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Short Communication

First record of *Grandidierella japonica* Stephensen, 1938 (Amphipoda: Aoridae) from mainland Europe

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Abstract

The non-native amphipod *Grandidierella japonica* Stephensen, 1938 is reported for the first time on the Atlantic coast of mainland Europe, specifically from Marennes-Oléron Bay, France. Likely vectors for this introduction include commercial shellfish transplants and ballast waters. A native of Japan, this species had previously only been reported twice outside the Pacific region; in both cases from coastal waters of England. Adults of both sexes, females carrying eggs, and juveniles were collected in Marennes-Oléron Bay, which suggests the species has become established.

Key words: alien species; Japan; shellfish farming activities; ballast water; Marennes-Oléron Bay; France

Introduction

Grandidierella japonica Stephensen, 1938 is an aorid amphipod species (Crustacea: Amphipoda: Aoridae) native to the Japanese archipelago (Chapman and Dorman 1975). Until recently, the species occurred exclusively in the Pacific region. Outside its native area, it was first reported in San Francisco Bay in 1966 (Chapman and Dorman 1975) but is now found in intertidal and subtidal sediments of bays and estuaries of the western coast of North America from Mexico to British Columbia, Canada (Greenstein and Tiefenthaler 1997; Okolodkov et al. 2007). It has also been reported from Hawaii (Coles et al. 1999) and New South Wales, Australia (Myers 1981). Outside the Pacific region, the only known reports of this species are from Southampton (1997) and the Orwell Estuary

(2007), south eastern England (Smith et al. 1999; Ashelby 2006; Noël 2011). The species is not listed in recent checklists available at the national scale for France (Dauvin and Bellan-Santini 2002), at the regional scale of the Southern Bay of Biscay (Bachelet et al. 2003), or anywhere on the coast of mainland Europe (Gouletquer et al. 2002; Wolff 2005; DAISIE 2009; Preisler et al. 2009; Haydar and Wolff 2011). To the best of our knowledge, this study represents the first report of *Grandidierella japonica*, a reproducing population, in coastal waters of mainland Europe.

Methods

As part of a national benthic survey to monitor intertidal macrofauna species available in early autumn to wintering shorebirds (RNF “Littoral Shorebirds and Benthic Macrofauna” observa-

