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Short Communication

First record of the Atlantic gammaridean amphipod *Melita nitida* Smith, 1873 (Crustacea) from German waters (Kiel Canal)

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Abstract

The amphipod *Melita nitida* Smith, 1873 is indigenous to the Atlantic coast of North America and so far has only been recorded as non-native species from the Pacific coast of North America and estuarine waters in The Netherlands. We detected a few specimens in the mesohaline part of the Kiel Canal (Germany) which showed considerable variation of some morphological characters. Transport in ballast water and in fouling on ships hulls seem to be the most likely introduction vector. A successful establishment of new populations of *M. nitida* in the Kiel Canal, other German estuaries or even the Baltic Sea cannot be excluded.

Key words: *Melita nitida*, amphipoda, neozoa, German marine waters

Introduction

The amphipod *Melita nitida* Smith, 1873, indigenous to the Atlantic coast of North America from the Gulf of Saint Lawrence to the Yucatan Peninsula (Bousfield 1973), so far has been recorded along the Pacific coast of North America from the Strait of Georgia (British Columbia) to the Elkhorn Slough, a central California estuary (Chapman 1988). In Europe *M. nitida* has only been found in The Netherlands (see Appendix 1). Four years after the first record in 1998, *M. nitida* seems to have established a relatively dense population within a restricted range in the Western Scheldt Estuary (Faasse and van Moorsel 2003). In recent years, however, *M. nitida* was also reported from the North Sea Canal connecting Amsterdam with the North Sea (Kaag 2002) as well as from the New Waterway, the artificial mouth of the river Rhine connecting Rotterdam with the North Sea (M. Faasse, pers. comm.). Here, we report on the occurrence of *M. nitida* in the Kiel Canal (Germany) and its identification characteristics. Possible introduction pathways and establishment success are discussed briefly.

This is the first record of *M. nitida* in German waters. In March 2010, in total 27 specimens were found subtidally on artificial hard substrates, i.e. rock fills, in the mesohaline, eastern part of the Kiel Canal (kilometre 92) connecting the North Sea via the Elbe Estuary with the Baltic Sea (54°15'N, 9°36'E; see Figure 1). Material (fixed specimens) have been deposited at the Federal Institute of Hydrology (Koblenz, Germany). Re-identification of fixed material from another survey in the eastern part of the Kiel Canal has confirmed the presence of *M. nitida* since 2008 or earlier [wrongly reported in BioConsult (2009) as *Melita pellucida* Sars, 1883; accepted name *Allomelita pellucida* (Sars, 1882)]. The specimens were gathered on hard and soft bottoms.

Identification

Melita nitida can be distinguished from native European melitid species by the following characters (Figure 2A-C; see more textual and graphical details: e.g. Mills 1964; Bousfield 1973; Sheridan 1979; Jarrett and Bousfield 1996; Faasse and van Moorsel 2003):

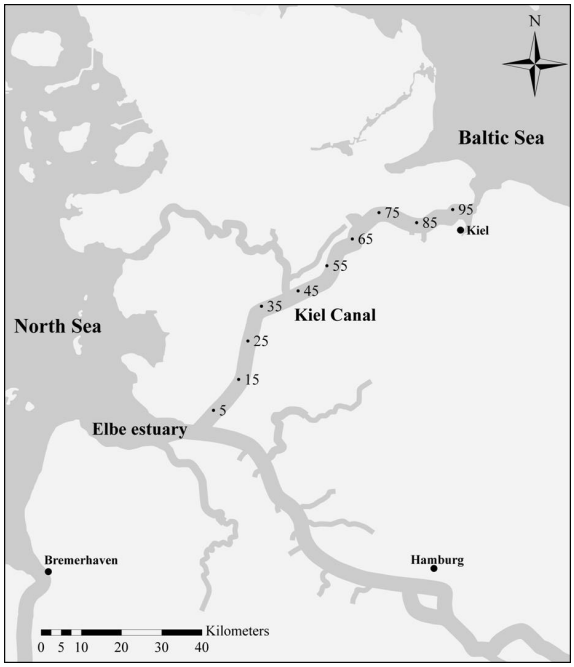

Figure 1. Geographic location of the Kiel Canal, Germany (54°15'N, 9°36'E). Numbers indicate the canal kilometres.

