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New records of *Fecampia abyssicola* (Platyhelminthes : Rhabdocoela : Fecampiidae)

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Abstract: : Cocoons of *Fecampia abyssicola* were dredged from several new localities in the Pacific, Indian, and Atlantic Oceans. The cocoons collected are described and a reconstruction is provided of the reproductive system of the adult worm in the spawning stage. The new sampling localities extend the depth range from which cocoons have been obtained, viz. between 1 302 m and 5 197 m.

Résumé : Des cocons de *Fecampia abyssicola* ont été dragués dans plusieurs localités nouvelles des océans Pacifique, Indien et Atlantique. Les cocons sont décrits et on présente une reconstruction de l'appareil reproducteur du ver adulte au stade de ponte. Les nouvelles localités permettent l'extension des limites de profondeur auxquelles des cocons ont été trouvés : ces limites sont respectivement 1 302 et 5 197 m.

INTRODUCTION

The flatworm family Fecampiidae contains the three genera *Fecampia* Giard, 1886, *Kronborgia* Christensen & Kanneworf, 1964, and *Glanduloderma* Jägersten, 1941. Fecampids parasitize on marine invertebrates, but after having reached sexual maturity the flatworms leave their hosts. Once outside their hosts, fecampids enclose themselves in a cocoon in which they deposit their egg capsules, after which the worms start to degenerate (Caullery & Mesnil, 1903 ; Christensen & Kanneworf, 1964).

Members of *Kronborgia* make straight or coiled tubiform cocoons which are open at both ends, while species of *Fecampia* produce more or less flask-shaped cocoons with only one opening. These cocoons have very characteristic, species-specific shapes. The cocoon of *Glanduloderma* is unknown.

From the biology of fecampids, it is evident that cocoons are more likely to be found during zoological surveys than the mature animals that produced them (cf. Christensen, 1981 b).

From the centre national de tri d'océanographie biologique in Brest, we received a small collection of flatworms taken during several French deep-sea cruises in the Atlantic, Indian, and Pacific Oceans. Several of these benthic samples contained cocoons unmistakably belonging to a fecampid species. The shape of the cocoons suggested that the animal involved was *Fecampia abyssicola*, described by Christensen (1981 a). In an attempt to obtain information on the morphology of the enclosed adult worm, some of the cocoons were sectioned and the preparations compared with Christensen's (1981 a) account of *F. abyssicola*.

In this paper we describe the cocoons collected, our histological findings concerning the adult worm, and the various locations from which the material was obtained.

MATERIAL AND METHODS

Cocoons of *F. abyssicola* were collected during the following French deep-sea cruises : ABYPLAINE, chief : Claude Monniot, Museum, Paris (see Monniot & Segonzac, 1985) ; Safari I, chief : Claude Monniot (see Monniot, 1984) ; BALGIM, chief : Philippe Bouchet, Museum, Paris ; WALVIS and SEABED, chief : Myriam Sibuet, IFREMER, Brest ; DRANOD, chief : Yan Morel, IFREMER, Brest. Material and collection sites are as follows :

ABYPLAINE. Station 4/CP 03, North Atlantic Ocean, 36° 48.7'N 19° 09.2'W 36° 49.4'N 19° 09.8'W, 4 960 m, 20.05.1981, 7 cocoons.
SAFARI I. Stat. 26/CP 16, Indian Ocean, 24° 23'S 58° 21'E, 4 890 - 5 043 m, 20 September 1979, 7 cocoons.
BALGIM. Stat. CP 10, North Atlantic, 36° 45.3'N 9° 32'W, 1 602 m, 29.05.1984, 2 cocoons ; stat. CP 62, North Atlantic, 35° 31.3'N 7° 26.2'W, 1 302 m, 04.06.1984, 3 cocoons.
WALVIS. Stat. CP 01, South Atlantic, 33° 53.6'S 05° 06.7'E, 5 040 m, 24.12.1978, 8 cocoons ; stat. CP 03, South Atlantic, 33° 21.8' S, 02° 40.4'E, 4 655 m, 28.12.1978, about 10 cocoons ; stat. CP 15, South Atlantic, 32° 29.4'S 13° 22.0'E, 3 677 m, 13.01.1979, 1 cocoon.
SEABED. Stat. CP 17, North Atlantic, 24° 51.98'N 25° 00.20'W, 5 197 m, 10.11.1980, 2 cocoons.
DRANOD. Stat. 44025, Pacific Ocean, 13° 13.0'N 129° 09.3'W, 4 740 m, 07.04.1982, 5 cocoons ; stat. 44047, Pacific Ocean, 13° 36.4'N 128° 10.3'W, 4 670 m, 12.04.1982, 14 cocoons.

