

Physa mosambiquensis (Clessin, 1886) rediscovered?

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An exotic fresh-water gastropod recently discovered in South Africa is identified as *Aplexa* (*Stenophysa*) *marmorata* (Physidae) and is considered conspecific with a population known from West Africa since at least 1911 and a single record from Mozambique dating from 1886. It is speculated that these introductions could have occurred via the Portuguese slave trade during the 16th and 17th centuries. A key to *A. marmorata*, another introduced physid *Physa acuta* and the indigenous, sinistral genus *Bulinus* is presented.

'n Uitheemse varswaterslak wat onlangs in Suid-Afrika ontdek is, is geïdentifiseer as *Aplexa* (*Stenophysa*) *marmorata* (Physidae) en word beskou as gelykoortig met 'n populasie in Wes-Afrika wat reeds sedert 1911 bekend is, asook met 'n enkele rekord vanuit Mosambiek, gedateer 1886. Daar word gespekuleer dat hierdie invoerings moontlik via die Portugese slawehandel gedurende die 16e en 17e eeue geskied het. 'n Sleutel tot *A. marmorata*, 'n ander ingevoerde spesie van die Physidae, *Physa acuta* en die inheemse, linksdraaiende genus *Bulinus* word voorgestel.

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Introduction

The North American fresh-water pulmonate gastropod *Physa acuta* (Physidae) was first collected in South Africa in 1956 (Hamilton-Attwell, de Kock & van Eeden 1970) although the first published account of its presence was by van Bruggen (1966). It was, however, probably introduced earlier since Jackson (1963) illustrated *P. mosambicensis* 'normally found in Natal and Zululand' but which, from its shape and small size, conforms to *P. acuta*. Similarly, Dr. D.S. Brown noted (*in litt.* 1988) that when he visited South Africa in 1963, *P. acuta* was already 'widespread'. The species has in fact become invasive and recent synopses (Brown 1980; Hamilton-Attwell, de Kock & van Eeden 1970) have shown it to occur in a discontinuous pattern over much of the sub-continent. During the past five years, specimens of a second physid species (Figure 1) have been collected from two localities in Natal and one in the eastern Transvaal. The Natal sites are (i) canals serving market gardens in the Durban suburb of Newlands (29°48'S / 30°57'E) in September 1983 and (ii) an artificial pond in Pinetown (29°48'S / 30°53'E) in October 1986 and the Transvaal site, an artificial pond in Tzaneen (23°50'S / 30°10'E) in January 1988. Snails from all three sites fit the descriptions of *Aplexa waterloti* given by Brown (1980) and *Physa waterloti* by Ranson & Cherbonnier (1951) for material from an area of West Africa including Ghana, Dahomey, Togo and Nigeria. The morphology of the penial complex of the South African snails corresponds to that described by Te (1973) for *Aplexa marmorata* from the West Indies (Figure 2).

Historical account

As is evident from the above, the name of this West African species has undergone both generic and specific changes in recent years. Specimens from Dahomey were originally described as *Physa* (*Aplecta*) *waterloti* by Germain (1911) and this name was retained by Ranson

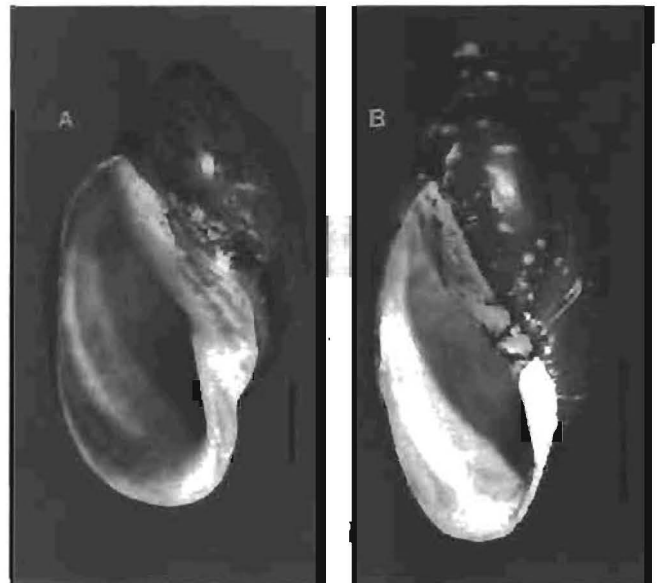


Figure 1 Photographs of the shells of *Physa acuta* from Pietermaritzburg (A) and *Aplexa marmorata* from Tzaneen (B). Bars = 2 mm.

