



## Proneomeniidae (Solenogastres, Cavibelonia) from the Bentart-2006 Expedition, with description of a new species

## Proneomeniidae (Solenogastres, Cavibelonia) de la Campaña Bentart-2006, con la descripción de una nueva especie

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### ABSTRACT

During the Spanish oceanographic expedition for the study of Antarctic benthos, Bentart-2006, carried out in the area of the Bellingshausen Sea and Antarctic Peninsula, seven specimens of Proneomeniidae (Solenogastres, Cavibelonia) were obtained. *Proneomenia bulbosa* sp. nov. is described here. A comparative table of the main specific characters of the species belonging to the genus *Proneomenia* is also included. New data of *Dorymenia usarpi* Salvini-Plawen, 1978 and *Dorymenia menchuescribanae* García-Álvarez, Urgorri and Salvini-Plawen, 2000 are presented here.

### RESUMEN

Durante la campaña oceanográfica española para el estudio del bentos antártico, Bentart-2006, se recogieron en el área del Mar de Bellingshausen y la Península Antártica siete especímenes de Proneomeniidae (Solenogastres, Cavibelonia). Se describe *Proneomenia bulbosa* sp. nov. Se incluye una tabla comparativa de los principales caracteres de las especies pertenecientes al género *Proneomenia*. Se presentan nuevos datos de *Dorymenia usarpi* Salvini-Plawen, 1978 y de *Dorymenia menchuescribanae* García-Álvarez, Urgorri and Salvini-Plawen, 2000.

### INTRODUCTION

The family Proneomeniidae is highly homogeneous, comprising species that are generally over 1 cm in length, most of them measuring between 2 and 5 cm long. They are characterized by presenting a thick cuticle with several layers of hollow acicular sclerites, a polystichous/polyserial radula and ventrolateral foregut glandular organs with a paired duct of epithelially arranged gland cells surrounded by musculature

(type C according to SALVINI-PLAWEN, 1978a; *Epimania* type according to HANDL AND TODT, 2005). The family includes two genera: *Proneomenia* and *Dorymenia*, which differ in the absence/presence of copulatory stylets.

The genus *Proneomenia* includes ten species, four of which belong to the Antarctic and Subantarctic biogeographic areas (SALVINI-PLAWEN, 1978a): *Proneomenia epibionta* Salvini-Plawen,

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1978 and *Proneomenia stillerythrocytica* Salvini-Plawen, 1978 were collected near the Falkland Islands; *Proneomenia praedatoria* Salvini-Plawen, 1978 comes from the Kerguelen Islands and Drake Passage. Only *Proneomenia gerlachei* Pelseneer, 1901 was collected in the same biogeographic area as *Proneomenia bulbosa* sp. nov., from the Bellingshausen Sea.

The genus *Dorymenia*, one of the largest of this class, includes twenty-four species, seventeen of which come from the Antarctic and Subantarctic biogeographic areas (SALVINI-PLAWEN, 1978a; GARCÍA-ÁLVAREZ ET AL., 1998; 2000, GARCÍA-ÁLVAREZ AND URGORRI, 2003). The two species of this genus studied herein, *Dorymenia usarpi* Salvini-Plawen, 1978 and *Dorymenia menchuescribanae* García-Álvarez, Ugorri and Salvini-Plawen, 2000, come from South Shetland Islands, an area in which six other species are known: *Dorymenia acutidentata* Salvini-Plawen, 1978, *Dorymenia cristata* Salvini-Plawen, 1978, *Dorymenia hesperidesi* García-Álvarez, Ugorri and Salvini-Plawen, 2000, *Dorymenia hoffmani* Salvini-Plawen, 1978, *Dorymenia parvidentata* García-Álvarez and Ugorri, 2003 and *Dorymenia tron-*

*cosoi* García-Álvarez, Ugorri and Salvini-Plawen, 1998.

## MATERIAL AND METHODS

The seven specimens studied were collected in three stations sampled during the expedition Bentart-2006, which was carried out on board the BIO Hespérides in January-February 2006 at Bellingshausen Sea and the Antarctic Peninsula. Specimens were fixed and preserved in 70% ethanol. For the study of sclerites, small pieces of cuticle of the dorsal middle part of the body and of the ventral groove were separated. These pieces were treated with sodium hypochlorite at 5% for 12 hours to isolate the sclerites. They were then washed with water, dried in a drying chamber at 40°C and mounted in Canada balsam. For their anatomical study, specimens were decalcified in an EDTA solution for 12 hours, they were embedded in paraffin, cut in transverse series of 10 µm in section, stained with Mallory trichromic and the reconstruction of the internal anatomy of their anterior and posterior body was performed.

## SYSTEMATICS

### Family Proneomeniidae Simroth, 1893

*Diagnosis:* See SALVINI-PLAWEN, 1978a; GARCÍA-ÁLVAREZ AND SALVINI-PLAWEN, 2007

### Genus *Proneomenia* Hubrecht, 1880

*Diagnosis:* See SALVINI-PLAWEN, 1978a; GARCÍA-ÁLVAREZ AND SALVINI-PLAWEN, 2007

*Type species:* *Proneomenia sluiteri* Hubrecht, 1880

### *Proneomenia bulbosa* sp. nov. (Figs. 1, 2)

**Type material:** Holotype 1 specimen 43 x 2.5 mm, cut in serial sections. Bellingshausen Sea (Antarctica). Bentart-2006, Station MB 34-2; coordinates: 70° 11.620' S, 84° 8.694' W; 603 m depth. The holotype, cut in serial sections, is deposited in the Museo Nacional de Ciencias Naturales of Madrid, number MNCN 15.02/25.