The samples WALVIS stat. CP 03, SAFARI stat. CP 16, and DRANOD stat. 44047 will be deposited in the Zoological Museum of the University of Amsterdam ; the other samples will be deposited in the Museum national d'histoire naturelle, Paris.

The cocoons were studied under a low-power binocular microscope. Only few of the cocoons contained egg capsules and thus possibly the adult worm itself.

Five of the cocoons with egg capsules were sectioned at intervals of 8 µm and the sections were stained in Mallory-Heidenhain : Zoological Museum, University of Amsterdam, V.P1. 819, WALVIS, stat. CP 01, serial sections on 13 slides ; V.P1. 819, WALVIS, stat. CP 03, serial sections on 5 slides ; V.P1. 820, DRANOD, stat. 44025, serial sections on 5 slides ; V.P1. 821.1, BALGIM, stat. CP 62, serial sections on 13 slides ; V.P1. 821.2, BALGIM, stat. CP 62, serial sections on 5 slides.

DESCRIPTION

THE COCOON

The dirty-white cocoons are flask-shaped, consisting of a rounded or oval capsule with a narrow and relatively long neck. All of the cocoons collected by the six deep-sea cruises are of a similar shape and look like the ones depicted in Fig. 1. However, the shape and size of individual cocoons may vary considerably. The neck or nozzle, for example, is straight in some cocoons, whereas in others it is curved to greater or lesser extent.

Size variation was determined by measuring on 37 cocoons the length of the capsule (i.e. the length of the cocoon without the neck), the width of the capsule, and the length of the nozzle. Capsule length varied between 2.75 and 7 mm ($\bar{x}$ = 4.34, sd = 1.02, n = 37), and the width between 2 and 5 mm ($\bar{x}$ = 3.27, sd = 0.69, n = 37), the length of the nozzle ranged from 1.75 to 5 mm ($\bar{x}$ = 2.90, sd = 0.66, n = 36). The great variation in size indicated by these figures is not due to heterogeneity between the samples because similar variation is found within each sample. For example, among the four cocoons measured from station 4/CP 03 of the deep-sea cruise ABYPLAINE, one was 7 mm long and another cocoon had a length of 2.75 mm. In the other samples size variation was less extreme but still considerable.

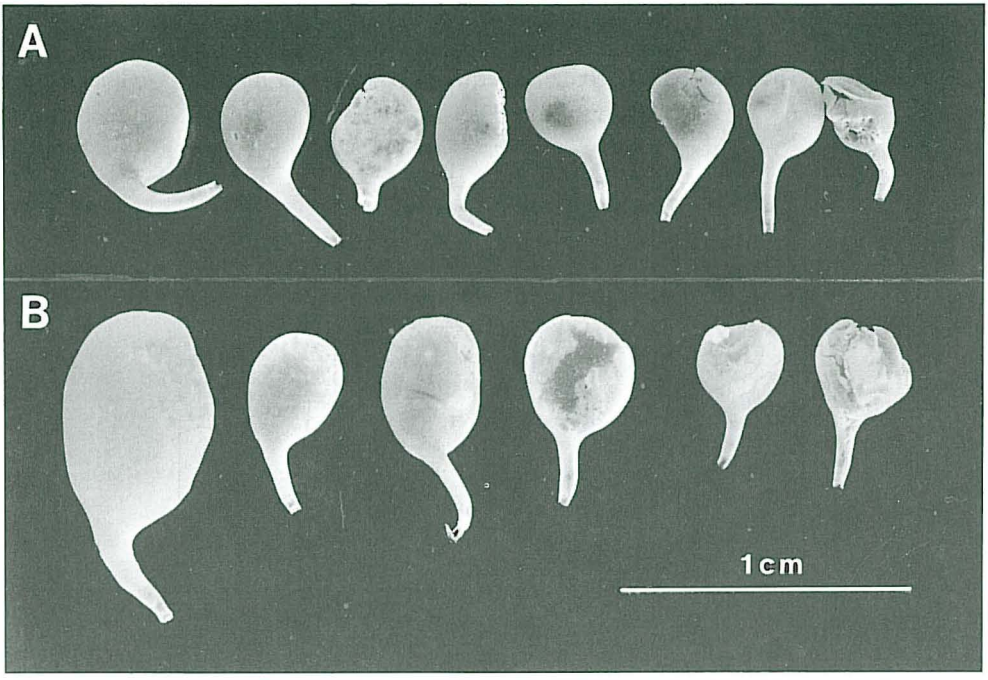

Fig. 1 - Dorsal view of cocoons from sample CP 01, South Atlantic (A) and sample CP 03, North Atlantic (B).

