

First description of deep-sea polyclad flatworms from the North Pacific: *Anocellidus* n. gen. *profundus* n. sp. (Anocellidae, n. fam.) and *Oligocladus voightae* n. sp. (Euryleptidae)

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Abstract

Two deep-sea polyclad species are described. Both species were found in association with wood-boring bivalves on oak and fir wood blocks that had been deployed on heavy sediment in the Cascadia Basin and Escanaba Trough in the North Pacific Ocean. *Anocellidus profundus* n. gen. n. sp. warrants erection of Anocellidae, n. fam. because of the unique position and orientation of the male copulatory apparatus. *A. profundus* lacks eyes but has long, nuchal tentacles and a ventral, arrowhead-shaped organ of putative sensory function. The male copulatory apparatus is located posterior to the male gonopore and is directed anteriorly. Highly muscularized spermiducal bulbs are present, a prostatic vesicle is lacking. A large Lang's vesicle characterizes the female reproductive system. *Oligocladus voightae* n. sp. is defined by the presence of a mouth located anterior to the brain. Few and minute tentacular eyes are present. The seminal vesicle is connected to an auxiliary sperm storage vesicle, and a posterior anal pore is present in the main median branch of the intestine. All type material is deposited at the Field Museum of Natural History, Chicago, Illinois, USA.

Resumen

Se describen dos nuevas especies de policládidos de la profundidad marina. *Anocellidus profundus* n. gen. n. sp. garantiza el establecimiento de la nueva familia Anocellidae, n. fam. debido a la posición y orientación única del aparato copulatorio masculino. *A. profundus* carece de ojos pero presenta tentáculos largos y un órgano ventral con forma de punta de flecha cuya función se presume es sensorial. El aparato copulatorio masculino esta localizado posterior al gonoporo masculino y dirigido anteriormente. En lugar de vesícula seminal dos bulbos espermiducal musculares están presentes y el sistema femenino se caracteriza por una vesícula de Lang de gran tamaño. La boca de *Oligocladus voightae* n. sp. esta localizada anterior al cerebro. Pocos diminutos ojos están presentes. La vesícula seminal esta conectada con una vesícula auxiliar que almacena espermatozoides y un poro anal esta presente en la rama media del intestino. Todo el material tipo esta

depositado en el Field Museum of Natural History, Chicago, Illinois, USA.

Key words: Acotylea, Cotylea, deep-sea turbellarians, Cascadia Basin, Escanaba Trough

Introduction

Polyclads are free-living, marine flatworms known to inhabit mostly littoral waters. Their vertical distributions appear limited by temperature, substrate preferences or biotic associations with seaweeds, corals, sponges, or ascidians (Prudhoe 1985). Typically, polyclads are benthic, although some pelagic species have been recorded and have been collected from surface waters (Faubel 1984b); other pelagic species have been found to depths of almost 1000 m (Palombi 1924). To date, only a single deep-sea benthic specimen has been recorded, *Stygolepta hjalmari*, from 603 m off the coast of Mauritania (Faubel 1984a). In fact, according to Herring (2002), free-living flatworms are not known from the deep sea and any flatworms found at these depths, probably only occur as parasites of other animals. The paucity of information about deep-sea flatworms may be due in part to their fragile body constructions, which easily will disintegrate during traditional trawl collection or to their body shape which allows them to waft away. Thus, the only way to obtain intact specimens is collecting with submersibles or Remotely Operated Vehicles (ROVs).

Here we describe two species of polyclad flatworms collected with such undersea vehicles from wood placed on deep-sea sediments of the Cascadia Basin and Escanaba Trough in the North Pacific Ocean.

Materials and methods

All specimens were collected by Dr. Janet R. Voight of the Field Museum (FMNH), Chicago Illinois, USA from oak and fir wood blocks that had been deployed in 2002 on the Cascadia Basin and Escanaba Trough in the North Pacific Ocean. Deployments were made at depths of 2642 m and 2660 m at two northern sites, respectively (Baby Bare Seamount at 47° 42.637'N 127° 47.292'W and Ocean Drilling Program (ODP) Drill Hole 1026B at 47° 45.765'N 127° 45.439'W), and to 3232 m depth at Escanaba Trough (41° 0.0272'N 127° 29.679'W). Recovery at the northern sites occurred in July 2003 by the ROV-*Jason II* (R/V T. G. THOMPSON) and at Escanaba Trough in August 2004 by the DVS *Alvin* (R/V ATLANTIS). Both Cascadia Basin and Escanaba Trough are characterized by heavy sediment associated with turbidite flows from the Pleistocene (Brunner *et al.* 1999). Details regarding deployment and recovery of the wood blocks and associated fauna can be found in Voight (2005).

Specimens examined here were fixed in 8% buffered formalin in seawater and stored

in 70% ethanol. Fixed animals were photographed, and body measurements were taken (measurements given as length mm x width mm). Segments adjacent to and behind the pharynx containing the reproductive structures were removed. Sections were embedded in paraffin, sagittally sectioned at 5–7 μm on an AO 820 (Spencer) microtome, stained with haematoxylin and eosin and mounted in Permount. For whole mounts, animals were dehydrated, cleared in Histoclear, and mounted in Histomount. Diagrammatic reconstructions of the reproductive system derive from sectioned material and whole mounts. Taxonomic identifications were based on the classification systems of Faubel (1983, 1984a).

Systematics

Suborder: Acotylea Lang, 1884

Superfamily: Ilyplanoidea Faubel, 1984a

Family: Anocellidae n. fam.

Definition: Ilyplanoidea without eyes. Ruffled pharynx located anteriorly; long, pointed tentacles present. Gonopores separate and male copulatory apparatus positioned posterior to male pore, hence directed forwards; armed with a long and pointed stylet directed backwards. Prostatic-like glands (prostatoid organs, *sensu* Faubel 1983) absent. Spermiducal bulbs present instead of a true seminal vesicle. Female apparatus with Lang's vesicle. A ventral disk of potentially sensory function, positioned anterior to the cerebral ganglion; this organ is not homologous with the cotylean sucker.

