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Zairian population of *Pisidium viridarium* KUIPER, 1956 (*Bivalvia: Heterodonta: Sphaeriidae*)

[With 9 figures in the text]

Abstract. In the present paper a description of a Zairian population of the pill-clam *Pisidium viridarium* KUIP. is made. The shell morphology, external anatomy, biology of reproduction and ecology of mentioned species are studied.

INTRODUCTION

Pisidium viridarium was described by KUIPER (1956) on the basis of specimens collected by B. VERDCOURT in the Kenyan Karura River. Later on the localities of this species were recorded in Southern Rhodesia (the Republic of Zimbabwe), Ethiopia, Uganda, Rwanda, Zaire, the Republic of South Africa, Basutoland (Lesotho) and Madagascar (KUIPER, 1964, 1966, BROWN 1967). This indicates that *P. viridarium* is one of the most widely distributed *Pisidium*-species in tropical Africa.

Despite the fact that this pill-clam is so common it is relatively little investigated. J. G. J. KUIPER's studies cited above give valuable data on the shell structure and geographical distribution of *P. viridarium* but little is till known of its ecology and nothing at all of its anatomy and biology.

A new site of *P. viridarium* was detected in southern Zaire, within the Shaba province. It is located close to the village Kiungu, near the road leading from Lubumbashi (Elisabethville) to Kasenga, about 40 km northeast of Lubumbashi. *P. viridarium* occurred in the small Luamisamba River, a tributary of the Luiswishi River, which belongs to the catchment area of the Luapula River.

The abundant samples of *P. viridarium* were collected in bogs constituting the

widespread headwaters of the Luamisamba River and in the upstream section of the river on 11th Aug. and 9th Sept. 1988. The section investigated was about 100 m long, 2–4 m wide and 0.10–0.50 m deep. The bottom was covered with a thick layer of fine clay sediments, causing a strong turbidity of the slow flowing water. The boggy headwaters covered an area of about 1 km^2, which was very extremely slimy and well water-saturated.

Samples were taken using a hand-net of 0.5 × 0.5 mm mesh size. The bottom sediment was then washed on a screen of the same mesh. The clams inhabiting the river and the spring-swamp produced a dense population that enabled to collect up to hundreds of specimens by a single haul of a net.

I owe my sincerest thanks to Mrs. Ewa Zajączkowska-Matusiak, M. Sc., for the original drawings of the *P. viridarium*. I am grateful to Mr. Ł. Głowacki, M.Sc., Department of Ecology and Vertebrate Zoology of the Łódź University, for preparing the English translation. I wish to express my heart-felt thanks to Dr. J. G. J. Kuiper, Paris, for verification of my determination of *P. viridarium*.

RESULTS

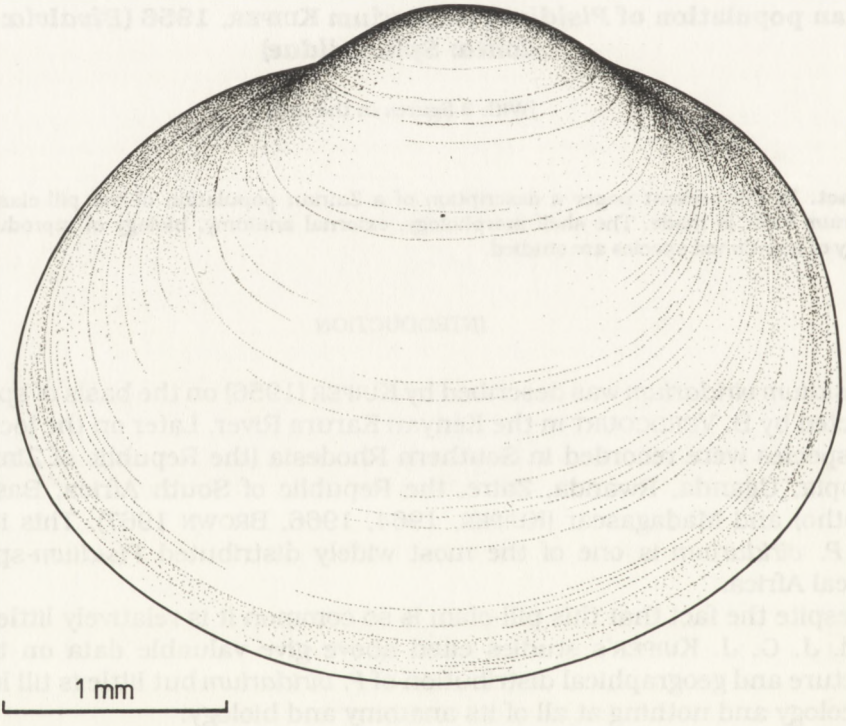

Fig. 1. Lateral view of *P. viridarium*.

