BioInvasions Records (2013) Volume 2, Issue 3: 215–219
doi: http://dx.doi.org/10.3391/bir.2013.2.3.07
© 2013 The Author(s). Journal compilation © 2013 REABIC
Open Access

Rapid Communication

Recent discovery of *Paranthura japonica* Richardson, 1909 (Crustacea: Isopoda: Paranthuridae) in European marine waters (Arcachon Bay, Bay of Biscay)

Nicolas Lavesque*, Jean-Claude Sorbe, Guy Bachelet, Benoit Gouillieux, Xavier de Montaudouin, Paulo Bonifacio, Hugues Blanchet and Sophie Dubois

UMR 5805 EPOC, CNRS, Université Bordeaux 1, Station Marine d'Arcachon, 2 rue du Professeur Jolyet, 33120 Arcachon, France

E-mail: n.lavesque@epoc.u-bordeaux1.fr (NL), sorbejc@gmail.com (JCS), g.bachelet@epoc.u-bordeaux1.fr (GB), b.gouillieux@epoc.u-bordeaux1.fr (BG), x.de-montaudouin@epoc.u-bordeaux1.fr (XM), p.bonifacio@epoc.u-bordeaux1.fr (PB), h.blanchet@epoc.u-bordeaux1.fr (HB), as.dubois@epoc.u-bordeaux1.fr (SD)

**Corresponding author*

Received: 24 June 2013 / Accepted: 17 September 2013 / Published online: 27 September 2013

Handling editor: Vadim Panov

Abstract

The Asiatic isopod *Paranthura japonica* Richardson, 1909 was collected in 2007 in Arcachon Bay (SW France), where the species occurs in a variety of habitats, both in the intertidal and at shallow depths. This species, native to the Sea of Japan, may have been accidentally introduced in Arcachon Bay with oyster transfers or as fouling on ship hulls.

Key words: *Paranthura japonica*; Isopoda; exotic species; Arcachon Bay; oyster transfers; fouling

Introduction

Only three *Paranthura* species (Crustacea: Isopoda: Paranthuridae) are known to occur in coastal Atlantic European waters: *P. costana* Bate & Westwood, 1866, from the Shetland Islands to Morocco (0–355 m depth), *P. nigropunctata* (Lucas, 1846), from the English Channel to Mauritania (0–84 m depth) (Junoy and Castelló 2003) and *P. santiparrai* Frutos, Sorbe & Junoy, 2011 recently described from the 'El Cachucho' Marine Protected Area, southern Bay of Biscay (498–817 m depth). The Asiatic species *Paranthura japonica* Richardson, 1909 was first described from a single female specimen collected in 1906 by the US steamer *Albatross* on the shore of Muroran (Hokkaido Island, Japan). At present, its known distribution includes many localities (0–15 m depth) from northern and southern coasts of Japan (Yamada et al. 2007; Nunomura, pers. comm.), eastern Russia (Nunomura 1975, 1977), and eastern China (Ong Che and Morton 1991; Li 2003; Zhang et al. 2009; Wang et al. 2010). Outside its native area, this species has been recorded in San Francisco Bay in 1993 (Cohen and Carlton 1995) and in Southern California in 2000 (Cohen et al. 2005) and is recognized as an exotic species in California (Ruiz et al. 2011). This paper reports the discovery of *P. japonica* in European marine waters (Arcachon Bay, SW France).

Material and methods

Study area

Arcachon Bay is a 180-km² macrotidal (maximum tidal range: 4.9 m) coastal lagoon situated on the south-western coast of France (Figure 1). This lagoon connects with the Atlantic Ocean by a narrow channel and receives freshwater inputs in its south-eastern part (Leyre River). It is characterised by large intertidal flats (115 km²), the lower parts of which are used for cupped oyster [*Crassostrea gigas* (Thunberg, 1793)] farming. Most of the intertidal area (46.2 km²) is covered by seagrass beds, *Zostera noltei* Hornemann, 1832 (Plus et al. 2010). In the inner lagoon, tidal channels represent an area of 71 km², with 1.02 km² occupied by eelgrass beds, *Zostera marina* Linnaeus, 1753 (Plus et al. 2010).