**Etymology:** From Latin *bulbus*, bulb, regarding the posterior body of the bulging body.

*Diagnosis:* Body without protuberances and keels, with a bulging and

acuminate posterior body. 300 µm thick cuticle. Hollow acicular sclerites (130-

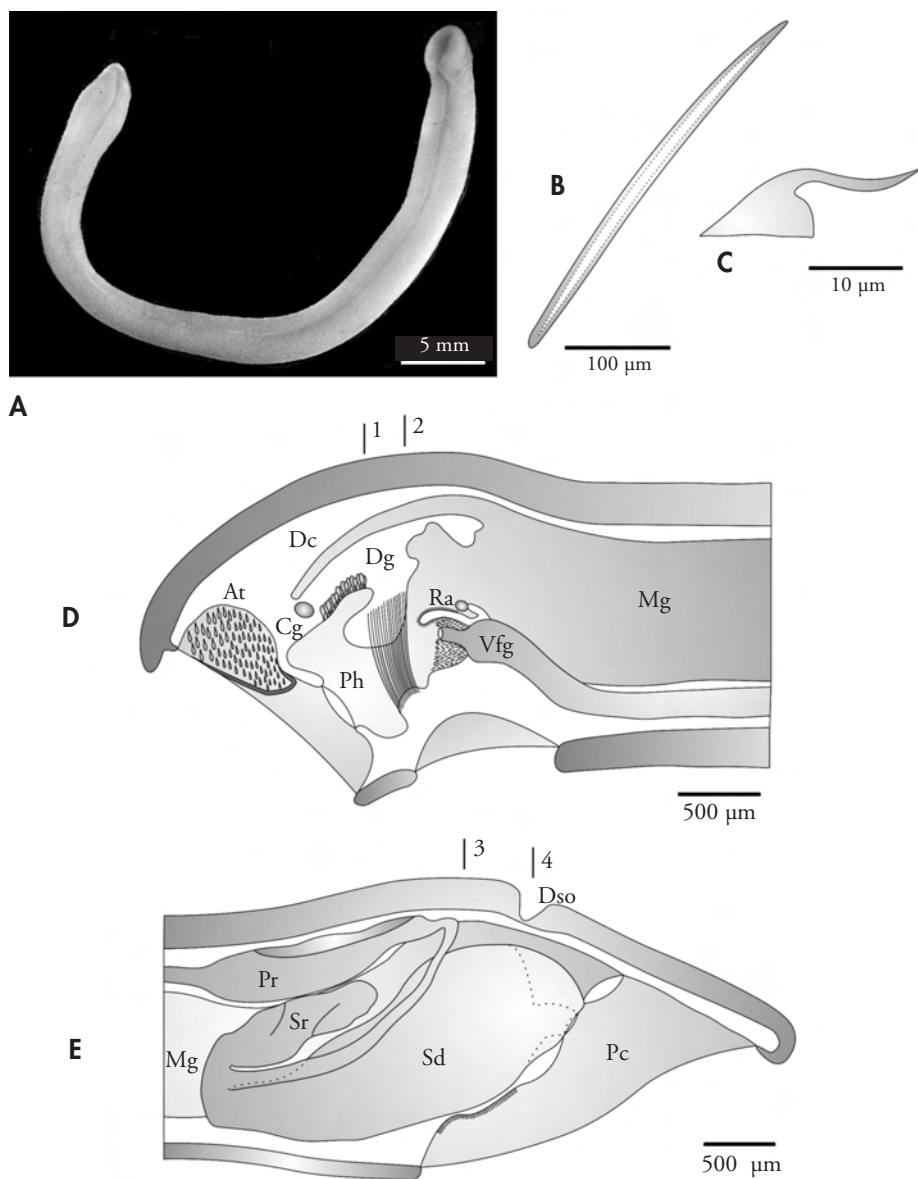


Figure 1. *Proneomenia bulbosa* sp. nov. A: habitus; B: hollow sclerites; C: radular tooth; D: schematic organization of the anterior body; E: schematic organization of the posterior body. Abbreviations, At: atrial sense organ; Cg: cerebral ganglion; Dc: dorsal caecum; Dg: dorsal gland; Dso: dorsoterminal sense organ; Mg: midgut; Pc: pallial cavity; Ph: pharynx; Pr: pericardium; Ra: radula apparatus; Sd: spawning duct; Sr: seminal receptacle; Vfg: ventral foregut glandular organ.

*Figura 1.* *Proneomenia bulbosa* sp. nov. A: habitus; B: escleritos huecos; C: diente radular; D: esquema de la organización de la parte anterior; E: esquema de la organización de la parte posterior. Abreviaturas, At: órgano sensitive atrial; Cg: ganglio cerebral; Dc: ciego dorsal; Dg: glándula dorsal; Dso: órgano sensitivo dorsoterminal; Mg: intestino; Pc: cavidad paleal; Ph: faringe; Pr: pericardio; Ra: aparato radular; Sd: conducto de desove; Sr: receptáculo seminal; Vfg: órgano glandular ventral de la faringe.

