Decapodid stage of *Neocrangon communis* (Decapoda, Crangonidae) from the eastern part of the Sea of Okhotsk

Личинка *Neocrangon communis* (Decapoda, Crangonidae) декаподитной стадии из восточной части Охотского моря

N.A. Sedova* & S.S. Grigoriev

Н.А. Седова, С.С. Григорьев

N.A. Sedova, Kamchatka Federal Technical University, Petropavlovsk-Kamchatsky, 683003, Russia. E-mail: sedova67@bk.ru

.S. Grigoriev, Kamchatka Division of Pacific Institute of Geography, Far East Branch, Russian Ac.Sc., Petropavlovsk-Kamchatsky, 683000, Russia. E-mail: sgri@inbox.ru

For the first time the morphology of the decapodid stage of *Neocrangon communis* is described in detail. The decapodid can be distinguished from those of the genera *Argis*, *Crangon*, and *Mesocrangon* by the morphology of their telson, antennae, antennulae, and carapace. The main distinguishing features of the decapodid of *N. communis* were two spines on medial line of the carapace, a short rostrum, relatively wide scaphocerite, characteristic shape and length of the terminal setae on the telson. Drawings of general view and some limbs are presented.

Впервые подробно описана личинка декаподитной стадии *Neocrangon communis*. Личинка этого вида отличалась от соответствующей стадии представителей родов *Argis*, *Crangon* и *Mesocrangon* по морфологии тельсона, антенны, антеннулы и карапакса. Основные признаки *N. communis* на стадии декаподит: два шипа на медианной линии карапакса, короткий рострум и относительно широкий скафоцерит, характерная форма и длина апикальных щетинок на тельсоне. Приводятся рисунки общего вида и отдельных конечностей.

Key words: shrimps, morphological features, development, description, rostrum, telson, carapace, Sea of Okhotsk, Decapoda, Crangonidae, *Neocrangon communis*

Ключевые слова: креветки, морфологические признаки, развитие, описание, рострум, тельсон, карапакс, Охотское море, Decapoda, Crangonidae, *Neocrangon communis*

INTRODUCTION

Although the larvae of the family Crangonidae regularly occur in plankton samples collected in the northwestern Pacific waters, larval stages only for 12 species are described. It is probably because of many crangonid species develop without metamorphosis or with very short metamorphosis (except a few genera that have “normal” larval development, e.g. Crangon, Philocheras etc.).

**Corresponding author*

Representatives of about 20 species and eight genera of shrimps from the family Crangonidae Haworth, 1825 inhabit the marine waters surrounding the Kamchatka Peninsula. Among them, representatives of two species of the genus *Neocrangon*, *N. communis* and *N. abyssorum* occur in the eastern part of the Okhotsk Sea (Sokolov, 2001).

Neocrangon communis Rathbun, 1899 is a Pacific boreal species, one of the most common and widespread species of the family Crangonidae. It occurs from 71°17´N (Chukchi Sea) (Makarov, 1941), through the Bering Sea to San Diego in North

America, and to Peter the Great Bay and the eastern coast of Honshu Island (Sea of Japan) (Sokolov, 2001).

Adults of this species occur from 116 to 1537 m of water depth (Komai & Komatsu, 2009; Butler, 1980). Based on the cited literature, shrimps of this species were found in their area in depths between 37 and 295 m, (water temperature 0.21–2.8 °C and salinity 32.66–33.39‰) (Sokolov, 2001). Females dominated the catches, but small-size females (CL < 9 mm) were scarce. The scarcity of small females suggests a possible case of protandric hermaphroditism which has been suggested for some crangonid species (Frechette et al., 1970; Boddeke et al. 1991; Sokolov, 2001).

In spite of the regular occurrence of larvae of *N. communis* in plankton samples, this is one of the least studied species in the northwestern part of the Pacific Ocean. The descriptions of the larval stages zoea I were given by Makarov (1966), Sedova & Grigoriev (2015) based on planktonic samples from the Sea of Okhotsk. Makarov (1966) only provided a short description of the decapodid of *Neocrangon communis*. Also descriptions of the decapodid 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 (Birshteyn & Vinogradov 1953; Kurata, 1964; Makarov, 1966, 1968; Squires, 1965; Tesmer & Broad, 1964). Description of the decapodid of *Mesocrangon intermedia* and detailed description of legs of I–V zoeal stages in *N. communis* and *M. intermedia* were presented in our previous studies (Sedova, 2013; Sedova & Grigoriev, 2014a,b; Sedova & Grigoriev, 2015).

