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THE EXOTIC FRESH-WATER SNAIL *HELISOMA DURYI* (WETHERBY, 1879) (PLANORBIDAE) IN SOUTHERN AFRICA

by

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With 4 text-figures

INTRODUCTION

Van Bruggen (1974) discussed the identity of specimens of the North American pulmonate genus *Helisoma* Swainson, 1840 (Mollusca: Planorbidae) from three localities in southern Africa. He identified *Helisoma (Seminolina)* cf. *duryi seminole* Pilsbry, 1934, from a farm dam in South West Africa and *Helisoma (?Pierosoma)* sp. from an artificial pond at Mandini in Zululand (recorded as *Helisoma* sp. by Brown, 1967) and from Cape Point on the Cape Peninsula. These identifications were based on shell characters since only dry material was available.

Snails belonging to *Helisoma* have been collected by the present author from two additional localities and are examined below. Both these populations occur(red) in the suburban areas of major South African cities. The five widely separated localities are shown in fig. 1.

Live *Helisoma* were collected in June 1969 from fish ponds in the rosarium in Jan van Riebeeck Park (26°07'S 28°01'E) in the Johannesburg suburb of Emmarentia. The snails were plentiful here, as was another exotic, *Physa acuta* (Draparnaud). Unfortunately the soft parts of these *Helisoma* were not kept and the population had disappeared by 1 November 1974 when the author paid a return visit. It is possible that the population was elminated by cleaning of the ponds during the intervening five and a half years.

In February 1973 Mr. B. Campbell of the Zoology Department, University of Cape Town, sent the author a collection of Gastropoda amongst which were three specimens of *Helisoma* collected on 25 March 1972 from marginal grass of the partly canalized Liesbeeck River in the Cape Town suburb of Observatory. During a visit to Campbell's locality (28 July 1975) the author was unable to find the species (probably due to recent flushing by severe floods) but collected it in a protected backwater some 400 m downstream. Here the snails occurred together with two other exotics, *P. acuta* and *Lymnaea columella* Say, in a dense bed of *Myriophyllum proserpinacoides* Gill. (also an exotic) and *Ceratophyllum* sp. *Helisoma*

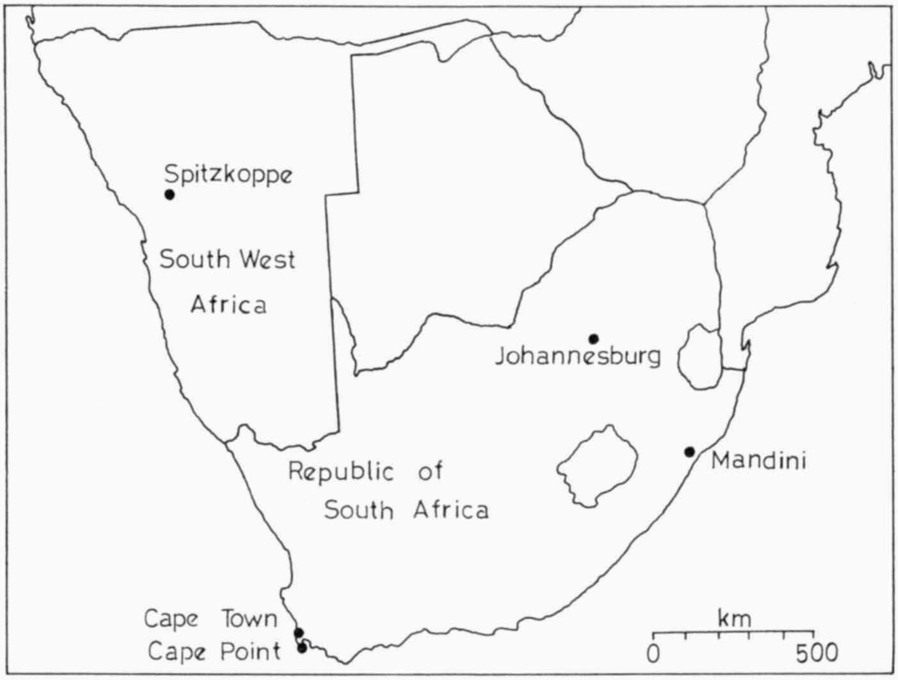

Fig. 1. Map of southern Africa showing the localities from which *Helisoma* has been recorded by Van Bruggen (1974) (Spitzkoppe, Mandini, Cape Point) and this paper (Johannesburg, Cape Town).

