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FIRST RECORD OF THE PARASITIC BARNACLE *SACCULINA SCABRA* BOSCHMA, 1931 (CRUSTACEA: CIRRIPEDIA: RHIZOCEPHALA) INFECTING THE SHALLOW WATER SWIMMING CRAB *CHARYBDIS TRUNCATA*

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***ABSTRACT.* –** The shallow water swimming crab *Charybdis truncata* is occasionally infected by *Sacculina* species in Hong Kong. Histological sectioning showed that the paired male receptacles are globular in shape and separated from each other. The paired receptacle ducts are united in the middle region and again separated near the duct openings which are light microscopically cuticularized. This species was identified as *Sacculina scabra* Boschma, 1931, according to the identification key of Boschma (1955). This is the first record of *S. scabra* since the type specimen was described by Boschma in 1931 in Borneo.

***KEY WORDS.* –** Barnacles, Rhizocephala, *Sacculina*, Parasite, *Charybdis*, Hong Kong.

INTRODUCTION

Sacculinidae (Rhizocephala) are parasitic barnacles that infect crabs (Høeg & Lützen, 1995, 1996; Walker, 2001). The larvae of Sacculinidae are dioecious, only the female cyprid infects the crab by settlement on the external cuticle or the gill filaments. The female cyprid then metamorphoses into a kentrogon which has a retracted hollow stylet (Glenner et al., 2000; Glenner, 2001). The vermigon inside the kentrogon is subsequently injected through the stylet into the haemolymph of the crab. After injection, the vermigon develops a root system inside the host's tissue and absorbs nutrients from the host's haemolymph (Bresciani & Høeg, 2001). The root system develops a reproductive body, the virgin externa, which is a sac-like structure growing from the crab's abdomen. The virgin externa consists of a mantle, a mantle cavity, an ovary and a pair of male receptacles. A male cyprid will then pass through the mantle opening of the virgin externa and enter the male receptacles where spermatogenesis takes place (Høeg, 1987). Sperm is then produced which fertilizes the eggs inside the mantle cavity (Høeg, 1990; Glenner et al., 2000; Glenner, 2001).

Most studies on species diversity and biology of the Sacculinidae are based on temperate regions (see Øksnebjerg, 2000; Walker, 2001). Research on *Sacculina* species in the Asian region has been conducted mainly in Japan (Lützen & Takahashi, 1997) and Taiwan (Huang & Lützen, 1998) whilst the Sacculinidae of China and other Asian regions have received little attention (Huang & Lützen, 1998). Identification of species of *Sacculina* is based mainly on the structure of the male receptacles, the collecteric glands, and the surface sculpture of the externa (Boschma, 1955; but see Rybakov & Høeg, 2001 for the use of scanning electron microscopes on mantle surface structure in rhizocephalan taxonomy).

In Hong Kong, several specimens of the shallow water swimming crab, *Charybdis truncata* Fabricius 1789 collected in trawl samples between 1997 and 2000 (see Morton, 2000) were infected by a *Sacculina* species. Unfortunately, those specimens were preserved in ethanol, resulting in poor preservation of the histological structure (see Huang & Lützen, 1998), making identification impossible. Live *Charybdis truncata*, infected with *Sacculina*, were collected during a trawl survey of the northern waters of Lantau Island, Hong Kong in 6/2002 and 6/2003, and immediately fixed in Bouin's solution. Histological sectioning of the male receptacles and the receptacle ducts confirmed the species to be *Sacculina scabra* Boschma, 1931, according to the identification key by Boschma (1955). The illustrations by Boschma (1931) are rough drawings based on poorly preserved specimens. The present paper describes the morphology of *S. scabra*, using improved sectioning techniques, and provides information for further research on this species in the Asian region.

