



Reports on the Free-Living Platyhelminthes from Australia: Typhloplanoida, with the Description of Three New Taxa

Authors: Willems, Wim, Artois, Tom, Vermin, Wouter, Backeljau, Thierry, and Schockaert, Ernest

Source: Zoological Science, 21(3) : 333-341

Published By: Zoological Society of Japan

URL: <https://doi.org/10.2108/zsj.21.333>

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Reports on the Free-Living Platyhelminthes from Australia: Typhloplanoida, with the Description of Three New Taxa

Wim Willems^{1*}, Tom Artois¹, Wouter Vermin¹, Thierry Backeljau²
and Ernest Schockaert¹

¹*Limburgs Universitair Centrum (LUC), Dept. SBG, Centre for Environmental Sciences, Research Group Biodiversity, Phylogeny and Population Studies, University Campus, Building D, B-3590 Diepenbeek, Belgium*

²*Royal Belgian Institute of Natural Sciences, Dept. Invertebrates, Vautierstraat 29, B-1000 Brussels, Belgium*

ABSTRACT—Five typhloplanoids from the Australian East Coast are reported, three of them new to science. Two taxa are members of Promesostomidae: *Vauclusia conica* n.g. n.sp., characterised by a cone-shaped stylet, the presence of a female bursa and a very long, partially-swollen female duct; *Brinkmanniella australiensis* n.sp. has a funnel-shaped stylet with a smooth distal tip. *Pilamonilla bimacula* n.g. n.sp. is a representative of the Solenopharyngidae, characterised by a stylet within a cirrus. The known species found are *Ceratopera axi* and *Ptychopera scutulifer*.

Key words: taxonomy, 'Turbellaria', Promesostomidae, Solenopharyngidae, Trigonostomidae

INTRODUCTION

Relatively few free-living platyhelminth species from Australia, excluding Polycladida, have been reported and described. To date, most of the microturbellarians are Proseriata, with 41 species reported and described (Curini-Galletti 1997, 1998; Curini-Galletti and Cannon, 1995, 1996a, b, 1997; Martens and Curini-Galletti, 1989; Curini-Galletti *et al.*, 2002; Faubel and Rohde, 1998). Also known are four species of Macrostomida (Faubel, Blome and Cannon, 1994; Sluys, 1986), a single representative of Kalyptorhynchia (the polycystidid *Gyatrix hermaphroditus* Ehrenberg, 1831, which seems to be a complex of sibling species (Curini-Galletti and Puccinelli, 1990, 1998)), five species of Dalyellioida (of which only one, *Luriculus australiensis* Faubel *et al.*, 1994, is from a marine habitat (Faubel, Rohde and Watson, 1994; Hartenstein and Dwine, 2000; Hochberg and Cannon, 2001, 2002a; Schmarda, 1859)) and 15 species of Typhloplanoida. Among the latter, ten species are from freshwater habitats (Hochberg and Cannon, 2002a; Kolasa and Schwartz, 1988; Noreña-Janssen and Faubel, 1992; Schmarda, 1859). The five marine typhloplanoids are: *Magnetia queenslandica* Hochberg and Cannon, 2002 (see Hochberg and Cannon, 2002b), and four species of *Trigonostomum* (Willems *et al.*, in press). However, in an ecolog-

ical study on tropical intertidal sediments Dittman (1991) recognised 108 different species, 16 of which were Typhloplanoida. In this contribution we report on five more typhloplanoids, of which three are new to science and two are known from localities outside Australia (*Ceratopera axi* (Riedl, 1954) Den Hartog, 1964 and *Ptychopera scutulifer* Ehlers and Ax, 1974), bringing the total number of named marine typhloplanoids to ten for Australia. They have all been found on the East Coast in areas around Townsville, Brisbane (North Stradbroke Island), Sydney and between Byron Bay and Coffs Harbour.

Next to their scientific names according to the Linnean system (and the International Code on Zoological Nomenclature (International Commission on Zoological Nomenclature, 1999)), we also propose a converted name for each species in the phylogenetic system (Phylocode; <http://www.ohio.edu/phylocode>) following the system proposed by Artois (2001).

MATERIAL AND METHODS

The specimens for this study were collected during two separate expeditions: the first in August–September 1996 by Tom Artois and Ernest Schockaert (ES) and the second by ES in September–November 1997. The animals were extracted from the sediment or from algae using the MgCl₂-decantation method (see Schockaert, 1996), studied alive and whole mounted with lactophenol. Remaining specimens, if any, were fixed in marine Bouin's solution, embedded in paraffin, serially sectioned (4 µm sections) and stained with Heidenhain's iron haematoxylin, using eosin as a counterstain.

* Corresponding author: Tel. +32-11-268383;
FAX. +32-11-268301.
E-mail: wim.willems@luc.ac.be

Camera lucida drawings of hard parts were made, using Nomarski interference. Drawings without a scale bar are freehand. Measurements of hard parts are taken axially, unless indicated otherwise. The positions of the gonopore and organs, and the measurements of the pharynx are expressed in percentages of the total body length (distances from the anterior tip of the body).

The type material of the new species will be deposited in the collections of the Queensland Museum, Brisbane, Australia. Voucher specimens of *Ceratopera axi* (Riedl, 1954) Den Hartog, 1964 from California and the Falklands, were loaned from the Swedish Museum of Natural History in Stockholm (SMNH). A whole mount of *Ptychopera scutulifer* Ehlers and Ax, 1974 from Somalia is present in the collections of the LUC (Diepenbeek, Belgium).

Abbreviations used in the figures

b: brain; bs: bursal stalk; cg: caudal glands; cga: common genital atrium; ci: cirrus; cil: cilia; de: ejaculatory duct; e: eye; ecm: external circular muscle; elm: external longitudinal muscle; fb: female bursa; fd: female duct; fg: female glands; gg: prostate glands; gm: glands of Minot; gp: common genital pore; i: intestine; icm: internal circular muscle; id: insemination duct; ilm: internal longitudinal muscle; lm: longitudinal muscle; m: mouth; ma: male atrium; od: oviduct; ov: ovary; pc: prepharyngeal cavity; pg: pharynx glands; ph: pharynx; pl: pharynx lumen; ppt: pharynx protractors; rg: rostral glands; rh: rhabdite; rm: radial muscle; s: stylet; sph: sphincter; t: testis; v: vas deferens; vd: vitelloduct; vg: prostate vesicle; vit: vitellaria; vs: seminal vesicle; y, z: features described in respective text.

