БИОТА РОССИЙСКИХ ВОД ЯПОНСКОГО МОРЯ

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RUSSIAN ACADEMY OF SCIENCES
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Institute of Marine Biology

РОССИЙСКАЯ АКАДЕМИЯ НАУК
ДАЛЬНЕВОСТОЧНОЕ ОТДЕЛЕНИЕ

Институт биологии моря
имени А.В. Жирмунского

БИОТА РОССИЙСКИХ ВОД ЯПОНСКОГО МОРЯ

Главный редактор серии академик А.В. Адрианов

BIOTA OF THE RUSSIAN WATERS OF THE SEA OF JAPAN

Volume 1

CRUSTACEA (CLADOCERA, LEPTOSTRACA, MYSIDACEA, EUPHAUSIACEA) AND PYCNOGONIDA

Part 2

Edited by
A.V. Adrianov

VLADIVOSTOK
DALNAUKA

2007

БИОТА РОССИЙСКИХ ВОД ЯПОНСКОГО МОРЯ

Том 1

РАКООБРАЗНЫЕ (ВЕТВИСТОУСЫЕ, ТОНКОПАНЦИРНЫЕ, МИЗИДЫ, ЭВФАУЗИИДЫ) И МОРСКИЕ ПАУКИ

Часть 2

Под редакцией
академика А.В. Адрианова

ВЛАДИВОСТОК
ДАЛЬНАУКА

2007

УДК 595 (571.6)

Биота российских вод Японского моря. Т. 1, ч. 2.

Ракообразные (ветвистоусые, тонкопанцирные, мизиды, эвфаузииды) и морские пауки / *В.В. Петряшев, Е.П. Турпаева, И.К. Ривьер, Л.С. Школдина, А.Г. Погодин, Б.М. Борисов; под ред. А.В. Адрианова*. Владивосток: Дальнаука, 2007. 161 с.
ISBN 978-5-8044-0736-8

В англоязычной версии первого тома определителя (русскоязычная версия вышла в 2004 г.) рассматриваются два отряда класса жаброногих ракообразных (Ctenopoda и Onychopoda), три отряда класса высших раков (Leptostraca, Mysidacea и Euphausiacea) и класс морские пауки. Всего в книге описано 11 семейств, 37 родов и 81 вид и подвид, известные в российских водах Японского моря и сопредельных акваторий. Для каждой группы даны краткая морфологическая характеристика, сведения по биологии и определительные таблицы семейств, родов и видов. Для видов приведены синонимия, описания, сведения о распространении и биологии.

Книга предназначена для морских биологов, зоологов, преподавателей и студентов-биологов.

Ил. 52 табл.-рис., 2 карты; библ. 218.

Biota of the Russian Waters of the Sea of Japan. Vol. 1, part 2.
Ed.-in-Chief A.V. Adrianov

Crustacea (Cladocera, Leptostraca, Mysidacea, Euphausiacea) and Pycnogonida / *V.V. Petryashov, E.P. Turpaeva, I.K. Rivyer, L.S. Shkoldina, A.G. Pogodin, B.M. Borisov; Ed. by. A.V. Adrianov*. Vladivostok: Dalnauka, 2007. 161 p.
ISBN 978-5-8044-0736-8

The English version of the first volume of the Key (the Russian one was published in 2004) includes two orders of the class Branchiopoda (Ctenopoda and Onychopoda), three orders of the class Malacostraca (Leptostraca, Mysidacea and Euphausiacea) and the class Pycnogonida. Totally 11 families, 37 genera and 81 species and subspecies from the Russian waters of the Sea of Japan and adjacent waters are treated in the book. Morphological and biological data, keys to families, genera and species for each group are given. Description of the species is supplemented with synonyms, distribution and biological data.

The book is intended for marine biologists, zoologists, and lecturers and students of the biological departments.

The book is illustrated by 52 plates of figures and 2 maps; bibl. 218.

ISBN 978-5-8044-0736-8 (т. 1, ч. 2)
ISBN 5-8044-0408-3

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Памяти Олега Григорьевича Кусакина
и Владимира Леонидовича Касьянова
посвящается

ПРЕДИСЛОВИЕ

В 2004 г. русская версия настоящего том открыла серию определителей "Биота российских вод Японского моря". Необходимость в подобных изданиях назрела давно, так как именно на берегах Японского моря находятся научно-исследовательские институты и университеты, занимающиеся комплексным изучением животных, растений, грибов и микроорганизмов Дальнего Востока России. В выполнении этого беспрецедентного проекта принимают участие 67 специалистов из 9 городов Российской Федерации и Украины. К настоящему времени вышло 5 томов этой сводки, посвященных нескольким группам ракообразных, морским паукам, прокариотам, форонидам и брахиоподам.

В серию определителей предполагается включить все современные виды свободноживущих и симбиотических организмов, обнаруженных в российских водах Японского моря (рис. 1, 2): от устья р. Туманная (Туманган) на юге до северной границы Татарского пролива по линии мыс Тык (51°45′ с.ш., 141°41′ в.д.) и мыс Южный (51°41′ с.ш., 141° 06′ в.д.) и западной границы пролива Лаперуза по линии мыс Кузнецова (46° 03′ с.ш., 141° 55′ в.д.) – мыс Носяппу (45°27′ с.ш., 141°39′ в.д.).

Первый том сводки "Биота российских вод Японского моря" посвящен морским паукам и четырем группам ракообразных. В их написании участвовали следующие авторы: Cladocera – И.К. Ривьер (Институт биологии внутренних вод им. И.Д. Папанина РАН, п/о Борок) и Л.С. Школдина (Институт биологии моря ДВО РАН, г. Владивосток), Leptostraca и Mysidacea – В.В. Петряшев (Зоологический институт РАН, г. Санкт-Петербург), Euphasiacea – В.В. Петряшев, А.Г. Погодин (ИБМ ДВО РАН) и Б.М. Борисов (ДВНИГМИ, г. Владивосток), Pycnogonida – Е.П. Турпаева (Институт океанологии им. П.П. Ширшова РАН, г. Москва).

Редактирование русскоязычной версии было выполнено О.Г. Кусакиным, В.Л. Касьяновым, В.Г. Чавтуром и А.В. Чернышевым. Подготовка первого тома была начата под руководством Олега Григорьевича Кусакина, который незадолго до кончины успел просмотреть рукописи всех разделов и приступил к написанию раздела по изоподам. По инициативе директора ИБМ Владимира Леонидовича Касьянова было принято решение издавать "Биоту…" на двух языках – русском и английском. Русскоязычным оставался только первый том, перевод которого занял два года. За это время авторы внесли в свои разделы некоторые дополнения и изменения.

Перевод на английский язык осуществлен Н.В. Мирошниковой. Над созданием оригинал-макета работал Е.С. Мороз. Техническая подготовка рукописи и её издание поддержаны Дальневосточным отделением Российской академии наук (программа фундаментальных исследований Президиума РАН «Биоразнообразие», грант № 06-I-П11-037).

Редколлегия

In memory of Oleg Grigorievich Kussakin
and Vladimir Leonidovich Kasyanov

FOREWORD

The Russian version of the present volume published in 2004 was the first in a series of identification keys *Biota of the Russian Waters of the Sea of Japan*. The need to publish such kind of books has been pressing for a long time, as it is on the coast of the Sea of Japan that many scientific institutions and universities, which conduct complex research of animals, plants, fungi, and microorganisms of the Russian Far East, are located. Sixty-seven scientists from nine cities of the Russian Federation and Ukraine take part in this unique project. Five volumes, devoted to several groups of crustaceans, sea spiders, prokaryotes, phoronids, and brachiopods have been already published by now.

The keys will comprise all known species of free-living and symbiotic organisms found in the Russian waters of the Sea of Japan (figs. 1, 2): from the mouth of the Tumen (Tumannaya) River in the south to the northern boundary of the Tatar Strait, going along the line between Tyk Cape (51°45′ N, 141°41′ E) and Yuzhny Cape (51°41′ N, 141°06′ E), and to the western boundary of the La Perouse (Soya) Strait, going along the line between Kuznetsov Cape (46°03′ N, 141°55′ E) and Noshappu Cape (45°27′ N, 141°39′ E). In cases of poorly studied groups of organisms, species from the adjacent water areas of the Sea of Japan and Sea of Okhotsk will be included.

The first volume of the key *Biota of the Russian Waters of the Sea of Japan* is devoted to the sea spiders and to four groups of crustaceans (Cladocera, Mysidacea, Leptostraca, and Euphausiacea). The chapter on the Cladocera was written by Irina K. Rivier (I.D. Papanin Institute for Biology of Inland Waters, Russian Academy of Sciences (RAS), Borok Village) and Larissa S. Shkoldina (Institute of Marine Biology, Far Eastern Branch of the RAS, Vladivostok), the chapters on the Leptostraca and Mysidacea, by Viktor V. Petryashov (Zoological Institute, RAS, St.-Petersburg), the chapter on the Euphasiacea, by Viktor V. Petryashov, Artur G. Pogodin (Institute of Marine Biology, Vladivostok), and Boris M. Borisov (Far Eastern Regional Hydrometeorological Research Institute, Vladovostok), and the chapter on the Pycnogonida, by Elena P. Turpaeva (P.P. Shirshov Institute of Oceanology, RAS, Moscow).

The Russian version was edited by Oleg G. Kussakin, Vladimir L. Kasyanov, Vladimir G. Chavtur, and Alexey V. Chernyshev. The preparation for publication began under the supervision of Oleg G. Kussakin, who, before his death, checked all the manuscripts and began to write a chapter on isopods. On the initiative of Vladimir L. Kasyanov, Director of the IMB, *Biota…* is published in two languages, Russian and English, and only the first volume was not translated. It took two years to prepare the English version, which was also slightly updated by the authors.

Translation into English was performed by N.V. Miroshnikova. The dummy layout was made by E.S. Moroz. The Far Eastern Branch of the Russian Academy of Sciences provided technical support and helped with publication (basic research program "Biodiversity" of the Presidium of the Russian Academy of Sciences, grant N 06-I-P11-037).

Editorial board

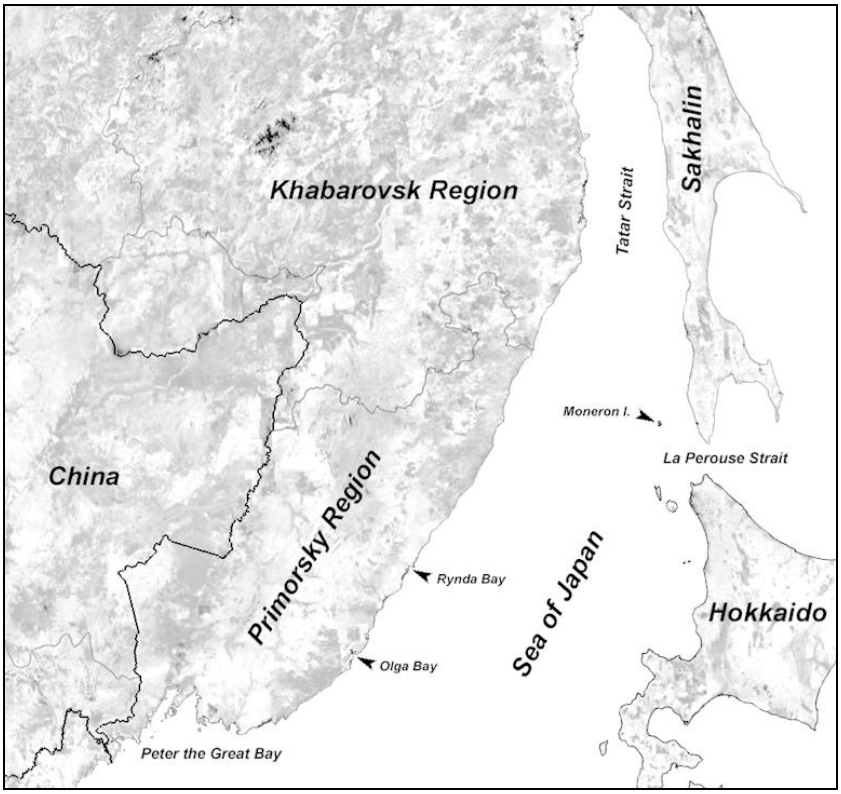

Fig. 1. Map of the northern part of the Sea of Japan

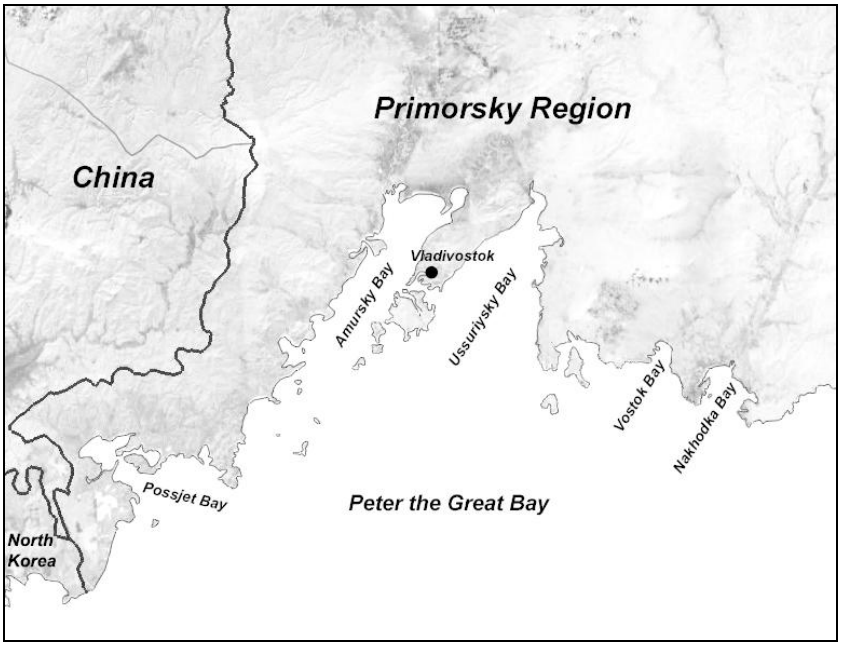

Fig. 2. Map of Peter the Great Bay

SUBPHYLUM CRUSTACEA

CLASS BRANCHIOPODA Latreille, 1817

Superorder CLADOCERA Milne-Edwards, 1840 sensu Negrea et al., 1999

Irina K. Rivier[1], *Larissa S. Shkoldina*[2]

General characteristics [3]

Cladocerans (superorder Cladocera) is a peculiar group of very small (usually smaller than 1 mm, rarer up to 4 mm) planktonic crustaceans of freshwater origin. They inhabit various continental and marine waters, where they are abundant and often dominate.

The body of most cladocerans is enclosed in a thin transparent shell, the dorsal part of which (brood pouch) bears embryos, while the lateral parts (valves) protect thoracic limbs in filter-feeding cladocerans; in predatory cladocerans the valves are not developed. Marine forms (*Penilia* and Podonidae) have the enclosed brood pouch covered by shell, which isolates embryos from the external environment. In the Podonidae the shell containing the brood pouch is enlarged; it grows together with embryos and has a hydrostatic function as well.

The body of cladocerans is divided into a head, a thorax, a usually reduced abdomen, and a postabdomen (cauda). There is a compound eye and an ocellus ("nauplius eye"), which is reduced in some taxa. The first pair of antennae (antennules) represents sense organs provided with papillae (aestetascs) and short sensory setae, obviously performing a tactile function. In males the antennules are usually movable and longer than in females. Antennae 2 are locomotory organs. The mouth parts (mandibles, maxillulae and maxillae) are situated posteriorly. They are used to manipulate and push food particles into the gut. The body is indistinctly segmented and provided with four to six pairs of thoracic limbs, being filtering organs in most cladocerans and grasping organs in predators. The postabdomen is situated posteriorly and usually provided with claws and "swimming" setae (*setae natatoriae*).

The distinctive feature of the cladocerans' life cycle is direct development (excluding the genus *Leptodora*, which has the stage of a metanauplius larva; the Leptodoridae are presently separated in the superorder Leptodorida) and the alternation of gamogenetic and parthenogenetic reproduction, including the stage of a resting (latent) egg. Hatching newborn cladocerans (the first generation) from resting eggs give rise to several parthenogenetic generations. In most cladocerans parthenogenetic eggs devel-

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[1] I.K. Rivier is the author of the systematic part of the chapter "Podonidae" and of the figures of Podonidae (excluding figs. 1–3, 5 in pl. VIII).

[2] L.S. Shkoldina is the author of the chapter "Sididae" and figures 1–4 in plate I (*Penilia avirostris*).

[3] The chapter "General description" and the parts concerning distribution, biology, and ecology are written by the authors in collaboration.

oping in the brood pouch have a full reserve of nutrients for embryos. But in members of the genus *Penilia* and the Onychopoda (Polyphemoidea) parthenogenetic eggs do not have the same reserve and get nutrients from the inner hypodermic wall of the brood pouch. Eggs develop in the brood pouch into tiny young cladocerans, which hatch out and grow into adults, going through several ecdyses. The young of the Polyphemoidae hatch out by the destruction of female's brood pouch; these young are born sexually mature.

The appearance of males in populations depends on unfavourable conditions. After fertilization the ovicell begins to accumulate yolk in the ovary. After the period of trophoplasmatic growth in the ovary, resting eggs having only an elastic membrane flow to the brood pouch where dense chitinous membranes are formed. In the podonids at complete ripening of the eggs the death of a female follows, and the resting eggs sink to the bottom (Swammerdam, 1685). Unlike the Cercopagidae, among which particular gamogenetic females appear, in the Podonidae the resting eggs are developed in parthenogenetic females after fertilization. The resting egg, covered with thick chitinous membranes protecting it from unfavourable environment conditions, rests on oozy sediments.

The present work is based on the taxonomic system, by which the superorder Cladocera includes three orders: Ctenopoda (two families), Anomopoda (ten families), and Onychopoda (three families) (Dumont & Negrea, 2002). The superorder Cladocera contains more than 450 species belonging to 52 genera. Most cladocerans (95%) are found in freshwater habitats, 3% (about 30 species) – in brackish water habitats (including landlocked seas, e.g. the Caspian and the Aral), and only eight species occur in marine environments (Bowman & Abele, 1982). One of these species belongs to the family Sididae (*Penilia avirostris* Dana, 1849), and other seven to the family Podonidae. All eight species occur in the Sea of Japan, and seven of them, excluding *Podon intermedius* Lilljeborg, 1853, are found in its northwestern part (Peter the Great Bay).

Most cladocerans, including Sididae, are filter feeders; they feed on algae, bacteria, and detritus. Species of the order Onychopoda (Polyphemoidea) are mostly predators, feeding on larger organisms (small crustaceans, rotifers, protozoans, and algae). Cladocerans represent the important trophic part of plankton communities, being consumers of organic matter and food for other organisms, particularly for fishes.

