

## Parental care in *Hemisus* (Anura: Hemisotidae)

D.E. van Dijk

c/o Department of Zoology, University of Stellenbosch,  
Stellenbosch, 7600 South Africa

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Accounts of parental care in Anura frequently include mention of the South African frog genus *Hemisus* and derive their information from what was written by the late Vincent Wager. An analysis is given of what exactly is known and what has been written, either from original observations or derived from other publications.

Since 1929 discussions of anuran biology, and particularly discussions of reproductive strategies, have often cited maternal care of the early stages of *Hemisus*, the shovel-nosed (or pig-nosed) burrowing frog of Africa. Recently the following comment was published (Duellman, 1993, p.228): 'The larvae of the African *Hemisus marmoratus* may be transported on the back of the female, who excavates a tunnel from an underground nest chamber to a pond (Bourquin 1985; van Dijk 1985).' In fact Bourquin refers to discovery of tadpole transport only, and van Dijk merely cites an overlooked report of tadpole transport (published 1907) and questions whether a tunnel to a pond is made. Reports of the excavation of a tunnel from an underground nest chamber to a pond are traceable to Wager (1929). A review of what exactly is known, and what exactly has been written about parental care in *Hemisus* might help to limit future spurious comments.

Apart from an overlooked account (Budgett 1900 *verbatim* in Bles 1907) all that was known of parental care in *Hemisus* until 1985 seems to have been derived from articles by Vincent Wager, especially in the past two decades from Wager (1965), a book on South African Frogs. Thus in a review of the care of the eggs of Cameroon Anura, Amiet (1991) begins 'Grâce à WAGER (1965) ...' (p.21). The reference ends with a statement similar to that of Duellman (1993): 'Les têtards, après l'éclosion, rejoignent le milieu aquatique grâce à une galerie de sortie forée par leur mère.' There are three accounts of the *Hemisus* female/tadpole interaction in Wager (1965), two on *H. marmoratus* (pp. 69–70 and pp. 178–179) and one on *H. guttatum* (pp.180–181). The account on *H. guttatum* deals with the behaviour of tadpoles left alone in a damp nest and concludes with a statement presumably derived from experience with *H. marmoratus*: 'Normally they would wriggle down the tunnel the mother digs for them until they reach the water'. The accounts on *H. marmoratus* differ subtly from one another. The first is in the present tense and passive voice, as though it was being described while it was occurring: 'At the end of eight days the developing tadpoles were showing strong wriggling tendencies, and were breaking out of the egg capsules. Mother now tunnelled towards the water, and the tadpoles in a mass, with constant wriggling movements, slowly followed her. When finally she broke through, she swam off and her responsibilities were over. The water flooded into the tunnel and the tadpoles started to swim until they emerged into the pond, where they continued to live as

normal tadpoles.' (pp. 69–70). This account records no association of the tadpoles with the mother other than following her to water shortly after they hatched. How it was possible to observe the tunnelling without disturbing it was not recorded. The second account is in the past tense and active voice, suggesting the description of a known behaviour, observed more than once: 'The eggs are laid in a spherical cavity, or nest, 2 inches in diameter with smoothed walls, and 3 inches to 6 inches below the surface of the ground, and from 3 inches to 3 feet from the water. The female sits on the eggs until they hatch, then digs a tunnel towards, and into, the water. The tadpoles wriggle down this tunnel in a mass, and swim off into the water' (p. 179). Again there is no reference to delay between hatching of the tadpoles and tunnelling of the mother.

The earliest account by Wager was given in a communication to the Royal Society of South Africa in Cape Town on June 20, 1928. The communication related to observations which formed the basis of an account published in 1929 in the society's transactions (Wager 1929). This was earlier than publication of the proceedings of the meeting, which were published with the transactions of 1930 (Wager 1930). The reference to Wager's work in Rose (1929) is a direct quotation from the abstract of the oral communication: 'the eggs are laid in small cavities under the surface of the bank of a pool and are looked after by the female until they are hatched. The female then digs a tunnel from the nest to the water down which the tadpoles wriggle in a mass. The young tadpoles have a peculiar method of respiration, and are able to remain alive out of water for as much as 18 days', (p. 78 and Appendix p. 216). Rose's book, and 1950 and 1962 versions with the same quotation, brought the account in Wager's abstract to a wide readership. This account differs in important respects from that in Wager (1929), which is as follows: 'The female, however, was always found in the nest sitting with her legs touching the floor of the cavity, and the underside of her body resting on the eggs. This is one of the few cases of maternal instinct found in frogs, as the female takes care of the eggs until they hatch. In two cases, old empty nests were found, and, although there were no visible remains, a tunnel could easily be traced where the soil was soft, wet and muddy, leading in a line through the bank to the water and entering the water some short distance below the surface. The newly hatched tadpoles are lively and indefatigable wrigglers, and, when this stage in their life is reached, it seems certain therefore that the mother burrows towards the water making a tunnel down which the tadpoles wriggle in a squirming mass until they reach the water. On entering the water the tadpoles immediately swim off in all directions, and the mother's responsibility is over' (p. 129). The deductions are based on two empty nests and the wriggling behaviour of newly hatched tadpoles. The initially circumspect 'it seems certain therefore...' is followed by what reads like a series of statements of fact.