The shells of *P. viridarium* from the Luamisamba River are oval in outline with umbones displaced somewhat posterad (fig. 1). As in most pisidies, the umbones are distinctly marked in the largest individuals. The shells are whitish, thin-walled and delicately striated (especially in their lower parts). Their characteristic

feature is the presence of very numerous, densely located canaliculi perforating the shell and visible on the surface in the form of pores (fig. 2). Dimensions of the largest shell are: 4.5 mm in length, 3.8 mm in height, and 2.7 mm in breadth (convexity). The shells are relatively little convex. Measurements of a series of 153 individuals chosen at random proves that the convexity increases proportionally to the shell size (fig. 3).

Fig. 2. *P. viridarium* – pattern of shell-microsculpture.

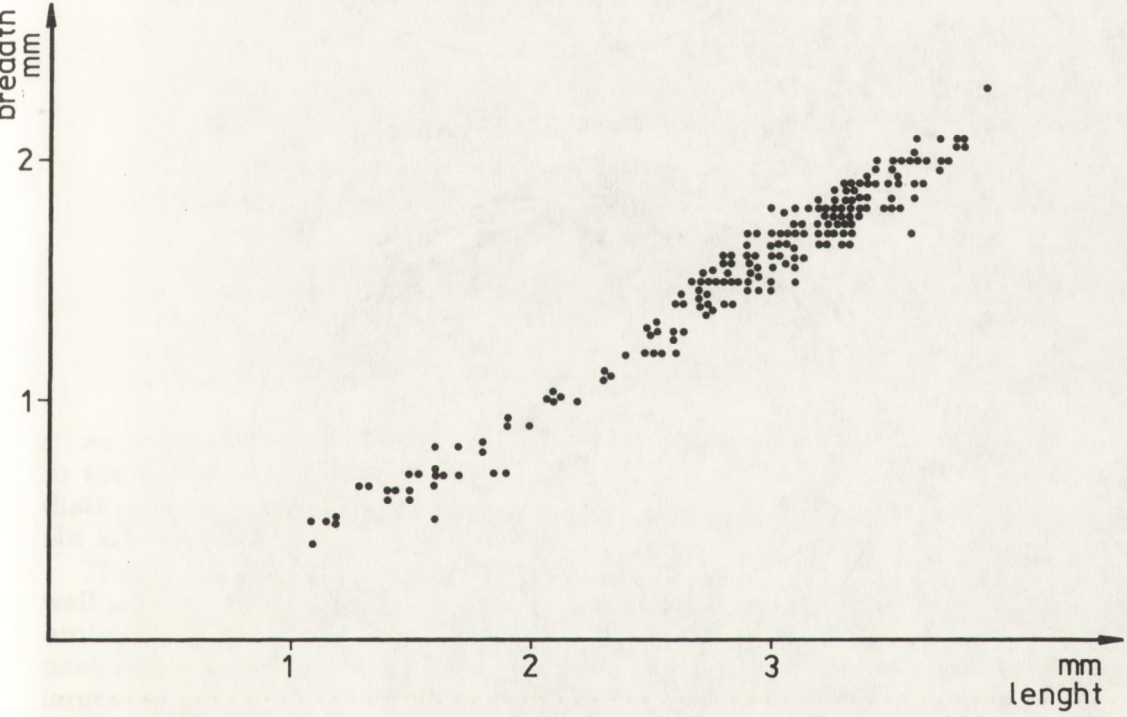

Fig. 3. Correlation between length and breadth of the shells of *P. viridarium* from the Luamisamba River.

The hinge-plate is relatively thin. The most characteristic feature is the occurrence of a callosity at the inner end of the lateral tooth PIII (fig. 4). This callosity develops at various extent, but in most values is easily noticeably (fig. 5).