Cladocerans are typical neritic species of the Sea of Japan. The coastal zone inhabited by various neritic animals is 3–5 miles wide in the northern part of the Sea of Japan, narrowing southward to a width of 0.5–1 mile within the Korea Strait and expanding to 7–10 miles in the eastern part of the sea near the Korea Strait (Kun & Meshcheryakova, 1954; Kun, 1975). Currents may bring cladocerans to the open sea (Brodsky, 1955; Meshcheryakova, 1960; Miklukhina, 1967). Some species of the superorder (*Pseudevadne tergestina*, *Podon leuckarti*, *Pleopis polyphemoides*, and *Penilia avirostris*) are indicators of coastal surface water conditions (Biryulin et al., 1970). In summer cladocerans may be abundant in the neritic zone. They are common and often dominate and subdominate in the plankton of Peter the Great Bay.

Specimens for drawing some missing biological stages of four species of the podonids (*Podon leuckarti*, *Pleopis polyphemoides*, *Evadne nordmanni*, and *Pseudevadne tergestina*) were picked out from the plankton samples collected in 1996–2002 in Vostok Bay (Peter the Great Bay) and in the south-western part of Peter the Great Bay.

Main references: Manuilova, 1964; Mordukhai-Boltovskoi & Rivier, 1987; Rivier, 1998; Dumont, Negrea, 2002.

Systematic part

KEY TO MARINE FAMILIES OF THE CLADOCERA

1(2). Shell oblong, with well-developed valves, not fused ventrally, covering 6 pairs of thoracic leaf-shaped limbs..... I. **Sididae** Baird, 1850 (p. 11)
2(1). Shell conical or oval, without valves, not covering 4 pairs of cylindrical thoracic limbs ..... II. **Podonidae** Mordukhai-Boltovskoi, 1968 (p. 14)

Order CTENOPODA Sars, 1865

I. Family **SIDIDAE** Baird, 1850

Shell oblong, elongated, oval; valves cover body with all appendages. Head relatively large, distinctly separated from body. Antennules movable, with 9 (Sidinae) or 6 (Peniliinae) estetascs, short in females, long and provided with long flagellum in males. Swimming antennae well developed, long, robust, biramous; exopod with numerous (not less than 8) plumose setae, situated at apex, as well as on sides of segments. Body provided with 6 pairs of leaf-shaped thoracic limbs of similar arrangement; endopods of 5 anterior pairs armed with rows of long filtratory setae. Postabdomen elongated, smooth, or armed with spines or setae.

Cladocerans of this family are filter feeders, eating microscopic algae, fine detritus, and bacteria. The family consists of two subfamilies. Members of one genus of the subfamily Peniliinae Dana, 1849 inhabit marine waters.

Subfamily Peniliinae Dana, 1849

Female head ventrally with two rostral outgrowths. Antennule with 6 aestetascs. Adults with big dorsal organ. Both branches of swimming antenna 2-segmented. Brood pouch closed; parthenogenetic eggs with little yolk; maxillary glands rounded, without long bending nephridial canals. Rudimentary epipodites present only on thoracic limbs 3 and 4. Postabdominal claws much longer than postabdomen itself.

Genus ***Penilia*** Dana, 1849

Type species: *Penilia avirostris* Dana, 1849.

The diagnosis of the genus coincides with the diagnosis of the subfamily.

The genus presumably consists of one species. Korovchinsky (2004) notes that *P. avirostris* has not yet been studied in detail over its wide geographical range and therefore should be regarded as a problematic taxon.

Penilia avirostris Dana, 1849
(Pl. I, figs. 1–10)

Dana, 1849: 47 (*Penilia avirostris, P. orientalis*); Manuilova, 1964: 106, fig. 25; Yamazi, 1966: 191–193, pl. 88, fig. 7 (*Penilia schmackeri*); An illustrated guide…, 1997: 612–613, pl. 1, figs. A–F.; Korovchinsky, 2004: 341–344, fig. 138.

Description. Parthenogenetic female. Valves transparent, elongated, oval, covering body and limbs (pl. I, fig. 1). Inflated dorsal part of shell encloses brood pouch with 6–12 developing embryos. Ventral and posterior margins of valves covered with acute teeth, ranging from 31 to 36 on ventral margin, and from 9 to 11 on posterior one, with 4–7 very small spinules placed among teeth. Posterior lower corner of valve extended to acute outgrowth, also with small spinules (pl. I, fig. 3). Head rounded, somewhat separated from body, provided with tubercle over eye and paired beak-shaped outgrowth (rostrum), covering bases of antennules. Eye small. Antennule short; base slightly curved, tubiform; apex bulging, bearing 6 estetascs and longer sensory seta (pl. I, fig. 5). Antenna long, thin, with bulb-shaped base (pl. I, fig. 4). Distal end of basipodite with 2 acute processes and spine on outer side. Proximal segment on each branch of antenna 3–5 times as long as distal one. Upper branch bears 8 setae and 3 spines (proximal segment with 2 setae and 2 spines, situated on sides; distal segment with 6 setae and 1 spine). Lower branch bears 5 setae and 2 spines (proximal segment with 1 seta and 1 spine; distal one with 4 setae and 1 spine).

Body provided with 6 pairs of thoracic limbs. Endopods slender, indistinctly segmented, covered with numerous thin setae; exopods flat, leaf-shaped, with several thick setae (pl. I, fig. 10). Postabdomen elongated, conical, covered with small hairs (pl. I, fig. 2). Abdominal claws very long, thin, slightly curved, acute, covered all along with several rows of tiny hairs. Two spines, unequal in length, situated near base of each abdominal claw, at its concave side.

Length up to 1.2 mm, height up to 1 mm.

Gamogenetic female. Dorsal part of shell inflated. Brood pouch with 1–2 large elliptical opaque eggs. Length of shell 1 mm.

Males smaller than females. Dorsal side of shell flat; head rounded; rostrum absent (pl. I, fig. 9). Antennule with long (extending to end of body) whip-shaped tactile seta (pl. I, fig. 8). Apex of endopod of thoracic limbs 1 provided with small acute curved hook (pl. I, fig. 7). Paired penis situated on ventral side of abdomen, near base of limbs 6. Caudal setae shorter than in females. Length of shell up to 0.9 mm.

Distribution. *P. avirostris* is a circumtropical-subtropical neritic species. It occurs in the coastal zones of continents and islands, in bays and inland seas of the Atlantic (between 40°N and 25°S) and Pacific (between 44°N and 37°20′S) oceans, as well as in the coastal waters of India. In Russia it is distributed in the Black Sea and the Sea of Japan (Peter the Great Bay). It may be transported by warm currents to the Tatar Strait (between 49°and 51°30′N) and to the shores of the South Sakhalin (Bokhan, 1984). It is found in the north-western part of the Pacific in the high seas, where Kuroshio and Oyashio currents meet (46–38°N and 142–154°E), more than 300–400 miles from the Kuril Islands. It is an indicator of the subtropical fauna here (Brodsky, 1955; Miklukhina, 1967).

Biology and ecology. *P. avirostris* is a typical neritic warm-water species and a common member of plankton communities in the coastal waters of the subtropical and tropical zones of the ocean. It is most abundant near river estuaries (Goswami & Devassy, 1991) and may come to river mouths, too (Egborge et al., 1994). In subtropical and tropical regions *P. avirostris* occurs at a depth of 30 m or near the bottom and does not make daily migrations (Mullin & Onbe, 1992; Onbe & Ikeda, 1995). In Peter the Great Bay in the regions 30–70 m deep the species was collected only from warm upper layer, not deeper than 20 m.

The species is most abundant usually in the middle of summer. In the Inland Sea of Japan it appears as early as late May, and the density is highest in mid-July (up to 10–60 thousand sp./m^3); in September-October cladocerans disappear from the plankton (Onbe, 1974; Onbe & Ikeda, 1995). The temperature and salinity ranges of the species are wide: in the coastal waters of China, namely near Hong Kong, it was found at a temperature of 16–32˚C and a salinity of 7.3–37.2‰ (Tang et al., 1995). In the north-western part of the Sea of Japan peaks of *P. avirostris* density have been recorded for later periods. In the southern part of Amursky Bay (Alekseev Bight of Popov Island, in 1973) *P. avirostris* appeared in July at a temperature of 17.9˚C; it was one of the most abundant (2245 sp./m^3) plankters in August at 21.1˚C; in September at 17.9˚C its density was 388 sp./m^3; in October its numbers drastically decreased to disappear by the end of the month (Mikulich & Biryulina, 1977). The species was not found in Peter the Great Bay during the "cold" years of 1962–1967 (Kos, 1969, 1974, 1976, 1977). In the south-western part of Peter the Great Bay *P. avirostris* appears sporadically in mid-July at a temperature of 14–17°C and attains maximum density (up to 560 sp./m^3) in late August at 20–22°C. In the eastern part of Peter the Great Bay the species is recorded for periods shorter than in the western part. In Vostok Bay it is usually found when the water is warmest (21.8–22.4°C), in late August and in September, reaching a density of 500 sp./m^3 *P. avirostris* occurs in Peter the Great Bay till the end of September or to October (Shkoldina, 2001).

Subitaneous (summer) eggs of *P. avirostris* are alecithal, they are nourished through the brood pouch. Every female bears from two to nine parthenogenetic embryos, Onbe (1974) recorded the highest (seven-nine) number of such embryos for June. The process of embryonic development divides into 12 stages (Della Croce & Bettanin, 1965). Generally the eggs develop in the brood pouch for three-four days, but sometimes the period shortens to just 30 hours; during 36–40 days the parthenogenetic female produces six generations (Onbe, 1978a). Females with resting eggs appear in the population when its density is highest (for the Inland Sea of Japan – in late July), making 1–2% of the whole number of specimens. Gamogenesis intensifies, and the number of the females with the resting eggs increases towards the end of warm season, reaching up to 50% of the population (Onbe, 1974, 1978a). Usually the female of *P. avirostris* has one, rarer two resting eggs, which develop going through nine successive stages (Onbe, 1978a). The further formation of the egg's membrane, its maturation, and the hatching out of a young cladoceran takes place in the oozy sediments. The length of the resting egg ranges from 0.21 to 0.29 mm (usually 0.25); the width, from 0.14 to 0.20 mm (usually 0.18 mm); the membrane is 0.10 mm thick, and the newborn cladoceran length is about 0.4 mm (Onbe, 1973, 1985; An illustrated guide…, 1997). The resting eggs are found in the sediments the year round; their maximum quantity is recorded for September (Onbe, 1978a).

In Peter the Great Bay in August and September mainly juveniles and parthenogenetic females are found. Great number of males and few gamogenetic females were recorded in Vostok Bay in late September at a surface temperature of 16.4–17°C.

P. avirostris feeds on microflagellates consuming bacteria (Turner et al., 1988).

Order ONYCHOPODA Sars, 1865

II. Family **PODONIDAE** Mordukhai-Boltovskoi, 1968

Body oval, more or less elongated. Shell not covering thoracic limbs, rudimentary, not separated into valves. It performs hydrostatic function and serves as place for development of embryos. Shell contains brood pouch growing together with embryos to fill up whole inside of it. Head large, formed of one strongly pigmented compound eye. Antennules small, immovable, fused with head. Antennae relatively small; upper branch (4-segmented) has 7 setae; lower branch (3-segmented) has 6 setae. Body has 4 pairs of thoracic limbs without filtratory setae, with well developed exopods on 3 anterior pairs and with maxillary processes. Endopod armed with 7–10 setae; exopod with 1–4 setae. Abdomen and cauda very short, so that cauda situated just behind limbs 4. Cauda in shape of rounded or pointed process, or with well developed claws of various shapes and sizes. Caudal ("swimming") setae well developed, situated on tubercle or on small cylindrical outgrowth. Male slightly smaller than female, with larger head and eye; testes well developed, projecting into valve cavity; limbs 1 with hooks; penes well developed, situated behind limbs 4.

Members of this family are viviparous; embryos are protected by the closed brood pouch and chitinous shell. Podonids are predators, with special limbs modified to catch various organisms ranging from 100 to 200 μm (dinoflagellates, centric diatoms, rotifers, and the like).

KEY TO THE GENERA OF THE FAMILY PODONIDAE

1(4). Exopods of limbs 2 and 3 with 3–4 setae.
2(3). Exopods of limbs 1 with 3–4 setae. Shell rounded .....1. ***Pleopis*** (p. 14)
3(2). Exopods of limbs 1 with 2 setae. Shell elongated.....2. ***Pseudevadne*** (p. 17)
4(1). Exopods of limbs 2 and 3 with 1–2 setae.
5(6). Exopods of limbs 2 with 1 seta. Shell semispherical, rounded at apex..... .....3. ***Podon*** (p. 19)
6(5). Exopods of limbs 2 with 2 setae. Shell elongated, tapering towards apex or pointed at its tip ..... 4. ***Evadne*** (p. 21)

1. Genus ***Pleopis*** Dana 1853

Type species: *Pleopis polyphemoides* (Leuckart, 1859).

Shell rounded, globular in females with numerous embryos, in males triangular, with rounded apex. Depression between head and shell clearly visible. Branches of antennae with shortened distal segments, twice as short as other antennal segments. This character differs *Pleopis* spp. from *Podon* spp. Four-segmented branch with 7

setae; 3-segmented branch with 6 setae. Exopods of thoracic limbs 1–3 with 3–4 setae. Cauda formed of 2 triangular pointed outgrowths. Caudal setae situated on small tubercle.

KEY TO THE SPECIES OF THE GENUS PLEOPIS

1 (2). Exopod of limbs 1–3 with 4 setae, cauda with caudal claws covered with spinules ..... 1. ***P. schmackeri*** (p. 15)

2 (1). Exopod of limbs 1–3 with 3 setae, cauda in shape of pointed conical tubercles ..... 2. ***P. polyphemoides*** (p. 16)

1. ***Pleopis schmackeri*** (Poppe, 1889)
(Pl. II, figs. 1–6)

Poppe, 1889: 293–300; Yamazi, 1966: 192, pl. 88, fig. 3 (*Podon schmackeri*); Mordukhai-Boltovskoi, 1978: 523–529, figs. 2, 3; Mordukhai-Boltovskoi & Rivier, 1987: 109–110, fig. 59; Rivier, 1998: 121–122, figs. 42–47 (*Pleopis schmackeri*).

Description. Parthenogenetic female. Body rounded; head separated from body by depression. Shell, containing brood pouch, semispherical. Swimming antennae short; terminal segment on each of 2 branches twice shorter than penultimate one; penultimate segment twice shorter than preceding one. Each exopod of limbs 1, 2, and 3 bears 4 setae; that of limb 4 with only 2 setae. Fourth seta on exopod of limbs 1–3 present among podonids only in *P. schmackeri*. Setal formula 4.4.4.2. Endopods armed with numerous setae, too. First segment of endopod of limb 1 with 7 setae on inner side; second segment with 2 short setae, twice shorter than apical ones. Maxillary processes especially developed on limbs 2 and 3, with long pointed spines. Caudal claws straight, thin, covered with clearly noticeable spinules. Caudal setae situated on tubercle, together with small denticles.

Height of parthenogenetic female from 0.45–0.65 mm to 0.87 mm (Kim & Onbe, 1989a). Same authors present sizes of 2 almost rounded males: height 0.43 and 0.46 mm, length 0.42 and 0.43 mm.

Distribution. *P. schmackeri* has the narrowest geographical range among the marine podonids. It is distributed along the Asian coast from the south-eastern shores of Indochina Peninsula (13°N) to the eastern coast of Korea (38°30′N). It is abundant in the bays north of Hong Kong, 22°30′N (Tang et al., 1995), inhabits the whole area of the Korea Strait, and comes into the southern regions of the Sea of Japan (Kim & Onbe, 1989b). The species also migrates north along the Japan Islands to 40°N and to the Pacific Ocean to 155°E (Kim & Onbe, 1989b).

The species is rarely found in Peter the Great Bay; it was recorded only sporadically in the south-western part of the bay in July and August (Shkoldina & Pogodin, 2001; Shkoldina et al., 2002).

Biology and ecology. The development begins in April in the southernmost points of the distributional range. The species is most abundant in August; in September and October only isolated specimens were found in the plankton. The most abundant populations (up to 100 sp./m^3) were recorded in the Korea Strait in August, and less numerous ones off the southern shores of Honshu Island and near Kii Peninsula

(Japan). *P. schmackeri* matures at a temperature of 19.7–30.4°C and a salinity of 29.37–34.27‰, while the optimal values for this species are 24° and 33.7‰ respectively (Kim & Onbe, 1989b). In various bays near Hong Kong it has been recorded at a temperature of 17–29°C and a salinity of 31–37‰ (Tang et al., 1995). *P. schmackeri* is not abundant in comparison with other marine podonid species. The maximum density has been recorded off the coasts of Korea (30–80 sp./m^3); near the southern coasts of Japan the highest density has been 6.4 sp./m^3.

According to Kim and Onbe (1989a), the mean fecundity of this species is 2.3–7.1 embryos, and the individual fecundity is one to 9 embryos. Other authors mention up to 19 embryos per a female (Tang et al., 1995). The largest specimens (0.45–0.65 mm) occur in the north of the range, about 45% of animals in the population being 0.5–0.55 mm long, bearing five-six embryos each (Kim & Onbe, 1989b).

The reproduction is so abundant owing to pedogenesis inherent in this species. Well-developed embryos being still in the brood pouch of the parthenogenetic female already have miniature rounded embryos in their own brood pouches (Kim & Onbe, 1989a).

Remarks. *P. schmackeri* differs from the other Podonidae in the presence of four setae on the exopods of limbs 1–3 and denticles on the caudal claws.

2. ***Pleopis polyphemoides*** (Leuckart, 1859)
(Pl. III, figs. 1–9; VIII, fig. 5)

Leuckart, 1859: 262–265, tabl. 7, fig. 5 (*Evadne polyphemoides*); Lilljeborg, 1900: 633–636, tabl, 85, figs. 7–11; Rammner, 1930: 4, figs. 5–6; Manuilova, 1964: 303, fig. 173; Yamazi, 1966: 191, pl. 88, fig. 2; Flössner, 1972: 395–397, abb. 186 (*Podon polyphemoides*); Negrea, 1983: 346–348, fig. 143; Mordukhai-Boltovskoi & Rivier, 1987: 110–112, fig. 60; Rivier, 1998: 123–124, fig. 48–56 (*Pleopis polyphemoides*).

Description. Parthenogenetic female. Shell rounded, inflated at great number of embryos. Head elongated, separated from body by pronounced depression. Swimming antenna, as in *P. schmackeri*, with small, weak as if undeveloped apical segment. Each exopod of thoracic limbs 1–3 with 3 setae; exopod of limb 4 with 2 setae. Formula of setae 3.3.3.2. Setae of exopod, as in *P. schmackeri*, short, not reaching apical setae of endopod. Cauda in shape of 2 conical outgrowths. Length 0.5–0.6 mm; height 0.55–0.65 mm.

Gamogenetic female. In the young female the brood pouch is empty, and a gamogenetic egg grows in the ovary, accumulating nutrients. When the egg is fully nourished, it moves into the brood pouch to form its membranes.

Size of resting egg 150–210 µm (mean size 180 µm) (Onbe, 1985).

Male. Shell small, far smaller than head, rounded at top. Testes on sides of intestine; penes well pronounced behind limbs 4. Apical segment on endopod of limbs 1 with hook on inner side. Male smaller than female (height up to 0.6 mm), but its head larger.

