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Aquatic Invasions Records

New range expansion of *Caprella mutica* Schurin, 1935 (Malacostraca: Caprellidae) to the German coast, North Sea

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Abstract

The caprellid amphipod *Caprella mutica* became rapidly established in the North Sea, on the west coasts of Scotland and Ireland, the Irish Sea and English Channel. The first record for *C. mutica* from Jade Bay, in the southern North Sea, is reported here. High densities exceeding three-hundred individuals per wood panel (approximately 7000 ind./m^{-2}) were found on wooden settlement panels in August/September 2009 associated with the tube-building amphipod species *Jassa marmorata* and *Corophium acherusicum*. The extensive mud-tube colonies of *J. marmorata* and *C. acherusicum* on the panels provide a suitable habitat for *C. mutica* attachment.

Key words: *Caprella mutica,* distribution, Jade Bay, North Sea, *Corophium acherusicum, Jassa marmorata*, fouling community

Introduction

The caprellid amphipod *Caprella mutica* Schurin, 1935, the Japanese skeleton shrimp, was first described from sub-boreal areas of north-east Asia in 1935. It has since spread to both northern and southern hemispheres. The first reports of *C. mutica* outside its native range were from the Atlantic coasts of North America in the 1970s (Carlton 1979) and 1980s (Marelli 1981). More recently it´s occurrence has been reported from New Zealand (Ashton et al. 2007a), the Iberian Peninsula (Martinez and Adarraga 2008), Alaska (Ashton et al. 2008) and British Columbia (Frey et al. 2009).

The first European record was found in a harbour in the Netherlands in 1994 (Cook et al. 2007). Further records were found in Belgium in 1998, Norway in 1999, Scotland in 2000 (Willis et al. 2004) and the German Bight in 2004 at the harbours of List/Sylt and on the coast of the island of Helgoland (Buschbaum and Gutow 2005). The general European distribution has been summarised by Ashton et al. (2007a) and Cook et al. (2007). There have been no previous accounts of this amphipod from Jade Bay.

Within its native range *C. mutica* attaches to macroalgae, bryozoans and hydroids that occur on rocky outcrops, submerged cliffs and man-made structures (Stachowicz and Byrnes 2006). Outside of its native range most of the observations have been made in areas of intense anthropogenic activity that include, harbours, marinas, navigation buoys and at aquaculture sites, such as fish cage netting or mussel longlines (Willis et al. 2004; Ashton 2006; Cook et al. 2007; Kerckhof et al. 2007).

Materials and methods

In 2004, 2005, 2008 and 2009, wood panels made from Monterey pine with a surface area of 450 cm^{-2} were exposed to study settlement patterns of the shipworm *Teredo navalis* Linnaeus, 1758 at the North-West oilpipe (NWO) GmbH terminal, Wilhelmshaven, NW Germany (Figure 1). In 2009, thickly layers of mud-tubes were detected on the wood panels for the first time (Figure 2).