duryi has a very localized distribution here (known only from the vicinity of the Royal Observatory) and was not found in the nearby Black River by Campbell (unpubl.). The Liesbeeck record is nevertheless the first from a natural watercourse in South Africa.

Identification

The Emmarentia *Helisoma* shells are a pale, translucent brown colour and conspicuously umbilicate. Sculpture consists solely of oblique growth striae, strongest ventrally. Whorls are angulate above and rounded below;

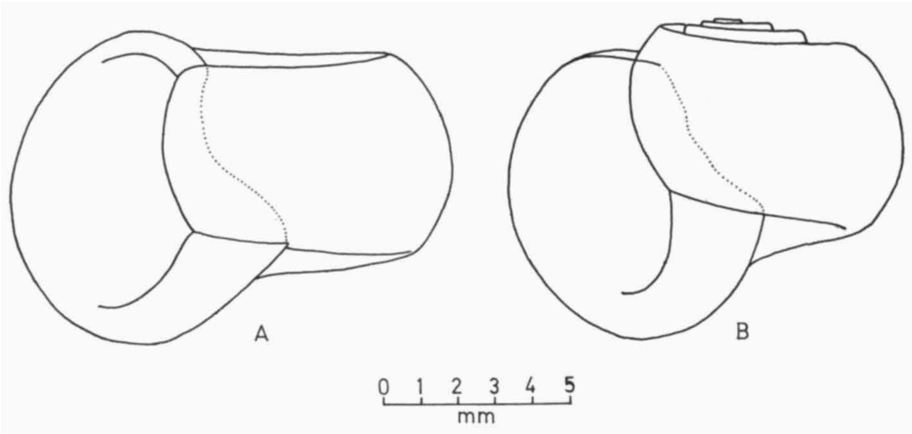

Fig. 2. *Helisoma (Seminolina) duryi* (Wetherby) from ponds in the rosarium in Jan van Riebeeck Park, Emmarentia, Johannesburg. A: shell with sunken spire (9.3 × 14.9 mm), B: scalarid shell (9.6 × 13.1 mm).

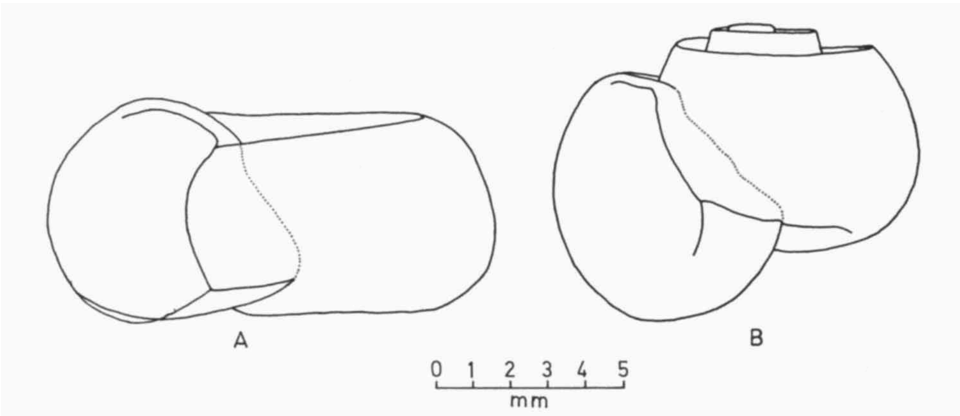

Fig. 3. *Helisoma (Seminolina) duryi* (Wetherby) from the Liesbeeck River, Observatory, Cape Town. A: shell with sunken spire (6.7 × 14.2 mm), B: scalarid shell (9.2 × 11.8 mm).

the last whorl is remarkably high and while the aperture is almost vertical in most specimens, it is noticeably oblique in some.