MATERIALS AND METHODS

The visceral mass from a single externa was dissected and fixed in Bouin's solution (seawater base). The mass was

Table 1. Morphological comparison of the Sacculinidae infecting *Charybdis* spp. in Asia: *Sacculina angulata*, (Huang & Lützen, 1998), *S. sereni* (Boschma, 1954; Huang & Lützen, 1998), *S. scabra* (present study), *S. lata* (Boschma, 1933), *Heterosaccus papillosus* (Shino, 1943; Boschma, 1950), *Drepanorchis tenuicutis* (Boschma, 1933) and *Loxothylacus nierstraszi* (Boschma, 1938).

	S. angulata	*S. serenei*	*S. scabra*	*S. lata*	*H. papillosus*	*D. tenuicutis*	*L. nierstraszi*
Externa morphology	Pentagonal, external cuticle is smooth.	Oval, external cuticle smooth.	Oval, external cuticle smooth.	Oval, external cuticle covered with short thick hairs.	Oval, external surface covered with small mammiform non-barbed papillae.	External cuticle thin and smooth.	Irregular, oval with external surface covered with small papillae.
Male receptacles	Separated, lying closely together, straight dorsal ventral course and located at posterior part of visceral mass.	Male receptacles elongated in shape, separated from each other. Receptacle ducts are straight and narrow.	Separated, located in posterior part of visceral mass, united in the receptacle duct. Separated again at the duct opening.	Receptacles united but separated in receptacle duct opening. Receptacles located at posterior part of visceral mass.	Receptacles completely united but with separate cavities.	Located at posterior part of visceral mass. Receptacles form a wide sac.	Receptacles located at posterior part of the visceral mass, completely separated from each other.
Host infected	*Charybdis bimaculata* (Taiwan)	*Charybdis feriata* (Indo China and Taiwan)	*Charybdis truncata* (Hong Kong)	*Charybdis truncata* *Charybdis japonica* *Charybdis bimaculata* (Japan)	*Charybdis bimaculatus* (Japan), *Charybdis japonicus* (Japan)	*Charybdis japonicus* (Japan)	*Charybdis truncata* (Japan)

embedded in paraplast, serially sectioned at 8µm and stained in Ehrlich's haematoxylin and eosin. The terminology used to describe the externa of *Sacculina* follows Lützen & Takahashi (1997).

TAXONOMY

CLASS CIRRIPEDIA
ORDER RHIZOCEPHALA
SUB-ORDER KENTROGONIDA
FAMILY SACCULINIDAE
Genus *Sacculina*

Sacculina scabra Boschma, 1931

***Diagnosis.* –** The externa is orange-yellow and globular in shape (Fig. 1). The external cuticle of the externa is smooth without excrescences. The paired male receptacles are globular, located close to each other and at the posterior region of the visceral mass (Fig. 2A, B). The linings of the receptacle ducts are thick and folded (Fig. 2C). The two receptacle ducts are united for part of their lengths (Fig. 2D) but separated again near the duct openings (Fig. 2E). The internal linings of the receptacle ducts are cuticularized at their openings under light microscopes (Fig. 2F; the entire internal linings of *Sacculina* spp. can be covered with a very thin layer of cuticles which can only be observed under Transverse Electron Microscopes; Høeg, 1987). The number of colleteric gland tubules in sections is 50 – 55 and they are arranged in five rows. The size of the tubules ranges from 180 to 250 µgm (Fig. 3).

DISCUSSION

The present study is the first record of *Sacculina scabra* Boschma, 1931, since the type specimen was described on the crab *Thalamita investigatoris* Alcock in Borneo. *Charybdis truncata* is in the same family (Portunidae) as *Thalamita*, suggesting that *S. scabra* may infect more than one species of this family. A similar phenomenon has also been recorded in *S. anomala* which infects both *Charybdis bimaculata* and *Thalamita cooperi* Stephenson & Hudson (see Huang & Lützen, 1998). In the Java Sea, the same host, *Charybdis truncata*, was also reported to be infected by *Loxothylacus nierstraszi* (Boschma, 1938). At various Asian localities, *Charybdis* spp. are recorded to be infected by a number of Rhizocephala species, which can be identified from the morphology of their male receptacles (see summary in Table 1).