Distribution. *P. polyphemoides* has the widest geographical range, extending even farther every year. It is exceptionally neritic species, occurring in relatively warm waters with wide range of salinity, from 1.05 to 35.23‰ (Negrea, 1983). It is distributed in the coastal waters of Europe, the North and South America, Africa, Southeast and East Asia. In the Russian waters of the Far Eastern seas it is common in Peter the

Great Bay, but no one specimen has been recorded from the Sea of Okhotsk and the Bering Sea.

Biology and ecology. *P. polyphemoides* is an exceptionally neritic species in the Far East seas. It prefers surface waters, but may occur to a depth of about 100 m. In Peter the Great Bay of the Sea of Japan it is found at a temperature from 6 to 26°C and from low (several ‰) to normal seawater salinity (Kos, 1977). Maximum density has been recorded for autumn. In the southwestern part of Peter the Great Bay the species has two peaks of density, in July and in September. Thus, in Sivuchya Bay its density reached 500 sp./m^3 in July, then in August at a surface water temperature of 20–22°C the population declined, and in September (at a temperature of 17–19°C) it reached 1047 sp./m^3 (18.3% of the total density of zooplankton) (Shkoldina & Shevchenko, 2001). In the western part of Peter the Great Bay *P. polyphemoides* appears in July at 18°C temperature and 33–34‰ salinity. Maximum density, 616 sp./m^3, was recorded for mid-October at 14.1°C, and specimens were found singly until January, when temperature fell below zero (Mikulich & Biryulina, 1977). In Vostok Bay the species is usually found during a period from June till October. Substantial desalination of the inner part of the bay stimulates its mass development (Shkoldina, 2001). It appears in small numbers in June at a temperature of 13.4–13.8°C (Shkoldina, 2002) and attains peak density (over 7.6 thousand sp./m^3) twice: in August at 21.3°C and in October at 14.3°C.

P. polyphemoides is abundant in the coastal waters of Korea in the Sea of Japan. Its density reaches 10% of the total density of the zooplankton in July. In November and December males and gamogenetic females comprise 30–40% of the total density of the population (Yoo & Kim, 1990). The species occurs in the coastal waters of Korea all the year round excluding February (Yoo & Kim, 1987). The seasonal dynamics and ecology of the species were most thoroughly studied for the Inland Sea of Japan (Onbe, 1974). *P. polyphemoides* is found there in the plankton from April-May until early August. Its density widely varies from year to year; it is highest (2–38 thousand sp./m^3) from late May till early July, at a temperature of 12–26.8°C. The species disappears at a temperature between 22.8 and 26.8°C, depending on a mean temperature of a year. It inhabits the upper 20 m deep layer of water, being most abundant to 10 m.

The fecundity of *P. polyphemoides* is two to ten embryos per female; it is maximal in April (four–ten); in late June the number of embryos decreases to two–six. Small amounts of males and females with resting eggs occur in mid-June. The newly hatched specimen of *P. polyphemoides* has well developed eye and limbs, and weakly developed brood pouch (Onbe, 1974).

Observations of *P. polyphemoides* in the ports of the Mediterranean Sea and Chesapeake Bay show that it is relatively tolerant to pollution; under conditions of eutrophication it even increases in numbers (Mordukhai-Boltovskoi & Rivier, 1987; Rivier, 1998).

2. Genus ***Pseudevadne*** Claus, 1877

Type species: *Pseudevadne tergestina* Claus, 1877.

Body oval or triangular, with rounded apex. Shell narrowing to apex or inflated, depending on size of embryos and their number, as in members of genus *Evadne*. Shell with strongly pronounced crests of fornix, and with pigment cells of hypodermis

placed in 5–8 parallel rows. Exopod of limb 1 with 2 setae, exopods of limbs 2–3 with 3 setae. Setal formula 2.3.3.1. Cauda in shape of triangular outgrowths.

Pseudevadne tergestina Claus, 1877
(Pl. IV, figs. 1–10; VIII, figs. 1–4)

Claus, 1877: 142, tabl. 5, figs. 15, 16 (*Pseudevadne tergestina*); Cheng & Chen, 1966: 174, pl. 3; Yamazi, 1966: 193, pl. 88, fig. 6 (*Evadne tergestina*); Mordukhai-Boltovskoi, 1969: 21, pl. 2, fig. 3 (*Pleopis tergestina*); 1978: 523–528, fig. 2; Negrea; 1983: 348–351, fig. 144; Mordukhai-Boltovskoi & Rivier, 1987: 112–114, fig. 62; Rivier, 1998: 123–126, figs. 57–65 (*Pseudevadne tergestina*).

Description. Parthenogenetic female. Shell oval, inflated if embryos mature and even more inflated if embryos numerous. Nuchal depression poorly pronounced, in adult female with large shell almost not pronounced at all. With young cladocerans hatching and new eggs entering brood pouch, the latter gets smaller and becomes triangular (pl. IV, fig. 10). Shell provided with fornix at level of basipodites of thoracic limbs, partially covering basipodites. Five to eight rows of hypodermic cells seen as dark spots situated along shell, clearly visible when embryos small, but poorly expressed when embryos or resting eggs reach maturity.

Antennae small; 3-segmented branch with 1 short and 5 long setae; 4-segmented branch with 1 short and 6 long setae. Exopods well expressed on limbs 1–3 only; their setae longer than apical setae of exopods. Exopod of limb 4 in form of small tubercle with 1 seta. Setal formula of exopods 2.3.3.1. Maxillary processes well developed on limbs 2 and 3. Caudal claws triangular. Height 0.8–1.2 mm. Size of shell depends on number of embryos.

Gamogenetic female can be clearly identified only after fertilization. Resting egg seen as small dark spot near limbs 3 and intestine. It grows in ovary until fully nourished, then moves into brood pouch, where hard chitinous membranes form (pl. IV, fig. 2; VIII, fig. 4).

Lower surface of shell has opening and funnel-shaped indentation (*vagina*) with canal leading to brood pouch (Onbe, 1978b). Similar arrangement for reproduction present in all podonids (Rivier, 1968). Gamogenetic female often has two eggs, one in each ovary. Size of resting egg 190–240 μm (usually 200 μm) (Onbe, 1985).

Male has relatively large head and eye. Hook (transformed terminal seta) on limb 1 regularly rounded, situated at end of enlarged apical segment. Other apical setae in male thicker than in female. Testes somewhat protruding into empty transparent shell cavity; penes behind limbs 4. Height to 0.85 mm.

Distribution. *P. tergestina* inhabits the neritic zones of subtropical and tropical regions. Warm currents may transport it to the temperate zones of the Atlantic and Pacific oceans.

The species is common in the plankton of Peter the Great Bay in warm seasons. In the 1930s *P. tergestina* was abundant in Possjet Bay and south of it at a temperature of 25–26°C (Brodsky, 1981); in the 1960s it was not found in Possjet Bay (Kos, 1976, 1977). In some years the species can be brought far north by Tsushima Current, up to the South Sakhalin and the South Kuril Islands (Brodsky, 1959). It does not commonly occur near the middle and northern Primorye (from Olga Bay to Vladimir Bay); but in the summers of warm years (for example, in 1974) *P. tergestina* was distributed as

far as the Tatar Strait (Bokhan, 1984). The species is also transported by the warm Kuroshio Current to the north-eastern tip of Hokkaido Island and to the South Kuril Islands (Onbe et al., 1996).

Biology and ecology. *P. tergestina* is a warm-water species of the Peter the Great Bay fauna, appearing in the middle of summer hydrological season. In 1973 it appeared in Alekseev Bight in August at a temperature of 21.1°C and in September (at 17.9°C) reached maximum density (59 sp./m^3). As water got colder, the density of the species sharply decreased, but it still occurred sporadically until December (Mikulich & Biryulina, 1977).

In the south-western part of Peter the Great Bay small numbers of *P. tergestina* appear in late August, its density growing in September up to 141 sp./m^3 (Shkoldina & Shevchenko, 2001). In September of 1996 gamogenetic females with one-two developing resting eggs each were recorded in some regions of the bay at a surface water temperature of 17–19°C.

In Vostok Bay *P. tergestina* usually appears in mid-August when the water is warmest (22.4°C), reaching a density of 186 sp./m^3, which decreases to 3.3 sp./m^3 in September (Shkoldina, 2001). It occurs singly until late October, when water temperature is 13–14°C. At this period gamogenetic females with resting eggs are found, too.

The species' biology and ecology was intensively studied for the Inland Sea of Japan. Onbe's records (1974) show that this species appears among the plankton in latitude about 34°20′N in May or June, reaching maximum abundance in July-August and staying in the sea until September-October. Maximum density (8.7–9.4 thousand sp./m^3) is registered at a temperature of 22.3–23°C, but in September assemblages up to 30 thousand sp./m^3 were recorded. The bulk of the cladocerans inhabit the upper layer of water (10–15 m), concentrating at a depth of 3 m in July and nearer to the surface in August. At night the number of females with mature embryos is maximal, and before dawn the young hatch. The same patterns of reproduction were observed in the Caspian *Evadne* (Rivier, 1969). During a period of gamogenetic reproduction a population includes from 2.2 to 12.5% of males and up to 12.4% of females with resting eggs. Females with resting eggs are among the largest specimens in a population (Onbe, 1978b). Japanese scientists observed the hatching of a young *P. tergestina* from a resting egg (pl. VIII, fig. 1). The process begins, like in all the Polyphemoidea, when a rounded egg breaks up into 2 unequal halves; an embryo at this stage already has a well-pigmented eye. The size of a resting egg varies from 190 to 240 μm (average size is 200 μm). Resting eggs are found in sediments all the year round, their number is maximal (7.7 thousand eggs/m^2) in July, with the peak density of the cladocerans in the plankton about 3 thousand sp./m^3 (Onbe, 1985).

Among the contents of the foregut of *P. tergestina* large centric diatoms were found (Kim et al., 1989).

3. Genus ***Podon*** Lilljeborg, 1853

Type species: *Podon leuckarti* (Sars, 1862).

Shell in females rounded, in males small, having irregular shape. Head elongated, anteriorly globular, separated from shell by clearly seen depression. Antennal branches with well-developed apical segments; number of setae on 4-segmented and 3-segmented branches identical (6 setae). Exopods of thoracic limbs weakly devel-

oped, small, armed with 1–2 setae. Endopods relatively weakly armed. First segment of limb 1 bears 5 small setae, second, 4: two long apical ones and two short ones. Cauda in shape of two thin, long, tapering appendages, not pointed at ends, with rows of small setules.

Podon leuckarti (Sars, 1862)
(Pl. V, figs. 1–11)

Sars, 1862: 293 (*Pleopis leuckarti*); Lilljeborg, 1900: 636–639, tabl. 85, fig. 12, tabl. 86, figs. 1–3; Rammner, 1930: 4, figs. 7–8; Manuilova, 1964: 305, fig. 174; Yamazi, 1966: 191, pl. 88, fig. 1; Mordukhai-Boltovskoi, 1969: 22, pl. 3, fig. 1; Flössner, 1972: 392, abb. 184; Negrea, 1983: 344–345, fig. 142; Mordukhai-Boltovskoi & Rivier, 1987: 115–116, fig. 64; Rivier, 1998: 127–128, figs. 66–74 (*Podon leuckarti*).

Description. Parthenogenetic female. Depression between head and shell clearly expressed. Head relatively large; nuchal organ situated nearer to depression. Shell semispherical; if embryos numerous, shell inflated, globular. Swimming antennae well developed, segments have normal size. Each branch with 6 setae, attached identically on outer and inner branches. Thoracic limbs relatively weakly armed. Each exopod of limbs 1–3 with 1 seta; exopod of limb 4 with 2 setae. Setae of exopods thick, straight, and covered with spinules. Setal formula 1.1.1.2. First segment of endopod of limb 1 with 4 long curved setae; each endopod of limbs 2–4 with 4 apical setae, 2 of them thick and relatively short. Maxillary processes on limbs 2 and 3 robust, with sensory setae and 2–3 large spines. Mandible bears 1 large tooth with 2 lateral denticles and strongly ramified process, placed perpendicular to main plane of mandible. Cauda in shape of 2 long thickening outgrowths with rows of small denticles and setae. Length up to 0.9 mm, height up to 0.8 mm.

Gamogenetic female. Shell globular if brood pouch filled with eggs. Egg has somewhat irregular shape. During membrane forming hypodermic cells clearly visible. Length of body up to 0.75 mm, height up to 0.8 mm. Diameter of resting egg 210–230 μm (Onbe, 1985).

Male. Shell smaller than head. Eye larger than in female. Penes small, testes almost not protruding into shell cavity. Apical segment of limb 1 enlarged, provided with well-developed hook. Length up to 0.9 mm, height up to 0.8 mm.

Distribution. *P. leuckarti* is one of the most widely dispersed marine species of the Podonidae. It is distributed from the coasts of Greenland to the southern tip of America, from the Spitsbergen and Wrangel Islands to the Mediterranean and South China seas. In the Russian waters of the Far East it occurs in the coastal zone of the northern tip of Chukchi Peninsula up to the Gulf of Anadyr, and penetrates in the warmest belt along the Koryak coast to Olyutorsky Bay and to the south along the coast of Kamchatka and the Commander Islands (Vinogradov, 1956). It is distributed in the western part of the Bering Sea (Geinrich, 1961) and the northern part of the Sea of Japan (Kun, 1975); it is common in Peter the Great Bay (Kos, 1976, 1977; Brodsky, 1981; Mikulich & Biryulina, 1977). However, it is the least abundant species of the podonids in the Inland Sea of Japan (Onbe, 1985).

Biology and ecology. *P. leuckarti* is a temperate-cold water species. It appears in the northern part of its geographical range when water is warmest (the end of summer to autumn), and the farther south along the range the earlier it appears. It occurs in the

plankton of the north-western part of the Sea of Japan and the Inland Sea of Japan from early spring till early summer. Records from the Chukchi, Bering and Japan seas testify that *P. leuckarti* is a neritic, eurythermal, and euryhaline species with a temperature range from 4 to 21˚C and a salinity range from 4 to 34‰ (average seawater salinity) (Kos, 1977).

In the western part of Peter the Great Bay (Alekseev Bight of Amursky Bay) the first appearance of *P. leuckarti* was recorded for April, when temperature rose above zero; in June the density was maximal, and in August, when water temperature reached 21˚C, the species disappeared (Mikulich & Biryulina, 1977).

In the south-western part of Peter the Great Bay *P. leuckarti* is also found only till August. In mid-July, when water temperature varied from 14 to 17˚C, the species generally occurred in bights and adjacent areas, with a mean density of 500 sp./m^3 (Shkoldina & Shevchenko, 2001). Sporadic occurrences were recorded from the open part of the Bay, and only for the cold near-bottom water layer.

In Vostok Bay *P. leuckarti* appears in early June at a water temperature of 12–13˚C, but by the end of June and later, at a temperature above 20˚C, it is not found (Shkoldina, 2001, 2002).

Seasonal dynamics of *P. leuckarti* is studied thoroughly for the Inland Sea of Japan (Onbe, 1974). The species appears there in early May, reaches maximum density in late June, and disappears in August. Other evidence (1974–1977) point out that the species is present in the plankton from February-March till June (Onbe, 1985), and its abundance is not more than 0.6–0.7 thousand sp./m^3.

Near the eastern coast of Hokkaido Island (43˚N, south of Sakhalin Island) *P. leuckarti* dominated among the podonids in mid-October. Parthenogenetic females comprised from 36 to 52.4% of all females in the population; gamogenetic females comprised from 39.8 to 52.8%. Most females had one resting egg; only one female had two eggs. Observations showed that in the daytime these cladocerans near the bottom or the surface may gather into assemblages, dissipating at night. Females with resting eggs mostly accumulate near the bottom and don't rise up to the surface, thus protecting themselves from predators (Saito & Hattori, 2000).

Among the contents of the intestine of *P. leuckarti* mostly centric diatoms including *Skeletonema costatum* were found (Kim et al., 1989).

4. Genus ***Evadne*** Loven, 1836

Type species: *Evadne nordmanni* Loven, 1836.

Shell elongated, with pointed apex. Head not clearly separated from shell. Nuchal organ situated on top of head. Branches of swimming antennae with 6 setae. Thoracic limbs biramous, with relatively long exopods. Each exopod of limbs 1–2 bears two setae; each exopod of limbs 3–4 bears one seta. Exopod of limb 1 equal in length to first segment of endopod. Cauda in shape of 2 conical pointed outgrowths.

KEY TO THE SPECIES OF THE GENUS EVADNE

1 (2). Exopod of limb 3 has 2 setae. Apex of shell produced into pointed peak .....
..... *1.* ***E. spinifera*** (p. 22)

2 (1). Exopod of limb 3 with one seta. Apex of shell pointed, but without peak .....
.....*2. **E. nordmanni*** (p. 23)

Evadne spinifera P.E. Müller, 1867
(Pl. VI, figs. 1–8)

Müller, 1867: 225, tabl. 6, figs. 11–12; Claus, 1877, tabl. 6, fig. 21; Lilljeborg, 1900: 647–649, tabl. 86, fig. 18; tabl, 87, figs. 1–3; Rammner, 1930: 5, figs. 11, 12; Dolgopolskaya, 1958: 51–56, figs. 18–21; Manuilova, 1964: 308, fig. 177; Yamazi, 1966: 192, pl. 88, fig. 4; Flössner, 1972: 400–401, abb. 188; Negrea, 1983: 353, fig. 146; Mordukhai-Boltovskoi & Rivier, 1987: 122, fig. 71; Rivier, 1998: 135, figs. 93–100 (*Evadne spinifera*).

Description. Parthenogenetic female. Body ovoid; no nuchal depression; head fused with shell, produced into pointed peak. Swimming antennae weakly developed; segments almost square. Apical segments on both branches more than twice shorter and thinner than preceding segments; each branch with 6 long, soft, plumose setae. Exopods of limbs 1–3 with 2 setae; setal formula 2.2.2.1. Mandible with one large tooth and 2 horn-shaped processes. Maxillary processes well developed on limbs 2 and 3. Length 0.6–0.8 mm, height 1.3–1.4 mm.

Male somewhat smaller than female, with large eye, characteristic for podonids, with narrower than in female shell having long pointed peak. Penes not protruding past limb 4; testes clearly visible in empty shell cavity. Apical segment of limb 1 with large, well-developed hook. Height 1.05–1.3 mm.

Distribution. *E. spinifera* is distributed in all the oceans, excluding polar seas, also in inland seas like the Baltic, the Mediterranean, and the Black. It rarer occurs in equatorial waters compared to temperate waters. *E. spinifera* does not penetrate the Okhotsk and Bering seas and is not common for the Sea of Japan, where it is the least abundant form among all the podonids of the Far East seas. Numerous works of Japanese scientists do not register this species for the Inland Sea of Japan.

Kos (1976, 1977) and Brodsky (1981), who made detailed research of the zooplankton of Possjet Bay, do not mention *E. spinifera* for this region, but it was found in 1989–1990 in the south-western part of Peter the Great Bay (Shkoldina & Pogodin, 1999, Shkoldina et al., 2004). The species occurs south of the Kuril Islands (40°N), where the warm Kuroshio Current flows (Brodsky, 1955). It is one of the subtropical species of Peter the Great Bay, the subtropical and tropical groups of species being two most important zoogeographical groups of the bay. *E. spinifera* does not occur in the neritic zones of the middle and northern coastal waters of Primorye (Kos, 1960).

