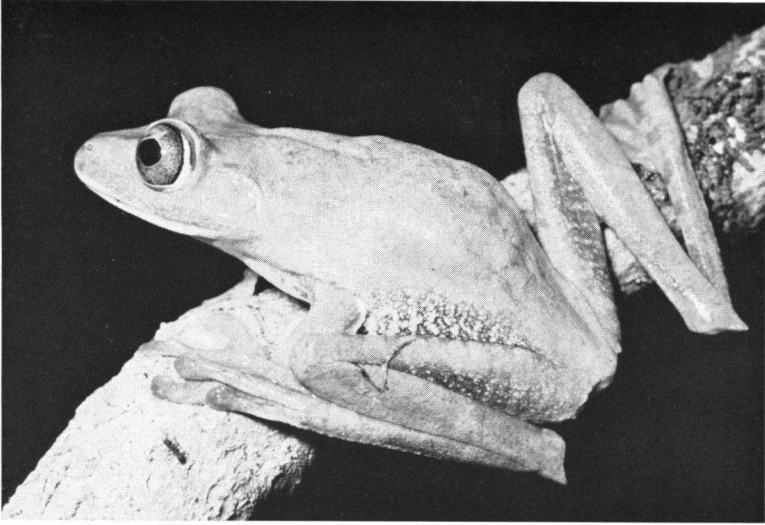
Plate IV



IVa. *Amphodus auratus* Boulenger



IVb. *Hyla rubra* (Daudin)



Va. *Hyla geographica geographica* Spix



Vb. *Nototheca fitzgeraldi* (Parker)



Plate VI



Vla. *Hyla misera* Werner



VIb. *Hyla punctata* (Schneider)



