

## Estuarine crabs of the Okhotsk Sea and the Sea of Japan: rare species and new records

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Submitted: 11.09.2017. Accepted: 24.11.2017

The paper presents the list of coastal estuarine crabs occurring in estuaries of rivers flowing into the southern part of the Okhotsk Sea and Russian coasts of the Sea of Japan. At the moment the list includes five species: *Hemigrapsus penicillatus* (de Haan, 1835) (Varunidae) (first satisfied record for the Russian fauna), *Hemigrapsus takanoi* Asakura and Watanabe, 2005 (Varunidae), *Eriocheir japonica* (de Haan, 1835) (Varunidae), *Helice tridens* (de Haan, 1835) (Varunidae) (recorded as extinct species for the area) and *Deiratonotus cristatum* (de Man, 1895) (Camptandriidae). Two species, *H. takanoi* and *E. japonica*, are widespread along the Russian coast of the Sea of Japan and in the southern part of the Okhotsk Sea. *Helice tridens* previously recorded the region by the literature as “widespread” is probably presently extinct in the studied area as not recorded since 2000-ies. Two remaining species, *D. cristatum* and *H. penicillatus*, are marked as restricted-range species: three populations of *D. cristatum* are known from the estuary of Amur river, the Nevelskiy Strait (the most northern part of the Sea of Japan) and the Salmon Bay of Sakhalin Island (southern part of Okhotsk Sea) respectively whereas the only confirmed habitat of *H. penicillatus* in the Russian fauna is the estuary Volchanka River in Vostok Bay of the Sea of Japan. Presented records are the most northern known populations of all listed species while the areas of their distribution of them are mostly located in a subtropical region of the Sea of Japan and east coast of the Korean Peninsula south to tropical waters. The paper describes the morphology, coloration, features of ecology and distribution of all estuarine crab species on the territory of Russia and adjacent areas.

**Key words:** Crustacea; Crustacea; Decapoda; Brachyura; Grapsoidea; Varunidae; Camptandriidae; crabs; estuaries; coastal; new records; the Sea of Japan; Okhotsk Sea

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### Introduction

Estuarine crabs (Crustacea: Decapoda: Brachyura) are important elements of almost all marine coastal ecosystems, especially in tropical latitudes, where there are represented by the highest number of species (=diversity) playing a significant role in the organization of coastal ecosystems (Morton and Zeng, 1982; Morton and Morton, 1983; Coldrey, 1986). In the Russian fauna coastal estuarine crabs are found only in the Far-Eastern Seas – the Sea of Japan and the southern part of the Okhotsk Sea, which are still not completely faunistically studied and new species for fauna and even for science still recorded from the area (Anker et al., 2016; Marin, 2013a–d, 2015, 2016; Marin and Sinelnikov, 2012; Marin et al., 2011, 2012a–c, 2013, 2015; Sirenko, 2013). At the moment, four estuarine species has been described, moreover, one species, *Helice tridens* (de Haan, 1835) (Varunidae), is probably extinct in the region because of the absence of fresh records since the 2000-ies are absent. Amphibious small crab *Deiratonotus cristatum* (de Man, 1895) (Camptandriidae) in Russian waters is presently known from several neighboring localities around Sakhalin Island (Labay, 2004). Two other estuarine species, *Hemigrapsus takanoi* Asakura and Watanabe, 2005 (Varunidae) and *Eriocheir japonica* (de Haan, 1835) (Varunidae), are widespread along the Russian mainland coasts of the Okhotsk Sea and the Sea of Japan from the estuary of the Amur River at north to the Posyeta Bay at south (Vinogradov, 1950; Marin, 2013a–d).

*Hemigrapsus takanoi* Asakura et Watanabe, 2005 has been described as a sibling species of *H. penicillatus* (de Haan, 1835) on the basis of a complex study of coloration, morphology, electrophoresis and genetic analysis (Asakura, Watanabe, 2005; Yamasaki et al., 2011). It was shown that *H. takanoi* lives along the coast of Hokkaido, Honshu, Shikoku and Kyushu Islands, Korean Peninsula, where it occurs together with *H. penicillatus*, whereas only *H. penicillatus* was found along the southern

coast of China and Formosa Island (Taiwan) (Asakura and Watanabe, 2005; Yamasaki et al., 2011). Individuals of *H. penicillatus* were discovered near the City of Sokcho in the northern part of the South Korean coast of the Sea of Japan (Marin, 2013c). However, several authors (Sakai, 2007; after Yamasaki et al., 2011) denies the validity of *H. takanoi* reporting individuals with morphological features of both species, and genetic analysis of the specimens from Japan that all belong to *H. penicillatus*. At the same time, it was shows that all specimens collected by Marin (2013b) along the Russian mainland coast of the Sea of Japan referred to *H. takanoi* whereas status of previously referred *H. penicillatus* (Brazhnikov, 1907; Kobayakova, 1936, 1958, 1967, 1979; Vinogradov, 1947, 1950) needs to be verified.

