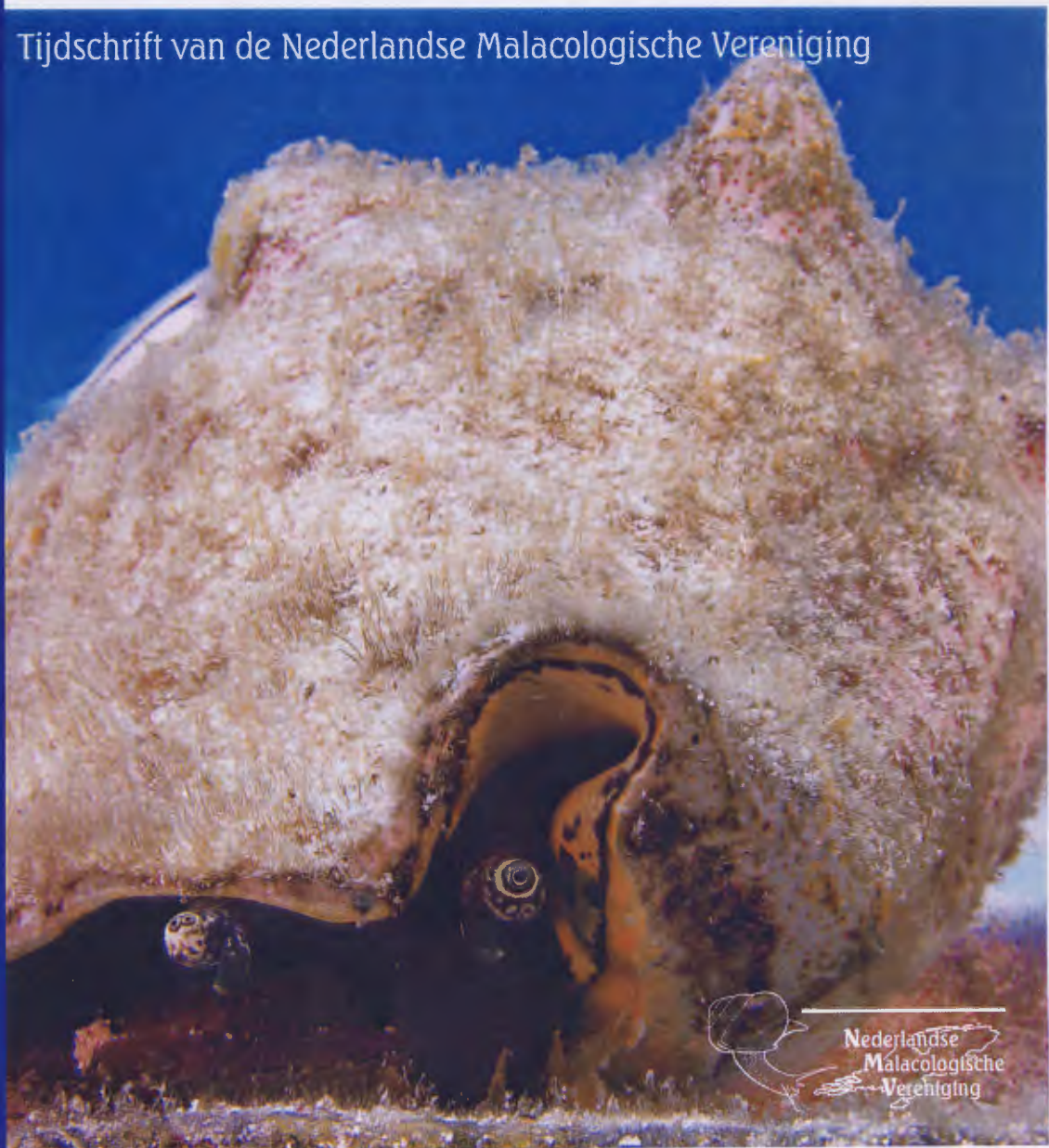


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Shipwrecks, ascidians and *Modiolarca subpicta* (Bivalvia, Mytilidae, Musculinae)

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A large population of *Modiolarca subpicta* is reported upon from a shipwreck in the Dutch part of the Brown Ridge in the central North Sea, where it occurs within individuals of the solitary sea-squirt *Ascidella aspersa*.

Key words: Bivalvia, Mytilidae, *Modiolarca*, Tunicata, *Ascidella*, commensal, North Sea, The Netherlands.

