

New Species of Scalibregmatidae (Annelida) from Slope and Abyssal Depths off Eastern Australia

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ABSTRACT. Seven new species of Scalibregmatidae are described from deep waters off the east coast of Australia. Samples were collected as part of the RV *Investigator* voyage IN2017_V03 in May/June 2017 using a Brenke sledge and 0.25 m² box core. Sample depths reported in the present study were from the lower continental slope of about 2450 m to abyssal depths up to 4280 m. These collections provide the first scalibregmatid polychaetes to be described from deep water off Australia. The new species of Scalibregmatidae are in the genera *Asclerocheilus* (1), *Axiokebuita* (1), *Oligobregma* (4), and *Pseudoscalibregma* (1). Each of the new species is compared and contrasted with their known congeners. *Asclerocheilus* and *Oligobregma* are the largest genera of the family in terms of numbers of species; the known species of each of these genera are tabulated and compared. The Scalibregmatidae known from abyssal depths of about 3000 m and greater are reviewed and discussed.

Introduction

The present study is based on annelids of the family Scalibregmatidae collected as part of the RV *Investigator* cruise (No. IN2017_V03) along the eastern continental margin of Australia in May/June 2017 (Gunton *et al.*, 2021). Scalibregmatids occur globally and range from the intertidal to the deep sea, but most species occur deeper than 100 m; this study represents the first report of deep-sea annelids of this family from Australian waters.

A review of the Scalibregmatidae was recently prepared by Blake (2020). The family includes approximately 70 species distributed in 15 genera identified largely by a suite of overlapping characters. Because so many species (and genera) occur in deep water, or are otherwise in habitats that are difficult to sample, there have been few species for which molecular sequences have been obtained. To date

there have been no phylogenetic analyses, morphological or molecular, that would serve to support a systematic revision of the family (Blake, 2020).

Scalibregmatids have an areolated appearance due to the presence of one to six annulated rows of elevated pads per segment. Their bodies are typically either elongate with an expanded anterior end and narrow abdominal region (arenicoliform) or short, thick, and without an expanded anterior end (maggot shaped); a few species have long, linear bodies (Blake, 2020). Scalibregmatids typically have a bifid or T-shaped prostomium with frontal or lateral horns. Parapodia are biramous with simple podial lobes; dorsal and ventral cirri occur in posterior parapodia of some genera. Branchiae, when present, are limited to a few anterior segments and have numerous branches. Setae are all simple and include capillaries, furcate setae, and sometimes large recurved acicular spines.

Keywords: *Asclerocheilus*, *Axiokebuita*, *Oligobregma*, *Pseudoscalibregma*, polychaetes, benthos, deep sea, new species

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Apart from several early studies using standard histological techniques, there has been little effort to analyse the internal anatomy of scalibregmatids. There have been no studies of the ultrastructure of any organ system. Little is known about scalibregmatid biology except that they are considered subsurface, burrowing, deposit feeders (Jumars *et al.*, 2015). Random observations of swimming scalibregmatids and the presence of long natatory-like setae (Clark, 1954) and the presence of sperm of the ect-aquasperm type (Blake, 2015) suggest that spawning takes place in the water column. However, spawning and early embryonic development are not known. Recent observations on postlarvae and juveniles provide important data on the developmental timing of morphology (Blake, 2015).

The present study includes seven new species in the scalibregmatid genera *Asclerocheilus* (1), *Axiokebuitta* (1), *Oligobregma* (4), and *Pseudoscalibregma* (1).

Materials and methods

Materials examined as part of this study. Biological samples were collected from 13 sites at one-degree intervals of latitude along the east coast of Australia from Tasmania (42°S) to Southern Queensland (24°S) on the RV *Investigator* (Cruise No. IN2017_V03), from 15th May to 16th June 2017. Seven Marine Parks (MP) were included (Freycinet MP, Flinders MP, East Gippsland MP, Jervis MP, Hunter MP, Central Eastern MP and Coral Sea MP) in the sampling areas. Benthic sampling was conducted at lower bathyal (c. 2500 m) and abyssal (c. 4000 m) depths, with seven comparative samples taken at shallower mid-bathyal depths (c. 1000 m). Three types of sampling gear were used: beam trawl, Brenke Sled, and box core. Selected specimens were photographed alive prior to preservation. The majority were preserved in 95% ethanol (ETOH), the remainder in 10% buffered formalin. Sled and trawl samples were generally sieved through a 1-mm-mesh screen; box core sediments were sieved on a 0.3-mm-mesh screen. Trawl and sled deployments were generally successful, but most of the box core deployments were not. Annelid specimens collected during the voyage were shipped to the Australian Museum, Sydney (AM), Museums Victoria, Melbourne (MV), and the Natural History Museum, London (NHMUK) where they were registered and sorted to the family level. At the respective institutions, annelids fixed in formalin were soaked in water, then preserved and later sorted in 80% ETOH, while ethanol-fixed annelids were sorted in 95% ETOH. The specimens studied here were provided by the AM; registration numbers are prefixed W.

Morphological observations. Specimens were examined using a Wild M-5 stereomicroscope and a Zeiss RA research microscope equipped with phase contrast optics. Photomicrographs were taken with a Nikon D7100 camera mounted on both the stereo- and compound microscopes. For observation, specimens were first stained with an aqueous solution of Shirlastain A to highlight difficult-to-see surficial morphology. Some specimens were stained with a saturated solution of Methyl Green (MG) in 70% ETOH in order to identify staining patterns of subdermal glands evident on some species. Line drawings were first sketched in pencil using a drawing tube or *camera lucida* on the Zeiss RA and later transferred to Dura-Lar® matte film and inked. Photographs were edited in Photoshop.

Molecular analysis. Tissue for each species treated in this study was provided for DNA acquisition. However, DNA acquisition was largely unsuccessful, likely due to handling during collection and preservation. The only successful results were for cytochrome c oxidase subunit 1 (COI) and mRNA S18 for *Asclerocheilus abyssalis* sp. nov. and COI for *Oligobregma profunda* sp. nov. The data has been submitted to GenBank. Comments are provided for these two species.

Abbreviations used on figures. *anC*, anal cirri; *anLb*, anal lobe; *caps*, capillary setae; *dCir*, dorsal cirrus; *fH*, frontal horn; *iPap*, interramal papilla; *latH*, lateral horn; *mo*, mouth; *neph*, nephridia; *neL*, neuropodial lobe; *noL*, notopodial lobe; *nuO*, nuchal organ; *per*, peristomium; *pr*, prostomium; *prob*, proboscis; *S*, setiger; *VCir*, ventral cirrus; *vRdg*, ventral ridge.

Taxonomic account

Family Scalibregmatidae Malmgren, 1867

Type genus: *Scalibregma* Rathke, 1843, by monotypy.

Diagnosis (after Blake, 2020): Body variably shaped: (1) elongate and narrow throughout, (2) fusiform, (3) thick, maggot-shaped, or (4) elongate arenicoliform with anterior segments greatly expanded; with no more than 30 to 60 setigerous segments. Body with one to five annular rings on each segment; each ring usually composed of elevated pads; distribution of these rings and pads differs among species; venter with mid-ventral groove or ridge formed of elevated pads along body, limited to one part of body or entirely absent. Prostomium either bilobed or T-shaped with two frontal or lateral horns, sometimes long, ciliated, and functioning as palps; eyes present or absent; nuchal slits present. Proboscis eversible, soft, unarmed. Peristomium with a dorsal ring typically single, encompassing prostomium; ventral part with one to three rings forming upper and lower lips of mouth. Branchiae present or absent, when present limited to four to six or fewer anterior setigers, always with multiple branches, usually dichotomous. Parapodia biramous, with weakly developed podial lobes; interramal sensory organs or papillae present; dorsal and/or ventral cirri present or absent in middle and posterior segments, when present often with internal tubular glands; postsetal lamellae rarely present. Setae all simple, including capillaries, furcate or lyrate setae present or absent, acicular spines on anterior segments present or absent; short spinous setae often present anterior to capillaries on setigers anterior to those where furcate setae begin. Pygidium with two or more lobes; anal cirri present or absent.

Remarks. Scalibregmatids are active burrowers and subsurface deposit feeders that never form tubes. They are readily recognized by their large, often maggot-shaped, bodies that have a rugose or lumpy looking surface and a prostomium typically with frontal horns. The family is composed of 15 genera and c. 72 species (Blake, 2015, 2020; Read & Fauchald, 2022). In Australia, six named species in five genera (*Asclerocheilus*, *Axiokebuitta*, *Hyboscolex*, *Oligobregma*, and *Pseudoscalibregma*) have been reported (<http://www.ala.org.au>). In the present study the deep-water samples contained four genera and seven new species (*Asclerocheilus abyssalis* sp. nov., *Axiokebuitta australis* sp. nov., *Oligobregma aristata* sp. nov., *Oligobregma bathyala*

sp. nov., *Oligobregma profunda* sp. nov., *Oligobregma renuncula* sp. nov., and *Pseudoscalibregma glandipodium* sp. nov.).

The following species are included in this article:

Asclerocheilus abyssalis sp. nov.
Axiokebuita australis sp. nov.
Oligobregma aristata sp. nov.
Oligobregma bathyala sp. nov.
Oligobregma profunda sp. nov.
Oligobregma renuncula sp. nov.
Pseudoscalibregma glandipodium sp. nov.

Genus *Asclerocheilus* Ashworth, 1901

Type species. *Lipobranchius intermedius* Saint Joseph, 1894. Designated by Ashworth (1901).

Synonym. *Kebuita* Chamberlin, 1919:390. Type species: *Eumenia glabra* Ehlers, 1887. *Fide* Blake, 2000.

Diagnosis. Body elongate, arenicoliform. Prostomium T-shaped with frontal horns. Parapodia of posterior segments reduced; dorsal and ventral cirri absent; interramal papillae or cilia present or absent; postsetal lamellae absent. Branchiae absent. Setae include capillaries, furcate setae, and large, conspicuous curved spines on setigers 1 to 4, sometimes accompanied by short spinous setae. Pygidium with long anal cirri.

Remarks. The genus *Asclerocheilus* is the second largest in the family with 15 species, including the one described here. One species, *A. tasmanius* Kirkegaard, 1996 is herein transferred to the genus *Oligobregma* because the holotype has well-developed podial lobes and parapodial cirri. By definition such parapodia are not found in the genus *Asclerocheilus*.

The genus *Asclerocheilus* was reviewed by Hartmann-Schröder (1994) and Blake (2000). Both authors reviewed existing species and described new species. Hartmann-Schröder (1994) described a new species, *A. shanei* from shelf depths of 122 m in Tasmania, Australia. She also reviewed and tabulated the distribution of acicular spines, capillaries, and furcate setae for the nine then-known species.

Blake (2000) redescribed *A. beringianus*, Ushakov, 1955, *A. californicus* Hartman, 1963 and established a new species, *A. kudenovi* Blake, 2000, based on old and newly collected offshore material from California. Blake (2000) also synonymized the genus *Kebuita* Chamberlin, 1919 with *Asclerocheilus*. In so doing, he also noted that *Oncoscolex* (*Eumenia*) *heterochaetus* Augener, 1906 had earlier been synonymized with *Kebuita glabra* (Ehlers, 1887) by Hartman (1938) and that because the latter was being referred to *Asclerocheilus*, the specimens identified *A. heterochaetus* Kudenov & Blake, 1978 from southeastern Australia became a junior homonym of *O. heterochaetus* Augener, 1906. For this reason, the homonym was renamed by Blake (2000) as *A. victoriensis*. Blake (2000) prepared a tabular summary of the 12 known species, expanding on the earlier summary by Hartmann-Schröder (1994). Subsequent to Blake (2000), Eibye-Jacobsen (2002) described two new species of *Asclerocheilus* from the Thai sector of the Andaman Sea in shelf depths of 40–80 m.

One new species, *Asclerocheilus abyssalis* sp. nov. has been discovered from off New South Wales. Each of the 15 known species of *Asclerocheilus* is compared in Table 1, thus updating the data reviewed by Hartmann-Schröder (1994) and Blake (2000). With the transfer of *A. tasmanius* to *Oligobregma*, *A. abyssalis* sp. nov. is the only member of the genus known from abyssal depths of 3000 m or greater. Although both *A. beringianus* and *A. intermedius* (Saint Joseph, 1894) are reported from deep-sea habitats, these depths are from the lower continental slope of ~2000 m, not abyssal depths. The remaining 12 species are from shallower continental shelf or upper slope depths (Table 1).

Asclerocheilus abyssalis sp. nov.

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Figs 1–2

Holotype: Eastern Australia, abyssal plain off Newcastle, New South Wales, RV *Investigator*, Sta. 065, coll. 30 May 2017, Benthic Trawl, distance 3.5 km, 33.441°S 151.469°E, 4280 m to 33.435°S 152.665°E, 4173 m (Australian Museum W.49504). **Paratypes** (4): same data as (2, AM W.52704); abyssal plain off New South Wales, Jervis Marine Park, RV *Investigator*, Sta. 053, coll. 28 May 2017, Benthic Trawl, distance 4.2 km, 35.114°S 151.469°E, 3952 m to 35.084°S 151.441°E, 4011 m (2, AM W.52703).

Description. A large species, all specimens complete, with a thick sausage-shaped body, narrowing only in far posterior segments (Fig. 1A). Parapodia reduced, only slightly enlarged on setigers 1–3; rest of body with no prominent podial lobes; parapodial cirri entirely absent. Holotype with 37 setigers, 4.6 cm long, about 1 cm wide (AM W.49504); largest paratype (AM W.52704) with 39 setigers, 4.9 cm long, and 0.8 cm wide. Body segments divided by a transverse groove, dividing each segment into two raised annuli extending across the body (Fig. 1A, B); these biannulate parts then subdivided by numerous crossing grooves consisting of rows of pads along body forming a basic biannulate pattern along body; some middle segments becoming triannulate. These pads best observed in far posterior segments; in anterior and middle body segments, annuli and pads becoming stretched and expanded by enlarged body, obscuring individual pads. Setigers 1–3 with grooves and pads not evident due to enlarged parapodia. Venter with shallow mid-ventral groove containing ridge along mid-line from posterior lip of mouth (Fig. 1B); ridge composed of raised rounded pads between segmental transverse grooves. Branchiae absent. Colour in alcohol light tan to grey; a few isolated areas of brown pigment associated parapodia of setigers 1–3 on holotype, otherwise without body pigment; paratypes without pigment.

Prostomium short, pear-shaped, bearing two short, forwardly directed lobes on anterior margin, each rounded on tips, appearing as short frontal horns (Fig. 1D); eyes absent; nuchal organs as a notch between prostomium and peristomium, swollen and everted on one paratype (AM W.52703). Peristomium a single lobed ring surrounding prostomium dorsally and surrounding mouth ventrally (Fig. 1C); oral opening surrounded by 9–10 elongate lobes; pharynx partially everted on one paratype (AM W.52703).

