

***Luitfriedia minuta* gen. et sp. nov. (Mollusca: Solenogastres), a new species from Galicia, North-West Spain.**

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Abstract: During the expeditions FAUNA IBERICA II and CANGREXO I off the coast of the Iberian peninsula, eighteen specimens of *Luitfriedia minuta* gen. et sp. nov., were collected in Galicia (NW Spain). The new species, which belongs to the sub-family Eleutheromeniinae of the family Pararhopaliidae, is characterized by a thick cuticle with hollow, acicular and hooked spicules; a pedal groove with one fold that does not enter the pallial cavity; the absence of a radula and a radular sac rudimentary; no dorsal pharyngeal gland; the ventral foregut glandular organs belong to the type A (according to Salvini-plawen, 1978); the midgut is devoid of a dorsal caecum; the posterior-most sole glands are enlarged and the unpaired genital orifice has a muscular sphincter. There are no copulatory and abdominal spicules; ten to twelve respiratory folds are present. The features of the new species are discussed and compared with those of other species of the subfamily.

Résumé: *Luitfriedia minuta* gen. et sp. nov. (Mollusca: Solenogastres), une nouvelle espèce décrite de Galice, nord-ouest de l'Espagne.

Les campagnes FAUNA IBERICA II et CANGREXO I, ont permis de recueillir dix-huit exemplaires de *Luitfriedia minuta* gen. et sp. nov. sur les côtes de la Galice. Cette nouvelle espèce appartient à la sous-famille des Eleutheromeniinae de la famille des Pararhopaliidae. Elle est caractérisée par une cuticule épaisse avec des spicules creux, aciculaires et crochus ; un sillon pédieux avec un pli qui ne pénètre pas dans la cavité palléale ; pas de radula et un sac radulaire rudimentaire ; pas de glande dorsale pharyngienne, les organes glandulaires ventraux du pharynx sont du type A (selon Salvini-Plawen, 1978) et l'intestin moyen est dépourvu de caecum dorsal ; les glandes postérieures du pied sont grandes, l'orifice génital impair possède un sphincter musclé. Il n'y a pas de spicules copulateurs ni abdominaux. Il y a dix à douze plis respiratoires. Les caractères de la nouvelle espèce sont discutés et comparés avec ceux des autres espèces de la sous-famille.

Keywords: *Luitfriedia minuta*, Mollusca, Solenogastres, North-West Spain.

Introduction

The Solenogastres are molluscs present on different marine bottoms, however data on their biology are scarce and the

knowledge of their diversity and biogeography is incomplete and fragmented. In Europe, this molluscan group has been mainly investigated on the Scandinavian coasts and in the Mediterranean Sea (Salvini-Plawen, 1997). In contrast, very few species have been reported from the coasts of the Iberian peninsula, especially the Atlantic ones. Several oceanographic sampling expeditions have been

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carried out recently, in order to examine the Solenogastres that live on this coast. Two expeditions, FAUNA IBERICA II and CANGREXO I, provided eighteen specimens of a species showing characters of the sub-family Eleutheromeniinae belonging to the family Pararrhopaliidae. The study of these specimens revealed that they belong to a new genus and a new species which are described in this paper.

Material and methods

Collection sites: "Banco de Galicia" (FAUNA IBERICA II; station 173-A), NW Spain (42°42'22"N-42°43'00"N; 11°47'52"W-11°45'47"W): sixteen specimens 0.7-1.75 mm by 0.3-0.6 mm, were collected on 28-06-91 with a box-corer trawl, from a coral bottom, *Madrepora oculata* (Linnaeus, 1758), at 760-769 m depth. Fishing grounds "A Quiniela" (CANGREXO I station M-6), Galicia NW Spain (43°17'22"N; 09°36'42"W): two specimens measuring 1.8 mm by 0.6 mm and 1.5 mm by 0.6 mm, were collected on 14-06-91 on board the "Noche de Reyes" during the CANGREXO I expedition for the study of the brachyuran decapod *Chaceon affinis* (A. Milne Edwards & Bouvier, 1894) from a bottom of ferromanganese nodules, calcareous plates, coal slag and small stones of terrigenous origin, at 507 m depth.