Nevertheless, several specimens of crabs with morphological features characteristic for *H. penicillatus* (according to Asakura, Watanabe, 2005) were found during field collecting in the estuary of the Volchanka River in Vostok Bay of the Sea of Japan in 2013 and 2014 (Marin and Kornienko, 2014). Moreover, a further survey at the southern coast of Sakhalin Island and the mainland coast of the Sea of Japan in 2013–2014 allowed to clarify the modern diversity and distribution of known species in details and represent the list of estuarine coastal crabs occurring in this region.

All collected material is deposited in the collection of the Laboratory of Ecology and Morphology of Marine Invertebrates of the A. N. Severtsov Institute of Ecology and Evolution of RAS (Moscow). Collections of Institute of Marine Biology (IMB FEB RAS, Vladivostok), Zoological Institute of RAS (ZIN RAS, St. Petersburg), Zoological Museum of Moscow State University (ZMMU, Moscow) were additionally processed for additional material on hermit crab associates. Species names and modern taxonomic position are given according to the international database WoRMS (World Register of Marine Species) and Marine Species Identification Portal. The body size is measured as the carapace width (CW) which is the widest distance between the dorsal edges of the carapace given in millimeters.

## Systematic part

Order Decapoda Latreille, 1803

Brachyura Linnaeus, 1758

Superfamily Grapsoidea MacLeay, 1838

Family Varunidae H. Milne Edwards, 1853

Genus *Hemigrapsus* Dana, 1851

### *Hemigrapsus penicillatus* (de Haan, 1835)

(Fig. 1)

*Grapsus (Eriocheir) penicillatus* de Haan, 1835: 60, pl. 11, fig. 5 [type locality: Japan].

*Brachynotus penicillatus*. – Miers, 1886: 264.

*Heterograpsus penicillatus*. – Ortmann, 1894b: 714.

*Hemigrapsus penicillatus*. – Stimpson, 1907: 126.

*Brachynotus brevidigitatus* Yokoya, 1928: 780, fig. 8.

**Definition diagnosis.** Detailed description of the species was given by Asakura and Watanabe (2005) from Japan and Marin (2013b) from Russian waters. From closely related congeneric species (see key below) characterized by the presence of tuft of bristles at the base of fingers of claws of pereopod I (chelipeds) *H. penicillatus* can be clearly separated by 1) the presence of large dark spots on the ventral side of the body, maxilliped III and proximal segments of pereopods I–II (Fig. 1 *c–g*) which are much smaller in *H. takanoi* (Fig. 2 *c, d, f*); 2) the presence of dark spots on the first thoracic sternites and abdomen in males and females (Fig. 1 *c, d*) which are usually absent in individuals of *H. takanoi* (Fig. 2 *d, f*); 3) the presence of relatively small tuft of bristles at the base of the fingers of claws in males reaching only the proximal quarter of the length of the fingers (Fig. 1 *e, h*), whereas the tuft of bristles is much larger and reaches to the midlength of fingers in males of *H. takanoi* (Fig. 2 *g, h, i*). Males of *H. penicillatus* are larger than females. CW of the largest observed male is 50 mm, CW of the largest observed female – 45 mm. Sexual dimorphism in claw size is observed for these crabs – claws in males are noticeably larger than in females (Fig. 1 *a, b*).

**Ecology.** Coastal brackish-water species. Individuals were found only in the estuary of Volchanka River, in the vicinity of the river mouth. In the observed area individuals of *H. penicillatus* construct shallow burrows in muddy or sandy-muddy soil, often found under dead clams, among stones, boulders and sea grass at the depth from 0 to 2 m; at greater depths as well as in other areas of Vostok Bay *H. penicillatus* have never been found.