Taxonomic remarks regarding the new family: According to Faubel (1983), the absence of a true prostatic vesicle is the taxonomic character defining the superfamily Ilyplanoidea which includes the families Enantiidae Graff 1889, Discocelidae Laidlaw 1903, Discoprosthididae, Euplanidae, Ilyplanidae, Mucroplanidae and Paluidae (the last five all by Faubel 1983). The ruffled pharynx and a male tract without a trace of prostatic-like glands or a prostatic vesicle would place this new species into the genus *Aprostatum*, within the Euplanidae. This family is defined by a ruffled, centrally located pharynx, a posteriorly-directed male copulatory apparatus, separate gonopores, and a complete lack of prostatic-like glands (Faubel 1983). Although these characters conform to those found in our new species, an additional character found in our specimens warrants the establishment of the new family Anocellidae.

The defining character of the Anocellidae is that the male copulatory apparatus is located posterior to the male gonopore and is directed anteriorly. This is exactly opposite of the condition found in the Euplanidae, where the male copulatory complex is located anterior to the male gonopore and directed posteriorly (Table 1). Using a single character

as a basis for a new family without a complete reanalysis of acotylean classification may appear precipitous, however, “orientation of male copulatory apparatus” weighs heavily in the classification system of acotyleans and has previously been used in defining families (Faubel 1983). In fact, Lang (1884) used it as the main character to establish the Cestoplanidae, a group in which the male copulatory apparatus is located posterior to the male gonopore and is directed anteriorly. Other morphological differences however eliminate placement of the new species in the Cestoplanidae (Table 1), thus justifying the establishment of the family Anocellidae.

TABLE 1. Comparison of morphological features of the new family Anocellidae with Euplanidae and Cestoplanidae.

Character	Anocellidae	Euplanidae	Cestoplanidae
Body form	Round to oval	Elongate, oval or cuneate	Very elongate, slender
Tentacles	Nuchal tentacles present	Absent or rudimentary	Absent
Eyes	Absent	Well-developed marginal eyes; tentacular, frontal and cerebral eyes-spots present	Eye-spots scattered over anterior end; definite cerebral and tentacular eyes absent
Prostatic vesicle	Absent	Absent	Present, interpolated
Location of male copulatory complex	Posterior to male gonopore	Anterior to male gonopore	Posterior to male gonopore
Orientation of male copulatory complex	Directed anteriorly	Directed posteriorly	Directed anteriorly
Ventral, sensory disk	Present	Absent	Absent

Key for the determination of the new family (modified from Faubel 1983)

1. ruffled pharynx 2
 - tubular or cylindrical pharynx, directed forwards Enantidae
2. male tract provided with prostatic-like glands 3
 - male tract completely lacking prostatic-like glands 7
3. male tract with glandular epithelium, prostatoid organs lacking 6
 - male tract with or without glandular epithelium, prostatoid organs present 4
4. male tract without prostatic-like lining 5
 - male tract with prostatic-like lining Discoprosthidae
5. male tract edged with numerous prostatoid organs Discocelidae
 - male tract without prostatoid organs; a single armed prostatoid organ opens independently from the male tract to the exterior Palauidae

6. like (3) and with bulbous, glandular chambered penis, prostatic-like glands are extraepithelialMucroplanidae
 - penis if present, is papilla-like rod-like or armed with a cuticular stylet Ilyplanidae
 7. male copulatory apparatus positioned anterior to male pore, hence directed backwards Euplanidae
 - male copulatory apparatus positioned posterior to the male gonopore, hence directed forwards; eyes lacking.....Anocellidae

Genus: *Anocellidus* n. gen.

Definition: with the characters of the family

Species: *profundus* n. sp. (Figs. 1–5)

Type material and locality:

a) Holotype, whole mount, one mature specimen (10 mm X 10 mm), FMNH 12555; collected 11 July, 2003 from 2660 m depth at ODP 1026B (47°45.765'N 127°45.439'W).

b) Paratype, one mature specimen as serial sagittal sections (13 mm X 12 mm), FMNH 12556; collected with holotype on 11 July, 2003 from 2660 m depth at ODP 1026B (47°45.765'N 127°45.439'W).

Other material examined:

c) Whole mount, one mature specimens (11 mm X 10 mm), FMNH 12557; collected with holotype on 11 July, 2003 from 2660 m depth at ODP 1026B (47°45.765'N 127°45.439'W).

d) One mature specimen, as serial sagittal sections (11 X 10 mm), FMNH 12558; collected with holotype on 11 July, 2003 from 2660 m depth at ODP 1026B (47°45.765'N 127°45.439'W).

e) One mature specimen, as serial sagittal sections (11 mm X 10 mm), FMNH 12559; collected 3 July, 2003 from 2642 m depth at Baby Bare Seamount (47° 42.637'N 127° 47.292'W).

f) Ethanol-preserved specimen, not sectioned or mounted, FMNH 11736; collected with holotype

g) Ethanol-preserved specimen, not sectioned or mounted, FMNH 11778; from Baby Bare Seamount.

h) Ethanol- preserved specimen, not sectioned or mounted, FMNH 12463; collected on 30 Aug, 2004 from Escanaba Trough, 20 m N of Marker 6X on Central Hill, from 3232 m depth (41° 00.272'N 127° 29.679'W).

Etymology: name from *an* = without, *ocell-* = little eye, for the absence of eyes, and *profundus* = deep, a reference to the depth at which the specimens were collected.

Distribution: To date, known from the type locality ODP 1026B (47°45.765'N 127°45.439'W), from Baby Bare Seamount (47° 42.637'N 127° 47.292'W), and from Escanaba Trough (41° 00.272'N 127° 29.679'W) at depths from 2642 to 3232 m.

