A record of the Asian mussel *Arcuatula senhousia* (Benson in Cantor, 1842) from NW Europe (the Netherlands)

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Een waarneming van de Aziatische mossel *Arcuatula senhousia* (Benson in Cantor, 1842) in noordwest Europa (Nederland)

Samenvatting. Op 7 juli 2018 werd het Aziatische mosseltje *Arcuatula senhousia* (Benson in Cantor, 1842) waargenomen in een klein, ondiep watertje bij het Goese Meer. Het watertje is door een weg van het Goese Meer gescheiden. Op de houten oeverbeschoeiing werden meer dan 30 exemplaren verzameld op een kwart vierkante meter, tussen een begroeiing van darmwier (*Ulva* spec.). In het Goese Meer zelf werd alleen de Mossel *Mytilus edulis* verzameld. Het Aziatische mosseltje is vanuit het West-Pacifische gebied verspreid naar de Pacifische kust van Noord-Amerika, Australië en Nieuw-Zeeland, de Middellandse Zee en het noordoostelijke deel van de Atlantische Oceaan. De noordelijkste vermelding van Europa in de literatuur stamt uit Zuidwest-Frankrijk (Bachelet *et al*., 2009). Op het internet is een vermelding van Southampton Water in Zuid-Engeland te vinden (National Biodiversity Network).
De Aziatische mossel is te herkennen aan de umbo's die iets achter de voorzijde van de schelp liggen, de ribben aan de voorzijde van de schelp en het ontbreken ervan aan de achterzijde, dit in tegenstelling tot soorten uit het genus *Musculus*. Aan de achterzijde zijn overigens vaak wel uitstralende kleurbanden aanwezig. Het is onbekend hoe de Aziatische mossel in Goes is terechtgekomen. Het is een goede verspreider, met een hoge fecunditeit en een lang larvestadium. Er kunnen hoge dichtheden bereikt worden, met ingrijpende invloed op andere organismen (Zenetos, 2016). Waarschijnlijk kwam het mosseltje ter plaatse al in 2017 of eerder voor; het grootste verzamelde lege exemplaar had een lengte van 23 mm. De Aziatische mossel heeft een voorkeur voor ondiepe, beschutte zeegebieden als estuaria en lagunes. Voor de voortplanting zijn hoge temperaturen nodig. In gematigde klimaten kan dat in warme microhabitats zijn; de soort heeft een hoge tolerantie voor lagere zoutgehaltes en lage zuurstofgehaltes (Zenetos, 2016).

Introduction

The Asian mussel *Arcuatula senhousia* is an originally West-Pacific species. Its native distribution encompasses an area from Siberia to Singapore. The species has been introduced to several parts of the world, mainly the Pacific coast of North America, Australia and New-Zealand, the Mediterranean Sea and the NE Atlantic (Bachelet, 2009 and references therein). Many synonyms for its name have been in use, in recent times particularly *Musculista senhousia*. Several vernacular names are known, different combinations of Asian, green, date and bag mussel, which all have their disadvantages.
Along the Atlantic coast of Europe no records north of the Bassin d'Arcachon in SW France (Bachelet *et al.* 2009) have been published in the scientific literature. However, there are online records from Southampton Water in southern England on 9 and 10 May 2016 (NBN – National Biodiversity Network). *A. senhousia* was collected in the Netherlands for the first time on 7 July 2018.

Description of the site

The southwest of the Netherlands is a delta area with estuaries, embayments and enclosed water bodies of different salinity and exposure. The international seaports Antwerp and Rotterdam are situated in the periphery of the area and in the centre shellfish culture is important. The site where *A. senhousia* was found is an area in the city of Goes where a shallow water body (maximum depth about 3 m), the 'Goese Meer', was dug out to create an attractive living quarter. The main water body is indirectly connected to the sea by a canal and lock gates. The small water where *A. senhousia* was collected (51°31'19.30"N, 3°54'35.55"E) is separated from the Goese Meer by a road and hence is isolated from the sea. This pool has a much smaller surface area and is probably even shallower. This may lead to higher maximum water temperatures in summer. *Mytilus edulis* Linnaeus, 1758 was not collected here, while in the Goese Meer it was the only mussel species collected. On 11 July 2018 the water temperature was 24 °C. Voucher specimens are deposited at Naturalis, RMNH.MOL.340739.