The prevalence of *S. scabra* in Hong Kong is low. In the present study, only three *Charybdis truncata* were infected out of more than 400 sampled from nine separate trawl nets (30 minutes trawling). The low prevalence of *S. scabra* indicates that the distribution of *S. scabra* is very localized. *S. polygenea* in Japan, for example, has low prevalence (< 10%) on *Hemigrapsus sanguineus* in locations facing the open sea but a high prevalence, about 65%, from several sheltered locations (Yamaguchi et al., 1984). Such local variations in prevalence are common in the Sacculinidae and in the Rhizocephala in general. It is, moreover, well known that rhizocephalans are parasitic sterilizers ('castrators') and at high prevalences they must therefore exert a strong selection pressure on the host (Høeg, 1995). This could make Rhizocephala-host systems very interesting models for studying co-evolution in a geographic-mosaic context and for example test whether host defenses against the parasite are relaxed in areas with low or no parasite prevalence (Høeg, 1995).

Research on Rhizocephala in the Asian region is limited. Future research should focus on the distribution patterns and prevalence of *S. scabra* but also on the functional morphology of the male receptacles as these structures are diagnostic between species.

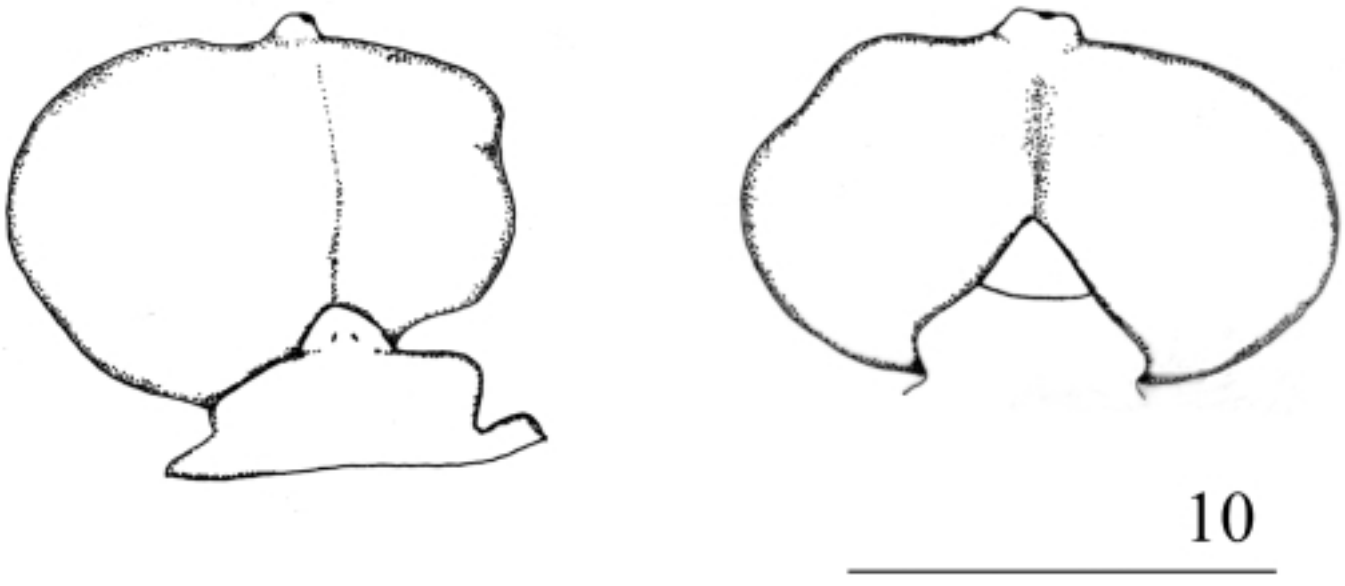

Fig. 1. Drawing of the externa of *Sacculina scabra* from a male and female *Charybdis truncata*. Scale bar in mm.