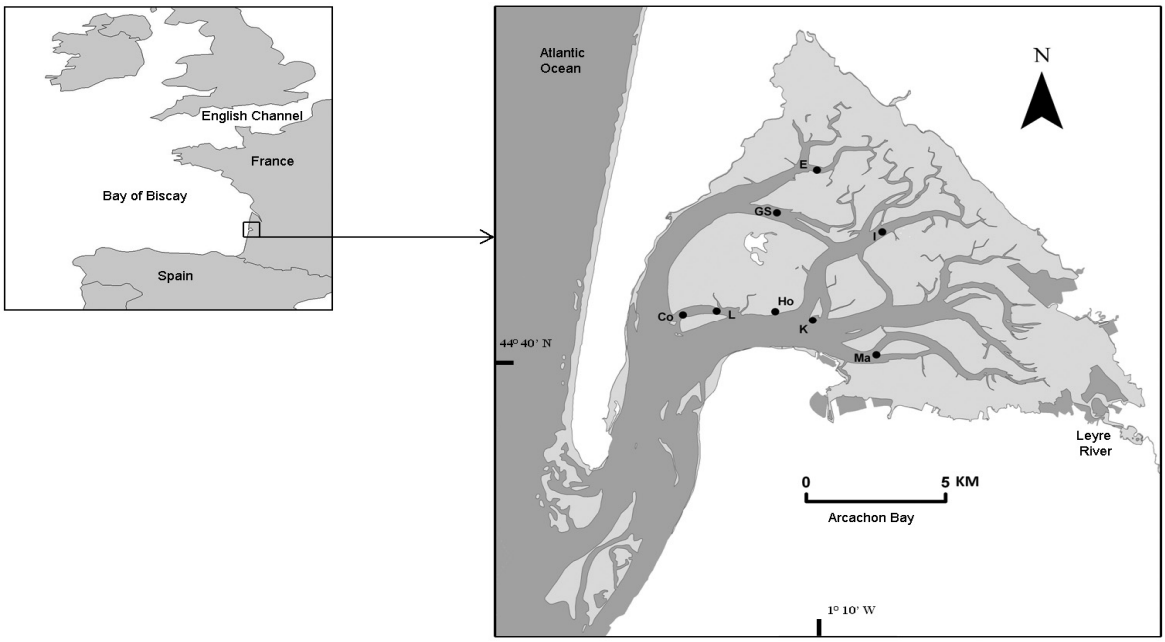

Figure 1. Stations where the benthic anthurid isopod *Paranthura japonica* was collected in Arcachon Bay.

Material examined

During surveys carried out between 2007 and 2010, *Paranthura japonica* was collected in several stations in Arcachon Bay (Figure 1). Bottom sediments were collected using a Van Veen grab in subtidal habitats or a hand-corer in intertidal habitats. These specimens (Figure 2) were compared to *P. japonica* specimens stored in the Muséum National d'Histoire Naturelle, Paris (Gurjanova leg, 1934, MNHN-IU-2009-45, Petrov Island, Sea of Japan) and in the Toyama Science Museum, Japan (Japanese specimens collected in the Toyama and Mutsu Bays, Honshu; N. Nunomura, Osaka Museum, pers. comm.). All specimens were examined under a Nikon SMZ 1500 stereomicroscope, photographed with a Nikon DS-Fi 2 camera and an image of one specimen drawn with a Wacom Intuos 5 tablet and the Inkscape software. Total length TL was measured with the NIS-Elements Analysis software from the cephalon anterior margin to the telson apex. Five specimens from Arcachon Bay (Station K) were deposited in the Muséum National d'Histoire Naturelle, Paris (MNHN-IU-2012-1359).

