

HISTORY AND HABITS OF THE EAST AFRICAN BULLFROG

By Arthur Loveridge

(Museum of Comparative Zoology, Cambridge, Massachusetts).

The receipt by the Coryndon Memorial Museum of a Machakos bullfrog (*Rana adspersa edulis*) with a length from snout to anus of $6\frac{1}{4}$ inches (160 mm.), reveals that the East African bullfrog attains dimensions comparable with those of the typical South African form (*Rana adspersa adspersa*) of which it should be regarded as a race.

The precise delimitation of ranges for the forms must remain unsettled till adequate series of the two races from Mozambique and neighbouring territories have been studied. For present convenience the Zambesi may be regarded as marking the southern limits of the East African bullfrog. If the river is really the limiting factor, the type locality must be restricted to "mainland opposite Mozambique Island," for the type material of *Pyxicephalus edulis* Peters (1854, Ber. Akad. Wiss. Berlin, p. 626) came from three localities, one of which—Tete—is on the south bank of the Zambesi.

So slight are the differences between the two races that Boulenger (1882, Cat. Batr. Sal. Brit. Mus., p. 33) referred *edulis* to the synonym of *Rana adspersa* (Tschudi, 1838) with which it has long been confused. It is an open question whether *Pyxicephalus*, characterised by robust habit, short limbs, and a digging tubercle on the heel, should be regarded as a full genus or, as I prefer, accorded subgeneric status.

Young bullfrogs are so utterly unlike the adults that it is not surprising that four juveniles from Quilimane, Mozambique, should have been designated *Phrynopsis boulengeri* by Pfeffer (1893, Jahrb. Hamburg. Wiss. Anst., 10, p. 101, pl. ii, figs. 5-6). Pfeffer based his new genus on the cartilaginous condition of the unforked omosternum and sternum a condition due to immaturity. In 1936, after examining Pfeffer's cotypes, I referred *boulengeri* to the synonym of *edulis*.

Another synonym, *Phrynopsis usambarae* Ahl (1924, Zool. Anz., 60, p. 271), was based on a young 25 mm. bullfrog from "Usambara" (District rather than Mountains, I imagine), Tanganyika Territory. This frog allegedly differed from *boulengeri* in having an inter-orbital space only two-thirds, instead of as broad as, an upper eyelid. The character is a notoriously variable one, permitting *usambarae* to be also synonymised without hesitation in 1936.

When a largish bullfrog from Orofillo, Somalia, was submitted to Miss Calabresi, she correctly observed it differed from *adspersa* in the length of its hind limbs, but overlooking the fact that the name *edulis* was already available and, indeed, had been recorded from nearby Gallaland by Peters in 1882, she named her frog *Pyxicephalus flavigula* Calabresi (1916, Monit. Zool. Ital., 27, p. 34, pl. ii, fig. 1). Under one or other of these five names, *Rana adspersa edulis* has been mentioned fifty times in herpetological literature since it was first described in 1854. The following notes summarize all that has been recorded of the life history of this interesting amphibian, chiefly observations by the present writer.

In East Africa these bullfrogs are most plentiful along the coastal plain, though occurring also in semi-arid upland savanna. However, owing to their burrowing habits they are rarely encountered except at the onset of the rains at which time the ground sometimes swarms with young ones ranging from half to one-and-a-half inches from snout to anus. What strikes the observer most is the disproportion of their short limbs to the obese, smooth-skinned bodies. The fingers, of course, are free of web, but the toes, with the exception of the longest, are half-webbed. At the base of the shortest toe is a compressed ridge that becomes quite horny in old rugose-skinned frogs. It is with this metatarsal tubercle that the bullfrog digs itself into sandy soil.

The general colour above ranges from olive in the young to plumbeous in adults; while extending from the tip of the snout to the anus of most young frogs is a pale green, vertebral stripe that disappears with age. From each eye three light stripes descend to the upper lip, occasionally these rather characteristic markings coalesce to eliminate the intervening dark bars and the entire lip region may be suffused with pale green or yellowish in half-grown frogs. The sides and sometimes, though to a lesser extent, the back, carry green and white vermiculations, while sometimes semi-circular patches of orange more or less surround the bases of all four limbs. The throat, chest and belly, which are pure white in the young except for brown or olive gular marmorations that may, or may not, be present, turn lemon yellow in later life. It may be supposed that this bright colouring is seasonal or sexual but it was displayed or absent in non-breeding bullfrogs of $3\frac{3}{8}$ to $3\frac{5}{8}$ inches taken at Bagamoyo on 11th November 1929. Like the dark gular markings that are sometimes absent in adult males, the whole question requires clarification.

With the breaking of the rains the adults assemble to breed in flooded areas. The tadpoles, as stated by Mitchell (1946, Nyasaland Agric. Quart. Journ., 6, p. 30) are gregarious, but in saying that they "are guarded by their parents for at least part of their lives" he is incorrect. On the contrary I have found both tadpoles and young *edulis* in the stomachs of adults on several occasions. The eviction from a pond of five hungry ducks in consequence of attacks by a bullfrog, is subject to a different interpretation, and may be attributed to the indiscriminate voraciousness of the species. Mitchell's frog kept popping up to see where the ducks were, then submerging for a fresh attack. When the birds finally left the water, the amphibian followed them out.