The shell morphology of these specimens corresponds to that of the *seminole* and *duryi* races of the *Helisoma (Seminolina) duryi* complex as described by Pilsbry (1934) and Baker (1945). Considerable variation exists among the shells, but they are characterized by the spire being either weakly raised above the shoulder of the basal whorl or slightly sunken (fig. 2). In only two specimens was it raised noticeably above the last whorl.

This is in contrast to the South West African material figured by Van Bruggen (1974) where most showed scalarid tendencies. The great height of the last whorl and shallow or sunken spire are named as conspicuous features of *Helisoma duryi duryi* (Wetherby, 1879) by Pilsbry (1934) and suggest that the Emmarentia material belongs to this form.

The Liesbeeck specimens also show considerable variation in shell morphology, with only one slightly scalarid specimen (fig. 3). The majority have their spires sunken below the upper margin of the aperture and are similar in colour and sculpture to those from Emmarentia. Though some of the Liesbeeck specimens have oblique apertures their whorls are more angular above. On account of the sunken spires of most specimens these too are placed in *H. duryi duryi*. The relatively shallow basal whorls remain a feature of this population however. The variation in shell shape shown by the Emmarentia, Liesbeeck and South West African (van Bruggen, 1974) populations is illustrated in fig. 4.

The genital anatomy, especially of the penial complex, is important for identifying members of *Helisoma*.

The penial complex of the Liesbeeck specimens corresponds closely with that illustrated and described for *Helisoma (S.) duryi* by Pilsbry (1934, fig. 1f-k) and Baker (1945, pl. 33 figs. 17-18). The preputium and penis sheath are of similar blunt shape though the former is slightly longer; the preputial duct is short and adnate, thus conforming more to the description of Pilsbry than of Baker. The stout conic penis extends into the preputium and a distinct ridge divides the two sacs. These anatomical characters confirm the placing of the Liesbeeck snails in *H. (S.) duryi*.

The species *H. duryi* is however an extremely variable one. Baker (1945) remarked that it is perhaps more variable than any other American species and that the different races of *H. duryi* merge into each other, several sometimes occurring together. The Emmarentia and Liesbeeck material has been lodged in the collection of the Rijksmuseum van Natuurlijke Historie (Leiden).

Discussion

Helisoma duryi is probably more widely established in South Africa than is generally supposed and additional populations undoubtedly remain to be found. It seems to occur mostly in isolated, artificial impoundments which might be overlooked during field surveys. Such impoundments are generally subject to periodic emptying and cleaning, and cannot support snail populations for long without continual recruitment from a natural source. In these

