FAUNA OF ARABIA **20**: 169–175 Date of publication: 05.09.2004

# *Anomopus telphusae* Piovanelli, 1903, an epizoic bdelloid (Rotifera: Bdelloidea) on the Socotran endemic crab *Socotrapotamon socotrensis* (Hilgendorf, 1883)

**Kay Van Damme and Hendrik Segers**

Abstract: The obligate epizoic rotifer *Anomopus telphusae* Piovanelli, 1903, so far known only from freshwater crabs in Italy and Bulgaria, is recorded from the Socotran endemic crab *Socotrapotamon socotrensis* (Hilgendorf, 1883). SEM micrographs of the most diagnostic structures, the trophi, and photographs of the animal are given for the first time.

## ***Anomopus telphusae* Piovanelli, 1903 الطفيل الخارجي**
## **(دولابيات Rotifera: Bdelloidea) على سرطان سقطرى المتوطن**
## ***Socotrapotamon socotrensis* (Hilgendorf, 1883)**

**كاي فان دامي و هندريك سيغرس**

**خلاصة:** تم تسجيل الطفيل الدولابي الإجباري الخارجي *Anomopus telphusae* Piovanelli, 1903، والمعروف حتى الآن كطفيل فقط على سرطانات المياه العذبة في إيطاليا وبلغاريا، في سرطان سقطرى المتوطن *Socotrapotamon socotrensis* (Hilgendorf, 1883)، تضمن البحث صوراً بواسطة المجهر الإلكتروني الماسح لأهم التراكيب التشخيصية والمغذية، وكذلك صور للحيوان لأول مرة.

## INTRODUCTION

During a UNDP/GEF-funded multidisciplinary expedition to Socotra (Yemen) in 1999, and a second field trip in 2001, freshwater and brackish water habitats were sampled throughout the Socotra Archipelago in order to investigate the freshwater invertebrates (for further details, see VAN

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DAMME et al. 2004). As part of this research, one juvenile and ten adult specimens of freshwater crabs belonging to the genus *Socotrapotamon* Brandis & Apel, 2000 were transported to the laboratory for observations in vivo. One juvenile specimen (carapace width 2.5 cm) was seen to be carrying moss-like patches on the dorsal exoskeleton, between the coxae and on the maxillae. These patches proved to consist of clusters of *Anomopus telphusae* Piovanelli, 1903, a rare and poorly known bdelloid rotifer, of which a description can be found in DONNER (1965). This species had not been recorded from anywhere outside Italy and Bulgaria, where it was found to be restricted to the freshwater crabs *Potamon fluviatile* (Herbst, 1785) and *P. ibericum* (Bieberstein 1808), respectively.

Rotifer species are known to have adapted to a wide range of freshwater habitats, including life as epi- and endozoics, but studies on these rotifers and their associations are relatively scarce (MAY 1989). The phylum had not been recorded from Socotra Island before, but rotifers are frequently found in zooplankton samples from the area.

## MATERIALS AND METHODS

Live observations were made under a stereomicroscope, and images were made using a digital camera, Nikon Coolpix 990, mounted on an Olympus BH-2. Trophi were isolated by dissolving the soft tissues with NaOCl, followed by repeated washing in distilled water and air-drying on a circular cover slip (SEGERS 1993, SEGERS & DUMONT 1993). After gold coating, the structures were examined using a JEOL-JSM 840 scanning electron microscope.

Abbreviations:

| | |
|---|---|
| GU | Collection at Ghent University, Laboratory of Animal Ecology, Belgium |
| NHCY | Natural History Collection Yemen |

## SYSTEMATIC ACCOUNT

Phylum **Rotifera** Cuvier, 1817
Class **Eurotatoria** De Ridder, 1957
Subclass **Bdelloidea** Hudson, 1884
Family **Philodinidae** Ehrenberg, 1838

***Anomopus*** Piovanelli, 1903

Type species: *Anomopus telphusae* Piovanelli, 1903.

Remarks: Only two species are described in this genus, both obligatorily epizoic. The status of *Anomopus chasmagnathi* Mañé-Garzón & Montero, 1973 is uncertain; the drawings of diagnostic features are not comparable with other species by modern standards of bdelloid taxonomy.

***Anomopus telphusae*** Piovanelli, 1903 Figs 1-3

*Anomopus telphusae* Piovanelli, 1903: 345-346.

