Typhloplanoida (Platyhelminthes, Rhabdocoela) from New Caledonia and eastern Australia, with the description of six new taxa

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Abstract Thirteen species of Typhloplanoida from the Australian east coast and New Caledonia are reported, six of them new to science. Three of these new species are representatives of the Promesostomidae: Coronhelmis cuypersi new species, Coronhelmis novaecaledoniensis new species, and Kymocares kanakorum new species. Austradenopharynx reynaertsi new genus and species is a member of the Solenopharyngidae. Two species are placed within the Typhloplanidae: Kaitalugia lydieae new genus and species and K. falcata new species. Furthermore, new localities are given for Messoplana minuta, known from the Weddell Sea, Brinkmanniella palmata, occurring on the North American Pacific coast, the Swedish west coast and in the Black and Mediterranean Seas, Ceratopera axi, a cosmopolitan species, and Vauclusia conica and Pilamonila bimaculata, two Australian species. For the sake of completeness, two more species of which insufficient material is available, are mentioned. A complete species list of all marine Typhloplanoida found in the region is given.

Keywords systematics; taxonomy; biodiversity; “Turbellaria”; Promesostomidae; Solenopharyngidae; Trigonostomidae; Typhloplanidae; Australia; New Caledonia

INTRODUCTION

Our knowledge of marine turbellarians, and of typhloplanoids in particular, from Australia and the adjacent island territories is very scattered. However, in an ecological study in northeastern Australia, Dittman (1991) recognised more than 100 different species of Turbellaria, of which 16 were undescribed typhloplanoids. Up to the present, 14 different species of Typhloplanoida have been described from the region (see Hochberg & Cannon 2003; Hochberg 2004; Willems et al. 2004a,b). An overview of all species occurring on the coasts of New Caledonia and eastern Australia, including those described in this contribution and two new species of Promesostoma Graff, 1882 (see further), is given in a species list for the region.

Six new species are described in the present contribution: three species from New Caledonia only; two species from the east coast of Australia only; and one species occurring in both regions. Furthermore, additional data are given on Ceratopera axi (Riedl, 1954) Den Hartog, 1964, Brinkmanniella palmata Karling, 1986, Messoplana minuta Artois et al., 2000, Vauclusia conica Willems et al., 2004 and Pilamonila bimaculata Willems et al., 2004. For the sake of completeness, two more species are added, Pratoplana sp. and Ptychopera sp. For both, only observations on live material have been made, and one whole mount in bad condition is available, not allowing exact identification. However, both species may be recognised when found in the future.

Additionally, two Promesostoma species were collected from New Caledonia. Because of the
taxonomical complexity and species-richness of this taxon, both species are described in a monographical treatment of *Promesostoma*, which is already submitted for publication elsewhere.

**MATERIAL AND METHODS**

The specimens for this study were collected during three expeditions: the first in August–September 1996 by Tom Artois and Ernest Schockaert (ES), the second by ES in September–November 1997 and the third by ES in July and August 2003.

The animals were extracted from the sediment or from algae using the MgCl$_2$-decantation method (see Schockaert 1996), studied alive and whole mounted with lactophenol. Additional specimens 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.

Camera lucida drawings of hard parts in the whole mounts were made with Nomarski microscopy. Drawings without a scale bar are freehand. Photographs are all from live animals and are taken with an Olympia C-5050 Zoom digital camera.

Measurements of hard parts are taken axially, unless indicated otherwise. The position of the gonopore and organs, and the measurements of the pharynx are expressed in percentages of the total body length (distance from the anterior tip of the body).

Voucher specimens of *Ceratopera axi* (Riedl, 1954) Den Hartog, 1964 from California and the Falklands were loaned from the collections of the Swedish Museum of Natural History in Stockholm (SMNH). Two whole mounts from Australia, one from Kerguelen, one from La Réunion and one from the Weddell Sea are present in the collections of the LUC (Diepenbeek, Belgium). Material of several solenopharyngid species from the SMNH collections was used for reference. The type material of *Vauclusia conica* and *Pilamonila bimaculata* is present in the collections of the Queensland Museum (QM), whereas the type material of *Messoplena minuta* is present in the LUC collections.

The type material of *Austradenopharynx reynaertsi* new genus and species and *Coronhelmis cuypersi* new species, both from Australia, will be deposited in the collections of the Queensland Museum, Brisbane, Australia. The type material of the New Caledonian species will be kept in the LUC collections.

**Abbreviations used in the figures**

b: brain; ba: bursal appendage; bc: copulatory bursa; bgg: basophilic prostate glands; bh: bursal hook; bu: bursa; cga: common genital atrium; cil1–2: cilia; cm: circular muscles; cop: copulatory organ; csp: cirrus spines; de: ejaculatory duct; ds: spermathecal duct; e: eye; egg: eosinophilic prostate glands; epg: extrapharyngeal glands; evs: extracapsular seminal vesicle; fd: female duct; gg: prostate glands; gl: glands; gp: common genital pore; gw: “Greifwulst” (prehensile girdle); igg: intracapsular prostate glands; ipg: intrapharyngeal glands; ivs: intracapsular seminal vesicle; lm: longitudinal muscles; m: mouth; ma: male atrium; mb: muscular bulb on female duct; od: oviduct; ov: ovary; pc: prepharyngeal cavity; pg: pharynx glands; ph: pharynx; pl: pharynx lumen; rg: rostral glands; rs: seminal receptacle; s: stylet; sep: muscular septum; sph: sphincter; t: testis; ut: uterus; v: vas deferens; vd: vitelloduct; vg: prostate vesicle; vit: vitellarium; vs: seminal vesicle; x, y, z: features described in respective text.

**TAXONOMIC ACCOUNT**

**Family Promesostomidae Den Hartog, 1964**

**Subfamily Brinkmaniellinae Luther, 1948**

*Brinkmanniella palmata* Karling, 1986  

*Fig. 1* NEW LOCALITIES: Ile Nou (Nouméa, New Caledonia): on Kuendu Beach in coarse-grained sand, 3 Aug 2003 and on algae in the lagoon, 10 Aug 2003.