The occurrence of warm-water species of the podonids, including *E. spinifera*, depends on the effect of warm waters moved by the considerably meandering Kuroshio Current. When the current veers from the coast, warm-water species disappear from Possjet and Peter the Great bays (Kos, 1969). The Kuroshio can transport *E. spinifera* as far as the north-eastern coast of Honshu Island (Onbe et al., 1996).

Biology and ecology. *E. spinifera* is a relatively poorly studied species. In the southern part of the Sea of Japan (Toyama Bay), where investigations were conducted from February 1990 to January 1991, maximum density of *E. spinifera* was recorded for July. In September these cladocerans were distributed vertically to a depth of 30 m at night and in the daytime migrated to the surface (Onbe & Ikeda, 1995).

Evadne nordmanni Loven, 1836
(Pl. VII, figs. 1–10)

Loven, 1836: 1, tabl. 1–2, figs. 1–16; Müller, 1867: 222, tabl. 6, figs. 8–10; Lilljeborg, 1900: 647, tabl. 86, figs. 4–17; Rammner, 1930: 5, figs. 9, 10; Dolgopolskaya, 1958: 46–50, figs. 14–16; Manuilova, 1964: 307–308, fig. 176; Cheng & Chen, 1966: 174, pl. 2; Yamazi, 1966: 192–193, pl. 88, fig. 5; Mordukhai-Boltovskoi, 1969: 23, pl. III, fig. 4; Flössner, 1972: 398–400, abb. 187; Onbe, 1974: 90–92, fig. 6, A; Negrea, 1983: 351–355, fig. 146; Mordukhai-Boltovskoi & Rivier, 1987: 123–125, fig. 78; Rivier, 1998: 135–136, figs. 101–109 (*Evadne nordmanni*).

Description. Parthenogenetic female. Shell elongated, with pointed apex, in old specimens with many embryos, oval, with rounded outline. Swimming antennae small, with decreased apical segments. Head not separated from shell. Exopod of limb 1 almost equal in length to second segment of endopod; exopods of limbs 2–3 small. Each exopod of limbs 1–2 with two setae, each exopod of limbs 3 with one seta; setal formula 2.2.1.1. Maxillary process well developed on limbs 2 and 3. Apical setae on endopod of limb 1 long, on endopod of limbs 2 and 3 short and claw-like. Cauda in shape of 2 conical pointed outgrowths. Length 0.6–0.7 mm, height up to 1.2–1.4 mm.

Gamogenetic female generally has one resting egg. Females with resting eggs almost largest specimens in population.

Male. Shell almost triangular. Testes protruded into shell cavity, clearly visible. Hooks on limb 1 thin, not pointed. Length 0.5–0.65 mm, height 0.7–0.8 mm.

Distribution. *E. nordmanni* is distributed in cold and temperate waters. It occurs in the open seas of the Arctic, Pacific, and the Atlantic oceans (excluding the tropical zones of the Pacific and the Atlantic); in the inland seas, namely the White, Baltic, Mediterranean, Black seas, and the Inland Sea of Japan (Rivier, 1998); as well as in the Far East seas (Kun, 1975).

In the north-western Pacific, the northernmost record of *E. nordmanni* is from the south of the Bering Sea, near Africa Cape (Vinogradov, 1956), whereas *Podon leuckarti* is distributed farther north. In the western part of the Bering Sea *E. nordmanni* occurs in the plankton at the beginning of autumn (September and October), when the water is warmest (Geinrich, 1961). In the Sea of Okhotsk the species can breed in the coastal zone around the whole periphery of the sea (Lubny-Gertsyk, 1959). Near the southern tip of Sakhalin Island *E. nordmanni* inhabits Aniva Bay and penetrates into the Sea of Japan via the La Perouse Strait (Ponomareva, 1961). It is a common species for the north-western part of the Sea of Japan, occurring in all bights and bays, including Peter the Great Bay (Kos, 1960; Shkoldina, 2001, 2002).

Cold currents bring *E. nordmanni* to the southern part of the Sea of Japan, along the coast of Korea. The farther south, the earlier (mid-spring to early spring) *E. nordmanni* appears in the plankton (Kim, 1985; Yoo & Kim, 1987; Onbe et al., 1996). The species also occurs near China (Jian Dong, 1991).

Biology and ecology. *E. nordmanni* is a temperate-cold water species. Its range is extended in north-south direction, and the periods of occurrence of this species in the plankton depend on the latitude and are regulated by the same mechanisms as in *Podon leuckarti*. In the Sea of Okhotsk and the Bering Sea *E. nordmanni* appears in late summer or in autumn (Vinogradov, 1956). In the Tatar Strait (49°–51°30′N) the appearance of all the podonid species depends on the extent of the warming up of the

water from year to year. For example, in cold years (1975) only *E. nordmanni* and *Podon leuckarti* were found in this area (Bokhan, 1984).

In the southernmost part of the Russian Far East waters (Peter the Great Bay) *E. nordmanni* appears in spring and reaches maximum density in early summer and in autumn. Thus, in Amursky Bay (Alekseev Bight of Popov Island) the species occurred in the plankton May through January and had two peaks of density, from mid-June to mid-July and from mid-October to mid-November. First specimens were recorded in May at a water temperature of 5°C, in June at an average temperature of 13.2°C the density was 230 sp./m^3, and in autumn, when temperature ranged from 9 to 3°C, a population maximum of 162 sp./m^3 was recorded (Mikulich & Biryulina, 1977).

Chuchukalo et al. (1980) show that *E. nordmanni* appeared in Amursky Bay (near Reineke Island) in early June at a water temperature of 11–13°C, and in July (at 21°C) the density already attained 7 thousand sp./m^3. Temperature rising to 21–22.3°C July through late August, *E. nordmanni* decreased in numbers to 0.5 thousand sp./m^3. In late autumn (November) at a temperature of 7.1°C the abundance of the species slightly enhanced (Chuchukalo et al., 1980).

In the south-western part of Peter the Great Bay *E. nordmanni* is vertically distributed from 0 to 50 m. Its peak density was recorded for July (in Kalevala Bight, 3.5 thousand sp./m^3); in August, when temperature was the warmest (21°C), the density sharply decreased; and in September rose again (Shkoldina & Shevchenko, 2001). Kos' records (1976) display that in mid-summer (late June–early July) the density of *E. nordmanni* was low (5–25 sp./m^3) in Possjet Bay at a temperature of 17–20°C. In this bay the species was found at a temperature of 6.6–21°C and a salinity of 26.31–33.17‰. A maximum density of *E. nordmanni* (260 sp./m^3) was registered at offshore stations (Kos, 1977).

In the south-western part of Peter the Great Bay gamogenetic females with latent eggs were recorded for July and September, and were not found in August. It may indicate that *E. nordmanni* has two reproduction cycles in the southern part of its distributional range. In 2002 in Vostok Bay *E. nordmanni* occurred in the plankton until late October, at a temperature of 12–13°C, and females with well-developed resting eggs constituted the bulk of the population.

The biology and ecology of *E. nordmanni* are most extensively studied for the Inland Sea of Japan (34°N). In this area the species appears in March-April and disappears in June; it attains a maximum density of 2.7–3.4 thousand sp./m^3 at 15–16°C. *E. nordmanni* appears in the plankton at a temperature from 8 to 11°C and disappears at a temperature from 21.4 to 23.8°C (Onbe, 1974). In March and April females have the largest size (length up to 0.55–0.6 mm) and highest fecundity (up to 10–12 embryos). Males and gamogenetic females appear in the population in mid-June, and by the end of the month parthenogenetic females almost disappear (Onbe, 1974). Resting eggs are light brown and have a size of about 200 μm (Onbe, 1985).

The analysis of the intestine's content showed that *E. nordmanni* feeds on large centric diatoms, particularly *Skeletonema costatum*. On other evidence, the podonids may also consume dinoflagellates (Kim et al., 1989).

References

An illustrated guide to marine plankton in Japan. 1997 / M. Chihara, M. Murano (eds.). Tokyo: Tokai University Press. 1576 p. (Order Cladocera. P. 609–624, pl. 1–9).

Biryulin, G.M., Biryulina, N.G., Mikulich, L.V. & L.P. Yakunin. 1970. Summer changes in the waters of Peter the Great Bay // Trudy DVNIGMI. N 30 (Okeanografiya i Morskaya Meteorologiya). P. 286–299. (In Russian).

Bokhan, L.I. 1984. Interannual changes in the mesoplankton of the northern Sea of Japan // Izvestiya TINRO. V. 109. P. 86–93. (In Russian).

Bowman, T.E. & L.G. Abele. 1982. Classification of the recent Crustacea // The Biology of Crustacea. V. 1. Systematics, the Fossil Record, and Biogeography / L.G. Abele (ed.). N.Y.: Academic Press. P. 1–27.

Brodsky, K.A. 1955. Plancton of the north-western Kuroshio and the Kurile region of the Pacific Ocean // Trudy Instituta Okeanologii. V. 18. P. 124–134. (In Russian).

Brodsky, K.A. 1959. Marine zooplankton of the South Sakhalin and the South Kuril Islands // Issledovaniya Dalnevostochnykh Morei SSSR. V. 6. P. 5–46. (In Russian).

Brodsky, K.A. 1981. Changes in species composition of copepods and cladocerans in Possiet and Amur Bays (Sea of Japan) in connection with temperature fluctuations of many years // Biologiya Morya. N 5. P. 21–27. (In Russian).

Claus, C. 1877. Zur Kenntnis des feineren Baues und der Organisation der Polyphemiden // Denkschr. K. Akad. Wiss., Wien. Bd 37. S. 137–160.

Cheng, S.C. & S.L. Chen. 1966. Studies on the marine Cladocera of China. I. Taxonomy // Oceanol. Limnol., Sinica. V. 8, N 2. P. 168–179.

Chuchukalo, V.I., Prahova, N.V. & A.M. Slabinsky. 1980. Results of the studies on plankton in some bights of Peter the Great Bay (annual report on the programme "Food resources for commercially important species of the Pacific Ocean"). N 76080592. Vladivostok: TINRO. 26 p. (The copy of the scientific report. Moscow: VNTITs. 1985) (In Russian).

Dana, J. 1849. Conspectus Crustaceorum in Orbis Terrarum circumnavigatione Carolo Wilkese Classe Republicae Foederatae Duce, lexit et descripsit // Am. J. Sci. Arts. Ser. 2. V. 8, N 23. P. 9–61.

Dana, J. 1853. Crustacea. Part. II. Daphniidea // U. S. expl. exped. during the years 1838–1842. P. 1262–1277.

Della Croce, N. & S. Bettanin. 1965. Sviluppo embrionale della forma partenogenetica di *Penilia avirostris* Dana // Cahiers Biol. Marine. V. 6. P. 269–275.

Dumont, H.J. & S.V. Negrea. 2002. Branchiopoda. Leiden: Backhuys Publ. 398 p.

Egborge, A.B.M., Onwudinjo, C.C. & P.C. Chigbu. 1994. Cladocera of coastal rivers of Western Nigeria // Hydrobiologia. V. 272. N 1–3. P. 39–46.

Flössner, D. 1972. Überfamilie Polyphemiodea (Onychopoda) // Branchiopoda, Branchiura. Jena. S. 386–407.

Geinrich, A.K. 1961. Seasonal occurrences in the plankton of the World Ocean // Trudy Instituta Okeanologii. V. 51. P. 58–81. (In Russian).

Goswami, S.C. & V.P. Devassy. 1991. Seasonal fluctuations in the occurrence of Cladocera in the Mandovi Zuari estuarine waters of Goa // Indian J. Mar. Sci. V. 20, N 20. P. 138–142.

Jian Dong. 1991. The Cladocera in the Dalian Bay // Mar. Sci., Haiyang Kexue. Qingdao N 5. P. 65–67.

Kim, S.W. 1985. Distribution of marine cladocerans in Jinhae Bay, Korea // Bull. Mar. Sci. V. 37, N 2. P. 768.

Kim, S.W. & T. Onbe. 1989a. Observation on the biology of the marine cladoceran *Podon schmackeri* // J. Crust. Biol. V. 9, N 1. P. 54–59.

Kim, S.W. & T. Onbe. 1989b. Distribution and zoogeography of marine cladoceran *Podon schmackeri* in the northwestern Pacific // Mar. Biol. V. 102. P. 203–210.

Kim, S.W., Onbe, T. & *Y.H. Yoon.* 1989. Feeding habits of marine cladocerans in the Inland Sea of Japan // Mar. Biol. V. 100. P. 313–318.

Korovchinsky, N.M. 2004. World Cladocera of the order Ctenopoda (morphology, systematics, ecology, and zoogeography) // Moscow: KMK Press. 410 p. (In Russian).

Kos, M.S. 1960. Copepoda and Cladocera of neritic plancton in the Marine Provinces and South-Kuril Isles // Zool. Zhurnal. V. 39, N 5. P. 655–661. (In Russian).

Kos, M.S. 1969. Decline of warm-water species role in the plankton of Possjet Bay (Sea of Japan) // Doklady Akademii Nauk. V. 184, N 4. P. 951–955. (In Russian).

Kos, M.S. 1974. Neritic zooplankton of the north-western Sea of Japan and of the Kuril-Sakhalin region // Gidrobiologiya i Biogeografiya Shelfov Kholodnykh i Umerennykh Vod Mirovogo Okeana: Abstracts of Scientific Reports. Leningrad, November 18–21, 1974. Leningrad: Nauka. P. 53–55. (In Russian).

Kos, M.S. 1976. Zooplankton of Possjet Bay // Pribrezhnyie Soobschestva Dalnevostochnykh Morei. Vladivostok: Institut Biologii Morya. P. 64–93. (In Russian).

Kos, M.S. 1977. Seasonal changes in composition, structure and distribution of zooplancton of Posjet Bay (Sea of Japan) // Issledovaniya Fauny Morei. V. 19 (27). P. 29–56. (In Russian).

Kun, M.S. 1975. Zooplankton of the Far East seas. Moscow: Pischevaya Promyshlennost. 147 p. (In Russian).

Kun, M.S. & I.M. Meshcheryakova. 1954. Distribution of the types of zooplankton in the Sea of Japan // Izvestiya TINRO. V. 39. P. 358–360. (In Russian).

Leuckart, R. 1859. Über das Vorkommen eines saugnapfartigen Haf tapparates bei den Daphniaden und verwandten Krebsen // Arch. Naturgesch. Bd 1, Hf. 25. S. 262–265.

Lilljeborg, W. 1900. Cladocera Sueciae // Nova Acta R. Soc. Sci. Upsaliensis. Ser. 2. V. 19. S. 1–701.

Loven, S. 1836. *Evadne nordmanni*, ett hittils okandt Entomostracon // Kongl. Vetenskaps. Akademiens Hande. f. ar. S. 1–73.

Lubny-Gertsyk, E.A. 1959. Composition and distribution of zooplankton of the Sea of Okhotsk // Trudy Instituta Okeanologii. V. 30. P. 68–98. (In Russian).

Manuilova, E.F. 1964. Cladocera of the USSR fauna (Opredeliteli po Faune SSSR, Zoological Institute, V. 88). Moscow; Leningrad: Nauka. 326 p. (In Russian).

Meshcheryakova, I.M. 1960. Seasonal changes in plankton of the open part of the Sea of Japan // Izvestiya TINRO. V. 46. P. 95–144. (In Russian).

Miklukhina, A.P. 1967. Some research data on the plankton of the Northwestern Pacific // Izvestiya TINRO. V. 61. P. 21–40. (In Russian).

Mikulich, L.V. & N.G. Biryulina. 1977. Plankton of Alekseev Bight (Peter the Great Bay) // Issledovaniya Okeanologicheskikh Polei Indiiskogo i Tikhogo Okeanov. Vladivostok: DVNTs SSSR. P. 103–136. (In Russian).

Mordukhai-Boltovskoi, F.D. 1968. On the taxonomy of the Polyphemoidae // Crustaceana. Leiden. V. 14, pt 2. P. 197–209.
Mordukhai-Boltovskoi, F.D. 1969. Order Cladocera // Opredelitel Fauny Chernogo i Azovskogo Morei. Kiev. P. 8–31. (In Russian).
Mordukhai-Boltovskoi, F.D. 1978. A contribution to the taxonomy of marine Podonidae (Cladocera) // Zool. Zhurnal. V. 57, N 4. P. 523–529. (In Russian).
Mordukhai-Boltovskoi, F.D. & I.K. Rivier. 1987. Predatory Cladocera of the world fauna. Leningrad: Nauka. 182 p. (In Russian).
Müller, P.E. 1867. Danmark Cladocera // Schiödtes Naturhist. Tidskr. Bd 3, N 5. S. 53–240.
Mullin, M.M. & T. Onbe. 1992. Diel reproduction and vertical distributions of the marine cladocerans, *Evadne tergestina* and *Penilia avirostris*, in contrasting coastal environments // J. Plankton Res. V. 14, N 1. P. 41–59.
Negrea, S. 1983. Fauna Republicii socialiste România. Crustacea. V. 4, Fasc. 12. Cladocera. Bucurest. P. 90–92, 341–355.
Onbe, T. 1973. Preliminary notes on the biology of the resting eggs of marine cladocerans // Bull. Plankton Soc. Japan. V. 20, N 1. P. 74–77.
Onbe, T. 1974. Studies on the ecology of marine Cladocerans // J. Fac. Fisch. Anim. Husb. Fukuyama Univ. V. 13, N 1. P. 84–179.
Onbe, T. 1978a. The life cycle of marine cladocerans // Bull. Plankton Soc. Japan. V. 25, N 1. P. 41–54.
Onbe, T. 1978b. Gamogenetic forms of *Evadne tergestina* Claus (Branchiopoda, Cladocera) of the Inland Sea of Japan // J. Fish. Husb. Hirosima Univ. V. 17, N 1. P. 43–52.
Onbe, T. 1983. Preliminary observations on the marine cladoceran *Pleopis ("Podon") schmackeri* (Poppe) // J. Fac. Appl. Biol. Sci. V. 22, N 1. P. 55–64.
Onbe, T. 1985. Seasonal fluctuations in the abundance of populations of marine cladocerans and their resting eggs in the Inland Sea of Japan // Mar. Biol. V. 87. P. 83–88.
Onbe, T. 1991. Some aspects of biology of resting eggs of marine cladocerans // Crustacean egg production. Crust. Iss. V. 7. P. 41–56.
Onbe, T. & *T. Ikeda.* 1995. Marine cladocerans in Toyama Bay, southern Japan Sea: seasonal occurrence and day-night vertical distributions // J. Plankton Res. V. 17, N 3. P. 595–609.
Onbe, T., Terazaki, M. & S. Nagasawa. 1996. Summer distribution of marine cladocerans in Otsuchi Bay, northeastern Honshu, Japan // Bull. Plankton Soc. Japan. V. 43, N 2. P. 121–131.
Ponomareva, L.A. 1961. Zooplankton of Aniva Bay // Trudy Instituta Okeanologii. V. 51. P. 103–111. (In Russian).
Poppe, S.A. 1889. Ein neuer *Podon* aus China nebst Bemerkungen zur Synonymie der bekannten podon // Arten. Adhandl. Naturwis. Vereinsin Bremen. Bd 10. S. 295–300.
Rammner, W. 1930. Phyllopoda. Tierwelt der Nord-u-Ostsee. Leipzig. Tiel. 10. S. 1–31.
Rivier, I.K. 1968. On reproduction of the Polyphemoidae (Podonidae) of the Caspian Sea // Biologiya i Troficheskiye Svyazi Presnovodnykh Bespozvonochnykh i Ryb. N 17 (20). P. 58–69. (In Russian).
Rivier, I.K. 1969. Diel rhythms in reproduction of the Polyphemoidae of the Caspian Sea // Fiziologiya Vodnykh Organizmov i Ih Rol v Krugovorote Organicheskogo Veschestva. N 19 (22). P. 128–136. (In Russian).