Identification

Arcuatula senhousia can be readily distinguished from *Mytilus* by the umbones which are situated behind the anterior margin (fig. 1). The part of the shell anterior to the umbones is ribbed (fig. 2); ribs are absent from the posterior part. On the posterior part radiating colour bands may be present. The absence of posterior ribs distinguishes *Arcuatula* from the related genus *Musculus*. Eight to 15 knobby hinge teeth are present (Hoenselaar & Hoenselaar, 1989) (fig. 3). The periostracum is greenish yellow with reddish brown radiating bands and sometimes blotches in smaller specimens, becoming more plain brown in larger specimens (fig. 4).

Ecology

Arcuatula senhousia prefers soft bottoms of shallow, sheltered seabeds, but may attach to firm substrata as well (Zenetos, 2016). Zenetos (2016) mentions salinities of 17-37 ppt at sites where *A. senhousia* was collected along the Pacific coast of North America. *A. senhousia* lives up to two years. In the first year it usually reaches a length of 15-20 mm, but exceptionally 25 mm (Zenetos, 2016). Maximum lengths recorded vary from 29-34 mm (Bachelet *et al*., 2009). Factors contributing to its success as an invader are the long larval phase (14-55 days) and its high fecundity (Zenetos, 2016 and references therein).
At the site in the Netherlands more than 30 specimens were collected from less than 0,25 m^2 of substratum. The mussels were scraped from a wooden reinforcement of the shore, covered with the green alga *Ulva* spec. (formerly *Enteromorpha* spec.). Other molluscs collected at the site were *Tritia nitida* (Jeffreys, 1867) and empty shells of *Ruditapes philippinarum* (Adams & Reeve, 1850).

Discussion

On the bottom of the pool where *Arcuatula senhousia* was collected also larger, empty shells up to 23 mm long (fig. 4) were collected, which suggests the mussels may have been already present in 2017. It is not clear how *A. senhousia* reached the

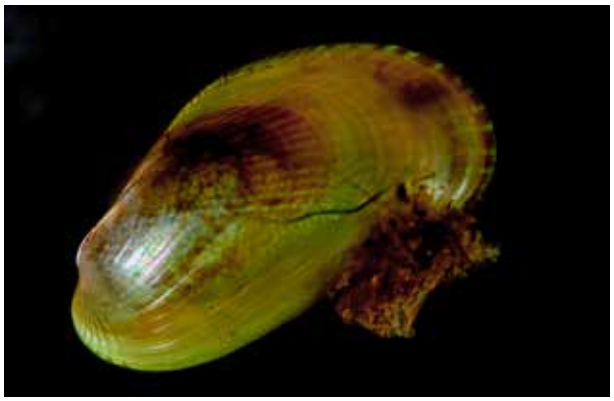

Fig. 1. *Arcuatula senhousia*, Goes, 7 July 2018. Photo Marco Faasse.

Fig. 2. *Arcuatula senhousia*, Goes, 7 July 2018, umbones and ribs. Photo Marco Faasse.

Fig. 3. *Arcuatula senhousia*, Goes, 7 July 2018, hinge. Photo Marco Faasse.

Fig. 4. *Arcuatula senhousia*, Goes, 7 July 2018, largest valve collected. Photo Marco Faasse.

Netherlands, but transport by international shipping seems unlikely in this case as it has never been collected from seaports in the southwest of the Netherlands (Wijnhoven *et al*., 2017). However, Slijkerman *et al*. (2017) report DNA of *A. senhousia* in ballast water tanks of a ship in Delfzijl or the Eemshaven in the north of the Netherlands on 15 July 2016. The ship had taken in ballast water in Tunesia on 1 July 2016. It has been argued that the success of this species depends on the duration of spells with high water temperatures (Asif & Krug, 2012). Zenetos (2016) mentions a minimum water temperature for reproduction of 22.5 °C. However, that does not imply it is unlikely to spread in NW Europe, as its native area encompasses Siberia. It is the availability of suitable microhabitats that counts (Asif & Krug, 2012). Furthermore, adaptation of introduced species is a common phenomenon (Asif & Krug, 2012 and references therein). The duration of the larval phase in *A. senhousia* is 14-55 days (Zenetos, 2016), which facilitates dispersal. In favourable circumstances *A. senhousia* is able to form dense aggregations, with a pronounced influence on benthos and plankton (Zenetos, 2016). Bachelet *et al*. (2009) predicted a secondary dispersal to NW Europe, which may have occurred recently. On the other hand, for the western coast of North America Asif & Krug (2012) suggest independent introductions to the northern and southern parts of that coast, respectively. They found genetic differences between those populations and with some precautions suggest a relation with their respective native climate. Anyway, at least temporary establishment in NW Europe is a fact and further dispersal may be expected.

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