

Rapid Communication

Records of two introduced Penaeidae (Crustacea: Decapoda) species from Le Havre Harbour, France, English Channel

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Abstract

Two introduced prawn Penaeidae were collected in Le Havre Harbour, Normandy, France, on 14 August 2016: *Marsupeanaeus japonicus* (Bate, 1888) and *Penaeus semisulcatus* De Haan, 1844. *M. japonicus* is native to the Indo-Pacific and the Red Sea, is already present in the western English Channel; and this is the first record for the eastern part of the English Channel. The catch of *P. semisulcatus* represents the first confirmed European record.

Key words: *Penaeus semisulcatus*, *Marsupeanaeus japonicus*, non-native species, Normandy

Introduction

Since the inventory of species introduced into French waters was compiled by Gouletquer et al. (2002), there has been increased interest in Non-Native Species (NNS), not only concerning new records but also for assessing their possible effects on the biodiversity and functioning of colonized marine ecosystems. Over the last two decades, several new NNS have been recorded in the English Channel (Stretfaris et al. 2005; Blanchard et al. 2010; Dewarumez et al. 2011; Minchin et al. 2013; Bishop et al. 2015; Gouletquer 2016). All of these NNS originated from the north western Pacific Ocean, and some have transited via the eastern American or British coasts to the French coast (Gouletquer 2016). Forty-six additional NNS have been recorded along the French coast of the English Channel since the inventory of Gouletquer et al. (2002) (the so-called cryptogenic species *sensu* Eno et al. 1997, excluded). Le Havre harbour is often the first or the only observation site (Breton and Vincent 1999; Ruellet and Breton 2012; Breton 2014, 2016), and there have been several ecological studies in this harbour using SCUBA-diving (Breton 1981, 2005, 2014, 2016; Breton et al. 1995, 2005).

The kuruma prawn *Marsupeanaeus japonicus* (Bate, 1888) is a subtropical species native to the Indian and western Pacific oceans. Its native distribution ranges from Japan in the north through south-east Asia to Australia in the south, extending as far west as east Africa and the Red Sea (Holthuis 1980). It lives on muddy or sandy substrates in water depths down to 90 m, but commonly around 10–20 m. Juveniles grow in estuaries and adults live in fully marine areas. Females can measure 235 mm in total length (TL) and males 200 mm in total length. *M. japonicus* was the first prawn to be cultivated in Japan, from the 1930s. Females release 300,000 to 700,000 eggs at night from spring to summer. In Japan, temperatures for spawning and larval development range between 20 and 32 °C (Hirata 1975; Coman et al. 2002). This species has been intentionally introduced to numerous European countries for aquaculture (Laubier and Laubier-Bonichon 1977). It also has migrated through the Suez Canal into the Mediterranean Sea (Boudouresque 1999). *M. japonicus* occurs along many Mediterranean coasts including Turkey, Cyprus, France and Sicily; the Adriatic Sea, and the Atlantic coast of Spain (Galil et al. 2002).