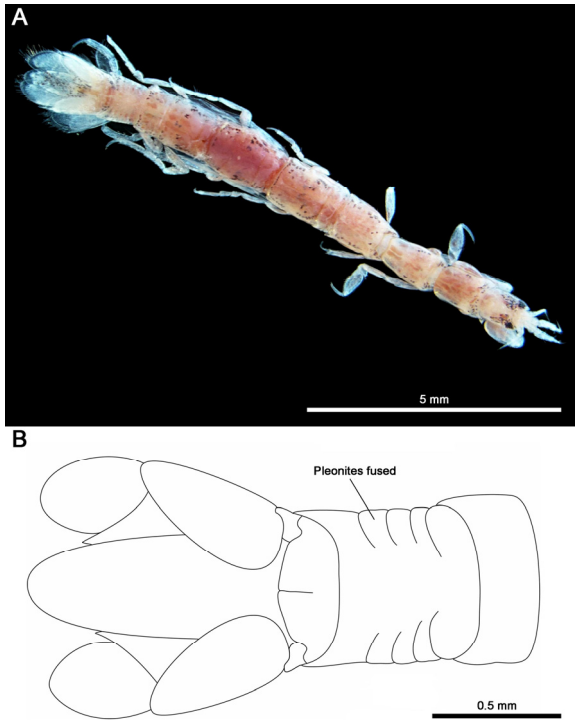

Figure 2. *Paranthura japonica*: (A) dorsal view of a specimen from Arcachon Bay, SW France (TL = 11.03 mm) (photograph by Benoit Gouillieux), (B) diagram of dorsal posterior part (setae not drawn), showing pleonites mediodorsally fused.

Results

We collected 35 specimens of *P. japonica* from a variety of habitats in Arcachon Bay: 22 individuals in mussel beds (stations Ma, Co, K), 2 individuals in intertidal oyster reefs (station Ho), 5 individuals in *Zostera marina* meadows (stations GS, L), 1 individual in a slipper limpet [*Crepidula fornicata* (Linnaeus, 1758)] bed (station I), and 5 specimens in muddy sands (station E) (Figure 1; Appendix 1).

As reported by Frutos et al. (2011), the specimens (males, females and juveniles) from Arcachon Bay can be easily separated from the European *Paranthura* species by the mid-dorsal fusion of their pleonites 1–5 (Figure 2B). Moreover, the comparison with specimens of *P. japonica* from the Sea of Japan revealed similar external morphology, characterized by the following features (and excludes other known Japanese *Paranthura* species, according to the descriptions by Nunomura (1974, 1975, 1977, 1993)): eyes composed of less than 17 ommatidia that are clumped together; short pleotelson barely exceeding the tip of uropods; pereonite 6 shorter than pereonite 5; and anterolateral angles of cephalon exceeding rostral projection. None of the other known *Paranthura* species shows such a combination of morphological characters. Therefore, we concluded that the Arcachon specimens were *P. japonica*.

At first glance, *P. japonica* could be confused with the cosmopolitan *Cyathura carinata* (Krøyer, 1847), a well-known littoral Anthuridae from European coasts, and including muddy fine sediments from Arcachon Bay (Salvat 1967). However, this last species can be distinguished by mouth appendages not acutely produced (a major morphological feature at family level), pleonites 1–5 completely fused, appendix masculina of pleopod 2 bearing distally two flat lobes and a stout anchor-shaped seta, and telson with two dorsal statocysts (see full description in Cléret 1960).

Discussion

The vector of introduction of *Paranthura japonica* in Arcachon Bay is difficult to determine. The natural spread of adult specimens from another location is unlikely for several reasons: (1) the species is known only from its native area (NE Pacific) and California; (2) as a benthic species, it does not seem able to swim over long distances; and (3) the major shipping harbours in SW France are situated far from Arcachon Bay (Bordeaux 200 km, Bayonne 150 km) and separated from the bay by highly dynamic, sandy, shores. Ship's ballast water and fouling have been hypothesized as the way of introduction of *P. japonica* on the Pacific coast of North America (Cohen and Carlton 1995; Cohen et al. 2005). In our opinion transport in ballast waters may be dismissed because of the direct development and the lack of pelagic larvae in Paranthuridae (Frutos et al. 2011), as well as the absence of large commercial ships in Arcachon Bay. Introduction with colonial organisms (e.g. sponges, hydroids, ascidians or bryozoans) fouling the hulls of sailing ships or pleasure boats is a possible vector for *P. japonica*'s entry in Arcachon Bay and was suggested for other isopods such as *Mesanthura* sp. in Italian harbours (Lorenti et al. 2009) and *Synidotea laevidorsalis* (Miers, 1881) on a world-wide scale (Chapman and Carlton 1994).