Adults of crangonids live burrowing into the substrate. 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 substrates. Shrimps of the genera *Neocrangon* and *Mesocrangon* live on fine-grained substrate 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).

Neocrangon communis is a sublitoral-bathyal species. The shrimp generally occurs on fine-grained substrate with an admixture of stones over shelf and upper part of continental slope (Vinogradov, 1950; Butler, 1980). In the Okhotsk and Bering Seas the adults were distributed in water layers from 30 to 555 m over bottom depth, in the Sea of Japan it occurred up to 1450 m, near California it was caught at 1537 m of bottom depth. In the eastern Bering Sea, the species was obtained at depths of 62 to 95 m on mud and sand substrate with water temperatures of 0.5–3.6 °C (Vinogradov, 1950; Butler, 1980). This species was caught by trawl together with *Pandalopsis dispar*, *Pandalus jordani*, and *P. borealis* at bottom depth 128–160 m in Canada (Butler, 1980). Females of carapace length 9.1–13.9 mm with external eggs were caught in January–February. Fertility of one female was about 2200 eggs, with a size of 0.9 × 0.75 mm (Slizkin, 2006).

Larvae of *N. communis* can be found in many plankton samples collected in Kamchatka waters over bottom depth close to 70 m from April to October. They often occur during summer in waters over the Western Kamchatka shelf, and sometimes they were caught along the south-eastern coast of Kamchatka Peninsula (Sedova & Grigoriev, 2013). In Avacha Bay (the eastern coast of Kamchatka peninsula) and in the western Bering Sea they also occur regularly, but in smaller abundances (Sedova & Andronov, 2013; Sedova & Grigoriev, 2013). Maximal abundance of the larvae (402 specimens per 1 m^2 of the sea surface) was found in 1999 in the north of the western Kamchatka shelf (Sedova & Andronov, 2013; Sedova & Grigoriev, 2013). Late larvae were caught in fall between 54 and 55°N (Sedova, 2004).

Larval development of *N. communis* is of a normal pelagic nature, not shortened, with five larval and one decapodid stages.

MATERIAL AND METHODS

This study is based on plankton samples collected during research surveys, performed in the eastern part of the Sea of Okhotsk (over the western Kamchatka shelf). Ichthyoplanktonic gear with a mouth diameter of 80 cm and mesh size 0.56 mm was used. Vertical total haul from bottom to surface was carried out with bottom depth 500 m and less, and from 500 m to surface in smaller bottom depths. The planktonic samples were fixed in 4% formalin. One larva of the decapodid in very good condition there was caught during one of the surveys (2013.08.05) at a station with coordinates 56°39´ of north latitude and 155°46´ of east longitude over 25 m of bottom depth.

Classification and morphology of larval stages was made following Tesmer & Broad (1964), and Wehrtmann (1991).

Measurements of the larva were made with an eyepiece micrometer with a precision of 0.1 mm as follows: carapace length (CL) from the anterior tip of the rostrum to the posterior median carapace margin; total length (TL) from the anterior tip of the rostrum to the telson back edge excluding telson setae.

RESULTS AND DISCUSSION

Identification

There was no doubt that the analyzed larva was of the family Crangonidae. Identification of our specimen as *N. communis* was based on the morphological features. In the following features the present decapodid differs from other species of the family.

Our decapodid identified as *N. communis* differs from the species of the genus *Argis* by body length and morphology of the rostrum and telson. The present decapodid is significantly smaller (in 1.5–2 times) than similar staged larvae of the genus *Argis*. The rostrum is longer and straight (but not dorsally as in *Argis*).

The medial, apical terminal spines on the telson in the present megalopawere significantly shorter than the lateral ones (whereas in megalopa of *A. dentata* and *A. lar* the medial, apical terminal spines are significantly longer).

On the median line of the carapace of our decapodid, as in larvae of the species of the genus *Argis*, there were two spines. But in contrast, in our decapodid the spines are closer together, whereas in *Argis* the spines are widely separated.