Parapodia reduced along entire body. Setigers 1–3 with noto- and neuropodia elongate rounded mounds separated by

Table 1. Comparison of some morphological characters of 15 known species of *Asclerocheilus*. *Asclerocheilus tasmanius* Kirkegaard, 1996 is here transferred to the genus *Oligobregma*. Notations: *A*, acicular spines; *C*, capillaries; *F*, furcate or lyrate setae; *SpS*, short spinous setae; setae: upper letters = notosetae; lower letters = neurosetae.

| species | setae setiger 1 | setae setiger 2 | setae setiger 3 | setae setiger 4 | prostomium | eyes: structure & colour | locality | reference |
|---|--------------------|--------------------|--------------------|--------------------|--------------------------------------|--|--|--|
| <i>abyssalis</i> sp. nov. | A+SpS A+SpS | A+SpS A+SpS | A+SpS A+SpS | C C | 2 short frontal lobes | absent | eastern Australia, off NSW, abyssal depths, 3952–4280 m | this study |
| <i>acirratus</i> (Hartman, 1966) | A+C F+C | F+C F+C | F+C F+C | F+C F+C | T-shaped with lateral horns | 2 pair double rows, red | California, offshore in algae; shallow subtidal | Hartman, 1966, 1969 |
| <i>ashworthi</i> Blake, 1981 | A+C F+C | A+C+F F+C | F+C F+C | F+C F+C | T-shaped with weakly developed horns | absent | Sub-Antarctic; 200–400 m | Blake, 1981 |
| <i>beringianus</i> Ushakov, 1955 | A+C F+C | A+C F+C | F+C F+C | F+C F+C | 2 recessed horns | absent | NE Pacific; Bering Sea; slope depths; 986–2006 m | Ushakov, 1955; Blake, 2000 |
| <i>californicus</i> Hartman, 1963 | A+C F+C | A+C F+C | F+C F+C | F+C F+C | 2 broad flaring lobes | absent | Southern California; shelf depths, 542–890 m | Hartman, 1963, 1966, 1969; Blake, 2000 |
| <i>capensis</i> Day, 1963 | A+C F+C | A+C F+C | F+C F+C | F+C F+C | 2 lateral horns | absent | South Africa, 9–26 m | Day, 1963, 1967 |
| <i>elisabethae</i> Eibye-Jacobsen, 2002 | A+C C | A+C F+C | F+C F+C | F+C F+C | 2 narrow elongate frontal horns | 2 pair orange-brown, diagonal bands | Thailand, Andaman Sea, 70–80 m | Eibye-Jacobsen, 2002 |
| <i>glabrus</i> (Ehlers, 1887) | A+C C | C C | C C | C C | 2 frontal horns | absent | Caribbean Sea, 320 m | Ehlers, 1887; Augener, 1906 (as <i>Oncoscolex heterochaetus</i>) |
| <i>intermedius</i> (Saint Joseph, 1894) | A+C A+C | A+C A+C | A+C A+C | F+C F+C | T-shaped | absent | eastern North Atlantic: Ireland to Azores; shelf depths to 551 m | Saint-Joseph, 1894; Fauvel, 1927; Hartmann-Schröder, 1971, 1996 |
| <i>kudenovi</i> Blake, 2000 | A+C F+C | A+C F+C | F+C F+C | F+C F+C | T-shaped, with 2 flaring lobes | 2 pair double rows, red | Central California; shelf depths in rocks; 90–120 m | Blake, 2000 |
| <i>mexicanus</i> Kudenov, 1983 | A+C F+C | F+C F+C | F+C F+C | F+C F+C | T-shaped, with 2 weak lateral lobes | 2 pair, thick, ?colour | Gulf of Mexico; shallow subtidal; 2–75 m | Kudenov, 1985 |
| <i>shanei</i> Hartmann-Schröder, 1994 | A A | A A | A A | F F | with 2 forwardly directed lobes | absent | Tasmania c. 125 m | Hartmann-Schröder, 1994 |
| <i>shananae</i> Eibye-Jacobsen, 2002 | A A+C | F+C F+C | F+C F+C | F+C F+C | with 2 thick tapering frontal lobes | 2 pair dark brown, diagonal bands, anterior band largest | Thailand, Andaman Sea, 70–76 m | Eibye-Jacobsen, 2002 |
| <i>tropicus</i> Blake, 1981 | A+C F+C | F+C F+C | F+C F+C | F+C F+C | with 2 flaring lobes | 2 groups, ocelli orange | Ecuador; shallow subtidal | Blake, 1981; Nogueira, 2002 |
| <i>victoriensis</i> Blake, 2000 | A+C A+C | A+C A+C | A+C A+C | A+C A+C | T-shaped, 2 lateral horns | 2 pair, V-shaped, ?colour | SE Australia; shallow subtidal | Kudenov & Blake, 1978 (as <i>A. heterochaetus</i> = homonym); Blake, 2000. |

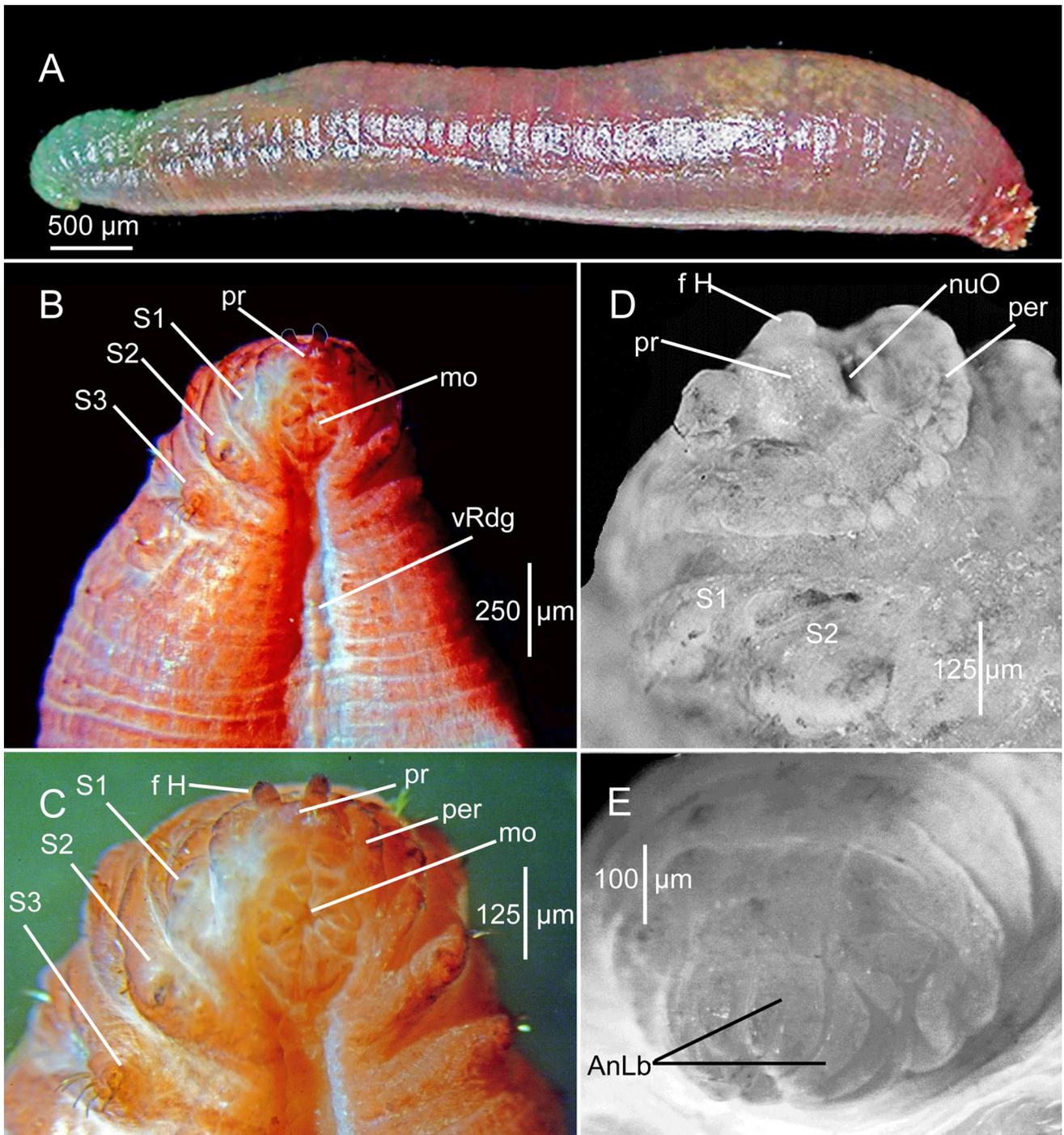


Figure 1. *Asclerocheilus abyssalis* sp. nov. (A) Entire worm, right lateral view (from life); (B) anterior end, ventral view; (C) same, detail of pre-setiger region and setigers 1–3; (D) anterior end, dorsal view; (E) posterior end, dorsal view. A–C, E, holotype (AM W.49504); D, paratype (AM W.52704); B, C, stained with Shirlastain A; A, in life photo taken at sea by Ms Karen Gowlett-Holmes.

low ridge; large curved acicular spines arising from curved groove on posterior side of podia. Subsequent parapodia of middle segments reduced to minute, oval, barely visible mounds, dorsal and ventral cirri entirely absent.

Setae of setigers 1–3 each with a single row of large brass-coloured acicular spines in both noto- and neuropodia (Figs 1B, 2A–D), alternating in part with short spinous setae (Fig. 2A, C, D); these often observed anterior to larger spines in position occupied by furcate setae in more posterior setigers; spinous setae no more than 1/3 length of large acicular

spines. Acicular spines of setigers 1–3 numbering 6–8 per notopodium and 6–7 per neuropodium; each spine curved, tapering to rounded tip (Fig. 2A, B).

Setae from setiger 4 through middle segments with 5–6 simple capillaries in both noto- and neuropodia. Furcate setae not observed in anterior and middle segments, but in prepared slide mounts, 3–4 minute capillaries, some sickle-shaped, observed in a bundle at base of 1–2 of the larger noto- and neuropodial capillaries (Fig. 2E). Furcate setae of posterior setigers with unique morphology consisting of

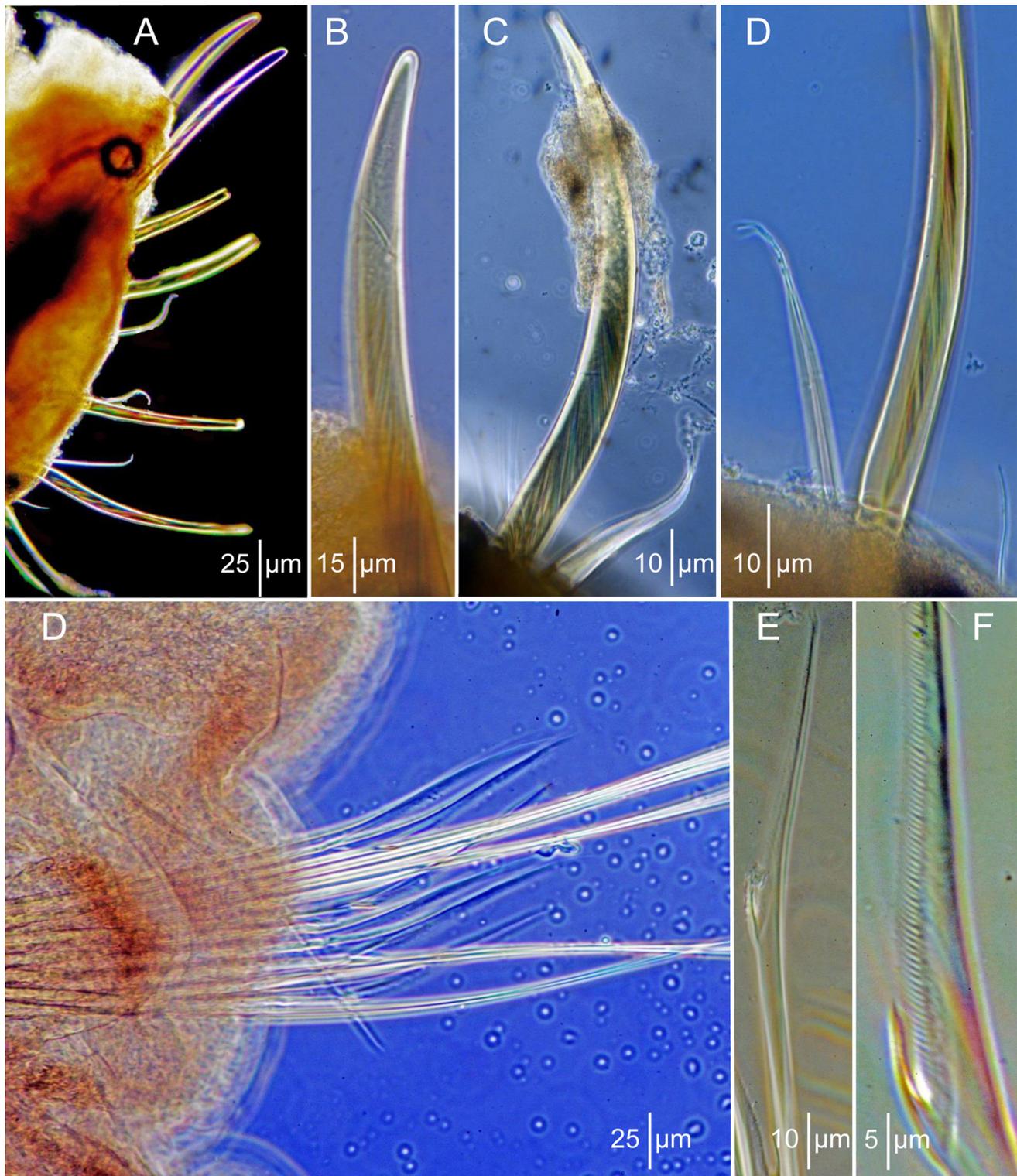


Figure 2. *Asclerocheilus abyssalis* sp. nov. (A) Setiger 2, anterior view; (B–D) acicular spines and short spinous setae from setiger 2; (E) posterior notopodium, anterior view; (F, G), Furcate setae. A–E paratype (AM W.52703); F–G, paratype (AM W.52704).

a short, narrow, sharply pointed tyne lacking denticles and a second tyne a long capillary-like blade with numerous denticles along inner margin (Fig. 2F–G). These unusual furcate setae numbering about 5–8 in posterior notopodia with 3–4 much larger simple capillaries; furcate setae also occur in posterior neuropodia but number no more than 2–4 with 2–3 capillaries. Typical short bifid furcate setae as found in other scalibregmatids not present.

Pygidium of holotype with about ten elongate lobes surrounding anal opening (Fig. 1E); cirri absent.

Remarks. Out of 15 known species of *Asclerocheilus*, only three including *A. abyssalis* sp. nov. are reported to have the three anteriormost setigers with acicular spines (Table 1). The other two are *A. intermedius* (Saint-Joseph, 1894) from the eastern North Atlantic in shelf depths, and *A. shanei*

Hartmann-Schröder, 1994 from off Tasmania, Australia, also in shelf depths. Another Australian species, *A. victoriensis* Blake, 2000 from Victoria in shallow subtidal depths, has four anterior setigers with acicular spines. The other 11 known species have either only one or two anterior setigers with acicular spines.

Asclerocheilus abyssalis sp. nov. is the only abyssal species of the genus and differs from other species of *Asclerocheilus* and all known scalibregmatids in the nature of the unusual furcate setae where a simple short smooth tyne or spur extends from the base of a second branch consisting of a long capillary-like blade with numerous thin denticles along the inner side (Fig. 2F–G). These unusual furcate setae occur in fascicles with larger smooth capillaries in posterior setigers.

There is little DNA data for scalibregmatids of the genus *Asclerocheilus*. The DNA sequencing effort for *A. abyssalis* sp. nov. only produced results for COI and 18S rRNA. The successful COI sequence for *A. abyssalis* sp. nov. diverged as a long branch not clustering with any published sequences of *Asclerocheilus* or other genera. The 18S rRNA sequence has an uncorrected distance of 5–6% from various scalibregmatid genera.

GenBank Accession Number: mt COI: OP572115; 18S rRNA: OP583944.

Etymology. The epithet is from *abyss*, Latin for a bottomless pit or the deep sea, in reference to this species being collected from abyssal depths greater than 3000 m.

Distribution. Eastern Australia off New Wales, abyssal depths, 3952–4280 m.

Genus *Axiokebuita* Pocklington & Fournier, 1987

Type species: *Axiokebuita millsii* Pocklington & Fournier, 1987, by monotypy.

Diagnosis. (Emended after Blake, 2020): Body elongate, with segments similar throughout, but some species with a fusiform shape; segments with one to four annulated rings composed of small, inconspicuous elevated pads, best developed on middle and posterior segments; venter with weakly developed median ridge. Prostomium triangular to pentagonal, truncate on anterior margin with long, subterminal ciliated lateral horns; eyes absent, nuchal organs in narrow grooves on posterior part. Peristomium a single, complete ring, weakly incised dorsally, divided into upper and lower lips of mouth ventrally; formed from large expanded lobes; unique paired ciliated “neck organs” present posterior to lower lip of mouth. Parapodia narrow ventral postsetal cirrus. Branchiae absent. Setae all capillaries, furcate and spinous setae absent; long, natatory-like setae present or absent. Pygidium reduced, short anal cirri present or absent; or with two pad-like lobes covered with papillae or papillae absent. Numerous cilia and ciliary patterns, present on lateral horns, prostomium, and interramal papillae; unique paired ciliated patches on ventral side of body.

Remarks. The genus *Axiokebuita* and type species, *A. millsii* were originally described from upper slope depths off Nova Scotia (Pocklington & Fournier, 1987). In the same paper,

the authors referred *Kebuita minuta* Hartman (1967) from Antarctica to their new genus while at the same time referred some of the Antarctic specimens to *A. millsii* implying that the species was bipolar in distribution. Records of *Axiokebuita* are few; the literature was reviewed by Blake (2020).

Parapar *et al.* (2011) examined specimens of *A. minuta* from Antarctica and among other things, referred the type-species, *A. millsii* to synonymy with *A. minuta* thus establishing the species as more or less cosmopolitan and bipolar in distribution. Unfortunately, these authors did not examine any specimens of *A. millsii* as part of their review. Martinez *et al.* (2013) recently described a new species, *A. cavernicola* from marine caves in the Canary Islands.