KNOWN DISTRIBUTION: North American Pacific coast (Karling 1986), Black Sea (leg. V. Mack-Fira; see
MATERIAL EXAMINED: Two specimens (one from each locality) studied alive and mounted.

REMARKS: The delicate stylet of the New Caledonian specimens is 56–58 µm long (n = 2) and shows six or seven “fingers”, which lie closely together (see Fig. 1). The distal tip is somewhat widened. The structure of the stylet resembles that of two out of six species of Brinkmanniella Luther, 1943: Brinkmanniella obtusa Luther, 1943 and B. palmata Karling, 1986, the difference between the two being the number of fingers (six in B. palmata, seven to eight in B. obtusa) and the fact that the distal tip is pointed (in B. obtusa) or blunt (Karling 1986). In the specimens from New Caledonia the distal tip of the stylet is blunt, not, however forming a fist-like structure as in B. palmata specimens from the North American Pacific coast, the Swedish west coast and the Black Sea and Mediterranean Sea. It is, however, never pointed as in B. obtusa.

**Coronhelmis cuypersi** new species

**LOCALITY:** Arrawarra (New South Wales, Australia): beach south of the marine station, between rocks, fine sand, 30 Oct 1997 (Type locality).

**MATERIAL EXAMINED:** One specimen studied alive and mounted, designated holotype (QM no. G223181).
Table 1  Comparison of all *Coronhelmis* species. ?, not known.

<table>
<thead>
<tr>
<th>Species</th>
<th>C. conspicus</th>
<th>C. cuypersi</th>
<th>C. exigus</th>
<th>C. inornatus</th>
<th>C. lutheri</th>
<th>C. multispinosus</th>
<th>C. noerrevangi</th>
<th>C. novae-caledoniae</th>
<th>C. tripartitus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length animal (mm)</td>
<td>1.5–2</td>
<td>1</td>
<td>0.8–1.0</td>
<td>0.6–0.8</td>
<td>0.8–1.4</td>
<td>0.5–1.5</td>
<td>0.8–1.2</td>
<td>1.2</td>
<td>0.6–1.0</td>
</tr>
<tr>
<td>Stylet length (µm)</td>
<td>60–80</td>
<td>24</td>
<td>30</td>
<td>11–12</td>
<td>17–26 (45 under strong pressure)</td>
<td>16–23 (±56 under strong pressure)</td>
<td>17–22</td>
<td>19</td>
<td>15–20</td>
</tr>
<tr>
<td>Length “manschette” (µm)</td>
<td>18–25</td>
<td>11</td>
<td>±5</td>
<td>absent</td>
<td>8–9</td>
<td>±33 µm (under strong pressure)</td>
<td>?</td>
<td>9</td>
<td>?</td>
</tr>
<tr>
<td>Stylet width (µm)</td>
<td>?</td>
<td>19</td>
<td>?</td>
<td>±10</td>
<td>12–24</td>
<td>18</td>
<td>17–20</td>
<td>29</td>
<td>11–14</td>
</tr>
<tr>
<td>No. of spiny rows (strong pressure)</td>
<td>4–5 (?)</td>
<td>?</td>
<td>1</td>
<td>1</td>
<td>max. 8</td>
<td>1</td>
<td>3</td>
<td>1 (?)</td>
<td>1</td>
</tr>
<tr>
<td>No. of spiny rows (no pressure)</td>
<td>2–3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1 (+2 without spines)</td>
</tr>
<tr>
<td>No. of spines</td>
<td>&gt;30</td>
<td>&gt;30</td>
<td>8–10</td>
<td>10–15</td>
<td>&gt;30</td>
<td>±10</td>
<td>15</td>
<td>15–20</td>
<td>25–30</td>
</tr>
<tr>
<td>Length spines (µm)</td>
<td>20–30</td>
<td>15</td>
<td>?</td>
<td>max. 11–12</td>
<td>5–10</td>
<td>13 (25)</td>
<td>5–9</td>
<td>9</td>
<td>?</td>
</tr>
<tr>
<td>Ejaculatory duct</td>
<td>short</td>
<td>very long (with spines distally)</td>
<td>short</td>
<td>short</td>
<td>short</td>
<td>short</td>
<td>short</td>
<td>short</td>
<td>short</td>
</tr>
<tr>
<td>Habitat</td>
<td>freshwater outlet</td>
<td>marine, eulittoral</td>
<td>freshwater outlet</td>
<td>marine, supralittoral</td>
<td>freshwater outlet; tidepools; brackish sandflats</td>
<td>brackish sandflats</td>
<td>marine, supralittoral; brackish sandflats; freshwater outlets</td>
<td>marine, eulittoral</td>
<td>marine, supralittoral</td>
</tr>
<tr>
<td>Distribution</td>
<td>Greenland</td>
<td>East Australia</td>
<td>Greenland</td>
<td>North Sea</td>
<td>Baltic Sea, North Atlantic, Alaska</td>
<td>Baltic Sea, North Sea</td>
<td>Greenland, Iceland, Färöer</td>
<td>New Caledonia</td>
<td>North Sea</td>
</tr>
</tbody>
</table>
ETYMOLOGY: Species dedicated to Dr Ann Cuypers (Centre for Environmental Sciences, LUC, Diepenbeek).

DESCRIPTION: The Australian specimen is ±1.0 mm long (measured on the whole mount). The pharynx is situated in the middle of the body (Fig. 2A: ph). The prostate vesicle (Fig. 2A,B: vg) is situated in the last third of the body and shows a little cap (Fig. 2B: x) as seen in the live animal. In the whole mount it seems to be an everted (permanently?) muscular collar. From here starts a rather long ejaculatory duct (Fig. 2B: de), which widens slightly distally where it is armed with small spines (thickened basement membrane; Fig. 2B: y). The whole system, prostate vesicle and ejaculatory duct, is enclosed in a septum, forming a typical duplex-type copulatory organ (terminology of Karling 1956). The stylet (Fig. 2C) surrounds the distal part of the ejaculatory duct, is 24 µm long, proximally 19 µm wide, with a proximal thin-walled, 11 µm-long part (“manschette” in Luther 1948) and a single ring of spines distally. The spines (more than 30) are all ±15 µm long. A copulatory bursa was not observed.

