

Short Communications

The tadpole of *Hyperolius mitchelli* (Anura: Hyperoliidae)

A. Channing*

Biochemistry Department, University of the Western Cape, Private Bag X17, Bellville, 7530, Republic of South Africa

Marie-Dominique Crapon de Caprona

Department of Biology, University of Bielefeld, 4800 Bielefeld, West Germany

Received 3 October 1986; accepted 23 January 1987

The tadpole of *Hyperolius mitchelli* is described. The specimens on which this description is based were reared in captivity from adults caught at Amani, Tanzania. These tadpoles possess rostral papillae, which together with a curtain of lingual papillae are characteristic of the species. Too few *Hyperolius* tadpoles have yet been described to present a diagnosis or identification key to the genus.

Die paddavis van *Hyperolius mitchelli* word beskryf. Die eksemplare waarop hierdie werk gebaseer is, is in die laboratorium geteel van volwassenes gevang naby Amani in Tanzania. Hierdie paddavisse besit rostrale papille, wat tesame met 'n gordyn van tongpapille, kenmerkend van die spesies is. Te min *Hyperolius*-paddavisse is reeds beskryf om 'n diagnose of 'n identifikasiesleutel vir die genus te gee.

*To whom correspondence should be addressed

The African reed frog genus *Hyperolius* consists of over a hundred polymorphic species (Frost 1985). The *H. puncticulatus* complex in east Africa was shown by Schiøtz (1975) to consist of two cryptic species, *H. mitchelli* Loveridge and *H. puncticulatus* (Pfeffer). Both species are morphologically similar and share a range of colour patterns. They are sympatric over much of their range and have been previously confused. The calls of the two species and slight morphological differences, however, confirm the species status of *H. mitchelli*

(Schiøtz 1975). The tadpole of *H. puncticulatus* is still unknown.

One of us (C.de C.) collected adult *H. mitchelli* from Amani, Usambara mountains, Tanzania, and maintained a breeding colony in the laboratory. *H. mitchelli* lays batches of 50–100 eggs at night, in a tight mass on the leaves of plants overhanging water. After 5 or 6 days the pale developing tadpoles wriggle off the leaves into the water during rain. They become darkly pigmented once they are free swimming.

Descriptive characters and nomenclature for the tadpoles of *H. mitchelli* are based on those of Van Dijk (1966) as modified by Channing (1972, 1974, 1976, 1978). The internal buccal anatomy was examined under a dissecting microscope and then prepared and photographed using a scanning electron microscope. The internal buccal anatomy was described using Wassersug's (1976) terminology.

The tadpoles on which this description is based are deposited in the collection of the Port Elizabeth Museum (PEM A1428).

External features

Based on five tadpoles 18–36 mm, stage 25 to 38 of Gosner (1960) plus an additional series through metamorphosis ($n=14$). All proportions are given as decimals, (e.g. the oral disc is 60% to 70% of the head width, expressed here as 0,6–0,7). All descriptive statistics are calculated with $n=5$. Measurements of the five tadpoles are presented in Table 1.

Mouth situated anteroventrally. Oral disc 0,6–0,7 head width at level of disc (\bar{x} 0,64; SD 0,04), not visible dorsally. Oral papillae pigmented, in a double row with a rostral gap 0,45–0,97 disc width (\bar{x} 0,62; SD 0,18). No mental gap. The inner row of oral papillae form a group of about seven papillae in the angle of the mouth. Papillae extend onto the rostrum in three of the four stage 33–42 larvae examined. These rostral papillae may consist of two larger asymmetrically placed papillae, or a series of irregular papillae extending sometimes to the nostrils. Suprarostrodont finely serrated, marginal 0,5 pigmented and keratinized. Infrarostrodont similar, except that light pigmentation extends laterally to the base. Keratodont formula usually 1/1+1;2. The two proximal rows of ventral keratodonts may both be divided to give

Table 1 Measurements of five tadpoles of *Hyperolius mitchelli* (mm)

Specimen	Length	Disk width	Head width at level of disk	Mental gap	Nostril width	Internarial distance	Rostro-nasal distance	Orbito-nasal distance	Head width at level of eyes	Extra-orbital proportion	Snout-spiracle	Trunk length	Height tail muscles	Height trunk
1	18	1,45	2,25	0,78	0,10	1,83	0,45	1,09	3,62	0,92	4,33	5,68	1,10	2,20
2	33	2,10	3,18	0,94	0,09	2,88	0,93	1,51	5,65	0,54	6,27	9,23	1,28	2,46
3	33	1,50	2,41	1,46	0,10	2,64	0,90	1,50	6,33	0,50	7,52	10,8	1,28	2,46
4	36	2,30	3,93	1,23	0,11	2,83	0,82	1,57	6,55	0,00	7,55	19,5	3,18	5,26
5	35	2,20	3,15	1,36	0,14	2,08	0,46	1,20	6,50	0,00	6,90	10,2	2,55	5,26