Our decapodid differ from the decapodid of the genus *Crangon* by having two spines on the median line of the carapace (versus in *Crangon* just a single one), and by the longer antennal flagella. In addition, the majority of *Crangon* species have a longer spine on the scaphocerite, extending beyond the distal edge. This spine in our decapodid was significantly shorter.

Furthermore, there is a small exopodite on the first pair of pereiopods in most species of *Crangon* (Kurata, 1964; Squires, 1965; Tesmer & Broad, 1964; Li & Hong, 2003), which was absent in our larvae.

Our decapodid differs from the species *M. intermedia* by a shorter rostrum, the structure of the telson, the position of the teeth on the carapace, width of the scaphocerite, a smaller body length, and structure of antennula. The total length of the decapodid of *M. intermedia* from waters near Kamchatka Peninsula was 9.0 mm, whereas our decapodid was much smaller (6.5 mm TL). Posterior spine on the median line of the carapace in our specimen is located closer to the front spine, unlike *M. intermedia*. The rostrum in the decapodid of *M. intermedia* reaches the distal edge of the eye, but in our decapodid it was 1.5 times shorter (Sedova & Grigoriev, 2014a). Scaphocerite of *M. intermedia* is much narrower. It is covered with a series of short setae on the outer edge. In our megalopa the outer edge of scaphocerite was naked, and the scaphocerite was much wider.

Spine on scaphocerite in our decapodid was much shorter than in *M. intermedia* and other crangonids. Exopodite of antennula in *M. intermedia* consists of three segments, and endopodite of four segments. In our decapodid endopodite and exopodite were two-segmented and relatively shorter. The telson in *M. intermedia* is narrower, but both pairs of terminal setae are very long. Angle setae in *M. intermedia* are strongly reduced. Central setae in our decapodid were in two times shorter than adjacent setae, and angled setae were longer than central ones. Flagellum in the decapodid of *M. intermedia* are two times longer than that of our decapodid and consists of more segments.

The only other species of the genus *Mesocrangon* in our waters is *M. volkii*. Representatives of this species have a short tubercle on the carapace instead of the posterior spine, although the larvae of *M. volkii* are unknown. The species was caught in the Bering Sea, but in the Ochotsk Sea it does not occur.

Our decapodid differ from the species of the genus *Sclerocrangon* by numbers of spines and by carapace sculpturing. In adults of the genus *Sclerocrangon,* three or four spines are present on the carapace, which is strongly sculptured. The decapodid of *S. salebrosa* have a very long and sharp rostrum and absent of spines on carapace (Makarov, 1968). The decapodid of other species from this genus that could occur in our waters have not been described.

Morphology of larvae as well as adults of *Paracrangon echinata* are very different from other crangonids. Our decapodid differ from the larvae of *P. echinata* by spines on carapace and teeth on the rostrum. In adults of *Paracrangon echinata,* there are three large spines on the carapace, as well as small and large dorsal teeth on the rostrum. The decapodid of *Paracrangon echinata* have not been described, but we can assume that it will also be very different.

The morphological features to identify the decapodid as *N. communis* are are as follows:

Suitable sizes. It is known that the total body length of larval stage V of zoea (last larval stage) of *N. communis* was 6.0–7.5 mm (Makarov, 1966; Sedova & Grigoriev, 2014b; Sedova, 2015). The decapodid of *C. dalli* have a similar body length to the last zoea stage (Makarov, 1966). The decapodid of *N. communis*, described by Makarov (1966), had total body length of approximately 7.0 mm. Larvae of *N. communis* of stage V of zoea were caught between 53° and 56°N along Kamchatka Peninsula, where the decapodid of this species were caught too. The structure of the rostrum, the position of spines on the carapace, the morphology of the antennae and the telson in larvae as described by Makarov (1966) corresponded to features of our specimen.

Rostrum in adults of *N. communis* is about 20% of the length of the carapace (Fig. 1c) (Sokolov, 2001), and in our decapodid almost so (Fig. 1a). In adults of *N. communis* on the median line of the front half of the carapace there were two spines (Fig. 1c), with the frontal spine being smaller. The spines were close together, like in our decapodid. This features distinguish the adults of *N. communis* from other crangonids.