DIAGNOSIS: Coronhelmis species with stylet 24 µm long and 19 µm wide, with one ring of more than 30 spines and ±9 µm long manschette. Spines 9 µm long, leaf-shaped with a thickened median ridge, extending beyond the proximal rim.

DISCUSSION ON THE TAXON Coronhelmis: Coronhelmis novaecaledoniae and C. cuypersi possess almost all diagnostic characters of the taxon Coronhelmis Luther, 1948: an elongated body, a copulatory bursa and an oval-shaped copulatory organ connected to a stylet that consists of a proximal part or manschette and a distal ring of spines (diagnosis of Luther 1948). A copulatory bursa was not observed in C. cuypersi (as for example also in C. conspicuus Ax, 1994, C. noerrevangii Ax, 1994 and C. exiguis Ax, 1994; see Ax 1994). An overview of all known species is given in Table 1. Coronhelmis urna Ax, 1954 is regarded as a junior synonym of C. lutheri Ax, 1951, following Luther 1962.

The only differences between the species are to be found in the detailed structure and size of the stylet (see Table 1). The stylet of C. novaecaledoniae is easily distinguished from that of other Coronhelmis species by the detailed structure of the spines. In all these species the spines are extremely simple, not leaf-shaped with a median ridge, as in C. novaecaledoniae.

The stylet of C. cuypersi closely resembles that of C. lutheri (see for instance Ax 1951: fig. 23; Ax 1994: fig. 1A,B, 2A,B; Luther 1962: fig. 19H; Ehlers 1974: fig. 11A,C; Ax & Armonies 1987: fig. 20D,E). In this species the stylet consists of telescopic rings, only visible under high pressure of the cover slide (see for instance Karling 1974: fig. 73; Ehlers 1974: fig. 11B; Ax 1994: fig. 1C, 2C). However, the long ejaculatory duct, armed with spines, is a unique feature within the taxon Coronhelmis; in all other Coronhelmis species the stylet is almost directly connected to the prostate vesicle, and the ejaculatory duct is extremely short.

Kymocarens kanakorum new species  

DISCUSSION: see Discussion on the taxon Coronhelmis.

Coronhelmis novaecaledoniae new species  

Fig. 2D–F, Table 1

LOCALITY: Ile Nou (Nouméa, New Caledonia): on Kuendu Beach in coarse-grained sand, 3 Aug 2003 (Type locality).

MATERIAL EXAMINED: One specimen studied alive and mounted, designated holotype (LUC no. 305).

ETYMOLOGY: The species name/epithet refers to its occurrence in New Caledonia.

DESCRIPTION: The animal is ±1.2 mm long (measured on the whole mount). The pharynx is situated in the middle of the body (Fig. 2E: ph). The overall structure of the genital system (based on observations of a live animal; Fig. 2D) does not deviate from that of other species of Coronhelmis Luther, 1948 (see for instance Luther 1948; Ehlers 1974; Ax 1994). The stylet (Fig. 2F) is 19 µm long and 29 µm wide. It consists of a proximal thin-walled, ±9 µm long part (manschette in Luther 1948) and one ring of spines (15–20) distally. The 9 µm long spines resemble a small leaf and are elongated oval in shape with a thickened ridge in the middle, which extends beyond the proximal rim. In the centre of the stylet a flower-shaped structure is present, which possibly is the thickened wall of the ejaculatory duct.

DIAGNOSIS: Coronhelmis species with stylet 19 µm long and 29 µm wide, with one ring of 15–20 spines and ±9 µm long manschette. Spines 9 µm long, leaf-shaped with a thickened median ridge, extending beyond the proximal rim.

Kymocarens kanakorum new species  

Fig. 3

LOCALITY: Ile Nou (Nouméa, New Caledonia): on Kuendu Beach in coarse-grained sand, 3 Aug 2003 (Type locality).

MATERIAL EXAMINED: One specimen studied alive and mounted, designated holotype (LUC no. 306).
ETYMOLOGY: The species name refers to the original inhabitants of New Caledonia, the Kanaki.

DESCRIPTION: Animal ±0.5 mm long (measured on the whole mount), with eyes. Two large rhabdite tracts present, running from behind the eyes to the sides of the “head” (Fig. 3A: rg). The caudal end of the animal is blunt, more or less forming a tail plate. Pharynx situated in the middle of the body (Fig. 3A: ph).

The common genital pore is situated at ±80%. Some small glands open into the common genital atrium, together with a large vesicle or copulatory bursa (Fig. 3B: bc). The paired testes lie in front of the pharynx (Fig. 3A: t). Paired, elongated ovovitellaria (Fig. 3A: ov + vit) extend over almost the entire body length, with the ovaries in the most caudal part (Fig. 3 A,B: ov).

The paired seminal vesicles fuse and open into the copulatory bulb (Fig. 3B: vg), which is filled with prostate secretion and an internal seminal vesicle. The bulb is connected to a slightly bent tubular stylet (Fig. 3C), which is 56 µm long and 14 µm wide at the proximal opening. This stylet shows a transverse, thin ridge, situated at ±85% of the stylet length. The terminal opening is asymmetrical in the single studied specimen.

The female genital system is relatively simple, only consisting of the two ovaries and a small sperm-containing vesicle in between both ovaries (Fig. 3B: bu).

DIAGNOSIS: *Kymocarens* species with eyes and simple, tubular stylet, 56 µm long and 14 µm wide, with a transverse ridge distally.