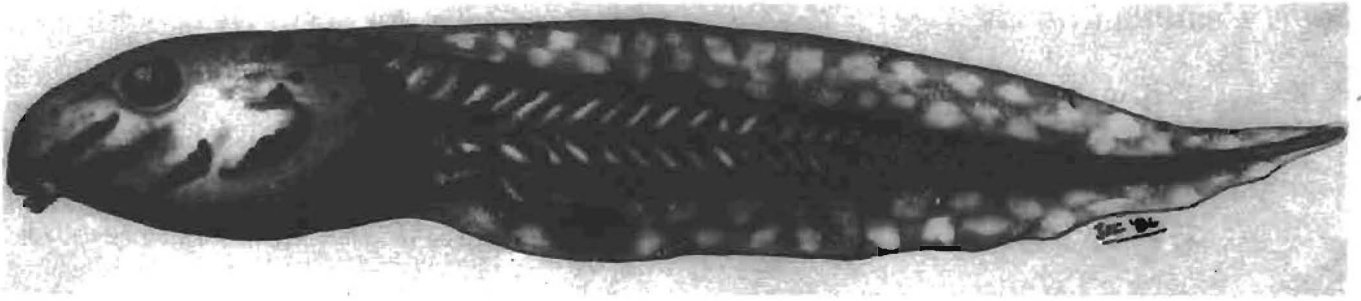


Figure 1 Pigmentation patterns of a typical *Hyperolius mitchelli* tadpole. Length = 33 mm.

a formula $1/2+2;1$.

Nostrils small, subcircular, rimmed. Orbitonasal line visible. Papillae usually present around nostrils, but not necessarily on both sides. Nasal passage visible laterally. Internarial ratio (width of nostril/internarial distance) = $0,03-0,07$ (\bar{x} $0,05$; SD $0,01$). Longitudinal position of nostrils (rostronasal distance/orbitonasal distance) = $0,38-0,62$ (\bar{x} = $0,51$; SD $0,09$). Eyes lateral in stage 33 tadpoles, but more medial at stage 25. Extra-ocular proportion (width of head minus distance between lateral limits of eyes/distance between lateral limits of eyes) = $0,0$ (stage 34+) - $0,25$ (stage 25) (\bar{x} $0,09$; SD $0,09$). Spiracle single, sinistral, situated $0,68-0,76$ posteriorly along trunk (\bar{x} $0,71$; SD $0,03$). Opening constricted, subcircular, visible laterally and dorsally.

Tail height greater than trunk height. Tail pointed, heterocercal. Maximum height of dorsal fin occurs about $0,3$ posteriorly along tail. Axis of tail extrapolated anteriorly passes through dorsal margin, of eye. Tail length/trunk length = $2,06-2,58$ (\bar{x} $2,34$; SD $0,19$). Height of caudal muscles at base of tail/height of trunk = $0,48-0,60$

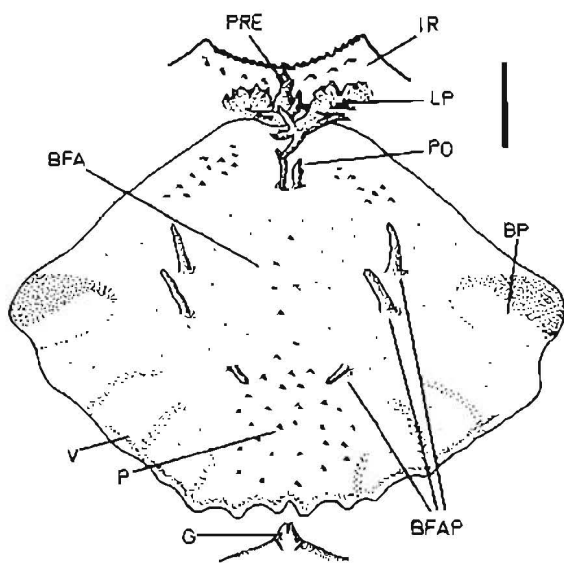


Figure 2 The buccal floor of a *Hyperolius mitchelli* tadpole. Scale line = $0,5$ mm. Abbreviations: BFA — buccal floor arena, BFAP — buccal floor arena papillae, BP — buccal pocket, G — glottis, IR — infrarostrodont, LP — lingual papillae, P — pustulations, PO — post lingual papillae, PRE — prelingual papillae, V — ventral velum.

(\bar{x} $0,53$; SD $0,04$) (Figure 1).

Pigmentation lightly stippled over trunk and tail. Fins and tail mottled. Orbitonasal line and ventral epidermis covering gut coils unpigmented.

Internal oral features

Buccal floor

The oval buccal floor is bounded anteriorly by two compound lingual papillae which overlap to form a dense filter (Figure 2). Between the lingual papillae and the mouth is a long medial prelingual papilla with a number of shorter papillae and pustulations at its base. This complex (Figure 3) is the most remarkable feature of the buccal cavity of these tadpoles, and is visible through the mouth of an intact tadpole. Two short postlingual papillae occur medially posterior to the lingual papillae.



Figure 3 The characteristic complex of lingual and pre-lingual papillae on the buccal floor of a *Hyperolius mitchelli* tadpole, looking ventrally. See Figure 2 for orientation and scale.