Several features of *Axiokebuita* species are reported as characteristic for the genus and differ from most Scalibregmatidae including (1) long thickened subterminal lateral prostomial horns (termed palps by Parapar *et al.*, 2011 and Martinez *et al.*, 2013) that are ciliated and likely assist in feeding and burrowing; (2) the presence of paired sensory “neck” organs on the peristomium ventral to the mouth and separate from the prostomial nuchal organs; (3) a unique pygidium present on some species, that bears a pair of lobes covered with minute papillae; (4) absence of furcate and acicular spines; (5) the presence of ciliary bands on the prostomial horns and elsewhere on the prostomium and body; (6) displacement of the interramal sense organ from a position between the parapodia to a location closer to the notosetae.

Among these characters, the long thickened lateral prostomial horns, neck organs, and absence of furcate setae and acicular spines appear to be more or less consistent among species. However, the pygidial morphology is not consistent and slender spinous setae are known from some specimens (Blake & Hilbig, 1990).

As part of a larger study of deep-water scalibregmatids, new collections of *Axiokebuita millsii* and other species are being re-evaluated and compared based on the new characters identified by Parapar *et al.* (2011). That study when published will serve to update the systematics of this genus and status of the closely related genera *Scalibregmidides* Hartmann-Schröder, 1965 and *Speleobregma* Bertelsen, 1986 (Blake, in preparation). In the meantime, *Axiokebuita australis* sp. nov. has been discovered in the deep-water samples collected as part of the RV *Investigator* IN2017_V03 survey off Southeastern Australia. That species is here described and compared with other known species.

Axiokebuita australis sp. nov.

urn:lsid:zoobank.org:act:C93CC779-84C1-4FC0-8252-FEE01BBA2968

Figs 3–4

Holotype: eastern Australia, continental slope off Tasmania, Freycinet Marine Park, RV *Investigator*, Sta. 011, coll. 19 May 2017, box core, 41.721°S 149.125°E, 2793 m (AM W.52681). **Paratypes** (2): same data as holotype (1, AM W.53989); abyssal plain off southeastern Victoria, East Gippsland Marine Park, RV *Investigator*, Sta. 033, coll. 24 May 2017, Brenke Sled, distance 2.6 km, 38.521°S 153.213°E 4107 m to 38.498°S 150.207°E 4064 m, dissected in part for DNA (1, AM W.52695).

Description. All three specimens complete: holotype (AM

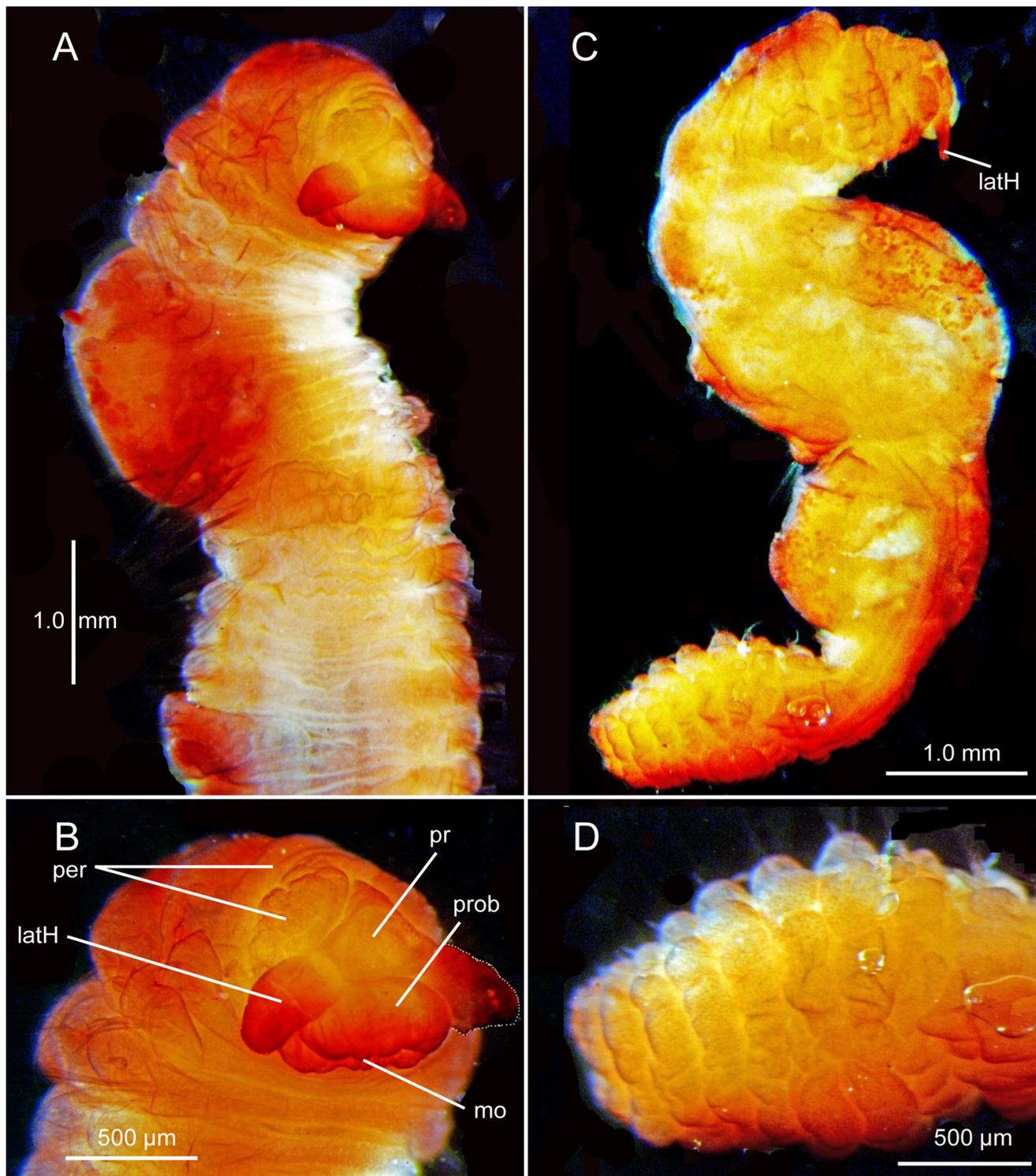


Figure 3. *Axiokebuita australis* sp. nov. (A) Anterior two thirds of holotype, lateral view; (B) detail of pre-setiger region of same; (C) entire paratype in dorsolateral view; (D) posterior end, right lateral view. A, B, holotype (AM W.52681); C, D, paratype (AM W.53989). All stained with Shirlastain A.

W.52681) with 22 setigers, 10.55 mm long and about 1.8 mm wide; paratype from Sta. 011 (AM W.53989) with 19 setigers, 8 mm long and 2 mm wide; paratype (AM W.52695) from Sta. 033 complete, but damaged and in two parts, with 19 setigers, about 6 mm long, about 1.2 mm wide (posterior section removed for DNA). Body thick, sausage-shaped; more or less rectangular in cross section (Fig. 3A, C), without dorsal or ventral grooves or ridges along body. Segments with one or

two rows of elevated pads across dorsum; setigers 1–4 with a biannulate pattern (Fig. 4A); most of body with uniannulate segments; ventrally, each anterior and middle segment with one to four annulated rows, these narrow, with separate raised pads indistinct, appearing more or less as single elevated ridge; posteriorly ventral surfaces with a single row of raised pads more or less continuous with dorsal rows (Fig. 3C, D). Colour in alcohol light tan with no pigmentation.

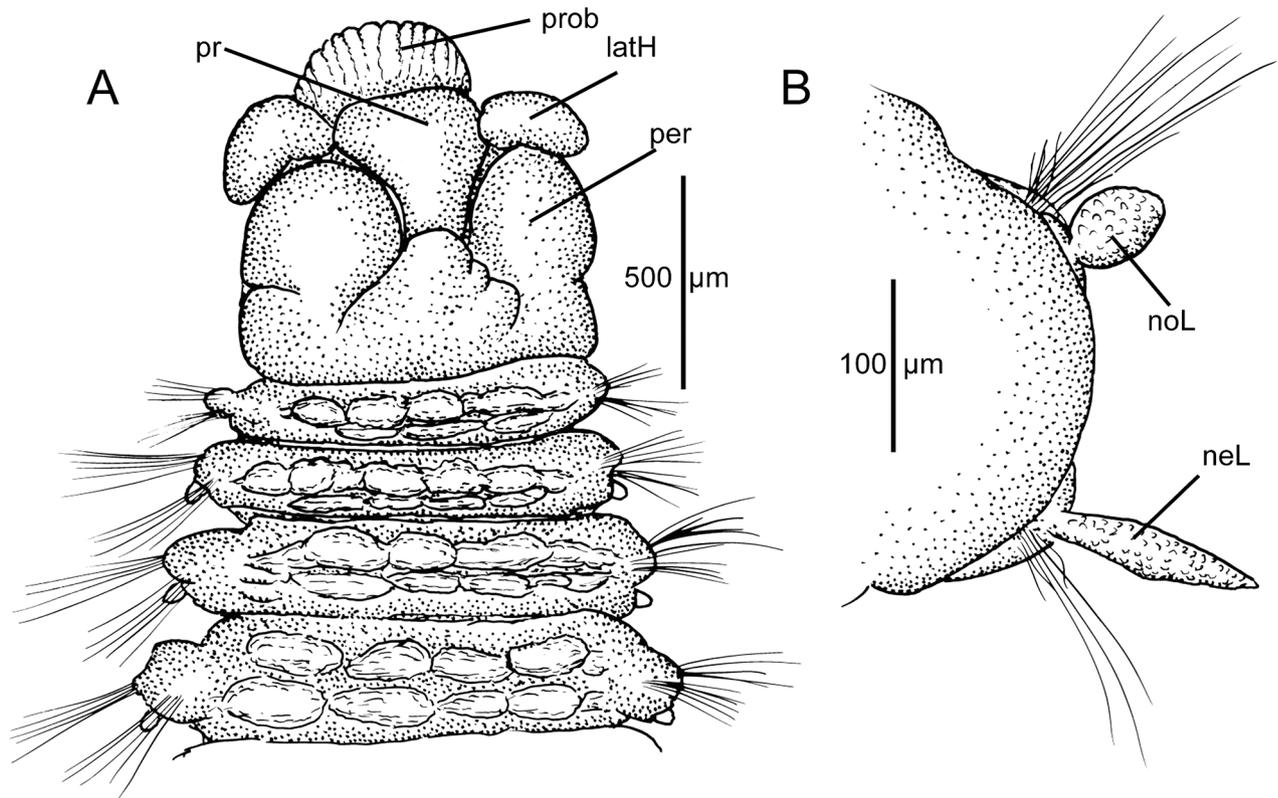


Figure 4. *Axiokebuia australis* sp. nov. (A) anterior end, dorsal view; (B) setiger 9, anterior view. A, paratype (AM W.53989); B, holotype (AM W.52681).

Prostomium pentagonal in shape (Figs 3A, B, 4A), straight across anterior end with two thick lateral horns arising from narrow subterminal sides (Figs 3A, B, 4A), followed by long curving borders meeting mid-dorsally; eyes absent, nuchal organs not observed. Peristomium irregularly encompassing prostomium dorsolaterally (Figs 3A, B, 4A) and surrounding mouth ventrally; proboscis emergent, with numerous elongate lobes surrounding oral opening (Figs 3B, 4A); neck organs observed on paratype (AM W.52695) as a pair of swellings ventrolateral on enlarged oral area; these obscured on holotype and other paratype due to ventral curvature and compression of entire pre-setiger area.

Parapodia reduced to blister-like swellings throughout, with noto- and neurosetae arising from notch on posterior sides. Notopodia with single short, oval to rounded postsetal lamella, this less conspicuous in posterior setigers; neuropodia with an elongate, fingerlike lamella; both lamellae from setiger 2 or 3 continuing to posterior end (Fig. 4B). Setae all thin capillaries in spreading fascicles throughout; furcate setae not observed. Notosetae long, with up to 35–45 per fascicle.

Pygidium a simple plate composed of 6–8 thickened lobes surrounded anal opening (Fig. 3D).

Remarks. *Axiokebuia australis* sp. nov. is most similar to *A. millsii*, the type-species, in lacking papillated pygidial lobes. Specimens of *A. millsii* from off New England in bathyal depths were observed as part of a separate study (Blake in preparation) to have a fusiform-shaped body, two large non-papillated lobes around the anal opening, and 2–3 rows of annulated pads along the body; these observations agree with the published observations of Pocklington and Fournier

(1987) from off Nova Scotia. In contrast, *A. australis* sp. nov. has a sausage or grub-shaped body, 6–8 small lobes around the anus, and two annulated rows of pads on setigers 1–4 but only a single row along the rest of the body.

Etymology. The epithet is from the Latin *australis*, in reference to the Australian and Southern Hemisphere location of this species.

Biology. Holotype (AM W.52681) and paratype (AM W.53989) with numerous oocytes in coelom measuring 80–100 μm in diameter.

Distribution. Continental slope and abyssal plain off SE Australia, Tasmania and Victoria, 2793–4064 m.

Genus *Oligobregma* Kudenov and Blake, 1978

Type species. *Pseudoscalibregma aciculata* Hartman, 1965. Designated by Kudenov & Blake (1978).

Diagnosis. Body elongate and arenicoliform with rows of elevated pads on dorsal and ventral segmental surfaces. Prostomium T-shaped with two prominent frontal horns; eyes present or absent; nuchal organs present. Peristomium achaetous, surrounding prostomium dorsally and forming upper and lower lips of mouth ventrally. Branchiae absent. Parapodia with well-developed dorsal and ventral cirri; interramal papilla present or absent. Capillaries present in all parapodia; furcate setae present anterior to capillaries from an anterior setiger: 2, 3, 4 or later; some species with short, slender, blunt, or pointed spinous setae anterior to

Table 2. Morphological comparison of 17 known species of *Oligobregma*. Abbreviations: *Ant*, anterior; *Atl*, Atlantic; *CCZ*, Clarion-Clipperton Zone; *intPap*, interramal papilla; *N*, north; *NeuroC*, neuropodial cirri; *NotoP*, notopodia; *NotoC*, notopodial cirri; *NeuroP*, neuropodia; *NW*, northwest; *Pap*, papilla; *Post*, posterior, *S*, south; *SE*, southeastern; *Set*, setiger; *W*, western.

| species | anterior setigers with acicular spines | prostomium | first furcate setae | segmental annulation patterns | posterior parapodia | pygidium | distribution & references |
|---|---|---|---------------------|--|---|-------------------------|---|
| species with acicular spines on setigers 1–2 | | | | | | | |
| <i>O. aciculata</i> (Hartman, 1965) | Both rami; spines hirsute | 2 short rounded frontal lobes | ?Set 3 | Not reported | NotoC short, rounded; NeuroC, triangular, pointed; with interramal Pap | Unknown | W North Atl, abyssal, 4850 m; Hartman, 1965 |
| <i>O. oculata</i> Kudenov & Blake, 1978 | Both rami | T-shaped, with digitiform lateral lobes | Set 3 | Set 1 smooth; Set 2 biannulate; Set 3 triannulate; rest with 4 or 5 annulations | NotoC narrow, as long as wide; NeuroC digitate, 3 times as long as wide; large intPap | “At least” 2 anal cirri | S of New Caledonia, 57 m; Kudenov & Blake, 1978 |
| <i>O. pseudocollare</i> Schüller & Hilbig, 2007 | NotoP only | With 2 laterally directed rounded lobes | Set 3 | Set 1–3 smooth; Set 4–9 tri- to quadriannulate, thereafter with 5 annulations | Short conical dorsal and ventral cirri | No cirri observed | Southern Ocean; Scotia and Weddell Seas, 753–3050 m; Schüller & Hilbig, 2007 |
| species with acicular spines on setigers 1–3 | | | | | | | |
| <i>O. aristata</i> sp. nov. | Both rami; spines with terminal arista | 2 short forwardly directed lobes; these notched in holotype | Set 5–6 | Set 1 a single large medial pad; set 2 uniannulate; set 3–4 triannulate; set 5–10 inflated, obscured; set 11–22 tri- to quadriannulate | NotoC large, inflated, with nipple-like tip directed dorally; NeuroC asymmetrical, nipple-like tip directed laterally | Unknown | Off Australia lower continental slope and abyssal depths, 2793–4031 m; This study |
| <i>O. collare</i> (Levenstein, 1975) | NotoP only; spines hirsute | 2 short forwardly directed rounded lobes | Set 4 | Set 1–2 smooth; set 3 to mid- body triannulate; post set quadriannulate | NotoC short, bluntly triangular; NeuroC short, conical; with interramal Pap | Up to 8 cirri | Southern Ocean, Antarctica, 1622–6070 m; Levenstein, 1975; Blake, 1981 |
| <i>O. mucronata</i> Blake, 2015 | Both rami; spines w/ terminal arista | 2 short, forwardly directed rounded lobes | Set 4 | Set 1–2 uniannulate; set 3, biannulate; set 4 and following quadriannulate | NotoC large, triangular, NeuroC large, triangular, with broad base; with interramal Pap | 4 anal cirri | East Antarctic Peninsula, 323–912 m; Blake, 2015 |
| <i>O. notiale</i> Blake, 1981 | NotoP only | 2 enlarged, diverging lateral lobes | Set 4 | Set 1 smooth to irregular; rest quadriannulate | NotoC large inflated lobe; NeuroC small, conical lobe; with large interramal Pap | 5 ventral cirri | Southern Ocean, Antarctica, 18–923 m; Blake, 1981 |
| <i>O. profunda</i> sp. nov. | Both rami of first row; rarely in second row of set 1; NeuroP of set 1–2, rarely 3; first row only. | 2 short rounded lobes, subapical | Set 5–6 | Set 1–3 smooth; set 4–end tri- to quadriannulate | NotoC and NeuroC erect; triangular with pointed tips | 4 anal cirri | Off eastern Australia, Tasmania to New South Wales, 3881–4176 m. This study. |