Diagnosis: Male copulatory apparatus posterior to the male pore and directed anteriorly, with a long and pointed stylet directed posterior; prostatic vesicle and prostatic-like glands absent. Well-developed, nuchal tentacles, eyes completely lacking. Ventral sensory disk present anterior to the cerebral ganglion.

Description

External features:

Color —Live and preserved specimens are whitish but testes and ovaries appear as numerous brown dots visible through the epidermis (Fig. 1). In cleared specimens, testes and ovaries arrayed radially about the pharynx; testes appear smaller and dark yellow.

Form —Preserved specimens range from 10 mm x 10 mm to 13 mm x 12 mm and have a fleshy, rounded body (Fig. 1A). The body margin is smooth without evident folds. Ventrally, an arrowhead-shaped organ of putative sensory function lies just anterior to the cerebral ganglion (Figs. 1B, 2, and 3).

Tentacles —long, pointed, non-retractile nuchal tentacles are present (Fig. 1A).

Eyes —absent.

Digestive system —a ruffled and very muscular pharynx with 4-5 deep folds on both sides is medial in the anterior third of the body (Figs. 1B, 2 and 4). A small mouth is present in the anterior part of the pharynx. In histological sections, a medial intestinal branch extends anteriorly dorsal to the brain and posteriorly dorsal to Lang's vesicle (Fig 3B). Three to four radial intestinal branches are very conspicuous on either side of the pharynx.

Reproductive anatomy:

Gonopores —male gonopore located just posterior to the mouth and ventral to the pharynx; female gonopore positioned medially, immediately posterior to the male spermiducal bulbs.

Male copulatory apparatus —located posterior to the male pore and directed anteriorly; the stylet, however, is recurved (Fig. 5). The prostatic vesicle is lacking and there is no evidence of a prostatoid organ or prostatic-like glands around the ejaculatory duct or of any glandular epithelium in the male tract. A seminal vesicle and vasa deferentia are absent but two highly muscularized spermiducal bulbs are present lateral and slightly posterior to the pharynx. The spermiducal bulbs appear as a W-shape in whole mounts (Fig. 2) and they fuse to form a single ejaculatory duct. The sinuous ejaculatory duct continues into a very long, thin and pointed stylet (Figs. 1B, 4, and 5). A very thin, deep stylet pocket parallels the ventral surface of the worm just ventral to the ejaculatory duct (Fig. 5). The male atrium is shallow and the stylet was found extruded in most specimens (Figs. 1B and 5).

Female apparatus —shallow female atrium. The vagina is spacious and curves

posterior, terminating in a large, elongated Lang's vesicle (Figs. 2, 3B, 4 and 5). The uteri lie on either side of Lang's vesicle and the oviducts form a loop before joining with the vagina immediately proximal to Lang's vesicle (Fig. 4).

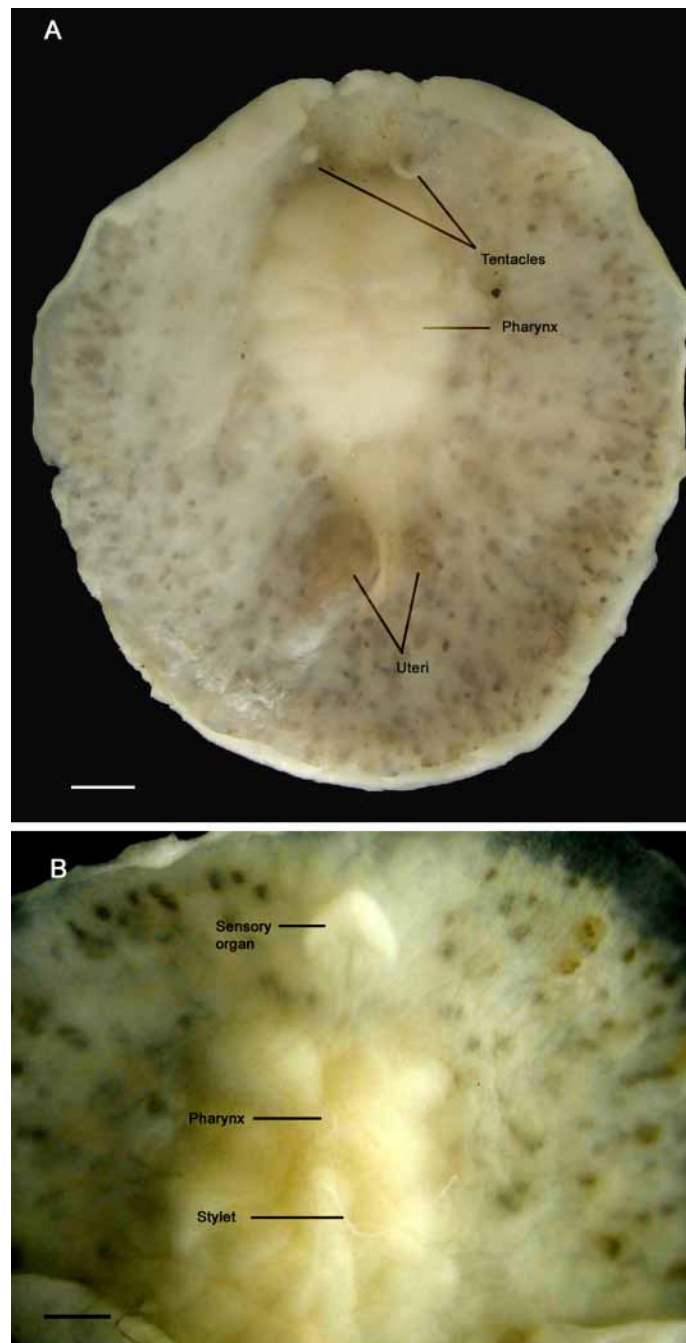


FIGURE 1. Preserved specimen of *Anocellidus profundus* n. sp.; photomicrographs. A. Anterior end, showing nuchal tentacles, highly folded pharynx, and uteri. Scale bar = 1 mm. B. Higher magnification of sensory organ. Note extruded stylet. Scale bar = 1 mm.

