

***Penilpidia ludwigi* (MARENZELLER, 1893) (Holothurioidea: Elpidiidae) rediscovered from the Eastern Mediterranean Sea**

D. FIEGE & Y. LIAO

Abstract: After more than 100 years, *Penilpidia ludwigi* (MARENZELLER, 1893) has been rediscovered. It was found widely distributed in the Eastern Mediterranean Sea, occurring even in its deepest parts. *P. ludwigi* shows an epibenthic mode of life, feeding on the sediment. Major taxonomic characters are described and earlier taxonomic studies briefly summarized in view of defining its systematic position.

Introduction

The holothurian fauna of the bathyal Mediterranean Sea is known to be remarkably poor, with only six species reported by HANSEN (1975), i.e., *Mesothuria verrilli*, *Mesothuria intestinalis*, *Pseudostichopus occultatus*, *Stichopus regalis*, *Molpadia musculus*, and *Penilpidia ludwigi*. This is probably a result of the geological history and the geographic isolation of this sea, impeding colonization by species of the Eastern Atlantic fauna. *P. ludwigi* is the only Mediterranean representative of the Elpidiidae, a true deep-sea group. It has never been found in other areas and is considered endemic to the Mediterranean Sea (HANSEN 1975). *Penilpidia ludwigi* was originally described by MARENZELLER in 1893 based on material collected by the "Pola"-expedition in 1891 from three stations between Crete and the Peloponnese at depths of 755-1292 m. These stations were later erroneously quoted as being situated south of Sicily by HANSEN (1975) and GEBRUK (1988). For more than a hundred years, *P. ludwigi* had not been recorded again.

Material and Methods

In 1993 the "Meteor"-25 expedition sampled deep-sea benthos along two transects across the Eastern Mediterranean Sea from the Gulf of Taranto to the Egyptian and Israeli coasts (Tab. 1, Fig. 1). At each station three replicate samples were taken with an USNEL spade corer (50 x 50 cm) (code: bc). Specimens of *Penilpidia ludwigi* were picked separately from the sediment surface and fixed with 4% formaldehyde diluted with seawater. For

microscopic examinations parts of the specimens were removed and transferred to glycerol with 4 % formaldehyde added. The soft tissue was dissolved with a solution of NaClO. After examination, a number of specimens was transferred to 70 % ethanol for preservation. For comparison, type material was also examined (NHMW 11150). The specimens are deposited in the Senckenberg Museum Frankfurt (SMF) and the Natural History Museum Vienna (NHMW).

Results and Discussion

In 1993, *Penilpidia ludwigi* (MARENZELLER, 1893) (Figs 2A, B, Fig. 3) was rediscovered in nine soft sediment samples taken at five stations in the Eastern Mediterranean Sea covering a depth range from 1006-4766 m, i.e., stations 16 and 17 southwest of the Peloponnese, stations 18 and 19 south of Crete, and station 24 off the Egyptian coast (Tab. 1, Fig. 1).

These findings show that *Penilpidia ludwigi* has a much wider distribution than the findings of the "Pola" expedition from 1891 suggested, inhabiting even the deepest parts of the Mediterranean. It seems to be restricted to the Eastern Mediterranean, but this impression could also be due to inadequate sampling in the western part. While most of the samples contained only a single specimen, two of the three samples taken at station 17 (4766 m) contained 14 and 13 specimens, respectively. These high numbers in such a small area suggest that mass aggregations might occur, as have been reported for other species, e.g. *Kolga hyalina* in the Atlantic (BILLETT and HANSEN 1982).

Penilpidia ludwigi (MARENZELLER 1893) was found to live epibenthically, feeding on the sediment, as indicated by the contents of the intestine in the transparent specimens (Fig. 2, Fig. 3). Specimens disintegrated very quickly due to the temperature change from 13-14 °C on the sea bottom to ca. 30 °C on the surface, thus making live observations impossible.

A total of 37 specimens were collected, measuring 15-20 mm in length and 4-6 mm in width, depending on the contraction during fixation. Specimens are unpigmented and transparent with the exception of the sediment-filled intestine (Figs 2A, B). The body shape is elongated ovoid, with the posterior part being somewhat narrower than the anterior and also more flattened dorso-ventrally. Six pairs of tubefeet border the posterior half of the flattened ventral sole. Ten tentacles surround the mouth, each bearing six to eight marginal lobes (Figs 2C, D). The spicules found in these appendages are simple, more or less curved rods with spines at their ends and sometimes also in the middle on the external side of the curve (see MARENZELLER 1893: Pl.