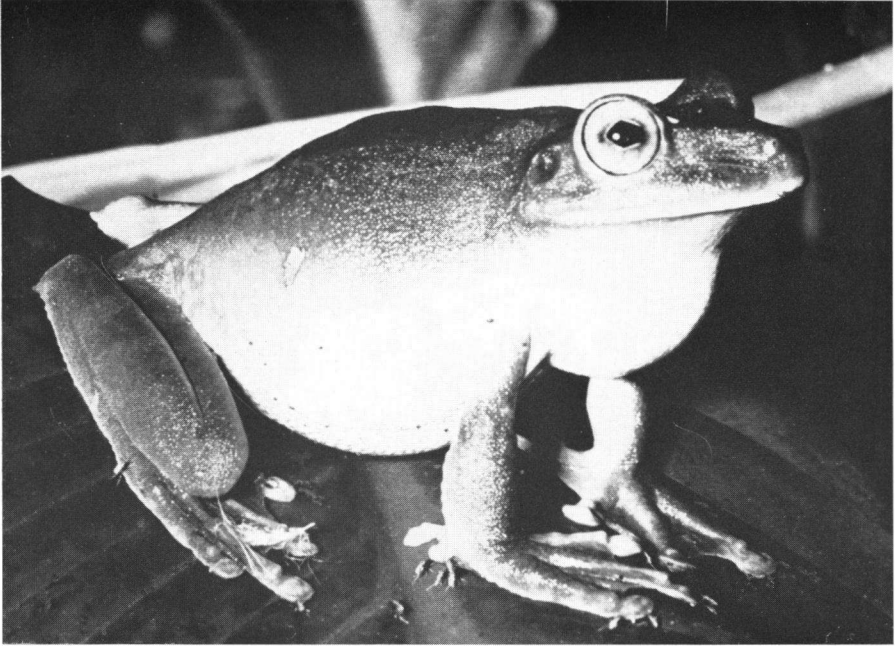


VII. *Hyla minuta* Peters

Plate VIII



VIII. *Hyla orophila* Lutz & Lutz

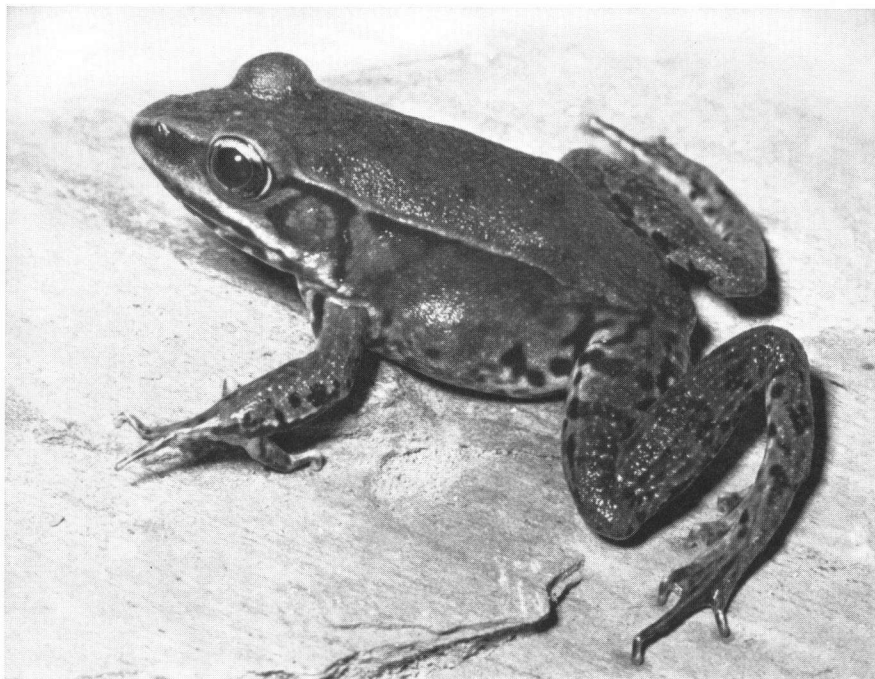


IXa. *Hyla maxima* (Laurenti)

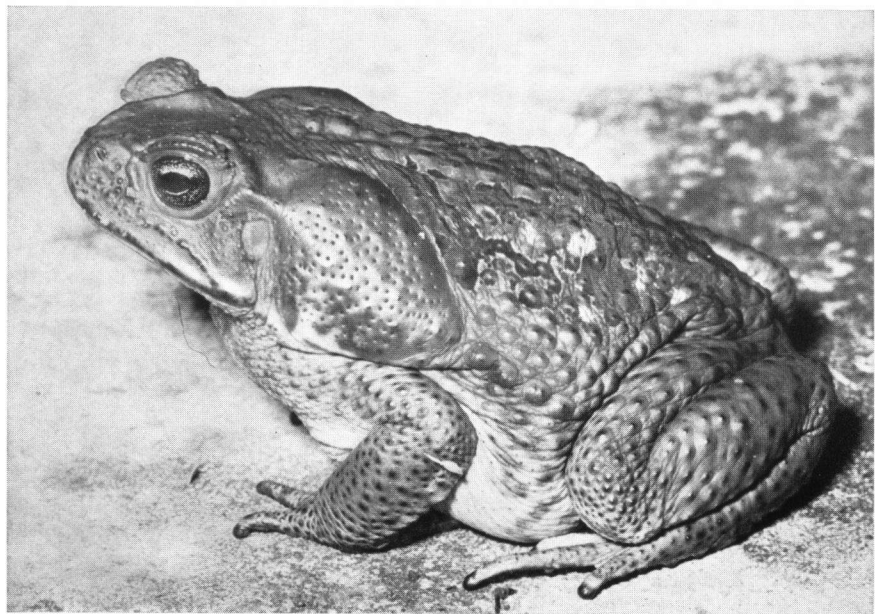


IXb. *Phrynohyas zonata* Spix

Plate X



Xa. *Rana palmipes* Spix



Xb. *Bufo marinus* (Linnaeus)



XIa. *Leptodactylus podicipinus petersi* (Steindachner)



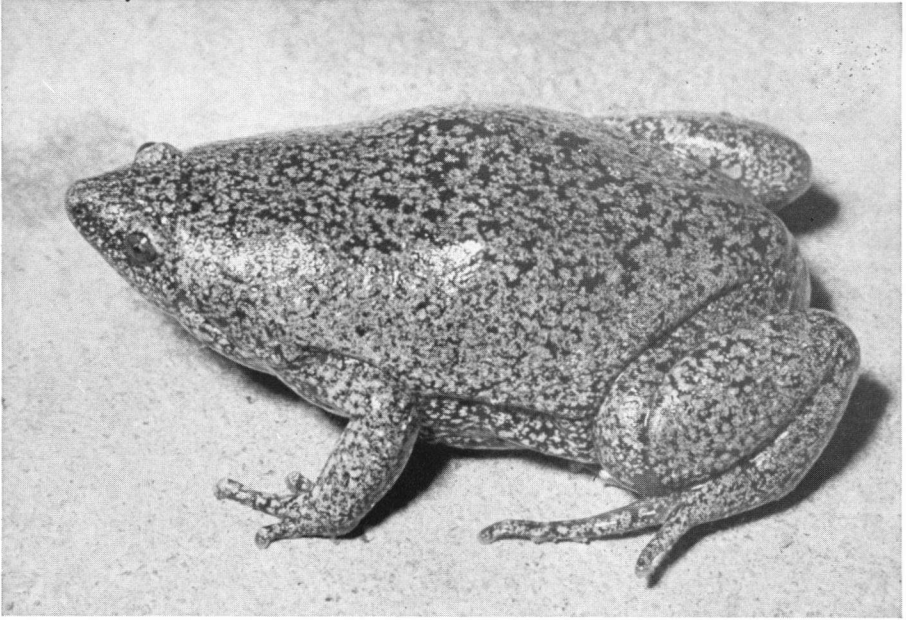
XIb. *Leptodactylus pentadactylus pentadactylus* (Laurenti)