Definitive observations would require that a tunnel be fortuitously excavated, without interfering with the female, just when she is burrowing to water, followed by tadpoles. The flooded grassy terrains in which *Hemisus* tadpoles are sometimes found, for instance the vleis investigated during collecting for production of a key to southern African tadpoles (van

Dijk 1966), appeared to be inconsistent with a female burrowing to water; flooding of burrows appears more likely in such terrains. Wager's accounts, up to 1965, and the derivative ones in Rose's books, needed to be treated with circumspection. When I received information from Dr. O. Bourquin that his school-boy son had reported seeing eggs and tadpoles on the back of a *Hemismus* dug up in a river bed, I examined the whole of a microfilm from which I had extracted information on fully developed tadpoles for the publication mentioned above, and found that tadpole phoresy in *H. marmoratus* in West Africa had in fact been reported by Bles (1907), quoting *verbatim* from the diary of J.S. Budgett. The rediscovery of the apparently totally overlooked reference was reported (van Dijk 1985), while Dr. Bourquin outlined his son's observations (Bourquin 1985). When Dr. Wager was revising his book I drew his attention, amongst other things, to these three papers. He added to his previous account: 'More reports of tadpoles swarming around the mother have recently been cited by van Dijk 1985, and Bourquin 1985' (Wager 1986, p. 127). Duellman & Channing (1988), in reviewing Wager's 2nd Edition comment: 'Although he cites Bourquin's (*sic*) (1985) and van Dijk's (1985) papers on *Hemismus* tadpoles, he does not mention that their findings contradict his own' (p.272). Fitzsimons (1935) does not refer to Wager when describing the finding of a nest of *H. m. marmoratus*: 'FIELD NOTES. A pair (Nos. 1232 and 1233) were taken together under a rotting log, lying in damp mud on the edge of a rain-filled pan, in mopane forest near Bushman Mine. The female (No. 1233) was found nestling in a small cavity, alongside a recently deposited egg-mass, while the male was a short distance away' (p.394). In a popular science book in Afrikaans on the frogs and toads of South Africa (*Soek- en Leer-Reeks*), Fitzsimons (1947) draws information from his own experience and from Wager (1929), and has a significant comment about the tadpoles and their egress: '*As gevolg van die aanhoudende beweging, kriel die paddavissies hulle weg af langs 'n voorheen bereide gang of tonnel (terselfdertyd as die nesholte gemaak en waarskynlik ook met die doel om die moeder van 'n uitgang te voorsien) tot die water, waar hulle onmiddellik wegsweem en hulle ontwikkeling in die gewone manier sonder verdere ouerlike toesig voltooi.*' [As a result of the continuous movement, the tadpoles wriggle their way along a previously prepared passage or tunnel (made at the same time as the nest cavity and probably also with the purpose of providing the mother with an exit) to the water, where they swim away immediately and complete their development in the usual manner without further parental supervision] (p.54). An unpublished thesis (Jacobsen 1989) gives an instance, regarding *H. marmoratus*, which seems to be inconsistent with Wager's description of the female tunnelling to water: 'Inhabit burrows frequently under rotting logs or stones. A male and female found together with a clutch of 222 tadpoles were 8 m from the water, which seems a bit far from water to dig a tunnel as mentioned by Wager (1965). Bourquin (1985) recorded an instance of *marmoratus* which had eggs and tadpoles adhering to its back. However in the nest found above, the eggs formed a roundish mass and did not adhere to the frog' (p. 1401). The terrains where *Hemismus* were found in Eastern Caprivi, Namibia (Channing 1989, and pers comm.) and some in Tanzania (pers. comm. R. Drewes)

are inconsistent with the bank near a pool scenario of Wager. Wager (1965) himself writes as follows of *Hemismus marmoratus*: 'Habitat: Open bushveld country in the vicinity of pans and swamps where the soil is moist' (p.178). It is not possible to obtain further comments from either Wager or Bourquin, since Vincent Atherstone Wager, enthusiastic observer of anurans and second discoverer of *Hemismus* nests, died on October 29th, 1989 in his 86th year (Obituary: Farquharson 1990), and D.J. Bourquin, promising young naturalist and second discoverer of transport of *Hemismus* tadpoles, was killed by a hit-and-run motorist shortly after completion of his school career at the age of 18 years.

In March 1991 a film on the rainy season in East Africa was shown on South African Television, which included sequences on the maternal behaviour of *Hemismus*. The female *Hemismus* was shown with eggs and later with tadpoles which were to be seen swarming up her sides. Tadpoles were later shown wriggling into water from the mouth of a tunnel, which was stated to have been made by the female. There were obvious indications of staging. Unfortunately those herpetologists who saw the film, did not record the makers.

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