In the material examined, only a few cocoons were attached to small pieces of stone. In all other cocoons, however, one side was more of less flattened, thus suggesting that they had also been attached to some sort of substratum. In some of the cocoons this flat, ventral surface showed a few distinct grooves as indications of a former attachment to a hard substratum. The dorsal surface of the cocoons is arched.

MORPHOLOGY OF THE ADULT WORM

The following description is based on worms being enclosed in the cocoons, i.e. on specimens in the spawning stage.

The oval-shaped body is covered with a nucleated epidermis, provided with cilia. The ectal part of the cubodital epidermal cells is packed with numerous short, rod-shaped rhabdites.

The epidermis is underlain with a single row of subepithelial circular muscles, and a thin layer of longitudinal muscles.

The body is almost completely filled with yolk cells, only some space being left at the most anterior and posterior ends of the body. In the anterior end eosinophilic glands are present which discharge their secretion to the exterior, the posterior end houses the reproductive system.

One series of serial sections allowed a sagittal reconstruction of the reproductive system (Fig. 2), but there remained uncertainty about what represents the dorsal and ventral aspect of the system. The yolk cells are discharged into well developed vitelline ducts on either side of the body. The ducts, which contain sperm, open separately into the proximal end of

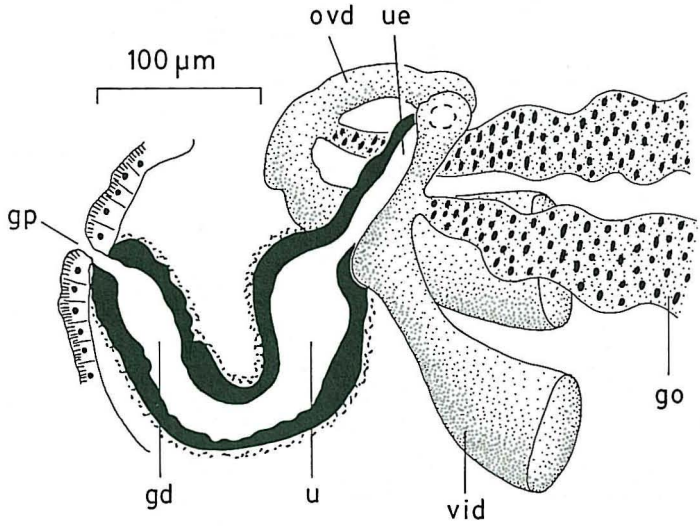

Fig. 2 - Sagittal and slightly diagrammatic reconstruction of the reproductive system of *F. abyssicola* (ZMA V.P1. 821.2). Abbreviations : gd, gonoduct ; go, gonad ; gp, gonopore ; ovd, ovo-vitelline duct ; u, uterus ; ue, uterus extension ; vid, vitelline duct.

the uterus extension. The vitelline ducts receive the openings of the gonads shortly before communicating with the uterus extension. As a consequence, the section of the vitelline ducts between the openings of the gonads and the point of communication with the uterus extension constitute the ovo-vitelline ducts.

The uterus extension communicates with the uterus, which via a curved gonoduct opens to the exterior through a very narrow gonopore, which is situated at the posterior end of the body. The uterus, including its extension, and the gonoduct are lined with cuboidal or tall, nucleated cells, and are surrounded by a layer of mostly circularly running muscle fibres.

ECOLOGY AND DISTRIBUTION

The cocoons came from deep water in three ocean basins, the collecting depths varying between 1 302 m and 5 197 m. Christensen's (1981 a) material came from the same three basins, viz. the Atlantic, Indian, and Pacific Oceans. When the new collecting sites presented in this paper are plotted on a map together with the localities given by Christensen (1981 a), the resulting figure (Fig. 3) strongly suggests that *F. abyssicola* has a world-wide distribution, at least between the 40° latitudes.

