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Rapid Communication

First record of the non-indigenous isopod *Ianiropsis serricaudis* Gurjanova, 1936 along the French coast of the English Channel

Aurore Raoux*, Jean-Philippe Pezy and Jean-Claude Dauvin

Normandie Univ, UNICAEN, UNIROUEN, Laboratoire Morphodynamique Continentale et Côtière, CNRS UMR 6143 M2C, 24 rue des Tilleuls, 14000 Caen, France

**Corresponding author*

E-mail: *aurore.raoux@unicaen.fr*

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Abstract

Specimens of the North-West Pacific Ocean isopod *Ianiropsis serricaudis* Gurjanova, 1936 were collected for the first time in 2019 from a harbour situated on the Normandy coast in northern France: Le Havre (192 specimens). *I. serricaudis* was recorded for the first time in Europe in the Netherlands in 2000 and for the first time in France (Arcachon) in 2013, the latter occurrence being due to oyster transfers. Although this species is non-indigenous to Normandy waters, it may have been introduced to France by oyster culture or by the fouling of the hulls of ships navigating between European countries and France.

Key words: introduced species, Le Havre harbour, non-indigenous species, fouling, Bay of Seine, alien isopod

Introduction

The introduction of non-indigenous species (NIS) is actually a source of biodiversity loss and habitat destruction (Roy et al. 2019). In Normandy waters, a total of 152 NIS have been recorded; among these species, 86 have been introduced through shipping (ballast waters and fouling) and 66 through aquaculture activity (*unpublished data*). In Normandy, the first records of NIS date back to the middle of the 19th century, with an increase in new sightings at the beginning of the 20th century and becoming even more important over the last three decades. Inventories of NIS species have been published for all European waters (Katsanevakis et al. 2013, 2014), as well as for coastal areas of the United Kingdom and France (Minchin et al. 2013; Goulletquer 2016), in the English Channel, along the coastline of Brittany (Blanchard et al. 2010), the Channel Islands (States of Jersey 2017), waters around the harbour at Le Havre in Normandy, France (Breton 2014), the Opal Coast (Dewarumez et al. 2011), and along the Belgian coast (Lescrauwaet et al. 2015). Maritime traffic along the English Channel has increased markedly with the development of international ports, ferries lines and recreational boating. In this shallow sea, the volume

of maritime shipping represents 15.4% of the total global traffic (Bahé 2008). Harbours are essentially composed of artificial structures (docks, floating pontoons, dykes and marinas). All of these structures provide suitable habitats for NIS and act as stepping-stones for their secondary dispersion (Darbyson et al. 2009; Davidson et al. 2010; Airoldi et al. 2015; López-Legentil et al. 2015).

The harbour at Le Havre located at the mouth of the Seine estuary is often the first site for the observation of an NIS in the English Channel (EC) (Breton and Vincent 1999; Ruellet and Breton 2012; Breton 2014, 2016). Scuba diving observations in the harbour basin have led to the reporting of 364 animal species of which 36 are non-indigenous (Breton 2014, 2016). Recently, in the Seine estuary, the mysid *Neomysis americana* (S.I. Smith, 1973) was recorded for the first time in the EC in 2017 (Pezy et al. 2018). In the Vauban basin of Le Havre harbour, three new NIS were recorded for the first time in the EC: the two amphipods *Aoroides semicurvatus* Ariyama, 2004 and *Aoroides longimerus* Ren & Zheng, 1996 (Dauvin et al. *in press*) and the isopod *Paranthura japonica* Richardson, 1909 (Pezy et al. 2020). These three species were recorded for the first time in France, in Arcachon Bay, in 2009, (Lavesque et al. 2013; Gouillieux et al. 2016), in an area which is a major centre for the cultivation of the oyster *Crassostrea gigas* (Thunberg, 1793). In the present study, specimens of the Western Pacific Ocean isopod *Ianiropsis serricaudis* were collected for the first time in Le Havre harbour.

