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## AMERICAN FROGS OF THE FAMILY PIPIDAE

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An opportunity to study the American Museum material of Neotropical Salientia was afforded me in the summer of 1946 by the kindness of the Curator of Amphibians and Reptiles, Mr. C. M. Bogert. After examination of the pipid specimens and perusal of the recent literature, it seemed to me that a new, even though brief and incomplete, appraisal of ranges and affinities would be useful. Some quite important facts have come to light which alter the pictures presented by Noble in 1931 and by Carvalho in 1939, and which could not have been known to them at the time they wrote.

I am indebted to my colleagues at the University of Michigan and at Harvard for information, and to Dr. Doris Cochran at the United States National Museum for the privilege of examining the Pipidae under her care.

The following generic names have been used for American pipids:

*Pipa* LAURENTI, 1768, *Synopsisin reptilium*, p. 24; monotype *americana* = *pipa*.

*Asterodactylus* WAGLER, 1830, *Natürliches System Amphibien*, p. 199; monotype *pipa*.

*Leptopus* MAYER, 1835, *Analect. Vergleich. Anat.*, vol. 1, p. 34; type hereby designated *asterodactylus* = *pipa*.

*Protopipa* NOBLE, 1925, *Amer. Mus. Novitates*, no. 164, p. 1; monotype *aspera*.

*Hemipipa* MIRANDA RIBEIRO, 1937, *O Campo*, p. 26; monotype *carvalhoi*.

There is thus an available generic name for three of the five species, none having been proposed as yet for *parva* or for *sneth-*

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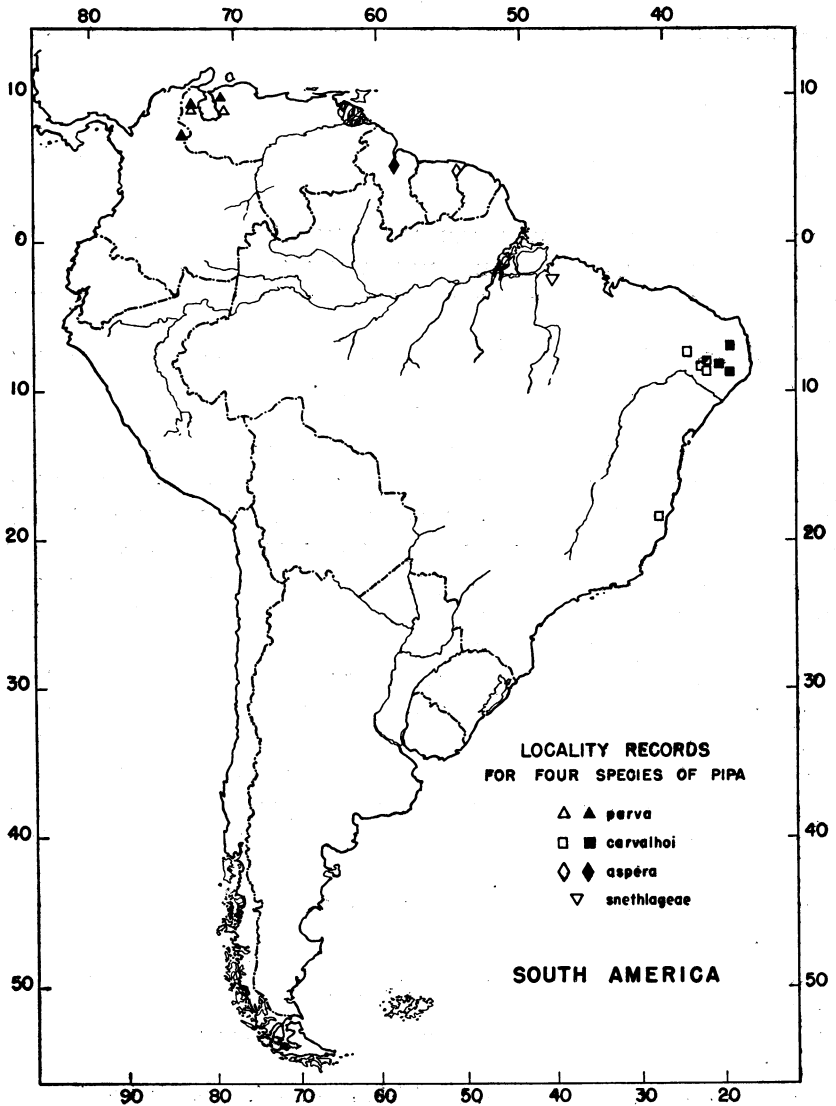