IV, Figs 8 B, C). The calcareous ring surrounding the mouth consists of five interlinked pieces. Each piece has four pairs of arms radiating from the centre.

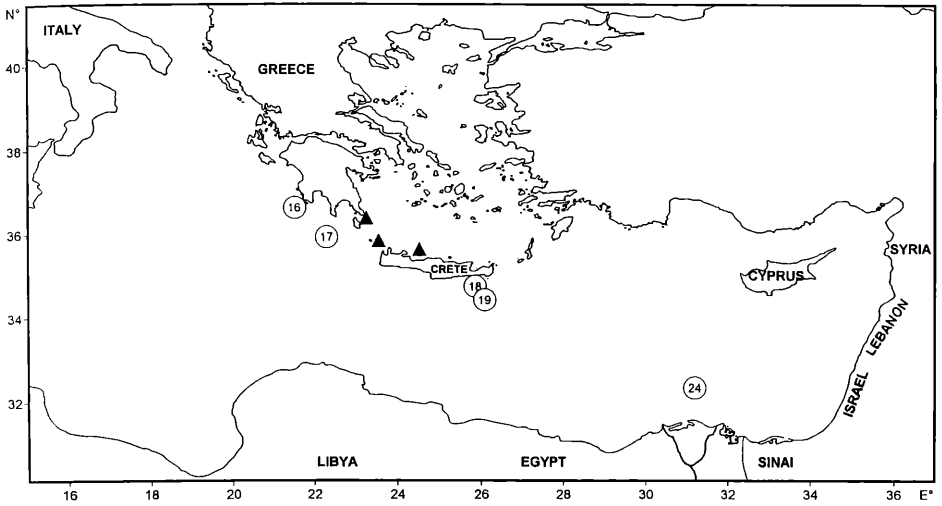


Fig. 1: Map of stations where *Penilpidia ludwigi* was found (▲: Stations of "Pola", 1891; ○ : Stations of "Meteor", 1993).

Tab. 1: Benthos stations of "Meteor" cruise 25 where *Penilpidia ludwigi* was collected (bc = box core).

Stations	Coordinates	Depth	Sample	No. of Specimens
#16	36°36.38N 21°34.02E	3848 m	bc2	1
#17	35°50.52N 22°19.91E	4766 m	bc1	14
			bc2	1
			bc3	13
#18	34°44.45N 25°51.05E	1377 m	bc3	1
#19	34°25.04N 26°05.75E	4391 m	bc1	1
			bc2	4
			bc3	1
#24	32°19.42N 31°10.60E	1006 m	bc2	1