Methods: the specimens were fixed and preserved in 70% alcohol. The spicules were studied by separating small pieces of the cuticle from the mid-dorsal area of the body and ventral groove. These pieces were treated with 5% sodium hypochlorite for 12 h in order to isolate the spicules. They were later rinsed with water, dried in a heater at 40°C and mounted using Eukitt. For the anatomical study, several specimens were decalcified in EDTA for 12 h., embedded in paraffin, then cut in series of 10 µm thick cross sections. The staining method used was Azan Heidenhain, and the anatomy was reconstructed on the basis of serial sections.

Results

Order Cavibelonia Salvini-Plawen, 1978

Hollow, acicular spicules arranged in one or several layers.

Family Pararrhopaliidae Salvini-Plawen, 1972

Radula distich or absent; ventral foregut organs are sub-epithelial glands (type A, according to Salvini-Plawen, 1978) or follicular glands surrounding the pharynx; hooked spicules present; dorsal pharyngeal gland present or not; respiratory organs present or not; the mantle has bristly spicules.

Sub-family Eleutheromeniinae Salvini-Plawen, 1978

With hooked spicules; without dorsal pharyngeal gland; ventral foregut glandular organs with pouch-shaped outlets.

Genus *Luitfriedia* gen. nov.

Diagnosis. Body with thick cuticle; hollow, acicular and hook-shaped spicules. Buccal opening in the atrium. Without radula and dorsal pharyngeal gland. Ventral foregut glandular organ subepithelial (Type A according to Salvini-Plawen, 1978). One dorsoterminal sense organ. Unpaired genital orifice. One pair of seminal receptacles. Without copulatory spicules. Respiratory folds present. Type species: *Luitfriedia minuta* sp. nov.

Luitfriedia minuta sp. nov.

Diagnosis. Body measuring up to 1.8 mm by 0.6 mm, without lumps or keel. Epidermis with thick cuticle and papillae. Atrial papillae single or in groups of two. Pedal groove with one fold that does not enter the pallial cavity. Rudimentary radular sac present. Midgut without dorsal caecum. Enlarged sole glands along the posterior-most pedal groove. Unpaired spawning duct with sphincter in the ventro-rostral wall of the pallial cavity. Without abdominal spicules. Ten to twelve respiratory folds.

Distribution. The type locality is "Banco de Galicia", NW Spain (42°42'22"N-42°43'00"N; 11°47'52"W-11°45'47"W). Another locality is the fishing grounds "A Quiniela", Galicia NW Spain (43°17'22"N; 09°36'42"W).

Type material. The holotype and paratype 1 (cut in serial sections), No MNCN 15.02/7 and paratype 16, No MNCN 15.02/8, are deposited in the Museo Nacional de Ciencias Naturales in Madrid. Paratypes 2-6 (cut in serial sections) and paratypes 7-15 and 17 are in the collection of the Animal Biology Department of the University of Santiago de Compostela.

Etymology: the genus is dedicated to Professor Dr. Luitfried v. Salvini-Plawen, eminent malacologist and an expert in the study of Solenogastres, who inspired us to study this interesting molluscan group. The species name refers to the small size of the specimens.

Description

Habitus: small-sized animals covered with long spicules that protrude from the mantle, giving it a bristly appearance. The longest spicules are found in the posterior region of the body (Fig. 1A). The ventral groove is clearly visible. In alcohol the colour of the animals is yellowish white.

Mantle: there are epidermal papillae and the cuticle is up to 40 µm thick. There are several types of hollow spicules: 1. acicular, slightly curved spicules (415 µm long), with a serrated distal end, having four to eight small denticles (Fig. 1D); 2. acicular, slightly sigmoid spicules (180 µm long), with a serrated end (Fig. 1E); 3. acicular, slightly sigmoid spicules (125 µm long) without a serrated end (Fig. 1B,F); 4. hooked spicules (200 µm long), with a sharp point at the top of the hook (Fig. 1C,G). The longest hooked spicules protrude from the cuticle and are bent towards the