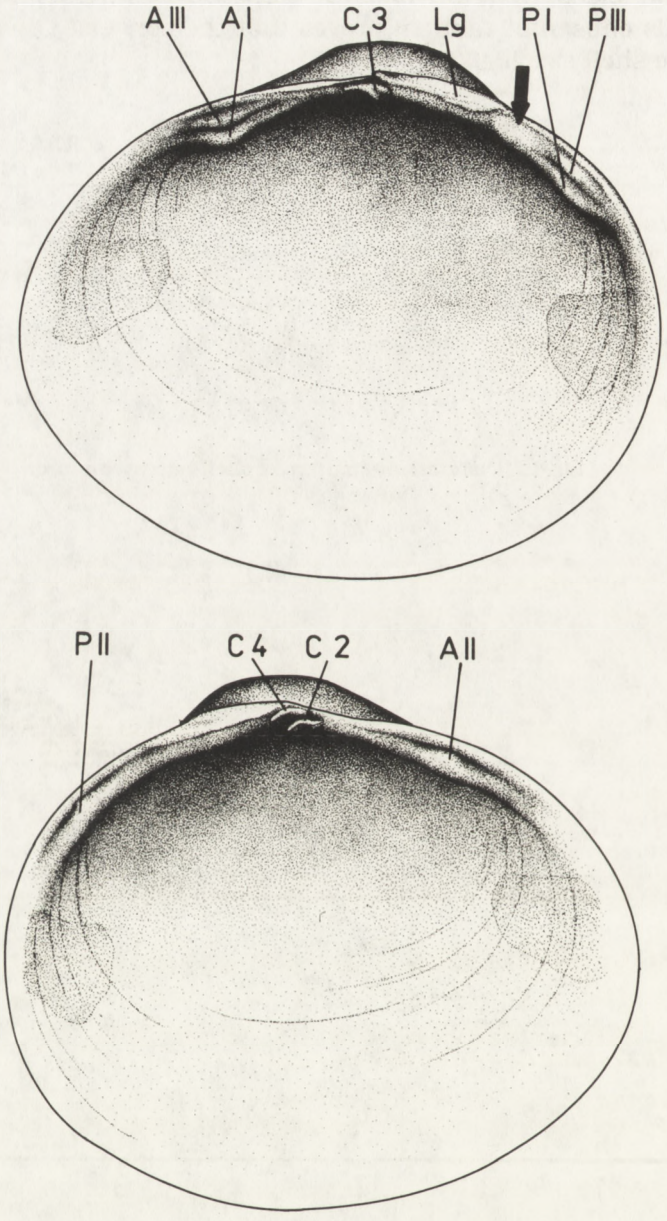

Fig. 4. Interior of shell of *P. viridarium*. Abbreviations: AI–AIII – anterior lateral teeth, C_2–C_3 – cardinal teeth, Lg – ligament-pit, PI-PIII – posterior lateral teeth; arrow shows a callosity on right valve.

The cardinal tooth C_3 is straight or little bent, situated parallel to the hinge-plate and forked in its posterior part; C_2 is relatively short, straight or slightly bent; C_4 is located above C_2 and somewhat displaced posterad; C_2 and C_4 are of about the same length or C_4 is a bit longer. The ligament-pit is relatively long and narrow. Lateral teeth well marked but not very large. In the right valve AIII and AI are more pronounced than PIII and PI. The left valve anterior tooth AII is better developed than the posterior one – PII (figs 4 and 5).

Fig. 5. Hinge plates of *Pisidium viridarium* from the Luamisamba River.

At gaping valves an exhalant siphon and branchial opening are well visible in the posterior part of the animal (fig. 6). They are close to each other but distinctly separated. Pre-siphonal suture, i.e. the distance between the mantle slit and branchial opening, is relatively short.

The inner gills are large, triangular, whereas the outer are much smaller but well developed and always visible. Digestive diverticula are located close to umbones and to the upper edge of the anterior gill (fig. 7). The anterior and posterior adductor muscles are situated at the same height; the anterior one is larger and more elongated (fig. 4).

In August 1988 the *P. viridarium* population of the Luamisamba River consisted mostly of mid-sized individuals of two size classes: 2.6–3.0 mm and 3.1–3.5 mm. The individuals of these two classes constituted together 58.1% of

the pill-clams collected. The remaining size classes were represented by a much lower number of individuals (fig. 8). In September the composition of the population was very similar: individuals 2.6–3.5 mm in shell length dominated constituting 66.1% of all pill-clams. Smaller and larger individuals were less abundant (fig. 8).