... continued next page

Table 2. (continued from previous page).

| species | anterior setigers with acicular spines | prostomium | first furcate setae | segmental annulation patterns | posterior parapodia | pygidium | distribution & references |
|--|---|--|---------------------|---|--|------------------------------|---|
| species with acicular spines on setigers 1–3 (continued) | | | | | | | |
| <i>O. renuncula</i> sp. nov. | NotoP spines in 2 rows set 1–2; first row only set 3; NeuroP, set 1–2, spines and caps both rows; set 3 all caps. | 2 short frontal horns, absent in juvs | Set 5 | Set 1–4 two rows, set 5–13 triannulate, set 14–28 with 3–4 rows. | NotoC and NeuroC triangular, with narrow rounded tips; with numerous elongate glands | 4 anal cirri | Off eastern Australia, NSW to Queensland, Coral Sea, abyssal 4005–4280 m. |
| <i>O. tasmania</i> (Kirkegaard, 1996) n. comb. | Both rami; set 1–2 with 2 rows spines; set 3 with 1 row spines & 1 row caps | 2 rounded lateral lobes | Set 4 | Not reported but Fig. 6a shows triannulate anteriorly; quadriannulate posteriorly. | Not reported, but distinct parapodia and short rounded lobes in Fig. 6a. | No cirri observed | Tasman Sea, NW of New Zealand, 3710–3830 m; Kirkegaard, 1996: fig. 6a–d |
| species with acicular spines on setigers 1–4 | | | | | | | |
| <i>O. bathyala</i> sp. nov. | NotoP rami; set 1–3 neuroP; spines hirsute, aristate | 2 short forwardly directed frontal lobes | Set 4–5 | Set 1, uniannulate; set 2–3, biannulate; set 4–13 triannulate; set 14–28 quadriannulate | NotoC asymmetrical, triangular with rounded tip; NeuroC asymmetrical, directed anteriorly, nipple-like tip; with internal tubular glands | 4 anal cirri | Off SE Australia, 2694–2774 m; This study |
| <i>O. brasierae</i> Wiklund <i>et al.</i> , 2019 | Both rami; spines hirsute | 2 large lateral rounded lobes | Set 5 | Ant smooth; Post quadriannulate | NotoC conical with broad base; NeuroC similar; with interramal Pap | “A few anal cirri” | N Equatorial Pac, CCZ, 4425 m; Wiklund <i>et al.</i> , 2019 |
| <i>O. lonchochaeta</i> Detinova, 1985 | Both rami; spines w/ expanded tip & terminal arista | 2 large thickened lateral lobes | Mid-body set | Set 1–4 triannulate; rest not reported | Not reported | Unknown | N Atlantic, Reykjanes Ridge; S of Iceland, 2930–2951 m; Detinova, 1985 |
| <i>O. quadrispinosa</i> Schüller & Hilbig, 2007 | NotoP only | T-shaped with 2 elongate, curved lateral lobes | Set 5 | Ant quadriannulate; post with 5 annuli | NotoC short, triangular, asymmetrical; NeuroC, long, triangular, tapering | “at least” 2 long anal cirri | Southern Ocean; Scotia and Weddell Seas, 2258–4069 m; Schüller & Hilbig, 2007 |
| <i>O. simplex</i> Kudenov & Blake, 1978 | Both rami | T-shaped with 2 thick, conical lateral lobes | Set 6 | Set 1–2 smooth; 3–4 biannulate; 5–15 quadriannulate | NotoC conical, thick pointed; NeuroC digitiform, narrow, 3 times longer than wide; with interramal Pap | “at least” 2 anal cirri | Victoria, Australia, Westernport Bay 11 m; Kudenov & Blake, 1978 |
| <i>O. tanai</i> Wiklund <i>et al.</i> , 2019 | NotoP only; spines hirsute, set 4, transitional | 2 short rounded lobes directed anteriorly | Set 5 | Not observed | NotoC short, conical; NeuroC, also short, conical; with interramal Pap | Unknown | N Equatorial Pac, CCZ, 4137–4425 m; Wiklund <i>et al.</i> , 2019 |
| <i>O. whaleyi</i> Wiklund <i>et al.</i> , 2019 | Both rami | 2 short rounded lobes on anterior margin | Set 11 | Ant smooth; mid-body quadriannulate | NotoC short, conical with broad base; NeuroC similar; with interramal Pap | Unknown | N Equatorial Pac, CCZ, 4425 m; Wiklund <i>et al.</i> , 2019 |

capillaries of setigers 1, 2, or 3, representing homologues of furcate setae found on following setigers. Pygidium with four or more anal cirri.

Remarks. With the addition of *O. tasmania*, transferred from *Asclerocheilus*, and four new species described here, there are now a total of 17 known species of *Oligobregma*, which now surpasses *Asclerocheilus* (with 15 species) as the largest genus in the family. Most species of *Oligobregma* are from the deep sea, with 13 of the 17 species reported from lower continental slope or abyssal depths. The morphology and distributions of all 17 species are compared in Table 2.

Oligobregma aristata sp. nov.

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Figs 5–6

Holotype: abyssal plain off New South Wales, eastern Australia, Hunter Marine Park, RV *Investigator*, Sta. 079, coll. 04 June 2017, Brenke sledge, 32.527°S 153.898°E to 30.163°S 153.524°E, 4031 m, Sta. 079 (AM W.53900).

Paratype (1): lower continental slope off Tasmania, eastern Australia, Freycinet Marine Park, RV *Investigator*, Sta. 11, coll. 19 May 2017, box core, 41.721°S 149.125°E, 2793 m (AM W.52683).

Description. Holotype mostly complete, missing pygidial segment, with 23 setigers, 13.6 mm long, 1.3 mm wide across first four anterior setigers, 2.32 mm wide across expanded middle setigers. Paratype smaller but incomplete, with middle segments removed for DNA analysis. Setigers 1–4 narrow (Fig. 5A, B), body expanded from setigers 5–10 then narrowing to posterior end. Body with transverse rows of raised pads best observed on setigers 1–4 (Fig. 5A, B) and 11–22; pads in 4–5 rows on expanded middle segments, but obscured by stretching, best seen ventrally. Dorsally, setiger 1 with a single enlarged medial dorsal pad; setiger 2 with a row of large pads; setigers 3–4 with three transverse rows of pads (Fig. 5A); setigers 11–22 with 3–4 narrow transverse rows of pads. Ventrally with a single transverse pad on setiger 1, setigers 2–3 with three rows of pads; setiger 4 with two rows of pads (Fig. 5B); prominent mid-ventral ridge extending from setiger 1 to end; ridge interrupts transverse rows of pads at each segmental boundary (Fig. 5B). Branchiae absent; posterior end not present on either specimen. Colour in alcohol, opaque white.

Prostomium broadly curved across anterior margin, weakly expanded laterally, dorsally narrowing posteriorly producing V-shape (Fig. 5A); merging with narrow peristomium; with two short, rounded lobes emerging subapically from anterior margin and extending forward forming a pair of short frontal horns (Fig. 5A, B), both horns with groove or notch producing weak bilobed appearance (Fig. 5A, B); eyes absent; nuchal organs visible as numerous fine cilia between posterior lateral margin of prostomium and narrow peristomial ring. Peristomium a single ring (Fig. 5A), dorsally merging with posterior margin of prostomium and ventrally forming lips of mouth with two anterior lobes, two lateral lobes, and about eight short narrow posterior lobes or papillae (Fig. 5B).

Parapodia with short, conical-shaped podial lobes from setigers 1–10, from setiger 11 lobes becoming longer,

developing prominent dorsal and ventral cirri (Fig. 6A); dorsal cirri broad, globular, tapering to nipple-like rounded tip directed dorsally (Fig. 6B); ventral cirri asymmetrical with broad basal attachment bearing anteriorly directed nipple-like tip (Fig. 6C); both dorsal and ventral cirri with lattice-like glandular cells encompassing entire cirrus and nipple-like tips; rounded button-like interramal papilla present (Fig. 6A), cilia not observed.

Heavy curved acicular spines present in both noto- and neuropodia of setigers 1–3 (Fig. 5A, B); notopodia of setigers 1–2 with 4–5 spines in first and second rows and 2–3 long capillaries in second row, setiger 3 with 3–4 spines in first row and all capillaries in second row. Neuropodia of setigers 1–2 with 3–4 spines in anterior and posterior rows, accompanied by a few capillaries; setiger 3 with 3–4 spines in first row and all capillaries in second row. Setiger 4 with all capillaries in two rows of both noto- and neuropodia. Individual spines curved, narrowing to pointed tip bearing distinct arista (Figs 5C, D, 6D). Short spinous setae anterior to heavy spines or capillaries absent. Furcate setae short, first present from setiger 5 anterior to long capillaries; furcate setae of posterior setigers longer, spine-like, more numerous, ten or more per noto- and neuropodium (Fig. 6A). Furcate setae with long unequal tynes bearing short bristles tween tynes (Figs 5A, 6E).

Remarks. *Oligobregma aristata* sp. nov. differs from other species off eastern Australia in having anterior acicular spines with an aristate-like tip. In addition, the short frontal horns of the holotype are distinctly notched or weakly bifid and the dorsal and ventral cirri of posterior parapodia are inflated and have nipple-like tips. Such frontal horns and dorsal and ventral cirri have not been observed previously in other scalibregmatids. The only other species of *Oligobregma* reported with aristate acicular spines is *O. mucronata* Blake, 2015 from the East Antarctic Peninsula in upper slope or bathyal depths less than 1000 m. However, *O. mucronata* has triangular-shaped dorsal and ventral cirri that taper to pointed tips instead of swollen asymmetrical cirri with nipple-like tips.

Etymology. The epithet is from *arista*, Latin for long pointed awn (of grasses) or ear; in reference to the pointed tip of the acicular spines of this species.

Distribution. Off eastern Australia lower continental slope and abyssal depths, 2793–4031 m.

Oligobregma bathyala sp. nov.

urn:lsid:zoobank.org:act:443CCA0A-F368-4BC0-AA42-CE42A5FF4046

Figs 7–8

Holotype: off eastern Australia, between Victoria and Tasmania, near Bass Strait Marine Park, RV *Investigator*, Sta. 023, coll. 22 May 2017, Brenke sledge, distance, 2.7 km, 39.462°S 149.277°E, to 39.465°S 149.246°E, 2774–2694 m (AM W.52686). **Paratypes (2):** same data as holotype (AM W.52687 and W.52688). **Juveniles (2):** off Tasmania, Freycinet Marine Park, Sta. 005, coll. 18 May 2017, Brenke Sledge, distance 2.8 km, 41.730°S 149.135°E, to 41.753°S 149.147°E, 2789–2779 m (2, AM W.53991).

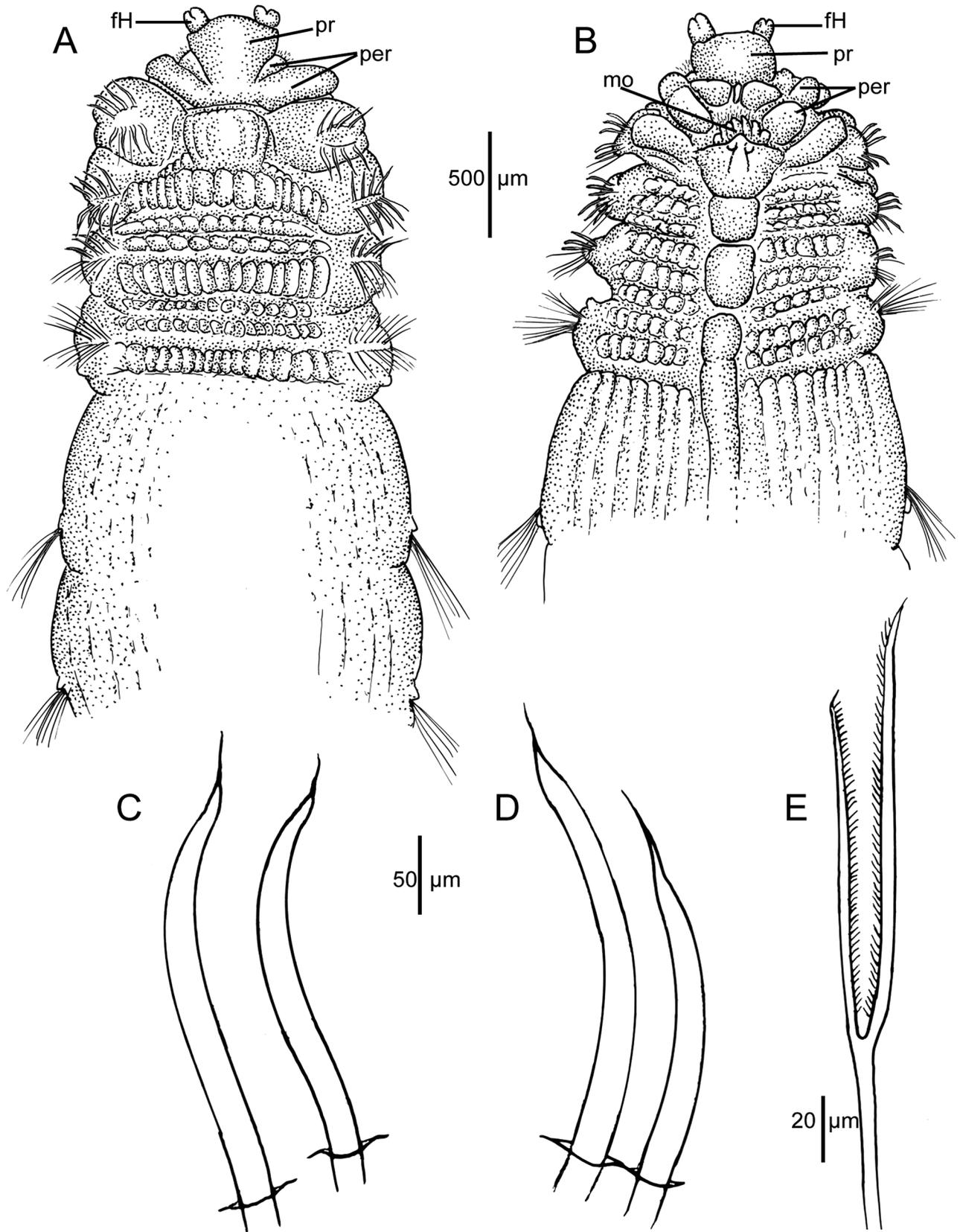


Figure 5. *Oligobregma aristata* sp. nov. Holotype (AM W.53990): (A) anterior end, dorsal view; (B) anterior end, ventral view; (C) notopodial acicular spines, setiger 1; (D) notopodial acicular spines, setiger 2; (E) furcate seta, setiger 19.