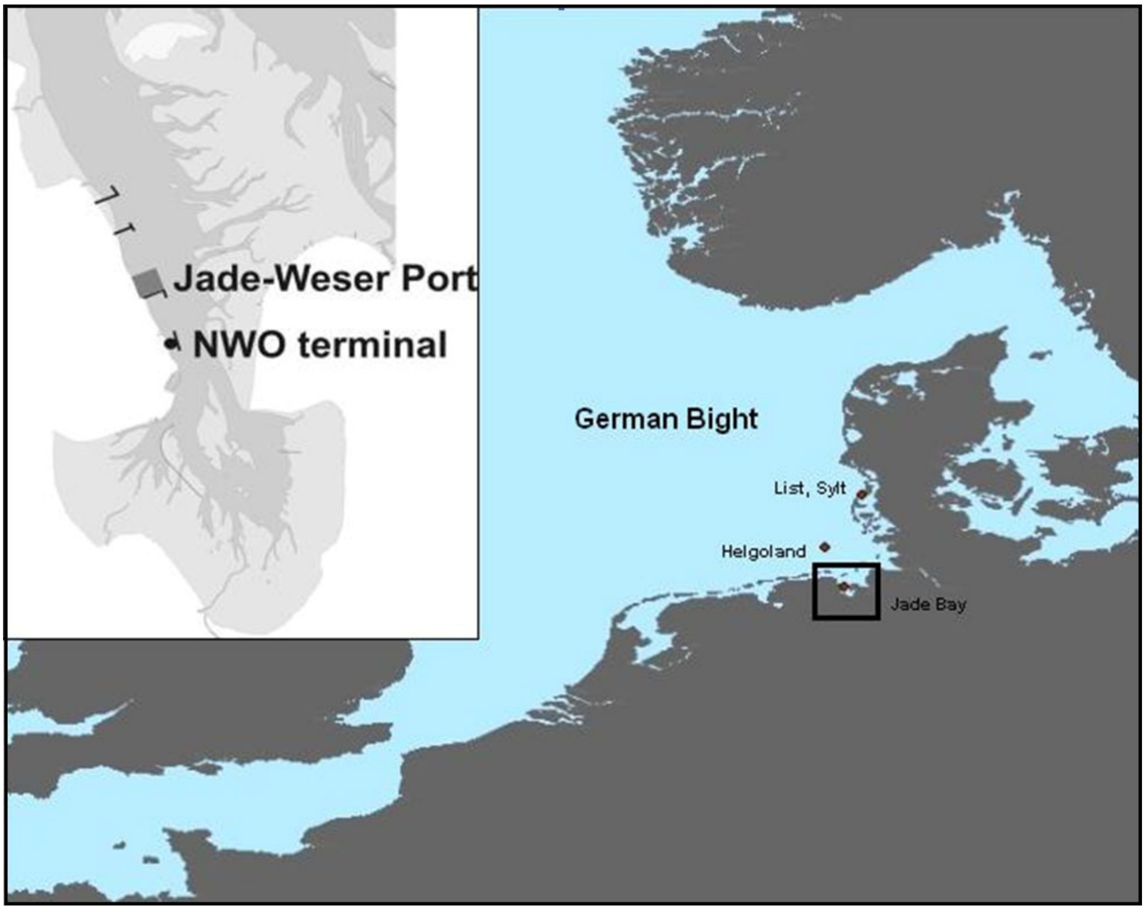

Figure 1. Area of investigation including previously records of *Caprella mutica* (see Annex 1) and the location of the new deep water port in the southern North Sea.

Figure 2. Mud-tubes and epibenthos as seen fouling the wood panels (left) and presence of *Caprella mutica* on the mud-tubes (Photograph by U. Schückel).

Figure 3. A preserved adult male *Caprella mutica* collected from Jade Bay, southern North Sea. Total body length is 22 mm (Photograph by H. Reiss).

Figure 4. A preserved adult female *Caprella mutica* collected from Jade Bay, southern North Sea. Total body length is 12 mm (Photograph by H. Reiss).

The mud-tubes and epibenthos were removed following recovery of the settlement panels and stored in 70% ethanol. Organisms were identified to lowest taxonomic species level. In addition, the fine sediment, trapped in the epibenthic assemblage was washed through a 300 µm mesh size and grain size was determined using laser diffractometry (Fritsch Analysette 22).

Results and discussion

In 2009 there was a high abundance of *C. mutica* (Figure 3 and 4) clinging on mud-tubes (Annex 1), of *Corophium acherusicum* (Costa, 1851) and *Jassa marmorata* (Holmes, 1903). More than three-hundred individuals of *C. mutica* per wood panel were scored.

This is the first record of *C. mutica* and the first account of this amphipod being associated with other tube building amphipods in Jade Bay. So far, *C. mutica* was found associated with several species of *Jassa* on the coast of the island of Helgoland (Boos and Beermann, pers. comm.) and was described as a typical member of sub-littoral fouling communities (Cook et al. 2010). However, only little is known about the role of dense associations of tubes produced by tube-building amphipod species as a suitable habitat for *C. mutica* attachment and the extent of competition between non-native and native fauna.

