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Redescription of *Heterokrohnia mirabilis* Ritter-Záhony, 1911 (Chaetognatha)

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ABSTRACT: The genus *Heterokrohnia* Ritter-Záhony, 1911 is redefined and the species *H. mirabilis* Ritter-Záhony, 1911 redescribed. The redescription is based upon the type specimens from Antarctic waters and additional specimens from Atlantic and Arctic waters. The species is compared to others of the genus. Furthermore, the identity of certain specimens reported as *H. mirabilis* is discussed.

INTRODUCTION

During the German Southpolar Expedition of the R.V. "Gauss" (1901–1903) eight chaetognaths were collected, for which Ritter-Záhony (1911) erected the genus *Heterokrohnia* with the type species *H. mirabilis*. The specimens were found at three stations south of the Kerguelen Islands. I received these eight specimens from the Zoological Museum for Natural History of the Humboldt University in Berlin when preparing the description of *H. fragilis* Kapp & Hagen, 1985 and *H. longidentata* Kapp & Hagen, 1985. Only three of the eight specimens belonged to *H. mirabilis*; five smaller specimens turned out to belong to *H. fragilis* or to *H. longidentata*. Consequently, some characters Ritter-Záhony had ascribed to *H. mirabilis* are not present in this species. On the other hand, a study of the three remaining specimens of *H. mirabilis* revealed some organs and structures not noticed by Ritter-Záhony. Therefore a redescription of *H. mirabilis* is considered indicated.

In addition, I studied the juvenile Atlantic specimens reported by A. C. Pierrot-Bults (1982) from the Zoological Museum, Amsterdam, and recently I was presented with five specimens collected during the Arctic expedition of R.V. "Polarstern" 1989 in the Greenland Sea.

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MATERIAL

Three specimens of the original type material, from the German Southpolar Expedition of R.V. "Gauss", 64°–66° S, 75°–85° E, 3400 m–2000 m depth, 10th of March and 3rd of April 1903.

Lectotype, 19 mm long, collected on 3rd of April 1903, two paralectotypes, 18.5 mm and 12 mm long, collected on 10th of March 1903, deposited in the Zoological Museum for Natural History of the Humboldt University, Berlin, under the original catalogue No. ZMB 4909.

Eight juvenile Atlantic specimens, reported by A. C. Pierrot-Bults (1982), from R.R.S. "Discovery", Cruise 52, Station 8281, Haul 48, at approximately 32° N 64° W, 3500 m–2500 m depth, March 1973.

Five specimens from the 6th Arctic expedition of R.V. "Polarstern", 74° 51' N, 3° 57' W, 3000 m–2000 m depth, 29th of May 1989.

DIAGNOSES

Heterokrohnia Ritter-Záhony, 1911

Habitus: relatively strong and relatively slender
Lateral fins: one pair of lateral fins on trunk and tail
Transverse musculature: in trunk and tail
Teeth: of variable structure, two rows or one row
Eyes: absent
Habitat: in general pelagic, abyssal
Type species: *H. mirabilis*, by monotypy

Heterokrohnia mirabilis Ritter-Záhony, 1911

(Figs 1–3)

Habitus: slender, relatively strong
Total length: up to 33 mm
Tail length: 30–42 % of total length (without tail fin)
Lateral fins: one pair, reaching from slightly below ventral ganglion to about mid-length of tail segment, completely rayed, or with few rays, or without rays, moderately broad, anterior part narrower than posterior part
Tail fin: spade-shaped, completely rayed, or with few rays, or without rays
Head: large
Apical gland cell complex: present, small
Hooks: up to 12, slender, slightly curved, tips following curvature of the grasping spines
Anterior teeth: up to 17, arranged like roof tiles, broad at the basis, tapering to a slender anterior part, inner edges beset with lamellae
Posterior teeth: up to 35, slender, of different length, partly bent, closely arranged
Vestibular organs: thick, with very small papillae
Transvestibular pores: present