Ianiropsis serricaudis was originally described from the North-West Pacific Ocean (Sea of Okhotsk to Sea of Japan, also called East Sea) in 1936. In fact, this species has also been recorded in the eastern Pacific region, especially in 1977 in California (Carlton 1979a, b; Hobbs et al. 2015), and in Washington state in 2010 (Cordell et al. 2013). It was also recorded on the western Atlantic margin, in Connecticut in 1999 (Pederson et al. 2005) and in New Jersey in 2012 (Hobbs et al. 2015), on the eastern Atlantic margin, in the Mediterranean and the Netherlands in 2000 (Faasse 2007), in the Ferrol Bay (North West Spanish coast) in 2011 (Martínez-Laiz et al. 2018) as well as in the lagoon of Venice in Italy in 2012–2014 (Marchini et al. 2016a, b). This species was also recorded in the English Channel in Southampton harbour in 2004, but no information was given on population density, and an occurrence was later reported in Plymouth waters (Hobbs et al. 2015) (Table 1).

In the framework of the ENBIMANOR project (ENrichissement de la BIodiversité MArine en NORmandie), field surveys were organized in Normandy (France) to monitor NIS in coastal marinas. One of the main goals of this project was to produce an inventory of all NIS present on the hard substrata of floating pontoons at eight marinas along the Normandy coast, from Granville in the West to Dieppe in the East (Figure 1). The sampling was carried out only in yacht harbours, excluding fishing and commercial ports.

Table 1. Distribution of introduced range of *Ianiropsis serricaudis* and associated species (NIS: Non-Indigenous Species; IS: Indigenous Species; A: Population density, number of individuals per m²).

Region	Location	First record	Habitat	Density	Reference
Eastern Pacific	San Francisco Bay (California)	1977	In association with NIS (*Dynoides dentisinus*, *Ciona intestinalis*, *Styela clava*)	–	Carlton 1979a, b
	Monterey Bay (California)	2002	In mudflat with NIS (*Ficopomatus enigmaticus*)	–	Heiman and Micheli 2010
	Puget Sound (Washington)	2010	In association with NIS (*Didemnum vexillum*)	20,000 (with *D. vexillum*) 1,000 (without ascidians)	Cordell et al. 2013
Western Atlantic	Long Island Sound, Mystic River (Connecticut)	1999	In association with NIS (*Botrylloides violaceus*) and IS (*Amathia dichotoma*, *Halichondria bowerbanki*, *Clathria prolifera*)	–	Hobbs et al. 2015
	Maine to Connecticut	2000–2013	In association with NIS (*Grateloupia turuturu*, *Didemnum vexillum*, *Botrylloides violaceus*, *Tricellaria inorpinata*) and IS (*Ulva* spp., *Chondrus crispus*)	–	Hobbs et al. 2015
	Barnegat Bay – (New Jersey)	2012–2013	In association with NIS (*Botryllus schlosseri*); cryptogenic alga (*Ulva lactuca*) and IS (*Einhornia crustulenta*, *Schizoporella* sp.)	7,000	Hobbs et al. 2015
	Sinepuxent Bay (Maryland)	2012	–	–	Morales-Núñez and Chigbu 2018
Eastern Atlantic	Netherlands	2000	In association with NIS (*Botrylloides violaceus*, *Didemnum vexillum*) and cryptogenic ascidian (*Diplosoma listerianum*)	–	Faasse 2007
	Southampton (UK)	2004	In association with NIS (*Styela clava*)	–	Hobbs et al. 2015
	Ferrol Bay (Spain)	2011			Martinez-Laiz et al. 2018
	Arcachon Bay (France)	2013	In association with NIS (*Crassostrea gigas, Styela clave, Ciona intestinalis*)	–	Gouillieux 2018
	Le Havre (France)	2019	In association with IS (*Mytilus edulis*) and NIS *Styela clava*	614 ± 773 (max: 1,952)	Present study
Mediterranean Sea	Lagoon of Venice (Italy)	2012	In association with NIS (*Botrylloides violaceus*, *Didemnum vexillum*, *Hydroides dianthus*, *Styela plicata*, *Tricellaria inopinata*)	–	Marchini et al. 2016a
	Olbia, Sardinia	2014	–	–	Machini et al. 2016b
	Cap d'Agde and Port Camargue (France)	2015	–	–	Ulman et al. 2017

During our recent study on the recording of NIS in Normandy, numerous specimens of *Ianiropsis serricaudis* Gurjanova, 1936 were found in Le Havre harbour. In this paper, we report and discuss this new NIS sighting along the French coast of the English Channel.

