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The horned frog *Cerathyla panamensis* was described by Stejneger (1917) on the basis of an adult and one young specimen from central Panamá. Despite its arresting appearance, this bizarre hylid frog has been rediscovered only recently and little is known of its biology. The present observations expand its known range to cover the length of Panamá, and show that its behavior is no less unusual than its anatomy.

DISTRIBUTION AND HABITATS

The following records are arranged from east to west (from Costa Rica to Colombia): Mr. Ratibor Hartmann possesses a specimen that he found in the mountains of Bocas del Toro Province, Panamá, in the Río Changena drainage, not many miles from the Costa Rican border; Dr. William E. Duellman and I saw the preserved specimen at Mr. Hartmann's coffee finca, near El Volcán, Chiriquí Province.

Dr. Curt R. Schneider, in 1963, found a young individual near the tiny community of Altos de Pacora, east of Cerro Jefe, at an elevation of approximately 750 m., in Panamá Province. I obtained a second individual there in December, 1964. This locality lies about 30 km. northeast of the city of Panama. Both specimens are in the collection of The University of Kansas Museum of Natural History.

The holotype and associated young specimen (U. S. National Museum 55320-55321) were reported by Stejneger as originating "at Signal Loma (Loma Peak) on the north Coast of Panama three miles south of San Isabel." This place lies north-northeast of Altos de Pacora, in the eastern end of Colón Province.

In late May, 1965, I had the fortune to collect eight specimens on the upper slopes of Cerro Pirre, 1,440–1,550 m., Darién Province, a locality only about 16 km. from the Colombian border. This series more than doubles the number previously available, and, except for one retained at Gorgas Memorial Laboratory, is deposited in The University of Kansas Museum of Natural History.

The above records show that *Cerathyla panamensis* occupies elevated ground (known elevations 750–1,550 m., or 2,460–5,084 ft.) throughout the length of Panamá, and that it probably occurs in adjacent parts of Costa Rica and Colombia. Probably the range is continuous on the Atlantic slopes of the Talamanca–Tabasará mountains of the western half of Panamá, where the species probably also

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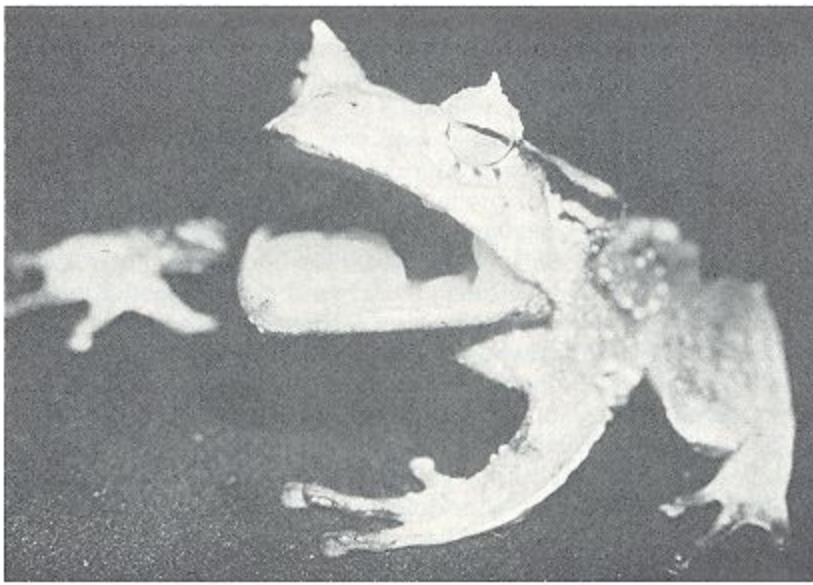

FIG. 1.—Defense stance of a horned frog, *Cerathyla panamensis*, from Cerro Pirre, Darién Province, Panamá. The tongue is a bright yellowish orange. Approximately life size; from a kodachrome by Curt R. Schneider.

occurs in places of suitably moist forest on the upper Pacific slopes. The absence of records from the relatively well-collected Canal Zone suggests a distributional break in the low country of central Panamá. The species inhabits low mountains just east of the Canal Zone, and from there possibly extends eastward in the northern coastal Cordillera de San Blas and Serranía del Darién, thence crossing with a slight lowland break to the Serranía de Pirre in south central Darién and probably also to the Serranía del Sapo along the Pacific Coast.