**Distribution.** The only known habitat of *H. penicillatus* at the territory of the Russian Federation is the estuary of Volchanka River in Vostok Bay of the Sea of Japan (this publication). Confirmed the occurrence of *H. penicillatus* is known from the area of Sokcho City of South Korean coast of the Sea of Japan (Marin, 2013b), Islands of Japan, southern coast of China and Formosa Island (Taiwan) (Asakura and Watanabe, 2005; Yamasaki et al., 2011). Previous records of the species from Sakhalin (Kobayakova, 1936; Vinogradov, 1947, 1950) and in Hawaii (Edmondson, 1959) need to be clarified but probably should be referred to *H. takanoi* (see below).

### *Hemigrapsus takanoi* Asakura and Watanabe, 2005

(Figs. 2, 3)

*Hemigrapsus takanoi* Asakura and Watanabe, 2005: 280, fig. 1–5, 6A–C, and 7 [type locality: Japan].

**Definition diagnosis.** Detailed description of the species was presented in the original description (Asakura, Watanabe, 2005). For the distinguishing features from closely related species of the genus characterized by the presence of tuft of bristles at the base of the fingers of pereopod I see the diagnosis of the previous species and the key given below. Males are larger than females: CW of the larger observed male is 45 mm, the larger female – 35 mm. Claw size of the males are noticeably larger than females (Fig. 2a, b) that is usual for the genus.

**Ecology.** Coastal species living in the Sea of Japan, with the native name along the Russian coasts – “*hairy-clawed coastal crab*”. Occurs from the littoral (Fig. 3) to a depth of 5–10 meters, among rocks, boulders and sea grass. In Salmon Bay of Sakhalin Island individuals of *H. takanoi* were found out of water during the low tide (Fig. 3) that is unusual for other Russian populations of the species which rarely or even never leave water (personal observations). The species is found on all kinds of substrates; crabs usually construct shallow burrows in muddy or sandy-muddy substrates, often found under shells of clams, especially females during the incubation of eggs.

**Distribution.** The species occurs along the Russian mainland coast of the Sea of Japan south of the Amur River, along the coast of the southern Kuril Islands and the southern part of Sakhalin Island (Vinogradov, 1950; Marin, 2013b; Marin and Kornienko, 2014). The species is also known from the Ishikari Bay of Hokkaido, along the coast of the Islands of Honshu, Shikoku and Kyushu (Asakura and Watanabe, 2005; Yamasaki et al., 2011). To the south, is likely distributed to south-eastern coast of China, Hong Kong and Formosa Island (Taiwan). As introduced species has been observed since the mid-1990s along the north-eastern Atlantic coast of Spain, in the North Sea along the coasts of Germany, Holland, Belgium and France, south part of the Black Sea (Nijland and Beekman, 2000; Udekem d and Faasse, 2002; Dauvin et al., 2009; Dauvin and Delhay, 2011) and in 2014 the species was recorded in the western part of the Baltic Sea (Geburzi et al, 2015).

**The key to the crabs of the genus *Hemigrapsus* Dana, 1851 (Varunidae), occurring in the Russian waters of the Sea of Japan and Okhotsk Sea (according to Vinogradov (1950), with remarks)\*:**

1. The carapace is square, with almost parallel lateral edges; walking legs relatively long, the total length of the distal parts of walking appendages almost 2 times longer than the width of the carapace; the length of propodus of walking appendages about 2.5–3 times greater than the width ..... ***Hemigrapsus longitarsis* (Miers, 1879)**  
(The species is distributed in the Sea of Japan from the Peter the Great Bay to Shandong Peninsula, and from the Tsugaru Strait to Nagasaki (Japan Islands); at depths from 3 to 16 meters);

– Carapace width considerably greater than its height, lateral margins slightly arcuate; walking appendages relatively short and stout, the total length of the distal parts of walking appendages about 1.5 times longer than the width of the carapace, with the length of propodus about 1.5–2 times greater than its width ..... 2

2. Infraorbital crest with very fine transverse tubercles continues without interruption at the external angle of the orbit. Claws of males without a tuft of bristles at the base of fingers ..... ***Hemigrapsus sanguineus* (De Haan, 1835)**  
(The species is widely distributed from the Sea of Japan to the Hawaiian Islands, Australia and New Zealand; found from the intertidal zone to a depth of 40–50 meters);