1. Absence of dorsal teeth on pleosomites and urosomites.

2. Accessory flagellum with at least two segments.

3. Male antenna 2 with prominent "bottle brush" setation on flagellum and distal parts of the peduncular article 5.

4. Only urosomite 2 with a group of posterior, dorso-lateral spines on either side.

Nevertheless, *M. nitida* may be confused with *Allomelita pellucida* (Sars, 1882), a brackish water amphipod, which is native to southern Norway, northern France and the Bristish Isles (Lincoln 1979; Stock 1984; Palerud and Vader 1991; Dauvin 1999; Bellan-Santini and Costello 2001). *Allomelita pellucida* is also characterized by the complete absence of teeth on pleosomites and urosomites, but differs from *M. nitida* in the segmentation of the accessory flagellum and the urosome spination. In *A. pellucida* the accessory flagellum is very small and consists of one segment only and all urosomites have one pair of dorso-lateral setules; additionally, one pair of spinules is described for urosomite 1 (Stock 1984) or for all urosomites (Lincoln 1979). Besides *A. pellucida*, the American amphipods of the so-called "*Melita nitida* complex" may be mixed up with *M. nitida*. Particularly *Melita intermedia* Sheridan, 1979 closely resembles *M. nitida* (see details in Sheridan 1979).

Although, these morphological characters prove to be a useful and reliable tool to distinguish *M. nitida* from closely related species, there is some variation among specimens of *M. nitida* in terms of distinguishing features and its taxonomy is a matter of debate. Chapman (1988) noted a variation of the antennal setation pattern within populations of *M. nitida* from South California and San Francisco Bay. Additionally, further morphological characters were controversially described in the literature. In his re-description Mills (1964) noted *M. nitida* with three-segmented accessory flagella and three to five spines on either side of urosomite 2, whereas Sheridan (1979) mentioned two-segmented accessory flagella and groups of only two spines each on urosomite 2 for *M. nitida* populations of Northwest Florida. Jarrett and Bousfield (1996) in turn described *M. nitida* with two-segmented accessory flagella combined with clusters of three to five spines on urosomite 2.

Considering the complete intraspecific variation range of *M. nitida*, *Melita setiflagella,* first described by Yamato (1988) for Japanese waters, may represent a synonym (Jarrett and Bousfield 1996; Faasse and van Moorsel 2003). Yamato`s specimens bore an accessory flagellum of three to four segments and spine groups of three to four spines on either side of urosomite 2.

Differences between the two *Melita* species were described in the setation patterns on antenna 2 and in the presence of a notch in the antennal sinus (see Yamato 1988). A comparison of specimens from Pacific localities and the Atlantic type locality may result in a synonymisation of the two species.

The specimens from the Kiel Canal show considerable variation as well (see Table 1). Here, the segment number of the accessory flagellum and the spine number on urosomite 2 seemed to be size-related. The full grown male specimens (up to 9.7 mm body length; Figure 2A-C), which were gathered in 2008, had three- and four-segmented accessory flagella and four spines per group on urosomite 2. Specimens collected in 2010 were smaller in size (Figure 3), had two-segmented accessory flagella and bore one or two spines per group on urosomite 2. Due to these observations we assign the specimens from the Kiel Canal to *M. nitida*.