450  $\mu\text{m}$  long). With one fold in the pedal groove that enters the pallial cavity. Dorsal pharynx gland present. Radula with 22-25 small and identical teeth with a wide base and a sharp sigmoid end. Ventrolateral foregut glandular organs type C/*Epimenia* type. Two types of erythrocytes: some elongated without granulations and a longitudinal groove and others spherical with granulations. Opening of the posteriorly unpaired spawning duct through a narrow tube with a sphincter. Seminal receptacles elongate, slightly lobulate. Small pallial cavity without diverticles and respiratory folds, with an anterior ventral groove. Without copulatory stylets. With abdominal spicules. One dorsoterminal sense organ.

**Description:** *Habitus:* Specimen 43 mm long x 2.5 mm thick. Body of circular section, without protuberances and keels, with a bulging and acuminate posterior body and a truncated and slightly bulging anterior body (Fig. 1A). Very marked pedal groove. White colour in alcohol.

*Mantle and pedal groove:* Thick cuticle (up to 300  $\mu\text{m}$  thick) with elongated epidermal papillae. Hollow acicular sclerites (130-450  $\mu\text{m}$  long) with thick walls (5-7  $\mu\text{m}$  thick), slightly curved, with a sharp distal end and a round proximal end (Fig. 1B). Sclerites are arranged in several interlacing layers, with the distal end slightly protruding from the cuticle, most of them are tangential or skeletal. The pedal groove presents one fold that enters the pallial cavity.

*Pallial cavity:* Small, without diverticles and respiratory folds and without copulatory stylets. It leads onto the outside through a narrow ventral longitudinal opening (Fig. 1E). In its middle part, it presents thick and glandulous ventrolateral walls with a large quantity of blood cells. The anus is located in the dorsal region of the cavity and the opening of the spawning duct is located ventrally to the anus, where it has a central position. The pallial cavity extends in its anterior region with a ventral groove that continues with the pedal groove and into which the fold of the pedal groove enters (Fig. 2C, D). The

ventral groove of the pallial cavity is located below the posterior part of the spawning duct and it leads onto the outside through a narrow longitudinal opening that continues with the opening of the pallial cavity. The lateral walls of the ventral groove are thick and glandulous, the abdominal spicules are located on them.

*Digestive system.* It presents a common atriobuccal cavity (Fig. 1D). The mouth opens dorsally in the posterior part of the atriobuccal cavity. The pharynx presents, dorsally and ventrally, a pair of small caeca near the mouth, which possibly form when the pharynx infolds. The anterior region of the pharynx has thick lateral walls with glands; a dorsal gland, which is made up of a short duct into which the gland cells open, is located in its dorsal region (Fig. 1D, 2A). The middle region presents a circular musculature, which is thicker in its dorsal part (Fig. 1D, 2B). Wide posterior part of the pharynx with a less developed musculature layer. The radula is polystichous/polyserial, with 22-25 small, identical teeth in each transverse row (25  $\mu\text{m}$  long from the base to their sharp end) with a wide base and a sharp and sigmoid end (Fig. 1C). The ventrolateral foregut glandular organs are type C according to SALVINI-PLAWEN, 1978a or *Epimenia* type following HANDL AND TODT, 2005, are made up of a pair of ducts covered by a muscular envelope inside which there are glandular epithelial cells. They are two long narrow tubes of circular section (approximate diameter 250  $\mu\text{m}$ ) and extend ventrolaterally to the intestine in the middle area of the body (Fig. 1D). There is a muscular radular sac located ventrally to the radula, into which the ventrolateral foregut glandular organs open through two non-glandulous ducts. The pharynx opens into the intestine through a short oesophagus, whose walls are quite thick. In its anterior region, the intestine has a narrow dorsal caecum that reaches the buccal area and has lateral constrictions caused by the dorsoventral musculature. The rectum is narrow, of circular section and very



Figure 2. *Proneomenia bulbosa* sp. nov. A, B, C, D: cross sections corresponding to lines 1, 2, 3, 4 in Figure 1. Abbreviations, Dg: dorsal gland; Dso: dorsoterminal sense organ; Ph: pharynx; Re: rectum; Sd: spawning duct.

Figura 2. *Proneomenia bulbosa* sp. nov. A, B, C, D: cortes en sección correspondientes a las líneas 1, 2, 3, 4 en la Figura 1. Abreviaturas, Dg: glándula dorsal; Dso: órgano sensitivo dorsoterminal; Ph: faringe; Re: recto; Sd: conducto de desove.

close to the dorsal wall of the body due to the large size of the spawning duct (Fig. 2C, D). The anus is located in the dorsal region of the pallial cavity, it is wide and circular (approximate diameter 450 µm).

*Nervous system and sense organs.* The cerebral ganglion is located above the anterior part of the pharynx and the buccal ganglia are lateral to the posterior part of the radular area (Fig. 1D). The atrium is located in the anterior part

of the common atriobuccal cavity, it has numerous digitiform papillae on its lateral walls and is delimited by a ventrolateral fold (Fig. 1D). There is a dorsoterminal sense organ in the dorsoposterior region of the body, above the rectum (Fig. 1E, 2D).