– Infraorbital crest short, not reaching the outer angle of the orbits, interrupted beneath the outer angle of the orbit and continues in the form of 2–4 closely situated tubercles. Males with a strong tuft of hairs at the base of finger of claws ..... 3

3. Dark spots on the first thoracic sternites large and also present on the abdomen in males and females; tuft of bristles at the base of the fingers of the claws in males relatively small, reaching only the proximal quarter of the length of the fingers ..... ***H. penicillatus***  
(The only known habitat of the species on the territory of the Russian Federation is the estuary of Volchanka River in Vostok Bay of the Sea of Japan; most of the previously published data about the distribution of the species needs to be clarified; found in the littoral zone to the depths of 1–3 meters);

– Dark spots on the first thoracic sternites small and absent on abdomen in males and females; tuft of bristles at the base of the fingers of claws in males large reaching the midlength of the fingers ..... ***H. takanoi***  
(The species occurs from the Tatar Strait and the coast of the Kuril Islands to the south-eastern coast of China, Hong Kong and Formosa Islands (Taiwan). Being an active invader, since mid-1990s reported from the North Sea and presently known from The Black and Baltic seas; found from the intertidal zone to the depth of 1–10 meters).

\*In the mostly well-studied area, the Vostok Bay of the Sea of Japan, all four species of crabs of the genus *Hemigrapsus* are reported together (Marin, Kornienko, 2014).

Genus *Eriocheir* de Haan, 1835

***Eriocheir japonica* (de Haan, 1835)**

(Fig. 4f, g)

*Grapsus* (*Eriocheir*) *japonicus* de Haan, 1833–1849 (1835): 59, pl. 17, pl. D [type locality: Japan]

*Eriocheir japonicus*. – Stebbing, 1893: 95, pl. 3.

*Eriochirus japonicus*. – Stimpson, 1907: 124.

**Definition diagnosis.** *Eriocheir japonica* generally differs from other members of the family Varunidae found in Russian waters by its large size (CW of mature individuals reaches 80–90 mm, males larger than females) completely covered with tufts of hairs, narrow "forehead", anterior (frontal) part of the carapace situated between inner angles of orbits, which is equal to one third of all the frontal width of the carapace (vs. whereas it is more than half the frontal width of the carapace in the other members of the family) and the 'hairy' claws of pereopods I. Young individuals of *E. japonica* (Fig. 4f) looks similar to individuals of *Deiratonotus cristatum* (de Man, 1895) (Fig 4a), but can be well distinguished by the form of claws – *D. cristatum* has finger (dactylus) with one big tooth located in the central part (Fig. 4c), whereas movable finger of the claw bears a row of small denticles in *E. japonica* (Fig. 4g).

**Ecology.** The coastal species living in fresh, brackish and sea water; found in rivers and estuaries of rivers flow into the Sea of Japan and south part of Okhotsk Sea where known as the "Japanese hairy-clawed crab". Occurs in the coastal zone to the depth of 15–20 meters; usually breeds near river mouths and estuaries with the salinity of 15–25 ‰ where forms a mass congregation that is considered as the optimal conditions for reproduction and development of the species; during feeding migrations rises on the rivers and lakes. The species is an active predator, and inflicts damages destroying the coastal zone of rivers and canals, where builds deep burrows during the breeding season. It is believed that in The Peter the Great Bay of the Sea of Japan is currently home for two species of the genus *Eriocheir*, *E. japonicus* and *Eriocheir sinensis* H. Milne Edwards, 1853, which are morphologically very similar and can be only determined with the help of the molecular analysis (Tang et al, 2003; Xu et al, 2009).

**Distribution.** The species occurs along the coast of mainland Russia from the Tatar Strait (the Strait of Nevelskoy and the estuary of Amur River) to the Posyeta Bay and the south-east coast of China, from the southern coast of Sakhalin to the southern Islands of Japan and the Islands of Formosa (Taiwan) (Sakai, 1939; Kim, 1973; Shokita et al., 2000; Tang et al, 2003; Xu et al, 2009). Closely related species, *E. sinensis* (the native range of this species is the coast of southern China (Sakai, 1939; Tang et al, 2003)), which is morphologically identical and differs significantly only genetically, since the 2000-ies has been found in rivers and estuaries along the coast of Europe, in the Black, Azov and Caspian seas (e.g. Cabral and Costa, 1999).