INTRODUCTION

It is well-known that live specimens of the mytilid bivalve *Modiolarca subpicta* (Cantraine, 1835) are usually found associated with a tunicate, in particular the sea-squirt

Ascidella aspersa (O.F. Müller, 1776) (Roberts & Breen, 1985; Bodger & Allen, 2008; Morton & Dinesen, 2011; Daan et al., 2013: 57). The mussels are protected by the tunicate's tunic, which may cover them almost completely so that they are easily overlooked, for example, in tunicates washed ashore. Bodger & Allen (2008) and Morton & Dinesen (2011) have, most recently, published details on the intimate relationship that exists between these two organisms. For data on the life histories of *M. subpicta* and *A. aspersa* we refer the reader to these publications.

Because the tunicate prefers hard substrata to settle upon, *Modiolarca subpicta* is largely restricted to that type of habitat. As a consequence, large stretches of the North Sea bottom, which consists mostly of sand, are uninhabitable for these species. The soft or sandy sea bottom is, however, dotted with



Fig. 1. The *Anna Graebe*, shipwrecked 12 January 1978, situated at 52° 39.6'N 03°31.7'E, at a depth of 28 metres. Photo Cor Kuyvenhoven.

isolated shipwrecks, which provide hard substrate for a variety of organisms. Such sessile species should only be able to reach these isolated habitats during their planktonic life-stage. In 2011, 2012 and 2013, several expeditions were organized focusing on monitoring the marine fauna on about 15 shipwrecks in the central North Sea (Lengkeek et al., 2013). The ascidian *Ascidiella aspersa* was found in large numbers on one of these shipwrecks. Here we report on the *M. subpicta* specimens found inside the tests of the wreck's sea-squirts.

SYSTEMATICS

We rely largely on Morton & Dinesen (2011) for details of the nomenclature of *Modiolarca subpicta*, adding only some data regarding Cantraine's original publications. In a separate pamphlet, Cantraine (1835a) published a Latin diagnosis for *Modiolus subpictus*, with additional data in French on distribution and shell morphology. According to a footnote, this pamphlet was a reprint from an article in the *Bulletin de*

l'Académie Royale des Sciences et Belles-Lettres de Bruxelles. The journal version (Cantraine, 1835b) is, however, only partly identical since the morphological data in French are omitted therein. The latter version was published as the report of a meeting which was held on 5 December 1835, whereas the separate publication closes with 'Ath [a city in Belgium], le 10 novembre 1835'. The so-called reprint could, therefore, be a preprint of the journal article.

The following synonymy shows that *Modiolarca subpicta* has been dealt with in the literature under several names. Some well-known publications in Dutch, containing figures of the shell, are cited for convenience.

Modiola discrepans – Lamarck, 1819: 114. Not *Mytilus discrepans* Montagu, 1803 [= *Musculus discors* (L., 1767)].

Modiolus subpictus Cantraine, 1835a: 27 "golfe de Venice"; 1835b: 397 "golfe de Venice". Syntype: Fig. 6.

Mytilus marmoratus Forbes, 1838. Not *Mytilus marmoratus* Schroeter, 1803.

Modiola tumida Hanley, 1843.

Crenella discrepans – Herklots, 1859: 163, 1 fig.

Musculus marmoratus (Forbes, 1838) – Entrop, 1959: 81, fig. 30. Tebble, 1966: 39, fig. 20A; 46, pl. 1 fig. j.

Musculus subpictus – World Register of Marine Species [WoRMS], <http://www.marinespecies.org/aphia.php?p=taxdetails&id=506128> (or 140460), last accessed 18.xi.2013.

Musculus (Modiolarca) subpictus – Huber, 2010: 111, 1 fig.

Modiolarca tumida – Roberts & Breen, 1985; Bodger & Allen, 2008.

Modiolarca subpicta – Bruyne, 2004: 145, 1 fig. Bruyne & Boer, 2008: 197, 3 figs. Morton & Dinesen, 2011. Daan et al., 2013: 57, 5 figs, 378.

In the Mollusca collection of Naturalis Biodiversity Center, Leiden, there is a sample of six bivalves and a single shell originating from Cantraine, with labels, identifying both *Modiola discors* and *Modiola discrepans* from 'Trieste'. We consider these specimens to be syntypes, assuming that the label has been written by somebody who regarded *Modiola discrepans* as a senior synonym of *Modiolus subpictus* and used the former name for the species. This view is

supported by the fact that Herklots (1859: 163), the former curator of Mollusca at Leiden, accepted this synonymy.

