DIAGNOSTIC CHARACTERS OF TOMOPTERNA AND RANA (SENSU STRICTO) TADPOLES

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In constructing keys to the families, subfamilies and genera of southern African tadpoles (Van Dijk 1966) it proved to be expedient to key out the other families to leave the Ranidae by elimination, to key out the other subfamilies of the Ranidae to leave the Raninae by elimination, and to key out the genera in the Raninae in the order *Hildebrantia*, *Ptychadena*, *Strongylopus*, *Pyxicephalus* (sensu stricto), *Hylarana*, *Tomopterna* and *Rana* (sensu stricto). The last step in the key to the genera as a whole is thus designed to distinguish *Tomopterna* from *Rana* (sensu stricto), these genera being left when the other genera have been keyed out by means of more or less striking features. *Tomopterna* tadpoles possess a conspicuous feature which they share, in the Raninae, with *Hildebrantia* and *Pyxicephalus* sensu stricto (from which they can be distinguished by oral features), namely the presence, from the earliest five-toed stage, of a spur on the hind foot, giving a six-toed appearance when the spur first appears. This feature has the disadvantage that it appears rather late and can be overlooked when it first appears. It is nevertheless an obvious feature to use in a key, and is in fact the only distinguishing character used for *Tomopterna* in the field key (Van Dijk 1966: 244–245); it is also one of the characters used in the main key, in fact the only one italicized in both alternatives, indicating that, on its own, presence of a spur in the five-toed stage diagnoses *Tomopterna* and, on its own, absence of a spur in the same developmental stage diagnoses *Rana* (sensu stricto).

In the main key, besides the spur on the foot, tail and spiracle characters were used, the former with the intention of making use of the relatively short tail of *Tomopterna d. delalandei* and *T. d. cryptotis*, the numerical limits being set in such a way that a good sample of *T. natalensis* would in addition alert an investigator to some of the specimens, and hence all of them if they all belonged to the same species, not being *Rana* (sensu stricto); consideration of the other characters would then indicate *Tomopterna* in the case of *T. natalensis*. The intentions of the last dichotomy in the key were not, however, achieved:

> 6. *Tail not as high as body and not more than 5/3 the length of the head and trunk.* Medial wall of spiracular opening closely applied to the body wall. Spiracular tube opens dorsoposteriorly broadly (*i.e.* with little constriction). *Spur develops beside the fifth toe as soon as this is developed* .. **Tomopterna** (*Pyxicephalus*)
> — Tail may be as high or higher than body and more than 5/3 the length of the head and trunk. Medial wall of spiracular opening may be raised from the body wall. Opening of spiracular tube typically somewhat constricted. *Spur absent from foot* .. .. **Rana** (sensu stricto)

The tail characters should have been expressed as follows:

> *Tail may be, and usually is, not more than 5/3 the length of the head and trunk* and is not as high as body. .. .. .. **Tomopterna** (*Pyxicephalus*)
> — *Tail more than* 5/3 *the length of the head and trunk* and may be as high or higher than the body. .. .. **Rana** (sensu stricto)

Balinsky (1969: 51–52) remarked on the tail characters as originally given as follows:

'Van Dijk (1966) claims that tadpoles of *Pyxicephalus natalensis* and *Pyxicephalus delalandii* may be distinguished from those of the genus *Rana* by the relative length of head plus body to length of tail. He states that in the two species of *Pyxicephalus* the tail is not longer than 5/3 (or 1.67) of the length of head plus body. According to Van Dijk in *Rana* tadpoles the tail is more than 5/3 (or 1.67) times the length of head plus body. My own measurements of the head and body and of the tail do not confirm Van Dijk's statement.

They are as follows:

Species	*No. of specimens measured*	*Average ratio of tail to body length in %*	*Range of variation*
Pyxicephalus delalandii	39	1.65	1.25–2.11
Pyxicephalus natalensis	21	1.95	1.57–2.33
Rana fasciata	11	1.93	1.50–2.21
Rana angolensis	37	2.08	1.68–2.64

It is evident that an average tadpole of *Pyxicephalus natalensis* would be classified as a *Rana* tadpole when using Van Dijk's key. Furthermore the range of variation is such that even some *Pyxicephalus delalandii* tadpoles might be classified as *Rana* tadpoles, whilst many *Rana fasciata* tadpoles fall in the range supposedly characteristic of *Pyxicephalus* tadpoles.'