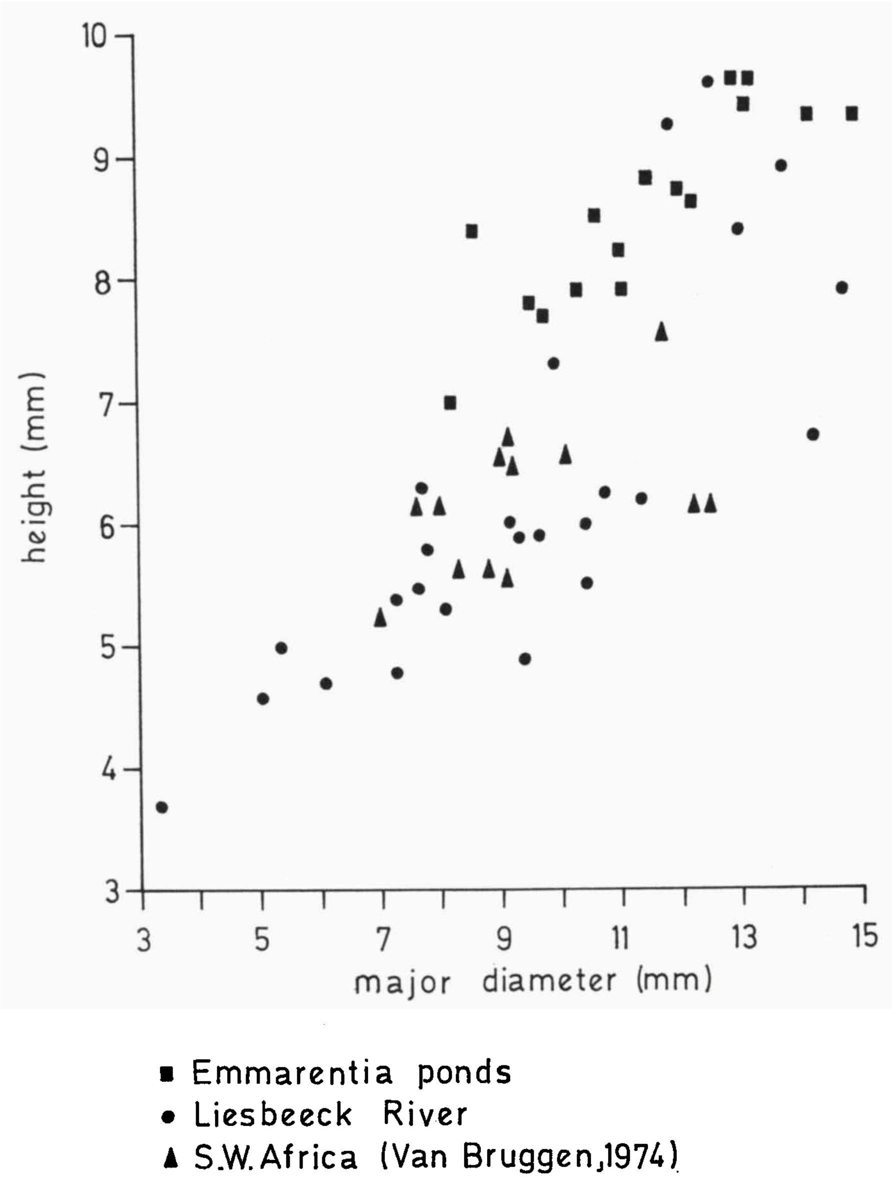

Fig. 4. Diagram relating shell height to major diameter for *Helisoma duryi* from the Emmarentia ponds and Liesbeeck River as well as from South West Africa (Van Bruggen, 1974).

situations *H. duryi* populations appear to be short-lived. Although known in southern Africa since 1969, it has not undergone the rapid spread recorded for two other alien aquatic snails, the North American *Lymnaea columella* (see Van Eeden & Brown, 1966) and the Mediterranean *Physa acuta* (see Hamilton-Attwell et al., 1970), though the possibility of its doing so cannot be ignored. Indeed the Emmarentia rosarium ponds drain into the adjacent Emmarentia dam which forms part of the Jukskei/Crocodile River system and although a brief search failed to reveal any, it is possible that *H. duryi* has spread into the dam and might yet appear elsewhere in the system. The first records of *L. columella* came from artificial waterbodies (Van Eeden & Brown, 1966).

H. duryi is endemic to Florida in the United States and is particularly abundant in the Everglades region of the extreme south of the state (Baker, 1945). The climate of this southerly part is, according to the Köppen classification, a tropical savannah type (Times Atlas of the World, 1968) and may thus have features, particularly of temperature, comparable to those of the eastern parts of South Africa. The species might therefore be tolerant of the warm waters that occur over these lowlands were it introduced into natural watercourses there.

