

7. TAXONOMY AND DISTRIBUTION OF ARROW-POISON FROGS IN COLOMBIA

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Some of the dendrobatid frogs are known to secrete from their skin a substance used by native tribes of Colombia for poisoning their arrows. The genus *Phyllobates*, to which the highly toxic "kokoi" belongs, is represented by 14 known forms in Colombia, while *Dendrobates*, also poisonous, has 11 kinds within the borders of that country.

These frogs are all rather small, the largest reaching a head-and-body length of less than two inches. They are often brilliantly colored with yellow or orange spots or stripes on a dark background in a certain pattern characteristic of each form. Unfortunately, these bright hues disappear in preservative, and the specimen becomes gray or bluish, sometimes with darker areas.

Arrow-poison frogs of the genera *Phyllobates* and *Dendrobates* are told apart by the presence or absence of teeth on the maxilla, members of *Phyllobates* possessing teeth that may be felt with the point of a pin along the inner maxillary border, while in *Dendrobates* this area is completely smooth and devoid of such teeth.

It was formerly believed that the presence or absence of a web between the toes of the hind foot further divided the genus *Phyllobates*, the frogs lacking such webs being placed in the genus *Prostherapis*. The variation in degree of webbing in some of the species is so great, however, that no valid reliance can be placed on it to justify such a separation on that characteristic, therefore since *Phyllobates* is the older name, all frogs since referred to as *Prostherapis* have been placed under *Phyllobates*.

While much collecting remains to be done in Colombia before we can have a complete picture of the distribution of the 25 forms there, at present the largest number of kinds is recorded from Antioquia and Chocó, each of these departments having four *Dendrobates* and five *Phyllobates*. Undoubtedly more intensive searching in other favourable regions will turn up as many or more for some of the other departments.

Other Central and South American countries also have a good population of arrow-poison frogs, although these at present appear to be more numerous in Colombia than in any of the adjoining regions.

These little frogs are terrestrial as a rule, living among the vegetation on the floor of the forest, or in heavy grass near some stream or pool. Their dappled golden spots or lines render them nearly invisible in such situations. They give

a gentle, whistling call, and this betrays their hiding place, although they are not readily seen even then. Presumably they feed upon small insects and other minute invertebrates. Very little has been recorded as to their actual feeding habits in the wild state.

Breeding occurs during the spring and summer. When the eggs have hatched, a male will present himself among the very young tadpoles, and they instinctively attach themselves to the skin of his back by their suction organs. He then carries them safely for several weeks, until they have grown sufficiently to fend for themselves. While the male is thus "incubating" the tadpoles, he frequently visits a shallow stream or a tree-hole containing rainwater, in which he immerses himself and the tadpoles for some time, thus keeping them from becoming too dry.

When using slivers of bamboo as blow-gun darts, the Indians had to employ a very quick-acting killing or paralyzing substance that would drop the bird or mammal they had hit before it could escape into the dense underbrush beside the jungle trail and so be lost to them as an item of food. For this purpose kokoi poison was in use long before the coming of the white man, and was singularly quick and effective once it had entered the bloodstream of the animal shot. According to Dr. Bernard Witkop of the National Institute of Health, whose analysis of it will be presented to you later in this symposium, it is one of the most powerful animal poisons yet known.

As a taxonomist, my chief interest in these frogs has been the identification of the Colombian forms, together with their aparent relationships. There follows a short summary of some of their characteristics, taken from a forthcoming paper on the frogs of Colombia by Dr. Coleman J. Goin and myself.

Both *Dendrobates* and *Phyllobates* are now considered to belong to the Subfamily DENDROBATINAE of the family RANIDAE. As I have already mentioned, members of the genus *Dendrobates* have no teeth on the maxillary bone, while *Phyllobates* possess such teeth, not readily visible except under a high-power lens, but easily felt by drawing a pin or other pointed object along the inside of the maxilla. Both genera have a longitudinal furrow along the top of each digit, forming two distinct platelets, unlike the single undivided disks found in most other frogs having enlarged toe and finger tips.

I shall consider first the 11 forms of *Dendrobates* now known from Colombia. In these the relative lengths of the first and second fingers are usually diagnostic, also the position reached by the adpressed heel in relation to the eye or tympanum. The color pattern is usually highly characteristic of the species. Due to the considerable amount of variation in the individuals of each species, the following statements as to the finger proportion, leg length and color pattern are only generally applicable, however, and each frog should be compared with the best available description and figure.