TAXONOMIC ACCOUNT

TRIGONOSTOMIDAE GRAFF, 1905 *sensu*

DEN HARTOG, 1964

Ceratopera Den Hartog, 1964

Ceratopera axi (Riedl, 1954) Den Hartog, 1964

ceratopera-axi (Riedl, 1954) Den Hartog, 1964

Proxenetes axi Riedl, 1954

Ceratopera bifida Ehlers and Ax, 1974

Locality in Australia. Arrawarra (New South Wales): on small, shell-shaped brown algae (*Pedina* sp.) (29/08/1996) and on *Pavonina*-like algae (27/08/1996) in intertidal rockpools.

Known distribution. Gulf of Naples and Sicily (Riedl, 1954); Galapagos (Ehlers and Ax, 1974); Falkland Islands and California (Karling, 1986); Weddell Sea and La Réunion (Artois *et al.* 2000).

Material. Observations on live, mature specimens and two whole mounts (one from each new locality). Whole mounts from Falkland and California (collections of SMNH).

Remarks. Following Karling (1986) and Artois *et al.* (2000), we consider *C. bifida* Ehlers and Ax, 1974 a junior synonym of *C. axi* (Riedl, 1954) Den Hartog, 1964. The stylet of one of the Australian specimens is 70 µm long (measured along the axis of the stylet; 56 µm if measured from top to bottom as in Ehlers and Ax, 1974). The bursal appendage of this specimen is 94 µm long and splits distally. Neither part could be measured in the second specimen. In comparison with other populations (see Table 1), the Australian specimen has the smallest stylet.

Table 1. Measurements of the stylet and the bursal appendage of *Ceratopera axi* in different populations.

	Stylet	Bursal appendage	Reference
Australia	70 µm	94 µm	this paper
Galapagos	94–95 µm	67–87 µm	Ehlers and Ax, 1974
Falklands	120–180 µm	91 µm	Karling, 1986
California	93–117 µm	102 µm	Karling, 1986
La Réunion	105 µm	77 µm	Artois <i>et al.</i> , 2000
Weddell Sea	124 µm	?	Artois <i>et al.</i> , 2000

Ptychopera Den Hartog, 1964

Ptychopera scutulifer Ehlers and Ax, 1974

ptychopera-scutulifer Ehlers and Ax, 1974

Localities in Australia. Arrawarra (New South Wales): southern part of the beach, on *Sargassum*-like algae in a large permanent pool at the beginning of a mass of rocks (27/08/1996). North Stradbroke Island, Amity Point (Queensland): in muddy sediment from amongst mangroves (14/08/1996).

Known distribution. Galapagos (Ehlers and Ax, 1974); Somalia (Schockaert and Martens, 1985).

Material. Two mature specimens studied alive and mounted (one from each new locality). A whole mount of a specimen from Somalia (collections of LUC).

Remarks. The specimen from Stradbroke Island has a 54 µm-long stylet (measured axially). The sclerotised part of the afferent female duct (Ehlers and Ax, 1974: ductus spermaticus) between the swollen part (Ehlers and Ax, 1974: receptaculum seminis) and the atrial bursa (Ehlers and Ax, 1974: bursa copulatrix) is 49 µm long and is bent over 90°. These data correspond with the measurements on specimens from the Galapagos (38–40 µm-long stylet, axially measured; 23 µm-long sclerotised part of the afferent duct; Ehlers and Ax, 1974) and from Somalia (45–47 µm-long stylet; 20 µm sclerotised part of the afferent duct; Schockaert and Martens, 1985). On the other hand, the stylet of the Arrawarra specimen measures 98 µm, while the distal part of the afferent duct is 140 µm long. Whether these aberrant values represent a fixed difference between populations or are due to individual variability is not yet clear. It is also the only specimen found on algae. We, however, prefer to retain the Arrawarra-specimen within this species until/unless further material should suggest otherwise.

PROMESOSTOMIDAE DEN HARTOG, 1964

Brinkmanniella Luther, 1943

Brinkmanniella australiensis n.sp.

brinkmanniella-australiensis n.sp.

(Fig. 1)

Locality in Australia. Arrawarra (New South Wales): on crustaceous algae on rocks on the beach north of the headland

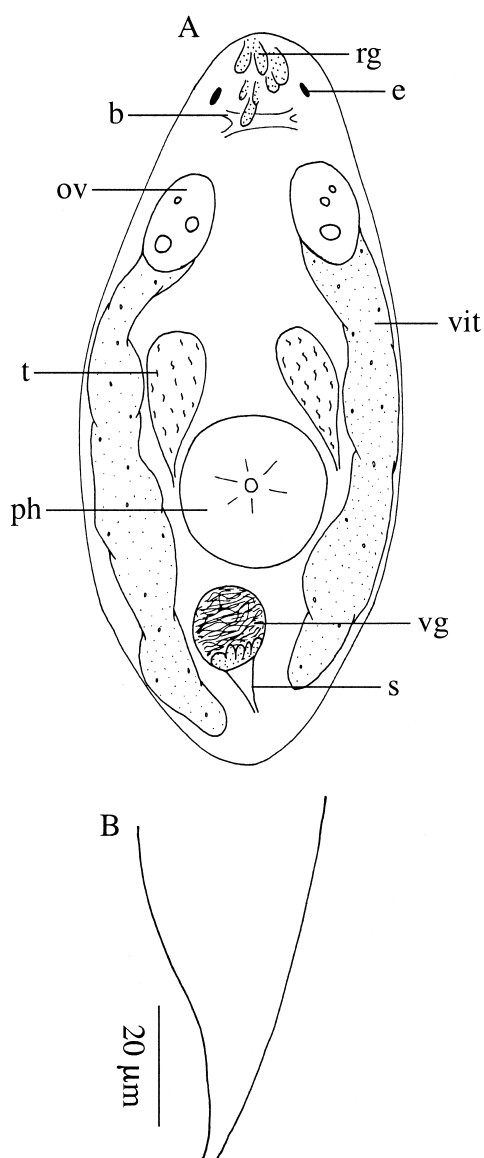


Fig. 1. *Brinkmanniella australiensis* n.sp. - A. General organisation (from a live specimen). - B. Stylet (from the holotype).