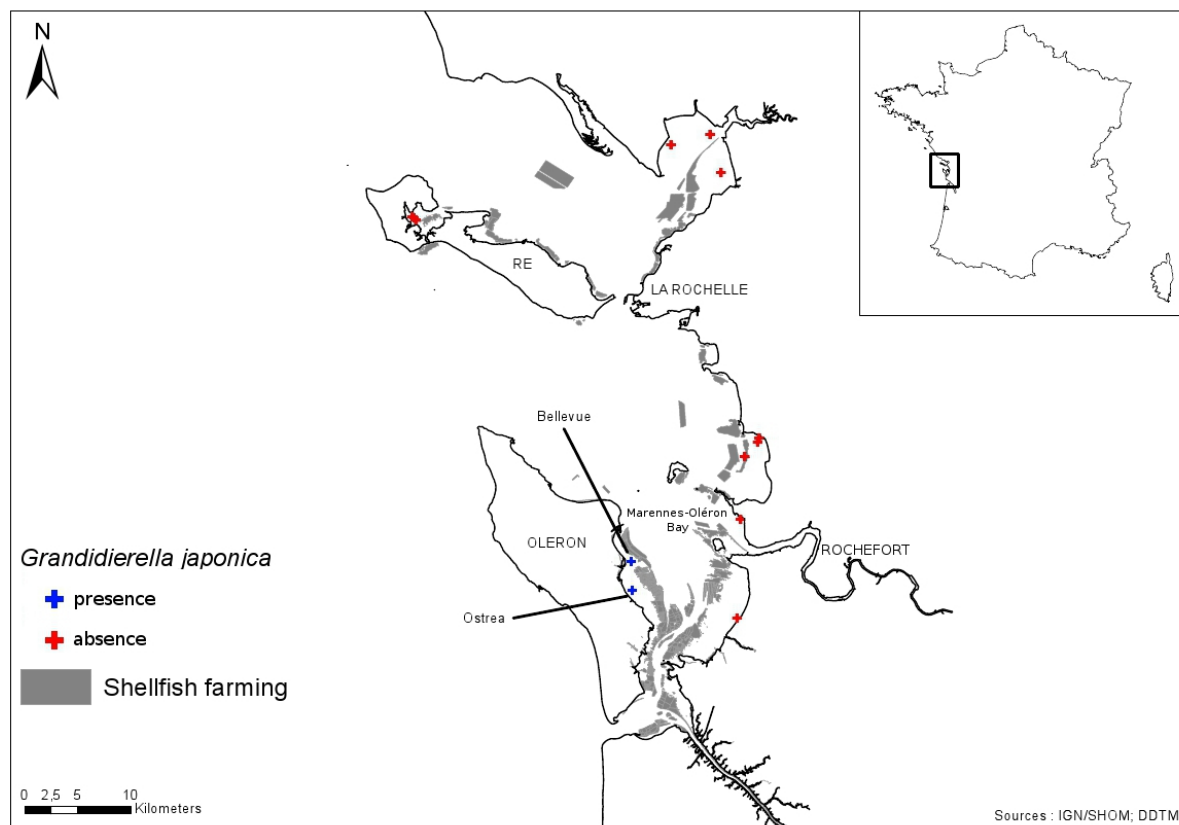


Figure 1. Location of the 13 stations (crosses) sampled in the Pertuis Charentais Sea within the framework of the RNF “Littoral Shorebirds and Benthic Macrofauna” observatory in 2009, 2010 and 2011. Blue crosses show the stations where *Grandidierella japonica* was found (Bellevue and Ostrea). Gray shading indicates the areas of intense bivalve aquaculture.

tory), 13 stations have been sampled within the Pertuis Charentais Sea every autumn since 2009 (Figure 1). Specimens of *Grandidierella japonica* have only been collected from two stations: Bellevue ($45^{\circ}56'20.40''\text{N}$, $01^{\circ}13'04.80''\text{W}$) and Ostrea ($45^{\circ}54'53.60''\text{N}$, $01^{\circ}12'56.60''\text{W}$). Located along the Eastern coast of Oléron Island (Figure 1), these stations lie on sheltered muddy and sandy shores. They are located in the vicinity of large shellfish farming areas where Pacific oysters (*Crassostrea gigas* Thunberg, 1793) are reared in bags on metal trestles (Gouletquer and Héral 1997; Gosling 2004), and blue mussels (*Mytilus edulis* Linnaeus, 1758) are reared on bouchots (Gouletquer and Héral 1997; Prou and Gouletquer 2002; Gosling 2004).

During analysis of samples collected at Bellevue and Ostrea on 8 November 2010, we

found two possible specimens of amphipods of the genus *Grandidierella* Coutière, 1904. Our preliminary identification was based on keys in Ruffo (1982) and Barnard and Karaman (1991). This aorid amphipod genus is, however, close to both the genera *Microdeutopus* Costa, 1853 and *Unciolella* Chevreux, 1911. It differs from the former mainly by the uniramous uropods 3 (Figure 2). It differs from the latter by: 1) the length of the uropod 3 rami, which is more than twice the length of the peduncle (Figure 2); 2) the third article of antenna 1, which is much less than half the length of the first article (Figure 3A); and 3) the carpochele gnathopods 1 of the male (Figure 3A, 4A). However, our identification remained tentative due to the poor condition of the female collected at Bellevue and the sub-adult male collected at Ostrea.

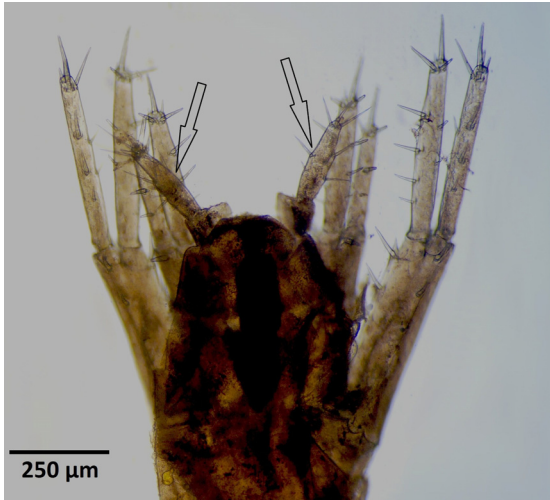


Figure 2. *Grandidierella japonica*, urosome showing uniramous uropods 3 (arrows). Alcohol preserved specimen collected at the Bellevue station on 20 August 2012. Photo by Jérôme Jourde.



Figure 3. *Grandidierella japonica*, male (A) and brooding female (B). Arrows show articles 1 and 3 of the male antenna 1. Alcohol preserved specimens collected at the Bellevue station on 20 August 2012. Note: the eggs were greenish in colour before alcohol preservation. Photo by Jérôme Jourde.

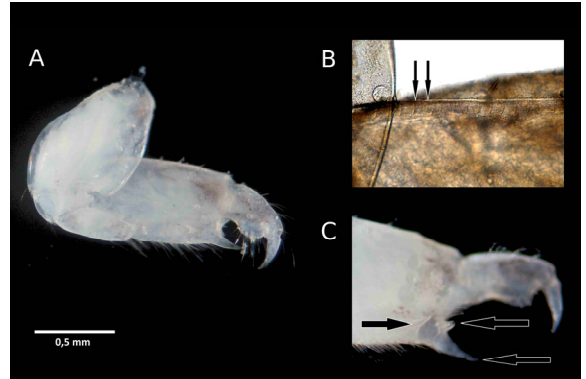


Figure 4. *Grandidierella japonica*, male gnathopod 1 left, inner surface (A), detail of anterior margin of the gnathopod 1 carpus, arrows show the transverse ridges (B), three teeth (arrows) on carpus distal part (C). Alcohol preserved specimen collected at the Bellevue station on 20 August 2012. Photo by Jérôme Jourde.