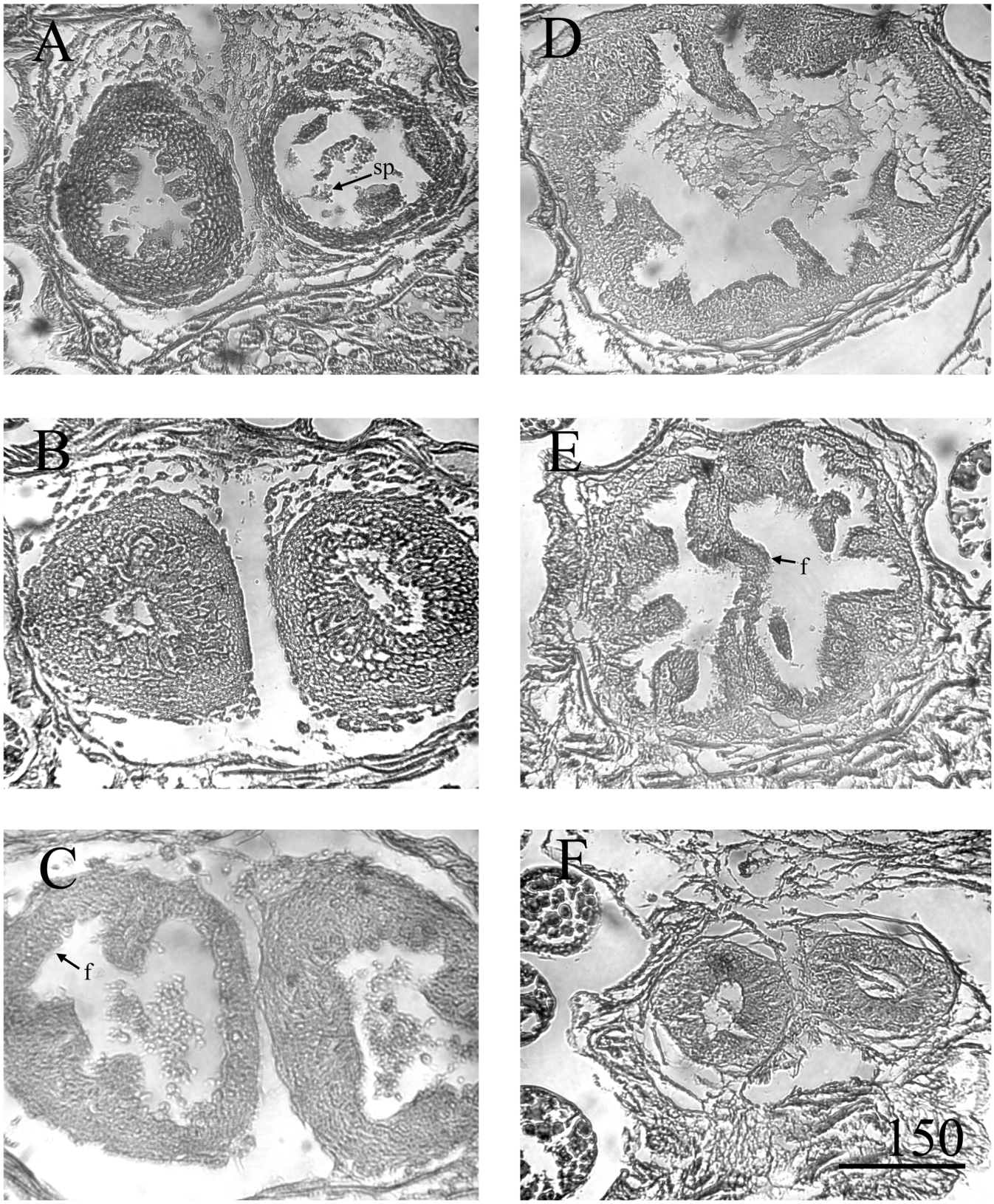

Fig. 2. Transverse sections of A) male receptacles, B) receptacle duct near the male receptacles showing the thick lining, C) folded lining (f) of receptacle duct, D) the paired receptacle ducts joined in the same chamber, E) the receptacle duct separated again at the region of the duct opening, F) receptacle duct opening, showing thick, cuticular lining. All the figures are to the same scale. Scale bar in µm.

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LITERATURE CITED

Boschma, H., 1931. Die Rhizocephalen der Siboga-expedition. Supplement. *Siboga-Experitie*, **XXXI bis**: 1 – 66.

Boschma, H., 1933. New Species of Sacculinidae in the collection of the United States National Museum. *Tijdschrift Voor Diegeneeskunde Series 3*, **3**: 219-241.

Boschma, H., 1938. *Loxothylacus nierstraszi*, a new species of Rhizocephalan parasite from the East Indies. *Archives Neerlandaises de Zoologie*, **3** (Supplement): 17-21.

Boschma, H., 1950. Notes on Sacculinidae, chiefly in the collection of the United States National Museum. *Zoologische Verhandelingen*, **7:** 3-55.

Boschma, H., 1954. Rhizocephala from Indo China IV. Parasites of the crab *Charybdis feriata* (Linnaeus). *Proceedings of Koninkl Nederl Akademie Van Wetenschappen Series C*, **57:** 378-389.

Boschma, H., 1955. The described species of the family Sacculinidae. *Zoologische Verhandelingen*, **27:** 1-76.

Bresciani J. & J. T. Høeg, 2001. Comparative ultrastructure of the root system in rhizocephalan barnacles (Crustacean: Cirripedia: Rhizocephala). *Journal of Morphology*, **249**: 9-42.