(27/08/1996) (type locality).

Material. One animal studied alive and mounted (holotype).

Etymology. The specific name refers to the species' occurrence in Australia.

Description. The animal is 0.9 mm long (measured on whole mount), pale yellow and has two eyes. The general organisation does not deviate from that of other *Brinkmanniella*-species (Fig. 1A; see also Ehlers, 1974; Karling, 1986; Luther, 1943, 1948; Marcus, 1951; Schockaert and Martens, 1985). The stylet (Fig. 1B) is thin-walled, straight and funnel-shaped. It is 57 µm long, and 32 µm wide proximally and slightly constricted about halfway along its length.

Diagnosis *Brinkmanniella australiensis*. Species of *Brinkmanniella* with straight funnel-shaped stylet of 57 µm long and proximally 32 µm wide, constricted halfway along its length and with a smooth distal tip.

Discussion. The representatives of the taxon *Brinkmanniella* are characterised by the rostral position of the ovaries, the absence of any special female atrial organs, apart from the female duct, and the caudally-situated pharynx. Schockaert and Martens (1985) gave a good overview of the main characters of *Brinkmanniella*-species. The stylets of *B. obtusa* Luther, 1943, *B. augusti* Marcus, 1951 and *B. palmata* Karling, 1986, show "fingers" at the distal opening (Karling, 1986), while *B. australiensis*, *B. macrostomoides* Luther, 1948, *B. procerastyla* Ehlers, 1974 and *B. microps* Schockaert and Martens, 1985 lack these "fingers". Of these latter four species, only *B. microps* and *B. australiensis* have a straight tubiform stylet, while it is curved in the other two species. The stylet of *B. microps* is only 30 µm long and 10 µm wide proximally and not constricted midway as in *B. australiensis*. The stylet of *B. australiensis* is twice as long with a width/length ratio of about 1/2.

***Vauclusia conica* n.g. n.sp.**

vauclusia-conica n.sp.

(Fig. 2)

Locality in Australia. Sydney, Vaucluse beach (New South Wales): flat beach with fine sand and numerous crab holes, in eu littoral (10/10/1997) (type locality).

Material. One individual studied alive and mounted (holotype). Three serially-sectioned specimens (paratypes).

Etymology. The genus name/prænomens refers to the type locality. The specific name emphasizes the overall structure of the copulatory organ. Conicus (Lat.): cone-shaped.

Description. The slender animal is ± 1.4 mm long (measured on the whole mount), without eyes. The cellular epidermis is ± 3.5 µm thick, with cilia of 3 µm long. The basement membrane is ± 1 µm thick. At the rostral end of the body, two types of large rhabdite glands are present. The first type, situated at the periphery of the glandular mass, produces large, basophilic rhabdites of 8.5–10.5 µm long. The glands in the centre produce eosinophilic rhabdites of the same size, but less densely packed within the cell bodies. All glands end at the rostral body tip, the basophilic ones stretching to the testes, the eosinophilic ones not further than the brain. There are also glands in the caudal body region (Fig. 2E: cg), opening ventrally behind the gonopore and producing large, basophilic rhabdites.

The mouth is situated at ± 65% and can be closed by a strong sphincter. The prepharyngeal cavity is lined with a low, nucleated epithelium and surrounded by only longitudinal muscles. The distal rim of the pharynx is lined with a very low epithelium, with a thick basement membrane and