The largest Colombian *Dendrobates* known at present is *trivittatus*, reaching a head-and-body length of 46 mm. In alcohol it is mostly slatecolor, with a lighter stripe down each side of the back, and a lighter unspotted venter. It is one of the two species in Colombia in which the first finger is distinctly longer than the second. It is known from Brazil, British Guiana, Ecuador and Peru, as well as from Amazonas in Colombia.

The other *Dendrobates* with the first finger longer than the second represents a new species found in Caquetá, Colombia. Until its description has been published, I am not at liberty to discuss it further.

Two well-known *Dendrobates* with the first finger nearly as long as the second and with the heel reaching to the center of the eye when extended forward are *hahneli* and *lugubris*. A pale axillary spot, light narrow dorsolateral lines and reticulations on the posterior half of the belly distinguish *hahneli*, a small species reaching 23 mm in length and known from Meta and Putumayo in Colombia, as well as Peru. Lacking the axillary spot, having wider dorsolateral lines, and with light spots or reticulations scattered on the belly, *lugubris* in alcohol is a slate-colored frog of 34 mm., perhaps much brighter in life; it is widely distributed in Colombia and is known also from Panama.

The next large division of Colombian *Dendrobates* consists of those having the first finger much shorter than the second. The first subgroup contains very small frogs, not longer, than 18 mm. In *opisthomelas* and *minutus ventrimaculatus* there is a large light spot on the under side of the upper arm reaching from the axilla nearly to the elbow. In the former the heel reaches the anterior border of the eye, and there are no definite dorsal stripes; it is known from Antioquia in Colombia. The latter, first described from Ecuador, has a shorter leg, with heel reaching only to the posterior corner of the eye; usually there is a wide middorsal and a pair of dorsolateral light stripes. It is found in Caldas and Caquetá, Colombia.

The nominate form of the last-named has no conspicuous light spot below the upper arm. It is known at present from Panama and from Antioquia in Colombia.

The last subgroup under those frogs with short first fingers are the "clown-frogs", so-called because of their brilliant colors and patterns. The subspecific name of one of these is *histrionicus*, meaning an "actor". This one is black above with a large light spot (yellow or orange in life) on the snout and another between the shoulders. Its lower surface is also dark, with a rectangular light spot covering throat and chest, and another on the posterior part of the belly. Its maximum known size is 38 mm., and it occurs in Antioquia, Caldas and Chocó in Colombia.

A second form of *tinctorius* is *wittei*, about the size but with many small rounded silvery-white (orange in life) spots on the anterior part of the back, these becoming much larger on the sacrum. The lower surface is pearl gray in alcohol, with an irregular black patch on the center of the throat. It is known only from Chocó in Colombia.

A third subspecies is *chocoensis*, light above with several irregular dark spots on the back and dark brown below. Possible intergrades between *chocoensis* and *histrionicus* have been taken at Playa de Oro on Rio San Juan, Chocó. This most interesting mountainous region gives rise to streams draining two watersheds, one pouring into the Caribbean, the other into the Pacific. Perhaps the early geological history of this area explains the occurrence here within a short distance of each other of the three subspecies of *tinctorius* just mentioned.

A fourth subspecies of *tinctorius*, *confluens*, occurs in Cauca and Nariño, Colombia. In alcohol it is olive-gray with many small irregular black spots, but was said to be scarlet in life. A great deal more remains to be done both in collecting and in analysing the characters of these little frogs before the final word as to their identity can be said.

The genus *Phyllobates* is as variable in some of its characteristics as is the foregoing *Dendrobates*. Some authorities have recognized Cope's genus *Prostherapis* for frogs with maxillary teeth having webbed toes,

reserving *Phyllobates* for those without webbing on the feet. I find that the variation in regard to degree of webbing is so great in some Colombian species that this distinction can no longer be applied, as some frogs may have no perceptible web, while others of the same species from the same locality may have a small but distinct vestigial web. A separation on the character of skin, — whether it tears easily or seems resistant to abrasion — coupled with large size, heavy build and lack of distinct light striped may yet be possible. Such a distinction using only preserved material has not proved feasible. At any rate, the 14 Colombian forms to be discussed are now considered to belong to the genus *Phyllobates*.