FIG. 1. Map of South America showing the localities where frogs of the family Pipidae (except *Pipa pipa*) have been taken. Solid symbols represent localities for material examined; hollow symbols represent other records.

*lageae*. One could call them all *Pipa*, or one could recognize five genera. In between these two extremes there are 50 possible arrangements of the five species into two, or three, or four genera,

and some sort of case could be made for at least 14 of these combinations on the basis of the characters given in the following list.

1. In *parva* the finger tips are bifurcate into two short lobes, and two similar ventrolateral lobes are present a little way proximal to the tip. Four similar lobes, all together at the tip, are present in *carvalhoi*, *aspera*, and *snethlageae*. In *pipa* the four are at the tip, but are much longer and are bifurcate distally.

2. In *carvalhoi* and in *parva* the eggs are small (not more than 2 mm. in diameter) and tadpoles emerge from them to take up an aquatic larval life. In *aspera*, *snethlageae*, and *pipa* the eggs are much larger, and perfectly formed froglets hatch from them.

3. Teeth are present on the premaxilla and maxilla in *carvalhoi* and in *aspera*, but not in the other three species.

4. Uniform horny scales, close together and pointed posteriorly, cover the surface of *snethlageae*. In the other species they are of two sizes, small ones scattered around larger ones. They are crowded together in *aspera* and *parva*; somewhat more sparsely strewn in *carvalhoi* and *pipa*. In *carvalhoi* they are feebly developed on the belly.

5. Epidermal sense organs, arranged in lines, are present in *carvalhoi* and *pipa*, absent in the other three species. In *pipa* the arrangement is one of four dorsal lines, to which *carvalhoi* adds a number of short lines on the side and on the ventral surface.

6. The tips of the first three toes are covered with black horny claws in *carvalhoi*. In *aspera* and in *parva* horn is present on the tips of these toes but is brown. In *snethlageae* and in *pipa* the integument of the tips is not modified.

7. An inner metatarsal tubercle is present in all the species with the exception of *parva*.

8. There is no modification of the integument around the mouth in *aspera* or in *parva*. In *carvalhoi* there is a dermal fold around the angle of the jaw. In *snethlageae* there are numerous, short, tentacle-like integumental structures in the region of the mouth and throat. In *pipa* there are a few similar structures, but there are also larger, flap-like appendages with irregular edges, one at the tip of the snout and one at the angle of each jaw.

9. The maximum length of the adult female of *parva* is 40 mm.; of *aspera* 48 mm.; of *snethlageae* 77 mm.; of *carvalhoi* 80 mm.; of *pipa* 200 mm.