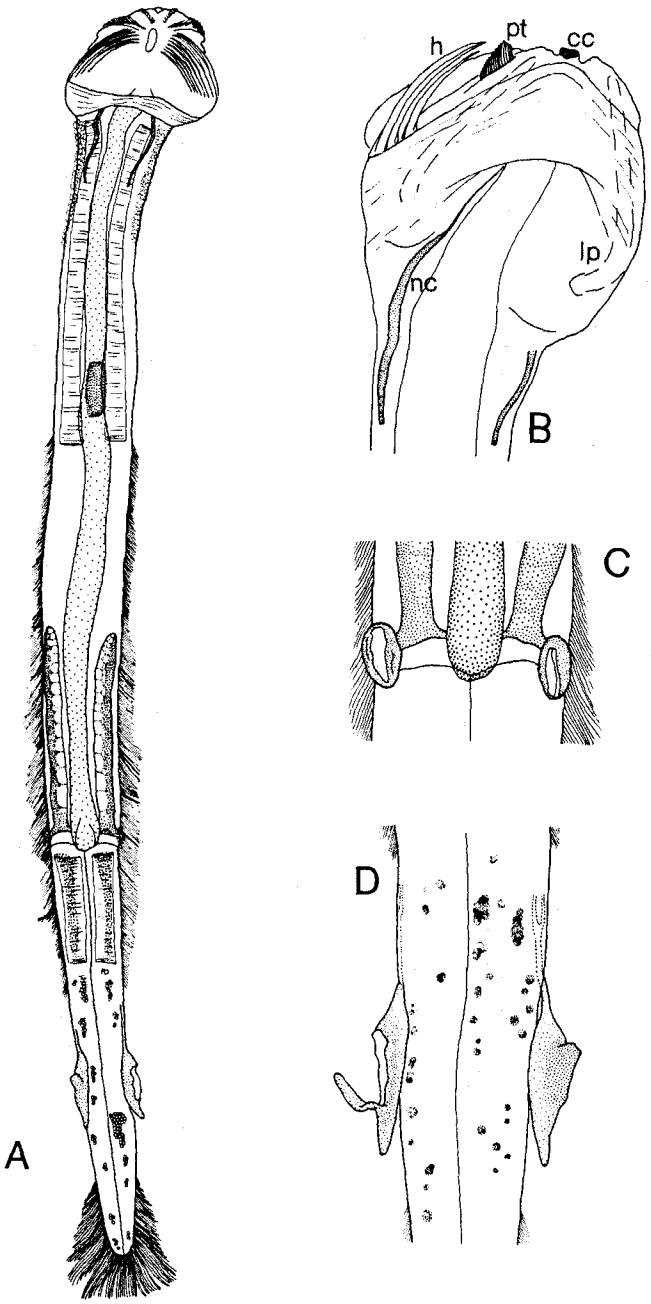


Fig. 1. *Heterokrohnia mirabilis* (drawn from Antarctic specimens). A: Habitus. B: Head, dorsal view; cc = apical gland cell complex, h = hooks, lp = lateral plates, nc = neck canals, pt = posterior teeth. C: Dorsolateral pouches in which the female gonads end. D: Seminal vesicles

