Megalopa of *Mesocrangon intermedia* (Decapoda: Crangonidae) from the eastern part of the Sea of Okhotsk

Мегалопа *Mesocrangon intermedia* (Decapoda: Crangonidae) из восточной части Охотского моря

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For the first time megalopa of *Mesocrangon intermedia* is described. The megalopa can be distinguished from that of the *Crangon* and *Neocrangon* by the morphology of its telson and carapace. The main distinguishing features of megalopa of *M. intermedia* were two spines on medial line of the carapace, a relatively long rostrum, a relatively narrow antennal scale, and the distinctive length of the terminal setae on the telson. Drawings of general view and individual limbs are presented.

Впервые описана стадия мегалопы *Mesocrangon intermedia*. Мегалопа этого вида отличается от соответствующей стадии видов родов *Crangon* и *Neocrangon* по морфологии тельсона и карапакса. Основные признаки стадии мегалопы *M. intermedia*: два шипа на медианной линии карапакса, относительно длинный рострум и относительно узкий скафоцерит, отличительная форма и длина апикальных щетинок на тельсоне. Приводятся рисунки общего вида и отдельных конечностей.

Key words: shrimps, morphological features, development, description, rostrum, telson, Decapoda, Crangonidae, *Mesocrangon*

Ключевые слова: креветки, морфологические признаки, развитие, описание, рострум, тельсон, Decapoda, Crangonidae, *Mesocrangon*

INTRODUCTION

Representatives of about 20 species and eight genera of shrimps from the family Crangonidae Haworth, 1825 inhabit marine waters surrounding Kamchatka Peninsula. Only two species from the genus *Mesocrangon* Zarenkov, 1965 occur there, while only one species, *Mesocrangon intermedia* (Stimpson, 1860), occurs along the western coast of Kamchatka Peninsula.

Although the larvae of the family Crangonidae regularly occur in plankton samples collected in the northwestern Pacific waters, larval stages only for 12 species were described. It was probably because the most species from the family develop without metamorphosis or with very short metamorphosis.

The Alaskan coastal shrimp *Mesocrangon intermedia,* Pacific boreal species, is one of the most common and widespread species of the family. It occurs from St. Lawrence Island (Bering Sea) to the Peter the Great

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Bay (Sea of Japan) and Yokohama above 15–400 m depth (Vinogradov, 1950). In the references area, the shrimps were collected at 51–191 m depth (usually 51–85 m depth), at water temperature 0.34–1.73 °C, and salinity 32.57–33.59‰ (Sokolov, 2001). Males were found only at one station at 56 m depth. Well visible oocytes were proliferated under the carapace of 25% of females. According to Slizkin (2006), adults of the present species frequently occurred together with decapods *Pandalus goniurus* Stimpson, 1860, *Chionoecetes opilio* (Fabricius, 1788), *Labidochirus splendescens* (Owen, 1839), and *Argis lar* (Owen, 1839).

Although the larvae of *M. intermedia* regularly occur in plankton samples, this is the least studied species in the northwestern part of the Pacific Ocean. Biology of *M. intermedia* has been studied insufficiently. The description of the zoeal larval stages were given by Makarov (1966) based on planktonic samples from the Sea of Okhotsk, however description of the megalopa was absent in literature. In that study (Makarov, 1966), only a short description of the megalopa of a close shrimp *Neocrangon communis* Rathbun, 1899 was provided. Also descriptions of megalopa of a few species from the genus *Crangon* Fabricius, 1758, *Argis* Kröyer, 1842, and *Sclerocrangon* Sars, 1883, occupying the eastern part of the Sea of Okhotsk are available (Birshtein & Vinogradov 1953; Kurata, 1964; Tesmer & Broad, 1964; Squires, 1965; Makarov, 1966, 1968). Detailed description of these legs of 1–5 zoeal stages in *N. communis* and *M. intermedia* were presented in our previous study (Sedova & Grigoriev, in press).

Adults of Crangonids live burrowing into the ground. Characteristic protuberance and spikes, as well as a special form of the rostrum only appear at postlarval or even juvenile stages (Makarov, 1966). Shrimps of the genus *Crangon* live on soft grounds. Shrimps of the genera *Neocrangon* Zarenkov, 1965 and *Mesocrangon* Zarenkov, 1965 live on fine-grained soil with an admixture of stones (Slizkin, 2006). All adults of the genus *Crangon* have only one spine on the median line of carapace, whereas all adults of the genus *Mesocrangon* have two spines (Nizyaev et al., 2006).