RESULTS AND DISCUSSION

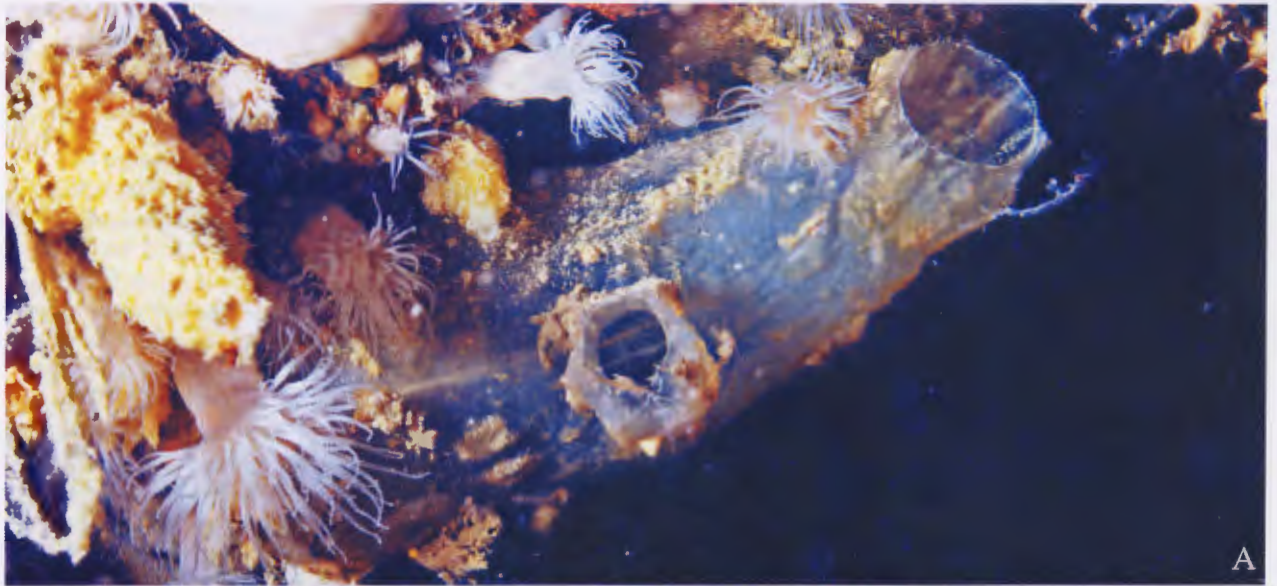
According to a distribution map that was published by Daan et al. (2013: 57, 378), living individuals of *Modiolarca subpicta* are known only (from 1985 onwards) from one locality in the Dutch part of the North Sea, that is, the Cleaver Bank, which is situated about 160 km NW of Den Helder (Daan et al., 2013). This area is exceptional in that the water is generally clear whereas the bottom is covered with stones and gravel, deposited there by the terminal moraine of a glacier during the Last Glacial Maximum (19,000–22,000 BP).

During a SCUBA expedition to the Dutch part of the Brown Ridge, further south in the central North Sea in June 2013, a large colony of the solitary ascidian *Asciidiella aspersa* was discovered on the wreck of the *Anna Graebe*, which wrecked on 12 January 1978, on route from Hamburg to London and now situated at 52°39.6'N 03°31.6'E, at a depth of 28 metres (Allen, 2011; Fig. 1). Thousands of individuals of *A. aspersa* were discovered inside the wreck. They were all hanging from the ceiling, at a place that appeared sheltered from currents and more or less free from sedimentation. The discovery of such quantities of this ascidian in the complete darkness inside a shipwreck at 28 metres, is unusual as hitherto this species has not been found by the research team on any other wreck in the central North Sea. *Asciidiella aspersa* is typically known to occur in high numbers in relatively shallow waters, because the floating eggs of this ascidian tend to drift towards the sea surface (Epel et al., 1999).