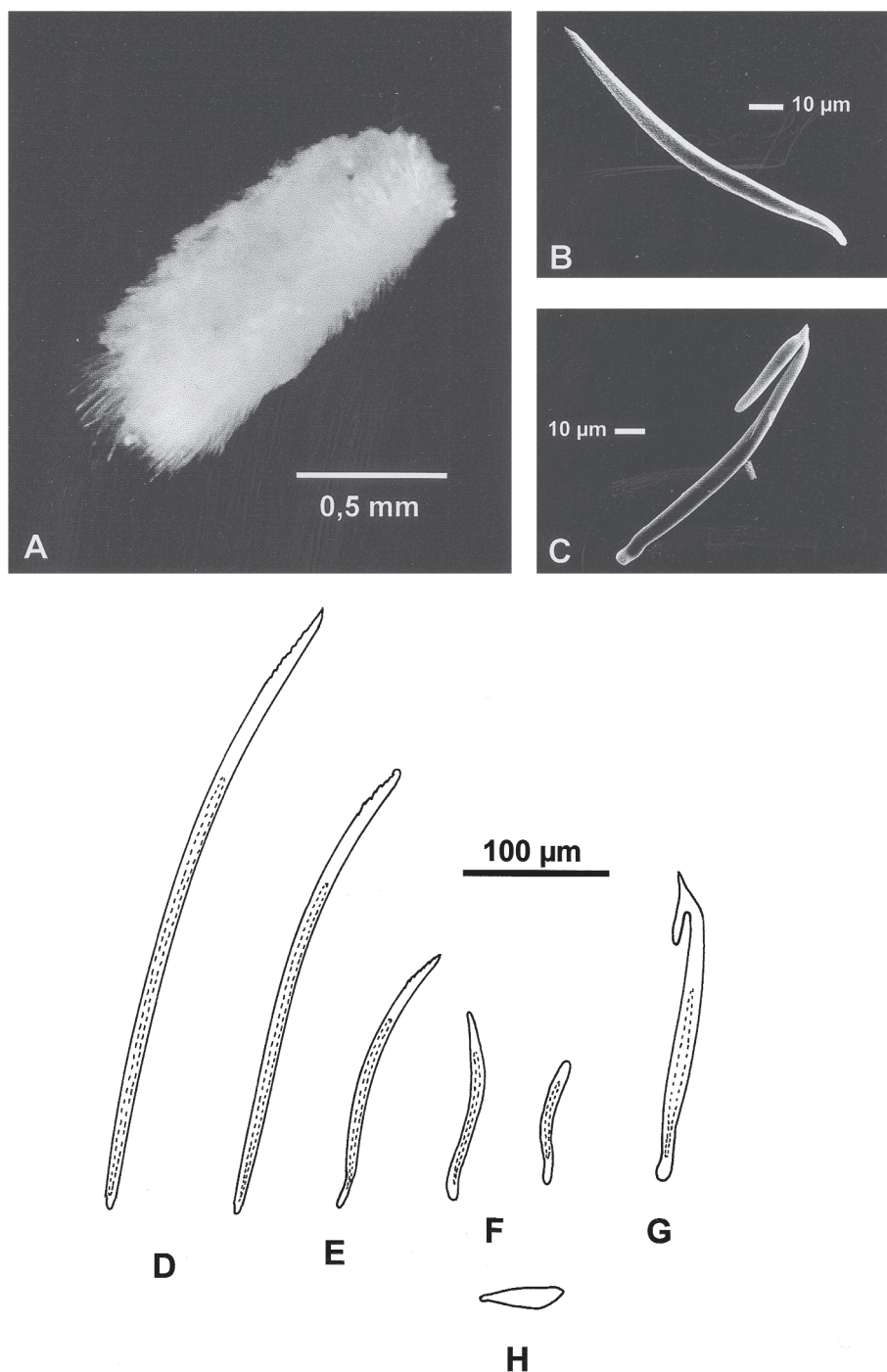


Figure 1. A. Photograph of *Luitfriedia minuta* gen. et sp. nov.; B. Hollow, acicular, slightly sigmoid spicule with the end not serrated; C. Hooked spicule; D. Hollow, acicular, slightly curved with a serrated distal end; E. Hollow, acicular, slightly sigmoid with a serrated end; F. Hollow, acicular, slightly sigmoid without a serrated end; G. Hooked spicule; H. Spicule alongside the pedal groove.