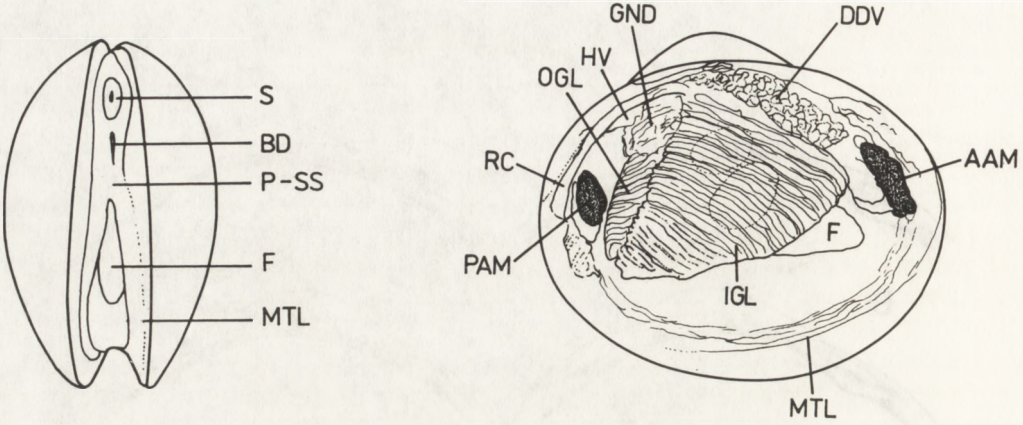

Fig. 6. and 7. *P. viridarium*. 6 – Posterior view; abbreviations: BD – branchial opening, F – foot, MTL – mantle, P-SS – pre-siphonal suture, S – siphon.7 – anatomy; abbreviations: AAM – anterior adductor muscle, DDV – digestive diverticulae, F – foot, GND – gonad, HV – heart ventricle, IGL – inner gill, MTL – mantle, OGL – outer gill, PAM – posterior adductor muscle, RC – rectum.

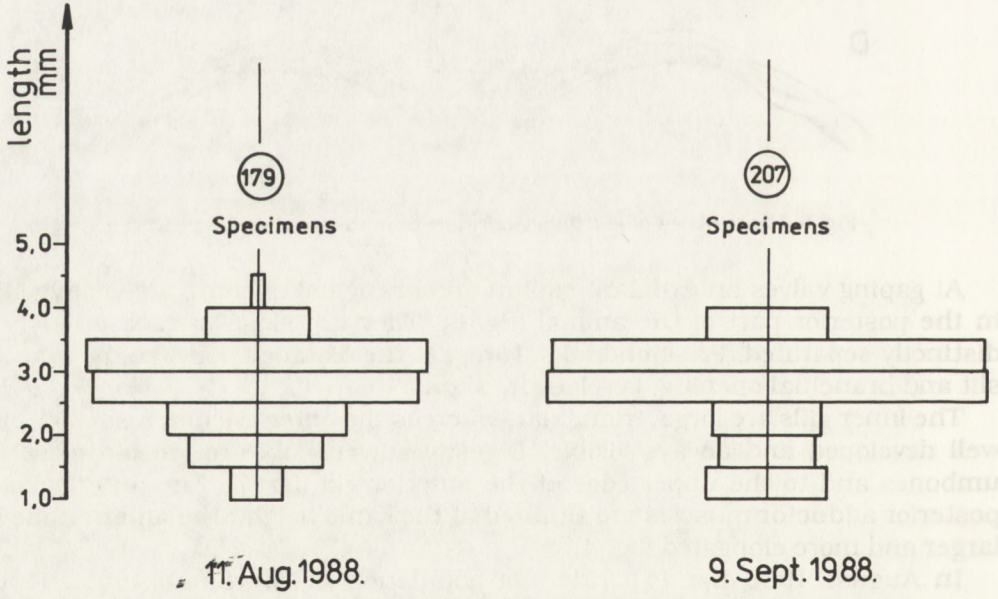

Fig. 8. Length-frequency distribution of *P. viridarium* in the Luamisamba River.

In the sample collected in August 14 gravid specimens (7.8%) were recorded with larvae in the gills (fig. 9). Gravid animals had shells 2.8–3.9 mm long. Larvae number ranged from 2 to 17, averaging 7. Larval individuals had 0.6–1.2 mm long shells. It was determined that 0.8 mm long embryos were still embedded in the brood-pouches (marsupies), while 0.9 mm and longer ones were already extra-marsupial. The largest extra-marsupial larvae were 1.2 mm length × 0.8 mm in height × 0.4 mm in breadth.