DISCUSSION: Although this species was only studied alive and on a single whole mount, a number of diagnostic features were observed, resulting in its placement within the taxon *Kymocarens* Ehlers & Ehlers, 1981. This taxon is characterised by the presence of large and conspicuous rostral rhabdite tracts, an adhesive tail plate, paired testes in front of the pharynx, paired seminal vesicles, a tubular stylet, paired ovovitellaria with the ovaries caudally, a bursal organ connected to the common genital atrium, and a female duct with a sperm-containing vesicle (see diagnosis in Ehlers & Ehlers 1981). Apart from *Kymocarens kanakorum*, two additional species of *Kymocarens* are known from the Galapagos and only from a few specimens. The New Caledonian species differs from both other species in the size and detailed structure of the stylet. In *K. proxenetoides* Ehlers & Ehlers, 1981 it is a simple, 49–50 µm long, elongated funnel, without ridges, whereas it is only
30 µm long and carries two terminal hooks and a thin plate in *K. tibialis* Ehlers & Ehlers, 1981 (see Ehlers & Ehlers 1981). Furthermore, the latter species lacks eyes, which are present in *K. proxenetoides* and *K. kanakorum*.

### Incertae sedis

**Vauclusia conica** Willems et al., 2004

**NEW LOCALITY:** North Stradbroke Island (Queensland, Australia): Dunwich, fine sand between mangroves in front of the marine station, 12 Aug 1996.

**KNOWN DISTRIBUTION:** Sydney, Australia (Willems et al. 2004a).

**MATERIAL EXAMINED:** One specimen studied alive and mounted. Holotype (whole mount) and three paratypes (sections) from Sydney (see Willems et al. 2004a).

**ADDITIONAL REMARKS:** The live animal from Stradbroke Island clearly showed two testes, as in the sectioned material from Sydney, whereas only one was visible in the live individual from Sydney (Willems et al. 2004a). The stylet of the new specimen is 30 µm long and 23 µm wide proximally. These measurements correspond with those of the holotype (29 µm long and 17 µm wide; see Willems et al. 2004a).

### Family Solenopharyngidae Graff, 1882

**Subfamily Solenopharynginae Ehlers, 1972**

**Austradenopharynx reynaertsi** new genus and species

**LOCALITY:** Sydney (New South Wales, Australia): Vaucluse Beach, flat beach with fine sand and numerous crab holes, 10 Oct 1997 (Type locality). North Stradbroke Island (Queensland, Australia): Adams Beach, sand plate with crab holes, medium coarse sand, 16 Sep 1996.

**MATERIAL EXAMINED:** Several specimens studied alive, one of them mounted and designated paratype (QM no. G223182). One serially-sectioned animal, designated holotype (QM no. G223183).

**ETYMOLOGY:** The genus name/praenomen refers to its southern distribution and resemblance to *Adenopharynx mitrabursalis* Ehlers, 1972. Auster (Lat.): south (wind). Species dedicated to the first author’s lifetime friend, Mr. David Reynaerts.

**REMARK:** The sectioned individual was damaged ventrally, leaving little of the ventral epidermis and muscle layers. This made the determination of the exact location of the mouth and gonopore somewhat speculative, and details on the structure of their connection to the prepharyngeal cavity and to the common genital atrium cannot be given. Due to the tiny size of the animal, some details regarding the genital system, and especially the female system, could not be determined precisely.

**DESCRIPTION:** The transparent animal is extremely small, only about 0.1 mm long (measured on the whole mount) and brightens when observed with Nomarski microscopy. Eyes are lacking. The syncytial epidermis is ±3 µm thick, slightly thinner dorsally, with cilia ±2 µm long. Dermal rhabdites are absent. In the live animal two rostral glands are visible (Fig. 4B: rg).

The mouth is situated at ±60% (see remark above). The prepharyngeal cavity (Fig. 4C: pc) is lined with a low, anucleated epithelium, surrounded by longitudinal muscles and a few weak circular ones around its distal part only. The pharynx (Fig. 4B: ph), short and almost globular in live animals, bulges deeply into the prepharyngeal cavity and is slightly inclined backwards. As in other solenopharyngids, there is a proximal, rather short, tubular part. The outer circular muscles are very strong, whereas the inner circular layer is much weaker. The exact number of internal longitudinal and radial muscles could not be determined. The radial muscles are thicker in the most proximal and in the tubular part of the pharynx. At least two types of pharyngeal glands are present. The large, coarse-grained basophilic glands have an extra-capsular part (Fig. 4C: epg), surrounded by longitudinal muscles. Small, eosinophilic glands (Fig. 4C: ipg) occur in between them in the distal part of the pharynx.

The common genital pore (Fig. 4B: gp) lies at ±70% (see remark above), just behind the mouth. The common genital atrium (Fig. 4A,C: cga) is lined with a very low, anucleated (?) epithelium and surrounded by inner circular and outer longitudinal muscles. From the dorsal side, it receives the copulatory bursa (Fig. 4C: bc). It is lined with a thickened basement membrane (pseudocuticula; clearly visible on the whole mount), covered with the remains of the epithelium. The basement membrane even forms two (or more?) large blunt teeth (Fig. 4C: bh), just before the bursal stalk enters the genital atrium. The bursa is surrounded by circular muscles and distally by an outer longitudinal layer as well. The paired testes are situated in the most anterior part of the body and are connected with each other through a wide “bridge”, in some live specimens giving the impression of an unpaired testis (see Fig. 4B: t). The unpaired ovary is situated caudally. The paired vitellaria extend over almost the entire body length.
The duplex-type copulatory organ (Fig. 4A; terminology of Karling 1956) enters the common genital atrium from the side, ventrally from the bursa, and is ±110 µm long (measured on the whole mount). It is entirely surrounded by a strong, inner circular muscle layer (Fig. 4A: cm), forming a sphincter close to the atrium (Fig. 4A: sph), and an outer longitudinal muscle layer (Fig. 4A: lm). The proximal part of the copulatory bulb contains a globular seminal vesicle (Fig. 4A: ivs), lined with a high, nucleated epithelium and containing thick, lively sperm. A thin muscular septum (Fig. 4A: sep) separates the seminal vesicle from the distal part of the copulatory organ. Sperm are released into the ejaculatory duct (Fig. 4A: de). Sperm are much thinner here. The ejaculatory duct (±80 µm long; ±3 µm wide) is lined with a thick basement membrane (or pseudocuticula). Muscles surrounding the ejaculatory duct could not be observed. Prostate glands (Fig. 4A: igg) enter the ejaculatory duct just distally from the seminal vesicle. At its very end (±three-quarters of its total length), distally from the sphincter, the ejaculatory duct widens (±9 µm); here the basement membrane is more thickened and forms many small spines (Fig. 4A: csp). This part of the ejaculatory duct bulges into the common genital atrium and resembles a pair of pincers in the live animal.