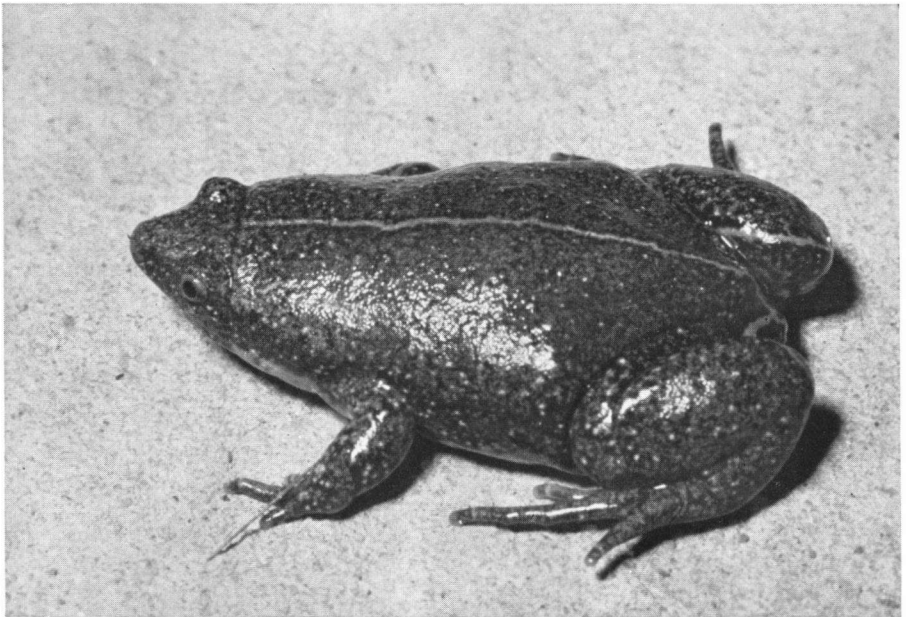
Plate XII



XII. *Eupemphix pustulosus trinitatis* Boulenger

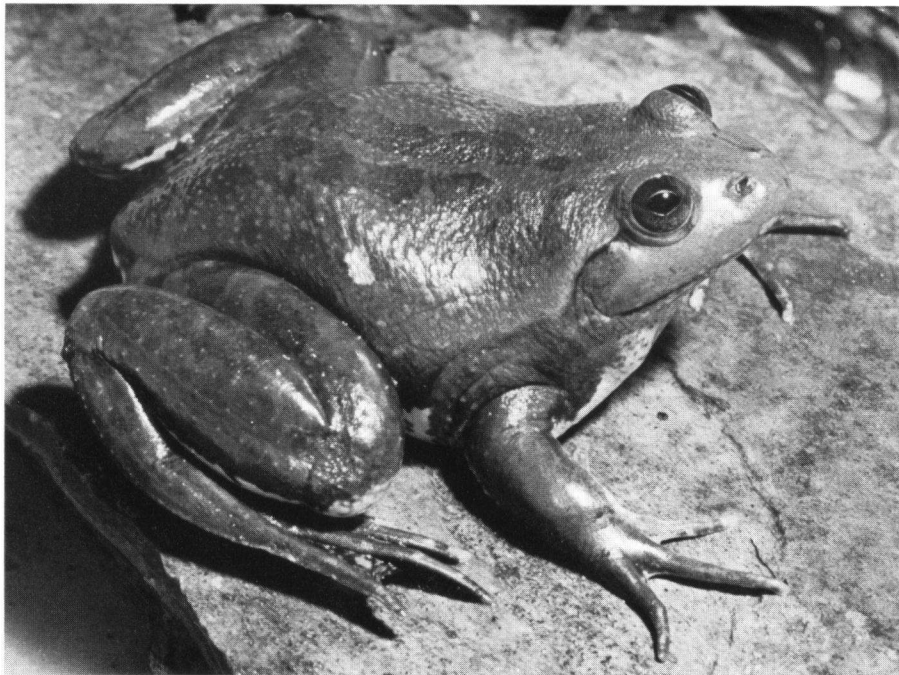


XIIIa. *Elachistocleis surinamensis* (Daudin)



XIIIb. *Elachistocleis ovalis* (Schneider)

Plate XIV



XIVa. *Pseudis paradoxus caribensis* Gallardo



XIVb. *Leptodactylus sibilatrix* (Wied)





XV. *Hyla crepitans* Wied