& Cherbonnier (1951). Te (1973) however transferred the species to the genus *Aplexa* and equated it to the West Indian *A. (Stenophysa) marmorata*. The West African snails were referred to as *A. (Stenophysa) waterloti* by Brown (1980) and *Physa marmorata* by van Damme (1984). In 1886, however, Clessin had recorded *Physa mosambiquensis* from Tette (= Tete) on the Zambezi river in central Mozambique (also cited by Connolly 1925, 1939) but which Connolly (1945) later equated with the West African *P. waterloti*. The Mozambique specimens were collected by Wilhelm C.H. Peters who travelled through Mozambique between 1842 and 1848. The locality of *P. mosambiquensis* given by Connolly (1925, 1939), viz 'LORENZO MARQUES. Tette', must be viewed with caution. Connolly's

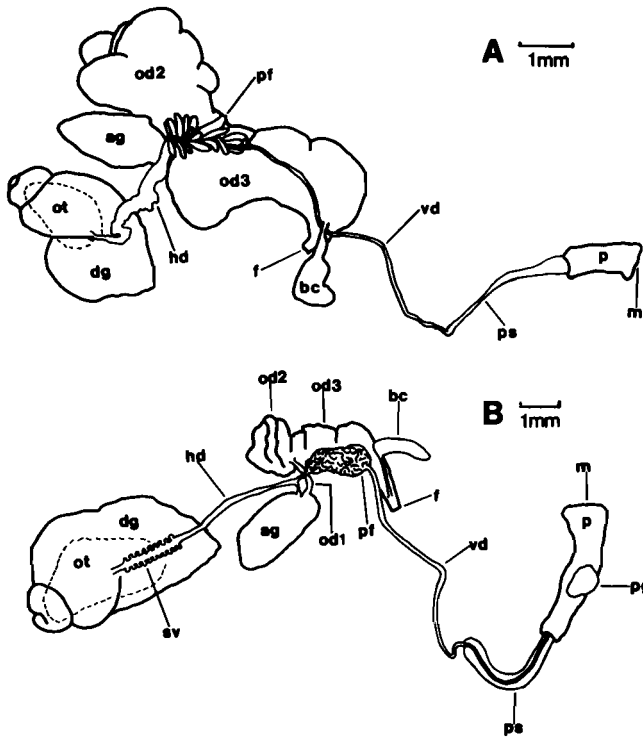


Figure 2 Reproductive systems of *Physa acuta* from Pietermaritzburg (A) and *Aplexa marmorata* from Tzaneen (B). ag = albumen gland, bc = bursa copulatrix, dg = digestive gland, f = female opening, hd = hermaphrodite duct, m = male opening, od1 = oviduct 1, od2 = oviduct 2, od3 = oviduct 3, ot = ovotestis, p = penis, pf = prostate follicles, pg = prostate gland, ps = penis sheath, sv = seminal vesicle, vd = vas deferens. Subdivisions of the oviduct are based on those proposed by Duncan (1958) on anatomical and functional grounds.

convention was to cite in capitals the district in which a specimen was collected, followed by the actual locality in smaller type but in this case, he refers to two entirely different places in Mozambique. This is further complicated by the fact that Clessin's (1886) description of the species simply cites 'Mosambique' as the type locality with no mention of more precise details though he did note that the specimens resembled South and Central American species more than East African ones. In 1925, Connolly mentioned that J. Thiele had provided him (presumably *in litt.*) with details of the radula of *P. mosambiquensis* housed in the Berlin Museum where six 'cotypes' (= syntypes) are still lodged under the accession number ZMB Moll.8484 (Kiliyas 1961) and it is possible that he included additional locality data as well. In their synopsis of the fresh-water malacofauna of Mozambique, de Azevedo, do Carmo, de Medeiros, Faro, Xavier, Gandara & de Morais (1961) did not list any further localities for this species.