Род *Helice* de Haan, 1833

***Helice tridens* (de Haan, 1835)**

(Fig. 4d, e)

*Oscypode* (*Helice*) *tridens* de Haan, 1833-1849 (1835): 57, pl. 11, fig. 2, pl. 15, fig. 6, pl. C. [type locality: Japan].

*Helice tridens*. – Milne Edwards H., 1853: 189.

**Definition diagnosis.** The species is characterized by the presence of well-marked oblique tubercle (rib) on ischiomerus of maxilliped II that clearly differ it from other members of the family Varunidae found on the territory of the Russian Federation.

**Ecology.** Freshwater and brackish-water species; till the 2000-is the species was common in the rivers flows into the Sea of Japan and their estuaries. At the moment the population of species in the area has dramatically decreased, and perhaps even the species is presently extinct in the specified range, as there are no any satisfied records since 2000 year (personal data). CW of mature individuals is 25–30 mm; males are larger than females and have a more developed claws pereopod I (based on the museum collections (ZMMU and ZIN RAS)).

**Distribution.** Distributed in the rivers flowing into the Sea of Japan; presently known from the southern Islands of Japan and along the coast of the Korean Peninsula (Ortmann, 1894a; Stimpson, 1907; Kim and Chang, 1985).

Надсемейство Oscypodoidea Rafinesque, 1815

Семейство Camptandriidae Stimpson, 1858

Род *Deiratonotus* Manning and Holthuis, 1981

***Deiratonotus cristatum* (de Man, 1895)**

(Fig. 4a–c)

*Cleistostoma dilatatum*. – (not de Haan, 1835) Ortmann, 1894a: 743.

*Paracleistostoma cristatum* de Man, 1895a: 590 [type locality: Tokyo Bay, Japan].

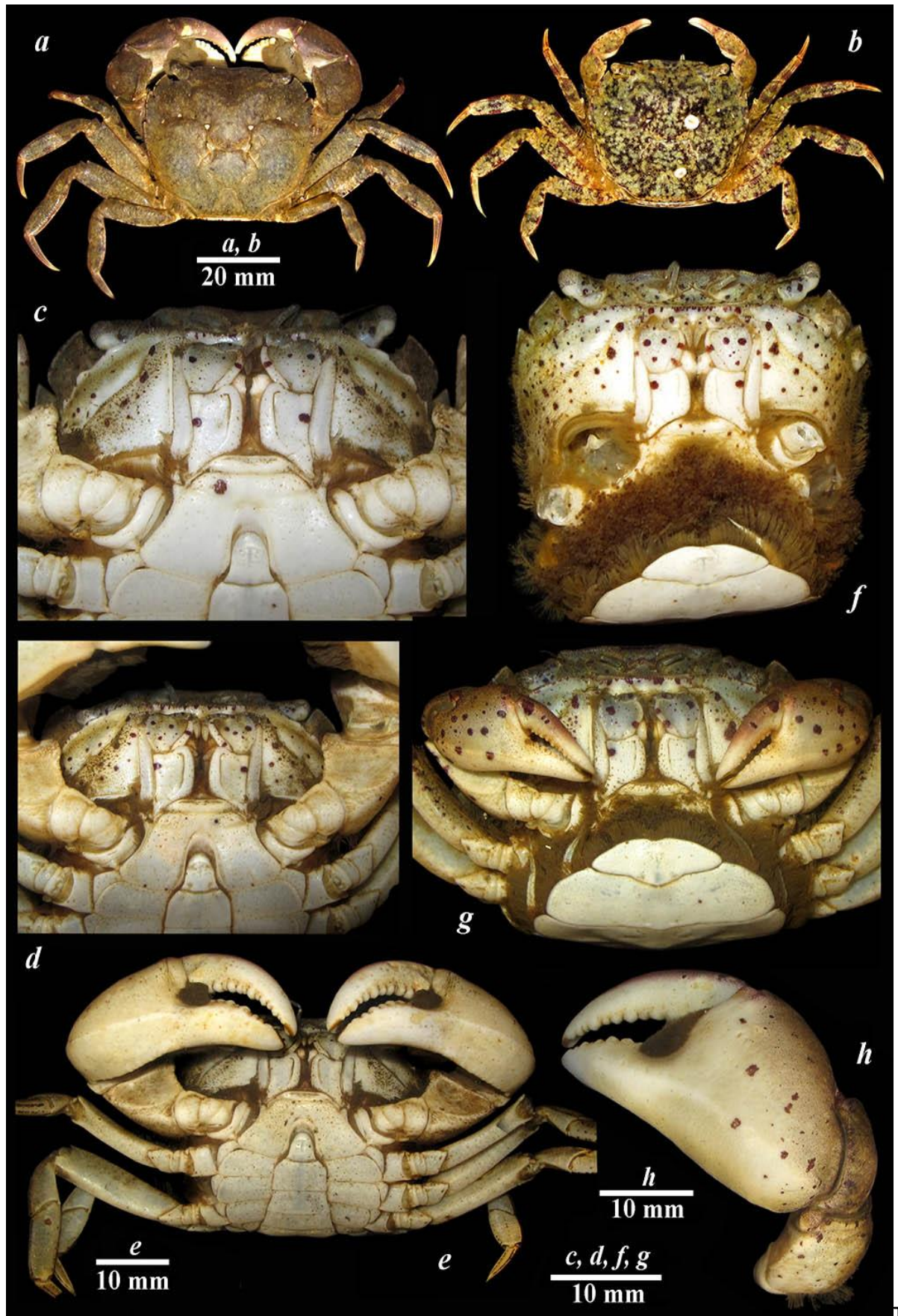
*Deiratonotus cristatus*. – Manning and Holthuis, 1981: 201, fig. 49.