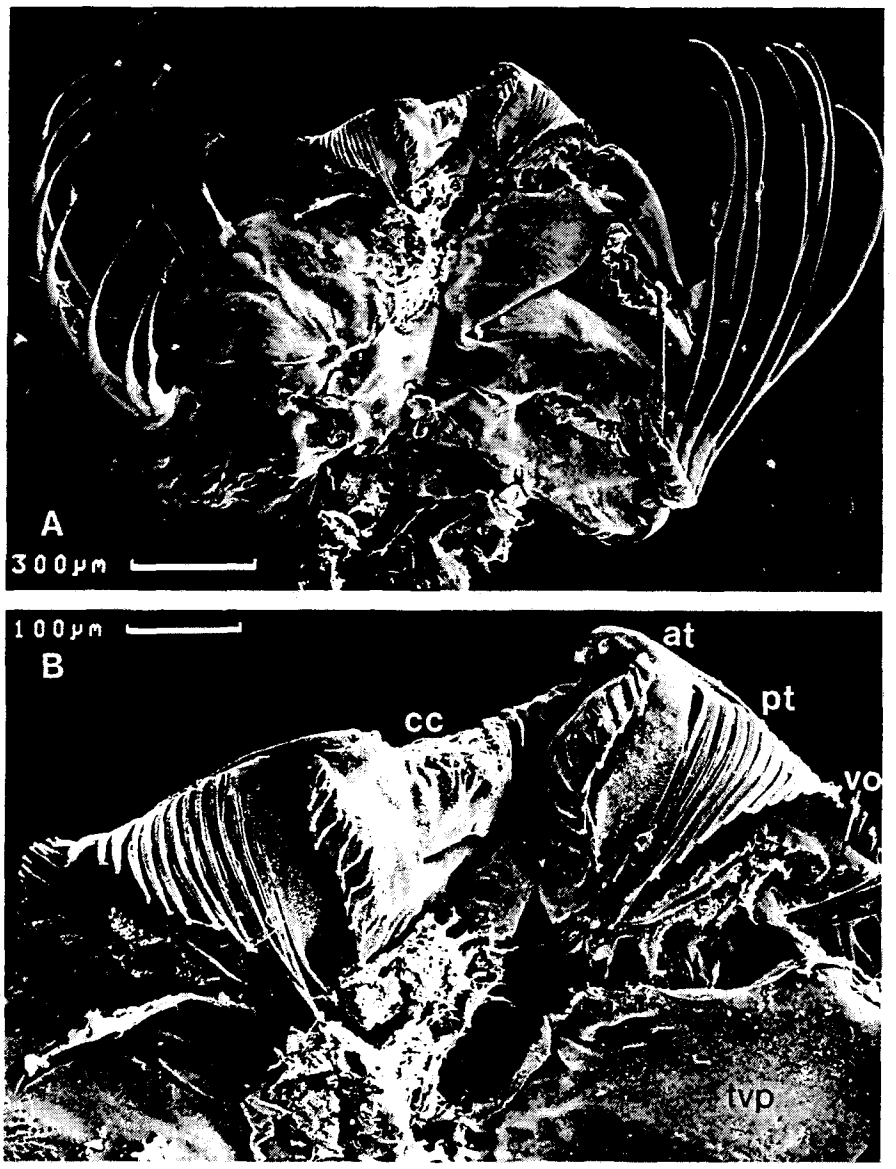
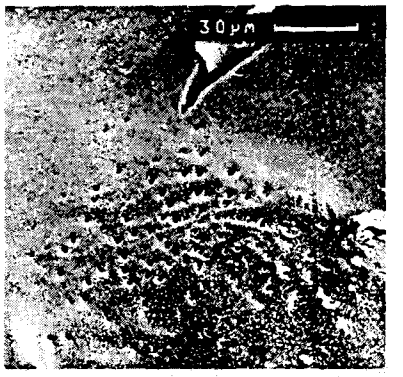


Fig. 2. *Heterokrohnia mirabilis* (from Arctic waters). A: Head, ventral view (ruptures due to preparation). B: Apical part of head; at = anterior teeth, cc =apical gland cell complex, pt = posterior teeth (the last ones are not visible), tvp = transvestibular pores, vo = vestibular organ. C: Anterior teeth, ventral view. D: Anterior teeth, lateral view (another specimen). E: Vestibular organ with small, shallow papillae and pores. F: Field of transvestibular pores. G: Transvestibular pores


