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Halomonhystera disjuncta – a young-carrying nematode first observed for the Baltic Sea in deep basins within chemical munitions disposal sites

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ABSTRACT

Three deep basins in the Baltic Sea were investigated within the framework of the CHEMSEA project (Chemical Munitions Search & Assessment), which aims to evaluate the ecological impact of chemical warfare agents dumped after World War II. Nematode communities, which comprise the most numerous and diverse organisms in the surveyed areas, were investigated as a key group of benthic fauna. One of the most successful nematode species was morphologically identified as *Halomonhystera disjuncta* (Bastian, 1865). The presence of this species, which is an active coloniser that is highly resistant to disturbed environments, may indicate that the sediments of these disposal sites are characterised by toxic conditions that are unfavourable for other metazoans. Moreover, ovoviviparous reproductive behaviour in which parents carry their brood internally, which is an important adaptation to harsh environmental conditions, was observed for specimens from Gdansk Deep and Gotland Deep. This reproductive strategy, which is uncommon for marine nematodes, has not previously been reported for nematodes from the Baltic Sea sediment.

1. Introduction

Large quantities of chemical warfare agents (CWAs) were deposited in the Baltic Sea by the Allied and Soviet forces after World War II (HELCOM, 1994). The potential hazards for the marine environment from the long-term disposal of munitions were ignored for many years. A lack of awareness of this issue has resulted in little knowledge concerning the dissipation of the CWAs and their toxicity in deep (> 100 m) marine waters. Thus, the Chemical Munitions Search & Assessment (CHEMSEA) project was initiated in 2011 to increase knowledge regarding these disposal sites (with a focus on the largest unofficial dump site at Gdansk Deep) and chemical warfare agents, to complete information gained during previous projects regarding the chemical weapons dumped in the Baltic Sea and to assess the ecological risk and the potential impact of the chemicals on fish and benthic organisms. A focus on the latter group is a novel approach, because no investigation concentrating on the benthic fauna of disposal sites has yet been performed. Special emphasis was placed on meiobenthic communities, and the differences in the nematode community structure between the disposal sites and a reference area were investigated (Kotwicki et al., 2016).

Here, we present the first observation for the Baltic Sea of a parental-caring nematode species, *Halomonhystera disjuncta* (Bastian, 1865). This species is the most successful nematode in the investigated Gdansk Deep sediments and is abundant in the Gotland Deep area (Kotwicki et al., 2016). The hatching of eggs into larvae within the body of female parents is relatively rare among marine, free-living nematodes (Decraemer et al., 2013). More frequently, this phenomenon is observed among plant-parasitic nematodes and parasites of both vertebrates and invertebrates (Luc et al., 1979). For *H. disjuncta*, unfavourable, usually toxic environmental conditions may have led to ovoviviparity (Van Gaever et al., 2006).

The genus *Halomonhystera* Andrássy, 2006, belongs to the Monhysteridae De Man, 1876, family. This common nematode family has a worldwide distribution and inhabits both terrestrial and marine ecosystems (Fonseca and Decraemer, 2008). The family is represented from high latitudes to subtropical shores, mostly in shallow marine and brackish waters. However, recent studies demonstrated that monhysterids also constituted an important component of deep-sea nematode communities (Fonseca and Soltwedel, 2007; Van Gaever et al., 2006; Vanreusel et al., 2010). *Halomonhystera* usually colonises highly disturbed sediments, such as cold seeps and hydrothermal vents (Van Gaever et al., 2006; Zekely et al., 2006), or organically enriched shallow waters (Ólafsson, 1992; Derycke et al., 2007b). *H. disjuncta* has a relatively disarrayed taxonomic history. The species was formerly known as *Monhystera disjuncta*, until Andrássy (1981)

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placed it in the genus *Geomonhystera*. Andrássy (2006) later divided *Geomonhystera* into two morphologically and ecologically distinct groups, placing the marine species, including *G. disjuncta*, into the newly established *Halomonhystera* genus and leaving the terrestrial representatives in the *Geomonhystera* genus. *H. disjuncta* exhibits significant differences within different lineages and recent molecular studies showed that this morphospecies is actually a complex of cryptic species (Derycke et al., 2007a; Fonseca et al., 2008; Van Geaver et al., 2009; Van Campenhout et al., 2013).

The *H. disjuncta* complex is reported from a wide range of habitats and geographical locations, including the shallow-water environment of the White Sea (Mokievsky et al., 2005), North Sea (Derycke et al., 2007a), Greenland Sea (Urban-Malinga et al., 2009), New Zealand waters (Leduc and Gwyther, 2008), as well as the deep-sea sediments of the Norwegian Sea and the Barents Sea (Van Gaever et al., 2006, 2009; Portnova et al., 2011). We know of only one report of *H. disjuncta* from the sediments of the Baltic Sea. Ólafsson (1992) reported the presence of this species in shallow-water sediments of the northwestern Baltic proper near decaying macrofauna organisms. To the best of our knowledge no *H. disjuncta* (or other free-living marine nematode) with an ovoviviparous reproductive mode has yet been reported for the Baltic Sea.

2. Materials and methods

The Gotland Deep, Bornholm Deep and Gdansk Deep disposal sites and a reference area were investigated (Fig. 1). The sediments of these four regions were sampled during several cruises between December 2011 and April 2013.