Larvae of *M. intermedia* are of normal, not shortened, development in pelagial zone, i.e. they have five larval and one postlarval stages. This species has a tendency of shorter period of hatching and a clear seasonal shift of larval stages in plankton. Eggs and larvae of this species are relatively large, and larvae can be found in many plankton samples collected in near Kamchatka waters from April to October (Makarov, 1966). They often occur during summer in waters over the Western Kamchatka shelf, and sometimes they were caught along south-eastern coast of Kamchatka Peninsula (Sedova, Grigoriev, 2013). Their abundance at one station over the Western Kamchatka shelf often reaches 400–500 larvae per m^2 (Sedova, 2004). In the Avacha Bay (the eastern coast of Kamchatka Peninsula) and in the western Bering Sea, they also meet regularly, but in smaller abundance (Sedova, Andronov, 2013; Sedova, Grigoriev, 2013).

MATERIALS AND METHODS

This study is based on planktonic samples collected during research survey, performed in the eastern part of the Sea of Okhotsk (above the western Kamchatka shelf) in September 1999 according to the fisheries research program of Kamchatka Research Institute of Fisheries and Oceanography (Petropavlovsk-Kamchatsky). Plankton was caught using ichthyoplankton gear, a conical net with mouth diameter 80 cm and mesh size 0.56 mm. The samples were fixed in 4% formalin. In total, three megolopae caught at the station with coordinates 51°59′N and 155°58′E over bottom depth 58 m were examined.

The samples were examined with a binocular microscope at 32-fold and 56-fold magnification. Measurements of larvae were made to the nearest 0.01 mm with an ocular

micrometer as total body length (TL) from the anterior tip of the rostrum to the median of median margin of the telson, excluding telson processes. The length of the larva was measured from the tip of rostrum to the telson back edge with eyepiece micrometer with preciseness to 0.1 mm.

RESULTS AND DISCUSSION

Identification

There was no doubt that these larvae were of the family Crangonidae. Identification of our specimens as *M. intermedia* was based on the morphological features. Our megalopa differed from other species of the family by the following features.

Megalopa of *M. intermedia* differed from the species of genus *Argis* by body length and length of rostrum. Total body length was 9 mm; rostrum long, almost reaching the far edge of the eye. From *A. lar* (Owen, 1839) our megalopa differed by a larger size (the older zoea full body length is 7.5 mm). The older larvae of *A. dentata* (Rathbun, 1902) is significanly larger than *M. intermedia* (up to 12 mm). The most important difference: all megalopae from the genus *Argis* have very short rostrum (not stretching further than vertical of mid eye).

Our megalopa differed from the megalopa of the genus *Crangon* by two spines on the median line of carapace (only one in *Crangon*). Besides, the oldest larvae of the genus *Crangon* were smaller (their total body length was not more than 7.5 mm). All megalopae of the genus *Crangon* have on average shorter apical spines of telson than the lateral ones (Kurata, 1964; Tesmer & Broad, 1964; Squires, 1965; Li & Hong, 2003).

Megalopa of *M. intermedia* differed from *Neocrangon communis* by the following features. The last larval stage of *N. communis* is significantly smaller (7 mm). The spines on the carapace in juvenile and adult of *N. communis* are shifted closer to the rostrum, i.e. are located in the front half of the carapace. There are also differences from megalopa of *N. communis* described by Makarov (1966). Adults of *N. communis* have longer rostrum, reaching the front edge of the eye. The most important difference is the median apical setae of telson, which are shorter than the lateral in *N. communis* (in *M. intermedia* – on the contrary).

Megalopa of *M. intermedia* differed from the species of the genus *Sclerocrangon* by number of spines and cuticular sculpture. Adults of the genus *Sclerocrangon* have three spines on carapace and strongly sculptured cuticle. Megalopa of *S. salebrosa* (Owen, 1839) has a very long sharp rostrum and small spine on carapace (Makarov, 1968). Megalopa of other species from this genus that occur in our waters have not been described.

Morphology of the larvae and adults of *Paracrangon echinata* Dana, 1852 are very different from other shrimps. Our megalopa differed from the larvae of *P. echinata* by spines on carapace and tooth on the rostrum. In the adults of *Paracrangon echinata* there are three big spines on carapace, as well as small and large dorsal teeth on the rostrum. Megalopa of *P. echinata* has not been described, but we can assume that it will also be very different.