Rivier, I.K. 1998. The predatory Cladocera (Onychopoda: Podonidae, Polyphemidae, Cercopagidae) and Leptodoridae of the world. Leiden. 214 p.

Saito, H. & H. Hattori. 2000. Diel vertical migration of the marine Cladoceran *Podon leuckarti*: variations with reproductive stage // J. Oceanol. V. 56. P. 153–160.

Sars, G.O. 1862. Hr. studios. medic. G.O. Sars fortsatte sit foredrag over de af ham i omegnen af Christiania iagttagne Crustacea, Cladocera // Forhandl. Vidensk.-Selsk. Christiania (1861). P. 250–302.

Shkoldina, L.S. 2001. On the zooplankton of the Zaliv Vostok marine refuge // V Dalnevostochnaya Konferentsiya po Zapovednomu Delu, Posvyaschennaya 80–letiyu so Dnya Rozhdeniya Akademika RAN A.V. Zhirmunskogo. Vladivostok, October 12–15, 2001: Materialy Konferentsii. Vladivostok: Dalnauka. P. 317–318. (In Russian).

Shkoldina, L.S. 2002. Description of zooplankton of the bights of the Vostok Bay west coast (Peter the Great Bay, Sea of Japan) at the beginning of summer // Ekologicheskie, Gumanitarnye I Sportivnye Aspekty Podvodnoi Deyatelnosti. Materialy Naychno-Prakticheskoi Konferentsii / Eds. V.I. Suslyaev, V.I. Goncharov. Tomsk: Izd-vo Tomskogo Universiteta. P. 123–134. (In Russian).

Shkoldina, L.S. & A.G. Pogodin. 1999. Composition of plankton and bioindication of waters in the south-western Peter the Great Bay, Sea of Japan // Biologiya Morya. V. 25, N 2. P. 178–180. (In Russian).

Shkoldina, L.S. & A.G. Pogodin. 2001. On the inventory of the zooplankton of the Far Eastern State Marine Reserve // V Dalnevostochnaya Konferentsiya po Zapovednomu Delu, Posvyaschennaya 80-letiyu so Dnya Rozhdeniya Akademika RAN A.V. Zhirmunskogo. Vladivostok, October 12–15, 2001: Materialy Konferentsii. Vladivostok: Dalnauka. P. 319–320. (In Russian).

Shkoldina, L.S., Pogodin, A.G. & V.I. Lapshina. 2004. Plankton. Composition of zooplankton // Dalnevostochny Morskoy Biosfernyi Zapovednik. V. 2. Biota / Ed. A.N. Tyurin. Vladivostok: Dalnauka. P. 637–648. (In Russian)

Shkoldina, L.S. & O.G. Shevchenko. 2001. The summer plankton of Sivuchya and Kalevala Bights (Peter the Great Bay, Sea of Japan) // Oceanography of the Japan Sea: Proc. CREAMS' 2000 Internat. Symp. Vladivostok: Dalnauka. P. 245–254.

Swammerdam, J. 1685. Histoire générale des Insectes. Ou l'on expose clairement la manière lente & presqu'insensible de l'accroissement de leurs membres, & ou l'on découvre évidemment l'erreur ou l'on tombe d'ordinaire au sujet de leur prétendue transformation. Utrecht, Jean Ribbius. pet. in-4, (8), 215, (1 bl), (2) p., 1 tabl., 13 pl.

Tang, K.W., Chen, Q.C. & C.K. Wong. 1995. Distribution and biology of marine cladocerans in the coastal waters of southern China // Hydrobiologia. V. 307, N 1–3. P. 99–107.

Turner, J.T., Tester, P.A. & R.L. Ferguson. 1988. The marine cladoceran *Penilia avirostris* and the "microbial loop" of pelagic food webs // Limnol. Oceanogr. V. 33. P. 245–255.

Vinogradov, M.E. 1956. Distribution of zooplankton in the western part of the Bering Sea // Trudy Vsesoyuznogo Gidrobiologicheskogo Obschestva. V. 7. P. 173–203. (In Russian).

Yamazi, I. 1966. Illustrations of marine plankton of Japan. Osaka: Hoikusha. 369 p.

Yoo, K. & S. Kim. 1987. Seasonal distribution of marine cladocerans of Chinhae Bay, Korea // J. Oceanol. Soc. Korea. V. 22, N 2. P. 80–86.

Yoo, K. & S. Kim. 1990. Seasonal change in the reproductive pattern of the marine cladoceran *Podon polyphemoides* in Korean waters // Bull. Korean Fish. Soc. V. 23, N 2. P. 141–144.

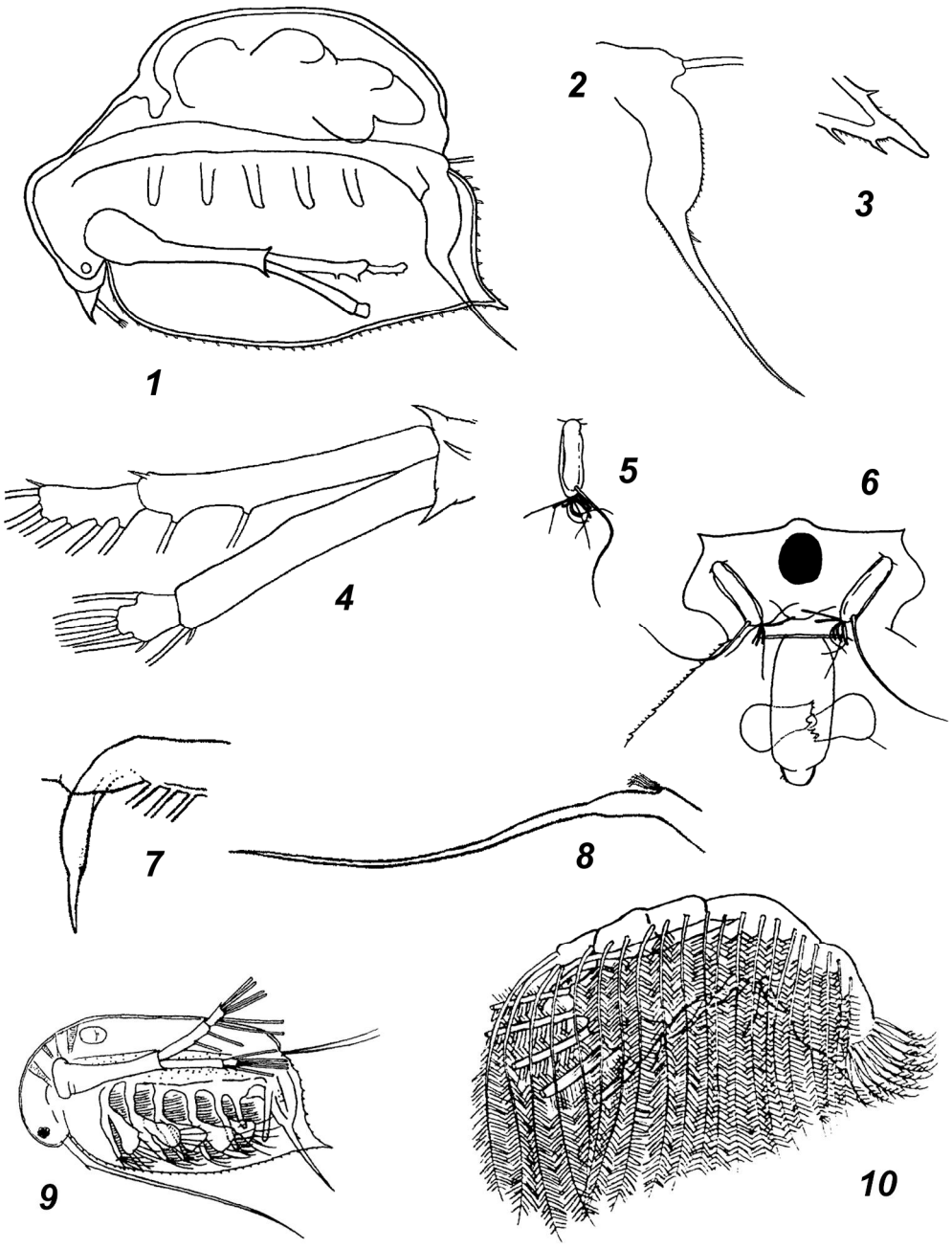


Plate I. *Penilia avirostris* (1–4 – original figs.; 7, 8 – from Negrea, 1983; 5, 6, 9, 10 – from An illustrated guide…, 1997): 1 – parthenogenetic female, lateral view; 2 – postabdomen, lateral view; 3 – female: posterior lower corner of valve; 4 – female: antenna; 5 – female: antennule; 6 – female: head, frontal view; 7 – male: hook on thoracic limb (P1); 8 – male: antenna; 9 – male, lateral view; 10 – thoracic limb

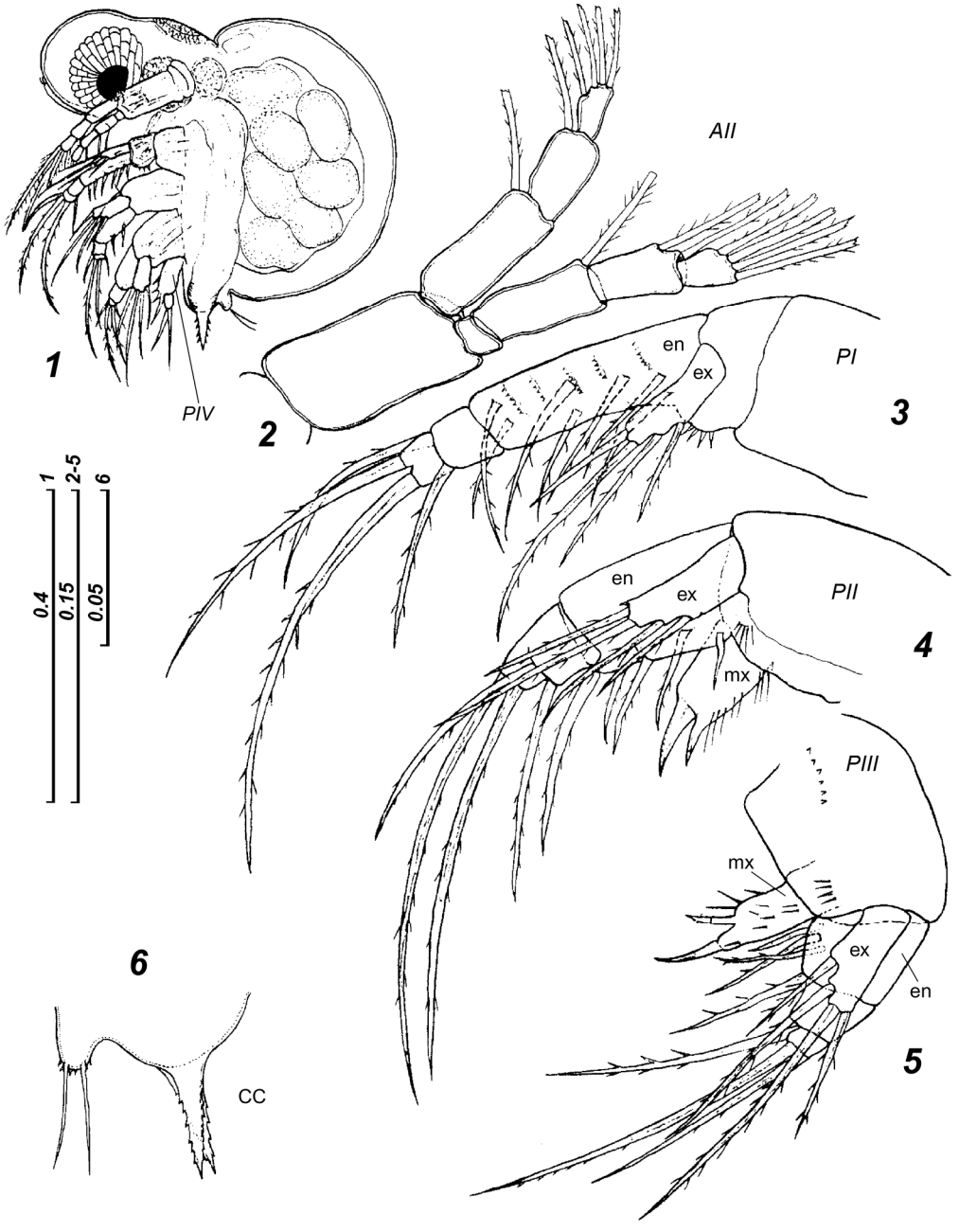


Plate II. *Pleopis schmackeri*: 1 – parthenogenetic female; 2 – antenna (AII); 3–5 – thoracic limbs (P1–P3); 6 – postabdomen; caudal claws (CC) and setae natatoriae; ex – exopod, en – endopod, mx – maxillary process

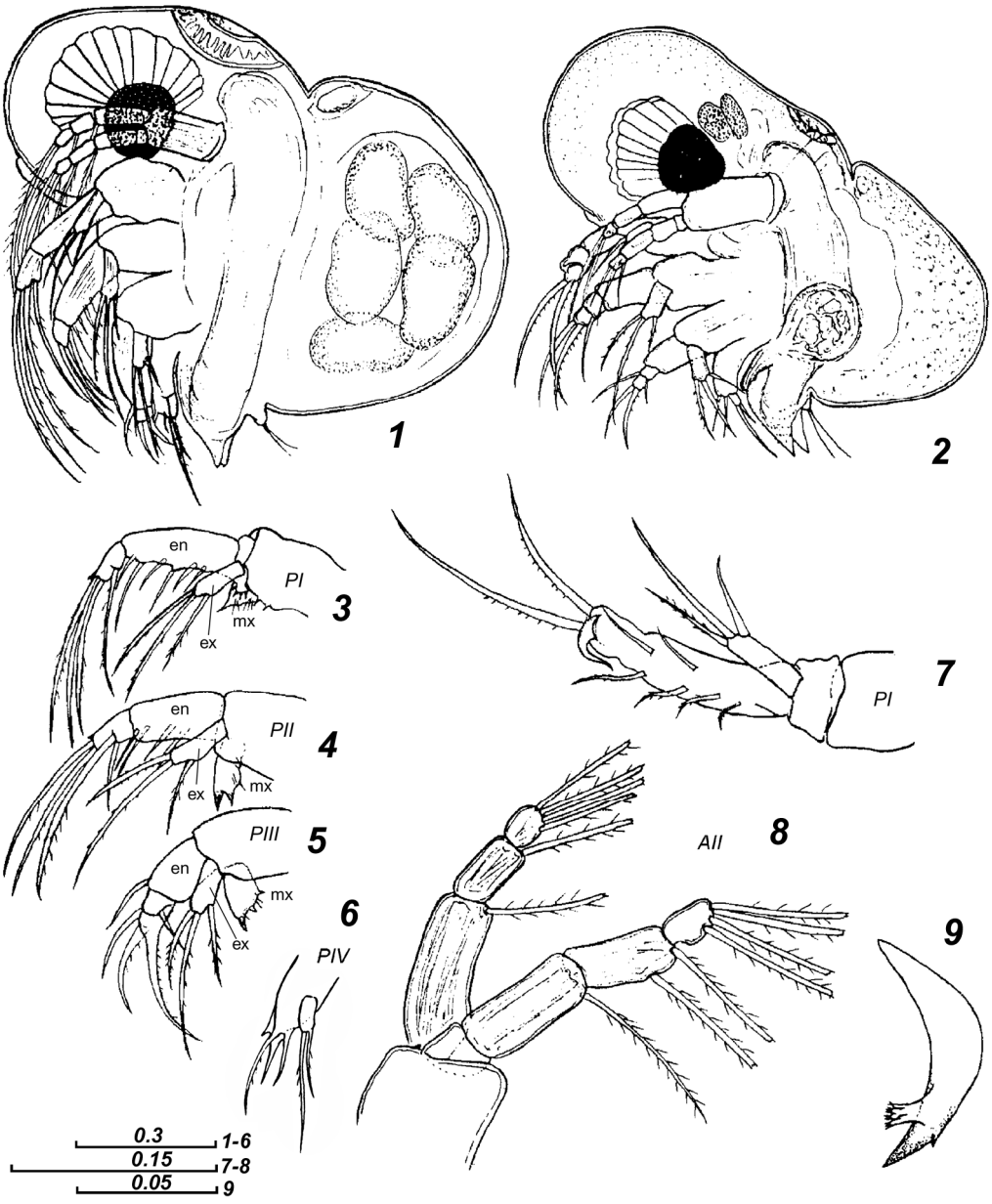


Plate III. *Pleopis polyphemoides*: 1 – parthenogenetic female; 2 – male; 3–6 – thoracic limbs; 7 – limb 1 of male; 8 – antenna; 9 – mandible. Abbreviations like in plate II