Materials and methods

The reproductive systems of *Aplexa marmorata* from the Natal localities named above and the W. Indies, and *P. acuta* from the Umsinduzi River, Pietermaritzburg, were dissected and typical examples drawn using a M5 Wild

Stereomicroscope fitted with a drawing tube. Shells of these *Aplexa* plus specimens from W. Africa were measured to the nearest 0,1 mm. Radulae of *A. marmorata* from Tzaneen were dissected following van Eeden & Oberholzer (1962), fixed in 3% glutaraldehyde buffered in 0,05 mol dm⁻³ phosphate buffer and dehydrated through an alcohol series. They were then critical-point dried in a Hitachi HCP-2 critical-point drier, coated with gold palladium in a Polaron E500 sputter-coating unit and viewed and photographed using a Hitachi S-570 SEM.

Identification

Specimens from the two Natal localities were placed in the subgenus *Aplexa* (*Stenophysa*) by Dr D.S. Brown (British Museum, Natural History) and provisionally identified as *A. (Stenophysa) marmorata*. This name is thus followed in this report. An examination of the reproductive systems of specimens from South Africa (Tzaneen) and the West Indies (St Lucia) revealed no obvious differences and, as noted above, conformed to Te's (1973) diagram for *A. marmorata*. Figure 3 compares shell shape, as described by regression lines relating height to maximum width, of series of *Aplexa marmorata* from Togo, West Africa; Natal and Transvaal, South Africa and St Lucia (West Indies) and shows variation between the different populations.

Because of the morphological similarity of *A. marmorata* to *P. acuta* and members of the indigenous genus *Bulinus* which also have a sinistral shell, a key to the three taxa is presented below. Relative dimensions of the shells of the two physids are given in Table 1 and show that the width of the shell of *A. marmorata* is narrower, particularly in those with a height above 4 mm than that of *P. acuta*. Certain other conchological characters are also useful in separating them. When

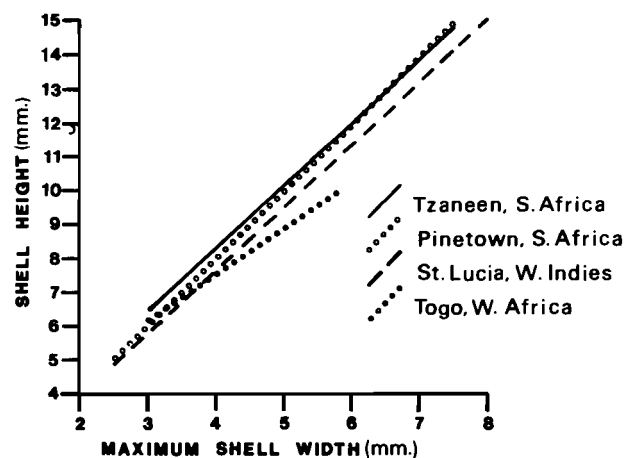


Figure 3 Relationship between shell height and maximum width for *A. marmorata* from Tzaneen, South Africa: height = 0,95 + 1,85 (width), $r^2 = 0,98$, $p < 0,001$, $n = 15$; Pinetown, South Africa: height = 1,58 + 1,63 (width), $r^2 = 0,95$, $p < 0,001$, $n = 23$; Togo, West Africa: height = 2,10 + 1,35 (width), $r^2 = 0,66$, $p < 0,001$, $n = 39$; St Lucia, West Indies: height = 0,35 + 1,83 (width), $r^2 = 0,94$, $p < 0,001$, $n = 67$.