*Gonopericardial system.* The gonads were full of ova and spermatozooids, in their anterior part they are not separated and the blood sinus flows dorsally to them, whereas they are separated at their

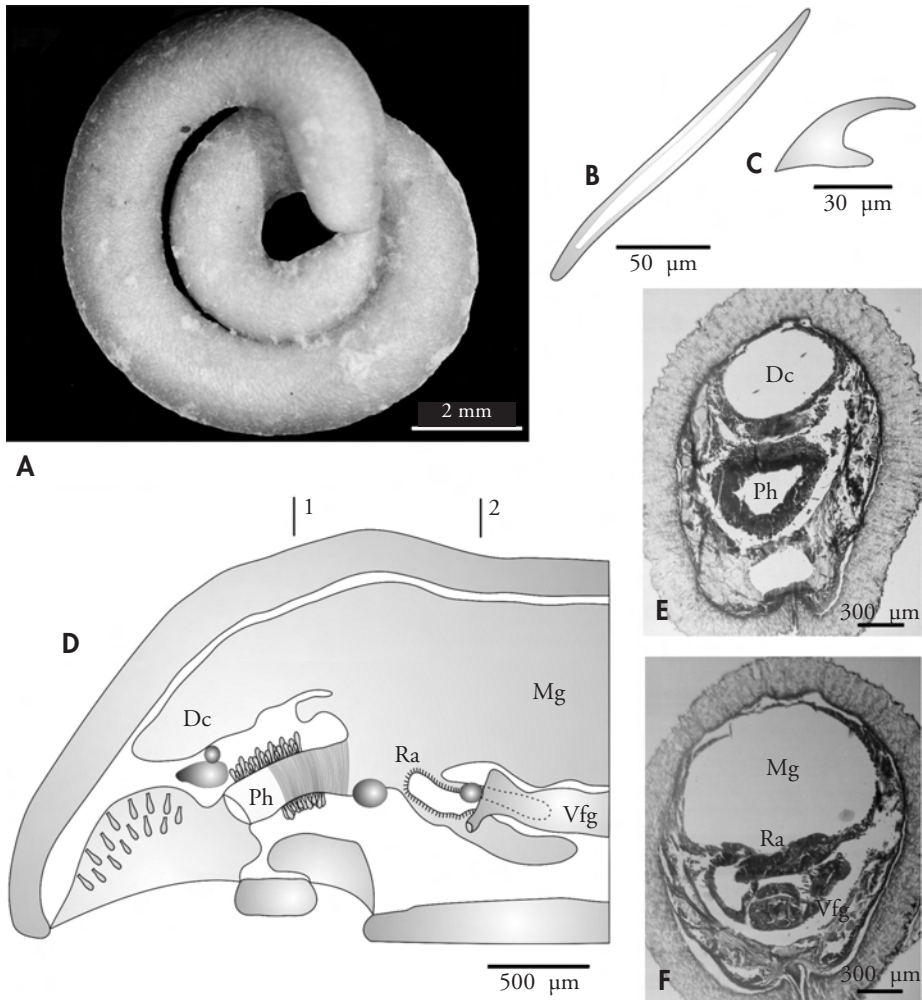


Figure 3. *Dorymenia usarpi* Salvini-Plawen, 1978. A: habitus; B: hollow sclerites; C: radular tooth; D: schematic organization of the anterior body; E, F: cross sections corresponding to lines 1, 2. Abbreviations, Dc: dorsal caecum; Mg: midgut; Ph: pharynx; Ra: radular apparatus; Vfg: ventral foregut glandular organ.

Figura 3. *Dorymenia usarpi* Salvini-Plawen, 1978. A: habitus; B: escleritos huecos; C: diente radular; D: esquema de la organización de la parte anterior; E, F: cortes en sección correspondientes a las líneas 1, 2. Abreviaturas, Dc: ciego dorsal; Mg: intestino; Ph: faringe; Ra: aparato radular; Vfg: órgano glandular ventral de la faringe.

posterior part and the sinus, full of blood cells, is located between them. There are two types of erythrocytes; some elongated (up to 14 µm long) without granulations or nucleus, with a longitudinal groove, and other spherical (diameter up

to 10 µm) with granulations. The pair of gonopericardioducts are well separated, narrow (diameter of 90 µm) with slightly folded walls, projecting into the anterior part of the pericardium. The pericardium is flat and wide, the heart has an anterior,

