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ORIGINAL ARTICLE

New records of holothurian-associated pea crab *Pinnixa tumida* Stimpson, 1858 (Crustacea: Decapoda: Pinnotheridae) from the Russian coastal waters of the Sea of Japan

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Pea crab *Pinnixa tumida* Stimpson, 1858 associated with burrowing holothurian *Paracaudina chilensis* (Müller, 1850) is recorded from the Peter the Great Bay and Posjeta Bay of the Sea of Japan. The new locality where the species was found in situated about 130 km north-east from the previous record and present the most northern distribution of the species in the Northern Pacific. The distribution of the species in other areas is discussed in the paper.
Keywords: Crustacea; Decapoda; Brachyura; Pinnotheridae; *Pinnixa tumida*; *Paracaudina*; pea crab; symbionts; new records; Sea of Japan

Introduction

The decapod fauna of Russian coastal waters of the Sea of Japan presently includes about 70 species from 22 families (Vinogradov 1950; Marin 2010, 2013a, c, 2017b; Marin & Kornienko 2014) including numerous species recently recorded from the area (Marin et al. 2011, 2013a–c, 2013; Marin 2013a–d, 2014, 2016a, b, 2017a, b, 2018a; Anker et al., 2016) as well as some species firstly found in other regions of the northern Pacific (Marin et al. 2015; Komai et al. 2017; Marin, 2018b) indicating that brachyuran and decapod fauna and the species distribution are still known incompletely.

Three species of pea crab genus Pinnixa White, 1846 (Crustacea: Decapoda: Pinnotheridae) have been recorded for the fauna of Russia, mostly from the western part of the Sea of Japan: *Pinnixa tumida* Stimpson, 1858, *P. rathbuni* Sakai, 1934 and *P. banzu* Komai, Nishi & Taru, 2014 (Vinogradov, 1950; Rybakov, 1986; Vasilenko, 1990; Sinelnikov & Marin, 2012; Marin, 2013a, b, 2015, 2016a; Marin & Kornienko, 2014). These species clearly differ morphologically as well as by ecological features. *P. tumida* was found in Posyet Bay in the intestine of the burrowing holothurian *Paracaudina chilensis* (Müller, 1850) (=*Caudina ransonnetti* Marenzeller von, 1881, a junior synonym) (Echinodermata: Holothuroidea: Caudinidae), *P. rathbuni* is living in burrows of the spoon worm *Urechis unicinctus* (von Drasche, 1881) (Annelida: Echiura: Urechidae) and *P. banzu* is known as inhabitant of the tubes of polychaete *Chaetopterus cautus* Marenzeller, 1879 (Annelida: Polychaeta: Chaetopteridae).

During an intensive study of decapod biodiversity along the Russian coast of the Sea of Japan, the species was found again from the northern part of the Peter the Great Bay that significantly increase the area of the species to the north.

Material and methods

Fieldwork and sampling were carried out along the Russian coasts of the Sea of Japan, in Peter the Great Bay (September 2017–2018) and Posyet Bay (July 2016). The material was collected from subtidal waters to the depth of 20 meters by snorkeling and SCUBA diving. Coloration of living specimens and their external morphology was photographed using digital camera Canon G16. All specimens were preserved in 70% ethanol for further DNA analysis. Carapace width (cw, mm), the maximal length between lateral margins of carapace, is used as standard measurement. Species names and modern taxonomic position are given according to Ng *et al.* (2008), Davie *et al.* (2015), the international database WoRMS (World Register of Marine Species) and Marine Species Identification Portal. The examined material is deposited in the personal personal author collection (LEMMI) deposited in A.N. Severtzov Institute of Ecology and Evolution of Russian Academy of Sciences, Moscow.

Results and discussion

Order Decapoda Latreille, 1803
Family Pinnotheridae De Haan, 1833
Genus *Pinnixa* White, 1846
***Pinnixa tumida* Stimpson, 1858**
(Fig. 1)
Pinnixa tumida Stimpson, 1858: 108 [type locality: Hakodate Bay, Japan].

Material Examined. Sea of Japan, Russia, Posyeta Bay – 2 ovigerous females, 5 males (LEMMI), Vitjaz Bay, 42°36'05.0"N, 131°11'01.2"E, muddy sand bottom, on Zostera beds, from holothurian burrowing in the sand, depth 2–3 m, snorkeling, coll. I. Marin & A. Mayorova, 16 June 2016; the Peter the Great Bay – 1 ovigerous female, 1 male (LEMMI), Astafieva Bay, 42°36'52.2"N 131°12'01.1"E, depth 1–1.5 m, clear sand bottom, from burrowing holothurian, hand sampling, coll. Marin I., August 2018; 2 ovigerous females, 2 males (LEMMI), Vostok Bay, 42°53'10.0"N, 132°43'42.9"E, sandy bottom, from holothurian burrowing in the sand, 10–15 m., SCUBA, coll. K. Dudka, August 2018.

Remarks. In contrast to the other representatives of the genus *Pinnixa* occurring in the Russian waters, *P. tumida* has a tooth in the middle of the cutting edge of the movable finger (dactylus) of the chela of pereiopod I (see Fig. 1c), while in *P. rathbuni* and *P. banzu* it is situated at the base of the immovable finger (polex) of the chela. The carapace width of sexually mature P. tumida is with the convex and strong calcified that also clearly differ the species from the congeners in the Sea of Japan.