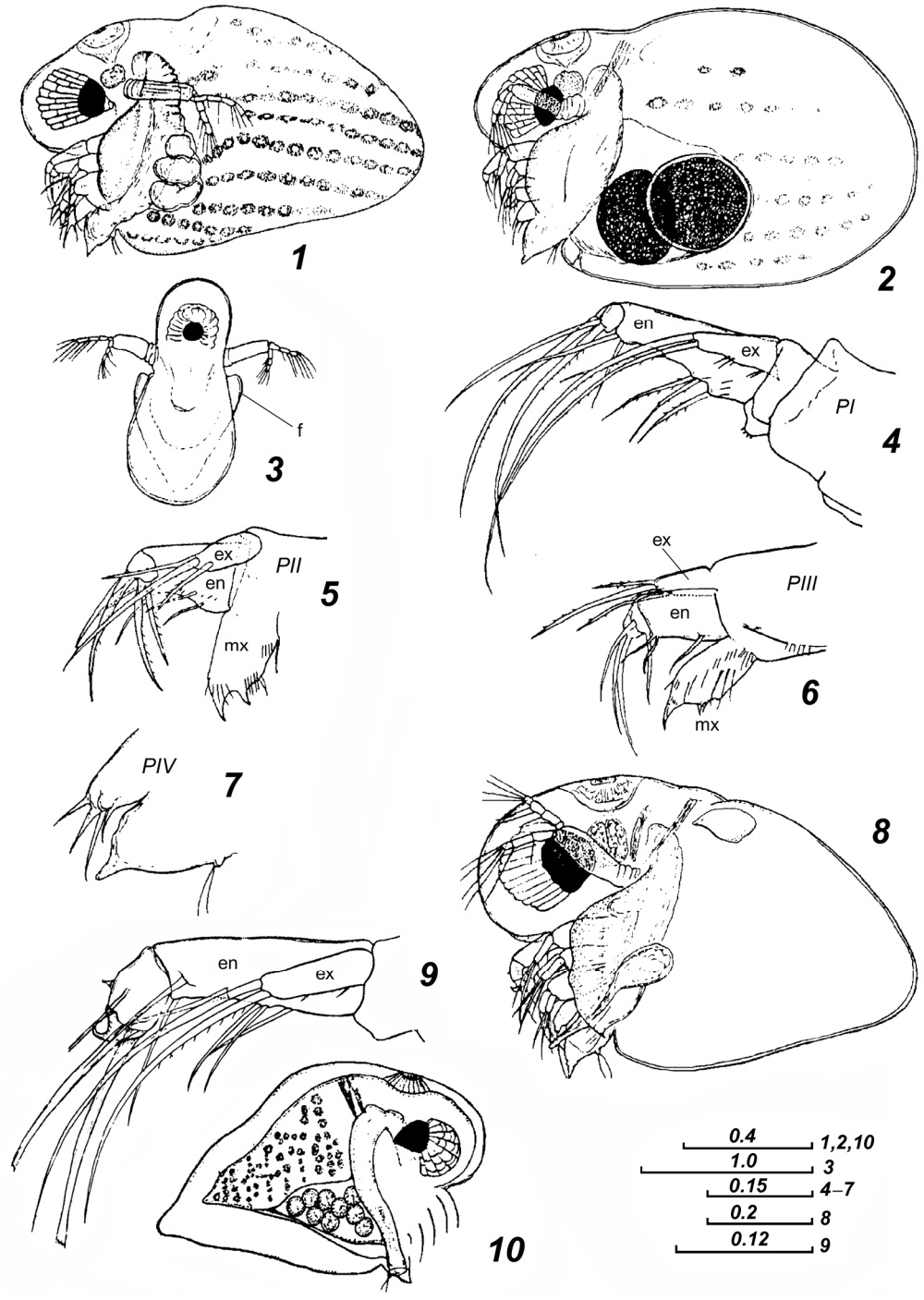


Plate IV. *Pseudevadne tergestina*: 1 – parthenogenetic female; 2 – gamogenetic female with mature resting eggs; 3 – female, dorsal view; 4–7 – thoracic limbs; 8 – male; 9 – limb 1 of male; 10 – parthenogenetic female just after molting and breeding (brood pouch contains new eggs); f – fornix. Other abbreviations like in plate II

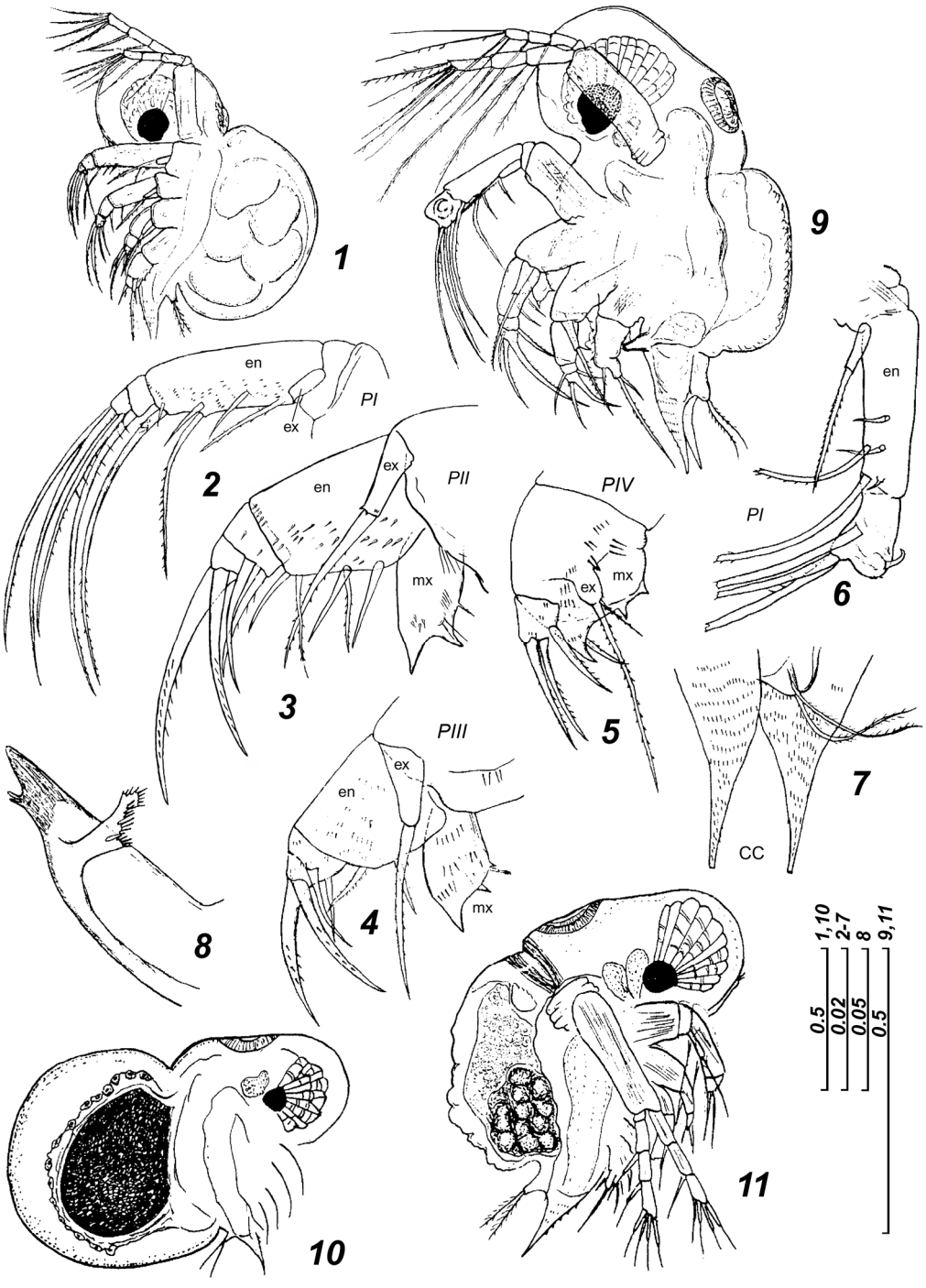


Plate V. *Podon leuckarti*: 1 – parthenogenetic female; 1–5 – thoracic limbs with maxillary processes; 6 – limb 1 of male; 7 – postabdomen with setae natatoriae; 8 – mandible; 9 – male; 10 – gamogenetic female with resting egg; 11 – parthenogenetic female just after molting and breeding (brood pouch contains new eggs). Abbreviations like in plate II

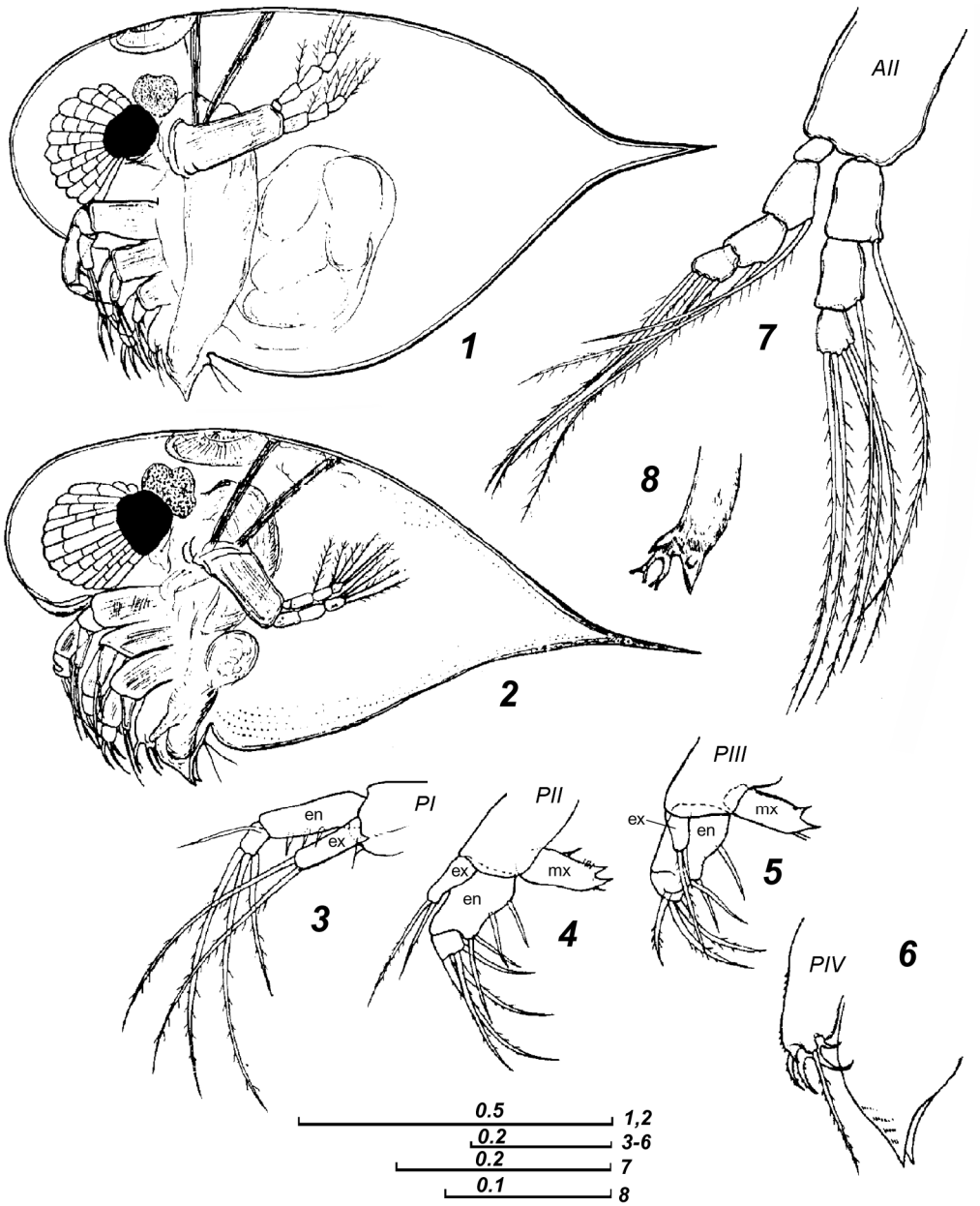


Plate VI. *Evadne spinifera*: 1 – parthenogenetic female; 2 – male; 3–6 – thoracic limbs; 7 – antenna; 8 – mandible. Abbreviations like in plate II

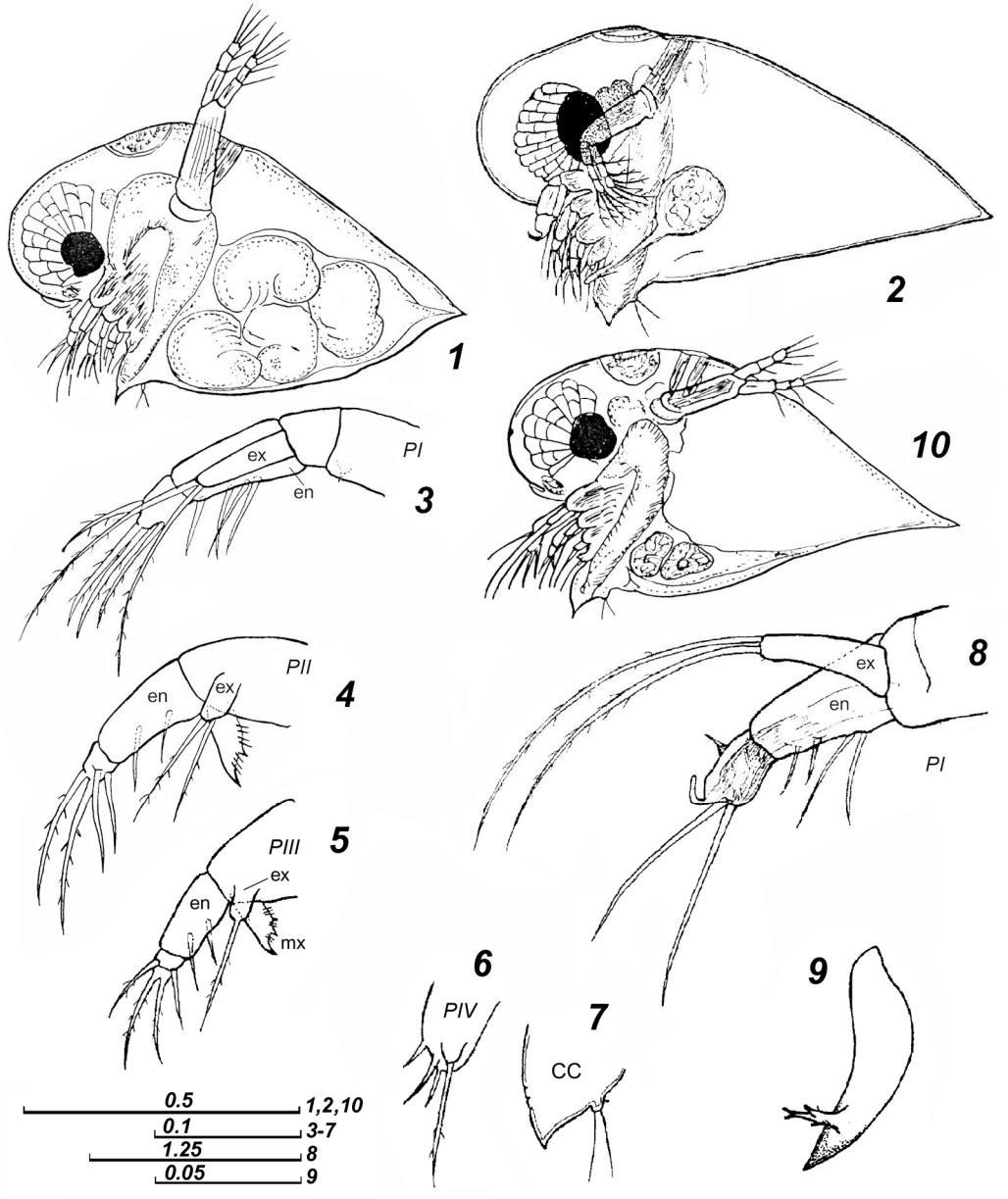


Plate VII. *Evadne nordmanni*: 1 – parthenogenetic female; 2 – male; 3–6 – thoracic limbs; 7 – postabdomen; 8 – limb 1 of male; 9 – mandible; 10 – young parthenogenetic female

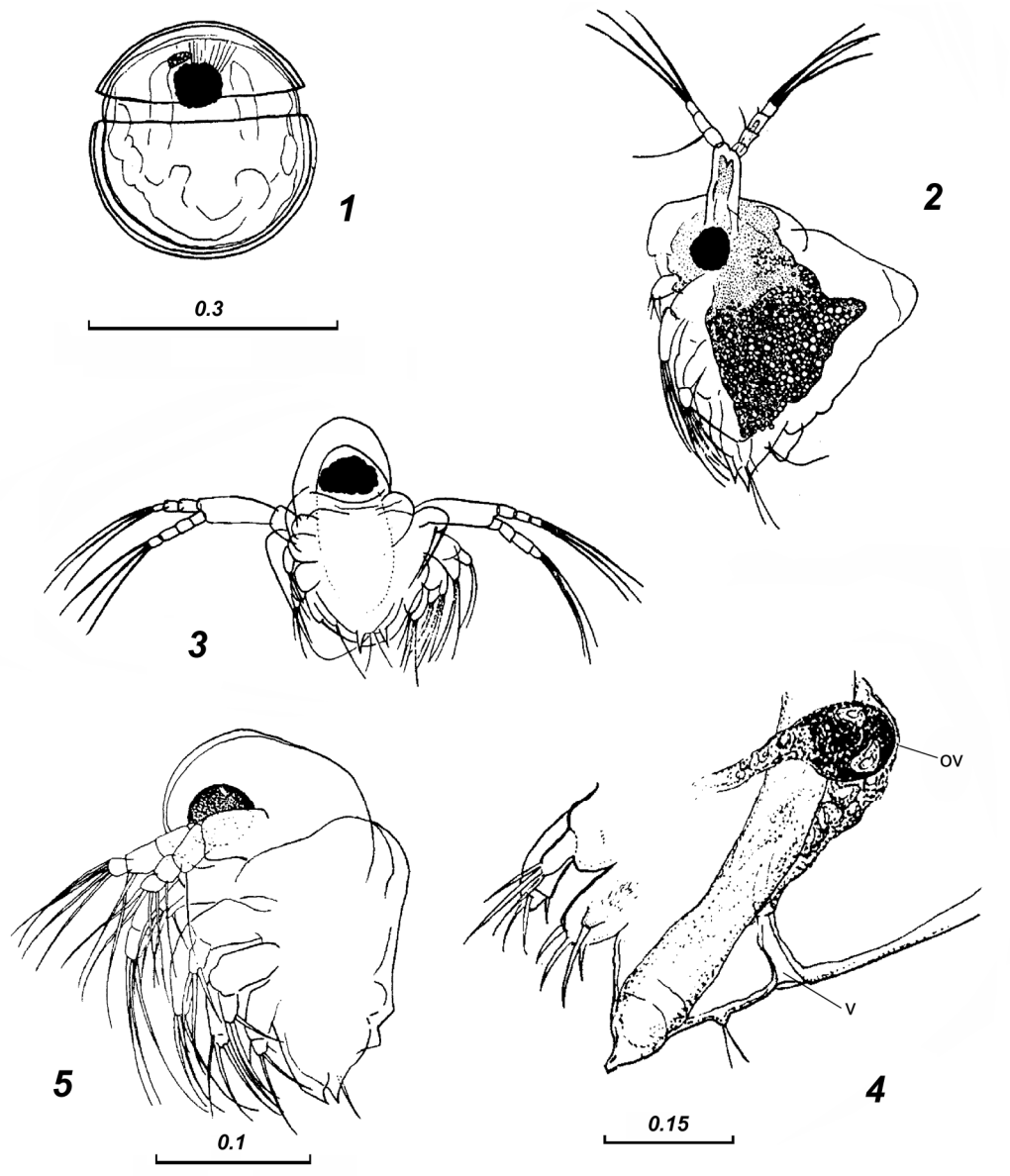


Plate VIII. *Pseudevadne tergestina* (1–4): 1 – embryo developing in a resting egg; 2, 3 – newly hatched parthenogenetic females (from Onbe, 1974); 4 – postabdomen and limbs (P3–P4) of gamogenetic female; resting egg growing in ovary (ov) and vagina (v).
Pleopis polyphemoides: 5 – young cladoceran, just hatched out of resting egg (from Onbe, 1974)

CLASS MALACOSTRACA Latreille, 1802

Order LEPTOSTRACA Claus, 1880

Viktor V. Petryashov

General characteristics

The leptostracans (order Leptostraca) are higher crustaceans belonging to the subclass Phyllocarida of the class Malacostraca. The body of a leptostracan is divided into two tagmata: the cephalothorax and the pleon. The body consists of five cephalic, eight thoracic, seven pleon segments, and a telson, ending with a furca, formed by two flat rami (pl. I, figs. 1, 2). The eyes are stalked, faceted, but in some deep-water species the eyes lack pigment and not faceted. The cephalon, thorax, and sometimes most part of the pleon are covered dorsally, laterally, and in some cases ventrally with a cephalothoracic shield, or carapace, fused to the dorsum of the protocephalon. The carapace is composed of two valves, fastened together by a muscle-retractor. The frontal margin of the carapace is provided in the middle with a plate-like movable rostrum. The leptostracans have a pair of antennules, a pair of antennas, eight pairs of thoracic appendages (thoracopods), and six pairs of abdominal appendages (pleopods). The antennule (antenna I) consists of a four-articulate peduncle (protopod) and a multiarticulate flagellum; the outer side of the antennule is provided with a flat antennular scale. The antenna (antenna II) is uniramous; it consists of a three-, rarer four-articulate peduncle and a multiarticulate flagellum-like endopod; an exopod is lacking. The thoracopods are leaf-shaped; each one is composed of a protopod, epipod, exopod, and an endopod, the latter may be one- or many-segmented. The articulations of the thoracopod parts may be fused. The first four pairs of the pleopods are well developed; each first to fourth pleopod consists of a two-segmented protopod, flat one-segmented exopod, and a flat two-segmented endopod. The fifth and sixth pairs of the pleopods are rudimentary small uniramous plates. The seventh pleonal segment is without any appendages.