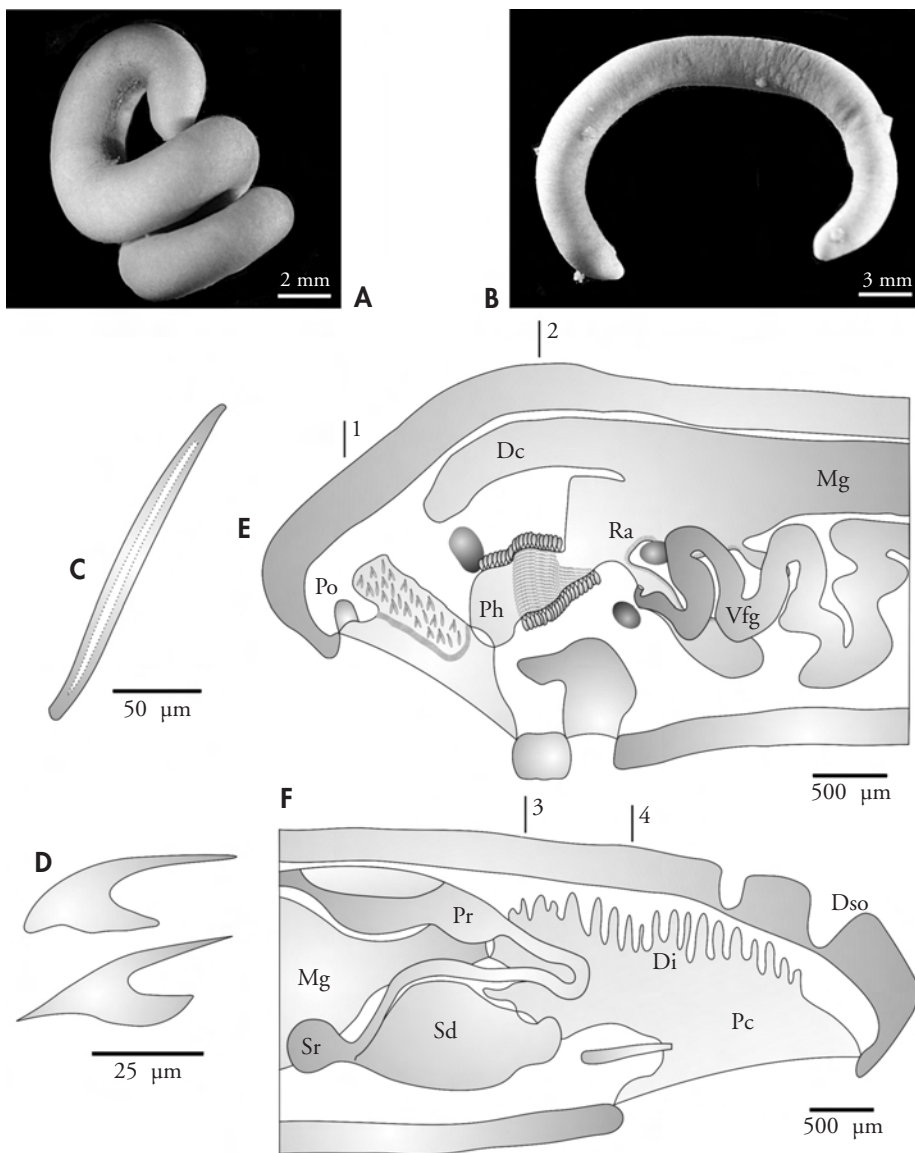


Figure 4. *Dorymenia menchuescribanae* García-Álvarez, Urgorri and Salvini-Plawen, 2000. A: habitus; B: specimen with colonies of Bryozoa *Celleporella* sp.; C: hollow sclerites; D: radular teeth; E: schematic organization of the anterior body; F: schematic organization of the posterior body. Abbreviations, Dc: dorsal caecum; Di: diverticle; Dso: dorsoterminal sense organ; Mg: midgut; Pc: pallial cavity; Ph: pharynx; Po: preatrial organ Pr: pericardium; Ra: radula apparatus; Sd: spawning duct; Sr: seminal receptacle; Vfg: ventral foregut glandular organ.

Figura 4. *Dorymenia menchuescribanae* García-Álvarez, Urgorri and Salvini-Plawen, 2000. A: habitus; B: espécimen con colonias de Bryozoa *Celleporella* sp.; C: escleritos huecos; D: dientes radulares; E: esquema de la organización de la parte anterior; F: esquema de la organización de la parte posterior. Abreviaturas, Dc: ciego dorsal; Di: divertículo; Dso: órgano sensitivo dorsoterminal; Mg: midgut; Pc: cavidad paleal; Ph: faringe; Po: órgano preatrial; Pr: pericardio; Ra: aparato radular; Sd: conducto de desove; Sr: receptáculo seminal; Vfg: órgano glandular ventral de la faringe.

wide and unpaired ventricle and two posterior and narrow auricles. Both pericardioducts come out laterally from the posterior part of the pericardium, they present their walls encircled by a circular musculature and the interior epithelium is folded. They join the dorsoanterior part of the spawning duct, in the same area where the seminal receptacles join (Fig. 1E). Both seminal receptacles are long, slightly lobulate and are located dorsally to the anterior part of the spawning ducts. The receptacles and the anterior part of the spawning ducts were full of spermatozooids. The spawning duct is paired in its anterior half, representing two tubular ducts that increase their

diameter from their anterior part to their fusion and their walls are very glandulous. The unpaired spawning duct fills almost the whole body space (Fig. 1E, 2C), it opens into the pallial cavity through a narrow tube with a folded internal wall and a sphincter made up of a layer of circular musculature (Fig. 1E, 2D). Laterally to this narrow end tube, the spawning duct continues in the posterior part with two caeca of gland walls that reach the anterior wall of the pallial cavity (Fig. 1E, 2D), these caeca may form when the spawning duct is retracted, as these specimens protrude the end part of the spawning duct and all the pallial cavity.

### Genus *Dorymenia* Heath, 1911

*Diagnosis:* See SALVINI-PLAWEN, 1978a; GARCÍA-ÁLVAREZ AND SALVINI-PLAWEN, 2007

*Type species:* *Dorymenia acuta* Heath, 1911

#### *Dorymenia usarpi* Salvini-Plawen, 1978 (Fig. 3)

**Material examined:** 1 specimen 29 mm long x 1.8 mm wide, cut in serial sections, Low Island (South Shetland Islands, Antarctica). Bentart-2006, Station LOW 45; coordinates 63° 43.171' S, 62° 21.16' W; 86 m depth.