Figure 1. A. Photographie de *Luitfriedia minuta* gen. et sp. nov.; B. Spicules creux, aciculaires, légèrement sigmoïdes à extrémité non denticulée; C. Spicules en crochet; D. Spicules creux, aciculaires, légèrement sigmoïdes à extrémité distale denticulée; E. Spicules creux, aciculaires, légèrement sigmoïdes à extrémité denticulée; F. Spicules creux, aciculaires, légèrement sigmoïdes sans extrémité denticulée; G. Spicules en crochet; H. Spicule situé le long du sillon pédieux.

posterior region of the body; others are arranged in several layers within the cuticle. On both sides of the pedal groove blade-shaped scales (Fig. 1H), up to 55 µm long, are present.

Pedal groove: it starts from a small, ciliated pedal pit that is located below the pharynx and connects to the outside through a narrow opening. The pedal groove has only one fold which does not penetrate the pallial cavity, and has the shape of an equilateral triangle on a transverse section of the body (Fig. 3B). The sole glands along the terminal groove are well developed (Fig. 3A-C) and very large especially below the rostral region of the spawning ducts.

Pallial Cavity: it is large (Fig. 3A), with ten to twelve radially arranged long respiratory folds. The spawning duct opens out on the ventro-frontal wall of the pallial cavity through an unpaired orifice with a muscular sphincter (Fig. 3A,D). The narrow anus opens out on the dorsal region.

Sense organs and nervous system: the atrio-buccal cavity connects to the exterior through a narrow opening. The atrium has a number of long papillae on its dorsal and lateral walls; these papillae are single or in groups of two from the same base (Fig. 2A,B). There is only one dorsoterminal sense organ in the region of the pallial cavity (Fig. 3A). The cerebral ganglion is located dorsally to the pharynx (Fig. 2A) and the supra-rectal commissure located dorsal to the rectum far from the anus (Fig. 3A).

Digestive tract: the mouth opens out into the posterior area of the atrium (Fig. 2A, B), flanked by