Glenner, H., 2001. Cypris metamorphosis, injection and earliest internal development of the Rhizocephalan *Loxothylacus panopaei*. Crustacea: Cirripedia: Rhizocephala: Sacculinidae. *Journal of Morphology*, **249**: 43-74.

Glenner, H., J. T. Høeg, J. J. O'Brien & T. D. Sherman, 2000. Invasive vermigon stage in the parasitic barnacles *Loxothylacus texanus* and *L. panopaei* (Sacculinidae): closing of the rhizocephalan life-cycle. *Marine Biology*, **136**: 249-257.

Høeg, J. T., 1987. Male cypris metamorphosis and a new larval form, the trichogon, in the parasitic barnacle *Sacculina carcini* (Crustacea: Cirripedia: Rhizocephala). *Philosophical Transactions of the Royal Society of London, Series B*, **317**: 47-63.

Høeg, J. T., 1990. 'Akentrogonid' host invasion and an entirely new type of life cycle in the Rhizocephalan parasite *Clistosaccus paguri* (Thecostraca: Cirripedia). *Journal of Crustacean Biology*, **10**: 37-52.

Høeg, J. T., 1995. The biology and life cycle of the Cirripedia Rhizocephala. *Journal of the Marine Biological Association of the United Kingdom*, **75**: 517-550.

Høeg, J. T. & J. Lützen, 1995. Life cycle and reproduction in the Cirripedia Rhizocephala. *Oceanography and Marine Biology Annual Review*, **33**: 427-485.

Høeg, J. T. & J. Lützen, 1996. Rhizocephala. In: Forest J. (ed.), *Traite de Zoologie VII. Fac. II.* Masson et Cie, Paris. Pp. 541-568.

Huang, J. F. & J. Lützen, 1998. Rhizocephalans (Crustacea: Cirripedia) from Taiwan. *Journal of Natural History*, **32**: 1319-1337.