*Remarks:* *Dorymenia usarpi* was known so far from Bransfield Strait, 311-426 m depth; South Orkney Islands, 485 m depth; and Ross Sea 342-732 m depth (SALVINI-PLAWEN, 1978a). The first two records are very close to the present one, although they are at slightly greater depths. Three dorsoterminal sense organs were observed in the specimen studied here, whereas the original description showed just one or two. Al-

though the bad histological state of the posterior body of the specimen did not make the description of the reproductive system possible, the dorsolateral bags of the pallial cavity typical of this species were visible. *Dorymenia hesperidesi*, a species close to *D. usarpi* described from the South Shetland Islands, presents clear differences regarding the size of the radular teeth and the erythrocytes shape (see Table I in GARCÍA-ÁLVAREZ ET AL., 2000).

#### *Dorymenia menchuescribanae* García-Álvarez, Urgorri and Salvini-Plawen, 2000 (Figs. 4, 5)

**Material examined:** 5 specimens 34-51 mm long x 2.5-3 mm wide, cut in serial sections. Miers Bluff, next to Falsa Bay (Livingston Island, South Shetland Islands, Antarctica); Bentart-2006, Station St GA; coordinates: Start: 62° 46.13' S, 60° 27.02' W, End: 62° 43.565' S, 60° 27.486' W; 42.8-50.2 m depth.

*Remarks:* The specimens studied herein were collected in the same geographic area and at a similar depth to

those known before. They are large specimens, over 3 cm long, with a slightly acuminate posterior body and generally



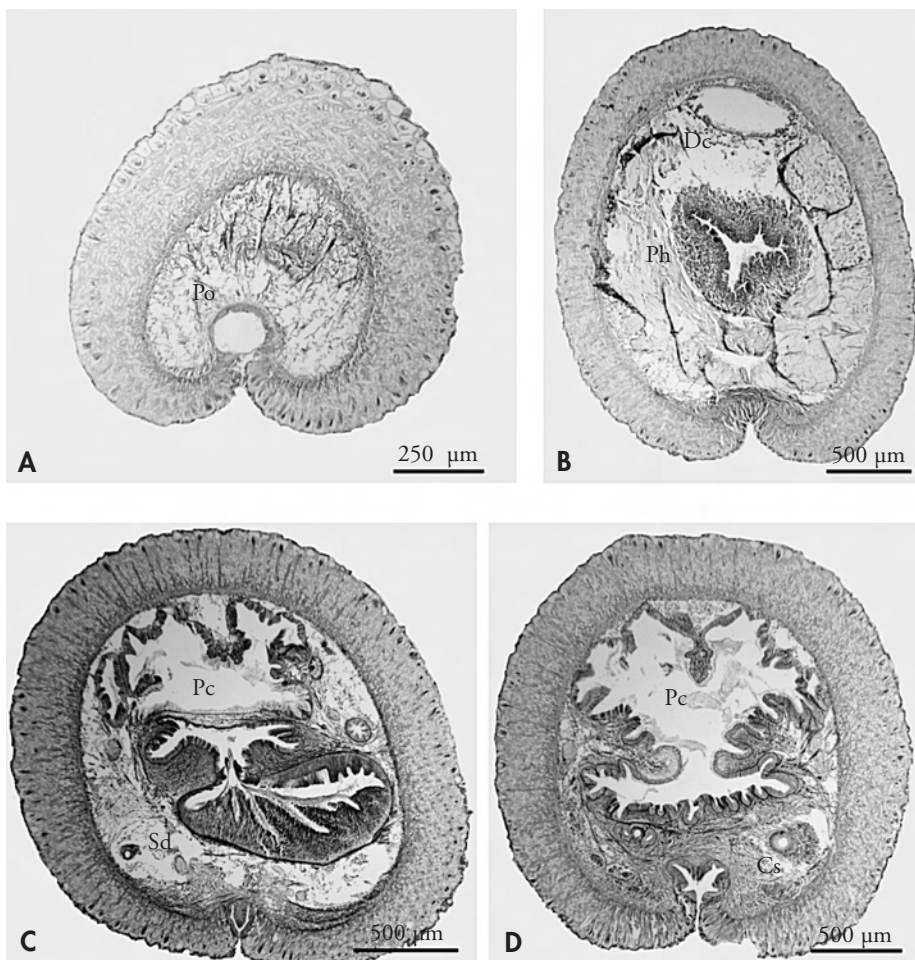


Figure 5. *Dorymenia menchuescribanae* García-Álvarez, Urganri and Salvini-Plawen, 2000. A, B, C, D: cross sections corresponding to lines 1, 2, 3, 4 in Figure 4. Abbreviations, Cs: copulatory stylet; Dc: dorsal caecum; Pc: pallial cavity; Ph: pharynx; Po: preatrial organ Sd: spawning duct.

*Figura 5.* *Dorymenia menchuescribanae* García-Álvarez, Urganri and Salvini-Plawen, 2000. A, B, C, D: cortes en sección correspondientes a las líneas 1, 2, 3, 4 en la Figura 4. Abreviaturas, Cs: estilete copulador; Dc: ciego dorsal; Pc: cavidad paleal; Ph: faringe; Po: órgano preatrial; Sd: conducto de desove.

seem to be rolled up (GARCÍA-ÁLVAREZ *ET AL.*, 2000). Some unknown characteristics could be observed in these specimens; they present a preatrial sense organ in the atriobuccal cavity (Figs. 4E, 5A); the number of dorsoterminal sense organs varies from two to four; and the opening of the spawning duct into the ventral bag of the pallial cavity may

have a frontal or ventral position (Figs. 4F, 5C), which may possibly vary according to the protruded state of the ventral bag and even of the cavity during copulation (see Table I in GARCÍA-ÁLVAREZ *ET AL.*, 2000). It should be pointed out finally that several colonies of Bryozoa *Celleporella* sp. were found on the cuticle in one of the specimens (Fig. 4B).