The female system is extremely complex. The single ovary is slender and elongated (in the sectioned individual) and is connected to the genital atrium via a very narrow female duct, which receives the single vitelloduct near the ovary. The most proximal part of the female duct is widened, almost funnel-shaped, and contains sperm. This part is also connected caudally to a large resorptive bursa (Fig. 4C: bu). Additionally, this bursa is connected through a globular sperm-containing vesicle (Fig. 4C: rs) to the common genital atrium, very close to the copulatory bursa. This vesicle is surrounded by circular muscles and is lined with a low, anucleated epithelium. A large sack, completely filled with large cells (Fig. 4C: ut) opens into the genital atrium from the caudal side (uterus in Ehlers 1972).

**Diagnosis:** *Austradenopharynx* new genus. Solenopharynginae with short, globular pharynx situated in the middle of the body. Copulatory organ of the duplex-type with pseudocuticularised ejaculatory duct. Copulatory bursa pseudocuticularised with two large, blunt teeth. Single ovary connected to common genital atrium through two ducts: a narrow female duct and a resorptive bursa that opens into the atrium near the copulatory bursa.

*Austradenopharynx reynaertsi* new species. Ejaculatory duct distally widened, with small spines.

**Discussion:** This species clearly is a member of the taxon Solenopharyngidae Graff, 1882, as it shows all diagnostic features of the taxon (see Ehlers 1972). Furthermore, it can be placed within the subtaxon Solenopharynginae Ehlers, 1972, based on the presence of a cirrus-like copulatory organ, a copulatory bursa and an unpaired ovary that is connected with the common genital atrium through two different ducts (Ehlers 1972). Within the Solenopharynginae, the different taxa mainly differ in the detailed structure of the copulatory organ. However, a copulatory organ with a pseudocuticularised ejaculatory duct that carries spines only distally is unique within the taxon. In all other Solenopharynginae the cirrus is pseudocuticularised over its whole length or carries spines over its whole length, but never a combination of both as in *Austradenopharynx reynaertsi*. Furthermore, a copulatory bursa that is lined with a very thick and strengthened basement membrane over its whole length, and has large teeth is also unique within the Solenopharynginae. A copulatory bursa that carries spines is only present in representatives of the taxon *Trisaccopharynx* Karling, 1940, whereas its wall is lined with a thick pseudocuticula (without spines or teeth) in *Adenopharynx mitrabursalis* Ehlers, 1972, *Culleopharynx armatus* (Riedl, 1956) Ehlers, 1972 and *Solenopharynx flavidus* Graff, 1882. Therefore, we conclude that *A. reynaertsi* is best placed in its own monospecific taxon for the time being. The alternative would be to synonymise all above taxa; a discussion on this issue is beyond the scope of this contribution.

**Incertae sedis**

*Pilamonila bimaculata* Willems et al., 2004

**New Localities:** Ile Nou (Nouméa, New Caledonia): Nouville, on algae in the lagoon south of the asylum, 3 and 10 Aug 2003; reef in western part of Kuendu Bay, on ramified algae, together with shell gravel and sand, 16 Aug 2003. Baie des Citrons (Nouméa, New Caledonia): on algae in the lagoon, 8 Aug 2003; Baie...

**Known distribution:** Arrawarra, New South Wales, Australia (Willems et al. 2004a).

**Material examined:** Observations on live animals. Four whole mounts and seven serially-sectioned animals. Type material (see Willems et al. 2004a).

**Additional remarks:** The specimens from New Caledonia are 0.3–0.6 mm long (measured on whole mounts). The observations on the serially-sectioned individuals confirm the data given by Willems et al. (2004a). The organisation of the genital system, even its detailed structure, is identical with that of the Australian specimens (see Willems et al. 2004a). The stylet could not be discerned in the whole mounts and even in the sectioned specimens it is inconspicuous. This is largely due to the state of contraction of the cirrus. When completely inverted (as in the New Caledonian specimens) the spines lie on top of the stylet, which also is extremely thin-walled. The only observed difference with the individuals of Australia is the cellular epidermis (stated as syncytial in Willems et al. (2004a) due to misinterpretation of the sectioned specimens from Australia).

**Family Trigonostomidae Graff, 1905 sensu Den Hartog, 1964**

**Subfamily Trigonostominae Luther, 1948 sensu Den Hartog, 1964**

*Ceratopera axi* (Riedl, 1954) Den Hartog, 1964

**Synonymies:** *Proxenetes axi* Riedl, 1954; *Ceratopera bifida* Ehlers & Ax, 1974


**Distribution:** Gulf of Naples and Sicily (Riedl 1954); Galapagos (Ehlers & Ax 1974); Falkland Islands and California (Karling 1986); Weddell Sea and La Réunion (Artois et al. 2000); Eastern Australia (Willems et al. 2004a); Kerguelen (own data).

**Material examined:** Two specimens studied alive and mounted (one from each new locality). Whole mounts from Falklands and California (collections SMNH), Australia, the Weddell Sea, La Réunion and Kerguelen (collections LUC).

**Additional remarks:** The stylet of the specimens from New Caledonia measures 78–98 µm (measured along the axis of the stylet); 56–62 µm if measured from top to bottom as in Ehlers & Ax 1974). The bursal appendage is 80 µm long (measurable on only one specimen). These data can be placed within the known range of measurements for this species (see Willems et al. 2004a; table 1; Willems et al. 2005). However, as the variation in the size of the stylet is rather large, it could very well be that it concerns a species complex instead of a single species, as indicated earlier (see Willems et al. 2005). Since this size variation is the only known difference between the populations, it is highly arbitrary to split this complex into different species. Such an act should be backed up by a more thorough morphological analysis, which is clearly without the scope of this contribution.