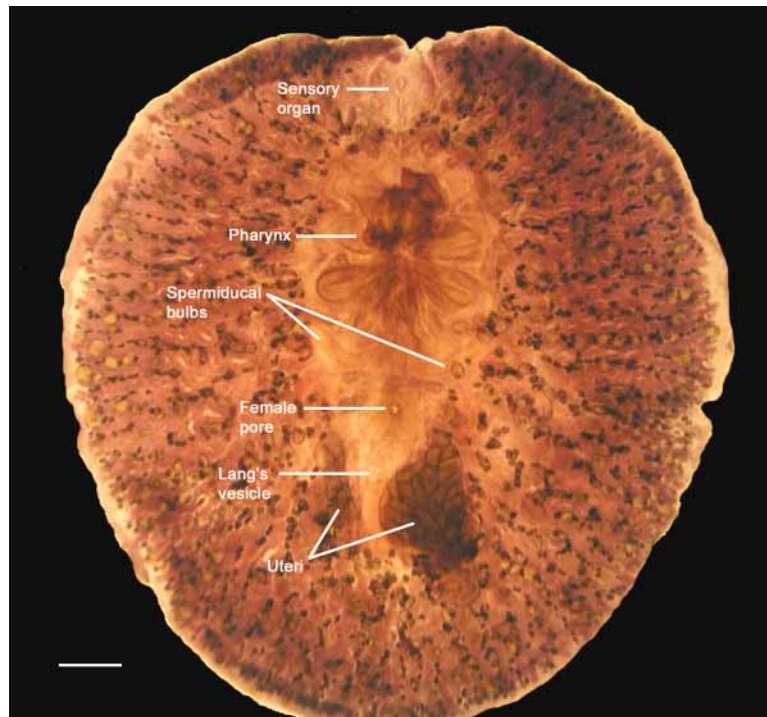


FIGURE 2. Cleared whole mount of *Anocellidus profundus* n. sp., showing sensory organ, pharynx, and structures of the male and female reproductive complexes. Scale bar = 1 mm.

Reference measurements from the largest (13 mm x 12 mm) available specimen: brain, 375 μ m in diameter; Lang's vesicle, 1.75 mm long; pharynx, 3mm long; stylet, 1037 μ m X 75 μ m; spermiducal bulbs, 300 μ m maximum diameter; tentacles, 625 μ m long X 250 μ m maximum diameter at their base.

Taxonomic remarks

Although the classification system of Prudhoe (1985) is more conservative because it recognizes fewer taxa, the use of Faubel (1983, 1984a) is appropriate because of its importance on characters of the reproductive system. *Anocellidus profundus* lacks a prostatic vesicle and in the system of Faubel (1983, 1984a), would be placed in the Ilyplanoidea. This superfamily corresponds to the Cestoplanoidea of Prudhoe (1985). Prudhoe (1985) subdivided the Acotylea into three superfamilies depending on the position of eyes, recognizing marginal, tentacular, cerebral, and frontal eyes. Absolute eye positions are often difficult to determine with areas of cerebral, marginal, and frontal eyes overlapping. And although in his lower taxonomic units, Faubel (1983, 1984a) does place importance on what we consider minor or developmentally plastic details (e. g., type of lining of the prostatic vesicle), the presence or absence of an entire structure such as the prostatic vesicle, does appear to be a much more reliable character than the position of eyes.