**Definition diagnosis.** The species is characterized by the presence of ribs on the dorsal surface of the carapace, small size, strongly flattened body and marked sexual dimorphism of claw of pereopod I (Fig. 4A, b) that clearly separates it from other coastal crabs found along the Russian coasts of Okhotsk Sea and the Sea of Japan.

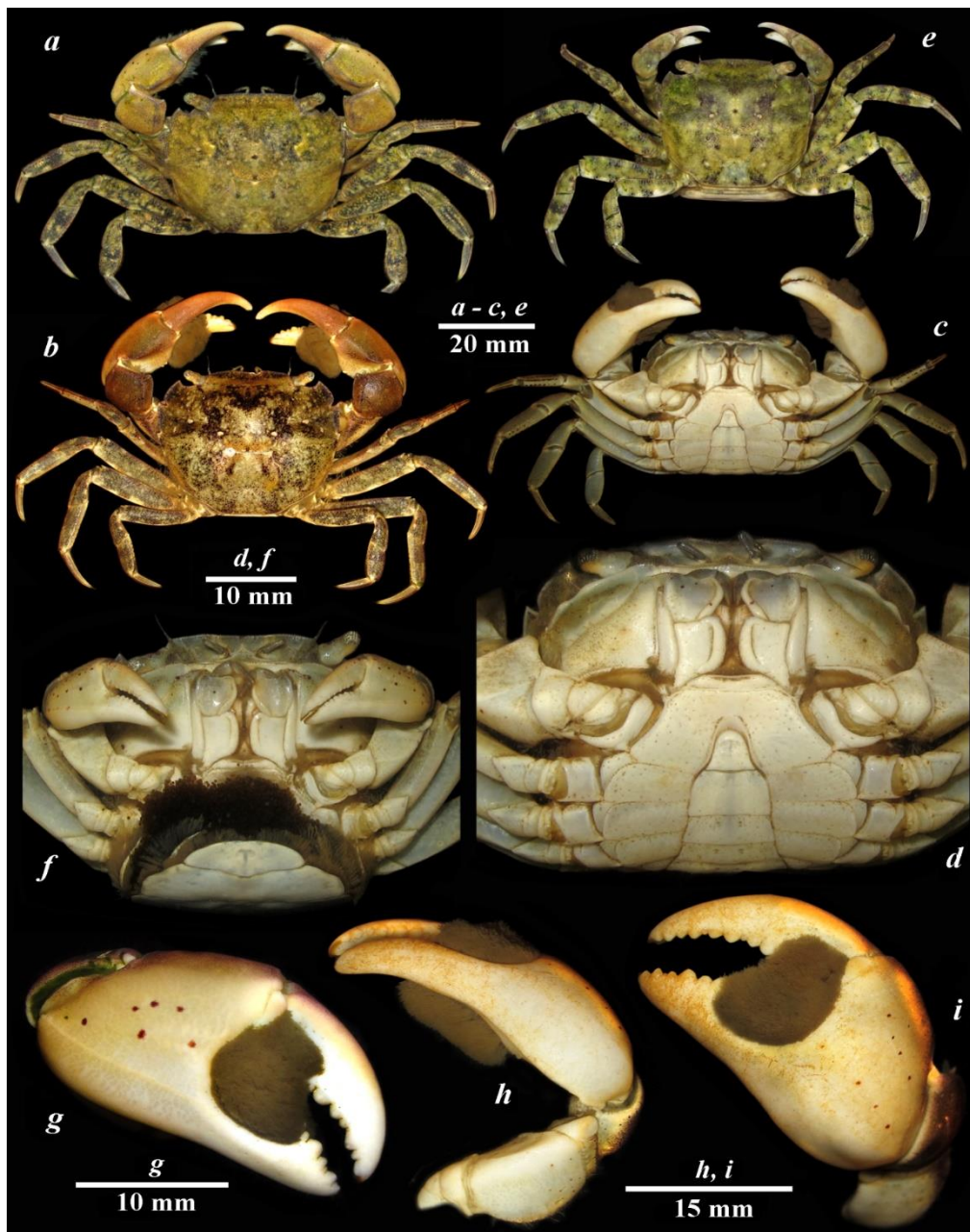
**Ecology.** Small coastal amphibious species constructing burrows in muddy or muddy-sandy substrates; each hole is inhabited by a single crab. The species is able to survive in waters with low and normal salinity as well as easily survive during a long period of drying. The collected specimens have maximal CW about 25 mm, females are slightly larger than males. It was observed that males are strongly territorial because of noticeable sexual dimorphism in the structure of claws. Claws are much stronger and robust with a strong tooth on dactylus in males (Fig. 4a, c) that apparently means any intraspecific interactions to fight for territory or any other resource. Claws in females are small with spoon-like dactylus (Fig. 4b) designed exclusively for the collection of food.