The leptostracans are marine crustaceans; they occur in depths from the high sublittoral to the bathypelagial zone. There are twenty-five species of them known presently. They are found in all the world oceans, except for the arctic waters. The leptostracans are deposit-feeders, and pelagic species are apparently filter-feeders.

In the females of the families Nebaliidae and Paranebaliidae setae of the thoracopods form a brood chamber, in which full maturation of embryos takes place. In Nebaliopsidae eggs are probably laid directly into the water, and organisms develop through metamorphosis.

The leptostracans can be collected using epibenthic sledges, horizontal and vertical plankton nets, as well as trawls and scoop nets. Fixation should be made in 75% ethanol and in 4% formaldehyde.

The order is composed of three families, one of which, Nebaliidae, was recorded in the Sea of Japan.

Main references: Dahl, 1985, 1996; Martin et al., 1996.

Systematic part

Family **NEBALIIDAE** Baird, 1850

Carapace without sculpture, with postero-dorsal cleft; mandible with well-developed mandibular palps and incisor processes; first maxilla with long whip-shaped palp; exopods of second-fourth pleopods not blade-shaped, elongate, slender, more than 4 times as long as broad.

The species of only one genus *Nebalia* of the seven genera of this family were found in the Sea of Japan.

Genus ***Nebalia*** Leach, 1814

Type species: *Nebalia herbstii* Leach, 1814.

Rostrum without subterminal spine; eye with dark pigment; eye-stalk with papilla; carapace without setae on posterior margin; posterior margins of 5th and 6th pleonal segments serrate; exopod of 1st pleopod with row of spinules placed medially on outer margin.

Two species of the genus *Nebalia* were recorded in the northern half of the Sea of Japan. The armature of the 5th and 6th pleopods is described as a character distinguishing them from other closely related species and for the purpose of showing the range of variations of this character in both species (other authors mention the smaller number of spines).

KEY TO THE SPECIES OF THE GENUS NEBALIA

1 (2). Spine-like denticles on posterior margins of pleonal segments broadly rounded distally (pl. II, fig. 1). Furcal rami approximately 1.5 times as long as telson (pl. II, fig. 5) ..... 1. ***N. bipes*** (p. 38)

2 (1). Spine-like denticles on posterior margins of pleonal segments acutely pointed (pl. II, fig. 6). Furcal rami approximately twice as long as telson (pl. II, fig. 10) .... 2. ***N. hessleri*** (p. 39)

1. ***Nebalia bipes*** (Fabricius, 1780) (Pl. I, figs. 1–7; II, figs. 1–5)

Fabricius, 1780: 246 (*Cancer bipes*); Kroyer, 1847: 436-446 (*Nebalia bipes*); Jankowski, 1976: 46–47, figs. 78, 80 (*Nebalia nemurensis*).

Description. Posterior margins of pleonal segments with denticles having broadly rounded tips. Dorsal terminal seta on peduncle of first pleopod reaches basal 1/3 to 1/2 of row of small setae on exopod. Fifth pleopod bears 4–10 distolateral spines. Sixth pleopod bears from 4 (in juveniles) to 5–7 distolateral spines. Furcal rami 1.4–1.7 times as long as telson. Length of body up to 13.5 mm.

Distribution. *N. bipes* is an amphiboreal species. It is distributed in the Atlantic and the Arctic Oceans from the North America, Iceland, and Trondheim Fjord (Nor-

way) to Greenland, the Spitsbergen, the White Sea, and the Novaya Zemlya (72°23′N, 52°41′E); in the Pacific Ocean from the Inland Sea of Japan to the Chukchi Sea (67°44.9′N, 172°47.9′W). In the Sea of Japan it occurs in Peter the Great Bay, off the northern coast of Primorye, and in the Tatar Strait.

Habitat and breeding. *N. bipes* is found in depths from 0 to 200–820 m, mostly to 50 m, on sandy, silty, less commonly on stony and rocky grounds, often among algae and sea grasses. Females with embryos were recorded in the Sea of Japan May through early September.

2. ***Nebalia hessleri*** Martin, Vetter & Cash-Clark, 1996 (Pl. II, figs. 6–10)

Martin et al., 1996: 347–372.

Description. Posterior margins of pleonal segments with acutely poined denticles. Dorsal terminal seta on peduncle of first pleopod reaches basal 1/3 of row of small setae on exopod. Fifth and sixth pleopods with 6–8 distolateral spines. Furcal rami 2–2.2 times as long as telson. Length of body up to 15 mm.

Distribution. Until recently, this species was known only from the type locality: 32°52.5′N, 117°15.5′W (La Jolla, South California). Four specimens of *N. hessleri* were collected on July 18, 1975 near the Asian coast, viz.: off the southern coast of Primorye, between Zeleny and Bugristy Capes (northeast of Povorotny Cape, about 42°50′N, 133°30′E).

Habitat. *N. hessleri* occurs in the high sublittoral zone between 10 and 20 m (type locality at 19 m).

Remarks. The specimens found in the Sea of Japan differ from the type specimens in the larger number of distolateral spines on fifth and sixth pleopods (7–8 spines in the Sea of Japan specimens versus 6 spines in the type specimens).

References

Cannon, H.G. 1960. Leptostraca. Klassen und Ordnungen des Tierreichs. Bd 5, Abt. 1, Buch 4, Tl. 1. 81 S.

Dahl, E. 1985. Crustacea Leptostraca, principles of taxonomy and a revision of European shelf species // Sarsia. V. 70, N 2–3. P. 135–166.

Dahl, E. 1996. Phyllocarides // Traite de Zoologie. Crustaces. Anatomie, systematique, biologie. T. 7, fas. 2. P. 865–896.

Fabricius, O. 1780. Fauna Groenlandica. (Hafniae et Lipsiae: I. G. Rothe). 452 p.

Jankowski, A.V. 1976. Family Nebaliidae // Zhivotnyie i Rasteniya Zaliva Petra Velikogo. Leningrad: Nauka. P. 46–47. (In Russian).

Kroyer, H. 1847. Karcinologiske Bidrag. Naturhistorisk Tidskrift. T. II. 2, Raekka. 453 p.

Martin, J.W., Vetter, E.W. & C.E. Cash-Clark. 1996. Description, external morphology, and natural history observations of *Nebalia hessleri*, new species (Phyllocarida: Leptostraca) from southern California, with a key to the extant families and genera of the Leptostraca // Crustacean Biology. V. 16, N 2. P. 347–372.

Yashnov, V.A. 1948. Order Leptostraca // Opredelitel Fauny i Flory Severnykh Morei SSSR. Moscow: Sovetskaya Nauka. P. 223. (In Russian).

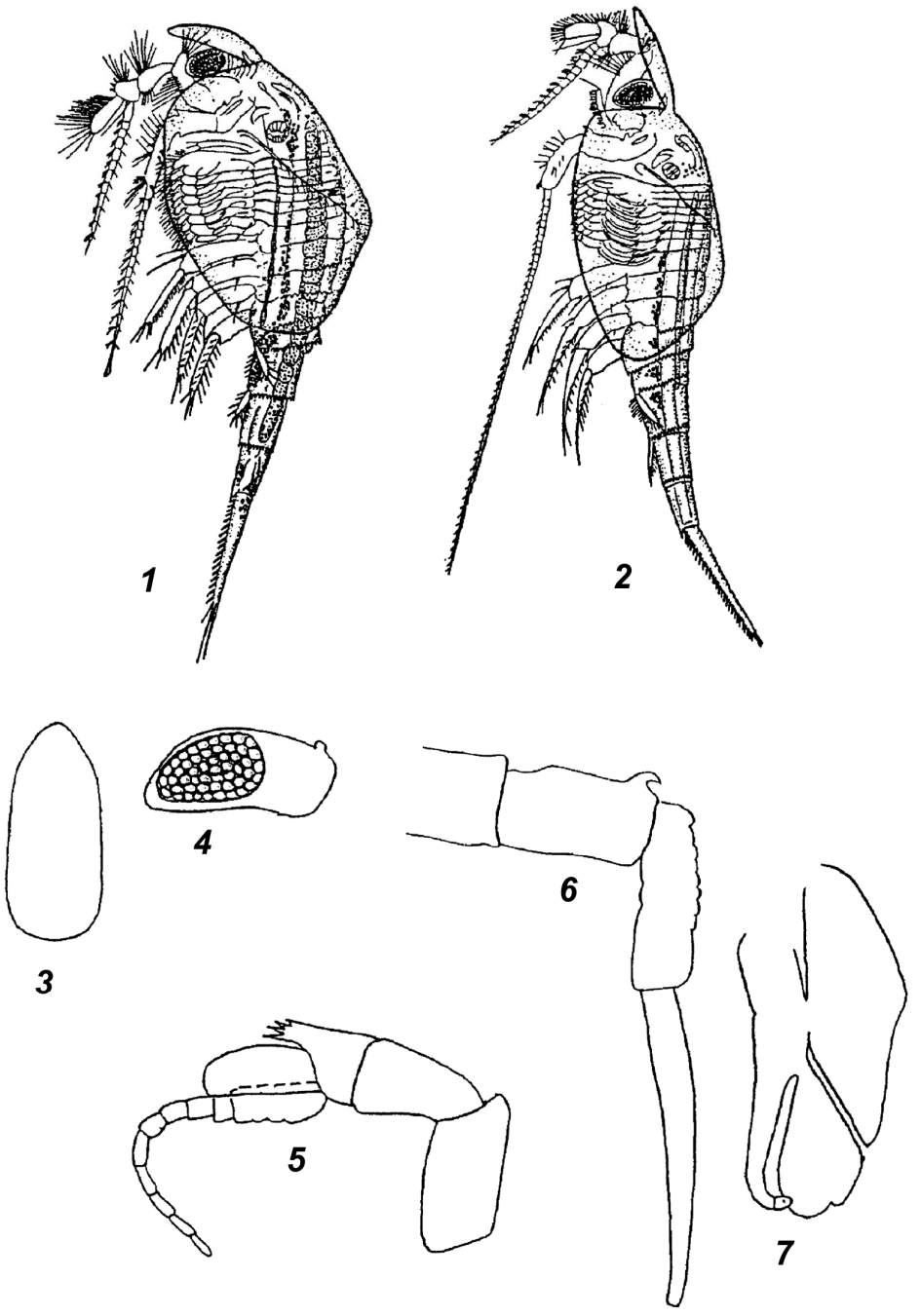


Plate I. *Nebalia bipes*: 1 – female (from Yashnov, 1948); 2 – male (from Yashnov, 1948); 3 – rostrum; 4 – eye; 5 – antennule; 6 – antenna; 7 – 3rd thoracopod

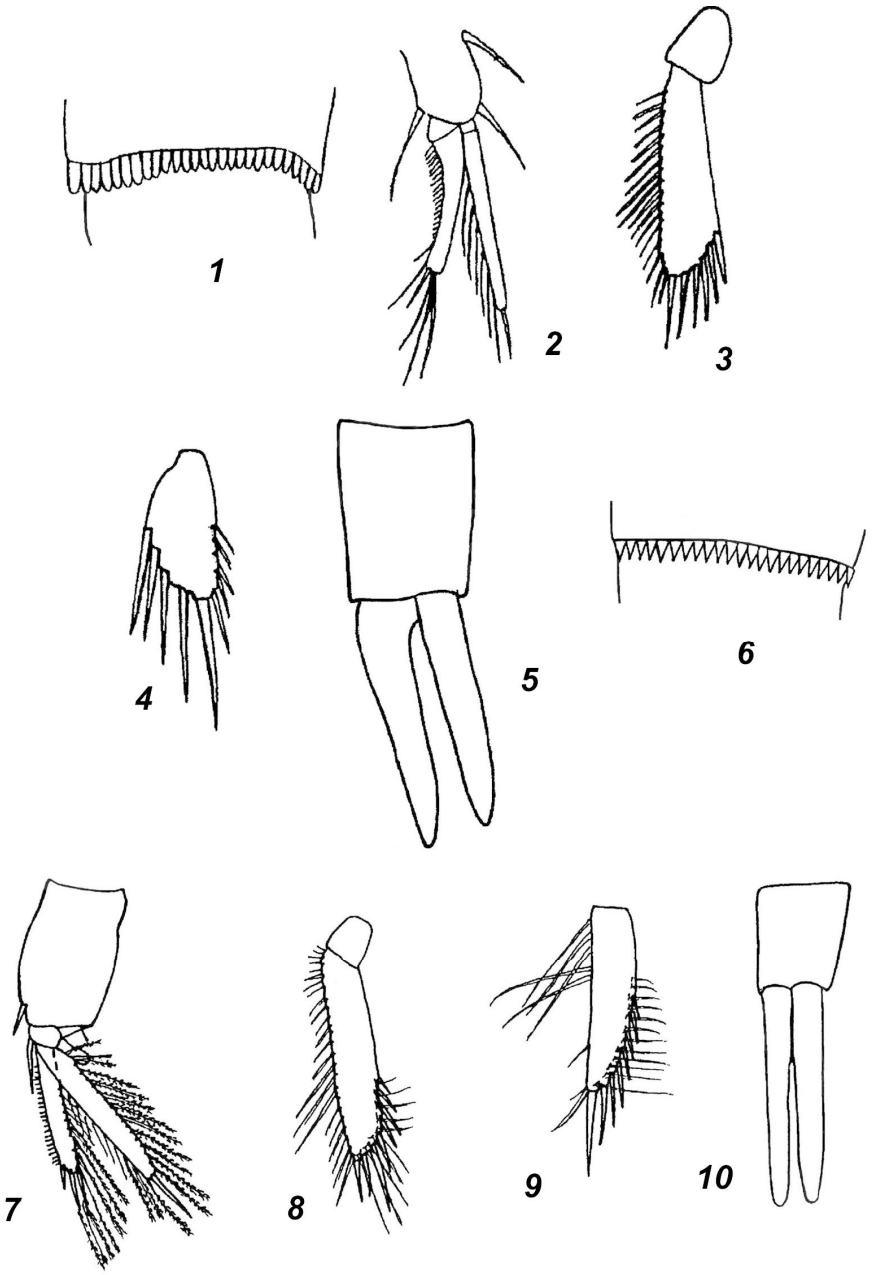


Plate II. *Nebalia bipes*: 1 – distal margin of 4th pleonal segment; 2 – first pleopod; 3 – 5th pleopod; 4 – 6th pleopod; 5 – telson with furca.
Nebalia hessleri: 6 – distal margin of 6th pleonal segment; 7 – first pleopod; 8 – 5th pleopod; 9 – 6th pleopod; 10 – telson with furca

Order MYSIDACEA Boas, 1883

Viktor V. Petryashov

General characteristics

The order Mysidacea is a subdivision of the superorder Peracarida. Mysids are shrimplike higher crustaceans (pl. I, fig. 1). Their body is divided into two tagmata: the cephalothorax and the abdomen. The body consists of six-seven segments of the head (five segments of the protocephalon and one to two segments of the maxilliped), six-seven thoracic segments, six abdominal ones, and the telson. The eyes are faceted and borne on movable stalks; visual elements sometimes more or less reduced, often resulting in the reduction of the eyes. Most part of the head and the thorax is covered with a well-developed head shield, or carapace, fused to the dorsum of three to four (rarer) anterior thoracic segments. The antennules (antennae 1) are well developed; they consist of a three-segmented peduncle and two many-segmented flagella. The third segment of the peduncle in males may bear a setaceous appendix masculina at the distal margin. The antennae (antennae 2) are also well developed; they consist of a three-segmented protopod, a scaled exopod (antennal scale, or scaphocerite), and an endopod. The endopod of the antenna is composed of a three- to four-segmented basal part and many-segmented flagellum. The mysids have eight pairs of thoracic limbs (thoracopods), one or two anterior pairs of which are transformed into maxillipeds. All thoracopods are biramous; they are composed of an exopod and an endopod, attached to a common base – protopod. Three constituent segments of the protopod are a precoxa (basal one), a coxa, and a basis (distal one). The coxa in several anterior thoracopods is provided with a process (epipod). The segments of the endopod, from the base to the apex, are a preischium, ischium, merus, carpus, propodus, and a dactylus. The end of the dactylus is often armed with a claw-like spine. There is often a knee-like prominence between the merus and the carpus. The mysids belonging to the tribe Erythropini and to the genus *Inusitatomysis* of the tribe Mysini have the carpus and the propodus joined obliquely, and the knee-like prominence is the feature inherent mainly to these groups. Members of the above-mentioned groups from the Sea of Japan, plus the species of the subfamily Gastrosaccinae may have the propodus further divided into subjoints, usually two in number. In many species the carpus and the propodus are fused and have secondary division into several small subjoints (this is characteristic of the most species of the tribe Mysini from the northern half of the Sea of Japan). The Sea of Japan species lack branchiae (podobranchs). Posterior two, or, rarer, three or seven pairs of the thoracopods in females are provided with well-developed plates (oostegites) on their inner sides. The oostegites form the marsupium, in which embryos develop; the development is full and direct. The mysids have five pairs of abdominal limbs (pleopods). The pleopods may be uniramous or biramous. They are often reduced or absent in females and better developed in males. In many species the fourth or, rarer, the third pair of the pleopods in males is elongate and modified, as it is used in copulation. One pair of flat biramous uropods and the telson form a tailfan. The species from the Sea of Japan are provided with the statocyst on the basal part of the endopods of the uropods.