Materials and methods

Study area

The fouling organisms described here originate from only one of the eight sampling sites: Le Havre Vauban basin, which is located on the north side of the mouth of the river Seine (49°29′26.51″N; 0°7′51,982″E). The samples were collected on the 25th February 2019.

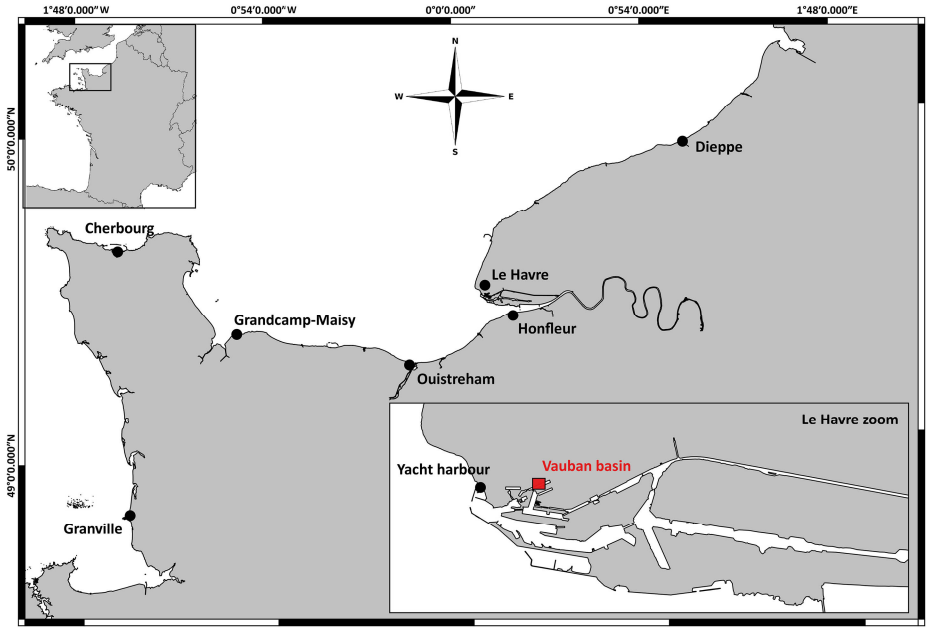


Figure 1. Map showing locations of the eight marinas sampled in Normandy during the ENBIMANOR project including the site where *Ianiropsis serricaudis* was found: Le Havre (Vauban Basin) in red square.

At Le Havre harbour, the fouling community is composed of the mussels (*Mytilus edulis* Linnaeus, 1758), the NIS ascidian (*Styela clava* Herman, 1881), the polychaete *Serpula vermicularis* Linnaeus, 1767 and some motile epifauna with high densities of the NIS caprellid amphipod *Caprella mutica* Schurin, 1935, and the ophiurid *Amphipholis squamata* (Della Chiaje, 1828).

Sampling strategy

At eight sites around the Normandy coast (Figure 1), samples were collected by scraping the fouling organisms off the hard substratum formed on floating pontoons using a frame of 0.25 m × 0.25 m or 0.42 m × 0.15 m depending on the pontoon structure. Five replicates were collected from each site, each replicate corresponding to a sampling surface of 0.0625 m². Additionally, approximately one hour was spent sampling different and distinct pontoon sections. Removed material was collected using a WP2 net (200 µm mesh size) to avoid any loss of marine organisms. The retrieved specimens were preserved in a 10% formaldehyde solution and taken to the laboratory for identification. Then, the organisms were sorted, identified and counted under a dissecting microscope and stored in alcohol. A total of 192 specimens of *I. serricaudis* (Figure 2) were collected and, one specimen was deposited in the crustacean collection of the National Museum of Natural History in Paris under collection number MNHN-IU-2019-3177.