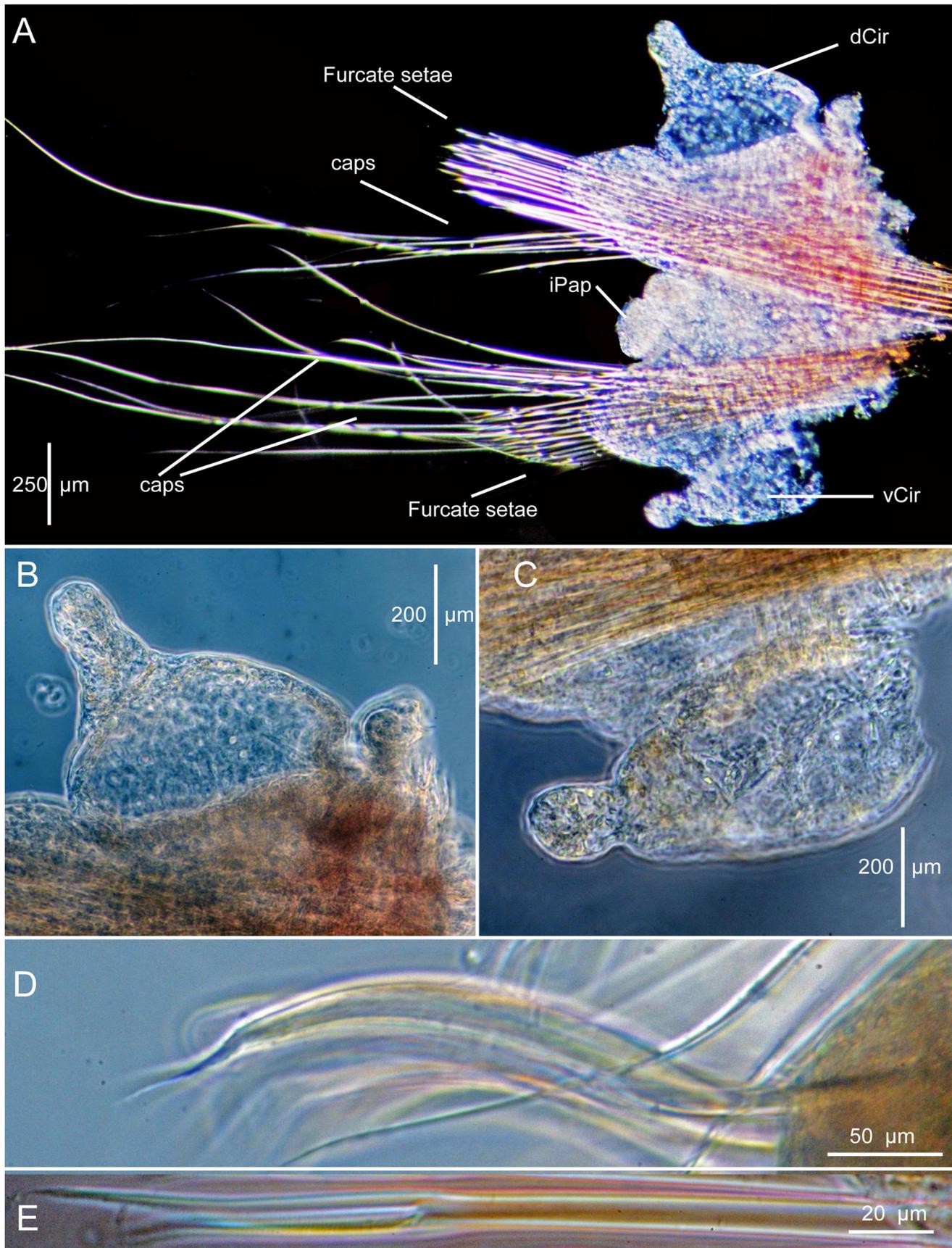


Figure 6. *Oligobregma aristata* sp. nov. Holotype (AM W.53990): (A) parapodium, setiger 19, anterior view; (B) dorsal cirrus, setiger 19; (C) ventral cirrus, setiger 19; (D) notopodial acicular spine, setiger 2; (E) furcate seta, setiger 19. A–D, stained with Shirlastain A.

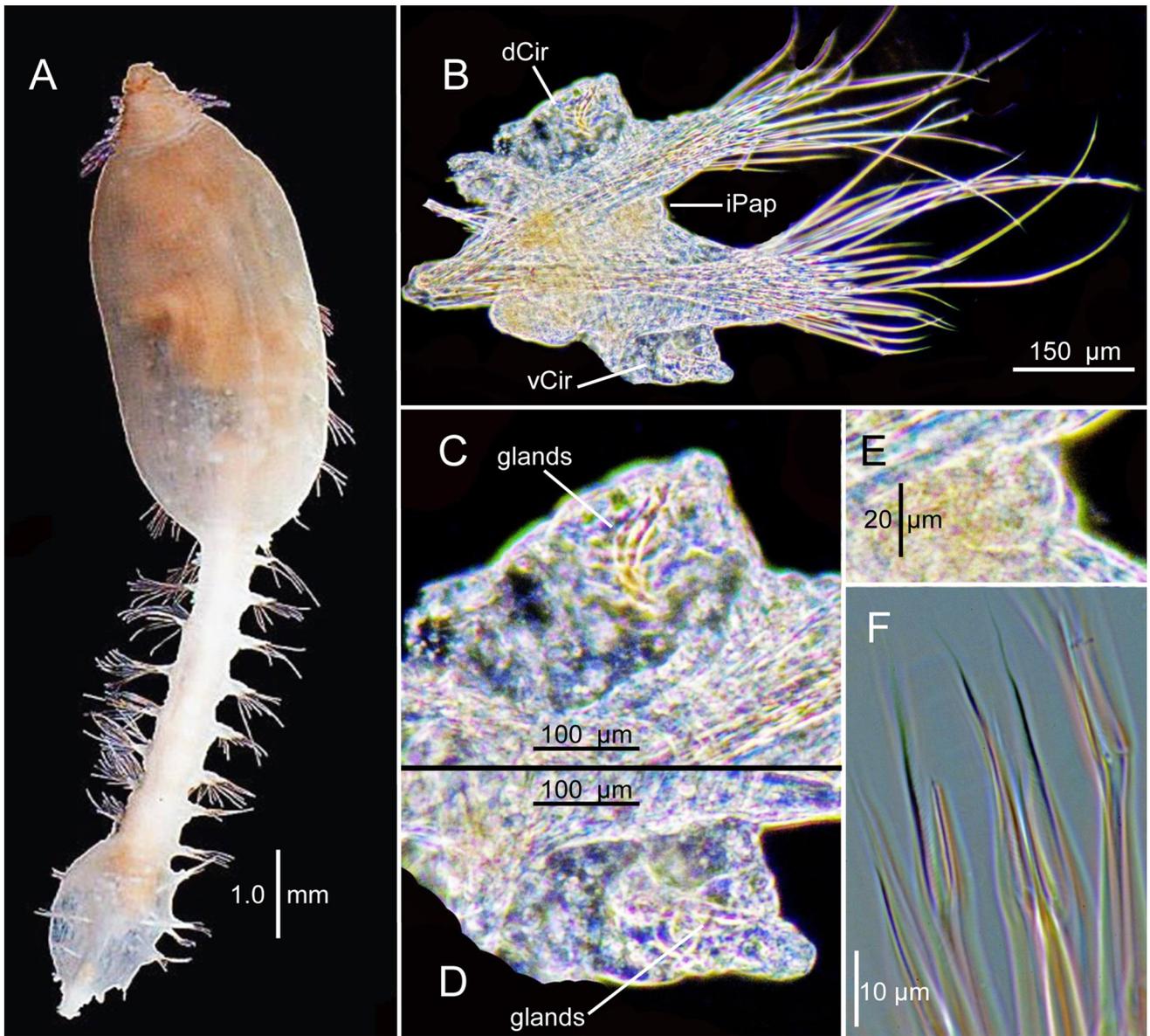


Figure 7. *Oligobregma bathyala* sp. nov. (A) anterior end, dorsal view; (B) posterior end, dorsal view; (C) notopodial acicular spines, setiger 2; (D) neuropodial acicular spines, setiger 2; (E) furcate seta. A, C, D, paratype (AM W.52688); B, E, paratype (AM W.52687).

Description. Three type specimens from Sta. 023 all complete: holotype (AM W.52686) with 28 setigers, 12.2 mm long, 2.8 mm wide across expanded anterior section; 0.6 mm wide across narrow posterior section, and 1.4 mm wide across far posterior pre-pygidial expanded section; paratype (AM W.52687) with 28 setigers, 12 mm long, 2.8 mm wide across expanded anterior section and 0.8 mm wide across narrow posterior section; paratype (AM W.52688) with 26 setigers, 12 mm long, 2.2 mm wide across expanded anterior section and 0.4 mm wide across narrow posterior section.

Setigers 1–4 narrow, with prominent parapodia and setal fascicles (Fig. 7A); setigers 5–14 expanded, parapodia reduced to short lobes (Fig. 8A); dorsal and ventral cirri developed by setiger 14; setigers 15–28 narrow with prominent parapodia and cirri, five pre-pygidial segments of holotype also expanded (Fig. 8A), but not on paratypes. Body with transverse rows of raised pads (Fig. 7A): setiger 1 with one row, setigers 2–3 with two rows, setiger 4 with one row, setigers 5–13 with three rows, but mostly obscured

in expanded segments; setigers 14–28 with four transverse rows of pads. Venter with similar transverse pad pattern, but interrupted by mid-ventral ridge from about setiger 2, ridge initially a low, rounded elevation, becoming narrow and conspicuous in posterior setigers after expanded section; this ridge with breaks or creases where transverse rows of pads occur. Branchiae absent. Colour in alcohol, light tan.

Prostomium broadly curved across anterior margin, expanded laterally, merging posteriorly with narrow peristomium; with two short, rounded frontal horns emerging subapically from anterior margin (Fig. 7A); eyes absent; nuchal organs as grooves between posterior lateral margin of prostomium and peristomium, cilia not observed. Peristomium a lobed ring surrounding prostomium dorsally and laterally (Fig. 7A), ventrally surrounding mouth as single anterior ridge and about eight elongate ventral and lateral lobes; proboscis a relatively smooth sac everted on both paratypes (Fig. 7A).

Parapodia with short conical lobes on setigers 1–13, from

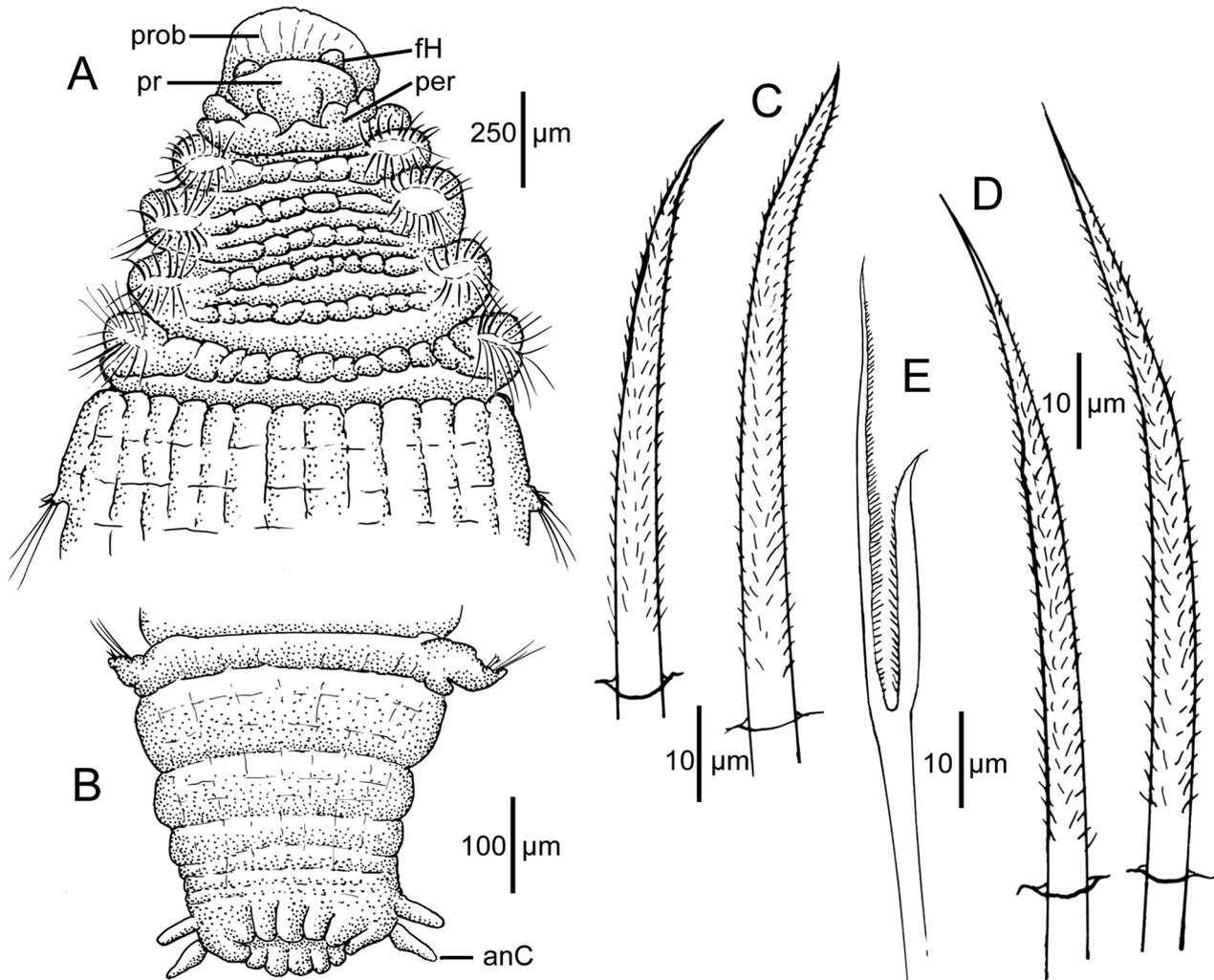


Figure 8. *Oligobregma bathyala* sp. nov. (A) entire worm, dorsal view (from life); (B) parapodium setiger 17, anterior view; (C) dorsal cirrus, setiger 17; (D) ventral cirrus, setiger 17; (E) interramal papilla from setiger 17; (F) furcate seta, setiger 17. A, holotype (AM W.52686); B–F, paratype (AM W.52687). A, in life photo taken at sea by Ms Karen Gowlett-Holmes.

setiger 14 lobes becoming longer, developing prominent dorsal and ventral cirri (Fig. 8B); dorsal cirri directed dorsolateral, asymmetrical, triangular-shaped, terminating with short rounded tip (Fig. 8C); ventral cirri directed ventrolateral, asymmetrical with broad basal attachment and short nipple-like tip (Fig. 8D); both dorsal and ventral cirri with darkly pigmented tubular glands directed towards tips (Fig. 8C, D); ciliated rounded button-like interramal papilla present (Fig. 8E).

Heavy curved acicular spines present in both noto- and neuropodia of setigers 1–3 and a few in notopodia of setiger 4; notopodia of setigers 1–2 with 8–9 spines in first and second rows and 2–3 long capillaries in second row, setiger 3 with 5–7 spines in first row and all capillaries in second row, setiger 4 with a few narrow spines with capillaries in first row and all capillaries in second row. Neuropodia of setigers 1–2 with 5–7 spines in anterior and posterior rows, accompanied by a few capillaries in second row; setiger 3 with 3–4 spines in first row and all capillaries in second row. Setiger 4 with all capillaries in two rows. Individual spines curved, narrowing to pointed tip or more elongated capillary tip; shaft of spines hirsute with numerous fibrils present along shaft (Fig. 7C, D). Short spinous setae anterior to heavy spines present on

notopodia of setigers 2–3. Furcate setae short, first present on setiger 4 or 5 anterior to long capillaries; furcate setae of posterior setigers longer, spine-like, more numerous with ten or more per noto- and neuropodia. Furcate setae with long unequal tynes bearing short bristles between tynes (Figs 7E, 8F).

Pygidium with terminal anus surrounded by about 12 lobes; four short anal cirri present (Fig. 7B).

Remarks. By having a few anterior acicular spines on setiger 4, and all spines of setigers 1–4 hirsute, *Oligobregma bathyala* sp. nov. has some similarity to *O. brasierae* Wiklund *et al.*, 2019 from the Clarion Clipperton Zone (CCZ), which also has acicular spines on setigers 1–4. The two species while both occurring in deep-water Pacific habitats, differ in the following respects. *Oligobregma bathyala* sp. nov. has short, rounded frontal horns that are subterminal and directed anteriorly, the posterior noto- and neuropodial cirri are broad basally, asymmetrical, and bear internal tubular glands, and the peristomium consists of a single ring with several dorsal and lateral lobes. In contrast, *O. brasierae* has large rounded frontal horns that are located anterolateral on the prostomium, the posterior noto- and neuropodial cirri are more erect and

not asymmetrical and bear internal glands that are not tubular, and the peristomium is a single smooth ring without lobes.

The only previously described species of *Oligobregma* reported with tubular-shaped glands in the noto- and neuropodial cirri is *O. mucronata* Blake, 2015 from the east Antarctic Peninsula. However, *O. mucronata* has acicular spines limited to setigers 1–3 instead of 1–4; the posterior cirri are more erect, not as asymmetrical, and have more of the tubular glands than *O. bathyala* sp. nov. In addition, the acicular spines of *O. mucronata* are distinctly aristate instead of a mix of spines having pointed to long, capillary tips.

Biology. A few isolated eggs measuring 95–100 µm in diameter are present in the holotype and one paratype (AM W.52699).