Coloration. One of brightly colored species within the genus. Dorsal surface of carapace and chela colored with brown and violet spots; setae on appendages deeply brown (see Fig. 1b, c). The reddish brown pigment in the carapace of these crabs, frequently retained in preserved specimens, is thought to be derived from carotenoids originally ingested by the host (Hopkins & Scanland, 1964; after Zmarzly, 1992).

Size. The largest female has cw. 14 mm, male has cw. 10 mm; the females are larger than the males.

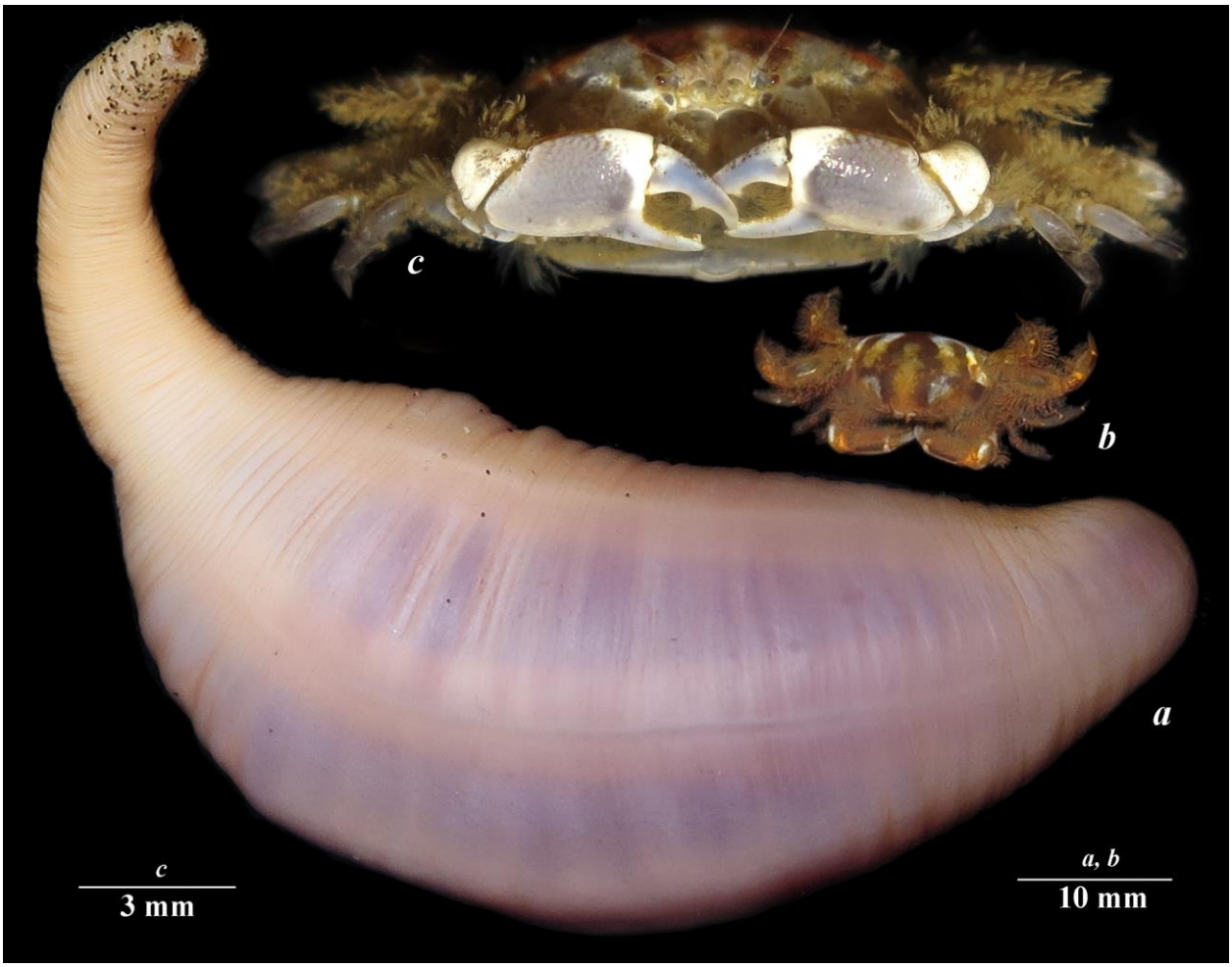

Figure 1. The pea crab *Pinnixa tumida* Stimpson, 1858 and its host – a burrowing holothurian *Paracaudina chillensis* (Müller, 1850): *a, b* – general view; *c* – frontal view.

Habitat and ecology. Subtidal species. The crab lives in the intestine of the burrowing holothurian *P. chilensis* (Konishi, 1977; Vassilenko, 1990; Takeda et al., 1997) probably representing an undescribed species of "*P. chillensis*" species complex)

(=*Caudina ransonnetti* Marenzeller von, 1881, a junior synonym). The species is mostly ecologically similar to *P. barnharti* Rathbun, 1918 living in the body cavity of the burrowing holothurian *Molpadia arenicola* (Stimpson, 1858), as well as holothurians of the genera *Chiridota* Eschscholtz, 1829 and Caudina Stimpson, 1853 along the Pacific coast of North America (Schmitt et al., 1973; Morris et al., 1980; Zmarzly, 1992).

Distribution. In Russian waters, *P. tumida* presently known from Posyeta Bay and the Peter the Great Bay of the Sea of Japan. In the Sea of Japan, this species was also found at the coasts of islands of Japan, Korean Peninsula, and in the Yellow Sea along the eastern coast of China (Kim, 1973; Konishi, 1977; Vassilenko, 1990; Dai & Yang, 1991; Komai et al., 1993).

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