**Distribution.** Observations over several years have shown that the species forms the stable population in the Bay Salmon in the southern Sakhalin (Labay, 2004; present paper), as well as in the area of the Nevelskoy Strait and the Amur estuary

(Labay, 2011). All known populations on the Russian territory represent the northern border of the area the species distribution. Common in warmer waters of Japan, from Hokkaido to the southern Islands; along the coast of the Korean Peninsula and the south-east coast of China (Dai and Yang, 1991; Komai et al, 1992; Shen, 1940).



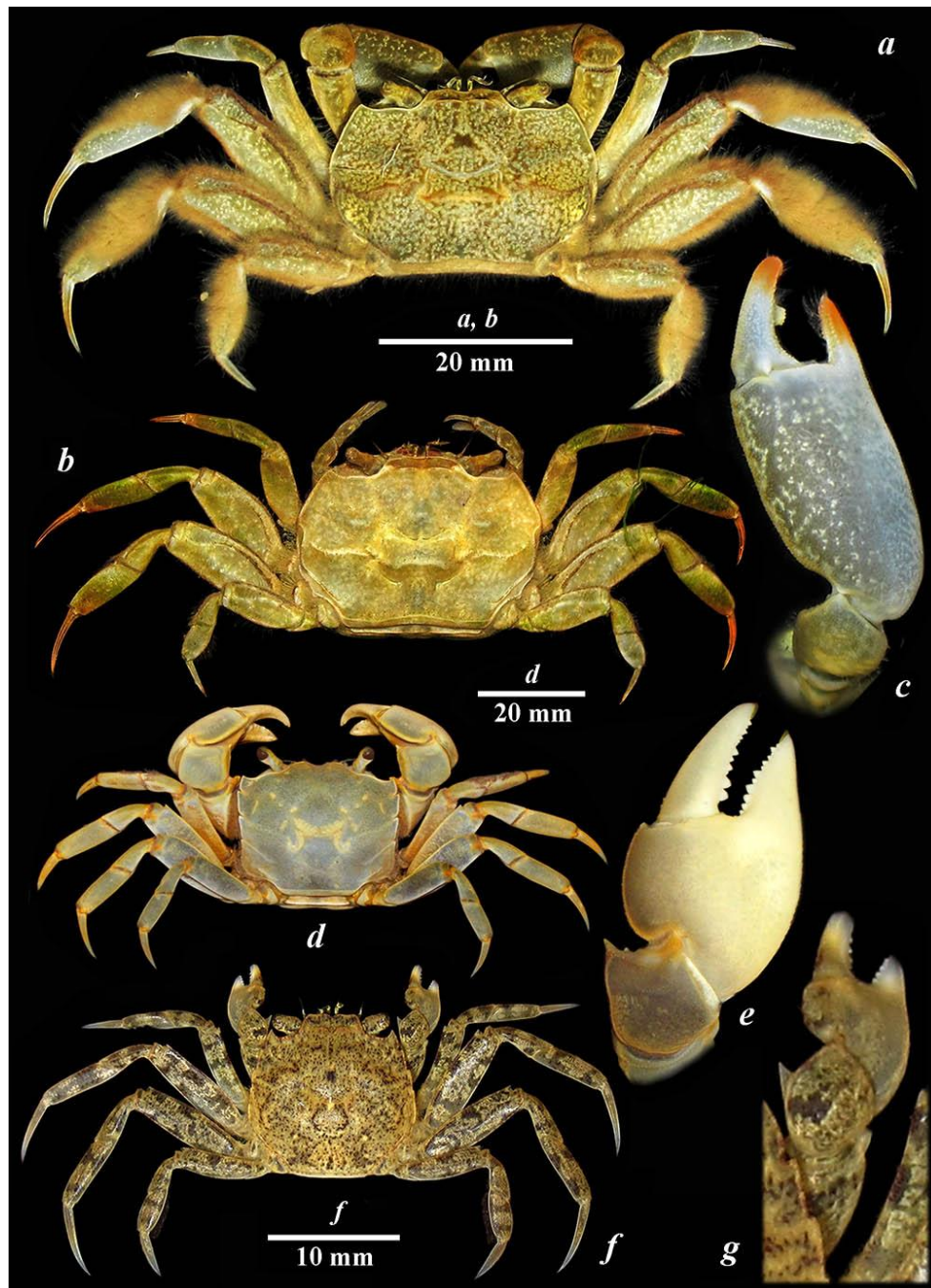
**Fig. 1.** *Hemigrapsus penicillatus* (De Haan, 1835) from estuary of Volchanka River, Vostok Bay: male (CW 30 mm) (*a, h*), female (CW 26 mm) (*b, g*), male (CW 34 mm) (*c*), male (CW 24 mm) (*d*), male (CW 38 mm) (*e*): *a, b* – general dorsal view; *c-g* – front of carapace and oral appendages; *h* – chela (propodus and fingers) of pereopod I of male, outer view.



**Fig. 2.** *Hemigrapsus takanoi* Asakura and Watanabe, 2005 from Vostok Bay, male (CW 28 mm) (a), male (CW 35 mm) (b, h, i), male (CW 32 mm) (c, d, g), female (CW 24 mm) (e, f): a, b, c, e – general dorsal view; d, f – front of carapace and oral appendages; g, i – chela (propodus and fingers) of pereopod I of male, outer view; h – chela of pereopod I of male, ventral view.