Etymology. The epithet is from the Greek, *bathys* for deep.

Distribution. Lower continental slope off SE Australia, 2694–2774 m.

Oligobregma profunda sp. nov.

urn:lsid:zoobank.org:act:B9DFDE17-E4E4-4D49-AFEC-6F859216F187

Figs 9–10

Holotype: abyssal plain off eastern Australia, New South Wales, Hunter Marine Park, RV *Investigator*, Sta. 079, coll. 04 June 2017, Brenke sledge, 32.527°S 153.898°E to 30.163°S 153.524°E, 4031 m (AM W.53992). **Paratypes** (131): same data as holotype (40, W.52698);—off Tasmania, Freycinet Marine Park, Sta. 009, coll. 19 May 2017, Brenke Sledge, distance 4.2 km, 41.626°S 149.560°E, to 41.662°S 149.149°E, 4021–4035 m (1, W.52678; 4, W.52680);—between Victoria and Tasmania, Flinders Marine Park, Sta. 016, coll. 21 May 2017, Brenke Sledge, distance 4.3 km, 40.463°S 149.415°E, to 40.461°S 149.364°E, 4129–4131 m (13 W.52685);—between Victoria and Tasmania, Bass Strait Marine Park, RV *Investigator*, Sta. 031, coll. 23 May 2017, Brenke sledge, 39.422°S 149.604°E to 39.391°S 149.597°E, 4150–4170 m (3, W.52690; 57, W.56291; 3, W.56292; 2, W.56293);—off SE Victoria, East Gippsland Marine Park, RV *Investigator*, Sta. 33, coll. 24 May 2017, Brenke sledge, 38.521°S 150.213°E to 38.498°S 150.207°E, 4107–4064 m (1, W.52694);—off SE New South Wales, Jervis Marine Park, RV *Investigator*, Sta. 54, 28 May 7 2017, Brenke Sledge, 38.117°S 151.473°E to 35.099°S 151.455°E, 4026–3881 m (7, W.53993). All in the Australian Museum.

Description. Holotype complete with 27 setigerous segments, 10.5 mm long, 0.35 mm wide across prostomium, 0.6 mm wide across setiger 1, and 1.45 mm wide across expanded setigers; complete paratype with 29 setigers (AM W.53992), 11.9 mm long, 1.0 mm wide across anterior setigers and 2 mm wide across expanded middle setigers. Body narrow over first four setigers (Figs 9A, 10A), then expanded through next 6–8 setigers, thereafter abruptly narrowing to posterior end (Fig. 10A), but sometimes with a few far posterior setigers again becoming expanded. Colour in alcohol opaque white, without body pigment.

Body segments with transverse annular rows of weakly raised pads; all setigers from 2–5 with 3–4 annular rings, best observed in middle and posterior segments (Fig. 10B); setigers 1–3 and swollen segments with annular rings and

raised pads not readily apparent. Venter with prominent ventral raised midline from setiger 1 continuing along entire body; this ridge appearing lumpy where it crosses over annular rings. Branchiae absent. Pygidium of holotype elongate with four short anal cirri and six short lobes surrounding anal opening (Fig. 9C).

Prostomium broadly curved across anterior margin, weakly expanded laterally, V-shaped dorsally, narrowing posteriorly, interrupting peristomial rings and extending onto dorsal surface of setiger 1 (Fig. 9A); with two short, rounded lobes emerging subapically from anterior margin and extending forward forming short frontal horns (Figs 9A, 10B); horns sometimes merged with lateral anterior prostomial margins; eyes absent; nuchal organs narrow slits along posterior margins anterior to peristomium. Peristomium a double-lobed ring surrounding prostomium dorsally and laterally, ventrally surrounding mouth with circle of raised lobes (Fig. 9B). Short proboscis everted on some specimens, each with numerous papillae on anterior end.

Parapodia with short, conical-shaped podial lobes in anterior third of body, becoming longer posteriorly; dorsal and ventral cirri present from setiger 14 on holotype, these podial lobes inconspicuous anteriorly, becoming longer and more prominent posteriorly (Fig. 10A, B); dorsal cirri triangular, broad, basally tapering to narrow pointed tip (Fig. 10C); ventral cirri asymmetrical, with broad basal attachment narrowing to rounded tip (Fig. 10C); dorsal cirri more erect than ventral cirri; both dorsal and ventral cirri with a few internal tubular-shaped glands extending toward nipple-like tips; button-like interramal papilla present (Fig. 10C), cilia not observed.

Heavy curved acicular spines present in both noto- and neuropodia of setigers 1–3 (Fig. 9A); notopodia of setigers 1–2 with 6–8 spines in first row and long capillaries in second row, setiger 3 with 3–4 spines in first row and capillaries in second row; largest specimens sometimes with 1–2 spines also in second row of setiger 1. Neuropodia with 3–5 spines in anterior row in setigers 1–2, accompanied by posterior row of capillaries; setiger 3 with 0–3 spines in first row and capillaries in second row. Individual spines curved, narrowing to pointed tip (Figs 9D–E, 10D). Notopodial spines more robust than those of neuropodia. Short spinous setae anterior to heavy spines or capillaries present or absent, if present only on neuropodia of setigers 3–4. Furcate setae short, first present from setiger 5 or 6 anterior to long capillaries in both noto- and neuropodia; furcate setae of posterior setigers longer, spine-like. Both short and long furcate setae with long unequal tyne bearing short bristles between tyne (Figs 9F, 10E); these numbering 3–4 per noto- and neuropodium in anterior segments and 8–10 or more in posterior most segments.

Remarks. *Oligobregma profunda* sp. nov., with anterior acicular spines in both rami of setigers 1–3, is most similar to *O. aristata* sp. nov., *O. mucronata*, and *O. tasmania* n. comb. All are from the southern hemisphere and most from deep water. Of these, *O. aristata* sp. nov. and *O. mucronata* have acicular spines with aristate tips, whereas *O. profunda* sp. nov. and *O. tasmania* n. comb. have spines with blunt or pointed, not aristate, tips. *Oligobregma tasmania* n. comb. is an abyssal species known only from its original account (Kirkegaard, 1996) and several important characters were not

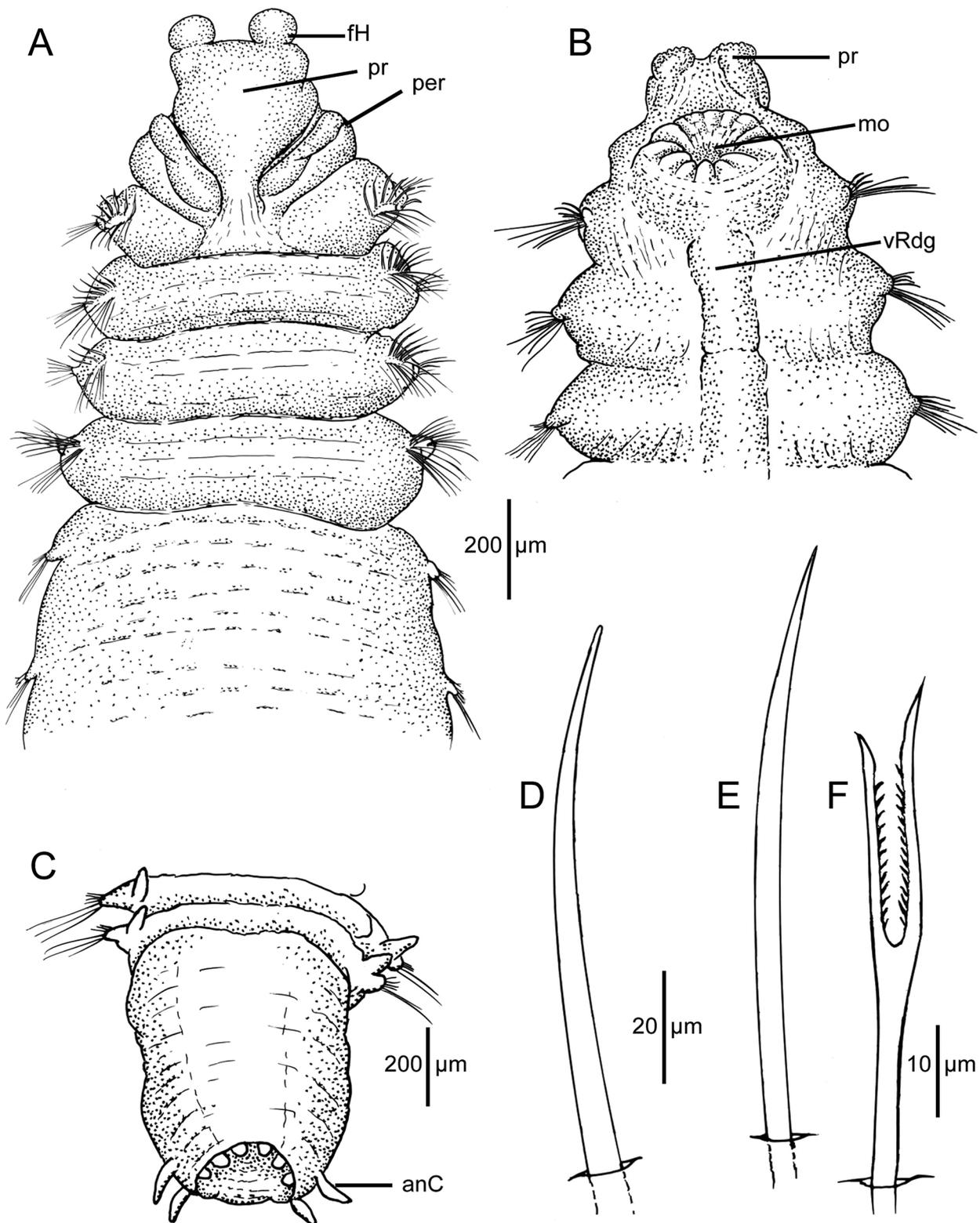


Figure 9. *Oligobregma profunda* sp. nov. (A) anterior end, dorsal view; (B) anterior end, ventral view; (C) posterior end, dorsal view; (D–E) notopodial acicular spines, setiger 2; (F) furcate seta. A, C holotype (AM W.53992); B, paratype (AM W.52691); D–F, paratype (AM W.52698).

mentioned or well-illustrated. However, Kirkegaard (1996: fig. 6a) suggests that the posterior dorsal cirri are low, not erect or prominent and the prostomium as figured suggests that two short lateral horns arise from a narrow prostomial lobe (Kirkegaard, 1996: fig. 6b). In contrast, the dorsal and ventral cirri of *O. profunda* sp. nov. are prominent triangular-

shaped cirri that taper to a pointed tip and the prostomium has two short, rounded frontal horns arising from a broadly curved anterior margin.

Little molecular data is available for species of *Oligobregma*. However, COI sequences were successful for *O. profunda* sp. nov. and diverged about 9% from *O.*

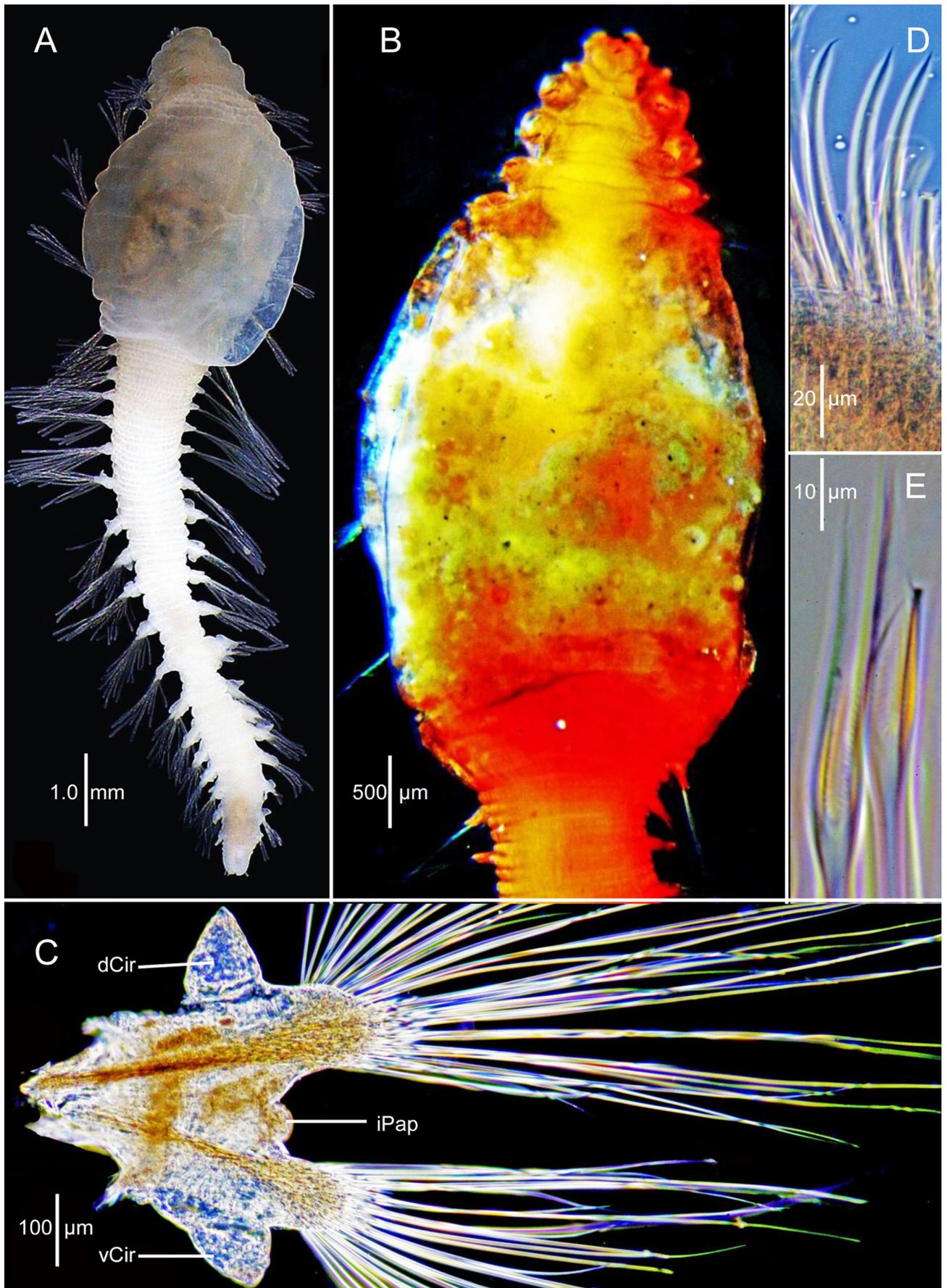


Figure 10. *Oligobregma profunda* sp. nov. (A) Entire worm, dorsal view (from life); (B) anterior half, dorsal view; (C) posterior parapodium, setiger 21, anterior view; (D) acicular spines, setiger 2; (E) furcate setae. A, C, E, holotype (AM W.53992); B–D, paratype (AM W.52698). B, C, stained with Shirlastain A; A, in life photo taken at sea by Ms Karen Gowlett-Holmes.

brasierae and *O. tanai*, two abyssal species from the CCZ. As presented in Table 2, species of *Oligobregma* may be divided into three groups based on the number of anterior setigers having acicular spines. The two CCZ species have acicular spines on setigers 1–4, whereas *O. profunda* sp. nov. has acicular spines on setigers 1–3.

GenBank Accession Number. COI: OP572114.

Etymology. The epithet is from *profundus*, Latin for deep in reference to the deep-sea habitat of this species.

Distribution. Abyssal depths off eastern Australia, Tasmania to New South Wales, 3881–4170 m.

Oligobregma renuncula sp. nov.

urn:lsid:zoobank.org:act:F62F250F-7F71-4473-94DB-3A69C1D3D037

Figs 11–12

Holotype: Abyssal plain, off Queensland, eastern Australia, SW of Fraser Island, Coral Sea, RV *Investigator*, Sta. 110, coll. 11 June 2017, BS, distance 6.1 km, 25.221°S 154.160°E to 25.261°S 154.200°E, 4005–4010 m (AM W.52702). **Paratypes** (20): same data as holotype (18, W.53994);—abyssal plain off Moreton Bay, Queensland, RV *Investigator*, Sta. 103, coll. 10 June 2017, BS, distance 6.8 km, 27.000°S 154.223°E, 27.061°S 154.223°E, 4260–4280 m (1, W.53995);—abyssal plain off New South Wales, eastern Australia, Hunter Marine Park, RV *Investigator*, Sta. 079, coll. 04 June 2017, Brenke sledge, distance 3.6 km, 32.527°S 153.898°E to 30.163°S 153.524°E, 4031 m (1, W.53996). All in Australian Museum.