From the genus *Mesocrangon* only *M. volkii* (Birstein et Vinogradov, 1953) can be found in our waters (exept *M. intermedia*). But it has mild tubercle instead of the back spine on carapace. Larvae of *M. volkii* have not been described. It occurs in the Bering Sea, but in the Ochotsk Sea the species was not found.

Other species from the genus *Neocrangon* are deep-water, and therefore they cannot occur in the samples. Their larvae have not been described. Adults of the genus *Neocrangon* have one spine on carapace, but not two spines like the larvae of *M. intermedia*.

The features, based on which our megalopa was identified as *M. intermedia*, were the following.

Suitable size. It is known that the total body length of larval stage V of zoea (last larval stage) of *M. intermedia* is 8–9 mm (Makarov, 1966; Sedova, 2013).

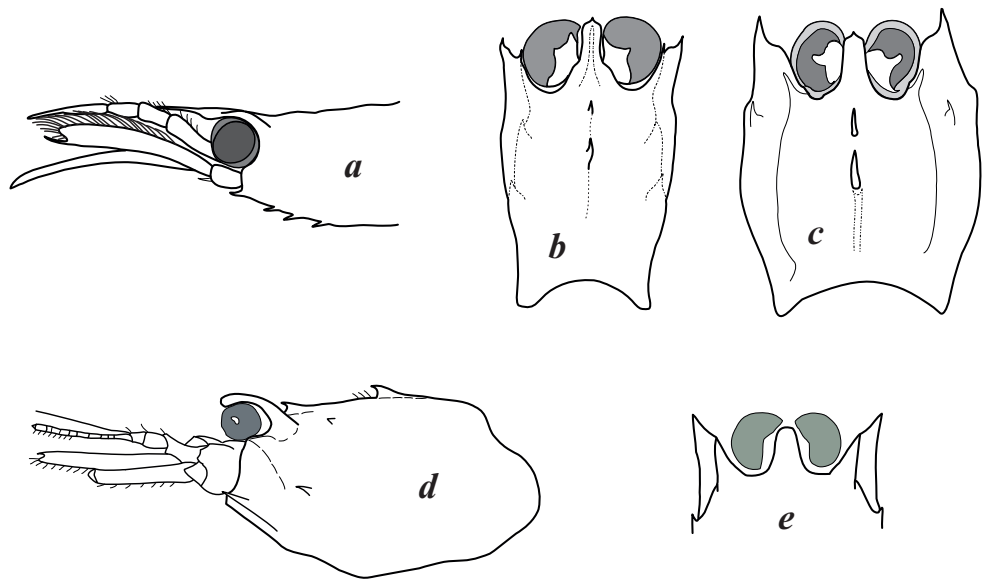

Fig. 1. Comparison of *M. intermedia* carapace morphology of zoea V, megalopa, juvenile, and adult: **a**, anterior part of zoea V (9 mm of TL); **b**, carapace of megalopa (9 mm of TL); **c**, carapace of juvenile (15 mm of TL); **d**, lateral view of adult female (40 mm of TL); **e**, anterior part of carapace of adult female (d, e, redrawing fragments after Sokolov, 2001).

M. intermedia has two spines on the median line of the carapace: frontal is small, rear is located approximately in the middle of the carapace. At the base of the posterior spine there are several short hairs. The same as in juveniles and adults of *M. intermedia* (Sokolov, 2001) (Fig. 1).

Structure and length of the rostrum in our megalopa was intermediate between zoea V and juveniles of *M. intermedia*. In the last larval stage of *M. intermedia* rostrum is quite long, much longer than edge of eye. In juveniles and adults of *M. intermedia* rostrum almost reaches the front edge of the eye. Lateral view of the rostrum was very characteristic and close to the adult *M. intermedia*, presented by Sokolov (2001). The comparison shows that the rostrum of *M. intermedia* is slightly concave in the middle part both in adults and our megalopa. The antennas of our specimens have relatively narrow scaphocerite which is also the distinctive character for *M. intermedia*.

DESCRIPTION

Total length of megalopae 9 mm. Eyes rounded, close to each other (Fig. 2a). Rostrum slightly pointed, reaching the front edge of the eye or a little further (in one specimen). Rostrum concave in the middle part (Fig. 1b).