The lateral buccal pockets and three or four elongate compound buccal floor arena papillae comprise the lateral margins of the buccal floor arena. The ventral velum is moderately scalloped with marginal projections and a small medial notch.

Buccal roof

The prenarial arena possesses a transversely arranged row of pustulations. The choanae open laterally into the buccal cavity and are not visible ventrally. A pair of infralabial papillae are present on each side. Two elongate postnarial papillae form the anterior border of the buccal roof arena. The buccal roof arena is subcircular, and covered posteriorly by many pustulations. The lateral and posterior margins of the buccal roof arena are bounded by six to eight compound papillae.

Discussion

These tadpoles key out easily as *Hyperolius* using Van Dijk's (1966) key. The rostral papillae are an unusual feature and may prove to be useful for identification. The function of these external papillae may be related to that of the dense curtain of lingual and prelingual papillae present in these tadpoles; both may serve a tactile function.

Hyperolius tadpoles swim with their mouths open (judging from the position of the keratodonts in preserved specimens). The rostral papillae and lingual papillae are ideally situated to detect food items or large particles which are potential feeding hazards. The lingual papillae could possibly prevent large particles from entering the mouth and clogging the gill filters in this species, but Hammerman (1967) has shown that they are chemoreceptive structures in other ranid tadpoles.

It is too early in the study of *Hyperolius* larvae to be able to distinguish morphological trends, or to construct an identification key to the various species.

Acknowledgements

We thank Prof. A. Nikondiwe for his help in Amani, Tanzania. This paper was written during a sabbatical while A.C. was at the Museum of Natural History at the University of Kansas. Dr. William E. Duellman kindly placed the museum facilities at his disposal.

References

- CHANNING, A. 1972. A description of *Bufo pusillus* tadpoles (Anura: Bufonidae). *Ann. Natal Mus.* 21: 509–511.
- CHANNING, A. 1974. A description of *Bufo pardalis* tadpoles (Anura: Bufonidae). *Zool. Afr.* 8:153–156.
- CHANNING, A. 1976. *Rana johnstoni inyangae* tadpoles from Rhodesia. *Arnoldia Rhod.* 8: 1–4.
- CHANNING, A. 1978. A new bufonid genus (Amphibia: Anura) from Rhodesia. *Herpetologica* 34: 394–397.
- FROST, D.R. 1985. Amphibian species of the world. Allen Press and The Association of Systematics Collections. Lawrence, Kansas.
- GOSNER, K.L. 1960. A simplified table for staging anuran

embryos and larvae with notes on identification.

Herpetologica 16: 183–190.

HAMMERMAN, D.L. 1967. Lingual premetamorphic papillae as larval taste structures in frogs. *Nature, London* 215: 98–99.

SCHIØTZ, A. 1975. The Treefrogs of Eastern Africa. Steenstrupia, Copenhagen.

VAN DIJK, D.E. 1966. Systematic and field keys to the families, genera and described species of southern African tadpoles. *Ann. Natal Mus.* 18: 231–286.

WASSERSUG, R.J. 1976. Oral morphology of anuran larvae: terminology and general description. *Occ. Papers Mus. Nat. Hist. Univ. Kansas* 48: 1–23.

Thermoregulation in the hippopotamus on land

P.G. Wright

Department of General Physiology, University of the Witwatersrand, Johannesburg, 2050 Republic of South Africa

Received 28 November 1986; accepted 6 March 1987

Restriction of a hippopotamus to the land under hot environmental conditions during the day resulted in an increase of no more than 1°C in core temperature. The rising adverse radiation and convection heat load was met by increase in evaporative water loss from the skin. The increased water loss was brought about by secretion from subdermal glands which wetted the skin surface and increased water movement through the integument. The hippopotamus normally avoids thermal stress on land by taking to the water for most of the day but it can restrain its core temperature under adverse conditions on land.

'n Seekoei, tydens die dag tot die land beperk onder warm omgewingstoestande, se kerntemperatuur het gestyg met niks meer as 1°C. Die toenemend ongunstige uitstralings- en konveksie-hittelading is teëgewerk deur 'n vermeerdering in die verdampingsverlies van water deur die vel. Die verhoogde watervlies is die gevolg van die benutting van die veloppervlak deur subdermale kliere wat ook vermeerderde waterbeweging deur die huid veroorsaak het. Die seekoei vermy hitespanning op land normaalweg deur in water te bly vir die grootste deel van die dag maar hy kán sy kerntemperatuur in ongunstige landtoestande beheer.

The bodycore temperature of the hippopotamus (*Hippopotamus amphibius* Linn.) sampled in individuals culled from a wild population under natural conditions showed a remarkable uniformity with no obvious 24-hourly rhythm (Luck & Wright 1959; Wright 1964). Consideration of heat loss mechanisms apparently available to this animal led Wright (1964) to suggest that autonomic control was limited but that the behavioural pattern minimized thermoregulatory problems. Luck & Wright (1964) demonstrated the high basal rate of trans-epidermal water loss on land and considered possible implications of this in relation to the structure of the skin.