Specimens examined: Yemen, Socotra Island: 15 spms, Wadi Ayhaft, 12°35.910'N 53°59.514'E, 300 m, clear shallow stream with conductivity 600 µS $cm^{-1}$, pH 7.6, K. Van Damme, 02.III.1999, GU. Five specimens will be deposited in the NHCY.

Diagnosis: Morphologically, *A. telphusae* Piovanelli, 1903 is easily recognisable by the relatively large width of the corona (Fig. 1 a-b), the presence of minute spurs on the foot

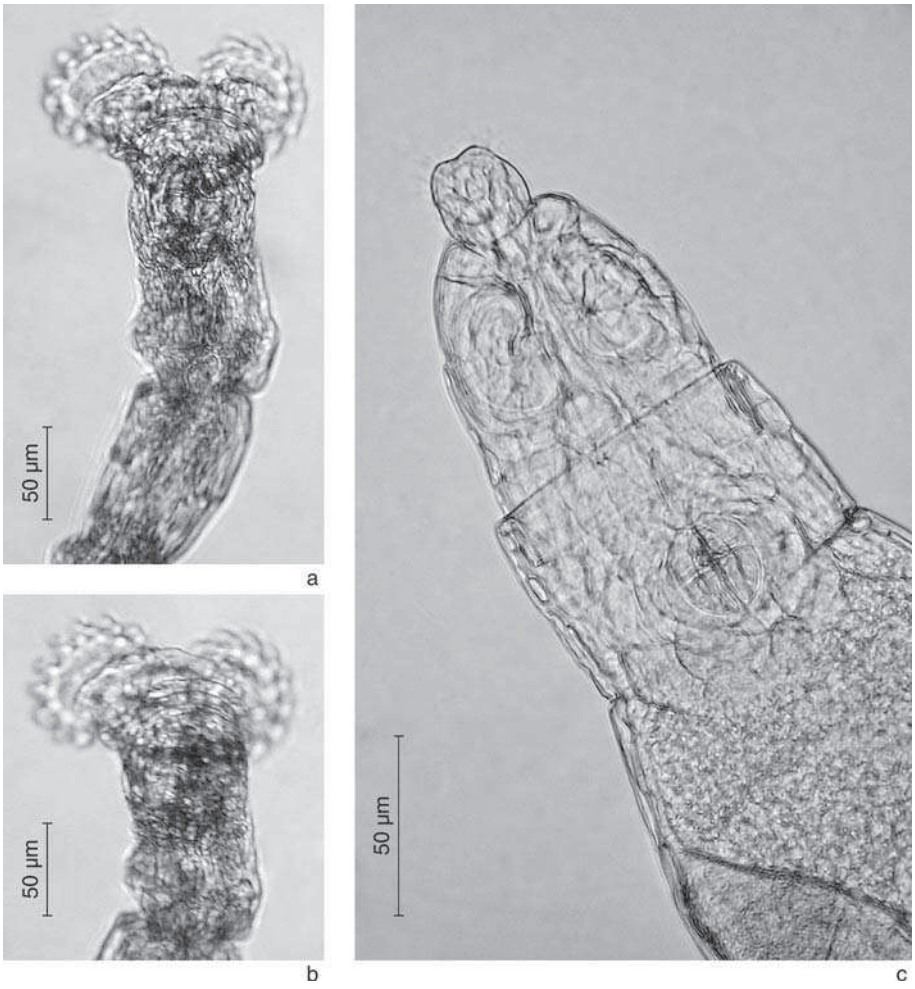


**Fig. 1:** Anterior region of *Anomopus telphusae* from Socotra Island; **a-b:** dorsal view of extended corona; **c:** dorsal view of head and rostrum, retracted trochal discs.