Table 1 Morphometric relationships in the shells of *A. marmorata* and *P. acuta*; $n = 15$ in all cases

A. marmorata

$$\text{Shell width} = -0,04 + 0,51 (\text{shell height})$$

$$r^2 = 0,99; p < 0,01$$

$$\text{Aperture height} = -0,29 + 0,76 (\text{shell height})$$

$$r^2 = 0,99; p < 0,01$$

P. acuta

$$\text{Shell width} = -0,54 + 0,69 (\text{shell height})$$

$$r^2 = 0,97; p < 0,01$$

$$\text{Aperture height} = -0,27 + 0,76 (\text{shell height})$$

$$r^2 = 0,98; p < 0,01$$

compared with *P. acuta*, the sutures of *A. marmorata* are shallow, the whorls weakly convex and the callus on the parieto-columellar lip poorly demarcated. With reference to shell dimensions, it is noteworthy that *Physa mosambiquensis* as illustrated by Connolly (1925, 1939) has a height/width (H/W) ratio of 1,98 while those from West Africa illustrated by Germain (1911) and Ranson & Cherbonnier (1951) vary between 1,69 and 1,92 (mean 1,81). This range slightly overlaps that given in the key below for *P. acuta*. The mean H/W ratio \pm S.D. for 39 snails from Togo and lodged in the British Museum (accession number ETD4145) was $1,88 \pm 0,17$ of which only six (15,4%) were less than 1,74. Similarly, for 67 specimens from St Lucia, West Indies (ETD2882), the

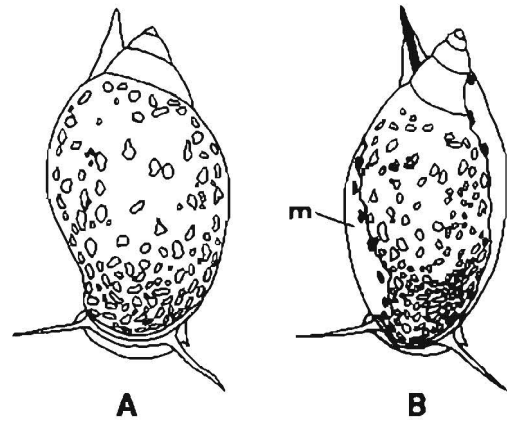


Figure 5 Life-drawings of *Physa acuta* from Pietermaritzburg (A) and *Aplexa marmorata* from Tzaneen (B) showing differences in the posterior end of the foot and the extension of the mantle edges (m). More pigmented spots occur on the left mantle edge of *A. marmorata* than on the right one. The translucent shells of these species often allow the pigmentation of the mantle itself to show through as a reticulate pattern.

mean H/W was $1,91 \pm 0,09$ with only one (1,5%) below 1,74. The radulae of the two species are similar, both having teeth arranged in oblique, transverse rows. These teeth bear numerous conical cusps which vary in number from tooth to tooth and several from a specimen from Tzaneen are illustrated in Figure 4. The foot of live *A. marmorata* is more elongate posteriorly, with a central black stripe that is absent in *P. acuta*. Processes along the edges of the mantle are characteristic of the family Physidae but exhibit considerable interspecific variation. In *P. acuta* they are finger-like and restricted to the underside of the shell whereas in *A. marmorata* the digitations are longer and the mantle edge may extend to cover virtually the entire shell (Figure 5).

Origin

The family Physidae as a whole has a Holarctic and Neotropical distribution and is not indigenous to Africa. *Physa acuta*, however, occurs in many areas and is widely regarded as an immigrant from North America (Brown 1980). The subgenus *Aplexa* (*Stenophysa*) is endemic to Central and South America and the restricted distribution of *Aplexa marmorata* in West Africa and now in South Africa as well, suggests that it has been introduced on more than one occasion but has not spread far. Te (1973) suggested that the West Indies was a probable source of origin for the West African population. In the case of the South African snails, the Pinetown focus was traced to a local nursery where it was found associated with the plant *Pistia stratiotes* but its origin, as with the Newlands and Tzaneen foci, remains obscure. The latter has been known since at least 1975 in cement tanks built around 1955 for breeding schistosomiasis host snails (D.L. Theron, personal communication). In terms of their proximity to one another, the finding of *A. marmorata* in the eastern Transvaal may be relevant to Clessin's (1886) record of