In our previous paper (Sedova & Grigoriev, 2015) we presented a detailed description of the last zoea stage of *N. communis*. In some of the larvae through the veils of the telson the next stage was seen (Fig. 1e). Two shorter central spines and two pairs of long terminal setae were well visible.

Comparing to other crangonids from our waters the larvae of *N. communis* have a shorter spine on scaphocerite (Fig. 1b), and compared to larvae of *M. intermedia* they have a wider scaphocerite.

Other species from the genus *Neocrangon* dwell in deep water, so they cannot occur in the planktonic samples, although theirlarvae have not been described. Adults of the genus *Neocrangon* have one spine on carapace, but not two like in our larva.

Description

The total length of the decapodid was 6.5 mm. Eyes were rounded, close to each other. Rostrum slightly pointed, quite short, reaching only slightly beyond the

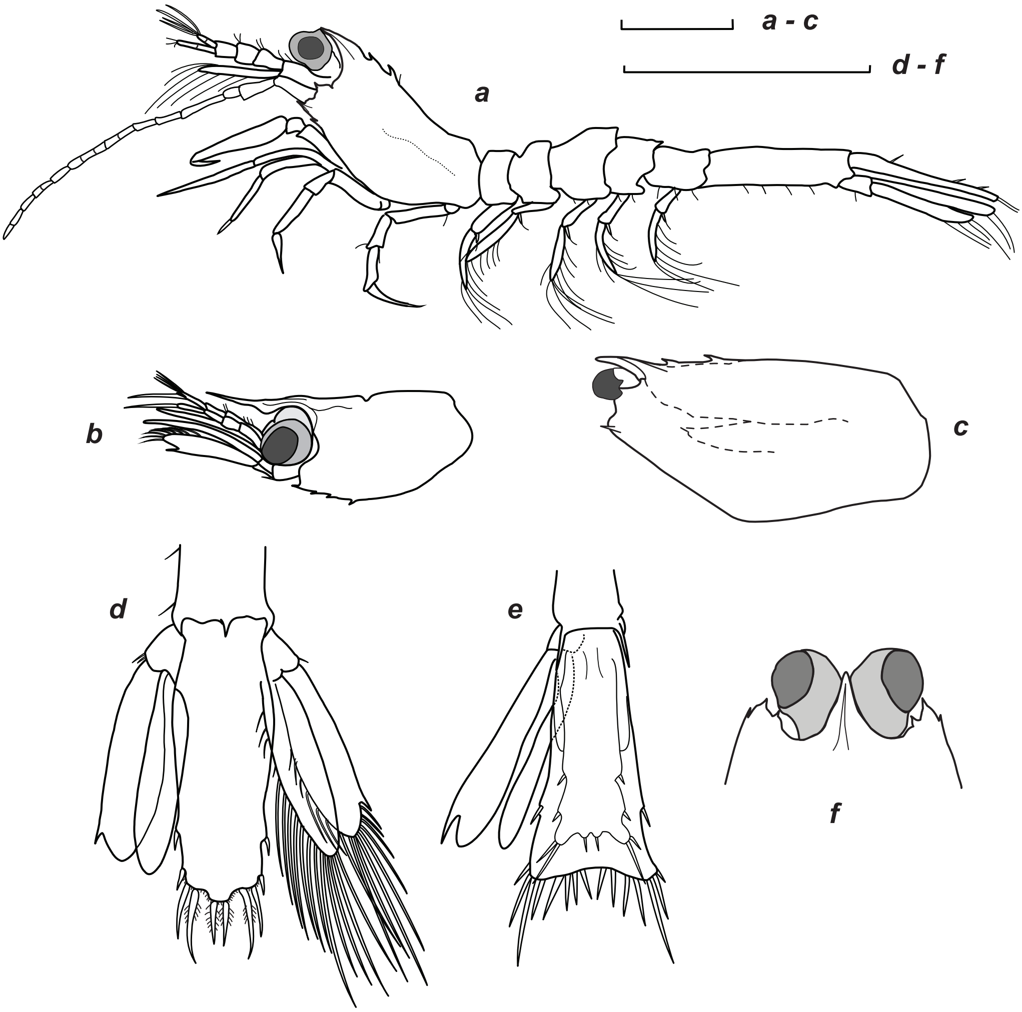

Fig. 1. *Neocrangon communis*: **a**, lateral view of body of decapodid; **b**, anterior part of body of zoea V; **c**, carapace of adult shrimp (redrawing fragments after Sokolov, 2001); **d**, telson of megalopa; **e**, telson of zoea V; **f**, rostrum of decapodid. Scale bars: 1 mm.