Lützen, J. & T. Takahashi, 1997. *Sacculina polygenea*, a new species of rhizocephalan (Cirripedia: Rhizocephala) from Japan, parasitic on the intertidal crab *Hemigrapsus sanguineus* (De Haan 1835) (Decapoda: Brachyura: Grapsidae). *Crustacean Research*, **26**: 103-108.

Morton, B., 2000. Hong Kong's international malacological and marine biological workshops: their successes and achievements. *National Taiwan Museum Special Publication Series*, **10**: 1-18.

Øksnebjerg, B., 2000. The Rhizocephala (Crustacea: Cirripedia) of the Mediterranean and Black Seas: taxonomy, biogeography, and ecology. *Israel Journal of Zoology*, **46**: 1-102.

Rybakov, A. V. & J. T. Høeg, 2002. The ultrastructure of retinacula in the Rhizocephala (Crustacea: Cirripedia) and their systematics significance. *Zoologischer Anzeiger*, **241**: 95-103.

Shino, S. M., 1943. Rhizocephala of Japan. *The Journal of the Sigenkagaku Kenkyusyo*, **1**: 1-36.

Walker, G., 2001. Introduction to the Rhizocephala (Crustacean: Cirripedia). *Journal of Morphology*, **248**: 1-8.

Yamaguchi, T., S. Tokunaga & H. Aratake, 1984. Contagious infections by the rhizocephalan parasite *Sacculina* sp. in the grapsid crab *Hemigrapsus sanguineus* (De Haan). *Crustacean Research*, **23**: 89-101.

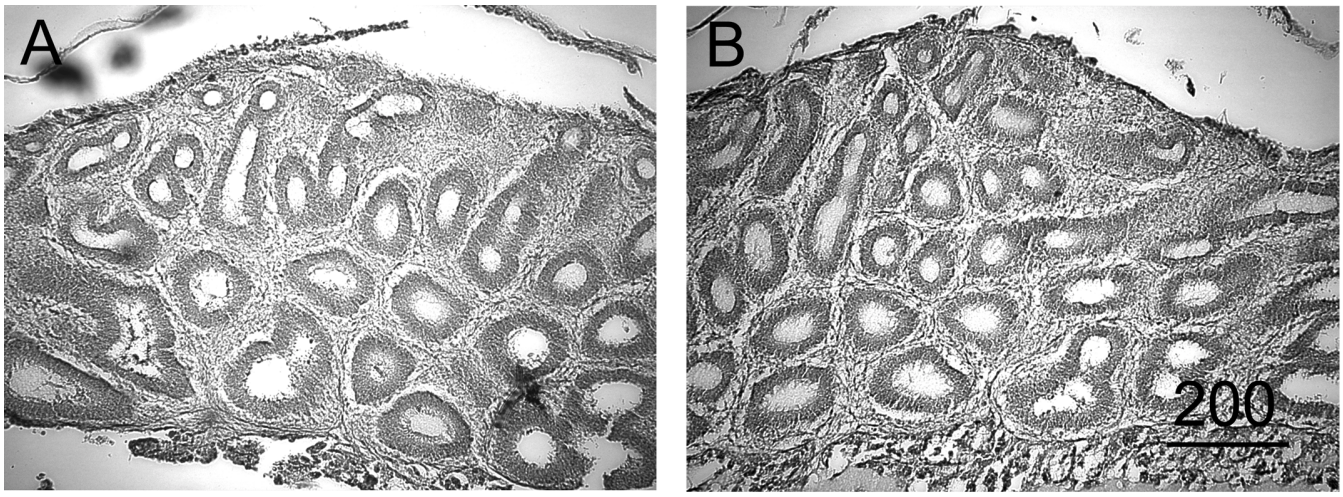

Fig. 3. Colleteric gland tubules of *Sacculina scabra* on the A) left hand side and B) right hand side of the visceral mass. Scale bar in μm.