Description. A small species, holotype complete with 29 setigers, 8.8 mm long, 0.87 mm wide across setiger 4, expanded middle segments 1.4 mm wide; most paratypes smaller, mostly juveniles, largest complete with 23 setigers, 3.45 mm long and 0.45 mm wide across setigers 1–4. Holotype with setigers 1–4 short, 4–5 times wider than long, following segments becoming thicker, about three times wider than long (Fig. 11A), producing sausage-shaped middle section, then narrowing again in posterior half of body. Smaller paratypes and juveniles enlarged and sausage-shaped from about setiger 5–6 (Fig. 12A), then narrowing again in far posterior setigers.

Setigers 1–4 narrow, with reduced parapodia and with setal fascicles appearing to arise from body wall (Figs 11A, 12A); setigers 5–12 expanded, stretched, with short podial lobes (Fig. 12A); developing dorsal and ventral cirri by setiger 13–14; setigers 13–29 narrow with prominent parapodia and cirri (Figs 11C, 12B). Body with transverse rows of raised pads: setigers 1–4 with two rows, setiger 4–13 with three rows, but these mostly obscured in expanded segments; setigers 14–29 with three transverse rows. Venter with setigers 1–3 relatively smooth, with transverse rows of pads first evident from setiger 5, with four rows weakly developed (Fig. 11B). Venter with mid-ventral ridge evident from mid body to posterior end. Branchiae absent. Colour in alcohol, light tan. Body pigmentation not present, but segmental pairs of conspicuous pigmented nephridia observed ventrally from setiger 3 to mid-body (Figs 11B, 12A). These nephridia best observed in smaller paratypes but a few present in holotype.

Prostomium V-shaped or triangular, with anterior margin broadly curved, dorsally tapering to narrow posterior margin, extending over peristomium and merging with setiger 1 (Fig. 11A); ventrally merging with anterior lip of mouth (Fig. 11B); two short frontal lobes or horns arising subterminal from anterior margin of holotype (Fig. 11A); these not developed or present as developing anlage on juveniles or smaller specimens (Fig. 11B); eyes absent; nuchal organs as grooves between posterior lateral margin of prostomium and peristomium, cilia not observed. Peristomium with two narrow rings dorsally and laterally, interrupted mid-dorsally by posterior end of prostomium (Fig. 11A); ventrally dominated by expanded oral area consisting of anterior lip with about five large lobes and posteriorly by numerous narrow lobes forming large posterior lip of mouth (Fig. 11B). Many specimens with short proboscis emergent.

Parapodia from about setiger 13 becoming longer, developing prominent dorsal and ventral cirri (Fig. 12B); dorsal cirri asymmetrical, triangular-shaped, directed dorsolateral, terminating in narrow rounded tip (Fig. 12C); ventral cirri asymmetrical with broad basal attachment, directed ventrolateral (Fig. 12D); both dorsal and ventral cirri with numerous golden-coloured elongate glands directed toward elongated surfaces; each gland internally striated and pigmented (Fig. 12B–D); interramal papilla not observed.

Heavy curved acicular spines present in notopodia of setigers 1–3 and neuropodia of setigers 1–2. Notopodia of setigers 1–2 with 5–6 spines in first and second rows and 2–3 long capillaries in second row, setiger 3 with 5–7 spines in first row and all capillaries in second row; setiger 4 with all capillaries in both rows. Neuropodia of setigers 1–2 with 5–7 spines in anterior and posterior rows accompanied by a few capillaries; setigers 3–4 with all capillaries. Notopodial spines (Fig. 11D) thicker than neuropodial spines (Fig. 11E). Individual spines curved, narrowing to pointed tip, not aristate; not hirsute, but with internal striae within shaft. Short spinous setae anterior to heavy spines absent. Furcate setae first present from setiger 5 anterior to long capillaries; furcate setae with unequal tynes bearing short bristles between tynes (Fig. 12E).

Pygidium of holotype with terminal anus surrounded by about 4–5 large lobes; four short anal cirri present (Fig. 11C). Smaller specimens lacking anal cirri or those present as short emergent anlage of cirri.

Remarks. *Oligobregma renuncula* sp. nov. is unusual among known species of Scalibregmatidae in the presence of prominent darkly pigmented pairs of nephridia clearly visible ventrally of all specimens examined. Details of nephridial morphology are known for *Scalibregma inflatum* through the studies of Danielssen (1859) and Ashworth (1901) and for *Sclerocheilus minutus* Grube, 1863 through work by DeHorne and DeHorne (1913), all summarized by Goodrich (1945). Although pairs of nephridia have been well-studied in these scalibregmatids and are visible in prepared optical sections or by histology, they have not been recorded as being pigmented and conspicuous in general observations.

Ashworth (1901) characterized the nephridia of *Scalibregma inflatum* and presumably all scalibregmatids as consisting of four parts: (1) a small funnel that opens segmentally on the anterior septa and leads to (2) a short tube that connects to (3) a larger and elongated U-shaped tube consisting of two linked parallel ciliated tubes that lead to (4)

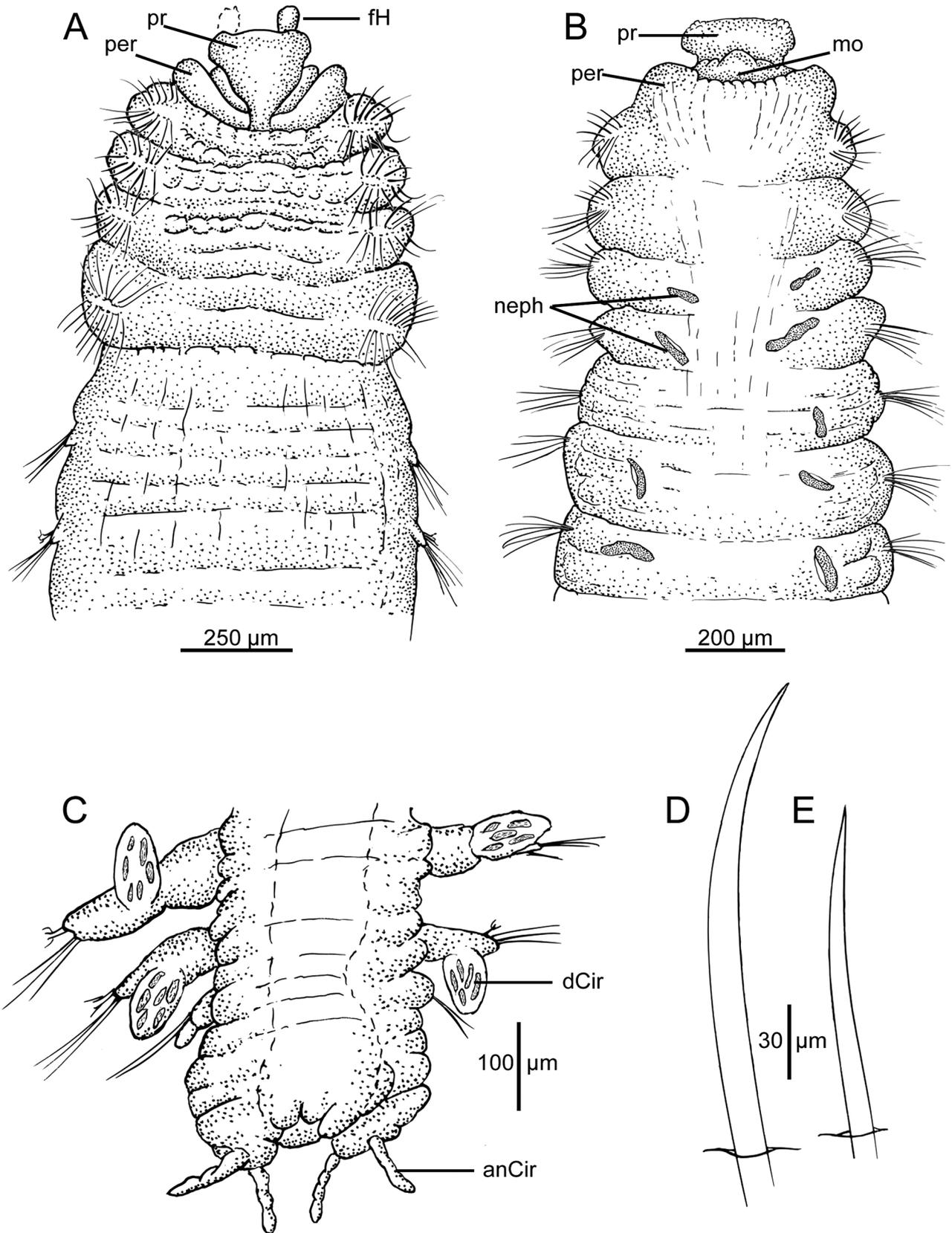


Figure 11. *Oligobregma renuncula* sp. nov. (A) anterior end, dorsal view; (B) anterior end, ventral view; (C) posterior end, dorsal view; (D) notopodial acicular spine from setiger 3; (E) neuropodial spine from setiger 3. A, C, holotype (AM W.52702); B, D, E, paratype (AM W.53994).

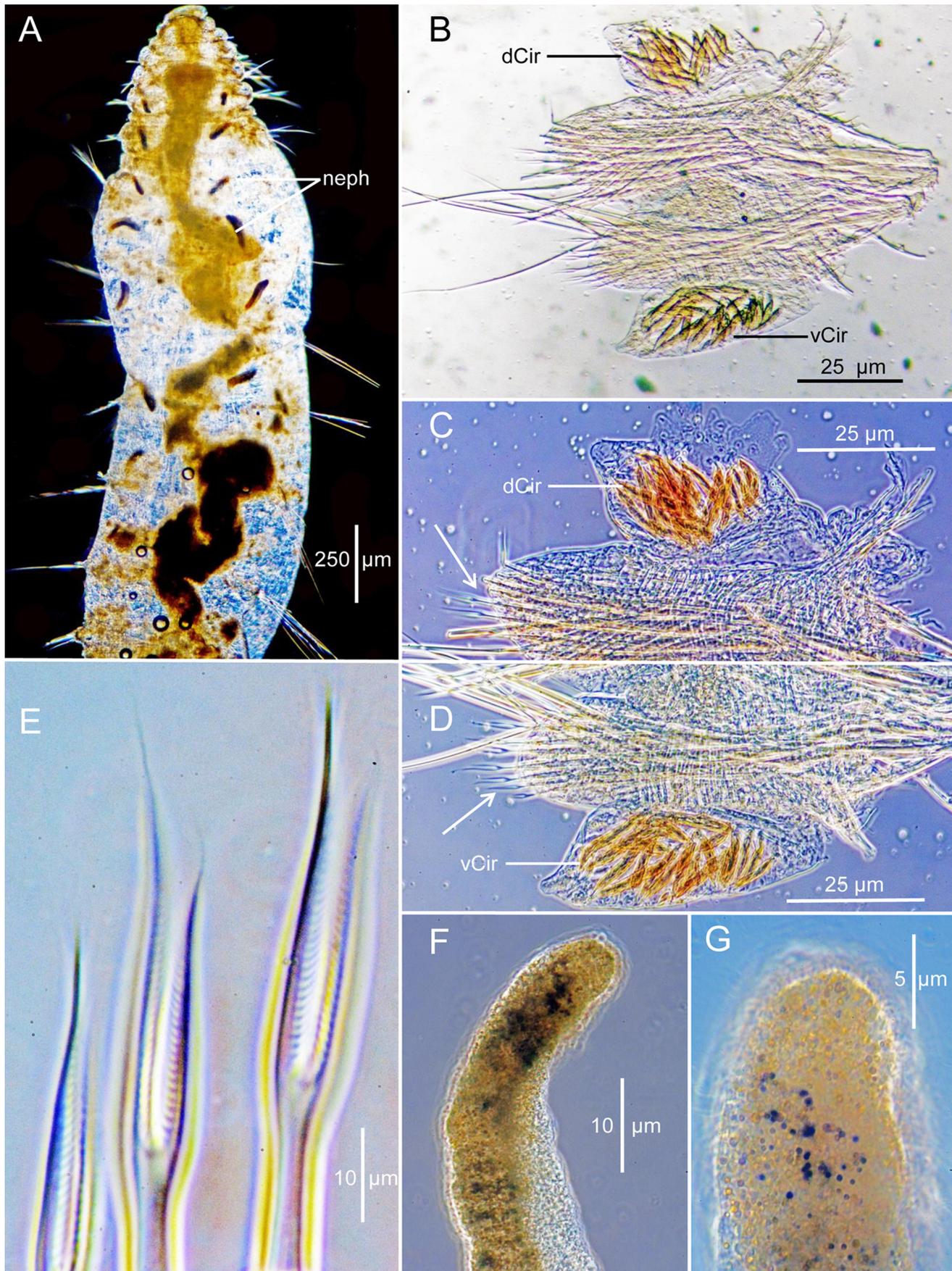


Figure 12. *Oligobregma renuncula* sp. nov. (A) anterior end, dorsal view; (B) setiger 23, anterior view; (C) dorsal cirrus, setiger 23; (D) ventral cirrus, setiger 23; (E) furcate setae from setiger 23; (F) pigmented nephridial loop; (G) detail of nephridial loop showing pigmented granules. A, F, G, paratypes (AM W.53994); B–E, holotype (AM W.52702). Arrows on C and D indicate furcate setae.

the nephridiopore. According to Ashworth (1901) the ciliated U-shaped tube is the only part of the nephridial morphology that is visible without dissection. In *O. renuncula* sp. nov. the visible portion includes the two adhering parts of the U-shaped tube, one part of which is pigmented and the other clear and unpigmented (Fig. 12F). The pigment is contained in numerous minute spherical bodies (Fig. 12G) the nature of which requires histology or electron microscopy (but see below).

In addition to the pigmented nephridia, *O. renuncula* sp. nov. is easily distinguished from the three other deep sea species of *Oligobregma* from off eastern Australia identified in this study by the numerous elongated and internally striated glands present in the dorsal and ventral cirri of posterior parapodia.

Biology. One specimen (AM W.53994) had eggs 130–135 µm in diameter. A detailed examination of the pigmented nephridia from one paratype (AM W.53994) using Phase Contrast optics magnified to 3000× revealed that the pigmented spherical bodies might be sperm nuclei; each sphere is approximately 2.5 µm in diameter; some appear to have an acrosome on one side, but no tail was observed. These observations suggest that the pigmented nephridia might serve as sperm storage organs or possibly spermatophores. Any further study of these unusual structures will require electron microscopy.

Etymology. The epithet is from the Latin, *renis*, for kidney, in reference to the conspicuous pigmented nephridia that characterize this species.

Distribution. Abyssal depths off eastern Australia from New South Wales to Queensland, Coral Sea, 4005–4280 m.

Genus *Pseudoscalibregma* Ashworth, 1901

Type species. *Scalibregma parvum* Hansen, 1879. Designated by Ashworth (1901).

Diagnosis. Body elongate, arenicoliform. Prostomium T-shaped with frontal horns. Peristomium a single ring, encompassing prostomium dorsally and forming upper lip of mouth ventrally; lower lip of mouth formed from elements of peristomium and setiger 1. Parapodia of posterior segments with dorsal and ventral cirri; interramal papillae present; postsetal lamellae absent. Branchiae absent. Setae include capillaries, lyrate setae, and sometimes few inconspicuous spinous setae among capillaries of setigers 1 to 2, blunt, pointed, or bifurcated, representing homologues of lyrate setae found on following setigers; large conspicuous spines absent. Pygidium with long anal cirri.

Pseudoscalibregma glandipodium sp. nov.

urn:lsid:zoobank.org:act:7CEA87F9-0A79-417F-9C2F-E67A0971D2CA

Figs 13–14

Holotype: Eastern Australia, abyssal plain off New South Wales, Jervis Marine Park, RV *Investigator*, Sta. 054, coll. 28 May 2017, Brenke Sled, distance 2.6 km, 35.117°S 151.473°E, 4026 m to 35.099°S 151.455°E, 3881 m (AM W.52697). **Paratypes** (5): continental slope off New South Wales, Hunter Marine Park, Sta. 076, coll. 03 Jun 2017, Brenke Sled, distance 4.2 km, 32.577°S 153.161°E, 2534 m to 32.613°S 153.149°E, 2480 m (1, W.52350);—Continental slope off Tasmania, Freycinet Marine Park, Sta. 005, 18 May 2017, Brenke Sled, distance 2.8 km, 41.730°S 149.135°E, 2789 to 41.753°S 149.147°E, 2779 m (2, W.52679);—Sta. 011, coll. 19 May 2017, box core, 41.721°S 149.125°E, 2793 m (2, W.52682). All in Australian Museum.