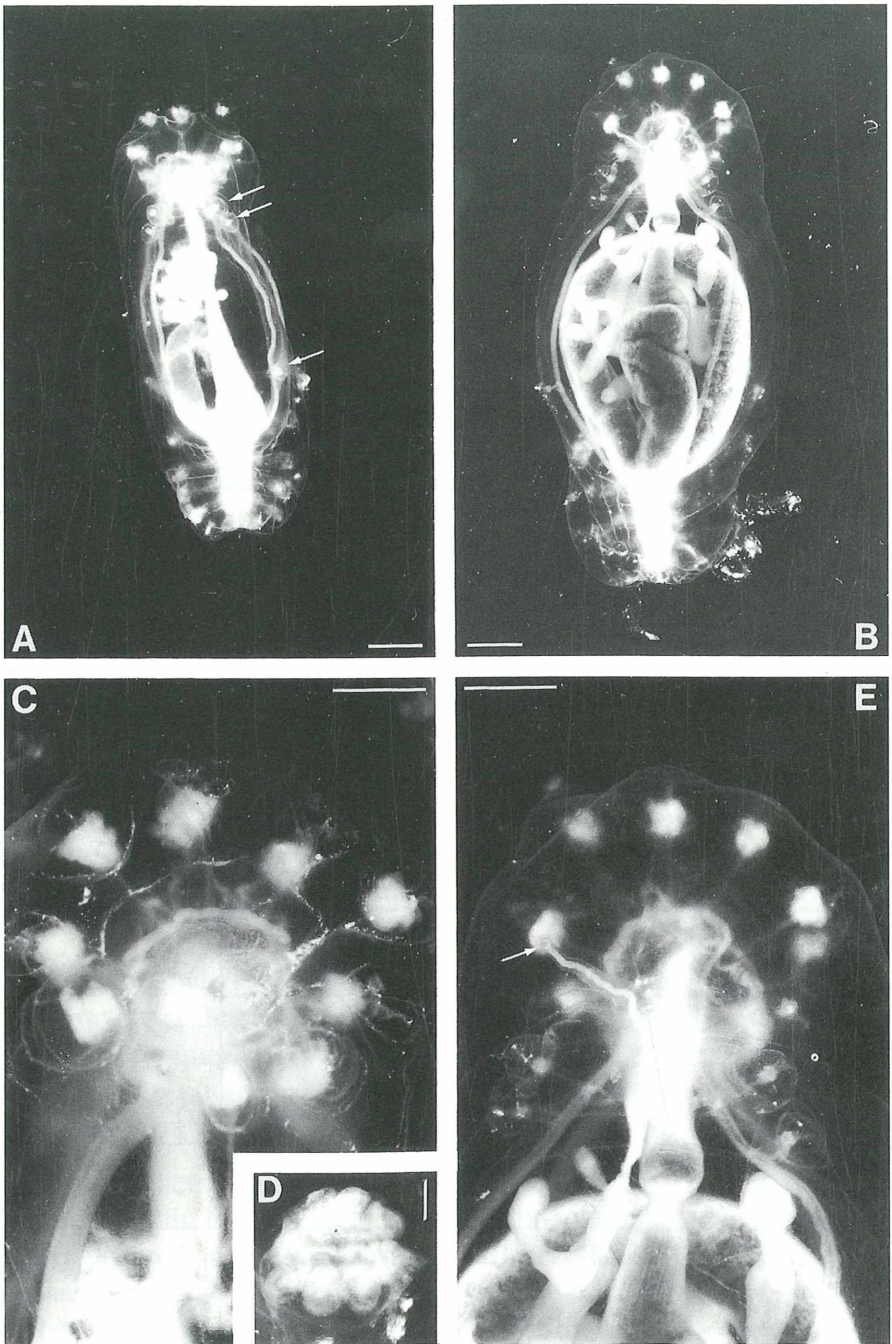


Fig. 2: *Penilpidia ludwigi*: A, B: dorsal view of two different specimens (→: dorsal papillae). C, D: ventral view of oral tentacles. E: dorsal view of anterior part showing dorsal papillae and genital porus (→). Scales: A, B: 2 mm; C, E: 1 mm; D: 0.2 mm.



Fig. 3: *Penilpidia ludwigi* feeding on the sediment surface.

The tube-like opening of the gonoduct is situated in front of the dorsal papillae (Fig. 2E). In most of the specimens, three pairs of retractile dorsal papillae are present (Figs 2A, E). Two pairs are located very closely together in trapezoidal arrangement at about one third of the length, the second pair being a little wider apart than the first pair. The posterior pair of the dorsal papillae is situated at the beginning of the posterior third of the body. In one specimen from station 17 bc3, only three dorsal papillae are present - one anterior pair and a single posterior papilla on the right side of the body.

The systematic position of *Penilpidia ludwigi* has been questioned several times. MARENZELLER (1893) described it in detail and placed it in the genus *Kolga*. In 1923 HÉROUARD transferred it to the genus *Periamma* because of the reduced posterior dorsal papillae and the presence of the "corpuscule ternaire". HANSEN (1975) attributed it to the genus *Irpa* based on the structure of the calcareous ring surrounding the mouth. In 1988 GEBRUK erected the genus *Penilpidia* comprising *P. ludwigi* and *P. pacifica*. Species of this genus were characterized by combining skeletal elements typical for *Peniagone* and *Elpidia*. BILLET and HANSEN (1982) assumed a close relationship between the genera *Elpidia*, *Kolga*, and *Irpa* due to the identical basic structure of the calcareous ring. The specimens collected by the "Meteor" 25 expedition will provide the basis for a taxonomic revision to define the proper systematic position of this tiny deep-sea holothurian.

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Addresses of the authors:

Dieter FIEGE, Forschungsinstitut Senckenberg, Sektion Marine Evertebraten II, Senckenberganlage 25, D-60325 Frankfurt/M, Germany.
(corresponding author)
e-mail: dfiege@sng.uni-frankfurt.de

Yulin LIAO, Institute of Oceanology, Chinese Academy of Sciences, 7 Nanhai Rd., 266071 Qingdao, China.

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