The snail is a favourite with aquarists perhaps because of the red colour of its soft parts, and recorded occurrences are probably due to escapees from captivity. As pointed out by Van Bruggen (1974) the existence of at least two species of *Helisoma* in southern Africa brings the number of exotic Mollusca known from this region to the considerable total of 28. *H. duryi* has also been introduced into Brazil (again presumably by aquarists) where an apparently isolated population was found in 1972 in a lake in the country's central region (Paraense, 1975, 1976).

The ability of *H. duryi* to survive in new environments focusses attention on repeated suggestions that it, as well as other exotic freshwater snails, should be tried as means of biological control of the snail intermediate hosts of schistosomiasis, particularly in irrigation schemes. A brief review of this aspect of schistosomiasis control may thus not be out of place here.

The use of *Helisoma (S.) duryi* for the biological control of schistosomiasis has only recently been advocated (Ferguson et al., 1958; Ferguson, 1972; Rasmussen, unpubl.; Abdallah & Nasr, 1973). Mention has also been made of the possible use of two members of the subgenus *Pierosoma*; Mandahl-Barth (unpubl.) suggested trials with *Helisoma (P.) tenue* (Philippi), a native of Mexico, but now widely distributed, for controlling *Bulinus* and African though not South American *Biomphalaria*, and Ferguson (1972) referred to "planorbid control by competitive exclusion" using *Helisoma (P.) caribeum* (d'Orbigny), a Cuban species. The rationale upon which these suggestions were based was twofold. First was the discovery by Berrie (1968) and Berrie & Visser (1963) of a toxin which, when present in the water at high concentrations, inhibited the growth and fecundity of the schistosome host snail *Biomphalaria sudanica* (Von Martens) under both field and laboratory conditions in Tanzania. Since this substance (an ester) was probably secreted by the snails themselves, an increase in snail population density to a high level appeared to result in excessively high concentrations of toxin being produced with consequent inhibitory effects on population growth, thus preventing overcrowding. Rasmussen (unpubl.) suggested from laboratory observations that by the secretion of an apparently similar toxin (though this was not identified) *H. duryi* could suppress the growth and fecundity of *Biomphalaria pfeifferi* (Krauss) at concentrations which had no visible effect on itself. The recent discovery on the island of St. Vincent (West Indies) of an eco-phenotype of *Helisoma duryi* indistinguishable from *Biomphalaria glabrata* on shell morphology and dimensions (Prentice et al., 1977) exposes a possible complication in interpreting the results of control trials using these species.

Second was the demonstration by Chernin (1968) that the presence of snails not susceptible to *Schistosoma mansoni* Sambon (i.e., *Helisoma*) in the same aquaria as the intermediate host species *Biomphalaria glabrata* (Say), reduced the infection frequency of the latter. The non-target snails apparently interfered with the host-location mechanism of the miracidia and the possibility therefore exists that the density of non-target species (of the same family or even subfamily as the intermediate host) might reduce the frequency of infection among susceptible species in the same habitat.

Previously the favoured potential competitor to the schistosome intermediate hosts was the prosobranch *Marisa cornuarietis* (L.) (Ampullariidae) which is indigenous to northern Columbia and the Orinoco watershed. This snail has been observed capable of displacing *B. glabrata* completely when introduced into the same aquarium (Olivier-Gonzalez & Ferguson, 1959; Olivier-Gonzalez et al., 1956; Ferguson et al., 1958) and also *B. pfeifferi* (cf. Michelson & Augustine, 1957). The larger *M. cornuarietis*, a voracious omnivore, was found by Chernin et al. (1956) not only to compete successfully with *B. glabrata* for available food, but to ingest the latter's egg-capsules and hatchlings while feeding. Apparently successful control of *B. glabrata* with this species were reported from field trials in several streams in Puerto Rico (Palmer et al., 1970; Radke et al., 1961; Jobin, 1970; Jobin et al., 1970, 1973) and on adjacent Vieques Island (Ferguson et al., 1968). However, since *M. cornuarietis*, in common with other Ampullariidae, will readily eat vascular plants (Ferguson et al., 1958), they pose a threat to the economy of rice paddies which are often important foci of schistosomiasis transmission.