It remains unclear when and how the first *Asciidiella aspersa* individuals settled either in or close to the *Anna Graebe* wreck. After release, the eggs of *A. aspersa* probably floated to the ceiling of the wreck where the offspring set-

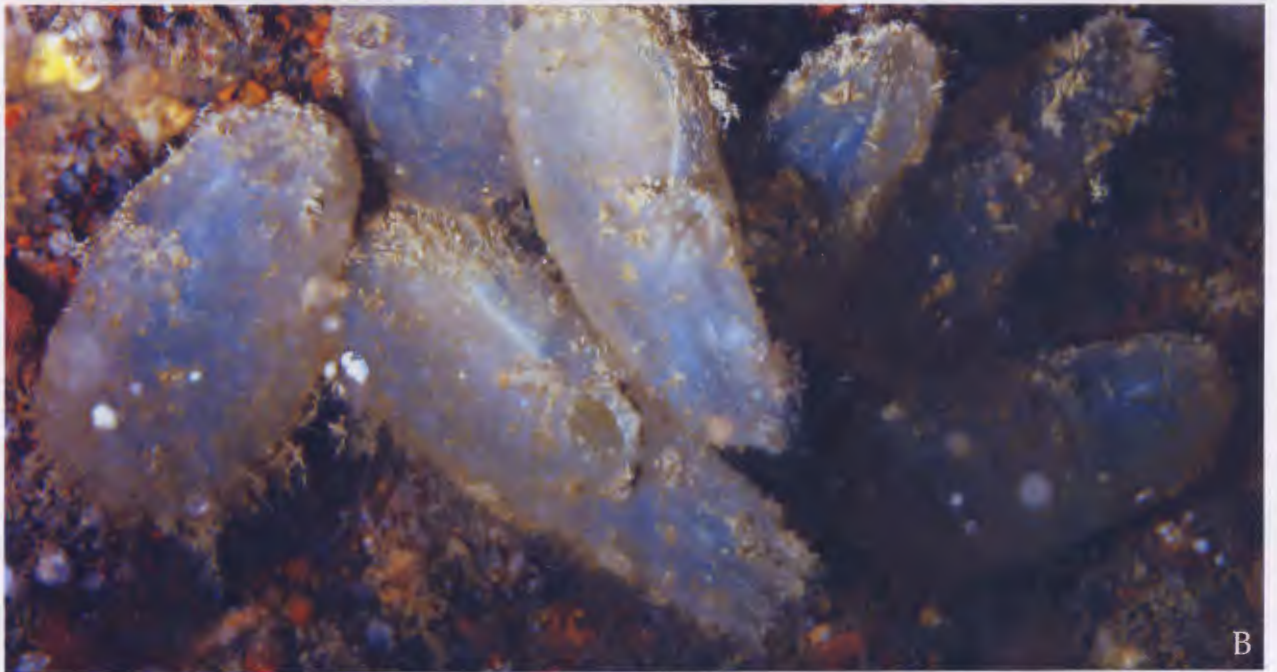
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Fig. 2. *Asciidiella aspersa* in situ. **A**, heavily fouled individual, with *Modiolarca subpicta* hidden inside the test (not visible); **B**, aggregation of individuals. Photos Adriaan Gittenberger.