The South African race has been known to take ducklings, but a lizard (*Latastia johnstonii*) is the largest vertebrate I have recovered from the stomach of an East African bullfrog. Two young *edulis*, when picked up and dropped into an ordinary entomological killing bottle, and despite the fairly rapid action of the cyanide, seized and partly swallowed two of their companions. In one *edulis* was a young Mascarene frog (*Rana m. mascareniensis*), in another a partly-digested sedge frog (*Hyperolius* sp.) together with a small crab (*Potamon bottegii*), a yellow millipede, carabid and various beetles, and the remains of other insects. A caterpillar, grasshopper and allied orthoptera, cockchafers, termites, ants including the formidable stink ants (*Megaponera foetans*), millipedes and a polydesmid, were recovered from sundry bullfrogs.

But the most astonishing meal I ever found in one of these amphibia had been taken by a Mikindani bullfrog, and appeared to indicate an imperviousness to stings that was truly astonishing. This creature's stomach held three scorpions each measuring $1\frac{1}{4}$ inches from head to end of sting; a centipede 4 inches long and $\frac{1}{3}$ inch broad; a millipede $2\frac{3}{4}$ inches long; a scutigera; a carabid beetle $1\frac{1}{2}$ inches long of a species that ejects formic acid; three black stink ants $\frac{1}{16}$ inch long; and the remains of a snail whose shell measured $\frac{7}{16}$ inch in diameter.

The only internal parasite I came across was an immature ♀ ascarid in a Bagamoyo bullfrog, but the pits and sores on the limbs of the Machakos frog in the Coryndon Museum are suggestive of myiasis. If correct, the fly responsible for the infestation may well represent an undescribed species as was the case with flies specializing in the parasitization of European and Australian amphibia.

Bullfrogs have other enemies. Near Dar es Salaam I found one with more than a score of dead driver ants, or *siafu* (*Dorylus nigricans brumeisteri*) attached to its belly and limbs. In some instances only the jaws and heads remained, like amphibian war medals, as mute testimony to what must have been an unpleasant encounter. At Mkonumbi I removed a young *edulis* from the stomach of a stripe-bellied sand-snake (*Psammophis sudanensis subtaenatus*) and at Mangasini a larger bullfrog from a spitting cobra (*Naja n. nigricolis*). At Port Herald, says Mitchell, many bullfrogs are swallowed by pelicans (*Pelecanus rufescens*) and later regurgitated, their bodies being found beneath the nests.

Man must also be reckoned among their foes, for the name *edulis* was given these bullfrogs by Peters on account of their being eaten by the natives of Mozambique. This is also true of the Sena tribesmen at Port Herald, according to Mitchell, and in Northern Rhodesia as reported by S.A. Neave.

I cannot confirm or deny Tornier's (1909) statement that this bullfrog, when alarmed, renders itself less conspicuous by squatting with feet drawn in so they are concealed by the body skin. According to Werner (1913) a frightened bullfrog inflates and cries loudly. That people, unfamiliar with the deep resonant call of this frog, are sometimes alarmed by it I do know. At Kilosa, on 17th March, when the first heavy downpours of the rainy season flooded a maize plantation to the depth of a foot my collector, Salimu bin Asmani, reported hearing a "grunting" sound that caused him to run for he thought it emanated from a leopard. Later he saw the snout of the "biggest frog I have ever seen" break the surface and emit the same call. They were calling also during the lesser rains at Bagamoyo on 11th November, so spawning may take place twice a year.

For the present it must remain uncertain whether the record of one of these bullfrogs attacking a man (*cf.* Loveridge, 1945, Copeia, p. 232) refers to *edulis* or the possibly recognisable western form *Rana a. maltzani* Boulenger (*inc. bufonia* Boettger), the type of which came from Rufisque, Senegal. Whether *Phrynopsis ventrimaculata* Neideng (1908) of Longji, Cameroons, is a synonym also requires investigation. The bullfrog that bit the leg of an African policeman as he was passing a pool one night near Tapili, Niangara, Belgian Congo, was not preserved. The $2\frac{3}{4}$ -inch female "*adpersa*" recorded by Werner (1908) from Khor Attar, Anglo-Egyptian Sudan, is doubtless referable to the same subspecies. No bullfrog of *this group* is known from Uganda, and until a series of the western frog is available for study we cannot say with certainty whether it is distinguishable from the eastern *edulis*.

Undoubtedly the three bony teeth at the front of the lower jaw are capable of inflicting a severe bite, for the outermost resemble canines and rise $\frac{5}{16}$ inch from the parapet of the jaw in the largest specimens of this bullfrog. No one has studied the life history of the East African race and much remains to be learned of its habits. A search of over 2,000 contributions to African herpetology reveals that *Rana adpersa edulis* is known only from the following localities:

Somalia: Caitoi, Webi Shebeli; Goscia; Orofillo. **Kenya Colony:** Frere Town; Gallaland; Golbanti; Gongoni; Karawa; Kenya region; Lake Jipe near Witu; Likoni; Machakos; Mkonumbi; Mombasa; Peccatoni; Pokomoni; Unyika; Witu. **Tanganyika Territory:** Amboni near Tanga; Bagamoyo; Dar es Salaam; Kilimatinde; Kilosa; Kitaya; Lake Balangida; Liwale; Mangasini; Mikindani; Mogogoni Swamp; Mohorro; Nyambita; Siga Caves; Tanga; Ugogo; Usambara (Neumann coll.); Wembere Blats. **Northern Rhodesia:** Broken Hill; Chama River to Luwumbu River; Lialui (Lealui); Luangwa (Loangwa) River; Lukashashi River. **Nyasaland:** Port Herald; Rift Valley; Shire Highlands (Günther, 1895). **Mozambique:** north of Zambesi; Boror; Cabaceira Peninsula; mainland opp. Mozambique Island; Quilimane; Sena.