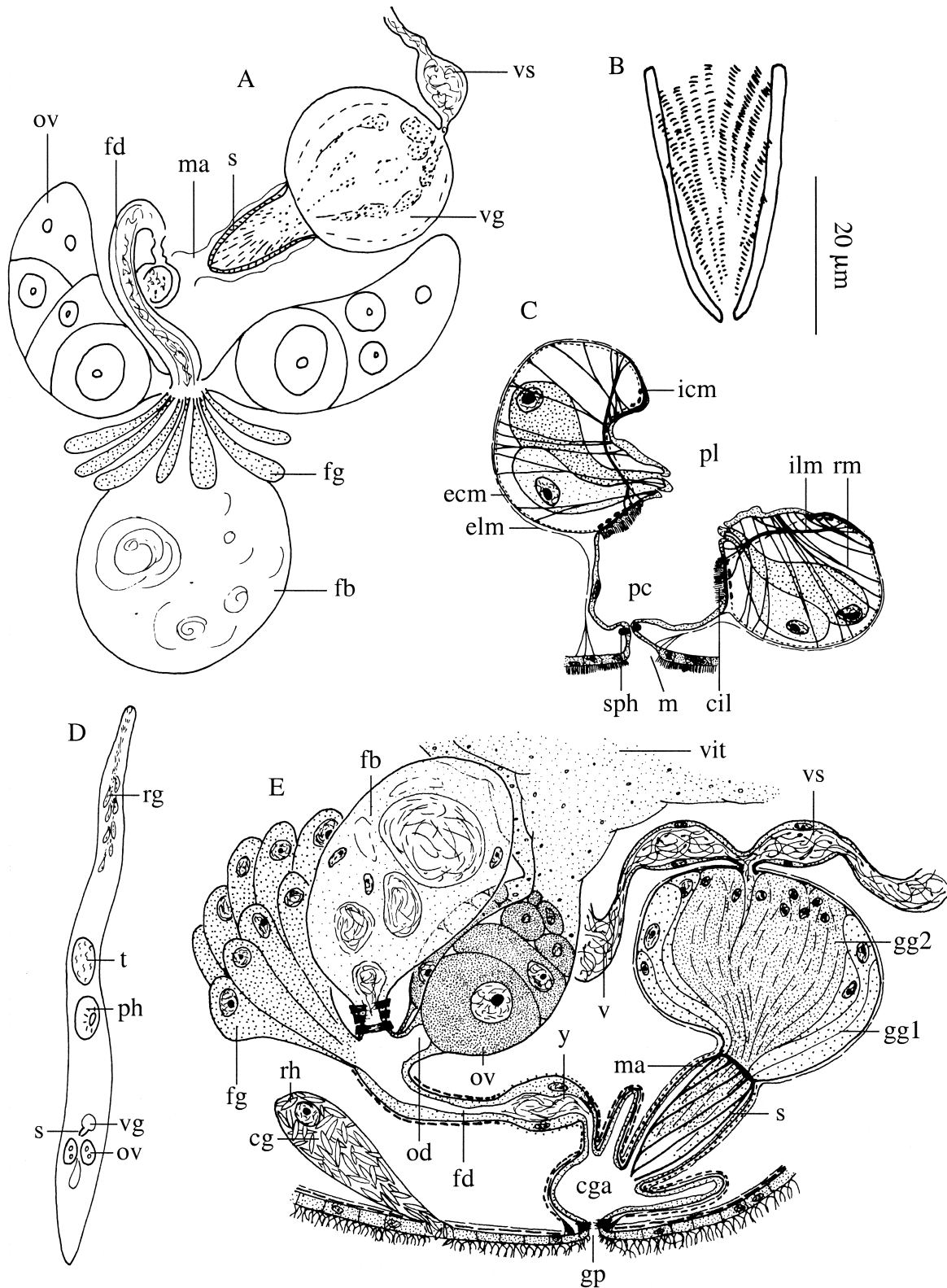


Fig. 2. *Vauclusia conica* n.g. n.sp. - A. Organisation of the genital system (from a live specimen). - B. Stilet (from the holotype). - C. Pharynx (reconstruction on sagittal sections). - D. Habitus of a live animal. - E. Reconstruction of the atrial organs from the right side.

cilia (Fig. 2C: cil). The pharynx lumen (Fig. 2C: pl) is lined with a low, anucleated epithelium. The epithelium of the proximal pharyngeal rim is degenerated, leaving only a thick

pseudocuticula. The inner circular muscles are thicker near the proximal and distal ends of the bulb. The exact number of internal longitudinal muscles could not be determined.

There are two types of eosinophilic pharyngeal glands, one coarse-grained and one fine-grained. They open into the lumen somewhat proximally from the distal sphincter, with the fine-grained ones most distally. In one of the sectioned specimens a third, basophilic gland could be observed. However, the exact location and the place of discharge could not be determined. The external pharyngeal muscle layers consisting of an inner circular (Fig. 2C: ecm) and an outer longitudinal one (Fig. 2C: elm), are rather weak.

The common genital pore is situated at $\pm 80\%$. The common genital atrium is lined with a high, anucleated epithelium and surrounded by an inner longitudinal and an outer circular muscle layer. Although the live specimen (Fig. 2D) apparently only showed one testis, there are clearly two testes in the sectioned specimens. The testes are situated ventrally just in front of the pharynx, at both sides of the body. The vasa deferentia are clearly visible in the sectioned specimens.

The paired seminal vesicles (only one observed in the live specimen; Fig. 2A) are lined with a low, nucleated epithelium. They continue towards the prostate vesicle, fusing when entering the prostate vesicle. The prostate vesicle (Fig. 2A: vg) is surrounded by a layer of longitudinal muscles, and contains fine-grained (Fig. 2E: gg2) and coarse-grained eosinophilic glands (Fig. 2E: gg1), the fine-grained glands located in the centre of the bulb. All glands are entirely intracapsular. The stylet (Fig. 2B), connected to the prostate vesicle, fills almost the entire male atrium. This stylet is cone-shaped, 29 μm long, 17 μm wide proximally and 5 μm wide distally. The exact structure of the stylet could not be determined, but probably consists of about eight elongated and spirally-running bars (or ridges), which show some striation. The male atrium (Fig. 2E: ma) enters the common genital atrium from the rostral side. It is lined with the same epithelium and surrounded by the same muscle layers as the common genital atrium, only the muscle layers have changed position, revealing an inner circular and an outer longitudinal muscle layer.

The ovoid ovaries are situated caudally from the gonopore. They form the distal part of the ovovitellaria. The female duct (Fig. 2E: fd) is long and enters the common genital atrium at the caudal side. It is lined with a high, anucleated epithelium and surrounded by strong circular muscles. Distally it is swollen and contains many sperm (Fig. 2E: y). This part is lined with a nucleated epithelium. Proximally the female duct ends in the female bursa (Fig. 2E: fb). It receives both oviducts somewhat distally from the bursal entrance. The part of the female duct between the bursa and the oviducts ("bursal stalk") is surrounded by circular muscles. The oviducts are rather short and lined with a low anucleated epithelium. A large bundle of coarse-grained eosinophilic glands (Fig. 2E: fg) enters the female duct ventrally at the bifurcation into the oviducts. A uterus is lacking.

Diagnoses *Vauclusia*. *Promesostomidae* with the pharynx

situated in the middle of the body. Inversion of muscle layers at the transition from the common genital atrium to the male genital atrium. Paired testes and seminal vesicles. Globular prostate vesicle with two types of secretion. Cone-shaped stylet, consisting of several plate-like bars (or ridges). Paired ovovitellaria. Very long female duct. Distal part of the female duct swollen and filled with sperm. Female bursa and female glands present. Type species: V. conica.

Vauclusia conica. Provisionally with the same diagnosis as the genus. Stylet 29 μm long.