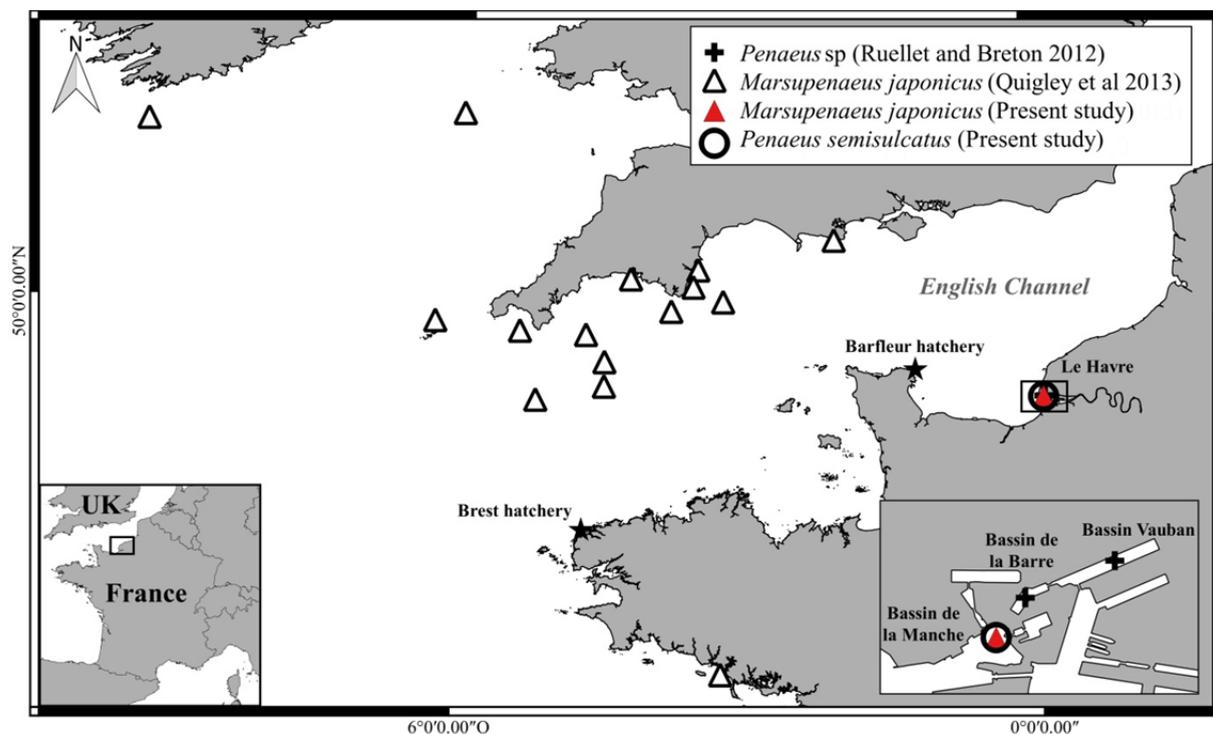


Figure 1. Map showing locations of records of *Penaeus* and *Marsupenaeus* species in the English Channel and the Irish Sea, as well as location of the “Bassin de la Manche” in Le Havre harbour in France (for details see Supplementary material Table S1).

French hatcheries of *M. japonicus* located on the Atlantic coasts and in the western English Channel (at Brest and Barfleur, respectively), are the most likely source of individuals collected by Irish fishermen (Quigley et al. 2013).

The tiger green prawn *Penaeus semisulcatus* De Haan, 1844 is a subtropical species native to the Indian and western Pacific living in the same area as *M. japonicus*, but its southern geographical distribution extends to Indonesia and the northern coasts of Australia. It lives in muddy or sandy substrates down to depths of 130 m, commonly abundant in waters shallower than 60 m. Juveniles grow in estuaries and adults live in marine areas. Under natural conditions, females can measure 230 mm and males 180 mm TL. Maheswarudu et al. (2011) estimated the age and size in Indian cultivated populations: under optimal conditions, they can live for more than 3 years and females can reach a maximum of 340 mm TL. In the Persian Gulf, the optimum reproductive size is approximately 54 mm for the carapace length (Niamaimandi et al. 2008). *P. semisulcatus* also has colonized the eastern Mediterranean coasts by the Suez Canal (Boudouresque 1999).

The REGENI project (REalisation d’un Guide des Espèces Non Indigènes) involves making an inven-

tory of NNS in Normandy. Three specimens belonging to the genus *Penaeus* were collected in Le Havre harbour and identified to the species level in August 2016. This note describes both of these prawn species and presents some hypotheses about their mode of introduction.

Methods

During the 2016 summer fieldwork campaign, a fishing survey was undertaken in Le Havre harbour (Figure 1) along the docks in the “Bassin de la Manche”. The fishing survey was carried out twice for two hours during the rising tide on the same day (14 August 2016). A trap fishing net for shrimps of 50 cm diameter (50 mm mesh) was used. This trap is used by the local fisherman to fish the local shrimp (*Palaemon serratus*). A mix of dry cat food, parsley, and head of fish was used as bait for the shrimps.