Table I. Comparative table of the main specific characters of species belonging to the genus *Proneomenia*.

	Distribution/ Depth	Habitus (mm)	Size ( $\mu\text{m}$ )	Cuticle ( $\mu\text{m}$ )
<i>P. acuminata</i>	E. coast USA, Caribbean Sea 250-650 m	Ends: anterior round and truncate; posterior pointed	20-30 x 1.7-1.8	Up to 250
<i>P. desiderata</i>	Marseille 20-30 m	Cylindrical, without keels	10	Up to 130
<i>P. epibionta</i>	Falkland I. 646-845 m	With dorsal and lateral long protuberances	30 x 2	Up to 200
<i>P. gerlachei</i>	Bellingshausen Sea 550 m	Cylindrical, without keels	45 x 2.5	Up to 400
<i>P. hawaiiensis</i>	Hawaiian I. 270-500 m	Thick ends; anterior truncate; posterior pointed	36 x 2	Up to 120
<i>P. insularis</i>	Hawaiian I. 1400-1800 m	Cylindrical, without keels	?	Up to 90
<i>P. praedatoria</i>	Kerguelen I. Drake S. 585-1240 m	With dorsal protuberances	28 x 2.2	Up to 200; protuberance 350
<i>P. sluiteri</i>	Barents Sea, Spitzbergen, Kara Sea-Laptev Sea 45-300 m	Round ends. Thick anterior	105-148	Up to 100
<i>P. stillerythrocytica</i>	Falkland I. 512-586 m	With dorsal protuberances	37 x 2	Up to 150; protuberance 225
<i>P. valdiviae</i>	Zanzibar 748 m	Ends: anterior round and truncate; posterior pointed	37 x 2	Up to 100
<i>P. bulbosa</i> n.sp.	Bellingshausen Sea 603 m	Thick ends; anterior truncate; posterior pointed	43 x 2.5	Up to 300

## DISCUSSION

Of the ten species described from the genus *Proneomenia*, only *Proneomenia gerlachei* Pelseneer, 1901 comes from the same biogeographic area and from a similar depth (Bellingshausen Sea, 70° 00' S, 81° 50' W, 550 m depth) (SALVINI-PLAWEN, 1978a) to *Proneomenia bulbosa* sp. nov. Both species present clear differences (Table I): in *P. gerlachei*, the hollow acicular sclerites only reach a length of 100  $\mu\text{m}$ , in each radular row there are 40 teeth with a narrow base and a pointed and small curved end, and the erythrocytes are oval (SALVINI-PLAWEN, 1978a); whereas in *P. bulbosa* sp. nov. the hollow acicular sclerites are long, up to 450  $\mu\text{m}$  in length, each radular transverse row

comprises 22-25 teeth with a wide base and a pointed sharp end, and it has two types of erythrocytes: some are elongated without granulations and with a longitudinal groove, others are round with granulations (cf. SALVINI-PLAWEN, 1978b).

Three species belong to the subantarctic biogeographic area (SALVINI-PLAWEN, 1978a): *Proneomenia epibionta* Salvini-Plawen, 1978, *Proneomenia stillerythrocytica* Salvini-Plawen, 1978 (Falkland Islands, 646-845 m and 512-586 m depth respectively) and *Proneomenia praedatoria* Salvini-Plawen, 1978 (Kerguelen Islands, and Drake Strait, 585-1240 m depth). In *P. epibionta* the cuticle is thinner (200  $\mu\text{m}$ ) than in *P. bulbosa* sp. nov. (300  $\mu\text{m}$ ) and has dorsal and lateral protuberances. The hollow

Tabla I. Tabla comparativa de los principales caracteres específicos de las especies del género *Proneomenia*.

	Sclerites length ( $\mu\text{m}$ )	Dorsal pharynx gland	Radular teeth	Oesophagus	Erythrocytes shape	Opening spawning duct	Dorsoterminal sense organ
<i>P. acuminata</i>	Up to 450	Yes	28 Narrow base	Yes	Oval	Narrow and muscular end duct	1
<i>P. desiderata</i>	?	No	14 Narrow base	No	Drop	?	1
<i>P. epibionta</i>	Up to 200	No	42-46 Narrow base	No	Oval	Groove in the ventral wall of the pallial cavity	4
<i>P. gerlachei</i>	Up to 100	Yes	40 Narrow base	No	Oval	Muscular canal	1
<i>P. hawaiiensis</i>	Up to 330	Yes	38-45 Narrow base	Yes	Spherical	Narrow end duct	1
<i>P. insularis</i>	Up to 200	No	34 Narrow base	Yes	Spherical	?	?
<i>P. praedatoria</i>	Up to 350	Yes	45 Wide base	Yes	Drop	In the ventral wall of pallial cavity	1-2
<i>P. sluiteri</i>	Up to 200	No	19-20 Wide base	Yes	Oval	Without end duct	1
<i>P. stillerythrocytica</i>	?	No	44-52 Wide base	?	Drop	Groove in the ventral wall of the pallial cavity	3
<i>P. valdiviae</i>	Up to 430	Yes	18	?	Drop	In ventral protuberance to the anus	1
<i>P. bulbosa</i> n. sp.	Up to 450	Yes	22-25 Wide base	Yes	Elongated and spherical	Narrow and muscular end duct	1