Discussion. The combination of paired, solid testes, paired ovovitellaria, lack of a second connection of the female gonads with the exterior and the presence of only one genital pore are diagnostic features of the Promesostomidae (see Den Hartog, 1964). The new species fits into this diagnosis. Its possible relationships within this taxon are less clear. The fact that the ovaries in *V. conica* are not separated from the vitellaria, and the shortness of its male genital atrium exclude it from the present taxa Adenorhynchinae Ax and Heller, 1970 and Promesostominae Luther, 1948. However it shares some characters with this last taxon such as the presence of a terminal female bursa and terminal female glands. The connection of the ovaries with the vitellaria (ovovitellaria) also suggests a relationship with members of the Brinkmanniellinae Luther, 1948. Both in the members of the Adenorhynchinae and the Brinkmanniellinae the male atrium is very short. The relative values of all these characters can only be assessed by a detailed cladistic analysis including many more 'Typhloplanoida'. Therefore, we refrain from allocating *V. conica* to any of the subtaxa within the Promesostomidae.

SOLENOPHARYNGIDAE GRAFF, 1882

Pilamonila bimacula n.g. n.sp.

pilamonila-bimacula n.sp.

(Figs 3–4)

Locality in Australia. Arrawarra (New South Wales): south of the headland, on *Sargassum*-like algae in a large permanent pool and on algae in a permanent pool in front of the marine station, lower eulittoral (27/08/1996) (type locality).

Material. Three mature animals studied alive and mounted (one designated holotype, the others paratypes) and three sectioned specimens (designated paratypes).

Etymology. The genus name/prænomens refers to the chain of globular structures in the female system. Pila (Lat.): ball. Monile (Lat.): necklace. The specific name emphasizes the presence of a stylet and an armed cirrus. Bis (Lat.): twice. Masculus (Lat.): manly.

Description. The animal is 0.4–0.5 mm long (measured on whole mount), with two eyes. The body is whitish with black to yellow-brown spots when observed under incident light, pale brown, and opaque when observed with transmitted

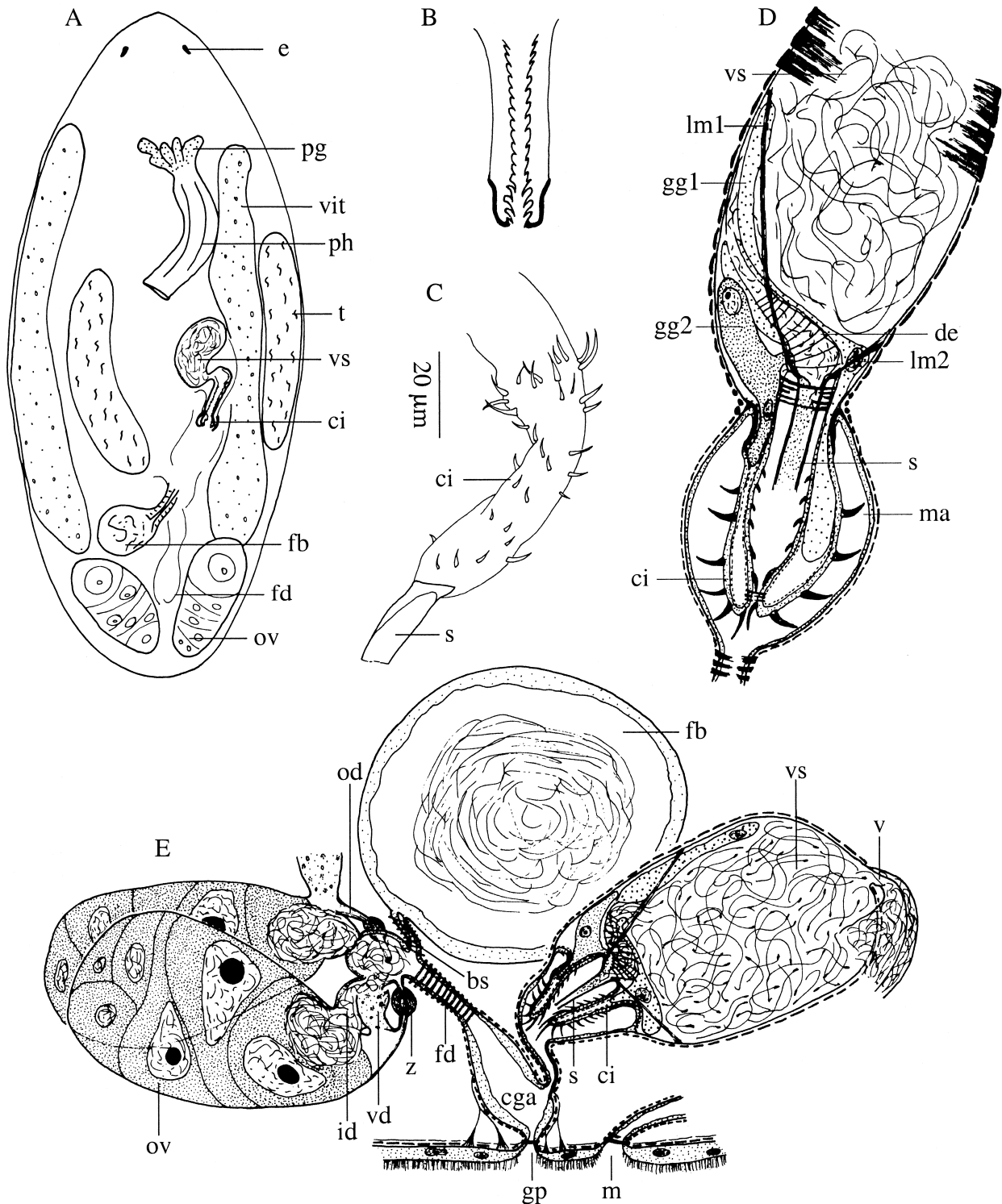


Fig. 3. *Pilamonila bimascula* n.g. n.sp. - A. General organisation (from a live specimen). - B. Inverted cirrus (from a live specimen). - C. Everted cirrus and stylet (from the holotype). - D. Male genital system (reconstruction on sagittal sections). - E. Reconstruction of the atrial organs from the right side.

light. The syncytial epidermis is 3 µm thick with cilia of 3 µm long. The basement membrane is ± 1 µm thick. Rhabdites are very small and equally distributed over the whole epidermis.

The elongated pharynx (Figs 3A: ph, 4C) is situated in the first body half with the mouth at $\pm 65\%$ (on sections). It is inclined towards the rostral body end. A narrow duct connects the mouth with the deep prepharyngeal cavity (Fig.