Results

Specimens were found in polyhaline waters, with salinities ranging from 26.6 to 32.1, and temperatures of 8.6 to 17.2 °C, at oxygen concentrations between 4.7 and 7.2 ml.l^{-1} and a turbidity of between 1.3 and 1.9 NTU.

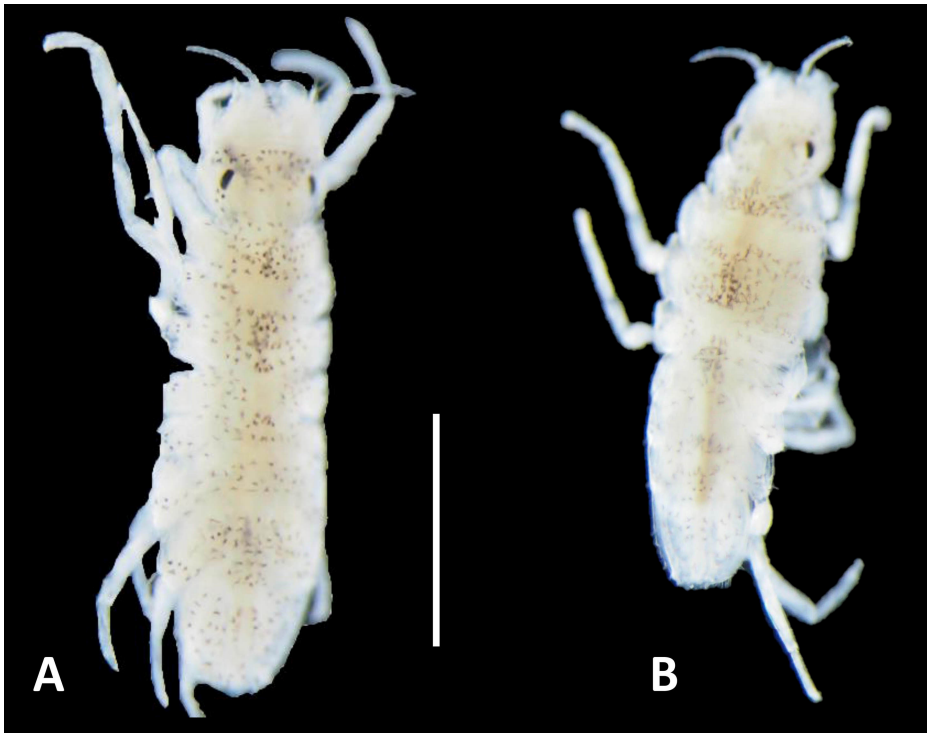


Figure 2. Photo of male (A) and female (B) dorsal view (scale bar: 2 mm). Photo by A. Raoux.

The genus *Ianiropsis* G.O. Sars, 1897 can be easily distinguished from the indigenous genus *Janira* Leach, 1814 because the pereopod 1 in *Ianiropsis* male has a carpus elongate and a propodus that is never enlarged. By contrast, in the case of *Janira*, the carpus and propodus are not elongate, being similar in length to pereopod 2–7 (Wilson and Wägele 1994). According to Hobbs et al. (2015) and Gouillieux (2018), *Ianiropsis serricaudis* males can be distinguished from other *Ianiropsis* species males by six important criteria: 1) the length of the antennal peduncle of articles 6 and 7 are as long or longer than half the body length, 2) the maxilliped palp is projecting and visible in front of the head in a dorsal view, 3) the pereopod 1 has a dactylus with two claws, whereas, the pereopod 7 has a dactylus with 2 or 3 claws, 4) then, the protopod is elongate and rectangular with a pleotelson bearing of 3 or 4 denticles on the lateral margin, 5) for the female, the length of the antennal peduncle article 7 is less than half the body length, 6) the maxilliped palp is not projecting and the pereopod 1 is as long as pereopod 2–7 with a carpus and propodus not particularly elongate.