*Messoplana minuta* Artois et al., 2000


**Known distribution:** Weddell Sea (Artois et al. 2000).

**Material examined:** One specimen studied alive and mounted. Type material (see Artois et al. 2000).

**Additional remarks:** The animal is 0.7 mm long (measured on the whole mount) and rather slender (Fig. 5A). The structure of the genital system (Fig. 5B) does not deviate from that of other species of *Messoplana* Den Hartog, 1966. The stylet of the Australian specimen (Fig. 5C) consists of a slightly bent tube, which is 34 µm long. Proximally it is attached to a hook-shaped, 22 µm-long accessory spine. The base of the copulatory organ, which carries both the stylet and the accessory spine, is 32 µm wide. The bursal appendage (Fig. 5D) is curved (>360°), 66 µm long and apparently not split distally. In the specimens of *Messoplana minuta* from the Weddell Sea the bursal appendage is split into two short tubes. This is extremely difficult to observe in our specimen, as well as in the type material of *M. minuta*. Nevertheless, the shapes and sizes of the copulatory organ and the bursal appendage of the Australian specimen are almost identical to those of the specimens from the Weddell Sea (Artois et al. 2000).

*Ptychopera* sp.

**Locality:** North Stradbroke Island (Queensland, Australia): Point Lookout, small rocky bay on the north side, on Ulva-like algae in a tidepool, 14 Sep 1996.

**Material examined:** One specimen studied alive and mounted (in bad condition).
DESCRIPTION AND REMARKS: Only one individual of this species was observed alive and the whole mount is in a bad condition. Therefore, this description must be seen as provisional.

The pharynx is situated in the first half of the body (Fig. 6A: ph). Paired testes and ovovitellaria are present. Paired seminal vesicles open into a large, globular prostate vesicle, which is connected to a complex stylet. Where a large bursal organ opens into the common genital atrium, some small, hard teeth are present. A pseudocuticularised, winding tube (Fig. 6B: ds) probably forms the connection between this bursa and the ovaries, functioning as a spermatic duct. These characters allow the placement of this species into the taxon *Ptychopera* Den Hartog, 1964 (see Den Hartog 1964). Only the detailed structure of the stylet could not be determined, because of the bad condition of the whole mount, making the identification of this species extremely difficult. We refrain from identifying this species, which is probably new to science, as no other *Ptychopera* species has similar teeth at the opening of the bursa. At the moment only one other species of this taxon is known to occur in Australia: *Ptychopera scutulifer* Ehlers & Ax, 1974 (see Willems et al. 2004a). However, in this species the pharynx is located in the most caudal part of the body and the stylet is very different in shape, in comparison with the situation observed on live material of the new specimen.

**Family Typhloplanidae Graff, 1905**

**Subfamily Typhloplaninae Luther, 1963**

*Pratopla* sp.  
**Fig. 7**

**LOCALITY:** Magnetic Island (Queensland, Australia): Cockle Bay, amongst mangroves in detritus-rich sediment with crab holes, 8 Sep 1996.

**MATERIAL EXAMINED:** One animal studied alive and mounted (in bad condition).
DESCRIPTION AND REMARKS: Only one individual of this species was observed alive and the whole mount is in a very bad condition. Therefore this description must be seen as provisional.

The animal is small, only about 0.3 mm (measured on the whole mount), with two eyes and two conspicuous rhabdite tracts (Fig. 7A: rg) in between them. The pharynx (Fig. 7A: ph) is situated just behind the middle of the body. The paired testes lie besides the pharynx. There is only one seminal vesicle (Fig. 7A,B: vs), which is obviously intra-capsular. The prostate vesicle also contains some coarse-grained prostate glands (Fig. 7B: gg), which have an extra-capsular part and enter the prostate vesicle from the side. The prostate vesicle itself is connected to a small, pseudocuticularised spine (Fig. 7B: s; thickened basement membrane of the male duct?). The vitellaria extend from about one-quarter of the body length caudally to just behind the pharynx. The large, elongated ovary lies immediately behind the pharynx. A large vesicle is present in the caudal body part. The exact nature of it could not be discerned, but probably it is a part of the female system.

This marine representative of the Typhloplanidae, which encompasses mostly freshwater species, is a representative of the taxon *Pratoplana* Ax, 1960. This taxon is characterised by the presence of a muscular prostate vesicle connected to a small funnel-shaped stylet, paired vitellaria, an unpaired ovary, caudally from the pharynx, a widened female duct, functioning as a “vesicula resorbiens” and a seminal receptacle (Ax 1960; Ehlers 1974). It has three representatives: *P. ayorae* Ehlers & Ehlers, 1989, *P. galeata* Ehlers, 1974 and *P. salsa* Ax, 1960. The specimen from Australia differs from *P. galeata* by the presence of eyes, by the shape of the prostate vesicle, which is extremely elongated in *P. galeata*, and by the presence of an intra-capsular seminal vesicle, paired extra-capsular in *P. galeata* (see Ehlers 1974). Furthermore, the stylet of *P. galeata* is 25 µm long and almost tubular, cup-shaped (Ehlers 1974), whereas it is short, funnel-shaped in the Australian specimen. *Pratoplana salsa* and

![Fig. 6 Ptychopera sp.: A, habitus of a live animal; B, organisation of the genital system (from a live specimen).](image)
in the number of seminal vesicles: paired extra-
capsular in *P. salsa* (Ax 1960) and unpaired intra-
capsular in *P. ayorae* (Ehlers & Ehlers 1989). The
Australian specimen therefore closely resembles *P.*
ayorae, in the structure of the stylet and the number
of seminal vesicles. However, since the detailed
structure and the size of the stylet were impossible
to determine because of the poor state of the whole
mount, we refrain from allocating this specimen to
an existing species or erecting a new species.