10. The appressed heel reaches beyond the tip of the snout in

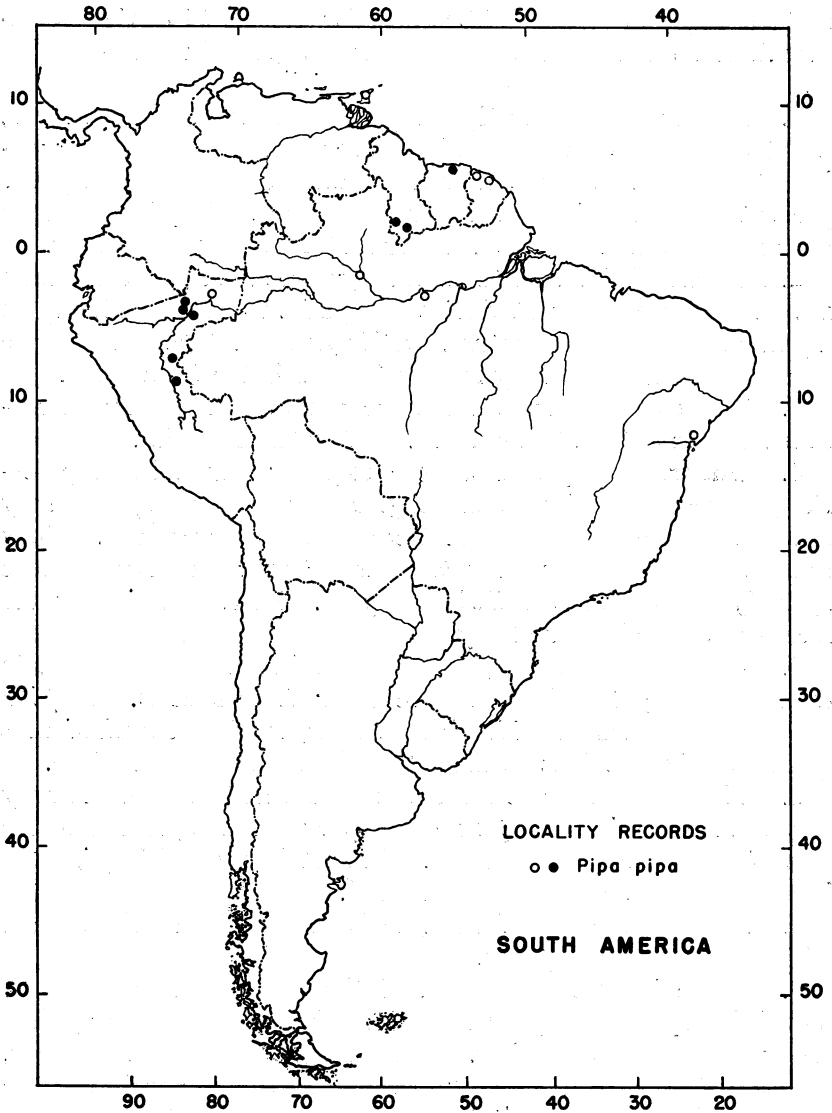


FIG. 2. Map of South America showing the localities where specimens of *Pipa pipa* have been taken. Solid symbols represent localities for material examined; hollow symbols represent other records.

*aspera*; to between the eye and the snout in *parva*; to the eye in *carvalhoi*; to the axilla in *sneithlageae* and in *pipa*.

11. The body is subcylindrical and rounded in all the species except *pipa*, where it is very depressed and flattened,

12. The head width is contained in the total length from 2 to 3 times in *pipa*; 3.7 to 3.8 times in *snethlageae*; about 4 times in *aspera* and in *carvalhoi*; 4 to 4.5 times in *parva*.

13. The diameter of the eye is contained in the interorbital distance 3 times in *carvalhoi*; 3.5 times in *aspera*; 4.5 times in *parva*; 6.6 times in *snethlageae*; 8 times in *pipa*.

The three genera *Pipa*, *Protopipa*, and *Hemipipa* are currently recognized on the basis of dentition or lack of it, and of direct development or lack of it. On this basis *snethlageae* belongs with *pipa* in the genus *Pipa*, but *parva* fits in with none of the other species and would, logically, become the type of a fourth genus. If one were to depart from the idea of "generic characters" and split on a basis of ecology and distribution, the widespread and highly specialized species *pipa* might form a monotypic genus, as against the other four smaller and less specialized forms. But as "entities should not be unnecessarily multiplied," and as there is no question of convenience when dealing with only five species, I prefer the simplest arrangement and consider them all as species of *Pipa*.

It is difficult to arrange the five American species phylogenetically. In most of the characters *carvalhoi* is the most primitive American form and *pipa* the most specialized. However, specialization of the finger tips is confined to American pipids, and in this respect *parva* is the most primitive, as its finger tips are only bifurcate, not quadrifurcate. Horny scales and lateral line organs in the adult are known in Saliencia only in the Pipidae, but the development of the two is somewhat mutually exclusive. The African genus *Xenopus* has lateral line organs but no scales. *Hymenochirus* in Africa and *P. parva*, *P. aspera*, and *P. snethlageae* in America have scales but no lateral line organs. In Africa *Pseudhymenochirus* has both, and in America *P. carvalhoi* and *P. pipa* have both. Possibly the presence of these two characters occurring together, rather than one of them to the exclusion of the other, is primitive for the Pipidae.