Dorsal part of the carapace covered with very sparse short hairs. Posterior margin of the carapace rounded. Median part of the carapace raised into a small keel, in its anterior part with two spines. Anterior-most spine smaller and sharper, located just behind the eyes. Posterior spine twice as larger as anterior, located in the middle of the carapace (Fig. 1b). Base of posterior with one or two short setae. Carapace weakly sculptured. Anteroventral margin with one denticle. Carapace with suborbital and pterygostomial spines. Small depression present behind spine. Two small spines present on the anterior carapace margin, behind each eye; posteroventral margin of carapace

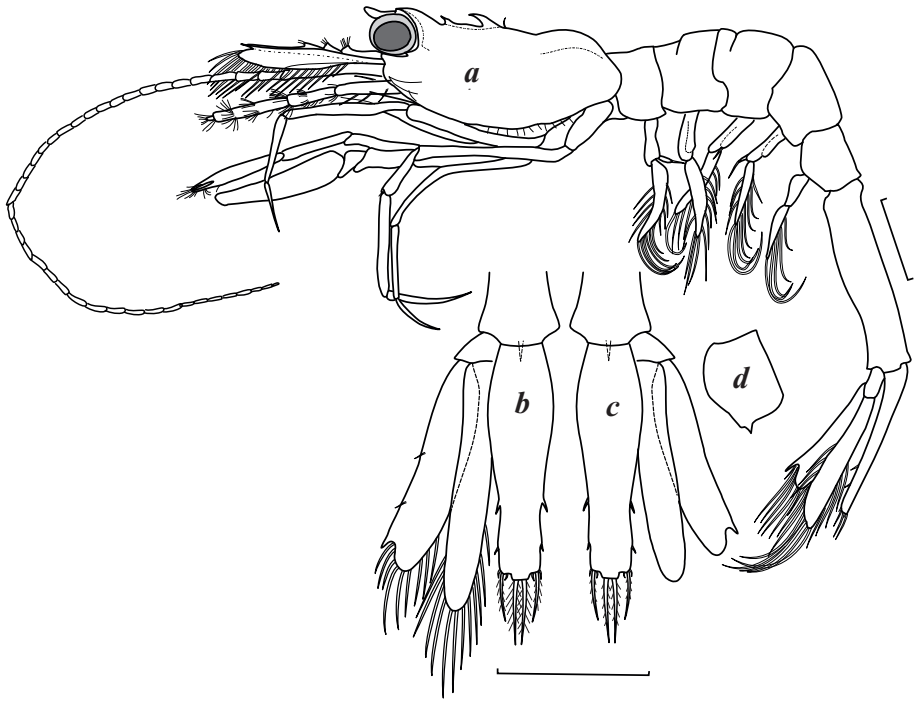

Fig. 2. Morphology of megalopa of *M. intermedia*: **a**, general side view; **b**, **c**, variants of structure of telson and uropods; **d**, form of fifth abdominal segment. Scale bar: 1 mm.

covered with short, widely spaced, weakly pubescent bristles.

Pleura of fifth abdominal somite in two specimens pointed (Fig. 2d), in one specimen rounded (Fig. 2a). The back edge of all abdominal segments smooth. A small anal spine present.

Base of antennula three-segmented. First segment with dorsal spine. Exopodite of antennule three-segmented, with three distal aesthetascs in the second segment and five aesthetascs in the third segment (Fig. 3b).

Flagellum of antenna consisting of 40 segments or more. Scaphocerite relatively narrow with a small spine at the base. Base of antennas with a small protuberance (Fig. 3a). Spine of scaphocerite reaching to or just beyond distal margin of blade. One of the short apical bristles located on the inner edge of the spine. Total number of scaphocerite setae 35.

Exopodite of maxilla with 25–26 setae (Fig. 3d). Basipodite of maxillule with six strong spines and six thin setae. Maxillule: coxal endite with four setae; basial endite with six cuspidate and six-seven simple setae; endopod with two short setae (Fig. 3c). Maxilla: coxal endites, basial endites and endopod with one seta; scaphognathite bearing 25–26 plumose setae marginally, posterior setae not elongated (Fig. 3d).