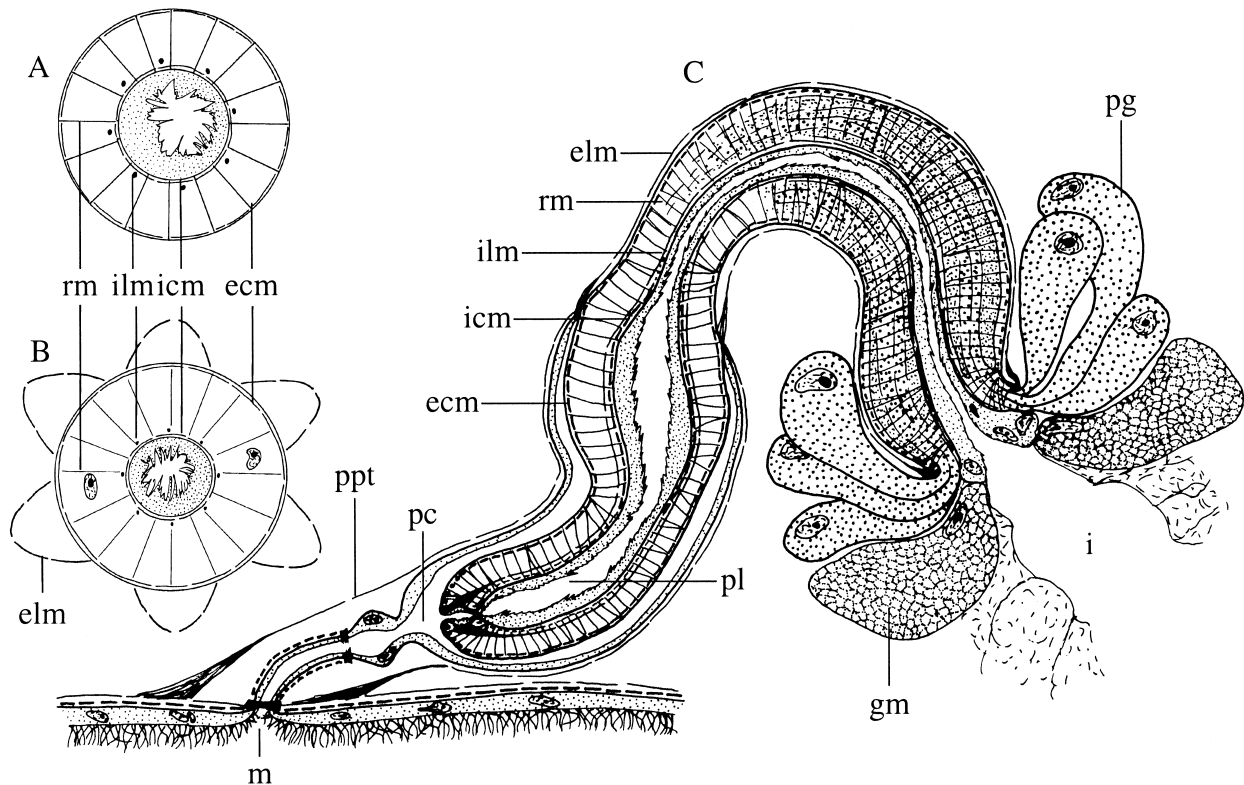


Fig. 4. *Pilamonila bimascula* n.g. n.sp. - A, B. Sections through the pharynx (A. Distally; B. Proximally). - C. Reconstruction of the pharynx from the right side.

4C: pc). This duct is lined with a low, anucleated epithelium and surrounded by strong circular muscles. At the transition of this duct with the prepharyngeal cavity the epithelium is much higher and shows some nuclei. The prepharyngeal cavity is lined with a low, nucleated epithelium and surrounded by longitudinal muscles. The distal pharyngeal rim has no cilia. The pharynx is surrounded by an outer longitudinal and an inner circular muscle layer. The former is, at least in the proximal part of the pharynx, arranged in six bundles forming a six-pointed star (Fig. 4B). Each "point of the star" contains four longitudinal fibres, showing a total of 24 external longitudinal muscles. The internal muscles consist of weak radial muscles (Fig. 4C: rm), a circular (Fig. 4C: icm) and a longitudinal layer (Fig. 4C: ilm). There are eight inner longitudinal and 16 radial muscle fibres (Fig. 4A). The epithelium of the lumen has degenerated to a pseudociliation. The pharynx contains coarse-grained eosinophilic glands and some coarse-grained basophilic glands. The latter enter the pharynx proximally, and thus have an extrapharyngeal part. The exact place where both types of glands open into the lumen could not be determined, but must be close to the distal end of the pharynx.

The common genital pore lies at 70%, just behind the mouth, and can be closed by a sphincter. The common genital atrium is lined with a high, anucleated epithelium and is surrounded by an inner circular and an outer longitudinal muscle layer.

The paired and elongated testes lie ventrally of the

prostate vesicle, just behind the pharynx. The vasa deferentia are short, and connect the testes with the intracapsular seminal vesicle (Fig. 3E: vs). This vesicle fills almost the entire proximal part of the copulatory bulb, and narrows distally to the ejaculatory duct (Fig. 3D: de). The ejaculatory duct runs centrally through prostate glands. It is lined with an anucleated, membranous epithelium, surrounded by weak circular muscles and connected to a small, tubiform stylet (Fig. 3C–E: s). There are basophilic (Fig. 3D: gg1) and eosinophilic (Fig. 3D: gg2) prostate glands, situated in the most distal part of the prostate vesicle and discharging their contents through the stylet. This stylet is 12–19 μm long and 4–5 μm wide (in the holotype: 19 μm and 4 μm respectively). It was visible in only two of the three whole mounts, but in all sectioned specimens. The copulatory bulb is surrounded by a circular muscle layer. From the stylet two groups of muscle fibers run obliquely through the copulatory bulb. The dorsal group attaches to the wall of the copulatory bulb in its proximal part (Fig. 3D: lm1), the ventral group in its distal part (Fig. 3D: lm2). The stylet lies in a cirrus, which bears small spines (1–2 μm) in its proximal part and large spines (5–8 μm) distally. Both parts are separated by a sphincter, and in the sectioned individuals the distal part of the cirrus was everted, and when completely everted (as in two of the whole mounts; Fig. 3C) the stylet appears at the end of the cirrus. The cirrus is lined with a low, membranous, anucleated epithelium, as also is the male atrium. Only at the transition between the male atrium and the spiny cirrus is the

epithelium hardened, and this forms a 'cap' at the end of the cirrus when it is completely inverted (Fig. 3B).