On 25th February 2019, a total of 192 individuals of this species were collected in samples from pontoons at Le Havre, associated with mussel beds.

At Le Havre harbour, the mean population density of *I. serricaudis* is 614 ± 773 individuals per m² with a minimum of 96 and a maximum of 1,952 individuals per m² in the five replicates, for a minimum size of 1.3 mm and a maximum size of 4.1 mm. The winter population was mainly composed of mature males and females. The structure of the population and its temporal changes will beconsidered when the total of the individuals collected during the two years ENBIMANOR project (2018–2020) will be available.

Discussion

Ianiropsis serricaudis is native to the western Pacific, extending from the Sea of Okhotsk to the Sea of Japan/East Sea, being found in Russian, Japanese and Korean waters (Marchini et al. 2016a; Gouillieux 2018; Martínez-Laiz et al. 2018). The species was subsequently recorded on the Atlantic coast from Maine to New Jersey (bays and estuaries), on the eastern Pacific coast (from Washington to California) and in Europe (Marchini et al. 2016 a, Gouillieux 2018; Martínez-Laiz et al. 2018). In fact, it was observed for the first time in 2000 in the Netherlands (Faasse 2007), in 2004 in The United Kingdom (Hobbs et al. 2015), in 2011 in Spain (Martínez-Laiz et al. 2018), in 2012 in Italy (Marchini et al. 2016a) and then in 2013 in France in Archachon Bay (Gouillieux 2018). At Le Havre harbour, the arrival of *I. serricaudis* is probably linked with maritime traffic through ballast water or fouling on the hulls of ships, in association with other organisms such as ascidians and bryozoans. In fact, Le Havre harbour is a hotspot for the introduction of marine NIS in the English Channel (Ruellet and Breton 2012; Breton 2014; Pezy et al. 2020) through shipping including recreational boating. These activities are known to be the main vectors for both primary introduction and secondary dispersion, via ballast water or biofouling (Ruiz et al. 2000).

In 2018, Gouillieux proposed that *I. serricaudis* had been accidently introduced into Arcachon Bay in 2013 through oyster transfers. On the same line, Martínez-Laiz et al. (2018), also suggested that the arrival of *I. serricaudis* in the Iberian Peninsula, is probably linked to accidental introduction with shellfish transfers. Finally, this vector was also suggested by Marchini et al. (2016a, b) to explain its introduction to Italy. However, the absence of aquaculture near Le Havre (especially oyster production) implies that, contrary the suggestion of Gouillieux (2018), oyster transfers cannot be a plausible vector here in the Havre harbor. As highlighted by Hobbs et al. (2015), maritime traffic remains the most probable pathway for the introduction of this species into European waters. Finally, the study of Martínez-Laiz et al. (2018), also showed that recreational boating is also a potential vector for this species (secondary transport).

As pointed out by several studies, due to its high invasive capability, this species is probably more widespread than previously reported along the North American and European coasts, especially on the coast of France, without even being noticed (Hobbs et al. 2015; Gouillieux 2018). In fact, According to Hobbs et al. (2015); Marchini et al. (2016a, b), *Ianiropsis serricaudis* can be easily confused with the cosmopolitan *Janira maculosa* Leach, 1814, an isopod present along the European coasts and *I. breviremis* (G.O Sars, 1883), which is the other species of the genus present in European waters. Thus, it is possible that this new finding is the result of a more intensive screening effort as well as the careful inventory of coastal marine invertebrates in harbours along the Normandy coast in the framework of the ENBIMANOR Project.

Although *I. serricaudis* is now a common species of shallow water marine habitats (fouling communities) on the Pacific Atlantic and European coasts, very little information is available about its ecological role in its native range. Thus, it will be interesting in the future to study the role of *I. serricaudis* as a competitor and as prey within its habitat.

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