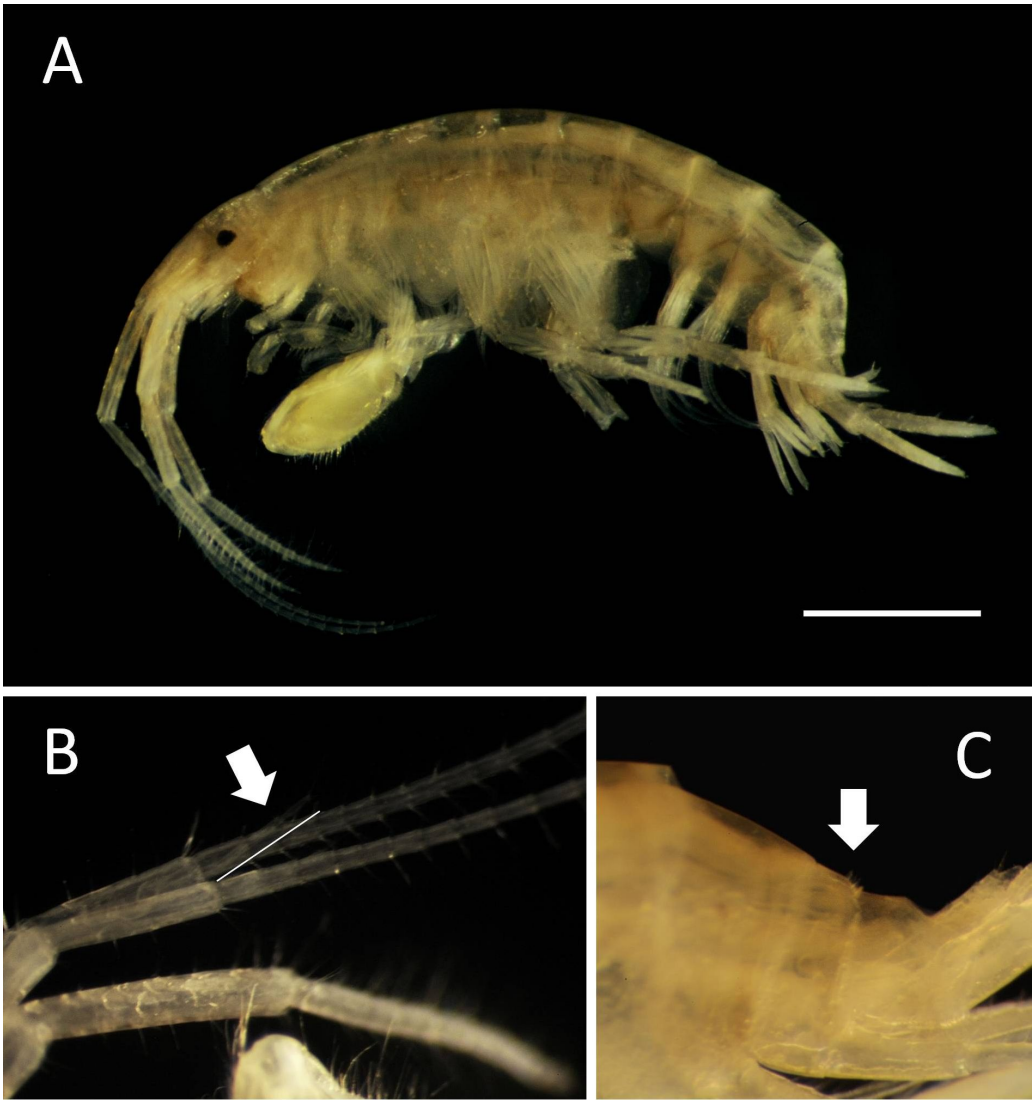

Figure 2. Adult male specimen of *Melita nitida* Smith, 1873, from the Kiel Canal (Germany) gathered between 10 and 12 June 2008. Scale bare = 2 mm, body length = 9.7 mm. (**A**) habitus, (**B**) first antenna with accessory flagellum (arrow, underline) and (**C**) urosome with urosomite 2 with spine group on posterior dorso-lateral border (arrow). Photographs by K. Reichert and J. Beermann.

Ecology

Since the occurrence of *M. nitida* in The Netherlands, the question has been how the species reached Northwest Europe and what its status is in European waters. Although it is not definitely proven how *M. nitida* reached The Netherlands, an unintentional introduction with ships is most frequently discussed (Faasse and van Moorsel 2003). This introductory vector seems to be most likely for the occurrence of *M. nitida* in the Kiel Canal, too. Transport in ballast water and in fouling on ships hulls is known as an important source of invading amphipods (see review by Conlan 1994 and references therein). Excluding small boats, such as recreational vessels, an average of more than 80 ships per day used the Kiel Canal in recent years, marking the canal as one of the most heavily used artificial waterways in the world (Waterways and Shipping Authority 2010). Although the density of organisms in ballast water is highly variable among ships (e.g. Smith

Figure 3. Juvenile specimen of *Melita nitida* Smith, 1873, from the Kiel Canal (Germany) gathered on 23 and 24 March 2010. Scale bare = 1 mm, body length = 3.8 mm. Photograph by K. Reichert and J. Beermann.