On 14 August 2016, three unidentified Penaeidae were caught in the “Bassin de la Manche” near the lock (Figure 1) at nightfall. The specimens were preserved in a 10% formaldehyde solution and taken to the laboratory for identification. The sea temperature at the sampling station was 19 °C and the salinity 30–32, which corresponds to a fully marine system.

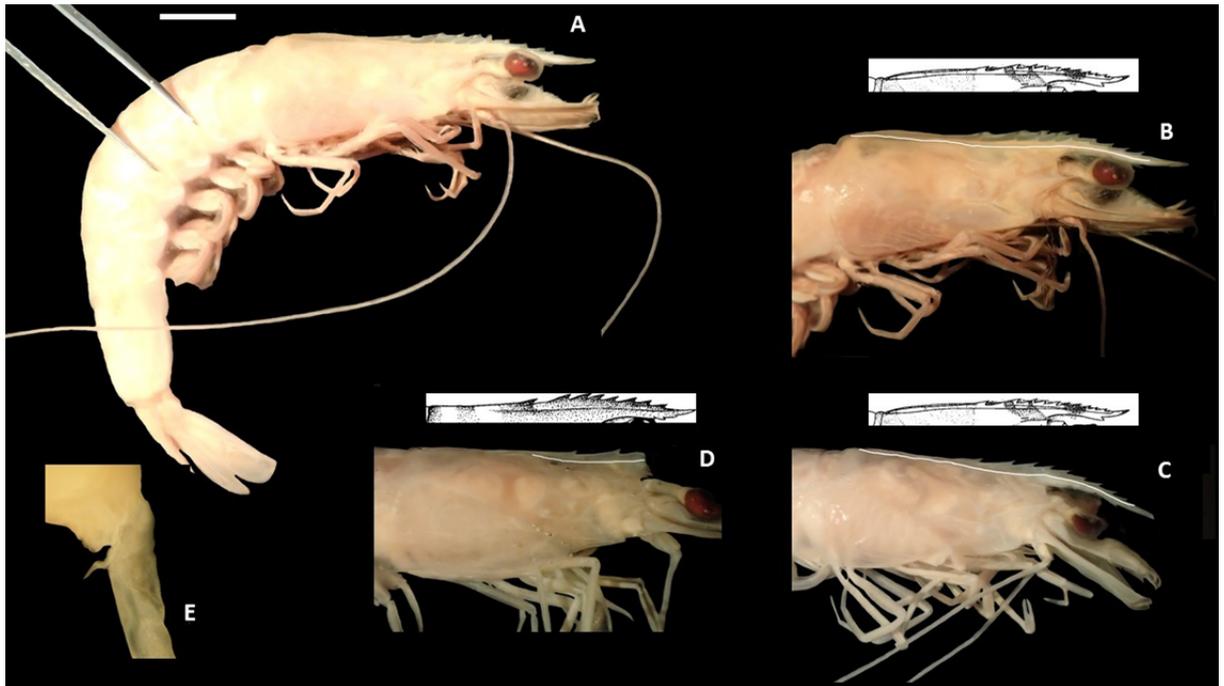


Figure 2. Entire *Penaeus* individual (A), thorax and rostrum of *Marsupenaeus japonicus* (B, C) and *P. semisulcatus* (D), and endopod of the fifth pereopod of *P. semisulcatus* (E). Scale bar: 10 mm. Photographs by Jean-Philippe Pezy.

Results

Two specimens showed a well-developed rostrum with 7–11 teeth on the dorsal margin and 1 tooth on the ventral margin. The body was pale, with brown bands and the pereopods and pleopods were pale yellow near their bases with blue markings near the tips. These two specimens were identified as probable juvenile males of *Marsupenaeus japonicus* (Fischer and Bianchi 1984). These two juveniles were 95 and 120 mm TL; 18 and 30 mm carapace length (CL); 4.66 g and 12.37 g fresh weight, respectively.