**Incertae sedis**

*Kaitalugia lydieae* new genus and species

*Fig. 8, 9*

**LOCALITY:** Baie des Citrons (Nouméa, New
Caledonia): on algae from the lagoon, 8 Aug 2003
(Type locality).

**MATERIAL EXAMINED:** Observations on live animals.
Three whole mounts, one of them designated
holotype (LUC no. 307), the others paratypes (LUC
no. 308–309). Seven serially-sectioned animals,
designated paratypes (LUC nos 310–316).

**ETYMOLOGY:** Genus name/praenomen refers to
Kaitalugi, a mythical island in Melanesia, where
ships are wrecked. Species dedicated to Mrs. Lydie
Grosemans, technical assistant at LUC, Diepenbeek
(Belgium).

**DESCRIPTION:** The uncoloured animals are 0.4–0.5 mm
long (measured on whole mounts) and have two
eyes. Rostral rhabdite glands (Fig. 8A: rg) are well
developed, filled with thick rod-shaped, ±2 µm-long
rhabdites. The cellular epidermis is ±3–4 µm thick
and carries ±3 µm-long cilia. Dermal rhabdites are
slender, rod-shaped, 3–6 µm long and scattered over
the body surface, slightly more densely packed on
the dorsal side.

The rosulate pharynx (Fig. 8A,C,D: ph) is situated
in the second body half, at about 60%. The mouth
can be closed by a strong sphincter and is connected
to the narrow prepharyngeal cavity by a very short
muscular tube. The prepharyngeal cavity proper
is lined with a low, anucleated (?) epithelium and
surrounded by longitudinal muscles. The distal rim
of the pharynx carries cilia (Fig. 8B: cil), a feature
difficult to discern because the cavity is very narrow.
The pharynx lumen is lined with a low anucleated (?)
epithelium. There are 24 internal longitudinal
muscles. Both radial and external circular muscle
layers are weak, whereas the internal circular
muscles are thickened, especially near the proximal
opening of the pharynx. Basophilic and eosinophilic
gland ducts open into the lumen, distally from the

*P. ayorae* resemble each other in the structure of
the stylet, which is a 6–7 µm long funnel-shaped
piece, with a narrow distal tip (Ax 1960; Ehlers &
Ehlers 1989), somewhat resembling the stylet of the
Australian specimen. However, both species differ
Fig. 8  Kaitalugia lydieae:  A, habitus of a live animal; B, reconstruction of the atrial organs from the left side (male genital system is displaced caudally for clarity); C, reconstruction from transverse sections of the female genital system; D, organisation of the genital system (from a live specimen); E, stylet (from the holotype).
so-called “Greifwulst” (prehensile girdle; Fig. 8B: gw), which carries long cilia (Fig. 8B: cil.).

The common genital pore lies at ±85% and is guarded by a sphincter. The common genital atrium is lined with a low anucleated (?) epithelium and is surrounded by weak, inner circular and outer longitudinal muscles. The paired testes are situated slightly in front of and at both sides of the pharynx. The large, single ovary is situated caudally. The vitellaria lie dorsally of the testes and extend from ±30% to the caudal body end.

In the live animal, two extra-capsular seminal vesicles were seen (Fig. 8A: evs), however, they were not observed in sectioned material, and may only represent temporary swellings of the vasa deferentia. The elongated copulatory bulb (Fig. 8A: vg) is directed rostrolaterally towards the pharynx (directed more caudally in Fig. 8B for clarity) and is surrounded by a strong inner circular muscle layer and a weak outer longitudinal one. The copulatory bulb contains a large elongated seminal vesicle (Fig. 8B: ivs), which is lined with a low epithelium, next to two types of glands, each with an extra-capsular part: coarse-grained basophilic (Fig. 8B: bgg) and fine-grained eosinophilic ones (Fig. 8B: egg). Both sperm and prostate secretion are discharged into the stylet (Fig. 8E), which is 27 µm long, 21 µm wide proximally and 8–9 µm wide distally (n = 2). It is a simple, short funnel-shaped piece, which narrows slightly distally, and shows a bent hook at one side. It lies in the male atrium (Fig. 8B: ma), which is lined with a low, anucleated epithelium and surrounded by inner circular and outer longitudinal muscles, and enters the common genital atrium from its caudal side.

The very large ovary is situated dorsocaudally and connected with the common genital atrium through a wide female duct. Near the ovary, the female duct is surrounded by some weak circular muscles. More distally, it is lined with a high, nucleated epithelium, surrounded by very weak longitudinal muscles, and filled with sperm. It is swollen asymmetrically, forming a kind of bursal organ in most sectioned individuals. Towards the atrium, the female duct narrows and is guarded by a muscular bulb (Fig. 8A–D: mb) that consists of strong radial muscles and is surrounded by longitudinal muscles, which are clearly stronger in this part than around the rest of the female duct. This muscular bulb is extremely obvious in live animals and contracts regularly (Fig. 9A–D). The female duct enters the common genital atrium from the rostrodorsal side, where a large bundle of basophilic glands (Fig. 8B,C: gl) opens into the genital atrium. A uterus is lacking.

**DIAGNOSIS:** *Kaitalugia* new genus. Typhloplanidae species with pharynx situated mid body. Distal rim and prehensile girdle (Greifwulst) of pharynx with cilia. Elongated copulatory bulb with intracapsular seminal vesicle. Stylet simple, funnel-shaped. Female duct swollen and filled with sperm, distally with a very strong muscular part. Large bundle of glands at transition of female duct to genital atrium.

*Kaitalugia lydieae* new species. *Kaitalugia* species with simple stylet, 27 µm long, 21 µm wide proximally and 8–9 µm wide distally, with a bent hook at one side.