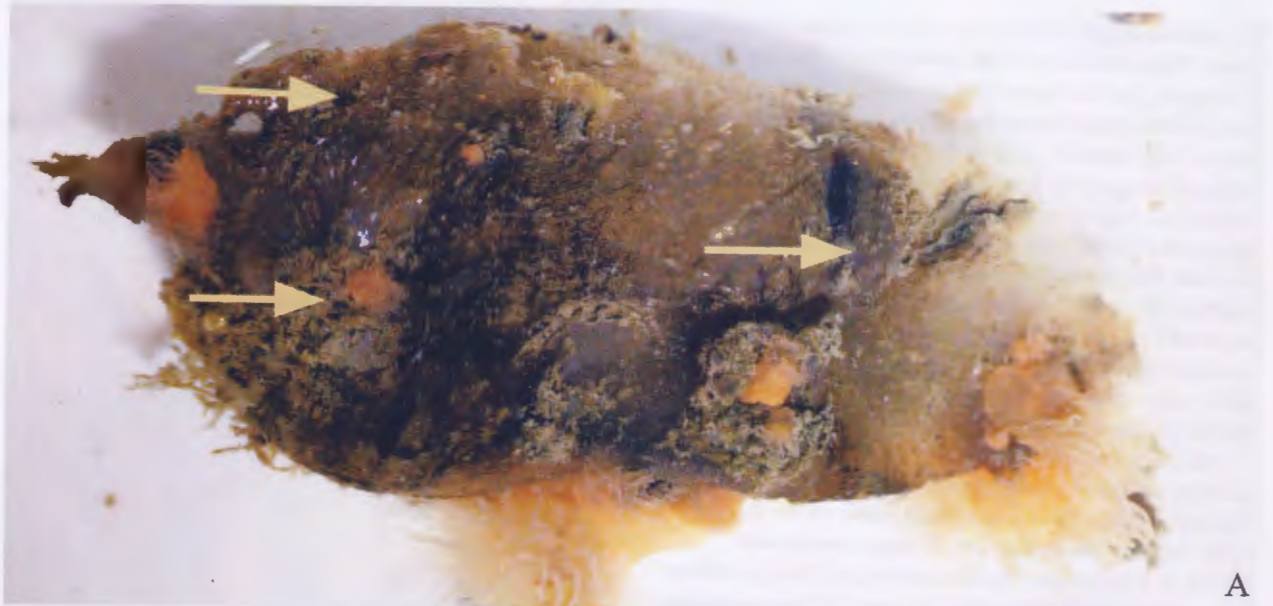
A

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B

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A



B

bled and eventually formed the observed dense sea-squirt colony. These ascidians in turn formed the habitat for *M. subpicta*. On close inspection, numerous specimens of this small mytilid bivalve were detected in the tests of the sea-squirts. They were all, more or less, encased within the tunicate's tissues (Figs 3-4). For some of these bivalves, for example the large specimen in Figures 4-5, the *A. aspersa* individual in which it was found, was most likely not its first host. This is because *A. aspersa* lives no longer than 18 months (Millar, 1952) and second year *M. subpicta* specimens are about 6 mm in shell length. Individuals larger than 9 mm are, thus, either forced to become free-living or should settle onto a new host of a later generation of *A. aspersa* (Bodger & Allen, 2008).

This record, once again, shows that shipwrecks may act as important distributional stepping stones in the North Sea. This includes species that need hard substrata like the sea-squirt *Ascidiella aspersa* but also the associates of such species, like the bivalve *Modiolarca subpicta*. The expeditions to the central North Sea in 2011, 2012 and 2013 concentrating on the marine life of shipwrecks, revealed that numerous

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Figs 4-6. *Modiolarca subpicta*. 4, Living *Modiolarca subpicta* specimen (length 15 mm) extracted from a cavity (*) in the tunic of *Ascidiella aspersa* (also illustrated in Figure 3). Photo Udo van Dongen.

5, *Modiolarca subpicta* (specimen in Figure 4), scale bar 5mm. Photo Adriaan Gittenberger. 6, *Modiolarca subpicta*, syntype (length 15 mm); 'Trieste'; F.-J. Cantraine colln, Naturalis Biodiversity Center, RMNH. MOL. 330680, scale bar 5mm. Photo Adriaan Gittenberger.

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Fig. 3. A living *Ascidiella aspersa* with retracted siphons (individual in Figure 2A), containing three virtually invisible *Modiolarca subpicta* (A, arrows point at the minute openings in the tunic through which the bivalves feed), two of which are revealed (B).

Photos Adriaan Gittenberger.



species that remain undetected in the more typical soft sea bed, focused on monitoring programmes (Gittenberger & van Loon, 2013), use these hard substrata as their preferred habitat, a spawning site and/or as stepping stones (Lengkeek et al., 2013; Schrieken et al., 2013). This accounts for many taxa (Gittenberger et al., 2013; Lengkeek et al., 2013), varying from cnidarians like the jewel anemone *Corynactis viridis* Allman, 1846, to fishes like the goldsinny wrasse *Ctenolabrus rupestris* (Linnaeus, 1758) and the leopard-spotted goby *Thorogobius ephippiatus* (Lowe, 1839). As with the herein described bivalve *M. subpicta* other molluscan species include the nudibranchs *Polycera faeroensis* Lemche, 1929, and *Doto dunnei* Lemche, 1976, the soft coral-eating gastropod *Simnia patula* (Pennant, 1777), and the squid *Alloteuthis subulata* (Lamarck, 1798) that attaches its egg-capsules to such wrecks (Gittenberger et al., 2011; Schrieken et al., 2011, 2013).

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