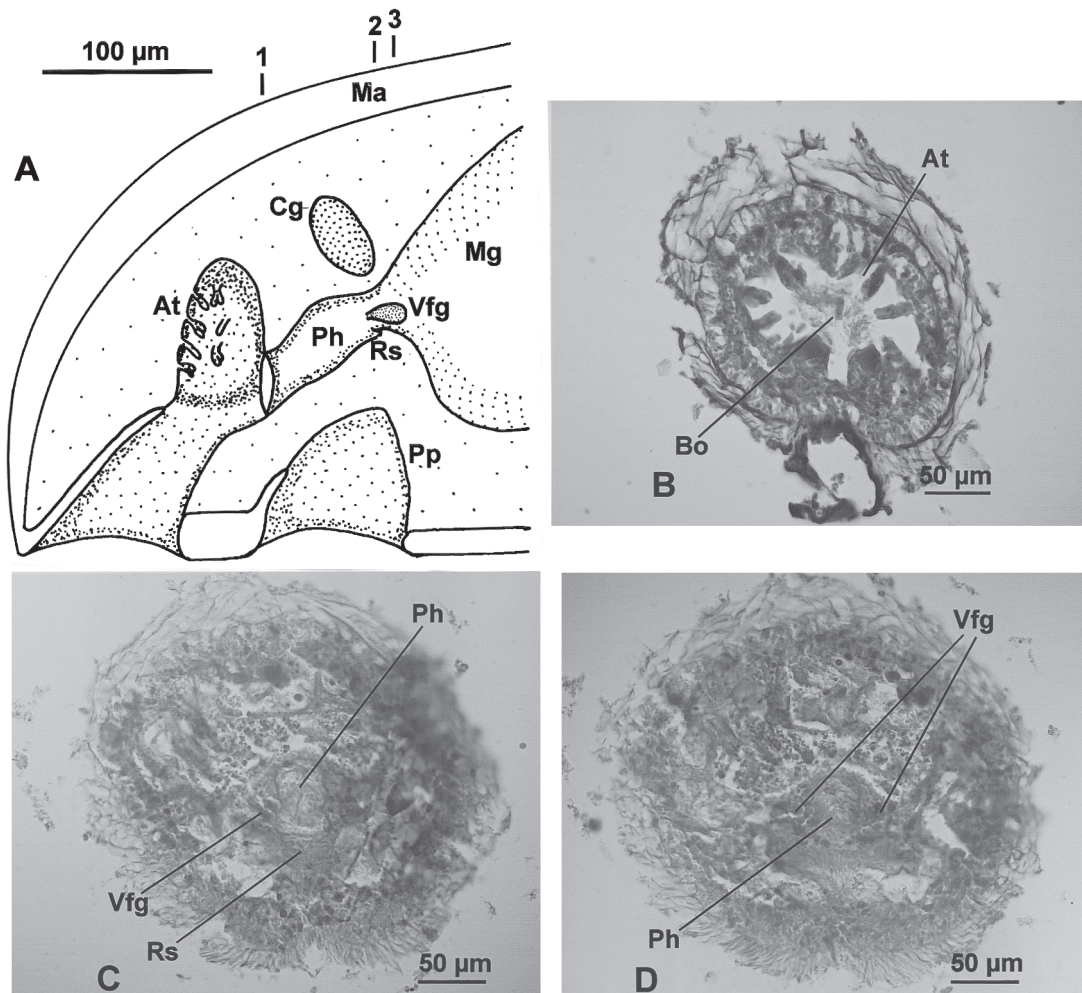


Figure 2. A. Schematic organization of the anterior body of *Luitfriedia minuta* gen. et sp. nov. B., C., D. Microphotograph of cross-sections corresponding to lines 1, 2, 3 of Fig. A. (At) Atrial sense organ; (Bo) Buccal opening; (Cg) Cerebral ganglion; (Ma) Mantle; (Mg) Midgut; (Ph) Pharynx; (Pp) Pedal pit; (Rs) Radular sac; (Vfg) Sac-like outlet of the ventral foregut glandular organ.

Figure 2. A. Schéma de l'organisation de l'extrémité antérieure du corps de *Luitfriedia minuta* gen. et sp. nov. B., C., D. Microphotographies de coupes transversales correspondant aux niveaux 1, 2, 3 de la Fig. A. (At) Organe sensoriel atrial; (Bo) Bouche; (Cg) - Ganglion cérébroïde; (Ma) Manteau; (Mg) Intestin moyen; (Ph) Pharynx; (Pp) Fosselette pédieuse; (Rs) Sac radulaire; (Vfg) Ouverture renflée de l'organe pharyngien glandulaire ventral.

two ciliated folds delimiting the atrial area. The buccal cavity is followed by a short and narrow pharynx leading axially into the midgut (Fig. 2A). There is no radula, but in one of the specimens studied we observed an unpaired, vestigial radular sac (Fig. 2C). The ventral foregut glandular organs are subepithelial (Type A, according to Salvini-Plawen, 1978) and they open out through a small pouch located on either side of the terminal part of the pharynx (Fig. 2C-D). The midgut has no dorsal caecum (Fig. 2A). The rectum is narrow and runs below the pericardium. It opens out through a narrow anus in the dorsal region of the pallial cavity (Fig. 3A).

Reproductive system: the pair of hermaphrodite gonads extends above the digestive tract and reach the anterior region of the body. They were full of sperm and eggs in all the specimens examined. The pericardium is small (Fig. 3A,C). The two pericardioducts start laterally from the terminal end of the pericardium, they curve and turn anteriorly, until they reach the dorsal wall of the spawning ducts with which they unite (Fig. 3A). There is a voluminous and elongated pair of seminal receptacles each opening frontally into the respective spawning duct. They are located dorsally to the spawning ducts and they extend to the terminal pericardial region (Fig. 3A,C,D). In some