**DISCUSSION:** *Kaitalugia lydieae* is characterised by the presence of a single ovary, which is a diagnostic feature for both Mariplanellinae Ax & Heller, 1970 and Typhloplanidae Graff, 1905. However, Mariplanellinae is a subtaxon of Trigonostomidae Graff, 1905 (sensu Den Hartog, 1964) of which the representatives have, apart from the female duct, a second connection between the ovary and the common genital atrium (Den Hartog 1964; Ax & Heller 1970; Ax 1971). Since this double connection is lacking in *K. lydieae*, this new species therefore has to be placed within the Typhloplanidae, which mainly contains freshwater species.

Within this family several taxa are recognised, almost all of which are based on doubtful or difficult to observe characters, such as the position of the testes relative to the vitellaria and the opening of the excretory system (mostly invisible in marine species). Therefore this species is not allocated to any of the subfamilies, but, for the time being, placed as a species incertae sedis within the taxon Typhloplanidae.

Within the Typhloplanidae few species are marine, and *K. lydieae* most closely resembles *Thalassoplanella collaris* Luther, 1946 and *Thalassoplanina geniculata* (Beklemishev, 1927) Ax, 1959. However, both species are easily distinguished from *K. lydieae* by the detailed structure of their stylet (see Luther 1946; Ax 1959), whereas the overall structure of the male system is very similar in all three species. The major differences are to be found in the female system. In *T. collaris* a separate copulatory bursa and a second rudimentary ovary are present (Luther 1946). Both features are absent in *K. lydieae*. Furthermore, the female duct of *T. collaris* is not swollen over almost its whole length, as in *K. lydieae*, but is connected to a terminal seminal receptacle (Luther 1946). In *T. geniculata*, on the other hand, the female system is also swollen.
Fig. 9 *Kaitalugia lydieae*: A–D, different stages of contraction of the muscular bulb on the female duct (from a live specimen).

over its whole length, but is connected to a terminal seminal receptacle (or vesicula resorbiens; Ax 1959) and shows a bulge (bursa copulatrix in Ax 1959) about half way along its length. Additionally, the female duct of *T. geniculata* is strongly muscular over its whole length, while in *K. lydieae* a highly muscular bulb in the distal part of the female duct occurs.

*Kaitalugia falcata* new species Fig. 10

LOCALITIES: Ile Nou (Nouméa, New Caledonia): Nouville, on algae from the lagoon south of the asylum, 16 Aug 2003 (Type locality). Arrawarra (New South Wales, Australia): Mullaway Headland, on red and brown algae in rock pools, 24 Jul 2003; Arrawarra: southern part of the beach near rocks, on *Sargassum*-like algae in a permanent pool, 27 Aug 1996.

MATERIAL EXAMINED: Observations on live animals. Four whole mounts, two of them in bad condition. One whole mount designated holotype (LUC no. 317).

ETYMOLOGY: Species name/epithet refers to the presence of a long, scythe-shaped spine on the stylet. *Falcatus* (Lat.): sickle- or scythe-shaped.

DESCRIPTION: The unpigmented animals are ±0.4 mm long (measured on whole mounts).
Rostrally two conspicuous rhabdite glands are present, running in between the eyes. The pharynx (Fig. 10A: ph) is situated just behind the middle of the body.

The testes lie at the same level as the pharynx, in the middle of the body. One external seminal vesicle (Fig. 10B: evs) was clearly visible in a live specimen. This seminal vesicle narrows, forming a seminal duct, which enters the copulatory bulb proximally. The bean-shaped copulatory bulb contains the intra-capsular seminal vesicle (Fig. 10B: ivs) and the prostate glands (with extra-capsular cell bodies). It is situated caudally of the pharynx and connected to the stylet (Fig. 10A,B: s, 10C), which is 29–34 µm long ($n = 3$; $m = 31$ µm), 17 µm wide proximally and 7–11 µm wide distally. The stylet is funnel-shaped with three distal projections, the first straight and dagger-like (12–15 µm long), the second short and bent (10 µm long) and the third long, narrow and scythe-shaped (16–25 µm long).

The vitellaria extend from just behind the rostral glands to the level of the pharynx, whereas the single ovary is situated caudally. A large bursal organ (swollen female duct?) is present and contains a star-shaped structure (Fig 10A,B: z; not visible on whole mounts).

**Diagnosis:** *Kaitalugia* species with 29–34 µm-long stylet carrying two additional projections distally: a straight dagger-like one (12–15 µm long) and a slender scythe-shaped one (16–25 µm long).
Table 2  Species list of all marine Typhloplanoida from the Coral Sea and Tasman Sea, with their known distribution within (column I) and outside (column II) the region. Abbreviations: A: eastern Australia; Al: Alaska; Ber: Bermuda; Braz: Brazil; BS: Baltic Sea; cosm: cosmopolitan; Cur: Curaçao; EA: East Africa; Gal: Galapagos; MS: Mediterranean Sea and Black Sea; NP: North American Pacific coast; NA: North American Atlantic coast; NC: New Caledonia; SAtl: southern Atlantic; SW: Swedish west coast; WS: Weddell Sea.

<table>
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<th>Species</th>
<th>I</th>
<th>II</th>
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DISCUSSION: This species must be placed within the taxon *Kaitalugia*, based on its overall resemblance with *K. lydieae*, in both the structure of the genital system (observations of live animals) and the detailed structure of the stylet. However, since no sectioned individuals were available, the detailed structure of the genital system could not be studied. The main difference with *K. lydieae* is the presence of a more or less star-shaped structure in the female duct, evidently the equivalent of the muscular bulb as in *K. lydieae*. However, it is not clear yet if this is a hard structure or a muscular contracting bulb as in *K. lydieae*.

SPECIES LIST OF TYPHLOPLANOIDA FROM THE CORAL SEA AND TASMAN SEA

On the Australian east coast and in New Caledonia 26 marine species of Typhloplanoida occur, of which 8 species are Promesostomidae, 2 are Solenopharyngidae, 11 are Trigonostomidae and 5 are Typhloplanidae.

An overview of these species and their distribution, is given in Table 2. For *Ceratopera axi* and all species of *Trigonostomum* Schmidt, 1852 only one reference is given, where all distribution data and references can be found.

The two new *Promesostoma* species are treated in a monography of the taxon.

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REFERENCES