It is not correct, as implied, that the tail characters *alone* were represented as diagnostic, nor is it correct that an average tadpole of *Tomopterna natalensis* would be incorrectly classified if *all* the characters in the key were used. Balinsky also substitutes *Rana* in his comments for *Rana* (sensu stricto) and hence includes in *Rana* the species keyed out as *Strongylopus* at an earlier step (see above); not surprisingly he finds overlap in tail characters between *Tomopterna* and *Strongylopus fasciatus*. Since *Rana angolensis* has the shortest tail of the *Rana* (sensu stricto) species in southern Africa, contrary to what he says Balinsky's data confirm the placing of the limit of tail length at 5/3 of the length of the head and trunk.

Balinsky uses the relative width of the base of the tail for separating *Pyxicephalus* (*Tomopterna*) *natalensis* and *P.* (*T.*) *delalandei* from *Rana*, *i.e. R. angolensis* and *R. fasciata* (*Rana* sensu stricto and *Strongylopus* respectively), and comments on the limitations of the criteria (p. 51). The width of the tail at its base is less than half the width of the body in some *Rana angolensis* tadpoles, notably among populations with a smaller maximum size; the limitations are greater than stated by Balinsky, and, since *Rana vertebralis* (and, ? =, *R. umbraculata*) from the Drakensberg of and around Lesotho has a slender tail, the character of relative width of the tail at its base cannot be considered as a generic character distinguishing *Tomopterna* from *Rana* (sensu stricto) without making provision for exceptions.

The final step in Balinsky's key is as follows:

10. Length up to 44 mm. Distal part of tail tends to be jet black. .. .. .. *Rana fasciata*
— Length up to 130 mm. Distal part of tail not appreciably darker than the proximal part .. .. *Rana angolensis*

Balinsky does not contrast highveld specimens of *S. fasciatus* with specimens from elsewhere in respect of the characters he uses; descriptions and figures from the Cape and Natal suggest that these characters are of questionable value. Hewitt (1937) figures a specimen (preserved) with no darker region on the tail posteriorly, while Wager (1965) figures three tadpoles, only one of which has a tail distinctly darker posteriorly; Hewitt's and Wager's descriptions are respectively 'The tadpole reaches a large size, length 2 inches, and is generally pale . . .' (p. 96) and 'They reach a maximum of 70 mm, and are flat, heavy tadpoles. . . . The tail and body are brown and stippled with darker spots, and the last half of the tail is usually black in colour.' (p. 153). An upper limit of 44 mm in length seems unrealistic unless it can be established that Transvaal highveld tadpoles of this species are consistently not even two-thirds the size of those in Natal. Balinsky gives no lower limit for the length of *Rana angolensis* tadpoles, but for this character to work in his key 44 mm should be the minimum size attained by *Rana angolensis* tadpoles when at their largest; this is certainly not the case for regions outside the highveld, since fully-grown tadpoles of this species measuring less than 40 mm (preserved) have been collected from Royal National Park, Natal Drakensberg; it is quite probable that *Rana angolensis* tadpoles which

never attain a length of 44 mm can be found on the Transvaal highveld.

With any quantitative character in tadpoles, such as a ratio, absolute size, or degree of pigmentation, keys should be thought of as applicable not to every individual tadpole, but to most of a population – in a good key 99 per cent or more. So far few corrections have been found to be necessary in the keys in Van Dijk (1966). One such involves the ratio of distance between the nostrils to nostril-width, where the limits were set at less than 6x and more than 10x; in the case of *Phrynobatrachus* (field key and p. 248) instead of 10x or greater the ratio should be set at more than 6x.

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EFFECTS OF SODIUM CHLORIDE ON THE FRESHWATER FISH LABEO CAPENSIS DURING AND AFTER TRANSPORTATION

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INTRODUCTION

The effects of capture and transportation on freshwater fish have been studied by many workers (Fujiya 1961; Bouck & Ball 1966; Mann 1965; Narasimhan & Sundararay 1971; Hattingh & Van Pletzen 1974, to name but a few). Amongst other things, it would appear that fish experience osmoregulatory problems during and after capture (Wedemeyer 1972; Hattingh & Van Pletzen 1974). To counter this phenomenon, it has been suggested that commercial salt (about 98 per cent NaCl) be added to the transportation water and the fish kept in this solution for some time afterwards (Hattingh *et al.* 1975). By using this method, a much lower mortality is obtained during transport.

The question now arises as to the nature of the protective function of the added NaCl. Is it merely a physical effect of increasing the osmotic pressure of the water and thus limiting water absorption through the skin and gills, or is there a more physiological effect? This paper reports some of our findings.

MATERIALS AND METHODS

The freshwater fish, *Labeo capensis*, was used in this study. Adult and healthy specimens were seined in local waters. For the first set of