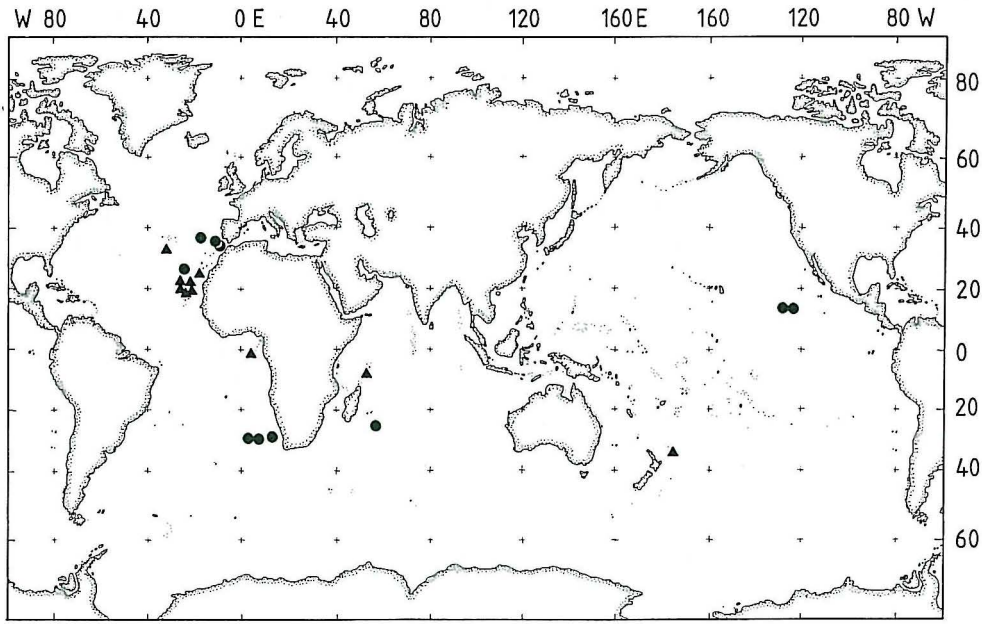

Fig. 3 - Geographical distribution of *Fecampia abyssicola*. Triangles : records from Christensen (1981 a). Circles : new records.

DISCUSSION

It was already mentioned in the introduction that the shape of the cocoons immediately suggested that the newly collected material concerned *F. abyssicola*. A comparison between Fig. 1 and the cocoons of *F. abyssicola* as depicted in Christensen's (1981 a) paper reveals that the shape of the newly collected cocoons is very similar to that of the type material. There is also a close agreement between our measurements and those given by Christensen (1981 a). In the material studied by the last-mentioned worker, cocoon length (without the neck) varied between 2.8 and 6.8 mm, which comes very close to our figures, viz. 2.75 and 7 mm. In Christensen's material there was also a very large cocoon which measured 8.6 mm in length, not counting the neck.

That the newly collected cocoons concern *F. abyssicola* is supported by the morphology of the adult worm. Notably, the reproductive system with its curved gonoduct in our specimens closely resembles the situation characteristic of the type specimens of *F. abyssicola* (cf. Christensen, 1981 a : Plate 6, C).

There is one difference between Christensen's (1981 a) description and our account that should be noted. Christensen (1981 a) did not provide a reconstruction of the reproductive system and only stated that the ovo-vitelline ducts lead to the uterus. Our reconstruction (Fig. 2) indicates that the ovo-vitelline ducts actually open into a clearly demarcated, narrow duct that communicates with the uterus. Following the terminology used in descriptions of other fecampids, we consider this duct to be the uterus extension.

Unfortunately, larvae could not be found in the egg capsules present in the cocoons examined by us.

The material of *F. abyssicola* examined by Christensen (1981 a) originated from deep sea samples taken at depths ranging between 1 500 and 4 730 m. The collecting sites which yielded the cocoons described in this paper extend this depth range in both directions since upper and lower limits are 1 302 m and 5 197 m, respectively.

Christensen (1981 b) expected *F. abyssicola* to be well distributed in the Atlantic, the Indian Ocean, and the West Pacific between the 40° latitudes. This prediction turned out to be correct as far as the Atlantic and the Indian Oceans are concerned. In addition to the new records for the North Atlantic, *F. abyssicola* is now known also from the South Atlantic and from a more southern locality in the Indian Ocean (Fig. 3). Concerning the Pacific Ocean the newly collected material shows that *F. abyssicola* is not confined to the West Pacific, as expected by Christensen (1981 b), but occurs also on the eastern side of the Pacific basin.

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