This study was based on the meiobenthos samples of Kotwicki et al. (2016), who described the sampling and laboratory analyses in detail. In general, the sediment samples from 76 stations were collected and analysed for meiofaunal characteristics including 30, 10 and 21 stations within the munitions disposal sites at Gotland Deep, Bornholm Deep and Gdansk Deep, respectively, and 15 stations within the reference area.

From each station, at least 120 randomly selected nematodes (or all individuals if fewer were present) were identified after the nematodes were hand-picked and mounted on slides in anhydrous glycerine, following formalin–ethanol–glycerol treatment to prevent dehydration (De Grisse, 1969). All the nematodes were identified using pictorial keys and relevant taxonomic literature (Platt and Warwick, 1983, 1988; Warwick et al., 1998; Deprez, 2005).

The identification of *H. disjuncta* was based on the dichotomous keys recently provided by Fonseca and Decraemer (2008). There are numerous morphological differences between *H. disjuncta* and the other twelve marine species of this genus (a list of valid *Halomonhystera* species can be found in Leduc (2014)). *H. disjuncta* can be identified using various characters e.g., the position of the vulva, the distance between the vulva and the anus, both the shape and the length of the tail, the body length, the spicule length and the position of the amphid (Fonseca and Decraemer, 2008).

3. Results and discussion

To date, thirteen species have been assigned to the *Halomonhystera* genus. Ten of them were described previously within the *Geomonhystera* genus and later accommodated within marine *Halomonhystera* (Andrássy, 2006). Recently, three new species have been assigned: *H. hickeyi* Zekely, Sørensen & Bright, 2006, *H. parasitica* Poinar, Duarte & Santos, 2010, and *H. tangaroa* Leduc, 2014. The *Halomonhystera* species have been described from wide a range of habitats, from the coastal waters of Kiel Bay (*H. socialis* Bütschli 1874), *Sargassum* weed in the Gulf of Mexico (*H. chitwoodi* Steiner, 1958),

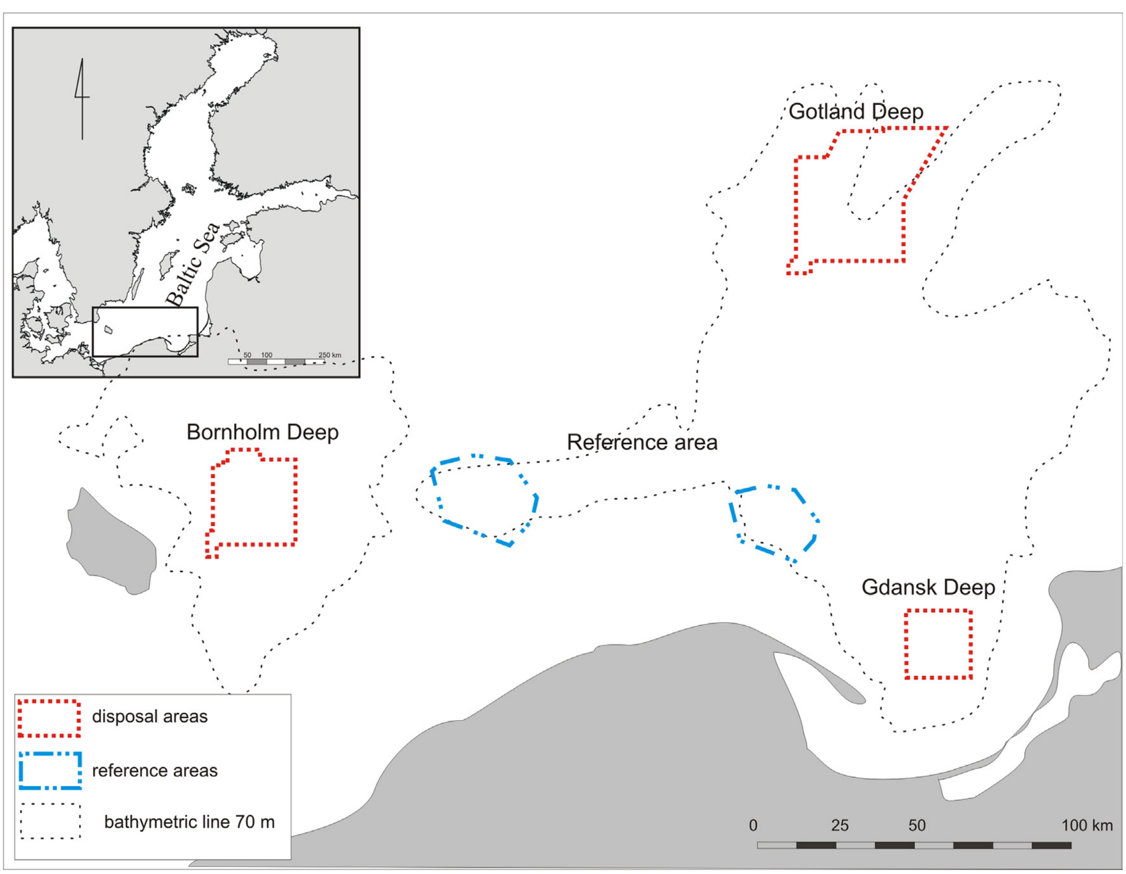

Fig. 1. Overview of the sampling area.