In the first section of these, in which the toes are free or nearly so, and the first finger is usually longer than the second, we find four species. In *bicolor* (the poisonous “kokoi” of which you will hear later), the back and posterior part of belly are uniform pearl-gray or slate color, although these parts are known to be bright red-orange in life, while the upper surfaces of the limbs, now gray, were once yellowish in tone. The anterior half of the belly, as well as the throat and chest, are cinereous in alcohol, but in life were straw yellow to cream color. A Peruvian example had numerous black spots on the throat and chest, with a dark triangle on the center of the belly. The “kokoi” is about 42 mm. in length when adult. In addition to Peru, this frog has been collected in Antioquia, Caldas, Cauca, Chocó and Valle.

A light dorsolateral stripe, sometimes faint, occurs in the remaining three species having the toes free. The first finger is longer than the second, and the heel reaches between the anterior and posterior corners of the eye in *boulengeri* and *femoralis*. The former has coarse dark reticulations on the belly which continue on the throat and form a pair of short parallel dark stripes on the chin. It is a small frog measuring only 22 mm. and is found in abundance on Gorgona Island, and rarely on the adjoining mainland in Nariño and Valle. Its close relative is *femoralis*, with the chin and anterior part of belly black, the posterior half of belly being marbled dark and light. It is not known to exceed 26 mm in length. We know it from British Guiana and Peru, and from Amazonas, Caldas, Caquetá, Mata, Putumayo and Valle in Colombia. A fourth species in this section is *mer-tensi*, with toes that may be barely to almost 1/8 webbed. Its legs are short, the heel reaching between the tympanum and the posterior corner of the eye. Its belly is drab with heavy dark reticulations, and it reaches a length of some 30 mm. At present it is known only from Cauca.

In the remaining Colombian *Phyllobates*, the toes are webbed at the base up to 2/3 webbed. Some have the first finger shorter than the second. Among this, nominate *subpunctatus* has the toes webbed only at the base, while its heel reaches the posterior corner of the tympanum. Its belly is pinkish buff often small scattered dark spots, and its maximum size is about 22 mm. It appears to be restricted to Cundinamarca. The next three have more extensive webs. In *vergeli* the heel reaches the tip of the snout, the belly is immaculate, and the size is about 22.5 mm. It likewise is unknown outside of Cundinamarca. In the two remaining in this section, both have dark spots or reticulations on the belly; in *chocoensis* the toes are 1/2 webbed, the maximum size is about 27.5 mm., and the range is Chocó and Antioquia. A new species not yet published falls near the three preceding.

In the next section the first and second fingers are subequal. *Palmatus* has the toes 1/3 to 1/2 webbed; the belly is immaculate drab, and the size is up to 36.5 mm. This is one of the species most notable for its easily abraded

skin. In the rather large number of preserved specimens examined, I found almost none in which the skin was not ragged and torn, even when obvious care had been taken in collecting and packing the specimens. In spite of its susceptibility to abrasion, it is one of the commonest *Phyllobates* in Colombia, being recorded from over half the states. A new subspecies of *subpunctatus* from Boyacá is likewise placed with frogs having the first and second fingers subequal.

The final species have the first finger longer than the second and possess distinct webs. In *brunneus* the heel reaches the anterior corner of the eye, the belly may be immaculate or finely spotted, while its size does not exceed 22.5 mm. It is found over a wide range, from Panama, Ecuador and Brazil, and including most of the states of Colombia. Two species have the heel reaching the center of the eye; one of these, *pratti*, has the belly immaculate and is very small, measuring only 18 mm. in length. It is known at present only from Chocó. The other, *latinasus*, has the lower surface immaculate except for a dark line around the lower jaw and a patch of dark dots below the shoulder. Its size may be up to 26 mm., and its range is Panama, Ecuador and through much of Colombia. The final species, *inguinalis*, has the toes $1/4$ webbed, the heel reaching to the center of the eye, and the belly drab with a few darker spots below the femur and tibia. It attains a length of 29 mm., and occurs in Panama and in northern and western Colombia.

Needless to add, a great deal more collecting and comparison of species is needed before we can say the final word on the taxonomy and variation of these remarkable genera of arrow-poison frogs.