This limited success in schistosomiasis control, its low cost (the average annual cost in one project area in Puerto Rico was calculated to be some sixty times less than for chemical control, Ruiz-Tiben et al., 1969; Jobin & Berrios-Durán, 1970) and the adoption by the Puerto Rican Department of Health of *M. cornuarietis* as a routine adjunct to its anti-schistosomiasis campaign (Jobin et al., 1973) has nevertheless fostered similar experiments in Egypt and attempts to find other suitable competitor species. Demian & Lufty (1965a, b) have shown experimentally that *M. cornuarietis* can displace Egyptian *Bulinus (B.) truncatus* (Audouin), *Biomphalaria alexandrina* (Ehrenberg) and *Lymnaea natalensis* Krauss, and Kamel (1973, cited by Hairston et al., 1975) recently demonstrated this against *Bulinus truncatus* in quasi-field conditions in Egypt.

Another ampullariid, *Pomacea* sp., was reported by Paulinyi & Paulini (1971, 1972) to compete successfully with *Biomphalaria glabrata* in both natural habitats and laboratory aquaria in Brazil. Ferguson (1972) and Hairston et al. (1975) referred to this species as *Pomacea australis* (d'Orbigny) and *P. haustrum* (Reeve) respectively. Doby et al. (1965) and Leger & Leger (1963) suggested that the European operculate gastropod *Potamopyrgus jenkinsi* (Smith) (Hydrobiidae) may be able to compete with *Bulinus truncatus,* the intermediate host of human urinary schistomiasis in North Africa and the bovine disease in Corsica. *Thiara granifera* (Lamarck) (Thiaridae), a prosobranch gastropod from the Orient, has also been named as a potential competitor against *Biomphalaria glabrata* (see Ferguson, 1972; Ferguson et al., 1958).

This somewhat repetitive literature lacks quantitative data on the ecological requirements of the snail species concerned. Results of laboratory investigations and casual observations may only indicate which species are the more liable (Wright, 1968) and be of little significance to field conditions. The results of field control trials are generally inconclusive and since other extrinsic factors are almost certainly involved it is impossible to estimate the effectiveness of the competition meaningfully. Until more is known of the tolerance of these suggested importations to different environmental factors and of their biology generally, their use in schistosomiasis control programmes is clearly inadviseable. Hairston et al. (1975) have presented a valuable critique of this subject, often with interpretations of published results less encouraging than those of the original authors. An obvious danger lies in the possibility of these animals, their parasites or symbionts introduced in this way, spreading from the confines of irrigation schemes into natural watercourses and perhaps becoming pests there. In addition, freshwater snails generally act as intermediate hosts for parasitic Trematoda which if not infective to man or his domestic stock, may cause cercarial dermatitis ("swimmer's itch") in people exposed to infected waters. *Thiara granifera* is in fact a known intermediate host for the human lung-fluke, *Paragonimus westermani* (Kerbert). In South Africa the now abundant *Lymnaea columella* is an efficient intermediate host for the liver fluke *Fasciola hepatica* L. and probably also *F. gigantica* Cobbold and may well have aggravated the transmission of this parasite in stock in this country.

Suggestions have recently been made (J. Bailey, personal communication, 1977) that biological control of schistosomiasis should be attempted in Swaziland through the use of a local snail competitor or, if one cannot be found, an exotic one. The deliberate introduction of an exotic snail would be a drastic measure which seems hazardous in the light of the dramatic spread over much of southern Africa by *Lymnaea columella* and *Physa acuta* in the past three decades, the possibility that *Helisoma duryi* may do likewise, and the damage caused to rice crops in Swaziland by the indigenous ampullariid, *Lanistes ovum* Troschel (see Schutte, unpubl.).

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