Accidental introduction with oyster transfers is a likelier hypothesis. Arcachon Bay is one of the major French oyster farming sites with a production of 7,000–8,000 t per year (Scourzic et al. 2011). In the early 1970s, the Portuguese cupped oyster *Crassostrea angulata* (Lamarck, 1819), which was farmed in the bay since the end of the 19th century, was decimated by a viral disease (Goulletquer et al. 2002). To sustain the local oyster industry, the exotic Pacific cupped oyster *C. gigas* was then massively introduced in Arcachon Bay between 1971 and 1975, as spat from Senday Bay, NE Honshu Island, Japan (1,176 t of spat collectors from 1971 to 1975) and as adults from British Columbia, Canada (137.5 t from 1971 to 1973) (Grizel and Héral 1991). Intentional oyster transfer is a well-known vector of accidental introduction for many alien species (Gruet et al. 1976; Verlaque et al. 2007), and may have been be responsible for the introduction of *P. japonica* in Arcachon Bay and was previously documented for other non-native species in this area (Bachelet et al. 2004, 2008). However, no import of cupped oyster from Japan to Arcachon has been officially reported after the 1970s. This means that *P. japonica* may have remained unnoticed in Arcachon Bay since that time, either because it was too rare or misidentified. Alternatively, it could have been introduced with an undeclared oyster transfer from Japan or from another area where this anthurid has not been identified so far.

In Japanese waters, *P. japonica* is associated with subtidal *Zostera* spp. meadows (Nakaoka et al. 2001; Yamada et al. 2007) or with colonies of brown algae *Sargassum* spp. (Nunomura 1977). In Arcachon Bay, it seems to be well established

in the whole area, including different locations and habitats, but it remains a rare species with low abundances (see Appendix 1).

P. japonica might be present in other European shellfish farming areas. The transfer of *C. gigas* among regions has caused the introduction and spread of numerous alien species in northern Europe (Goulletquer et al. 2002). The lack of previous records in Europe might be due to the small size of individuals, the low abundance of local populations, or its misidentification (including a possible confusion with *Cyathura carinata*).

Acknowledgements

The authors wish to thank F. Prince (captain of RV Planula IV, INSU-OASU, Arcachon) and scuba divers (Gendarmerie Nationale, Brigade Nautique Côtière d'Arcachon) for their help during samplings in Arcachon Bay. Thanks to L. Corbari (Muséum National d'Histoire Naturelle, Paris) and N. Nunomura (Toyama Science Museum, Japan) for the loan of *Paranthura japonica* specimens from their collections. Some specimens were collected during S. Dubois's field work within the scope of the scientific projects ORIQUART (EC2CO-PNEC) and OSQUAR (Conseil Régional d'Aquitaine) and during surveys funded by the Syndicat Intercommunal du Bassin d'Arcachon. Authors are very grateful to Kamille Hammerstrom for her help in correcting the English text. Finally, we would also like to thank the anonymous referees for their critical review of the manuscript.

References

Bachelet G, Blanchet H, Cottet M, Dang C, de Montaudouin X, de Moura Queiros A, Gouillieux B, Lavesque N (2008) A round-the-world tour almost completed: first records of the invasive mussel *Musculista senhousia* in the North-east Atlantic (southern Bay of Biscay). *Marine Biodiversity Records* 2, e119, http://dx.doi.org/10.1017/S1755267209001080

Bachelet G, Simon-Bouhet B, Desclaux C, Garcia-Meunier P, Mairesse G, de Montaudouin X, Raigné H, Randriambao K, Sauriau PG, Viard F (2004) Invasion of the eastern Bay of Biscay by the nassariid gastropod *Cyclope neritea*: origin and effects on resident fauna. *Marine Ecology Progress Series* 276: 147–159, http://dx.doi.org/10.3354/meps276147