**Fig. 3.** Individuals of *Hemigrapsus takanoi* Asakura and Watanabe, 2005 at the littoral zone of the Salmon Bay at Sakhalin Island (south part of Okhotsk Sea) during the low tide (photo credits – PhD. A.S Mayorova (IMB FEB RAS)).



**Fig. 4.** *Deiratonotus cristatum* (de Man, 1895) from Salmon Bay at Sakhalin Island, male, CW 20 mm (*a, c*), female, CW 18 mm (*b*); *Helice tridens* (De Haan, 1835) (photographed in Busan, South Korea in August 2013), male, CW 45 mm (*d, e*); *Eriocheir japonica* (De Haan, 1835) from estuary of Volchanka River, Vostok Bay, juvenile specimen, CW 14 mm (*f, g*): *a, b, d, f* – general dorsal view; *c, e, g* – chela (propodus and fingers) of pereopod I of male, outer view.

## Acknowledgements

The author is sincerely grateful to the director and staff of the scientific station "Vostok" of A.V. Zhirmunsky Institute of Marine Biology, Vladivostok (IMB FEB RAS) and PhDs Korn O.M., Kornienko E.S. Mayorova A.S. for help during field work.

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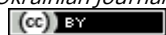


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**Citation:**

Marin, I.N. (2017). Estuarine crabs of the Okhotsk Sea and the Sea of Japan: rare species and new records. *Ukrainian Journal of Ecology*, 7(4), 444–452.



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