Previous panels exposed in the study area, in the years before, were devoid of muddy sediments and such tubes. These panels were dominated by *T. navalis* with records of 879

(2004) and 909 ind./m^{-2} (2008) (Liebezeit, unpublished data), by barnacles and hydroids. Interestingly, *T. navalis* was not found on the panels in 2009. We assumed that the building of a deep water port to the north of the study site possibly changed environmental conditions, which may have suited the establishment of the tube building amphipods thus enabling *C. mutica* to take advantage of this attachment surface.

It is known that *C. acherusicum* and *J. marmorata* are often associated with fouling of surfaces (Onbé, 1966; Karez and Ludynia, 2003), especially in areas with high turbidity (Barnard, 1958). The collected sediment in 2009 had a mean grain size of 7.8 µm and was finer than suspended material of 13.2 µm in Jade Bay in 2008 (unpublished data). It is likely that the dredging activities related to the building of a deep water port might have been responsible for the fine sediments noted in 2009 and used for tube building. The tube colonies provide settlement opportunities for other benthic organisms, mainly polychaetes such as *Hediste diversicolor* (O.F. Müller, 1776) and *Eteone longa* (Fabricius, 1780) normally present in the sediment.

C. mutica is an opportunistic feeder using a variety of different feeding strategies depending on their food availability. Previously studies has shown that *C. mutica* is predominantly a detritivore (Guerra-Garcia and Tiero de Figueroa 2009), but also capable of filtering particles out of the water column by using its second pair of antennae as a sieve (Nauwelaerts et al. 2007). *C. mutica* held in aquaria feed on microalgae and diatoms (Cook et al. 2010), also a cannibalistic behaviour has been observed (Shucksmith 2007). We assumed that *C. mutica,* which is able to switch between feeding strategies depending on food availability could have directly benefited from the increase in food availability due to higher turbidity in the water column related to dredging activities and also because of a higher sedimentation rate of organic material due to a trapping effect on the amphipod tubes and hydroids.

Possible feeding of *C. mutica* on the two amphipod species, as described by Keith (1969) for *Caprella californica* Stimpson, 1857 and *Caprella equilibra* Say, 1818, consuming caprellids, amphipods, isopods, harpacticoid copepods and ostracods, has yet to be clarified by further studies. More studies are also necessary to investigate a possible competition between *C. mutica* and the two tube-building amphipod species. Several authors mentioned a potentially competition for similar food resources and for space between *C. mutica* and several native amphipods (*Caprella linearis* (Linnaeus, 1767)*, Jassa* spp.) and isopods (*Idotea* spp.) (Sano et al. 2003; Guerra-Garcia et al. 2004; Shucksmith et al. 2009), which may led to a displacement of the native species from the substrate (Shucksmith 2007). Together with its tolerance to a wide range of temperatures (< 2°C to 28°C) and capability of surviving in marine to brackish water (Ashton et al. 2007b) (in the present study salinity ranged between 26.4 and 32.2 psu) this seem to indicate that it is likely that *C. mutica* will continue to expand its range further within the North Sea, where there are suitable attachment surfaces present.

The present record of *C. mutica* in the Jade Bay extends the known distribution in the North Sea. Its wide tolerance range, including areas with high levels of turbidity, indicate that it has a propensity to colonise many habitats. It´s high reproductive capability, by producing multiple broods and its association with human activities in coastal habitats (Ashton et al. 2006) is likely to ensure its sustained occurrence in the North Sea which, in turn, might have an influence on the ecosystem and food webs.

In areas where amphipods are abundant teleosts may benefit. Onbé (1966) described for the Fukuyama Harbor Area, an increase of *C. acherusicum* in the stomach contents of different small-sized or juvenile fishes, corresponding to the time when the population density of *C. acherusicum* was the highest.

Further studies will clarify whether the observed amphipod fouling community successfully establishes in Jade Bay.

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Annex 1. Records of *Caprella mutica* in the southern North Sea.

Location	Record coordinates		Date	Reference
	Latitude, N	Longitude, E		
List/Sylt	55°01'	08°26'	2004	Buschbaum and Gutow 2005
Helgoland	54°11'	07°53'	2004	Buschbaum and Gutow 2005
Jade Bay	53°33'27"	08°09'45"	2009	present study