Some idea of the relationship of the American pipids to the African pipids may be gained by the distribution of the characters listed below.

1. All the American forms have a division of the tips of the fingers, and this is true of none of the African forms

2. Females of all the American species carry their eggs in temporary pits formed in the dorsal skin. This has not been reported for any African form and is known not to be true for some.

3. In the American species the sternum is relatively small, the epicoracoid cartilages extending laterally beyond it. In the African forms the reverse is the case, and the sternum extends laterally beyond the epicoracoids.

4. All American species have horny scales, at least on the dorsum. In Africa these are found only in the three species of the west African genus *Hymenochirus*, and in the single species of the west African genus *Pseudhymenochirus*.

5. All African forms have claws on the first three toes. In American forms claws are as well developed only in *P. carvalhoi* and are not present in *snethlageae* and *pipa*.

6. No American species have webbed fingers. In Africa these occur in *Hymenochirus* and *Pseudhymenochirus*.

7. No American species have eyelids. These are at least present in some degree of development in *Pseudhymenochirus* and in the five species of *Xenopus* (Africa from the Cape of Good Hope north to Portuguese Guinea and to Eritrea).

8. No American species have vomerine teeth. These are present in about half of the species of *Xenopus*.

9. None of the American species has a tentacle in front of and below the eye, such as is developed in *Xenopus*.

10. None of the American species has a bony sheath for the median Eustachian tube, as has been described for *Hymenochirus*.

11. No African forms have direct development, but it is known positively to occur in two American forms and probably occurs in a third.

12. As far as the species have been examined, *Xenopus* has eight presacral vertebrae, *Pipa* has seven (first and second fused), and *Hymenochirus* has five.

13. Maxillary teeth, present in two American species, are likewise present in five African forms (*Xenopus*).

14. Epidermal sense organs, in linear rows, are present in two American species and in the African species referred to *Xenopus* and *Pseudhymenochirus*.

15. The tadpoles of *P. carvalhoi* and of *P. parva* are closely similar and agree in all important characters with the tadpole of the African *Xenopus*, save that the latter has oral tentacles.

Three characters differentiate all American species from all

African ones: the small sternum, the division of the finger tips, and the egg carrying by the females. The latter two definitely indicate the American forms to be less primitive. The only additional trait not found in African forms is the direct development without a tadpole stage, present in three of the five American species. There are five characters not found in any of the American forms: webbed fingers, eyelids, vomerine teeth, the eye tentacle, and the bony Eustachian tube sheath. The first three are primitive. These five traits seem to be scattered in a rather uncorrelated manner, every African species having from one to three of them. *Pseudhymenochirus merlini*, for instance, seems to be a complete melange of characters formerly thought to be confined to *Xenopus* or to *Hymenochirus*, and with none clearly peculiar to itself. Unfortunately it is known only from a single specimen from near the coast of French Guinea, and nothing is known of its skeleton.

Anatomically, therefore, the American species form a natural group as opposed to African species, but the differences cannot be considered as of more than generic value. The resemblances far outweigh them and are indeed remarkable in view of the present distribution of the living forms of this highly specialized group of frogs.

Tadpoles of a quite pipid structure and closely similar to the tadpoles of *carvalhoi* and *parva* occur in Mexico and Guatemala. They have been considered to be the larvae of *Rhinophrynus dorsalis*, but, as this frog is extraordinarily different from any known pipid both in structure and habits, it is not impossible that the identification is incorrect. One wonders whether the true parent might not be an undiscovered North American pipid.

#### **Pipa carvalhoi** (Miranda Ribeiro)

1937 (Jan.) *Protopipa carvalhoi* MIRANDA RIBEIRO, O Campo, pp. 54, 56, figs. 1-3. Types presumably in the Museu Nacional in Rio de Janeiro. Riacho do Cavallo, Serra do Cachoera, near Casinhas, municipality of Surubim, state of Pernambuco, Brazil, 590 meters altitude.