Four additional specimens (females) were found in samples collected at the Bellevue station on 30 November 2011. Although the specimens were in good condition, identifying female aroid amphipods to species is difficult; mature males are generally required. To confirm the species identity, additional qualitative benthic samples were made at the Bellevue station on 20 August 2012.

Results

From samples collected at the Bellevue station on 20 August 2012, we obtained 70 specimens in good condition: 21 mature males (Figure 3A); 31 females including 8 brooding females (Figure 3B); and 18 undifferentiated juveniles.

Diagnosis: The mature males had transverse ridges on the carpus anterior margin of the gnathopods 1 (figure 4B). In the genus *Grandidierella*, only five species have such ridges: namely *G. japonica*, *G. perlata* Schellenberg, 1938, *G. taihuensis* Morino and Dai, 1990, *G. vietnamica* Dang, 1968 (Ariyama 1996) and *G. chaohuensis* Hou and Li, 2002 (Hou and Li 2002). However, the specimens can be identified as *G. japonica*, because only *G. japonica* has three teeth on the carpus of the male gnathopod 1 (Figure 4C). In addition, morphological characters of the specimens agree well with the descriptions and figures of *G. japonica* provided by Stephensen (1938), Chapman and Dorman (1975), Hirayama (1984) and Ariyama (1996).

Discussion

In the case of *Grandidierella japonica* introduction into Californian waters, the most likely hypothesis is commercial transplant of *Crassostrea gigas* spat from Japan (Chapman and Dorman 1975). The same vector may apply here because the Marennes-Oléron Bay is the most important area for shellfish farming along the French coast (Gouilletquer and Héral 1997). Oyster culture in this sheltered bay has been characterized by a series of flourishing and declining periods of activity, particularly over the last century when a complete collapse of the Portuguese oyster *Crassostrea angulata* industry occurred [*C. angulata* (Lamarck, 1819) is now considered as a junior synonym of *C. gigas* (WoRMS 2012)]. Large quantities of *C. gigas* were imported from British Columbia and Japan during the late 1960s and 1970s to counter both the disappearance of *C. angulata* populations and the decline in native flat oyster stocks (*Ostrea edulis* Linnaeus, 1758) due to disease and parasite outbreaks (Grizel and Héral 1991; Gouilletquer and Héral 1997). It is now well established that the movement of *C. gigas* between countries has led to establishment of numerous alien species into Northern Europe (Gouilletquer et al. 2002; Wolff and Reise 2002). Indeed, the oyster industry appears to be the main vector of introduction for more than 25% of the 104 alien species recorded along the French Atlantic coast (Gouilletquer et al. (2002). However, other vectors of introduction such as ballast waters and ship fouling cannot be excluded because *G. japonica* has become established in vicinity of major ports involved in international cargo transport (Coles et al. 1999; Smith et al. 1999; Ashelby 2006). In the context of this study, there are two major seaports handling international cargo nearby: Port Atlantique La Rochelle, which is located North of Marennes-Oléron Bay; and the Port of Rochefort located 25 km upstream of the Charente estuary mouth (Figure 1). A 1993–1995 study analysing ships' traffic and ballast water estimated total annual ballast for both ports to be 1.2 million metric tons (Masson 2003).

The timing of introduction of *G. japonica* into Marennes-Oléron Bay is difficult to establish. For three decades, there have been no official commercial transplants of *C. gigas* because oyster imports from the Pacific ended by 1982 due to parasite infestation (Grizel and Héral 1991; Wolff and Reise 2002). The species may

have been present but not identified because the genus *Grandidierella* can be easily confused with other aorid genera, especially *Microdeutopus*. Moreover, neither the species nor the genus was described in the taxonomic works most commonly used for amphipod identification in French Atlantic waters (Chevreux and Fage 1925; Lincoln 1979). As already noted by Ashelby (2006), this may have led to the species being overlooked during the last decades. Even so, introduction of *G. japonica* into Marennes-Oléron Bay prior to the 1980s would seem unlikely because there were large scale benthic surveys of both intertidal and subtidal areas within Marennes-Oléron Bay during the 1980s and 1990s with no records of the genus (Montaudouin and Sauriau 2000). An alternative hypothesis is that this is a recent introduction similar to that in English waters (Smith et al. 1999; Ashelby 2006).

The current extent of the geographic range of *G. japonica* along the French Atlantic coast is unknown. For now, this appears to be an isolated occurrence because there is no evidence of its presence anywhere else in the Pertuis Charentais area or anywhere on coast of mainland Europe. As the presence of brooding females suggests a self-sustaining population exists in Marennes-Oléron Bay and, given the difficulty in identifying the species, it may well be present elsewhere in European waters. Now that a reproducing population of the species has been confirmed, special attention during all benthic monitoring programs would seem to be warranted to better define the species' geographic range in European waters. This would also allow an evaluation of species' invasiveness potential in European waters and permit measurement of significant effects on native fauna.

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