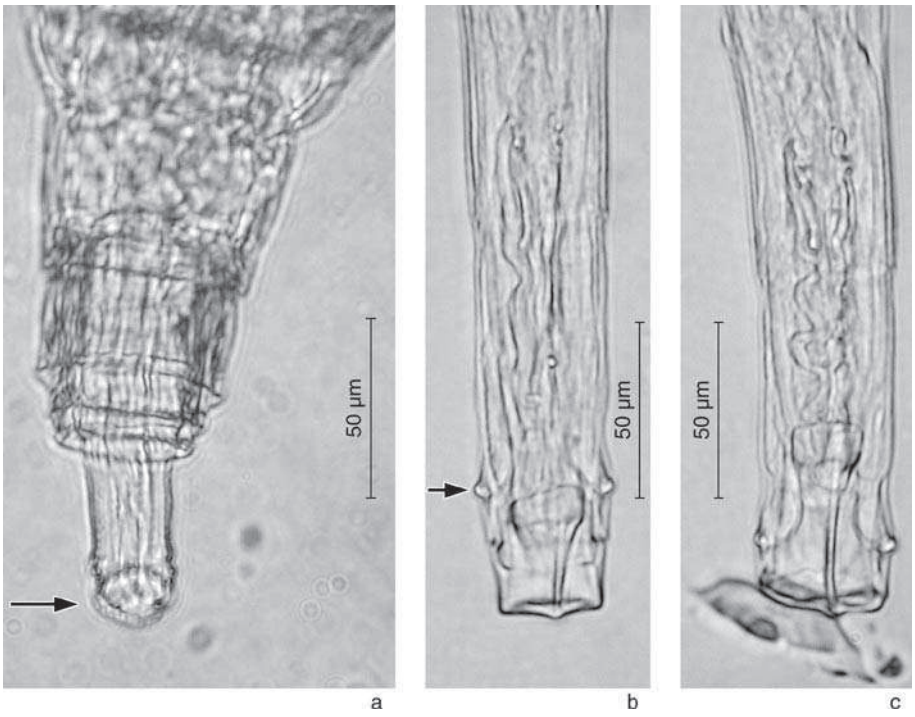


**Fig. 2:** Caudal region of *Anomopus telphusae* from Socotra Island; **a:** last foot pseudosegment and adhesive disc (arrow); **b:** foot with spurs (arrow), last pseudosegment retracted; **c:** foot with spurs and detached adhesive patch.