Chapman JW, Carlton JT (1994) Predicted discoveries of the introduced isopod *Synidotea laevidorsalis* (Miers, 1881). *Journal of Crustacean Biology* 14: 700–714, http://dx.doi.org/10.2307/1548863

Cléret JJ (1960) Etude de *Cyathura carinata* (Krøyer) (Isopode Anthuridae) 1. Redescription de l'espèce et discussion systématique. *Cahiers de Biologie Marine* 1: 433–452

Cohen AN, Carlton JT (1995) Biological Study. Nonindigenous aquatic species in a United States estuary: A case study of the biological invasions of the San Francisco Bay and Delta. US Fish and Wildlife Service, Washington, DC, 246 pp

Cohen AN, Harris LH, Bingham BL, Carlton JT, Chapman JW, Lambert CC, Lambert G, Ljubenkov JC, Murray SN, Rao LC, Reardon K, Schwindt E (2005) Rapid Assessment Survey for exotic organisms in southern California bays and harbors, and abundance in port and non-port areas. *Biological Invasions* 7: 995–1002, http://dx.doi.org/10.1007/s10530-004-3121-1

Frutos I, Sorbe JC, Junoy J (2011) The first blind *Paranthura* species (Crustacea, Isopoda, Paranthuridae) from the 'El Cachucho' Marine Protected Area (Le Danois Bank, southern Bay of Biscay). *Zootaxa* 2971: 17–32

Goulletquer P, Bachelet G, Sauriau PG, Noel P (2002) Open Atlantic coast of Europe - A century of introduced species into French waters. In: Leppäkoski E, Gollasch S, Olenin S (eds), Invasive aquatic species of Europe. Distribution, impacts and management. Kluwer Academic Publishers, Dordrecht, The Netherlands, pp 276–290, http://dx.doi.org/10.1007/978-94-015-9956-6_30

Grizel H, Héral M (1991) Introduction into France of the Japanese oyster (*Crassostrea gigas*). *Journal du Conseil International pour l'Exploration de la Mer* 47: 399–403

Gruet Y, Héral M, Robert JM (1976) Premières observations sur l'introduction de la faune associée au naissain d'huîtres japonaises *Crassostrea gigas* (Thunberg), importé sur la côte atlantique française. *Cahiers de Biologie Marine* 17: 173–184

Junoy J, Castelló J (2003) Catálogo de las especies ibéricas y baleares de isópodos marinos (Crustacea, Isopoda). *Boletín del Instituto Español de Oceanografía* 19: 293–325

Lorenti M, Dappiano M, Gambi MC (2009) Occurrence and ecology of *Mesanthura* (Crustacea: Isopoda: Anthuridea) in two Italian harbours. *Marine Biodiversity Records* 2, e48, http://dx.doi.org/10.1017/S1755267209000542

Li L (2003) Hong Kong's isopods. In: Morton B (ed) Perspectives on marine environment change in Hong Kong and Southern China. Hong Kong University Press, pp 137–166

Nakaoka M, Toyohara T, Matsumasa M (2001) Seasonal and between-substrate variation in mobile epifaunal community in a multispecific seagrass bed of Otsuchi Bay, Japan. *Marine Ecology* 22: 379–395, http://dx.doi.org/10.1046/j.1439-0485.2001.01726.x

Nunomura N (1974) Marine Isopoda from the coast of Hikigawa Town, Kii Peninsula, middle Japan (1). Bulletin *of the Osaka Museum of Natural History* 28: 1–12

Nunomura N (1975) Marine Isopoda from the rocky shore of Osaka Bay, middle Japan (1). *Bulletin of the Osaka Museum of Natural History* 29: 15–35

Nunomura N (1977) Marine Isopoda from Amakusa, Kyushu (I). *Publications of the Amakusa Marine Biological Laboratory* 4: 71–90