1937 (Mar.) *Hemipipa carvalhoi* MIRANDA RIBEIRO, O Campo, p. 26. CARVALHO, 1939, Bol. Biol., new ser., vol. 4, no. 3, p. 394, figs. 1-24, pls. 1-4. MYERS AND CARVALHO, 1945, Bol. Mus. Nac. Rio de Janeiro, new ser., no. 35, p. 8, figs. 4-12.

The localities mentioned in the above cited literature fall into two groups: a set of seven at altitudes of from 590 to 1000 meters in the states of Pernambuco and the extreme southeast of Ceará;

a single locality in the state of Espírito Santo, near São João de Petropolis, 1500 km. farther south and "in the lowlands" (Myers and Carvalho, 1945). To the first set I can add the locality Areia, in the state of Paraíba, from six specimens in the United States National Museum (Nos. 109129-109134). The National Museum also has adults from two of the Pernambuco localities mentioned in the original description (Nos. 102685, 102686, Garanhuns; 119093-119098, Poçoão).

Myers and Carvalho (1945, p. 9) remark that "during and after a rain, examples were seen in the dooryard of the house, 20 or 30 meters away from the water, hopping about on land in broad daylight, apparently foraging for insects." The species is thus not wholly aquatic.

### *Pipa parva* Ruthven and Gaige

1923 *Pipa parva* RUTHVEN AND GAIGE, Occas. Papers Mus. Zool. Univ. Michigan, no. 136, p. 1. Sabana de Mendoza, Venezuela. M.Z.U.M. No. 57443. BARBOUR, 1923, Proc. New England Zool. Club, vol. 9, p. 4, pl. 2, fig. 3. LUTZ, 1927, Mem. Inst. Oswaldo Cruz, vol. 20, pp. 38, 41, 54, 56, pl. 8, fig. 1.

1939 *Protopipa parva* CARVALHO, Bol. Biol., new ser., vol. 4, no. 3, p. 397, figs. 6b-6c.

The type locality, in the province of Trujillo, is some 20 miles east of Lake Maracaibo, at an elevation of about 135 meters. Lutz obtained a specimen from Zulia, west of the lake. The United States National Museum has a large series collected by L. P. Schultz, and Hermano Nicéforo Mária has also taken this species. I am thus able to add to the range the Venezuelan province of Falcon, east of the lake (U.S.N.M. Nos. 115818-115820, 15 km. west of El Mena); Encontrados, west of the lake (Hermano Nicéforo, *in litt.*), Río San Juan (U.S.N.M. Nos. 115770-115817), and 20 km. west of Rosario (U.S.N.M. Nos. 115767-115769), all in the province of Zulia; and in Colombia the department of Norte de Santander (a specimen sent me by Hermano Nicéforo from Rio Zulia, north of Cúcuta). The range of this species is thus the lowlands of the Maracaibo Lake drainage, in Colombia and in Venezuela.

Ruthven's types were collected by Carriker "in a covered drain." Hermano Nicéforo writes me that his specimens, three in all, were "picked up at night, near the water." They are thus not wholly aquatic.

The whole dorsal area of pulliferous females is tumid. Nu-



merous tadpoles are U.S.N.M. No. 115817 from near Rosario and U.S.N.M. No. 115820 from El Mena.

### *Pipa aspera* Müller

1924 *Pipa aspera* MÜLLER, Zool. Anz., vol. 58, p. 291. Type, Munich No. 19/1923. Albina at the mouth of the Maroni River, Dutch Guiana.

1925 *Protopipa aspera* NOBLE, Amer. Mus. Novitates, no. 164, p. 1; 1927, Ann. New York Acad. Sci., vol. 30, pp. 71-74, figs. 11-12.

The species was based on a single male specimen. In 1924 Beebe and his colleagues found it at Kartabo, British Guiana, and this is the locality for 15 specimens in the American Museum collection (Nos. 25191-25192, 51175-51177, 52827-52831, and five unnumbered). Among the latter specimens is a female with three newborn froglets. Surprisingly enough there is a much older specimen in the collection (No. 5797) without any data.