C


D
10µm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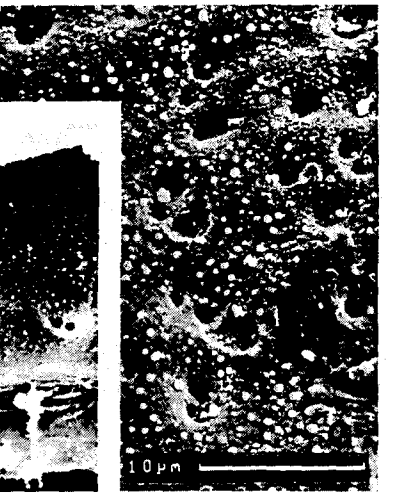
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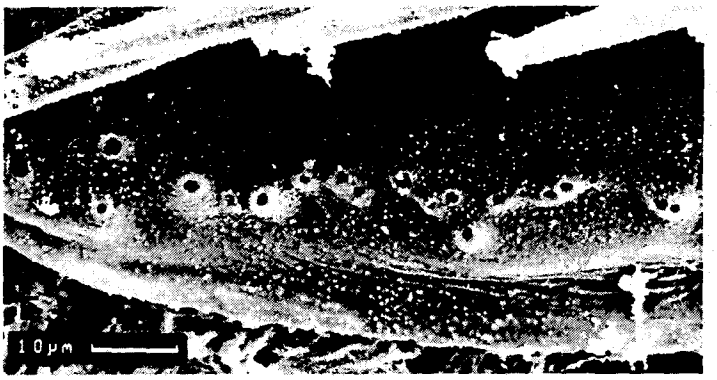
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Fig. 3. *Heterokrohnia mirabilis* (from Antarctic waters). A: Posterior part of head and anterior part of trunk with neck canals and alveolar tissue. B: Alveolar tissue and neck canals

Eyes: absent
Corona ciliata: not observed
Neck canals: lateral in anterior part of the trunk, extending dorsally into head, not always observed
Alveolar tissue: remnants of it observed to reach about half the distance between head and ventral ganglion, not always observed
Intestinal diverticle: absent
Intestine: relative broad, beginning a short distance below neck, sometimes containing oil globules in its walls, red in living specimens
Anus: at trunk-tail-septum
Transverse musculature: in trunk reaching from neck to slightly beyond ventral ganglion, in anterior third of tail
Ovaries: extending to about half the distance between ventral ganglion and trunk tail septum, ending in small dorsolateral pouches, with ducts at posterior inner end
Testes: reaching about a third of the tail length
Seminal vesicles: slightly distant from the lateral fins and tail fin, opening at their mid-region
Habitat: pelagic, abyssal
Geographic distribution: cosmopolitan

DISCUSSION

Comparison with other species

Heterokrohnia mirabilis can be distinguished from all other *Heterokrohnia* species – except from *H. involucrum* Dawson, 1968 – by its numerous, flat and pointed anterior teeth, its greater number of long, thin, and partly bent posterior teeth, and its thick, smooth looking vestibular organs bearing a row of tiny papillae. *H. mirabilis* and *H. involucrum* differ in the extent of their alveolar tissue. In *H. mirabilis* it is restricted to the anterior part of the trunk; in *H. involucrum* it covers the whole body and is conspicuous on the trunk and the anterior part of the tail. Perhaps *H. mirabilis* might be confused with *H. murina* Casanova, 1986 if only the number (in juveniles) and the shape of the posterior teeth are compared. However, in *H. murina* the anterior teeth are shaped differently (see Fig. 26 in Kapp, 1991, this volume) and the anterior part of the head is longer.

Remarks concerning several characters

Ritter-Záhony ascribed large papillae of vestibular organs, bent tips of hooks and a large size of the apical gland cell complex to *H. mirabilis*, because he considered *H. fragilis* and *H. longidentata* as juveniles of this species. However, these characters are absent in *H. mirabilis*. On the other hand, light- and electron microscopic studies revealed structures not described by Ritter-Záhony: lamellae of the anterior teeth, transvestibular pores, alveolar tissue, neck canals, pouches at the end of the seminal receptacles, and ducts at the inner posterior end of the ovaries.

The fins of the Antarctic specimens of *H. mirabilis* are in poor condition, as Ritter-Záhony (1911) already mentioned, as are the fins of the more recently caught *Heterokrohnia* specimens, so that their contours could not be drawn exactly; they must be left to further observation. The fins of the Antarctic specimens are completely rayed, whereas the fins of the Atlantic and Arctic specimens have only few or no fin rays at all. The material at hand is not sufficient to ascertain whether or not there are geographic differences and whether or not rays develop very late and slowly during ontogeny. As yet the presence or absence of fin rays has been regarded as a species-specific character in the genus *Heterokrohnia*; now it is obvious that more information is needed for the judgement of this feature and its usefulness in taxonomy.