The female duct (Fig. 3E: fd) enters the common genital atrium dorsally. It is lined with a low, anucleated epithelium and surrounded by circular muscles. Proximally the female duct widens and is filled with sperm. It bifurcates towards the ovaries and these insemination ducts (Fig. 3E: id) are swollen and also filled with sperm. Both ovaries have a second connection (Fig. 3E: od) to the swollen part of the female duct. These ducts receive the vitelloglands (Fig. 3E: vd) and are therefore to be considered the oviducts. In the middle of the oviducts a sclerotized ring appears (Fig. 3E: z). The bursa (Fig. 3E: fb) lies above the female duct. This large, globular bursa is also connected to the swollen part of the female duct by a short, very narrow canal, surrounded by circular muscles (Fig. 3E: bs). A uterus is lacking.

Diagnoses *Pilamonila*. Solenopharyngidae with the mouth situated at 2/3 of the body. Pharynx elongated, with well-developed basophilic glands proximally. Testes paired. Large internal seminal vesicle. Male copulatory organ consists of a spiny cirrus and a simple tubiform stylet within the cirrus. Ovaries paired. Large female bursa with muscular bursal stalk. Double connection between ovaries and female duct: swollen spermatid ducts filled with sperm, and narrow oviducts, halfway surrounded by a thickened sclerotised ring. Type species: *P. bimascula*.

***Pilamonila bimascula*.** Provisionally with the same diagnosis as the genus. Stylet $\pm 15 \mu\text{m}$ long, cirrus with small proximal spines (1–2 μm) and large distal spines (5–8 μm).

Discussion. Based on the ventrocaudally-oriented, elongated pharynx, strongly-developed extrapharyngeal glands, the caudally-situated mouth, the presence of a common genital pore, paired testes, unpaired seminal vesicle, intracapsular prostate glands, the presence of a cirrus and paired vitellaria, this species is placed within the Solenopharyngidae Graff, 1882 (see Ehlers, 1972). The general structure of the male copulatory organ does not seem to deviate from that of other solenopharyngids, except for the presence of a sclerotised structure at the end of the ejaculatory duct. This hard part is a 'real' single-walled stylet in contrast with the sclerotised lining of the ejaculatory duct as in *Proceropharynx litoralis* Ehlers, 1972 and *Lenopharynx tubatus* Schockaert and Martens, 1985 (see Schockaert and Martens, 1985). The paired ovaries of *P. bimascula* suggest a placement within the subfamily Lenopharynginae Ehlers, 1972. However, the organisation of the female system with the double connection between the ovaries and the female duct is completely aberrant from that in all other representatives of the Solenopharyngidae. At the moment we refrain from speculation about the relationships of *P. bimascula* within the Solenopharyngidae and placement in any of the subfamilies recognised by Ehlers (1972).

ACKNOWLEDGEMENTS

We thank Mrs. Natascha Steffanie for serial sectioning and staining of the animals, Mr. Frank Van Belleghem for helping us with the figures and Dr. N. Watson for correcting the English. Dr. Sven Boström is thanked for sending us the material of *C. axi*, present in the collection of the Swedish Museum of Natural History (Stockholm). The first author is supported by a specialisation grant of the Flemish Institute for the Benefit of Scientific and Technological Research in the Industry (IWT). The several sampling expeditions were supported by grants of the Fund for Scientific Research-Flanders (Belgium).

REFERENCES

- Artois T (2001) Phylogenetic nomenclature: the end of binominal nomenclature? *Belg J Zool* 131: 87–89
- Artois T, Vermin W, Schockaert E (2000) Rhabdocoela (Platyhelminthes) from the Weddell Sea (Antarctica) with the description of eight new species. *Belg J Zool* 130: 103–110
- Curini-Galletti MC (1997) Contribution to the knowledge of the Proseriata (Platyhelminthes: Seriata) from eastern Australia: genera *Necia* Marcus, 1950 and *Pseudomonocelis* Meixner, 1938 (partim). *It J Zool* 64: 75–81
- Curini-Galletti M (1998) The genus *Polystyliphora* Ax, 1958 (Platyhelminthes: Proseriata) in eastern Australia. *J nat Hist* 32: 473–499
- Curini-Galletti M, Cannon L (1995) Contribution to the knowledge of the Proseriata (Platyhelminthes: Seriata) from eastern Australia. II. Genera *Pseudomonocelis* Meixner, 1943 and *Acanthopseudomonocelis* n. g.. *Contr Zool* 65: 271–280
- Curini-Galletti M, Cannon LRG (1996a) Five new species of *Monocelis* Ehrenberg, 1831 (Platyhelminthes: Proseriata) from eastern Australia. *J nat Hist* 30: 1741–1759
- Curini-Galletti M, Cannon LRG (1996b) The genus *Minona* (Platyhelminthes, Seriata) in eastern Australia. *Zool Scripta* 25: 193–202
- Curini-Galletti M, Cannon LRG (1997) A polypharyngeal marine flatworm (Platyhelminthes, Proseriata, Archimonocelididae) from eastern Australia. *Zool J Linn Soc* 121: 485–494
- Curini-Galletti MC, Oggiano G, Casu M (2002) The genus *Nematoplana* Meixner, 1938 (Platyhelminthes: Unguiphora) in eastern Australia. *J nat Hist* 36: 1023–1046
- Curini-Galletti MC, Puccinelli I (1990) The *Gyatrix hermaphroditus* species complex (Platyhelminthes: Kalyptorhynchia) in the Darwin Area (Northern Territory, Australia). *Trans am Microsc Soc* 109: 368–379
- Curini-Galletti MC, Puccinelli I. 1998. The *Gyatrix hermaphroditus* species complex (Kalyptorhynchia: Polycystididae) in marine habitats of eastern Australia. *Hydrobiologia* 383: 287–298
- Den Hartog C (1964) A preliminary revision of the *Proxenetes* group (Trigonostomidae, Turbellaria). I, II, III. *Proc Kon Ned Akad Wetensch C* 67: 371–407
- Dittman S (1991) Plathelminths in tropical intertidal sediments of northeastern Australia. *Hydrobiologia* 227: 369–374
- Ehlers U (1972) Systematisch-phylogenetische Untersuchungen an der Familie Solenopharyngidae (Turbellaria, Neorhabdocoela). Mit Darstellung von 7 neuen psammobionten Arten des Sylter Sandstrandes. *Mikrofauna des Meeresbodens* 11: 3–78
- Ehlers U (1974) Interstitielle Typhloplanoida (Turbellaria) aus dem Litoral der Nordseeinsel Sylt. *Mikrofauna des Meeresbodens* 49: 427–526
- Ehlers U, Ax P (1974) Interstitielle Fauna von Galapagos VIII. Trigonostominae (Turbellaria, Typhloplanoida). *Mikrofauna des Meeresbodens* 30: 641–671
- Faubel A, Blome D, Cannon LRG (1994) Sandy Beach Meiofauna