acicular sclerites only reach 200  $\mu\text{m}$  in length, in each radular row there are 42-46 teeth and they are much longer (80-100  $\mu\text{m}$ ) than in *P. bulbosa* sp. nov. (25  $\mu\text{m}$ ), there is no dorsal pharynx gland and the erythrocytes are oval. *P. stillerythrocytica* has a 150  $\mu\text{m}$  thick cuticle with dorsal protuberances, it possesses 44-52 teeth per radular row similar to those of *P. epibionta* and it has no dorsal pharynx gland. In *P. praedatoria* the cuticle shows dorsal protuberances up to 350  $\mu\text{m}$  thick and has 45 teeth per radular row with a length of 40-50  $\mu\text{m}$  (Table I).

The six remaining species shows several differences (Table I): *Proneomenia acuminata* Wirén, 1892 (W. Indian Ocean, 550 m depth; Florida and Massachusetts (USA), 250-650 m depth) has no circular

musculature in the pharynx, the 28 teeth per radular row have a narrow base and a non-curved sharp end, erythrocytes are oval with a central axis (HEATH, 1918). *Proneomenia desiderata* Kowalevsky and Marion, 1887 (Marseille, 20-30 m depth) has a radula with 14 teeth per transverse row, it has no dorsal pharynx gland, the pericardium shows two ventrolateral bags and erythrocytes are drop-shaped (KOWALEVSKY AND MARION, 1887). *Proneomenia hawaiiensis* Heath, 1905 and *Proneomenia insularis* Heath, 1911 were collected off Hawaii at 270-500 m and 1400-1800 m depth respectively. *P. hawaiiensis* has a radula with 38-45 teeth per transverse row with a narrow base and pointed ends. *P. insularis* has no dorsal pharynx gland and the radula shows 34

teeth per row (HEATH, 1911). *Proneomenia sluiteri* Hubrecht, 1880 (Arctic Ocean: Barents Sea, 200-292 m depth; Spitzbergen (Svalbard Islands), Kara Sea to Laptev Sea, 45-300 m depth) has 200  $\mu\text{m}$  long sclerites, it has no dorsal pharynx gland, the rectum presents a sphincter and the spawning duct is divided in two parts by a muscular constriction (HUBRECHT, 1881). Finally, *Proneomenia valdiviae* Thiele, 1902 (Zanzibar (Indian Ocean), 748 m depth) has a 100  $\mu\text{m}$  thick cuticle, 18 radular teeth per row and the opening of the spawning duct in the pallial cavity is very narrow and is

located in a ventral protuberance to the anus (THIELE, 1902).

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## BIBLIOGRAPHY

- GARCÍA-ÁLVAREZ O. AND SALVINI-PLAWEN L.V. 2007. Species and diagnosis of the Families and Genera of Solenogastres (Mollusca). *Iberus*, 25 (2): 73-143.
- GARCÍA-ÁLVAREZ O. AND URGORRI V. 2003. Solenogastres molluscs from the BENTART Collection (South Shetland Islands, Antarctica), with a description of a new species. *Iberus*, 21 (1), 43-56.
- GARCÍA-ÁLVAREZ O., URGORRI V. AND SALVINI-PLAWEN L.V. 1998. *Dorymenia troncosoi* sp. nov. (Mollusca Solenogastres: Proneomeniidae), a new species from the South Shetland Islands (Antarctica). *Polar Biology*, 20: 382-387.
- GARCÍA-ÁLVAREZ O., URGORRI V. AND SALVINI-PLAWEN L.V. 2000. Two new species of *Dorymenia* (Mollusca: Solenogastres: Proneomeniidae) from the South Shetland Islands (Antarctica). *Journal of the Marine Biological Association of the United Kingdom*, 80: 835-842.
- HANDL C. AND TODT C. 2005. Foregut Glands of Solenogastres (Mollusca): Anatomy and Revised Terminology. *Journal of Morphology*, 265: 28-42.
- HEATH H. 1911. Reports on the scientific results of the expedition to the tropical Pacific, XIV. The Solenogastres. *Memoirs of the Museum of Comparative Zoology at Harvard College*, 45 (1): 1-182.
- HEATH H. 1918. Solenogastres from the Eastern Coast of North America. *Memoirs of the Museum of Comparative Zoology at Harvard College*, 45 (2): 183-263.
- HUBRECHT A. 1881. *Proneomenia sluiteri* gen. et sp. n. with remarks upon the anatomy and histology of the Amphineura. *Niederländische Archiv für Zoologie*, 9 (1): 1-75.
- KOWALEVSKY A. AND MARION A. 1887. Contributions a l'histoire des Solenogastres ou Aplacophores. *Annales du Musée d'Histoire Naturelle de Marseille, Zoologie*, 3 (1): 1-77.
- SALVINI-PLAWEN L.V. 1978a. Antarktische und subantarktische Solenogastres-Eine Monographie: 1898-1974. *Zoologica*, Stuttgart: 128, 1-315.
- SALVINI-PLAWEN L.V. 1978b. Different blood-cells in species-pairs of Solenogastres (Mollusca). *Zoologischer Anzeiger*, 200: 27-30.
- THIELE J. 1902. *Proneomenia valdiviae* n. sp. *Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer "Valdivia", 1898-1899*, 3: 167-174.