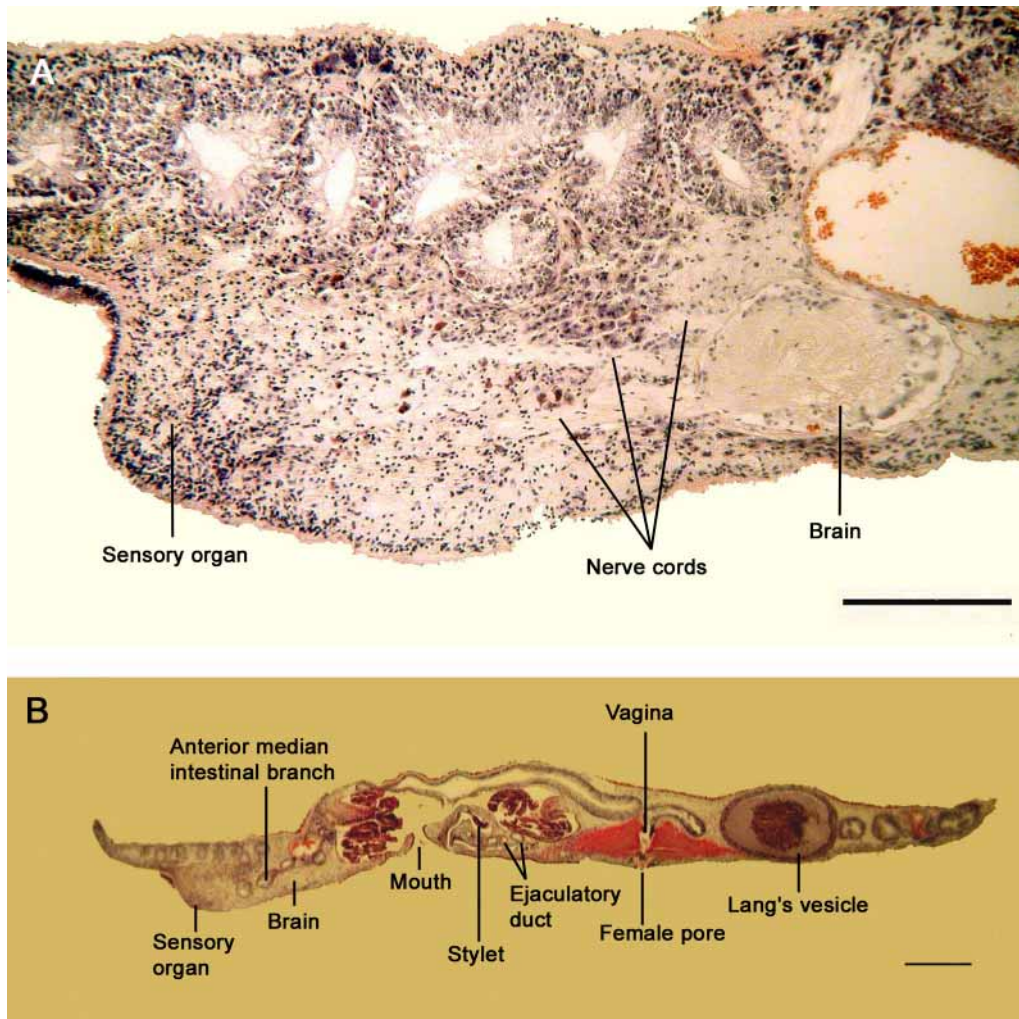


FIGURE 3. *Anocellidus profundus* n. sp.; photomicrographs. A. Sagittal histological section through the anterior end. Nerve cords can be seen extending from the brain to the sensory organ. Scale bar = 250 μm. B. Sagittal histological section, showing reproductive and digestive structures. Scale bar = 1 mm.

Even though the reproductive anatomy of *Anocellidus profundus* is somewhat similar to that of species in the euplanid genus *Aprostatum*, it clearly does not pertain to that genus (Table 2). The presence of nuchal tentacles, the total absence of eyes, and the presence of a unique ventral sensory organ also separate *A. profundus* from all other members of the Euplanidae (Table 1). In fact, current classification interprets the defining character of “orientation of male reproductive complex” in *A. profundus* as meriting familial status.

Here we note the presence of tentacles in *Anocellidus profundus*, although the character’s systematic value is uncertain. For example, Faubel (1983) defines the genus *Armatoplana* as lacking tentacles, however, *Armatoplana divae* has tentacles (Faubel

1983), as does *A. colombiana* (Bolaños *et al.*, 2006). Also the absence of eyes in *A. profundus* may relate more to its environment than to its phylogenetic history.

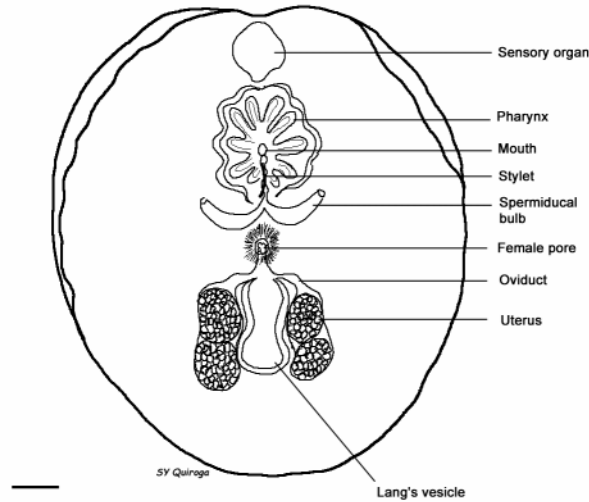


FIGURE 4. Diagram of ventral view of *Anocellidus profundus* n. sp. Scale bar = 1 mm.

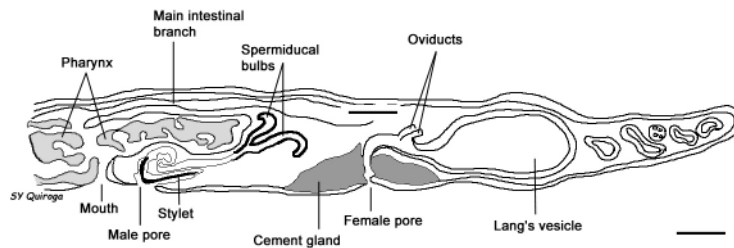


FIGURE 5. Schematic representation of the male and female reproductive structures of *Anocellidus profundus* n. sp. Scale bar = 250 μ m.

However, we recognize the ventrally located putative sensory organ anterior to the cerebral ganglion as an unusual character. A cursory examination of this disk may result in its being confused with a cotylean sucker and the mistaken placement of the specimens in the Cotylea. The presence or absence of a true sucker posterior to the female gonopore has defined the suborders Cotylea (with sucker) and Acotylea (without sucker) (Lang, 1884). However, exceptions exist; species of acotyleans with a sucker include *Leptoplana tremellaris* (O.F. Müller 1774) and *Itannia ornata* Marcus 1947, although these suckers are never positioned behind the female gonopore (the typical sucker position in cotyleans). In *L. tremellaris*, the sucker is a depression between the male and female gonopore along the midline of the body (Faubel 1983). In *I. ornata*, two adhesive organs are posterior to the gonopore on either side of the midline (Marcus 1952). Despite the presence of such suckers, other characteristics, such as position of the tentacles, structure of the copulatory

complex, and arrangement of eyes determine the placement of *I. ornata* into the Acotylea (Bock 1913, Hyman 1951, Faubel 1983, 1984, Prudhoe 1985). Similarly, the presence of a Lang's vesicle and nuchal tentacles in *Anocellidus profundus* clearly places this species in the Acotylea.

TABLE 2. Comparison of morphological features of species in the genus *Aprostatum** (i. e., lacking a prostatic vesicle and/or prostatoid organs) and the new species *Anocellidus profundus*.