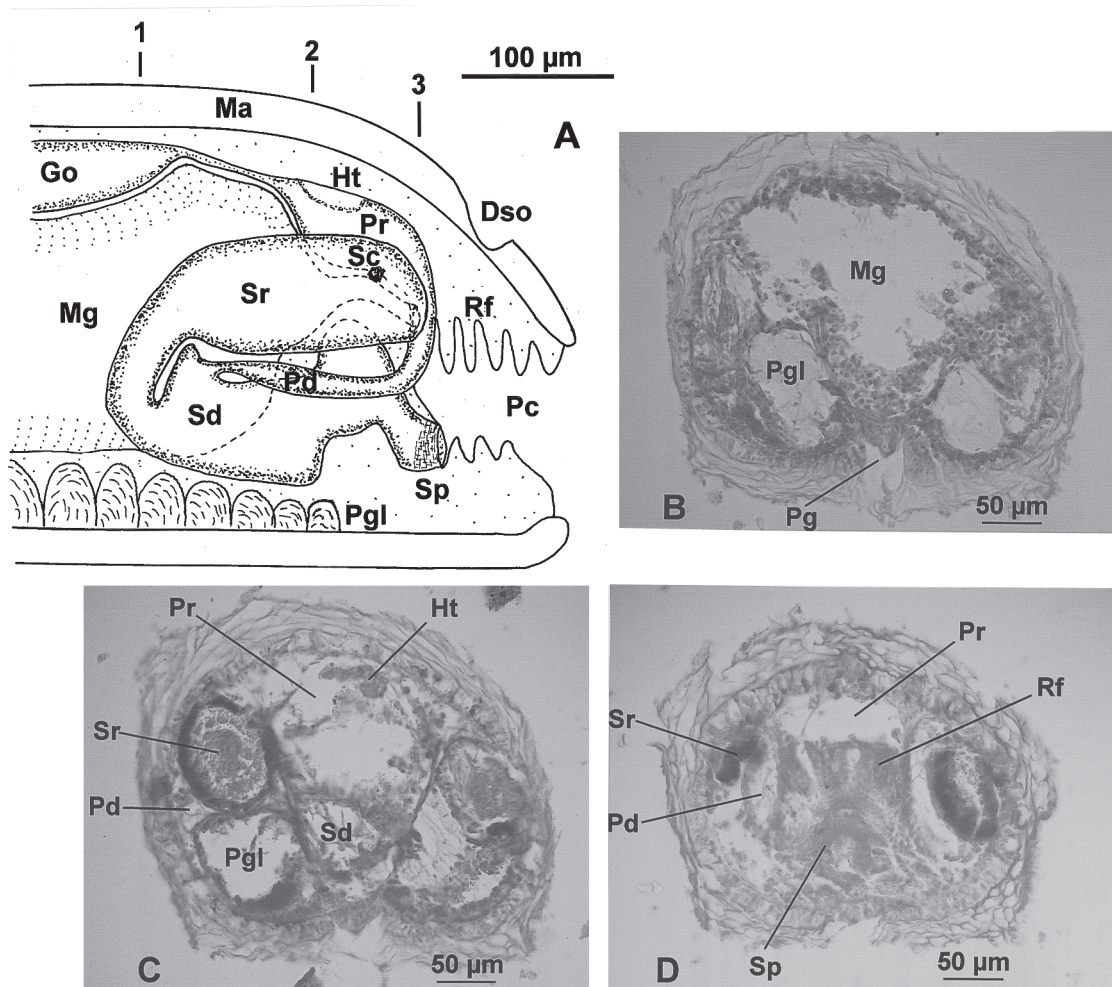


Figure 3. A Schematic organization of the posterior body of *Luitfriedia minuta* gen. et sp. nov. B, C, D Microphotograph of cross-sections corresponding to lines 1, 2, 3 in A. (Dso) Dorsoterminal sense organ; (Go) Gonad; (Ht) Heart; (Ma) Mantle; (Mg) Midgut; (Pc) Pallial cavity; (Pd) Pericardioduct; (Pg) Pedal groove; (Pgl) Sole glands; (Pr) Pericardium; (Rf) Respiratory folds; (Sc) Supra-rectal commissure; (Sd) Spawning duct; (Sp) Sphincter; (Sr) Seminal receptacle.