- of Eastern Australia (Southern Queensland and New South Wales). I. Introduction and Macrostomida (Platyhelminthes). *Invertebr Taxon* 8: 989–1007
- Faubel A, Rohde K (1998) Sandy Beach Meiofauna of Eastern Australia (Southern Queensland and New South Wales). IV. Proseriata, Platyhelminthes. *Mitt hamb zool Mus Inst* 95: 7–28
- Faubel A, Rohde K, Watson NA (1994) Sandy Beach Meiofauna of Eastern Australia (Southern Queensland and New South Wales). II. *Luriculus australiensis*, gen. et sp. nov. (Luridae: Dalyelliidae: Platyhelminthes). *Invertebr Taxon* 8: 1009–1015
- Hartenstein V, Dwine KA (2000) Freshwater dalyellid flatworm, *Gieysztoria superba* sp. nov. (Dalyelliidae: Rhabdoceola) from southeast Queensland, Australia. *Memoirs Queensland Museum* 45: 381–384
- Hochberg R, Cannon LRG (2001) A new species of *Gieysztoria* (Platyhelminthes; Rhabdoceola; Dalyelliidae) from a freshwater lake in Queensland, Australia. *Zootaxa* 11: 1–8
- Hochberg R, Cannon LRG (2002a) Two new freshwater rhabdoceols, *Austrodalyellia* gen. nov. and *Haplodidymos* gen. nov. (Platyhelminthes) from Queensland, Australia. *Zootaxa* 44: 1–15
- Hochberg R, Cannon LRG (2002b) *Magnetia queenslandica*, a new genus and new species of typhloplanid flatworm (Platyhelminthes: Rhabdoceola) from Magnetic Island in North Queensland, Australia. *Raffles Bull of Zool* 51: 1–6
- International Commission on Zoological Nomenclature (1999) International Code of Zoological Nomenclature. 4th ed, International Trust for Zoological Nomenclature, London
- Karling TG (1986) Free-living marine Rhabdoceola (Platyhelminthes) from the N. American Pacific coast. With remarks on species from other areas. *Zool Scr* 15: 201–219
- Kolasa J, Schwartz SC (1988) Two new *Mesostoma* species (Turbellaria, Rhabdoceola) from Australia. *Zool Scr* 17: 329–335
- Luther A (1943) Untersuchungen an Rhabdoceolen Turbellarien - VII- Über einige Repräsentanten der Familie Proxenetidae. *Acta Zool Fenn* 38: 3–95
- Luther A (1948) Untersuchungen an Rhabdoceolen Turbellarien - VII- Über einige marine Dalyellioida. -VIII- Beiträge zur Kenntnis der Typhloplanoida. *Acta Zool Fenn* 55: 3–122
- Marcus E (1951) Turbellaria Brasileiros (9). *Bol Fac Fil Cienc Letr Univ S. Paulo, Zoologia* 16: 5–215
- Martens PM, Curini-Galletti MC (1989) Monocelididae and Archimonocelididae (Platyhelminthes Proseriata) from South Sulawesi (Indonesia) and Northern Australia with biogeographical remarks. *Trop Zool* 2: 175–205
- Noreña-Janssen C, Faubel A (1992) Revision of the subfamily Mesostominae (Rhabdoceola, Platyhelminthes). *Mitt hamb zool Mus Inst* 89: 7–47
- Riedl R (1954) Neue Turbellarien aus dem mediterranen Felslitoral-Ergebnisse der "Unterwasser Expedition AUSTRIA 1948–1949". *Zool Jb Abt Syst* 82: 157–244
- Schmarda LK (1859) Neue wirbellosen Thiere. Beobachtet und gesammelt auf einer Reise un die Erde 1853 bis 1857 Band 1: Turbellarien, Rotatorien und Anneliden. W. Engelmann, Leipzig
- Schockaert ER (1996) The Importance of Turbellarians in Ecosystems. In "Methods for the Examination of Organismal Diversity in Soils and Sediments" Ed by GS Hall, CAB International, Wallingford, pp 211–225
- Schockaert ER, Martens PM (1985) Turbellaria from Somalia. III. Lecithoepitheliata and Typhloplanoida. *Monit zool ital (NS) Supple* 20: 27–41
- Sluys R (1986) First representative of the order macrostomida in Australia (Platyhelminthes, Macrostomidae). *Records of the South Australian Museum* 19: 399–404
- Willems WR, Artois TJ, Vermin WA, Schockaert ER (in press) Revision of the taxon *Trigonostomum* Schmidt, 1852 (Platyhelminthes, Typhloplanoida, Trigonostomidae) with the description of seven new species. *Zool J Linn Soc*

(Received October 16, 2003 / Accepted December 23, 2003)