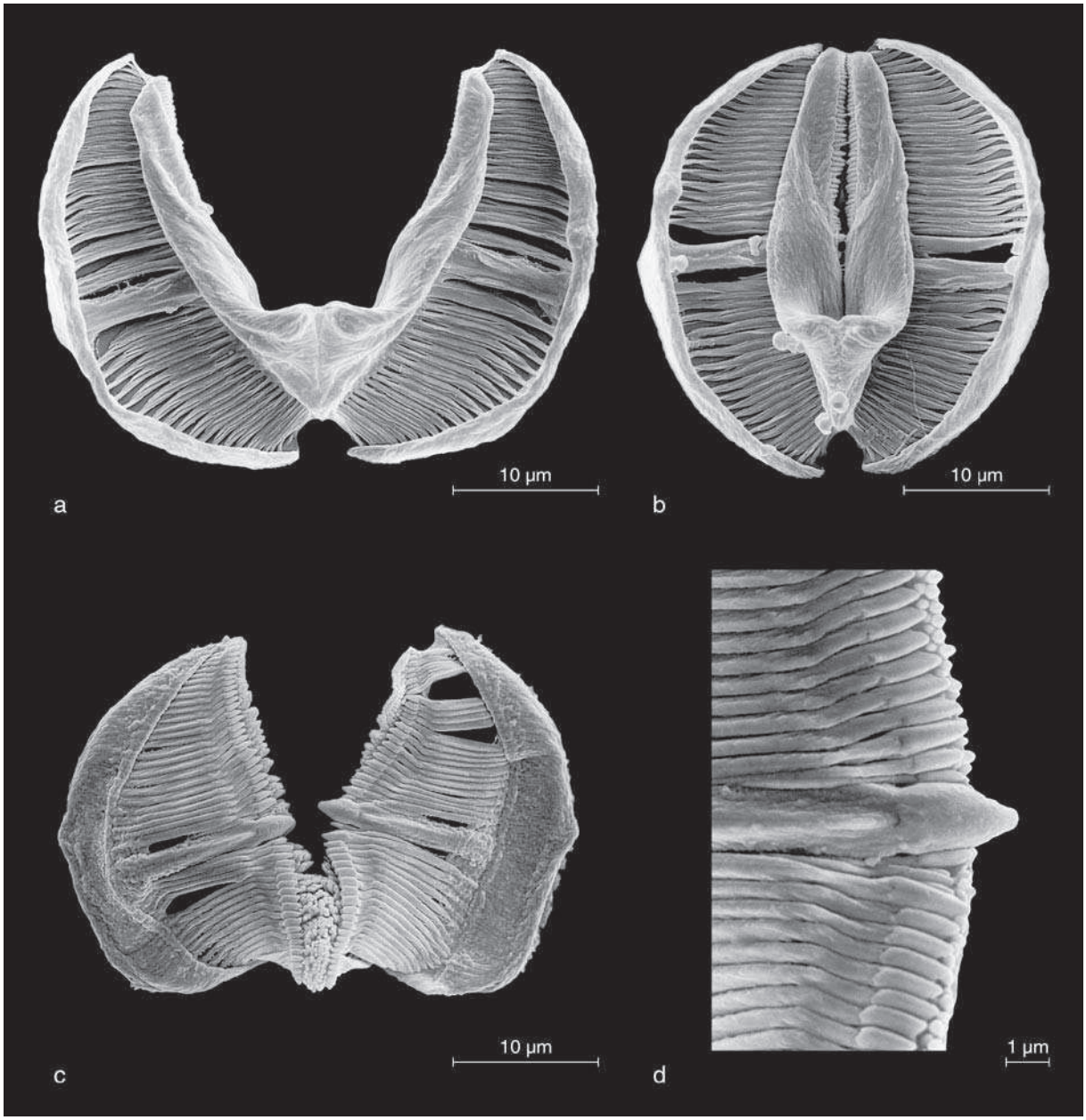


**Fig. 3:** Trophi of *Anomopus telphusae* from Socotra Island, SEM micrographs; **a:** frontal view of opened trophi; **b:** detail of right uncus, showing tip of major uncus tooth, frontal view; **c:** caudal view of opened trophi; **d:** caudal view of closed trophi.

(Fig. 2 b-c) and the presence of a single major tooth on both unci (Fig. 3 c-d), a unique feature within the Bdelloidea.

Description of specimens from Socotra: Body length in extended state, measured from penultimate pseudosegment to rostral tip, 460-600 µm, with an average of 510 µm (n = 10). Longitudinal striation of the body visible in median portion of the animals. Corona relatively wide: about twice as wide as the head (Fig. 1 a-b). Rostrum relatively stout, dorsal lamella indented (Fig. 1 c). Dorsal antenna (not shown) long and slender. Toes absent (Fig. 2 a), last pseudosegment with terminal adhesive disc (Fig. 2 a). Spurs particularly small (Fig. 2 b-c), conical.

Trophi as in Fig. 3; terminology after MELONE et al. (1998). Maximum length 30 µm, maximum width (closed) 27.5 µm (n = 3). Rami (Fig. 3 a-b): total length 25 µm, relatively straight and robust, almost one third of total width of trophi. Unci typically semicircular with one median major uncus tooth (Fig. 3 c-d), with projecting rami scleropillii. About 20-22 minor teeth proximal to the articulation and 25-26 distal minor teeth. Manubria typically semicircular in shape.

Observations: We found *Anomopus telphusae* present in patches on the juvenile freshwater crab, attached between 'hairs' on the exoskeleton of the host (carapace, limb bases, mouthparts and region between the eye-stalks). Animals were also found externally on the dorsal carapace of the juvenile specimen. Juvenile *Socotrapotamon* have groups of short hairs on the carapace, in which a matrix of detrital particles and bacteria gathers, providing a suitable attachment site for epizoic organisms. In addition to the rotifers, we also observed ciliates here. The branchial cavities of the crab were not subjected to closer examination for the presence of *Anomopus* or for other, more specialised epizoic rotifers which are also known to exist (see FONTANETO et al. 2004). We did not investigate adult crabs for the presence of epizoic organisms.

Little is known about the biology of this species and its relationship with its host. Apparently no damage is caused to the host, suggesting that the epizoic is more of a commensal than a parasite. However, there is a fine line between these two terms, and it is not clear where *Anomopus* fits. Free-living *A. telphusae* were observed by BARTOŠ (1957) to survive only 2-3 days after being separated from their host, and this is confirmed by our findings. Adult *Socotrapotamon* spend most of their time during the day hiding under stones or in self-made burrows in a moist environment, in the direct vicinity of streams and rivers. Juveniles remain in the water at all times, hiding by means of camouflage in sand, on and under stones and between plants (Van Damme, pers. obs.).