Figure 3. A. Schéma de l'organisation de la partie postérieure du corps de *Luitfriedia minuta* gen. et sp. nov. B., C., D. Microphotographies des coupes transversales correspondant aux niveaux indiqués en 1, 2, 3 sur A. (Dso) Organe sensorial dorsal postérieur; (Go) Gonade; (Ht) Cœur; (Ma) Manteau; (Mg) Intestin moyen; (Pc) Cavité palléale; (Pd) Canal péricardique; (Pg) Sillon pédieux; (Pgl) Glande pédieuse; (Pr) Péricarde; (Rf) Plis respiratoires; (Sc) Commissure supra-rectale; (Sd) Canal de ponte; (Sp) Sphincter; (Sr) Réceptacle séminal.

specimens they were found to be full of sperm. The two spawning ducts extend along the ventrolateral part of the body. They are circular in cross section, voluminous, and have a thick glandular wall. The two ducts fuse to form a single duct which continues below the rectum (Fig. 3C); it is wide, dorsoventrally flattened and has glandular walls. This duct opens out on to the ventral region of the pallial cavity (Fig. 3A,D) through an unpaired genital pore which has a muscular sphincter.

Discussion

Luitfriedia minuta gen. et sp. nov. belongs to the order Cavibelonia, owing to the presence of epidermal papillae and of hollow, acicular spicules arranged in several layers in the cuticle (Salvini-Plawen, 1978). The subepithelial ventral foregut glandular organs of type A (Salvini-Plawen, 1978), the mantle with hooked spicules and respiratory folds, place this species within the varied family Pararrhopaliidae.

Currently, the family Pararrhopaliidae is divided into five sub-families: Eleutheromeniinae, Pararrhopaliinae, Lophomeniinae, Halomeniinae and Unciherpiinae (Salvini-Plawen, 1978; García-Alvarez et al., 2001). *Luitfriedia minuta* gen. nov. et sp. nov. is placed within the subfamily Eleutheromeniinae, owing to its hooked spicules, the ventral glandular organs of the foregut with outlets in the shape of pouches, and the absence of a dorsal pharyngeal gland.

The subfamily Eleutheromeniinae includes two monospecific genera: *Eleutheromenia* Salvini-Plawen, 1967 and *Gephyroherpia* Salvini-Plawen, 1978. *Eleutheromenia* may be distinguished from *Luitfriedia* gen. nov., because it has a distich radula and copulatory spicules. *Gephyroherpia* may be distinguished from *Luitfriedia* gen. nov., because it has also a distich radula and a buccal opening, separated from the atrium (Table 1) (Pruvot, 1891; Salvini Plawen, 1967, 1978).

Table 1. A comparative table of characters of the genera in the sub-family Eleutheromeniinae.

Tableau 1. Tableau comparatif des caractères des trois genres appartenant à la sous-famille des Eleutheromeniinae.

	<i>Eleutheromenia</i>	<i>Gephyroherpia</i>	<i>Luitfriedia</i> gen. nov.
Cuticle	thin	thick	thick
Buccal opening	in atrium	not in atrium	in atrium
Radula	distich	distich	absent
Genital orifice	unpaired	unpaired	unpaired
Copulatory spicules	present	absent	absent
Respiratory folds	present	present	present
Dorsoterminal sense organ	present	present	present

Eleutheromenia sierra (Pruvot, 1890) was recorded from the Isle of Portaló (Cabo de Creus), off the Spanish Mediterranean coast, to Trondheim, Norway (see Salvini-

Plawen, 1997). It may be distinguished from *Luitfriedia minuta* by its strong dorsal keel with fifteen slightly irregular lobes, which are laterally compressed, a midgut with a dorsal caecum, seminal vesicles, but no seminal receptacles and it has twenty eighth respiratory folds in the pallial cavity (Pruvot, 1891; Salvini-Plawen, 1967).

Gephyroherpia antarctica Salvini-Plawen, 1978 is an Antarctic species, collected in the Ross Sea and Davis sea, at 342-714 m depth. It may be distinguished from *Luitfriedia minuta* by its abdominal spicules and a midgut with a paired dorsal caecum (Salvini-Plawen, 1978).

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