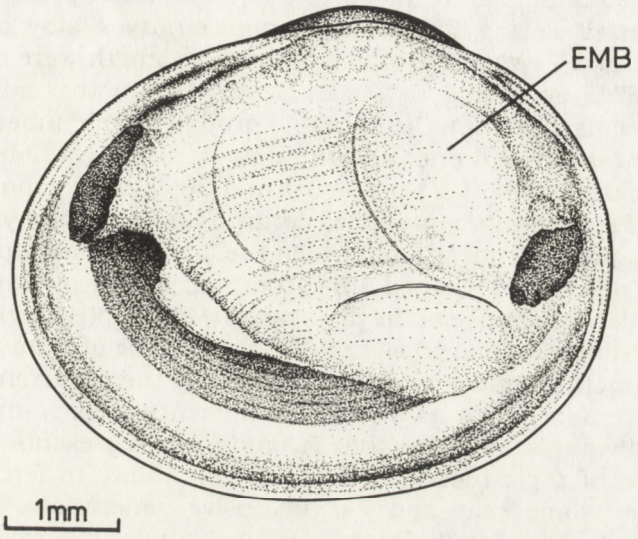

Fig. 9. Gravid specimen of *P. viridarium* from the Luamisamba River; EMB – embryo.

Presence of embryos in gills was also noticed in specimens sampled in September. 6 specimens out of 207 (2.9%) were gravid. The length of larvae ranged from 0.5 to 1.1 mm. These larvae were detected in parental individuals 2.6–3.5 mm in length. Larvae number ranged from 5 to 9.

The age distribution of *P. viridarium* presented in histograms (fig. 8) shows that juvenile individuals (1.0–2.0 mm in shell length) constituted an important part during the dry season (August, September). This testifies that in that period extra-marsupial larvae are born by parental individuals.

DISCUSSION

The present investigations proves that *P. viridarium* is one of the most common and widespread *Pisidium*-species of tropical Africa. In agreement with former KUIPER's (1964, 1966) observations *P. viridarium* prefers boggy habitats and slowly flowing river sections. In environments of this type the pill-clam reaches high abundance.

A callosity of the anterior part of the posterior lateral tooth – PIII is the character that allows most certain distinguishing between *P. viridarium* and

other African *Pisidium*-species. In pill-clams from the Luamisamba River this feature is as strongly developed as in the specimens from Zimbabwe (KUIPER, 1964; fig. 10) and Ethiopia (KUIPER, 1966; pl. VIII, fig. 4). It was decisively stronger than in *P. viridarium* from the Zairian River Lubumbashi (KUIPER, 1966; pl. VIII, fig. 5).

The size of the largest extra-marsupial embryos (1.1–1.2 mm) and the length of smallest free-living individuals (1.1–1.2 mm) proves that young *P. viridarium* are born with sizes similar to those of other *Pisidium*-species (MEIER-BROOK 1977). However, it seems that *P. viridarium* embryos stay a bit longer in brood-pouches. In *P. viridarium* larvae 0.8 mm in length were observed in the brood sacs, while according to MEIER-BROOK (1977) the embryos of other *Pisidium* free themselves from the sacs and drop to gill-chamber at 0.7 mm.

The analyzed material do not allow to reconstruct the whole life cycle of *P. viridarium*. The composition of the August and September populations suggest however, that *P. viridarium* reproduces continuously over the year (fig. 8). The reproduction is probably most intensive in the late rainy season (March–April), when animals which had reached 2.6–3.5 mm in length by August were most likely born. With the advance of the dry season (May-September) environmental conditions worsen in water-bodies and the abundance of released brood declines, but reproduction continues. This is proved by the occurrence of free-living clams 1.1–1.5 mm in length as well as the presence of extra-marsupial larvae in parental individuals. It seems that *P. viridarium* represents the continuous interparity type of reproduction, i.e. it has the ability to fertilize and breed throughout the whole year and its successive generations are not clearly separated (HEARD, 1965, MEIER-BROOK, 1970). A similar life-cycle was described by MEIER-BROOK (1970) in the Brazilian species *P. forense* M.-B.

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STRESZCZENIE

[Tytuł: Zairska populacja *Pisidium viridarium* KUIPER, 1956 (*Bivalvia: Heterodonta: Sphaeriidae*)]

Nowe stanowisko afrykańskiej groszkówki – *P. viridarium* – wykrył autor na obrzarze źródłowym rzeki Luamisamba (dorzecze Luapuli) w prowincji Shaba. Analizowano budowę muszli, morfologię miękkich części ciała oraz ekologię i biologię rozrodu tego małża. Cechami charakterystycznymi muszli są bardzo liczne drobne kanaliki (pory) (rys. 2) oraz obecność modzelowatego zgrubienia na listwie zamka – w sąsiedztwie zęba PIII (rys. 4).

P. viridarium rozmnaża się prawdopodobnie w ciągu całego roku, a największa intensywność rozrodu przypada na koniec okresu deszczowego (marzec–kwiecień). Liczba embrionów produkowanych przez jednego osobnika rodzicielskiego wynosiła 2–17, średnio 7. Długość muszli nowo narodzonych małży: 1,1–1,2 mm.

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