Chaetognath workers know that the number of anterior and posterior teeth is variable in all chaetognath species, because they generally increase until sexual maturity and decrease afterwards. In *H. mirabilis* the number of teeth also increases with progressing length of the animal, but this number varies extraordinarily (Table 1, Fig. 4). For the identification of *Heterokrohnia* species the structure of the teeth is more important than their number. Despite the worldwide distribution of *H. mirabilis* no geographical differences in the shape and arrangement of the teeth are observed; the anterior teeth of the Antarctic specimens have lamellae at the inner edges like the Atlantic and Arctic species.

The species recently described as *H. mirabiloides* by Casanova & Chidgey (1990) is here regarded as junior synonym of *H. mirabilis*. According to these authors, *H. mirabiloides* is separated from *H. mirabilis* "principally in the number and shape of the posterior teeth" (Casanova & Chidgey, 1990, page 109). Concerning the number of posterior teeth, I cannot confirm such a separation from

Table 1. Body length and numbers of hooks and teeth of *Heterokrohnia mirabilis* (total length rounded off to the nearest 0.5 mm because some specimens were strongly bent, and body and head in others were separated)

Body length (mm)	No. of hooks	No. of anterior teeth	No. of posterior teeth	Locality
7	9/10	2/ 3	6/ 6	Atlantic
7	9/10	7/ 7	11/13	Atlantic
7	10/11	9/10	16/18	Atlantic
7.5	11/11	8/ 8	17/18	Atlantic
9	12/12	12/13	21/21	Atlantic
10.5	11/11	11/ 9	15/16	Atlantic
10.5	10/10	8/ –	18/19	Atlantic
11.5	9/10	13/15	30/30	Atlantic
12	10/ –	10/11	25/ –	Antarctic
12.5	7/ 8	7/ –	17/17	Arctic
13.5	10/10	5/ 7	15/17	Arctic
15	10/11	11/11	28/30	Arctic
17	9/ –	10/11	19/21	Arctic
18.5	9/10	15/15	29/30	Antarctic
19	11/11	14/15	33/ –	Antarctic
20	9/10	16/17	34/35	Arctic

the material at my disposal because of the extraordinary variability in the number of teeth of *H. mirabilis* (see Table 1, Fig. 4). Concerning the shape of posterior teeth, the different views in the illustrations in Casanova & Chidgey (1990, page 111), the heads photographed under different angles, do not allow a definitive judgement. In any case, part of the posterior teeth of *H. mirabilis* is strongly bent and not almost straight, as Casanova & Chidgey (1990) wrote.

Only remnants of alveolar tissue are conserved in two Antarctic specimens (of 18.6 and 19 mm length), and rather thin alveolar tissue just beneath the head is present in two Arctic specimens (of 17 and 20 mm length). Probably, alveolar tissue develops very late in ontogeny and is therefore absent in juveniles. Future investigations are needed to reveal its complete shape and extension.

Neck canals have been observed only once; they are present in the 19 mm-long Antarctic specimen.

The function of the dorsolateral pouches in which the seminal receptacles end is not known. The pouches may serve for reception of sperm or might be the first stage of developing marsupial sacs. They show slit-like openings, which may be natural or may be caused by fixation and long preservation.

All the preserved animals I studied were colourless, but Ritter-Záhony (1911) reported that the specimens of the "Gauss" expedition were red like *Sagitta macrocephala*. When I observed *S. macrocephala* and *Eukrohnia fowleri* immediately after their collection, I found an intensive dark orange-red colour in the walls of the intestine, in the medium septum of the tail segment, in the lateral fields, and in the membranes of some head muscles. So, I assume that at least the intestine of *H. mirabilis* is orange-red. The complete colour pattern must be subject to future observation.