middle of the eye (Fig. 1f). Median part of carapace raised into a small keel. In the front part of the carapace there were two spines, anterior spine smaller and sharper, located just behind the eyes, posterior spine larger and located close to the frontal spine (Fig. 1a). At the base of the posterior spine one short seta was present. Postorbital spines were small. Pleurae from abdomen segments one to five of rounded. A small anal spine was present.

Base of antennula three-segmented, first segment with a series of short setae. Exopodite of antennula two-segmented, with four long distal aesthetascs and one very small one (Fig. 2a). Endopodite two-segmented with one lateral and four short terminal setae. Flagellum of antenna consists of 16 segments. Scaphocerite wide, distal tooth short, not reaching distal edge of lamella (Fig. 2f). There were a total of 24 setae on the scaphocerite. Basipodite of maxillula with six spines and two lateral setae (Fig. 2c). Coxal endite of maxillula with three bristles. Endopodite with one short bristle. Exopodite of maxilla with 27 bristles (Fig. 2b).

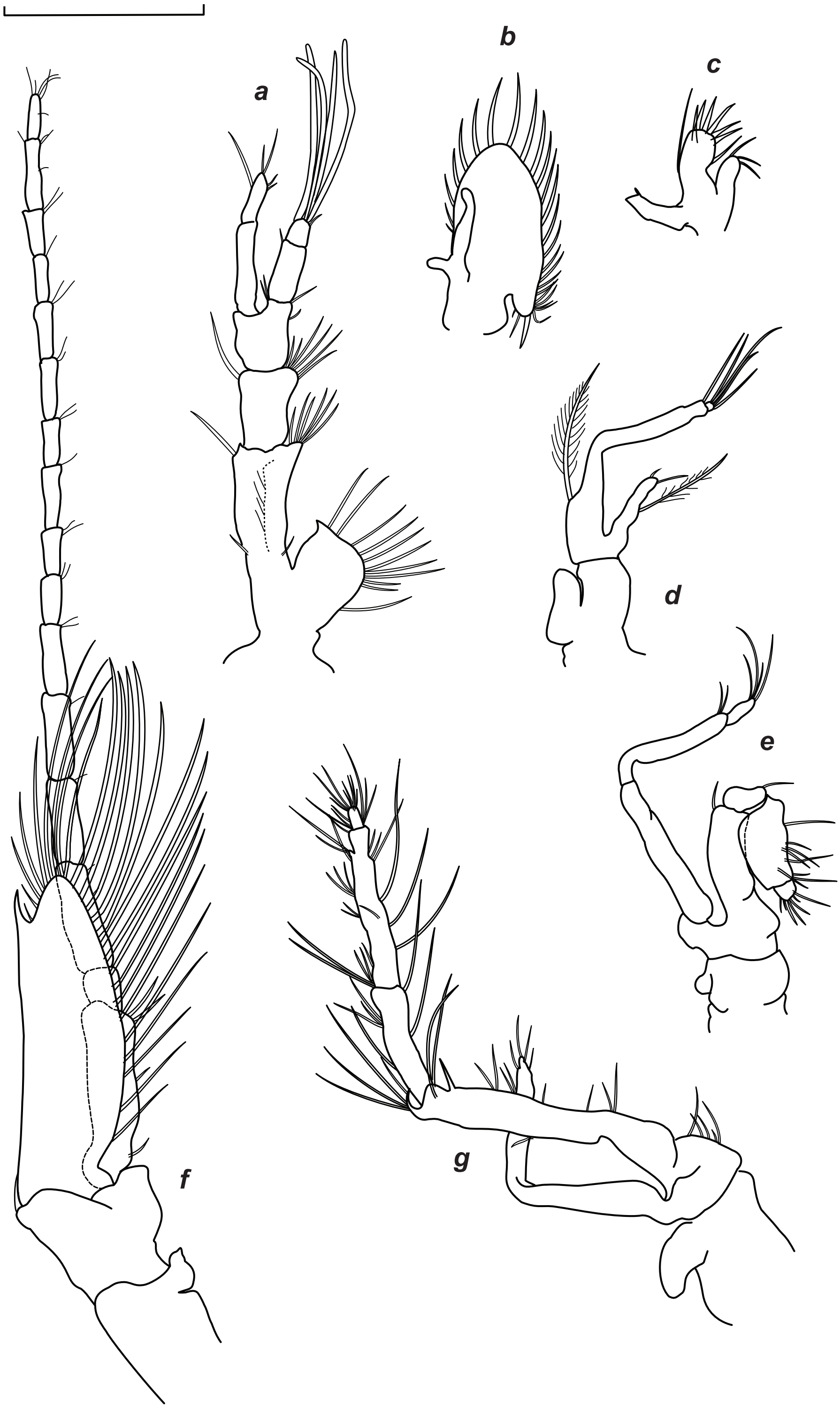

Fig. 2. *Neocrangon communis*, decapodid; **a**, antennula; **b**, maxilla; **c**, maxillula; **d**, maxilliped 1; **e**, maxilliped 2; **f**, antenna; **g**, maxilliped 3. Scale bar: 0.5 mm.