Description. A small to moderate sized species, holotype complete with 31 setigers, 13 mm long, 3.4 mm wide across expanded anterior body and 0.8 mm wide across narrow posterior segments (Fig. 13A). Paratypes smaller, one from Sta. 011 (AM W.52682) with 26 setigers, 3.6 mm long, 0.95 mm across anterior setigers and 0.5 mm across posterior setigers. Body enlarged anteriorly, tapering posteriorly to narrow pygidial segment (Fig. 13A). Individual segments mostly biannulate, with prominent transverse ridge connecting right and left parapodia both dorsally and ventrally; second narrow ridge present anterior to parapodial ridge producing biannulate segments; segments separated by intersegmental groove, best seen in posterior segments; segmentation largely obscured on enlarged anterior segments. Segments not noticeably divided into rows of elevated pads as in most other scalibregmatids. Ventral surface of expanded anterior segments with subdermal longitudinal bands, probably muscles extending from peristomium to beginning of narrow posterior segments (Figs 13C, 14B). Dorsal and ventral grooves or ridges absent; posterior segments with narrow ventral line, probably nerve cord. Branchiae absent. Colour in alcohol opaque white; without body pigment.

Prostomium entire across anterior margin, bearing two narrow diverging frontal horns (Figs 13A–C, 14A, B); eyes absent; nuchal organs observed as a pair of swollen lobes on paratypes, relatively smooth (Fig. 14A); curved grooves on holotype. Peristomium a single ring dorsally; ventrally forming upper and lower lips of mouth; each lip with 6–7 short lobes (Fig. 14B); proboscis partially everted on two paratypes (AM W.52682).

Parapodia of anterior setigers relatively inconspicuous with short conical lobes and noto- and neuropodia well separated. Parapodia of posterior setigers becoming longer, bearing elevated inflated dorsal and ventral cirri (Fig. 13D); each cirrus irregularly shaped, lumpy, bearing large internal glands (Fig. 13D–E); interramal papillae absent.

Setigers 1–3 with capillaries arranged in 3–4 rows in both noto- and neuropodia of holotype, 2–3 rows on smaller paratypes, each successive row with longer setae; spinous

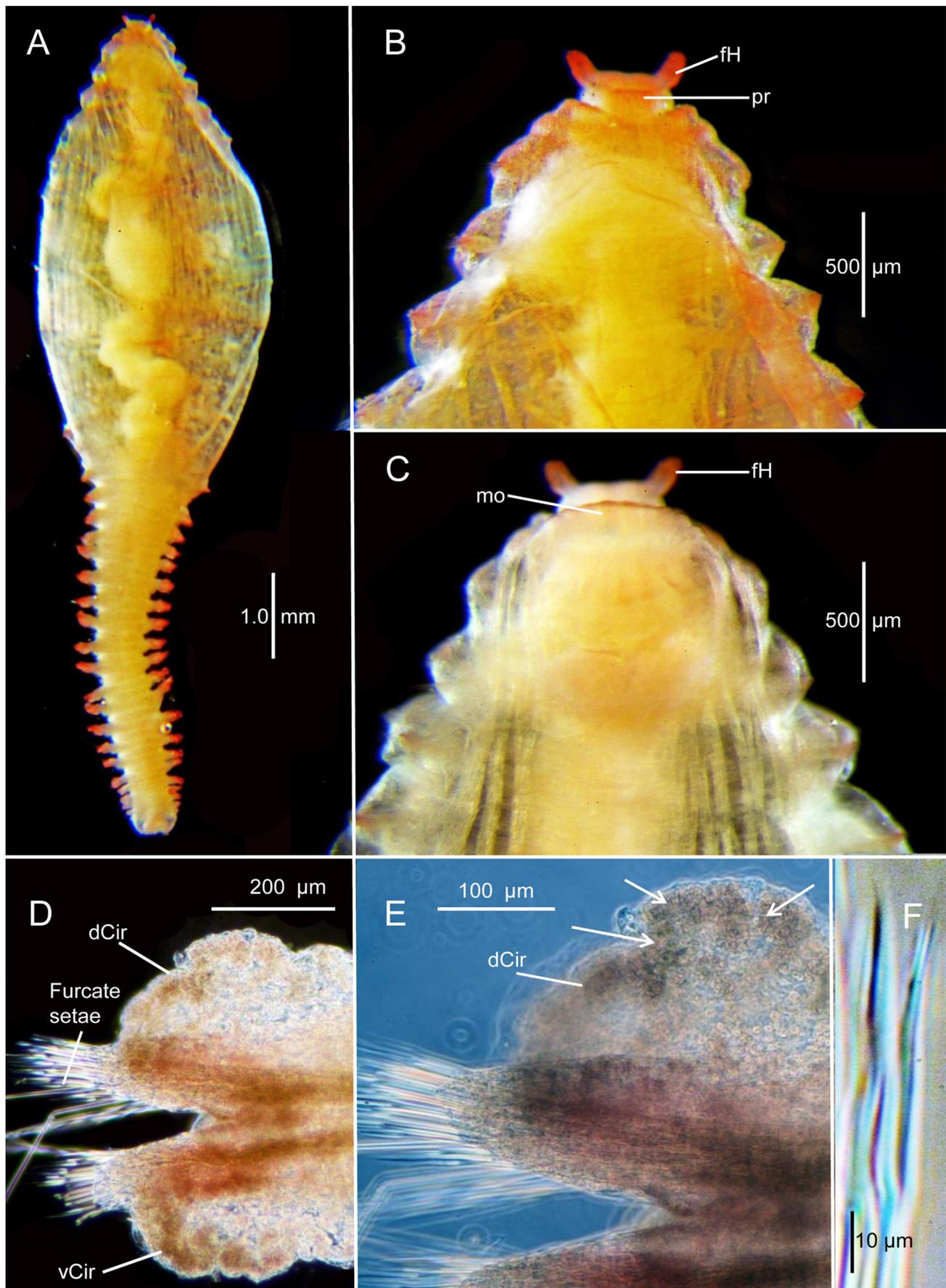


Figure 13. *Pseudoscalibregma glandipodium* sp. nov. Holotype (AM W.52697): (A) entire worm, dorsal view; (B) anterior end, dorsal view; (C) anterior end, ventral view; (D) posterior parapodium anterior view; (E) detail of dorsal cirrus from posterior parapodium, arrows indicate internal gland cells; (F) furcate seta. All stained with Shirlastain A.

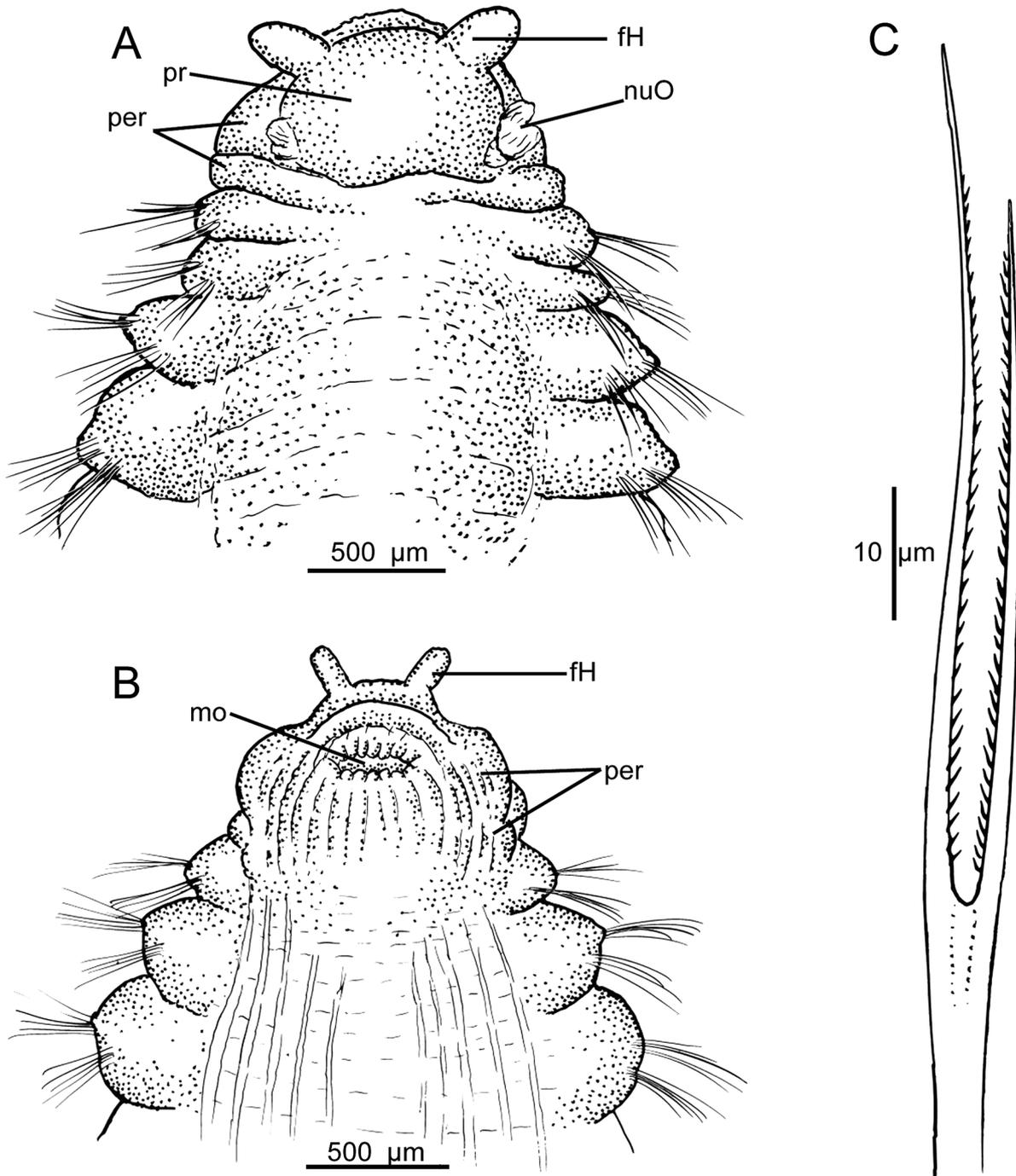


Figure 14. *Pseudoscalibregma glandipodium* sp. nov. (A) anterior end dorsal view; (B) anterior end, ventral view; (C) furcate seta. A, paratype (AM W.52682); B, C, holotype (AM W.52697).

setae not present on any specimens. Furcate setae from setiger 2 continuing on noto- and neuropodia on all setigers, these numbering 2–4 on anterior setigers, increasing to 9–10 per podium on posterior setigers of holotype; only 3–4 on smaller paratypes. Furcate setae present in first row followed by longer capillaries in subsequent row; each furcate seta with a pair of long tapering unequal tynes (Figs 13F, 14C) with minute denticles along inner borders of tynes (Fig. 14C).

Pygidium a simple lobe surrounding anus; holotype with one anal cirrus, subsequently lost; one paratype with anal

two cirri; based on other species of this genus, this species likely with at least four anal cirri.

Remarks. *Pseudoscalibregma glandipodium* sp. nov. is most similar to *P. bransfieldium* (Hartman, 1967) from continental slope depths of Antarctic seas in having dorsal and ventral cirri appearing as bulbous glandular extensions of the podial lobes. The two species differ in that *P. glandipodium* sp. nov. has no interramal cirrus between the noto- and neuropodia and no short acicular spines in the first few setigers, whereas *P. bransfieldium* has both of these characters. In addition,

P. bransfieldium is reported to have a ventral groove along the body (Blake, 2015), whereas *P. glandipodium* sp. nov. has a relatively smooth ventral surface. Ecologically, *P. glandipodium* sp. nov. is a lower slope and abyssal species reaching depths of 4000 m. In contrast, *P. bransfieldium* is an Antarctic shelf and upper slope species reaching depths of only about 900 m (Blake, 2015).

Etymology. The epithet is from the Latin *glandis*, for glandular, and *podium*, for a foot-like structure in reference to the glandular nature of the parapodia of this species.

Distribution. Eastern Australia, off Tasmania and New South Wales; lower continental slope and abyssal depths, 2480–4026 m.

Discussion

Abyssal Scalibregmatidae. To date, and including new species described in the present study, about 77 species of Scalibregmatidae in 15 genera are known and recognized (Blake, 2020; Read & Fauchald, 2022). Of these, 19 valid species from five genera are known from lower continental slope and rise and abyssal depths of 2700–3000 m and greater, with 14 of these exceeding depths of 4000 m (Table 3). These 19 species represent 25% of the known species of Scalibregmatidae, most of which have been described in the last 25 years, reflecting the increasing interest in deep-water

exploration. The dominant deep-sea scalibregmatid genus is *Oligobregma* with 13 of 17 species occurring in abyssal depths.

Of the 19 abyssal scalibregmatid species listed here, 16 occur either in the North Atlantic Ocean, central Pacific Ocean, eastern Australia or seas around Antarctic. There are no published records from abyssal depths in the Indian Ocean, South Atlantic Ocean, or from most areas of the North Pacific Ocean. However, as part of long-term monitoring of a deep-ocean dredged material disposal off San Francisco, California, at least eight undescribed species of Scalibregmatidae are known from depths of 2800–3200 m in the Pacific (Blake *et al.*, 2009; Blake unpublished).

In addition to the species listed in Table 3, Hartman (1965) and Hartman & Fauchald (1971) recorded *Asclerocheilus beringianus* Ushakov, 1955, a bathyal species from the Bering Sea in abyssal depths down to 5018 m from the western North Atlantic. However, no specimens that could be referred this species were collected after extensive surveys of the U.S. Atlantic slope from the US/Canadian boundary to off South Carolina in depths 2000–3500 m. Instead, several undescribed scalibregmatid species were encountered (Blake, unpublished). Hartman & Fauchald (1971) also described *Neolipobranchius glabrus* from 4436 m from the same surveys. Blake (2015) reexamined the holotype of this species and determined that it was a juvenile and lacked all typical scalibregmatid characteristics and suggested it was a juvenile of *Travisia*.

Table 3. Records of abyssal Scalibregmatidae. Abbreviations: CCZ, Clarion Clipperton Zone; E, Eastern; N, North; W, Western; NSW, New South Wales; NZ, New Zealand; Tas, Tasmania; Vic, Victoria.

| genus/species | depth (m) | location | reference |
|--|-----------|---|--|
| <i>Asclerocheilus abyssalis</i> sp. nov. | 3952–4280 | E Australia, off NSW | this study |
| <i>Axiokibuita australis</i> sp. nov. | 2793–4064 | E Australia, off Tas, Vic | this study |
| <i>Oligobregma aciculata</i> | 4850 | W North Atlantic Ocean | Hartman, 1965; Hartman & Fauchald, 1971 |
| <i>Oligobregma aristata</i> sp. nov. | 2793–4031 | E Australia, off Tas, NSW | this study |
| <i>Oligobregma bathyala</i> sp. nov. | 2694–2774 | E Australia, off Tas, Vic | this study |
| <i>Oligobregma brasierae</i> | 4425 | Pacific Ocean, CCZ | Wiklund <i>et al.</i> , 2019 |
| <i>Oligobregma collare</i> | 1622–6070 | Antarctic Seas | Levenstein, 1975; Blake, 1981 |
| <i>Oligobregma lonchochaeta</i> | 2931–2951 | N Atlantic Ocean, S of Iceland | Detinova, 1885 |
| <i>Oligobregma profunda</i> sp. nov. | 3881–4176 | E Australia, off Tas to NSW | this study |
| <i>Oligobregma pseudocollare</i> | 3050 | Antarctic Seas | Schüller & Hilbig, 2007 |
| <i>Oligobregma quadrispinosa</i> | 2258–4069 | Antarctic Seas | Schüller & Hilbig, 2007 |
| <i>Oligobregma renuncula</i> sp. nov. | 4005–4425 | E Australia, off NSW to Queensland, Coral Sea | this study |
| <i>Oligobregma tanai</i> | 4137–4425 | Pacific Ocean, CCZ | Wiklund <i>et al.</i> , 2019 |
| <i>Oligobregma tasmania</i> n. comb. | 3710–3830 | Pacific Ocean, Tasman Sea off NZ | Kirkegaard, 1996 (as <i>Asclerocheilus</i>); this study |
| <i>Oligobregma whaleyi</i> | 4425 | Pacific Ocean, CCZ | Wiklund <i>et al.</i> , 2019 |
| <i>Pseudoscalibregma glandipodium</i> sp. nov. | 2480–4026 | E Australia, off Tas, NSW | this study |
| <i>Pseudoscalibregma pallens</i> | 8928–9174 | Pacific Ocean, Kermadec Trench | Levenstein, 1962 |
| <i>Pseudoscalibregma papilia</i> | 1970–3690 | Antarctic Sea | Schüller, 2008 |
| <i>Scalibregmella antennata</i> | 4800–5000 | W North Atlantic Ocean | Hartman & Fauchald, 1971; Blake, 2020 |

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