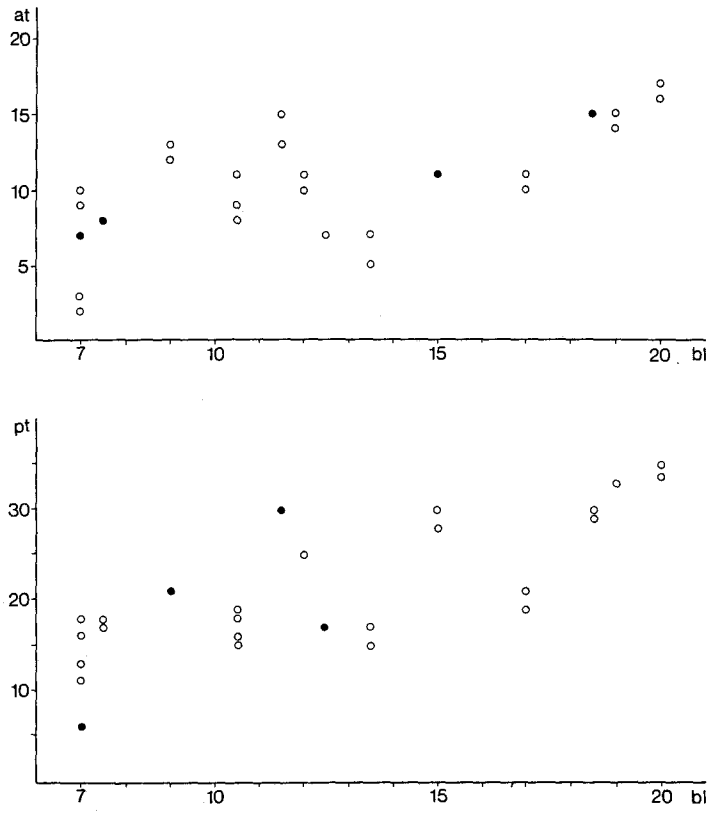

Fig. 4. *Heterokrohnia mirabilis*, number of anterior and posterior teeth in correlation to body length; at = anterior teeth, bl = body length, pt = posterior teeth, ○ = number of left o r right teeth, ● = number of both left a n d right teeth

Earlier records of *Heterokrohnia mirabilis*

The study of the data and descriptions of the specimens of *H. mirabilis* present in the literature reveal that not all of these specimens belong to this species. This might be due to the incomplete original description which also includes two other species.

Jameson (1914) was not certain about the specimen of *H. mirabilis* he found in Antarctic waters (68°25′ S, 27°10′ W, length 22.5 mm, tail length 25.6 %, hooks 11, anterior teeth ?, posterior teeth 14, transverse musculature in trunk and tail). David (1958) regarded it as a damaged *Eukrohnia hamata*, but based on our present knowledge we can assume that Jameson really found a specimen belonging to the genus *Heterokrohnia*, but not to the species *H. mirabilis*. His data are not sufficient for identification.

When Tschindonova (1955) identified a specimen from the Kurilian Trench as *H. mirabilis*, she pointed out a certain variability in many features of chaetognath species. Indeed, one disadvantage in the investigation of the genus *Heterokrohnia* is the fact that we have little experience concerning the range of variability of the characters because of the few specimens found as yet. Tchindonova's specimen seems to belong to a species

other than *H. mirabilis* (length 36 mm, tail length 44.4 %, hooks 14, anterior teeth 13–13, posterior teeth 14–16, lateral fins without finrays, beginning near ventral ganglion, tail fin rayed, apical gland cell complex small, ovaries nearly reaching ventral ganglion); but this is not sure because of the great variability in the number of teeth and the uncertainty concerning the finrays. Knowledge of the structure of the head armature seems necessary for the clarification of this question.

David (1958) described two specimens from Antarctic waters (57°36' S, 29°54' W). The larger one is *H. mirabilis* according to the number of teeth and the drawing of the head in his paper. The smaller one (length 10.2 mm, anterior teeth 3/?, posterior teeth 1/1) could perhaps be a specimen of *H. fragilis*.

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