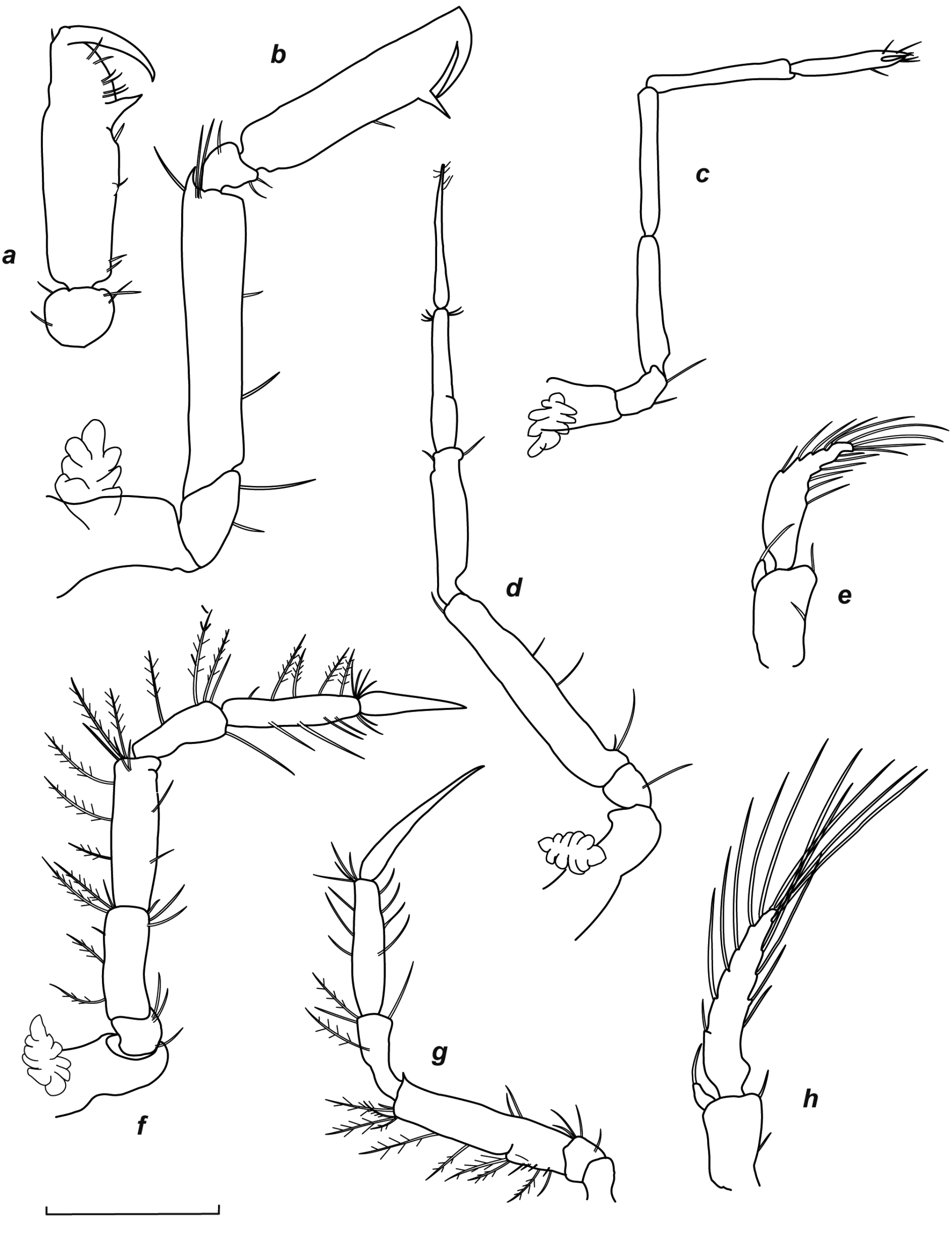

Fig. 3. *Neocrangon communis*, decapodid; **a**, distal segment of P1; **b**, P1 in total; **c**, **d**, second and third pereopods; **e**, fifth pleopod; **f**, **g**, four and fifth pereopods; **h**, second pleopod. Scale bar: 0.5 mm.

First maxilliped: basis with large epipodite; endopod unsegmented with three setae; exopod with two subterminal setae and four terminal plumose natatory setae (Fig. 2d).

Second maxilliped: basis with small epipodite. Endopodite four-segmented with one, one, eight, seven long setae on each segment; exopodite with five setae (Fig. 2e).

Maxillipeds were of a typical structure (Fig. 2d, e, g). First maxilliped: basis with large epipodite; endopod unsegmented with three setae; exopod with two subterminal setae and four terminal plumose natatory setae (Fig. 2d). Second maxilliped: basis with small epipodite.

Endopodite four-segmented with one, one, eight, seven long setae on each segment correspondingly; exopodite with five setae (Fig. 2e).

Third maxilliped: coxa with epipodite (Fig. 2g). Basipodite with five setae; endopod four-segmented with numerous short setae placed as shown; exopod two-segmented, with two subterminal and four terminal setae.

Pereopods are uniramous, consist of five to seven segments (Fig. 3a–d, f, g). Subchella on the first pair of pereopods was well-developed, and that is characteristic for all representatives of the family. In the second pair of pereopods the claw was very small, narrow. The gills are located at the base of pereopods. All five pairs of pleopods are well developed, with long swimming setae, and one seta on one segmented flagellum (Fig. 3e, h).

Telson was almost rectangular, with two pairs of lateral spines. There are three pairs of long setae on the end of the telson. Medial setae were shorter, on average almost twice as short. Endopodite of uropods slightly longer then exopodite. Uropods shorter then telson. Spine on uropods was short (Fig. 1d).