Maxillipeds typical for the family (Fig. 4a–c). First maxilliped: basis with epipodite and one seta; endopod unsegmented with four setae; exopod with two subterminal setae and four terminal plumose natatory setae (Fig. 4a). Second maxilliped: basis with epipodite. Endopodite four-segmented with no, one, one, seventeen long setae on each segment, correspondingly, plus two or three short setae; exopodite with five setae (Fig. 4b). Third maxilliped: coxopodite

Fig. 3. The structure of forelegs of megalopa of *M. intermedia*: **a**, antenna; **b**, antennule; **c**, maxillule; **d**, maxilla. Scale bars: a, b, 1 mm; c, d, 0.5 mm.

with epipodite and one short seta (Fig. 4c). Basipodite with 12 setae; endopod five-segmented with numerous short setae placed as shown; exopod two-segmented, with one subterminal and four terminal setae.

Pereopods uniramous, consisting of six-seven segments (Fig. 5a–e). Subchella on the first pair of pereopods well-developed, as characteristic for all representatives of the family. Strong spine on fourth segment of P1 (Fig. 5f). Claw of second pereopods rather small, narrow. Gills located at the base of pereopods (Fig. 4e). All of five pairs of pleopods well developed, with long natatory setae and one seta on one-segmented flagellum (Fig. 4d).

Telson relatively long and narrow, with two pairs of lateral spinules. Two pairs of long setae at the end of the telson. Inner pair of setae longer, and distal pairs of setae slightly shorter and slightly pubescent. Degree of pubescence of terminal setae different. In one specimen one of the inner setae very long and densely pubescent,