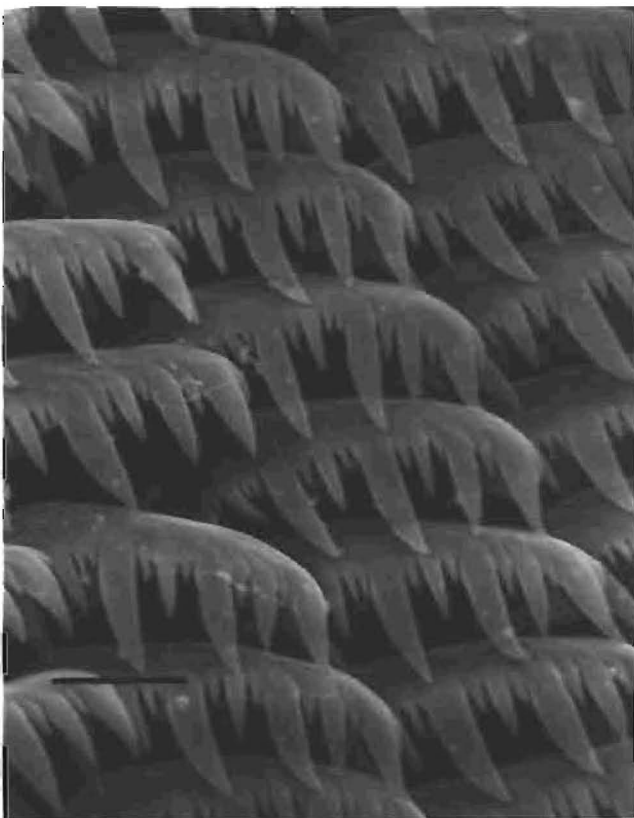


Figure 4 Scanning electron micrograph of several teeth of *Aplexa marmorata* (shell height 7,0 mm) from Tzaneen. Bar = 5 μ m.

Physa mosambiquensis from Mozambique. So too, the fact that outside its native West Indies and South America, *A. marmorata* is known only from western and south-eastern Africa, may be related to the Portuguese slave trade between Africa and Brazil during the 16th and 17th centuries. Not only did most of the slaves in Brazil come from the Nigeria/Dahomey region of West Africa but, according to Axelson (1973), the preferred route from Portugal to Mozambique was by sailing across the Atlantic to the Brazilian coast and then in a south-easterly direction to round the Cape of Good Hope. This traffic would thus have provided frequent connections between Brazil and both west and south-eastern Africa. Although Brown (1980) noted that in West Africa, *A. marmorata* is usually found in waterbodies modified by man and the same applies to the South African snails, it does not occur in tropical fish farms and therefore does not seem to be associated with the aquarium trade. In this respect it should be emphasized that the canals at the Durban locality drained into the Umgeni River so that this, coupled with potentially high rates of dispersal through human action, must render introductions into natural systems likely. Neither *A. marmorata* nor any other member of the Physidae is known to act as an intermediate host for human schistosomiasis.

Key

1. Shell matt, dark and opaque; spire rounded; pseudobranch present; mantle without retractile processes; transverse rows of radula nearly straight; blood pigmented with haemoglobin *Bulinus* spp. (Family Planorbidae).
- Shell glossy, translucent with spots visible on the mantle beneath (Figure 5); spire sharply pointed; pseudobranch absent; mantle with retractile processes; transverse rows of radula 'V' shaped; blood not pigmented 2
2. Shell with H/W ratio of 1,74–2,16; mantle processes long, finger-like and extending over whole shell; copulatory organ without externally visible preputial (accessory) gland; posterior end of foot darkly pigmented and pencil-like (Figures 2 & 5) *Aplexa marmorata*.
3. Shell with H/W ratio of 1,38–1,74; mantle processes short, resembling shallow scallops and not extending over shell; copulatory organ with conspicuous, externally visible preputial gland; posterior end of foot not darkly pigmented or pencil-like (Figures 2 & 5) *Physa acuta*.

Note added in proof: *Aplexa marmorata* was collected in June and July 1989 from a lake in the Bluff Nature Reserve, Durban (29°56'S / 31°59'E), by G.B. Wilken (University of Natal). This is the first time that this species has been found in a natural waterbody in South Africa.

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