A few larvae with a total body length 6.5–7.0 mm similar that the one described herein, were caught over the western Kamchatka shelf in 1999 and 2003 (1999.07.26, latitude 53°N bottom depth 25 m; and 2003.09.27, latitude 53°20´N, bottom depth about 30 m), but here these larvae are not considered.

CONCLUSION

Detailed studies of a caught larva identified as *Neocrangon communis* showed that the decapodid of this species differs from the corresponding stages of the genera *Argis, Crangon, Mesocrangon* by morphology of the telson, antennae, antennulae and carapace. The main distinguishing features of the decapodid of *N. communis* were two spines on the median line of the carapace, a short rostrum, relatively wide scaphocerite, characteristic shape and length of the terminal setae on the telson.

In previous studies, we observed that larval development of *M. intermedia* is closed to *N. communis* (Sedova, 2013; Sedova & Grigoriev, 2014b; 2015). Our decapodid is different from *M. intermedia* decapodid but is similar to the one described by Makarov (1966), although somewhat smaller. According to our data, the average body length of the zoea V of *N. communis* was 7.2 mm. A reduction in the body length of the decapodid stage can be due to the sharp shortening of the rostrum. At the last stage of zoea, length of the rostrum was an average of 45% of the length of the carapace, and on stage of decapodid, only 20% (Figs 1a–c).

Our decapodid at this stage more differs from the species of the genus *Crangon* than from the species of the genus *Mesocrangon*. Nevertheless, our decapodid differs from the species of the genus *Argis* less than that of *Crangon*, but more than from *Mesocrangon*.

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