Nunomura N (1993) Marine isopod crustaceans of Seto Inland Sea deposited at the Toyama Science Museum 1. Suborder Anthuridea-1. *Bulletin of the Toyama Science Museum* 16: 15–30

Ong Che RG, Morton B (1991) Spatial and temporal variations in the subtidal macrobenthic community of Tai Tam Bay, Hong Kong. *Asian Marine Biology* 8: 193–216

Plus M, Dalloyau S, Trut G, Auby I, de Montaudouin X, Emery E, Noel C, Viala C (2010) Long-term evolution (1988–2008) of *Zostera* spp. meadows in Arcachon Bay (Bay of Biscay). *Estuarine, Coastal and Shelf Science* 87: 357–366, http://dx.doi.org/10.1016/j.ecss.2010.01.016

Ruiz G, Fofonoff P, Steves B, Dahlstrom A (2011) Marine crustacean invasions in North America: a synthesis of historical records and documented impacts. In: Galil BS, Clark PF, Carlton JT (eds), In the wrong place – Alien marine crustaceans: distribution, biology and impacts. *Invading Nature* 6. Springer, pp 215–250, http://dx.doi.org/10.1007/978-94-007-0591-3_6

Salvat B (1967) La macrofaune carcinologique endogée des sédiments meubles intertidaux (Tanaïdacés, Isopodes et Amphipodes), éthologie, bionomie et cycle biologique. Mémoires du Muséum National d'Histoire Naturelle, Série A, *Zoologie* 15: 1–275

Scourzic T, Loyen M, Fabre E, Tessier A, Dalias N, Trut G, Maurer D, Simonnet B (2011) Evaluation du stock d'huîtres sauvages et en élevage dans le Bassin d'Arcachon. Contrat Agence des Aires Marines Protégées & OCEANIDE, 70 pp

Verlaque M, Boudouresque CF, Mineur F (2007) Oyster transfers as a vector for marine species introductions: a realistic approach based on the macrophytes. In: Impact of mariculture on coastal ecosystems. CIESM Workshop Monographs 32, pp 39–47

Wang CF, Ren XQ, Xu RL (2010) Composition, abundance, and diversity of the Peracarida on different vegetation types in the Qi'ao-Dan'gan Island Mangrove Nature Reserve on Qi'ao Island in the Pearl River estuary, China. *Zoological Studies* 49: 608–615

Yamada K, Hori M, Tanaka Y, Hasegawa N, Nakaoka M (2007) Temporal and spatial macrofauna community changes along a salinity gradient in seagrass meadows of Akkeshi-ko estuary and Akkeshi Bay, northern Japan. *Hydrobiologia* 592: 345–358, http://dx.doi.org/10.1007/s10750-007-0767-6

Zhang J, Hansen PK, Fang J, Wang W, Jiang Z (2009) Assessment of the local environmental impact of intensive marine shellfish and seaweed farming – Application of the MOM system in the Sungo Bay, China. *Aquaculture* 287: 304–310, http://dx.doi.org/10.1016/j.aquaculture.2008.10.008

Appendix 1. Records of the non-indigenous benthic isopod *Paranthura japonica* in Arcachon Bay. N: number of individuals collected. Sites: see Figure 1.

Sites	Date	Habitat	Tidal level (m)	Latitude	Longitude	N
Ho	June 2007	oyster reef	+1	44°40' N	01°10' W	1
Ho	December 2007	oyster reef	+1	44°40' N	01°10' W	1
Ma	October 2008	mussel bed	-3	44°39' N	01°07' W	12
Co	June 2009	mussel bed	-4.7	44°40' N	01°12' W	2
E	September 2009	muddy sands	-3.8	44°43' N	01°09' W	5
GS	September 2009	*Zostera* meadow	-3.9	44°42' N	01°10' W	1
I	September 2009	slipper limpet bed	-4.3	44°42' N	01°07' W	1
K	September 2009	mussel bed	-7.8	44°40' N	01°09' W	5
L	September 2009	*Zostera* meadow	-3.9	44°40' N	01°11' W	4
Ma	October 2010	mussel bed	-3	44°39' N	01°07' W	3