Species	Pharynx	Eyes	Tentacles
<i>Anocellidus profundus</i>	Anterior with 4-5 folds	Absent	Long, pointed nuchal tentacles
<i>Aprostatum stiliferum</i> *	Numerous folds	Marginal eyes in irregular rows surrounding entire body; numerous small eyes in fan-shape over cephalic region	Absent
<i>Aprostatum clippertoni</i>	Small, with small lateral folds	As in <i>A. stiliferum</i>	Absent
<i>Aprostatum longipenis</i>	Morphologically uniform	Present	Absent

continued.

Species	Ventral sensory organ	Spermiducal bulbs	Seminal vesicle	Penis stylet	Lang's vesicle
<i>Anocellidus profundus</i>	Anterior to cerebral ganglion	Present without vasa deferentia	Absent	Long pointed directed backwards	Large, oval
<i>Aprostatum stiliferum</i> *	Absent	Present	Absent	Tubular, pointed	Large
<i>Aprostatum clippertoni</i>	Absent	Absent	Absent	Thin, short	Small
<i>Aprostatum longipenis</i>	Absent	Present	Absent	Tubular, pointed	Large

*The status of the genus *Aprostatum* needs re-evaluation. Bock (1913) designated *Aprostatum stiliferum* as the type species of that genus, listing its lack of either a prostatoid organ or a seminal vesicle as a defining character. However, an examination of material from Chile showed the presence of both a seminal vesicle and a prostatic organ in *A. stiliferum* (Marcus 1954).

Three noteworthy characteristics of this putative sensory organ of *Anocellidus profundus* show that it is not homologous with the cotylean sucker. First, lateral nerve cords appear to innervate the organ (Fig. 3A), secondly, rhabdites are completely lacking from the organ's epithelium (a distinct characteristic of cotylean suckers), and finally, the organ is located just subterminal to the anterior margin. From these observations, it

appears then that this organ may serve a sensory rather than an adhesive function. However, additional studies are certainly needed to confirm this.

Suborder: Cotylea Lang, 1884

Superfamily: Euryleptoidea

Family: Euryleptidae

Genus: *Oligocladus*

Species: *voightae* n. sp. (Figs. 6–10)

Type material and locality:

a) Holotype, whole mount, one mature specimen (12 mm x 10 mm), FMNH 12560, collected 30 August, 2004 from Escanaba Trough, 20 m N of Marker 6X on Central Hill, from 3232 m depth (41° 00.272'N 127° 29.679'W).

b) Paratype, one mature specimen as serial sagittal sections (11 mm x 9 mm), FMNH 12464, collected with holotype 30 August, 2004 from Escanaba Trough, 20 m N of Marker 6X on Central Hill, from 3232 m (depth 41° 00.272'N 127° 29.679'W).

Distribution: To date, found only at type locality

Etymology: Species named in honor of Dr. Janet Voight of the Field Museum of Natural History, Chicago, Illinois.

Diagnosis: Mouth anterior to the brain. Eyes, few and minute, scattered on the tentacles. Seminal vesicle connected posteriorly to an auxiliary storage vesicle containing a basophilic substance (possibly sperm). Auxilliary storage vesicle extends dorsally over the seminal vesicle. Posterior anal pore in main median branch of the intestine.

Description

External features:

Color —preserved animals have a milky white dorsal surface with ovaries appearing as dark brown spots that form a radial pattern. White intestinal branches are visible through the epidermis. The ventral surface is white.

Form —oval body shape, margins without folds except for the ones forming the tentacles. The two specimens measured 12mm x10 mm and 11 mm x 9 mm, respectively. A very conspicuous sucker is located right in the center of the ventral surface, posterior to the pharynx (Figs. 9 and 10).

Tentacles —Short (~600 µm), blunt, marginal tentacles formed mainly by the elongation of the body margin rather than the folding of it (Fig. 6).

Eyes —Few and minute, scattered over the tentacles. Cerebral and marginal eyes absent.

Digestive system —the mouth is a small opening, anterior to the brain (Fig. 8A). The

very muscular and cylindrical pharynx is directed forward and located in the anterior half of the worm, just anterior to the sucker. It folds back on itself in an S-shape, possibly due to a preservation artifact (Figs. 8A and 10). The pharynx connects to a median intestinal branch which itself extends anteriorly dorsal to the brain, and posteriorly almost to the body margin. The posterior part of the median intestinal branch divides into 6 to 8 large, radial branches and 4 smaller ones just dorsal to the pharynx (Fig. 7). An anal pore is present on the median intestinal branch just prior to the terminal end of the branch itself (Fig. 7). An anterior vesicle opening to the exterior was observed, but there is no evidence of it being connected or related to the digestive system.