At the time that Noble proposed the generic name *Protopipa* for *aspera* full information as to the characters and life history of *parva* was unavailable to him, and *carvalhoi* had not been described.

### *Pipa snethlageae* Müller

1914 *Pipa snethlageae* MÜLLER, Ann. Mag. Nat. Hist., ser. 8, vol. 14, p. 102. BARBOUR, 1923, Proc. New England Zool. Club, vol. 9, p. 4, pl. 2, fig. 2. MÜLLER, 1924, Zool. Anz., vol. 58, p. 293. Type, Munich No. 1/1914, collected by E. Snethlage. Type locality: Utinga near Belem, Pará, Brazil.

Müller had, besides the adult female type, another female and a male. In his original description the male is said to measure 73 mm. snout to vent; in his later paper 75 mm. No other specimens have been reported. The American Museum has a male (No. 52056), without any data whatever, which agrees rather well with the measurements of the male paratype and may possibly be that specimen.

### *Pipa pipa* (Linné)

1758 *Rana pipa* LINNÉ, Systema naturae, ed. 10, vol. 1, p. 210. Surinam.

1768 *Pipa americana* LAURENTI, Synopsis reptilium, p. 25. Surinam.

1799 *Rana dorsigera* SCHNEIDER, Historiae amphiborum, pt. 1, p. 121, pls. 1-3. Guiana and Surinam.

1820 *Pipa tedo* MERREM, Tentamen systematis amphiborum, p. 179. Substitute name for *pipa* Linné.

1824 *Pipa cururu* SPIX, Animalia nova . . . species . . . novae . . . ranarum . . . Brasiliam, vol. 3, p. 53. Types in Munich. Bahia and River Amazon.

1824 *Pipa curucuru* SPIX, tom. cit., pl. 53. Variant spelling of *cururu* Spix.

1835 *Leptopus asterodactylus* MAYER, Analect. Vergleich. Anat., p. 34. Substitute name for *americana* Laurenti.

[1836-1849] *Pipa surinamensis* DUVERNOY in Cuvier, Le règne animal, ed. 3, Paris (Masson), fig. 2, pl. 39. Substitute name for *pipa* Linné.

[1836-1849] *Pipa laevis* DUVERNOY, *tom. cit.*, p. 155, footnote 2. Type said to be in Paris. Rio Negro, Brazil.

1858 *Pipa sedo* SCHLEGEL, Handleiding . . . Dierkunde, vol. 2, p. 59, pl. 4, fig. 78. No copy of this zoology text for Dutch military students is in the United States. I assume that the name is a substitute or an error for *tedo* Merrem and hence for *pipa* Linné.

1923 *Pipa pernigra* BARBOUR, Proc. New England Zool. Club, vol. 9, p. 4, pl. 2, fig. 1. Type, No. 1442, in the Museum of Comparative Zoölogy collected by Louis Agassiz. Lago Maximo, near Villa Bella, Brazil (between the mouths of the Madeira and the Tapajóz).

Neither Laurenti nor Schneider mentioned *Rana pipa* of Linné. It is not clear whether they were describing new species or proposing substitute names. In the cases where I have used the term "substitute name" it is obvious from the context that the authors concerned were proposing a new name for an entity already named. Spix, Duvernoy, and Barbour, however, in proposing the names *cururu* (or *curucuru*), *laevis*, and *pernigra*, were definitely of the opinion that they had before them examples of hitherto unnamed species. These names are therefore available for use if new material shows any reason to separate specimens from Bahia or from the Rio Negro or from the middle Amazon from typical *Pipa pipa* of Surinam. Barbour (1923) quotes a letter from Müller to the effect that Spix's three types of *cururu* were still well preserved and were *Pipa pipa*. Later French workers have not recognized *laevis*, although presumably having access to the type. Barbour's type of *pernigra* was "small," "badly preserved," "somewhat macerated and the skin of the back is badly torn." Fresh specimens from the southern border of British Guiana agree with fresh specimens from the upper Amazon and the Ucayali.