Table 1. Morphological variation characteristics of *Melita nitida* specimens found in the Kiel Canal.

	Accessory flagellum	Antenna 2	Gnathopod 2	Urosomite 2
Juvenile (3.8 mm)	2-segmented	clusters of medium-sized setae on flagellum and distal parts of peduncle segment 2	dactylus closing along posterior propodal margin	posterior 1 spine and 1 spinule dorso-laterally on either site
Adult male (9.7 mm)	4-segmented	"bottle brush" setation on flagellum and distal parts of peduncle segment 2	dactylus closing across inner surface of propodus; palmar margins densely fringed with setae	posterior 4 spines dorso-laterally on either site

et al. 1999), an estimate of almost three million invertebrate individuals per day have been released by ballast water from overseas areas to German coastal and estuarine waters (Gollasch 1996). Less likely, but not completely ruled out, may be the spread by rafting on abiotic substrates (e.g. plastic) or macroalgae (e.g. Conlan 1994; Thiel and Gutow 2005).

Whether a successful establishment of new populations of *M. nitida* will occur in the Kiel Canal predominantly depends on the general suitability of the habitat. The occurrence of *M. nitida* in Northeast Pacific estuaries as well as in the Western Scheldt Estuary in The Netherlands shows a broad tolerance of both temperature (0 up to 32°C) and salinity (3 to 30 psu). Moreover, *M. nitida* occurs in various habitats from intertidal marshes and muddy bottom areas (Bousfield 1973; Sheridan 1979) to subtidal hard substrates (Chapman 1988; Faasse and van Moorsel 2003) – analogous to our observations in the Kiel Canal. Thus, neither the temperature regime nor the salinity or the substrate seems to be a limiting factor for a successful establishment in the Kiel Canal and range extensions to other German estuaries or even the Baltic Sea are therefore likely. Moreover, the establishment success of neozoa has been related to various anthropogenically induced environmental changes ranging from habitat change at small spatial scales to disturbance events at long-term scales (see Byers 2002 and reference therein). Not surprisingly the occurrence of *M. nitida* is also described for

newly formed habitats or refuges in Northeast Pacific estuaries and in the Western Scheldt (Chapman 1988; Faasse and van Moorsel 2003). Accordingly, structural modifications of the eastern part of the Kiel Canal in the next years could even favour the establishing process of *M. nitida* populations.

Possible effects

The establishment of *M. nitida* populations may effect resident species, particularly species from the same ecological guild (i.e. other amphipods). In the Kiel Canal *M. nitida* mainly co-occurred with *Monocorophium insidiosum* (Crawford, 1937) and *Leptocheirus pilosus* Zaddach, 1844. As information on ecological and/or physiological characteristics of *M. nitida* is scarce it is difficult to assess possible species interactions. However, we cannot rule out that *M. nitida* is a robust, highly competitive species since this amphipod has been able to establish permanent populations in waters, such as Northeast Pacific estuaries, where *M. nitida* is non-native. Future studies should reveal the population development, e.g. possible expansion to other German estuaries or even the Baltic Sea, as well as possible ecological effects on the resident species assemblages of the Kiel Canal.

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Appendix 1. Records of *Melita nitida* Smith, 1873 in Europe.

Location	Geographic coordinates (WGS84)		Date	Reference
	Latitude, N	Longitude, E		
The Netherlands				
Western Scheldt / near Bath	51.40167	4.20972	1998	van Moorsel and Waardenburg (1999); Faasse and van Moorsel (2003)
Western Scheldt / Walsoorden	51.38250	4.02833	1999	Faasse and van Moorsel (2003)
Western Scheldt / Baarland	51.40840	3.88590	2000	Faasse and van Moorsel (2003)
North Sea Canal	52.46389	4.55833	2001	Kaag (2002)
New Waterway	51.94194	4.19139	2010	M. Faasse (pers. comm.)
Germany				
Kiel Canal	54.24184	9.60099	2008	Bioconsult (2009)
Kiel Canal	54.24184	9.60099	2010	present study