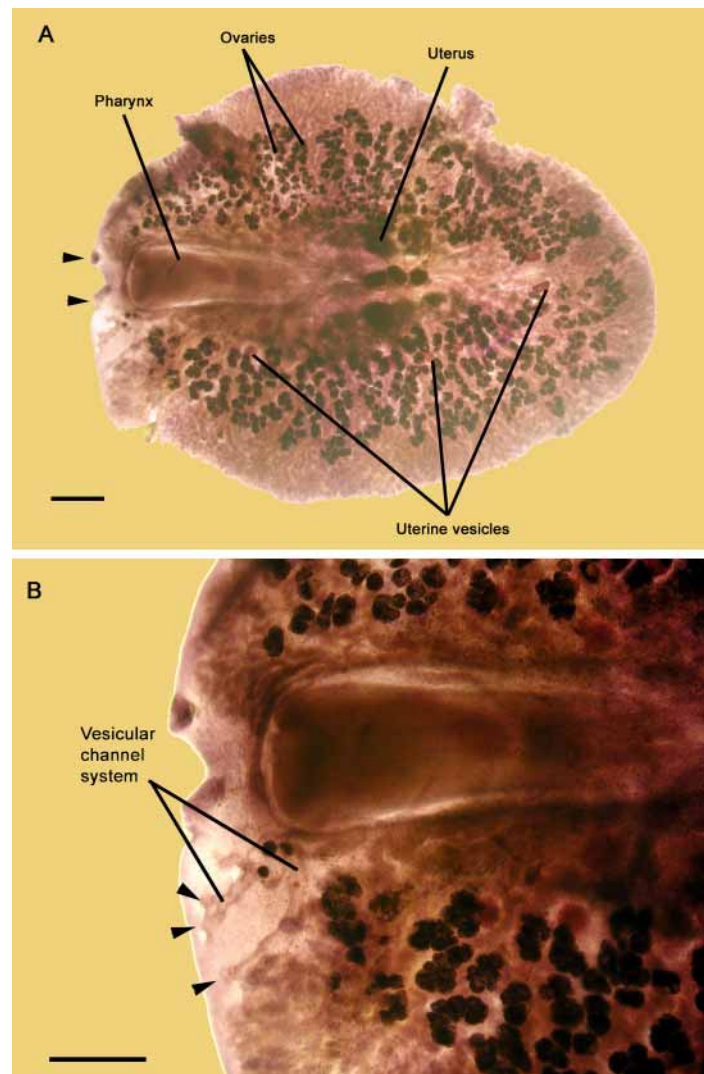


FIGURE 6. Whole mount of *Oligocladus voightae* n. sp.; photomicrographs. A. Anterior end, showing tentacles (arrow heads), massive pharynx, and female reproductive structures. Scale bar = 1 mm. B. Higher magnification of anterior end. Arrow heads indicate putative pores of vesicular channel system. Note, channels are only found on one side of the animal. Scale bar = 1 mm.



FIGURE 7. Sagittal section of *Oligocladus voightae* n. sp., showing details of intestine and characteristic anal pore (arrow). Scale bar = 1 mm.

Reproductive anatomy:

Gonopores —pores are well separated from each other. The female pore is posterior to the male pore and located well anterior of the sucker.

Male copulatory apparatus —testes are scattered ventrally all over the body but are especially concentrated in the posterior end. The male apparatus is rather small compared to the size of the animal. A free prostatic vesicle (125 μm) is located just dorsal to the male atrium (Fig. 8). The seminal vesicle is larger than the prostatic vesicle (175 μm), and is located posterior to the atrium. In addition, the seminal vesicle is connected to an accessory storage vesicle containing a basophilic substance, possibly sperm (Figs. 8 and 10). This accessory vesicle wraps itself dorsally around the seminal vesicle. A deep atrium houses a pointed stylet (175 μm).

Female copulatory apparatus —The ovaries are dorsal and scattered over the entire body, fanning out in a radial pattern from the pharynx (Fig. 6A). Two small uterine trunks are present behind the pharynx. Numerous uterine vesicles are present (Figs. 6A and 9). The female atrium is not very deep and connected to a simple vagina, which in turn connects to oviducts.

Taxonomic remarks:

Both, Faubel (1984a) and Prudhoe (1985) are in agreement of the genus *Oligocladus* in the Euryleptidae. Therefore, either classification system may be used for its identification. Conspicuous characters such as a digestive system with a median main intestinal branch, a plicate, cylindrical pharynx extending anteriorly to the level of the brain, a male copulatory complex located anterior to the female one, and a true free prostatic vesicle, clearly place this species in the family Euryleptidae. Among the Euryleptidae, three genera share the possession of an anal pore in the main intestinal branch, *Oligocladus*, *Cycloporus*, and *Leptoteredra*. However, only *Oligocladus* and *Cycloporus* also possess a pair of uterine trunks with multiple uterine vesicles (Faubel 1984).

Oligocladus and *Cycloporus* are distinguished by the presence of many peripheral vesicles opening to the exterior. In *Cycloporus* these vesicles have clear connections to the digestive system; in *Oligocladus* they do not. In one examined specimen, a vesicular channel system opening via several pores to the exterior was observed in the anterior portion, albeit only on one side of the worm. However, the relationship of this channel system to the digestive system is uncertain. In addition, an obvious anal pore opening dorsally from the caudal end of the main intestinal branch confirmed a placement into *Oligocladus* rather than *Cycloporus*.

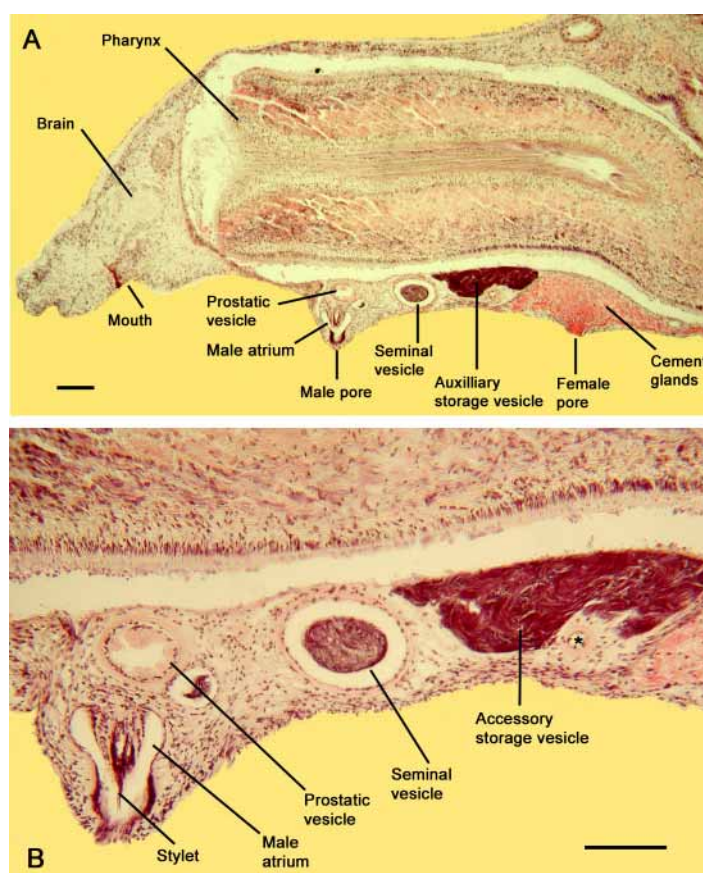


FIGURE 8. *Oligocladus voightae* n. sp.; photomicrographs. A. Sagittal histological section of the anterior end showing position of brain posterior to mouth and details of the male and female reproductive systems. Scale bar = 150 μ m. B. Higher magnification sagittal section through male copulatory complex. Asterisk indicates the connecting duct between the seminal vesicle and the accessory storage vesicle. Scale bar = 100 μ m.