The range of *Pipa pipa* is much more extensive than would appear from most of the recent literature. I consider it to occur in Trinidad, Venezuela, the three Guianas, Brazil, Colombia, Ecuador, Peru, and Bolivia. The evidence will be given below.

GRENADA: Boulenger (1882, p. 459) lists a British Museum specimen from this island, a record which has not appeared in any later consideration of either the family Pipidae or the Antillean fauna. Barbour (1914, p. 218), discussing erroneous records for other species from the Antilles, mentions having received a letter

from Boulenger, under the date of November 6, 1911, with the information that a collection from New Granada (Colombia) was erroneously published in the British Museum catalogues as from Grenada Island. Several "Grenada" species are mentioned by Barbour in this connection, but *Pipa pipa* is not among them, and the record has not been questioned but ignored. I here take the position that the "Grenada Isl." record for *Pipa pipa* is erroneous.

TRINIDAD: Apparently first recorded from the island by Barbour in 1923 (p. 3), "recently found in Trinidad."

COLOMBIA: Perhaps the "Grenada Isl." specimen in the British Museum came from New Granada. If so, *Pipa pipa* can be regarded as Colombian. In any case, it has been taken on the Amazon both above and below Colombian territory, so that its occurrence in Colombia is as certain as anything can be.

VENEZUELA: I am not aware of any records from this country, but a frog which is known to occur in British Guiana, in Trinidad, and at Iquitos, Peru, is virtually certain to be found in Venezuela.

BRITISH GUIANA: While the species has long been known to exist in the colony, definite locality records are few. The American Museum material provides two: Marudi, headwaters of the Rupununi, and Onora, falls on the upper Essequibo. Both localities are far south near the Brazilian border. The frogs were collected by Snedigar when he was with the Terry-Holden expedition. The Onora specimens are numbered 53493-53494. The Marudi specimen is numbered 53492. Only slightly less definite in locality are 30 specimens from "head of Rupununi River" (Nos. 53495-53500 and 24 untagged), also collected by Snedigar.

FRENCH GUIANA: The species was recorded from "Cayenne," but I know of no definite locality record unless "la Mana" (Guichenot, 1855, p. 92) refers to Mana, in French Guiana.

DUTCH GUIANA: The species was well known from "Surinam" even in pre-Linnean days, but I can find no definite locality recorded except Paramaribo, whence the American Museum has a specimen numbered 15004.

BRAZIL: The type localities of *P. cururu* Spix, of *P. pernigra* Barbour, and of *P. laevis* Duvernoy indicate an extensive range in Brazil, from Bahia to between the mouths of the Madeira and the Tapajóz, and to the Rio Negro. Possibly Brazilian is A.M.N.H. No. 39761, from "Johnson's Farm, upper Amazon, May 1, 1931." The precise position of this locality remains a mystery. None of

the present American Museum herpetologists were on the staff in 1931, and I have so far found no one who knows of "Johnson's Farm."

PERU: In 1870 Cope (p. 156) recorded *Pipa surinamensis* from Pebas, collected by Orton, a record which has been completely ignored by all authors. American Museum material, collected and presented by Dr. Harvey Bassler, extends the Peruvian range south into the Ucayali Valley. The localities are listed in a north-south order, and the numbers are those of the American Museum specimens.

LOCALITY	A.M.N.H. No.	SOUTH	LATITUDE
Iquitos	42559		4°
Río Itaya (near Iquitos)	42863, 43261		4°
Monte Carmelo (near Isla Cedro)	43201		5°
Middle Río Utaquinía	42885		8°
Sobral, Río Tamayo	43368		9°

ECUADOR: If the species ranges into the northern rivers tributary to the Amazon to anything like the extent that it follows the Ucayali south, it is quite likely to be taken in the Oriente of Ecuador. There are, as yet, no records for the country.

BOLIVIA: A southward range in the Madeira Valley, comparable to that in the Ucayali Valley, could mean occurrence of the species in northern Bolivia, but no records are known.

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