During moulting of the crab, the bdelloids were observed to abandon the exuvium, and to swim and crawl freely in the water thereafter. Some re-attached to the host after its carapace had hardened. We placed a second *Socotrapotamon*, reared simultaneously in a separate container and devoid of epizoic bdelloids, in bdelloid-containing water for two days. When this crab was checked one year later, groups of *A. telphusae* were found externally between the eye-stalks, on the mouthparts and between the coxae of walking limbs three and four, but were far less common than on the original host.

## DISCUSSION

*Anomopus telphusae* was reported earlier from branchial cavities of "*Telphusa fluviatilis*" from Trieste, Italy (PIOVANELLI 1903), a species currently known as *Potamon (Euthelphusa) fluviatile* (Herbst, 1885), known from Italy, Dalmatia as far as the Ionian Islands, and the Peloponnese (see BRANDIS et al. 2000). Recently, FONTANETO et al. (2004) confirmed this association with freshwater crabs from a locality near Florence, Italy: specimens of *A. telphusae* were found in the branchial chamber and on the exoskeleton of the host. BARTOŠ (1957) recorded the species from the gills, limb bases and mouthparts of "*Potamon potamon*" originating from Vavrá, Bulgaria, a species now called *Potamon (Pontipotamon) ibericum* (Bieberstein, 1808), with a Ponto-Caspian distribution (BRANDIS et al. 2000). *Anomopus chasmagnathi* was described from the branchial chamber of *Chasmagnathus granulata* Dana, 1851 from Uruguay (MAÑÉ-GARZÓN & MONTERO 1973). The current record of *A. telphusae* on the Socotran endemic *Socotrapotamon* is only the third known record, and is the first outside the Mediterranean region. Further research will have to establish whether these populations are as identical at the molecular level as they appear to be morphologically.

*Socotrapotamon* is believed to be a relic of a group of Potamidae more closely related to *Potamiscus* Alcock, 1909 than to *Potamon* Savigny, 1816, which is thought to have inhabited south-western Arabia, Iran and northern Pakistan during the late Miocene (APEL & BRANDIS 2000). Cannibalism, more common directly after moulting by the prey when the carapace is still weak, is a main food source for *Socotrapotamon* (Van Damme, pers. obs.). This, together with the observed colonisation of a crab in bdelloid-containing water, can be seen as an important factor for the distribution of *A. telphusae*. However, it remains unclear how this bdelloid species arrived on Socotra, an island well known for its endemics and thought to have been isolated tectonically since the Oligocene (for details on the palaeogeography of the island, see VAN DAMME et al. 2004). The current distribution of this animal could be wider than currently known, as epizoics of freshwater crustaceans are easily overlooked. More populations and species from various regions should be investigated for the presence of these small animals, as they could help in the interpretation of the biogeographical patterns of their hosts. Further investigation should also be carried out in order to gain a better understanding of the biology of *Anomopus* and its relationship to its host.

Note: During the same expedition in 1999, the senior author observed another organism associated externally with *Socotrapotamon socotrensis*, in a shallow mountain stream in the Hagghier Mountains (Adho Dimello, Adona Pass, 12°34.562'N 54°02.910'E, 950 m, conductivity 680 µS $cm^{-1}$, pH 7.8). This belonged to the Hirudinea, and specimens preserved in alcohol were given to Dr E. Neubert for further study. These relatively large (elongated state: 4-6 cm), brown-black Hirudinea were found mainly attached by the oral sucker on the dorsal side of the carapace and between the coxae of the freshwater crabs. Whether or not they feed directly on the host remains unclear.

## ACKNOWLEDGEMENTS

This study was carried out within the framework of the GEF-funded project "Conservation and Sustainable Use of Biodiversity of Socotra Archipelago", overseen by the United Nations Office for Project Services (UNOPS YEM/96/G32) in conjunction with the Environmental Protection Council (EPC) of Yemen (now called Environment Protection Authority, EPA), to whom we are grateful.

The first author also wishes to express gratitude to the other members of the expedition team, especially Dr A. Miller, Dr M. Morris, Dr E. Neubert, Dr H. Pohl, Dr U. Joger and Dr W. Wranik. Special thanks are also due to our invaluable Yemeni colleagues A. Raheeb, Dr A. Karim Nasher, Dr M. Al-Jumaily and A.S. Sa'id. Thanks also to Dr H.J. Dumont, Dr D. Brandis and Dr M. Apel for valuable comments on the manuscript.

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Manuscript submitted: 12 March 2003
Manuscript accepted: 03 September 2003