Additionally, Hadenfeldt (1929) recognizes the position of the brain posterior to the mouth as unique to the genus *Oligocladus*, with only two species. According to Faubel (1984), the anatomy of *O. auritus* is not very well known, although Lang (1884) placed it into this genus because its brain is posterior to the mouth. Thus, the position of the brain of

O. voightae supports the placement of this species in the genus *Oligocladus*. Furthermore, the general anatomy of *O. voightae* corresponds well with that of *O. sanginolentus* with the exception of the presence of two sharply-defined clusters of cerebral eyes and an anteriorly trifurcated intestinal trunk in the latter species (Prudhoe, 1985).

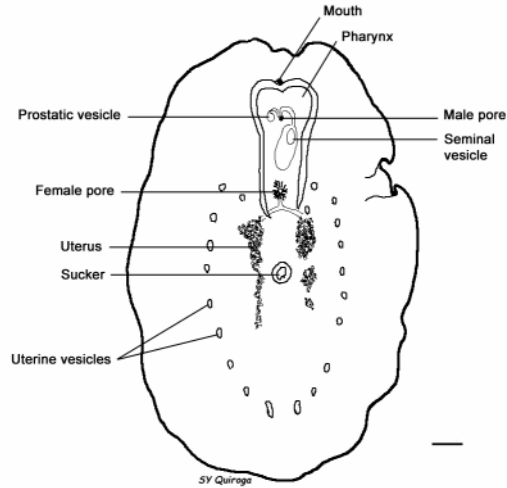


FIGURE 9. Diagram of ventral view of *Oligocladus voightae* n. sp., showing position of male and female reproductive structures. Scale bar = 1 mm.

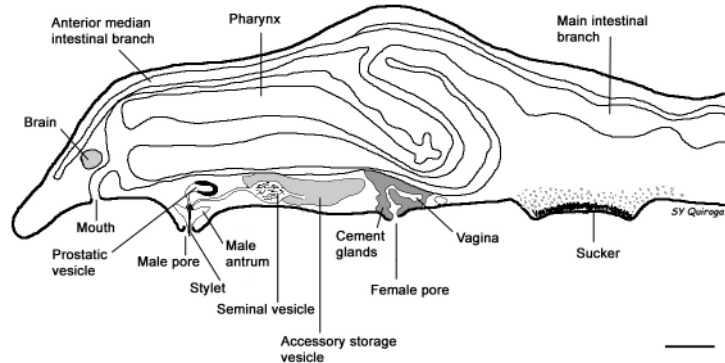


FIGURE 10. Schematic sagittal representation of reproductive and digestive systems of *Oligocladus voightae* n. sp. Scale bar = 250 μ m.

Ecological remarks:

It is interesting to note that the two newly described species so far have been collected only from deep-sea wood deployments heavily colonized by wood-boring clams (species of which are currently being described, Dr. J. Voight, Chicago Field Museum, pers. comm.). Previously, Turner (1978) demonstrated the importance of deep-sea wood deployments in the establishment of a highly diverse community, consisting of wood-boring bivalves, predatory polychaetes and gastropods, galatheid crabs, echinoderms and

most likely fish. With respect to flatworms, Turner (1978) reports a single specimen of a predatory turbellarian only; the most abundant taxa of her study being gastropods and polychaetes.

This contrasts sharply with polyclad densities found at Escanaba Trough and ODP. In August 2004, 149 specimens were collected from four 18 inch x 4 inch x 4 inch pieces of lumber at Escanaba Trough that had been deployed there in July 2002, and in July 2003, 47 specimens were collected from ODP 1026B and 33 specimens from near Baby Bare Seamount off identical deployments made in September 2002 (Dr. J. Voight, pers. comm.).

The ecological function of the two newly described species may be inferred from known predatory behavior of other polyclads. Acotyleans of the families Leptoplanidae and Stylochidae are known to prey on rock and pearl oysters (Newman *et al.* 1993, O'Connor & Newman 2001), blue mussels (Galleni *et al.* 1980, Villalba *et al.* 1997), barnacles (Murina *et al.* 1995), and cultured giant clams (Newman *et al.* 1993). Their impact can be substantial, as they often feed exclusively on spat or juvenile bivalves, resulting in as much as 90% mortality (Newman *et al.* 1993). Predation by a stylochid polyclad on oysters has been reported also for the US Atlantic and Gulf of Mexico coasts (Provenzano 1961, Webster & Medford 1961, Christensen 1973, Chintala *et al.* 1993), and Newell *et al.* (2000) were able to show that small (< 5 mm²) polyclads were instrumental in significantly reducing the numbers of young oyster spat (less than 3 weeks post-settlement) in Chesapeake Bay.

Recently, Ritson-Williams *et al.* (2006) described the predatory behavior of a planocericid, concluding that this flatworm uses tetrodotoxin to capture and kill its mollusk prey. From the observed ecological association of *Anocellidus profundus* and *Oligocladus voightae* with deep-sea bivalves, it is tempting to speculate that the flatworms may use a toxin such as tetrodotoxin to subdue their prey. At this point, however, such predator-prey interactions, and the presence of toxins in deep-sea flatworms remain to be demonstrated.

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