The third, smaller, individual, had a broken rostrum. The adrostral groove (Figure 2D) was present but less deep, did not extend to the posterior margin of the carapace but did extend as far as the epigastric tooth. This character is common to both criterion refers to both *P. semisulcatus* and *P. monodon* Fabricius, 1798 (based on Tirmizi 1969). The presence of a small exopod on the fifth pereopod confirmed the identification as *P. semisulcatus* (Figure 2E). Holthuis (1980) mentioned this exopod occurs only on males (Figure 2E). This juvenile male measured 80 mm TL, 19 mm CL, and 3.54 g fresh weight. The report of *P. semisulcatus*, unknown elsewhere in the

English Channel, increases the number of NNS unique to Le Havre harbour to 28.

The specimens were archived in the crustacean collection of the National Museum of Natural History at Paris, under the collection number MNHN-IU-2016-10929 for the two specimens of *Marsupenaeus japonicus* and under the collection number MNHN-IU-2016-10930 for the *Penaeus semisulcatus* specimen.

Discussion

In 2008, an unknown species of the genus *Penaeus* Fabricius, 1798 was first recorded by scuba observations in Le Havre harbour (“Bassin de la Barre” and “Bassin Vauban”) (Ruellet and Breton 2012) (Figure 1). This study confirmed the observations of the genera mentioned by Breton (2014). As well, Quigley et al. (2013) recorded *Marsupenaeus japonicus* (= *Penaeus japonicus*) at 12 locations in the Western part of the English Channel during the last two decades (Figure 1). In agreement with Clark (1990a, b), these authors suggested that the specimens found in UK waters correspond to individuals which had escaped from French fish farms on the Atlantic coast and in the English Channel near Brest (Brittany)

and Barfleur (Normandy). In contrast, the presence of *P. semisulcatus* was surprising because of the absence of cultivation of this species in the area.

The larvae of *M. japonicus* require water temperatures above 24 °C for development, and the rate of growth increases with temperature up to 32 °C, the optimum being 28–30 °C (Galil 2006; Hewitt and Duncan 2001). Indeed, *M. japonicus* cannot survive below a minimum water temperature of 15 °C, with individuals becoming lethargic and no longer feeding (Laubier and Laubier-Bonichon 1977). The ideal temperatures for development, 25–27 °C for *M. japonicus* (Hirata 1975) and 30 °C for *P. semisulcatus* (Kumlu et al. 2000), are high compared to those typical of French waters. The salinity of Le Havre harbour is between 27 and 35 (Breton 1995), which inhibits local hatching and induces high mortalities for juveniles of *Penaeus*, yet adults prefer salinities > 35 (Galil 2006). Kumlu et al. (2000) obtained good survival rates at low salinities (25) when associated with relatively low temperatures (22–26 °C).

In an earlier study (Le Gendre et al. 2014), buoys were released at different points in the Bay of Seine to simulate dispersal of larval blue mussel *Mytilus edulis* Linnaeus, 1758. The dispersal was towards the west of the bay or offshore—not in the direction of the Seine Estuary. Considering their thermal and salinity preferences, it seems more likely that the *Marsupenaeus japonicus* specimens recorded in Le Havre harbour were derived from larvae present in ballast water. Moreover, the occurrence of a second *Penaeus* species (*P. semisulcatus*) in the absence of any hatchery for this species in Europe also suggests introduction via ballast water.

A salinity gradient exists within the different basins in Le Havre harbour with a connection to the open sea as well as freshwater inputs from the Seine River. Thus, in the different basins, organisms such as penaeid shrimps can find favourable conditions for their development. Moreover, the water temperature in the basin is higher than in the open sea due to the presence of docks (personal observation). The hypothesis is that the human infrastructure around the basins can lead to an elevation of the local water temperature and favour the larval development of some introduced species. Juvenile specimens can return to the sea by the lock. Another explanation could be the release of hot water from a power station located in Le Havre harbour, which leads to elevation of natural temperatures from below 10 °C to a maximum of 30 °C (Moulin and Beslin, 2012). These hot water discharges are located near the sampling site and would facilitate the development of *Penaeus* larvae in this area.

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Supplementary material

The following supplementary material is available for this article:

Table S1. Records of *Penaeus semisulcatus* and *Marsupenaeus japonicus* from Le Havre Harbour.

This material is available as part of online article from:

http://www.reabic.net/journals/bir/2017/Supplements/BIR_2017_Pezy_etal_Table_S1.xlsx