All known localities lie in lower montane forested areas of generally high rainfall, although the central Panamá stations are influenced by a season of lower rainfall. The abundance of *Cerathyla* (eight collected in three nights) on Cerro Pirre, at elevations of 1,440–1,550 m., possibly results from a nearly optimum habitat. Above 1,400 m. Cerro Pirre supports a kind of cloud forest, presumably with abundant year-round moisture (although the lower slopes of the mountain are definitely exposed to a Pacific-side dry season); striking features of this zone are the abundance of bromelaids in trees and on the ground, tree ferns, and tree-trunk moss in a shaded, cool forest that is exposed to frequent mist.

BEHAVIOR

Mr. Hartmann's specimen was said to be calling from the forest floor. Dr. Schneider found his specimen by day, while raking

in the litter under a stilt palm. The individual that I obtained at Altos de Pacora was on a stick lying on bare soil, in a roadside ditch at night. All of the specimens from Cerro Pirre were taken at night. Six were on low perches (log, sticks, dead palm fronds) only one-half to 2 feet above ground, and two were on palm fronds 3 to 4 feet above the forest floor. Thus, indications are that *C. panamensis* is nocturnal, probably hiding by day in litter on the forest floor, and utilizing low perches during its period of activity.

The condition of the holotype and associated juvenile specimen (Stejneger, 1917) showed that the eggs are carried on the back of an adult (the female, according to Stejneger), where the young complete their transformation. At least 14 eggs seemed to have been attached (by whitish cords) to the holotype shortly before its preservation.

The individuals obtained by me, at Altos de Pacora and Cerro Pirre, exhibited remarkable defense behavior. These frogs made no attempt to escape unless unduly prodded. Rather, when picked up or tapped on the snout, they gaped the mouth (Fig. 1) and sometimes slightly arched the body by throwing the head up and back. The effect was striking owing to a bright, yellowish orange tongue (yellow in one), as well as to the large mouth and weird head shape. These frogs varied individually in the extent of this behavior and in the number of times it could be induced. Thus, one individual opened the mouth only slightly and for only a few seconds at a time, whereas the others gaped widely, for periods ranging from several seconds to a minute depending in part on the degree of stimulus. One individual could not be induced to perform after the first time, several quit after the first few days, and two gave the mouth display, upon occasional demand, for several weeks after capture. Prodding, foot-pinching, and snout-tapping were the stimuli used; also the display was evoked by the jostling of other individuals of *Cerathyla* in the same bag. They leaped away, if not restrained, after varying amounts of stimulation. Several were notably insistent on facing the source of their torment, quickly swinging the opened mouth about when worried from a new quarter. The display is not all bluff, for several readily bit any object placed close to the mouth and one even fastened its jaws around the head of a neighboring *Cerathyla*. By offering a finger to the first *Cerathyla* captured, I was made painfully aware of the two sharp odontoids (on front of lower jaw) that proved capable of piercing human flesh; one must wait patiently for the grip to be released, or else pry apart the jaws.

Such traits as described in the paragraph above comprise a defense behavior not readily classified as either warning or bluff, but rather as something intermediate. I have no doubt that the bright yellowish orange coloration of the tongue is an integral part of the

gaping-mouth behavior, for frog tongues are not often pigmented, whereas the flashing of bright colors is commonplace in bluffing and warning displays of many types of animals. Defense behavior, other than direct flight, is rare among frogs, and calls to mind the remarkable belligerency of certain South American leptodactylids of the genus *Ceratophrys*, which, however, lack mouth pigmentation so far as I am aware.

The frogs made no noise when captured, but on one occasion, when removing an individual from a bag, I was startled into dropping the frog by a loud catlike squall. I was unable purposely to cause a repeat of this noise, but it was sometimes produced when several of the frogs were moving about in the same bag. The noise perhaps serves as a "get-off" signal, like the antihomosexual release calls made by some male anurans during breeding activity. Unfortunately, I was unable to determine the sex of frogs that made the cries, which emitted usually from the depths of my pack, when the frogs were jostled on the long trail from Cerro Pirre.

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