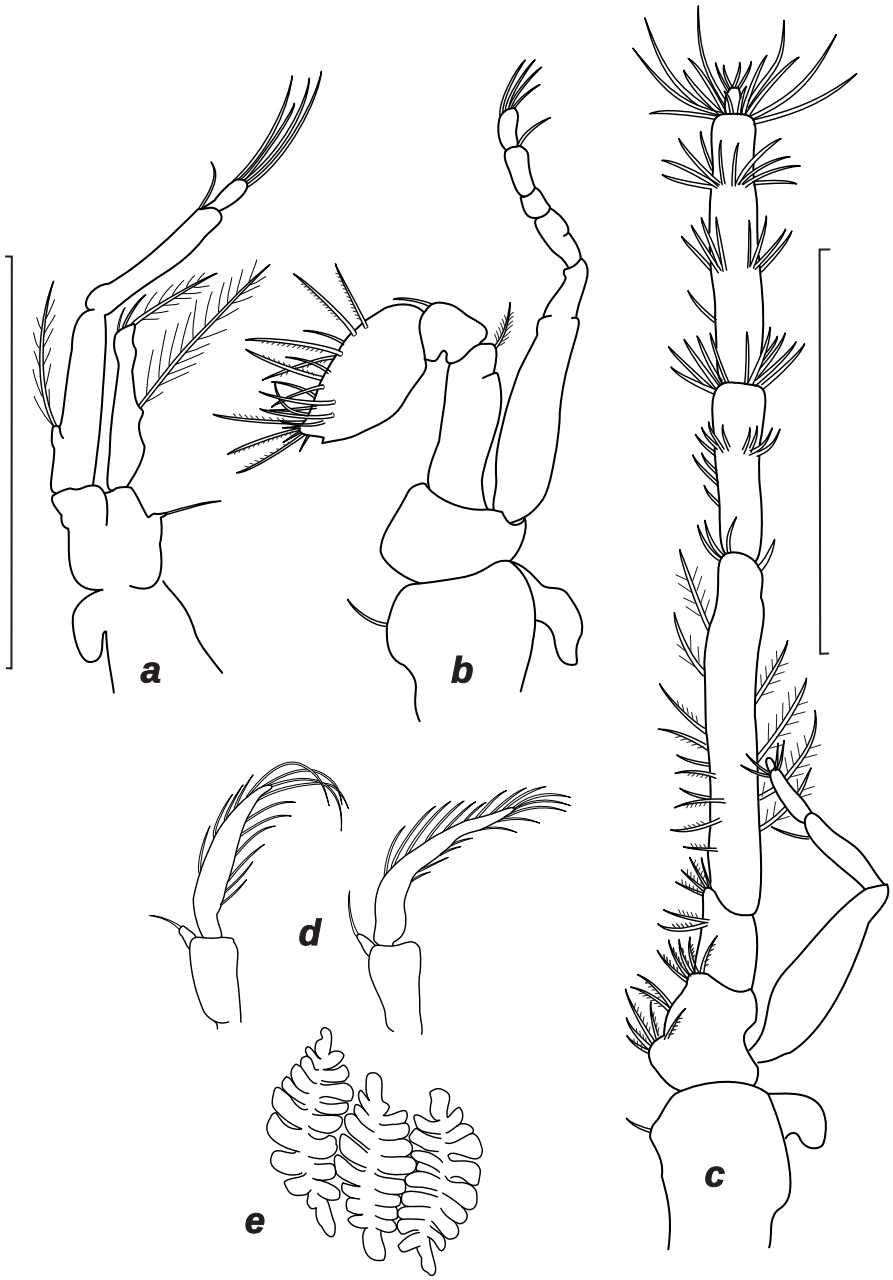

Fig. 4. Morphology of megalopa of *M. intermedia*: **a**–**c**, maxillipeds 1–3, respectively; **d**, pleopods; **e**, gills. Scale bar: a–c, 1 mm.

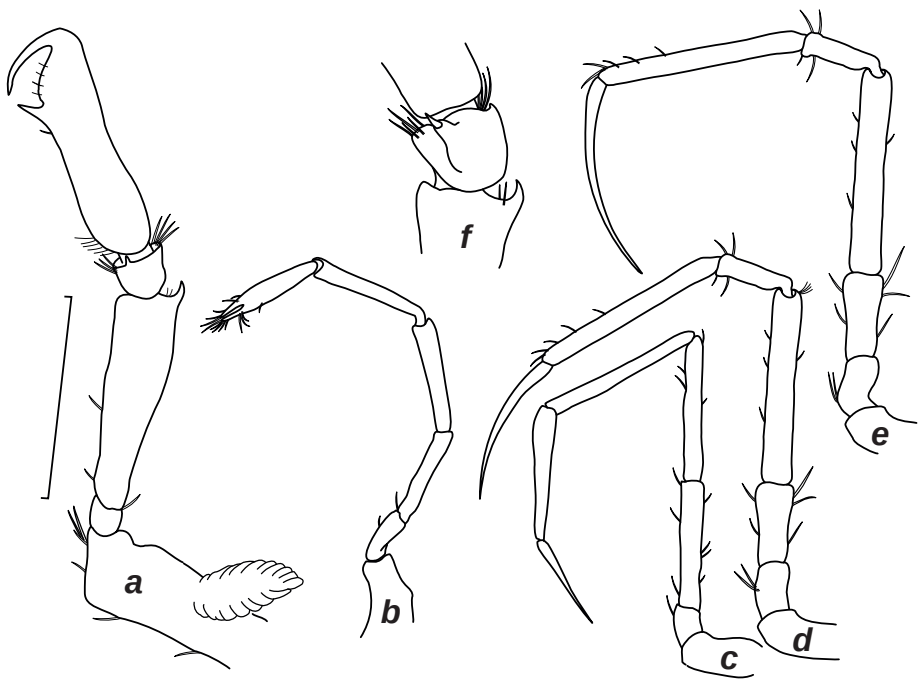

Fig. 5. Morphology of megalopa of *M. intermedia*: **a**–**e**, first-fifth pair of pereopods; **f**, fragment of first pair of pereopod. Scale bar: 1 mm.

but in other specimens bristles shorter (Fig. 2b, c). Two spinules at base of median setae. Endopod of uropod in some specimens longer than telson, in the rest about equal in length to the telson. Spine on uropod exopod short.

CONCLUSION

In our previous studies (Sedova, 2013) it was shown that the larval development of *Mesocrangon intermedia* was closest to *Neocrangon communis*. Our megalopae were very different from the description of the megalopae of *N. communis* made by Makarov (1966). Correctness of the recognition of *N. communis* megalopae as described by Makarov (1966) seems doubtful, because all zoeal stages of this species have the rostrum longer than in other species of the family Crangonidae. In the zoea V of *N. communis* the rostrum has the same length as in *M. intermedia*. In adults of both species the rostrum reaches the frontal edge of the eyes (Sokolov, 2001). Postlarvae of *C. septemspinosa* Say, 1818 have the same rostrum type (Tesmer & Broad, 1964). Significantly shortened rostrum is characteristic of the genus *Argis*, which also has two median spines on the carapace (Squires, 1965). For the eastern part of the Sea of Okhotsk, at least six species of this genus are reported (Slizkin, 2006). Therefore, it is possible that the specimens described by Makarov (1966) belong to one of them.

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