The mysids inhabit marine, brackish, and fresh waters; they are distributed vertically in depths from 0 to 8500 m. There are nekto-benthic (hyperbenthic), pelagic, and epibenthic forms among the mysids; several species are the commensals of sponges. Nekto-benthic and epibenthic species occur over and on various types of substrates.

At present about 1000 species belonging to 152 genera of mysids are known. They inhabit all the oceans, most abundant in tropical and subtropical waters, the number of species decreasing towards polar regions. The mysids are omnivorous; most species are filter-feeders or carnivores.

Mysidacea of the Sea of Japan belong to five biogeographical groups, namely: amphiboreal-arctic (2 species), Pacific subtropical-boreal (2 species), West Pacific subtropical-boreal (2 species), Pacific widespread boreal (4 species), and West Pacific widespread boreal (7 species). It means that the widespread boreal species predominate in the fauna of this region (11 species). The subtropical-boreal species (4 in number) should not be considered to occur in warm waters, as they are found in the northern areas of the Bering Sea, and most of them also in the Chukchi Sea. Two amphiboreal-arctic species must be really cold-water ones, and are therefore in the Sea of Japan recorded only from the Tatar Strait. The analysis of the sublittoral mysid fauna refers the studied region to the Manchurian-Kamchatkan district of the Far Eastern biogeographical superprovince, while the analysis of very poor meso-bathypelagic fauna refers it to the Sea of Japan district of the Japanese – Far Eastern province (Petryashov, 2005).

Mysids should be collected using horizontal plankton nets and epibenthic sledges. Mysids are rather numerous in vertical samples taken by large plankton nets; they may also be collected by benthopelagic samplers attached to the trawls, pelagic and bottom trawls, and scoop nets. They are rarely found among the material taken by dredgers. The mysids should be fixed in 75% - ethanol or in 4% - formaldehyde.

The present keys are based on the Murano's classification (Murano, 1999) with some additions and modifications from Tchindonova (1981) and Nouvel et al. (1999):

- suborder Lophogastrida
  - family Gnathophausiidae
  - family Lophogastridae
  - family Eucopiidae
- suborder Stygiomysina
  - family Lepidomysidae
  - family Stygiomysidae
- suborder Petalophthalmina
  - family Petalophthalmidae
- suborder Mysida
  - family Boreomysidae
  - family Mysidae
    - subfamily Thalassomysinae
    - subfamily Siriellinae
    - subfamily Rhopalophthalminae
    - subfamily Gastrosaccinae
    - subfamily Mysinae
    - subfamily Mysidellinae

It should be noted that there is no yet consensus on the system of the order. Many researchers establish only two suborders within the order Mysidacea, viz. Lophogastrida and Mysida, including the other two suborders into the suborder Mysida. Other authors erect the suborder Lophogastrida as a separate order (Martin & Davis, 2001). Some biologists don't accept the independence of the families Gnathophausiidae and Boreomysidae. There is no general agreement among authors as to the number of tribes in the subfamily Mysinae. Some workers separate only four tribes (Erythropini, Leptomysini, Mysini, and Heteromysini) and attribute the rest to the tribe Erythropini and one genus to the tribe Leptomysini.

Members of the suborder Mysida and the family Mysidae have been found in the Russian waters of the Sea of Japan.

Systematic part

Suborder Mysida Boas, 1883

Branchiae on thoracopods absent. Basal part of endopod of uropod provided with statocyst.

I. Family **MYSIDAE** Dana, 1850

Female marsupium consists of two, rarer three pairs of well-developed oostegites (in some genera rudimentary pairs of oostegites also present). (Species inhabiting the Russian waters of the Sea of Japan have one-segmented exopod of uropod; no rudimentary suture; outer margin covered with numerous (more than 10) spines, but without setae, or covered with numerous setae, but without spines).

Only two subfamilies of six occur in the northern part of the Sea of Japan.

KEY TO THE SUBFAMILIES OF THE FAMILY MYSIDAE

1(2). Female marsupium consists of two pairs of oostegites and one pair of lateral (epimeral) lamellae of first abdominal segment (pl. II, fig. 6). Outer margin of exopod of uropod without setae, with 1, 2, or more spines (pl. II, fig. 3) ....I. **Gastrosaccinae** (p. 44)

2(1). Female marsupium consists of 2, rarer 3 pairs of oostegites, lateral (epimeral) lamellae on first abdominal segment absent (pl. IV, fig. 6; XIV, fig. 2). Outer margin of exopod of uropod without spines, with numerous setae (pl. III, fig. 6) .. ..II. **Mysinae** (p. 46)

I. Subfamily **Gastrosaccinae** Norman, 1892

Female marsupium consists of two pairs of oostegites and one pair of epimeral lamellae of first abdominal segment. Exopod of uropod one-segmented, outer margin with one, two, or more spines, without setae from distal spine to base of exopod.

Only one genus (*Archaeomysis*) of eight ones constituting the subfamily Gastrosaccinae is found in the Russian waters of the Sea of Japan.

1. Genus ***Archaeomysis*** Czerniavsky, 1882

Type species: *Archaeomysis grebnitzkii* Czerniavsky, 1882.

Male pleopods biramous. Exopod of pleopod 3 very much elongate, consists of more than 5 segments; stick-shaped seta situated on apex; endopod consists of 1–7 segments (pl. II, fig. 2). Pleopods 1–5 of female biramous. Outer margin of exopod of uropod bears more than 10 spines gradually increasing in length towards apex (pl. II, fig. 3).

1. ***Archaeomysis grebnitzkii*** Czerniavsky, 1882
(Pl. II, figs. 1–7)

Czerniavsky, 1882a: 73 (*Archaeomysis grebnitzkii*); Holmes, 1894: 563 (*Callomysis maculata*); Zimmer, 1927: 635 (*Archaeomysis maculata*); Hanamura, 1997: 688–697 (*Archaeomysis articulata*).

Description. Relatively deep slit situated on each side of dorsodistal depression of carapace, in most specimens covered by fold of integument. Antennal scale almost rectangular; outer margin smooth, without setae, with one distal spine projecting beyond its apex; antennal scale 2.25–4.0 times as long as broad. Pleopod 3 in males longest; exopod of pleopod 3 extends to middle of fifth segment of abdomen, or even to basal part of telson; ratio of length of basal segment of exopod to length of protopod (sympod) is 0.6–1.0; other segments of this exopod small, numbering from 1–3 (in immature males) to 4–8. Endopod of this pleopod relatively short, number of segments ranges from 1–3 (in immature males) to 3–7 (in adult males). Distal 2/3–3/4 of outer margin of exopod of uropod bears 10 to 25 spines (juveniles have not less than 4 spines). Telson elongate, trapezoid, with V-shaped cleft on apex, 1.8–3.3 times as long as broad at base; lateral margins bear 5–7 pairs of spines in juveniles, and up to 7–11 pairs in adult specimens. Maximum length of male 19.0 mm; maximum length of female 23.1 mm.

Distribution. *A. grebnitzkii* is a widespread Pacific boreal species (if *A. japonica* is accepted as a variety of *A. grebnitzkii*, then it is a subtropical-boreal species). It is distributed from the Island of St. Paul (the eastern Bering Sea) and Ugolnaya Bight (the south-eastern part of the Gulf of Anadyr) in the north, to the south of California (La Jolla), Hokkaido Island and Peter the Great Bay (*A. japonica* is distributed as far south as Nagasaki).

Habitat and breeding. In the Sea of Japan, as well as everywhere within its area of distribution, *A. grebnitzkii* is found from the upper level of the littoral zone (during high tides) to depths of 34–40 m. It occurs on various substrates, from rocks to sandy mud, though it prefers sand or other substrates mixed with sand, or with patches of sand. It is a eurythermal (from -1.8° to +26°C) and euryhaline (18.0–34.3‰) species. Females with embryos were recorded in the Sea of Japan from July to September, number of embryos varied between 11 and 75.

Remarks. The species *A. articulata* Hanamura, 1997 is a geographical variety of *A. grebnitzkii*. All the characters described in the differential diagnosis give an indication that there are transitional forms between *tipica* and *articulata*. These transitional forms are most numerous in the north-eastern part of Peter the Great Bay.

II. Subfamily **Mysinae** Hansen, 1910

Female marsupiums consist of 2–3 pairs of oostegites; epimeral lamellae absent on first abdominal segment. Outer margin of exopod of uropod bears setae, no spines.

The subfamily Mysinae comprises six tribes; the species of two of them inhabit the northern part of the Sea of Japan.

KEY TO THE TRIBES OF THE SUBFAMILY MYSINAE

1(2). Carpus and propodus of each endopod of thoracopods 3–8 with obliquely articulated (pl. III, fig. 4). Outer margin of antennal scale (or at least its basal third) smooth, unarmed, often with distal spine (pl. III, fig. 2; pl. IV, fig. 1–5); sometimes antennal scale absent or reduced to spine. Male pleopods 2–5 well developed, biramous, natatory ..... 1. **Erythropini** (p. 46)

2(1). Carpus and propodus of each endopod of thoracopods 3–8 fused, with secondary division into subjoints; no oblique articulation (pl. VI, fig. 5; XVI, fig. 4) (except for genus *Inusitatomysis* (pl. V, fig. 5). Forms of antennal scale and telson greatly vary: mysids from Russian waters of Sea of Japan have outer margin of antennal scale setose, without spines (pl. VI, fig. 3; VII, fig. 3), or saw-toothed, without setae (pl. V, fig. 3). In males at least second pleopod rudimentary and uniramous. Exopod of fourth pleopod in males elongate and modified (pl. VI, fig. 4; VII, fig. 5), except for genus *Inusitatomysis*: endopod elongate and exopod rudimentary (pl. V, fig. 6) ..... 2. **Mysini** (p. 49)

1. Tribe **Erythropini** Hansen, 1910

Stalked eyes well developed, have ordinary shape or visual elements of eyes divided into two distinct regions. Antennal gland not hypertrophied. Outer margin of antennal scale, or at least its basal third, smooth, unarmed (armed with setae only in genus *Nipponerythrops*). Sometimes antennal scale absent or reduced to spine. Carpus and propodus of each endopod of thoracopods 3–8 obliquely articulated (except for genus *Arachnomysis*). Male pelopods 2–5 well developed, biramous, natatory. Telson entire, without cleft.

Two of twenty-nine genera of this tribe (under the classification by Tchindonova (1981)) are found in the Sea of Japan.

KEY TO THE GENERA OF THE TRIBE ERYTHROPINI

1(2). Lateral margins of distal half of telson armed with spines (pl. III, fig. 7) (Endopod of male pleopod 4 elongate and with strong seta on apex [pl. III, fig. 5]).....
.....1. ***Holmesiella*** (p. 47)

2(1). Lateral margins of telson smooth, unarmed (pl. IV, fig. 4–7). (Male pleopod 1 with normally developed, many-segmented exopod and unsegmented endopod (pl. IV, fig. 2), other male pleopods well developed and have normal shape [pl. IV, fig. 3]) ..... 2. ***Meterythrops*** (p. 47)

1. Genus ***Holmesiella*** Ortmann, 1908

Type species: *H. anomala* Ortmann, 1908.

Eyes large, spherical. Antennal scale long, straight, extends beyond distal margin of antennular peduncle. Endopod of male pleopod 4 longer than exopod, with long and strong seta on apex. Telson elongate, triangular; apex narrowly truncate, with one pair of plumose setae and two pairs of spines; inner pair of spines noticeably shorter than outer pair; distal 1/2–2/3 of lateral margin of telson with spines gradually increasing in length towards apex of telson.

The genus consists of two species, one of which is found in the Sea of Japan.

1. ***Holmesiella anomala*** Ortmann, 1908
(Pl. III, figs. 1–7)

Ortmann, 1908: 6–7.

Description. Second and third segments of antennular peduncle have ordinary articulation: margin of third segment does not cover dorsally distal part of second segment. Antennal scale lanceolate, 3–5.5 times as long as broad; distal spine-like denticle on its outer margin does not reach its apex. Endopod of male pleopod 4 very much elongate, 2.7–3.4 times longer than exopod. Telson 1.5–2.0 times as long as broad at base; lateral margins armed with 11 to 22 spines. Maximum length of males 39.3 mm, maximum length of females 45.8 mm.

Distribution. *H. anomala* is a widespread Pacific boreal species, distributed from the Sea of Japan coast of Korea (36°19′N, 129°47′E), Sagami Bay, and the south of California to the Bering Sea (the crosspiece of Olyutorsky Cape). The species has been recorded in the Sea of Japan only once.

Habitat and breeding. *H. anomala* is a sublittoral-upper bathyal species, vertically distributed from 10–25 m to a depth of 1320 m. It is mainly found in the upper bathyal zone and moves to the sublittoral and epipelagic zones apparently in course of daily vertical migrations. It is found in waters with a temperature of -1.7° to +4°C and a salinity of 29.5–34.35‰. *H. anomala* occurs predominantly over silty and sandy bottoms. There are no records for the breeding of this species in the Sea of Japan.

2. Genus ***Meterythrops*** Smith, 1879

Type species: *M. robusta* Smith, 1879.

Eyes spherical. Antennal scale elongate and lanceolate, or diamond-shaped; extends to distal margin of antennular peduncle. Anterior margin of carapace produced into triangular rostral plate with broadly rounded apex. Endopod of male pleopod 1 one-segmented, exopod many-segmented. Telson elongate, triangular, with slightly truncated apex; lateral margins smooth, unarmed; apex with two pairs of spines and one pair of median plumose setae.

This genus consists of five species, two of which inhabit the Sea of Japan.

1(2). Eyes large, twice as long as first segment of antennular peduncle, extend beyond lateral margins of carapace in dorsal view (pl. IV, fig. 1).....1. ***M. robusta*** (p. 48)
2(1). Eyes small, almost equal in length to first segment of antennular peduncle, do not extend beyond lateral margins of carapace in dorsal view (pl. IV, fig. 5) ....2. ***M. microphthalma*** (p. 48)

1. ***Meterythrops robusta*** Smith, 1879
(Pl. IV, figs. 1–4)

Smith, 1879: 93 (*Meterythrops robusta*); G.O. Sars, 1879: 98 (*Parerythrops robusta*).

Description. Eyes large, spherical, 2 times as long as first segment of antennular peduncle; extend beyond lateral margins of carapace in dorsal view. Antennal scale usually lanceolate, rarer diamond-shaped, 1.8–4 times as long as broad (usually 2–3 times). Distal part of scale, extending beyond base of spine on outer margin, comprises 0.28 to 0.5 of whole length of antennal scale (usually about 1/3). Maximum length of females 21.0 mm, maximum length of males 24.0 mm (in the Tatar Strait – correspondingly 10.2 mm and 13.6 mm).

Distribution. *M. robusta* is an amphiboreal-arctic species. In the Atlantic Ocean and in the Arctic it is known from the eastern coast of the USA (40° N) and southern Norway to Greenland (69° N near the western coast), the eastern Murman Coast, and along the continental slope of the Arctic basin to the East Siberian Sea (78°06.3′N, 154°15.7′E). In the Pacific Ocean it is distributed from the Strait of Juan de Fuca, the south-western coast of Sakhalin Island and the eastern coast of Iturup Island (Kurils) to the Bering Sea (60° N).

In the Sea of Japan it has been recorded only in the Tatar Strait off the south-western coast of Sakhalin, near the villages of Kalinino and Antonovo.

Habitat and breeding. *M. robusta* occurs in the sublittoral and upper bathyal zones, between 17 and 620 m of depth: it is common in the Pacific in depths from 100 to 200 m, and in the Tatar Strait it is found in depths from 60 to 125 m. It occurs in waters with a temperature from -1.8° to +15°C and a salinity of 29.5–35‰, usually over sandy and silty bottoms, sometimes mixed with stones. There are no records for the breeding of this species in the Sea of Japan.

2. ***Meterythrops microphthalma*** Tattersall, 1951
(Pl. IV, figs. 5–7)

Tattersall, 1951: 113–116 (*Meterythrops microphthalma*); Taniguchi, 1969: 47–48 (*Meterythrops robusta*).

Description. Eyes relatively small, almost equal in length to first segment of antennular peduncle, do not extend beyond lateral margins of carapace in dorsal view. Antennal scale diamond-shaped, 2.1–3.8 times as long as broad. Distal part of scale, extending beyond base of robust spine on outer margin, comprises 1/3–1/2 of whole length of antennal scale (usually about 2/5). Maximum body length all over area of distribution, as well as in Sea of Japan: of females 23.5 mm, of males 24.6 mm.

Distribution. *M. microphthalma* is a West Pacific widespread boreal species. It is distributed from Sagami Bay (the eastern coast of Honshu Island) and the southern Sea of Japan to the northern Bering Sea (60° N, near Olyutorsky Cape).

Habitat and breeding. *M. microphthalma* inhabits the mesopelagic and bathypelagic zones; during vertical migrations it can also penetrate the epipelagic zone. It is found from 10–26 m to a depth of 2800 m; at night it usually occurs at 800–200 m, in the daytime – at 1100–600 m. It is found in waters with a temperature from +0.2° to +5°C and a salinity of 33–34.4‰. Females with embryos were recorded in the Sea of Japan from January till February and from August till October. The number of embryos in each female varies between 8 and 24. *M. microphthalma* is a most abundant meso-bathypelagic mysid species in the Sea of Japan and Sea of Okhotsk.

2. Tribe **Mysini** Hansen, 1910

Carpus and propodus of thoracopods 3–8 fused, with secondary division into subjoints, without oblique articulation (except for genus *Inusitatomysis*). Forms of antennal scale and telson greatly vary: in genera from Russian waters of Sea of Japan outer margin of antennal scale setose and without spines, or (in genus *Inusitatomysis*) saw-toothed and without setae; telson entire, not cleft on apex, cleft only in genus *Inusitatomysis*. In males at least pleopod 2 rudimentary and uniramous. Exopod of male pleopod 4 elongate and modified, except for species of genus *Inusitatomysis*, which have endopod elongate and exopod rudimentary.

The tribe Mysini is comprised of 48 genera, and the mysids of nine genera occur in the northern part of the Sea of Japan, namely: *Inusitatomysis*, *Xenacanthomysis*, *Stilomysis*, *Disacanthomysis*, *Neomysis*, *Boreoacanthomysis*, *Hemiacanthomysis*, *Exacanthomysis*, and *Paracanthomysis*.

KEY TO THE GENERA OF THE TRIBE MYSINI

1(2). Outer margin of antennal scale saw-toothed, without setae (pl. V, fig. 3). Telson with V-shaped cleft on apex (pl. V, fig. 8).....1. ***Inusitatomysis*** (p. 50)

2(1). Outer margin of antennal scale with setae along its full length, lacks spines (pl. VI, fig. 3; VII, fig. 3; IX, fig. 1). Telson entire, not cleft (pl. VI, fig. 7; IX, fig. 7; XII, figs. 5, 6; XIV, fig. 5).

3(4). Second and third segments of antennular peduncle in males with spiny knob-like processes; inner flagellum of antennule with row of striated shell-like processes (pl. VI, fig. 2). Exopod of male pleopod 4 relatively robust, strongly curved at base, one- to three-segmented, usually one-segmented with one or two indications of suture (pl. VI, fig. 4). (Eyes cylindrical [pl. VI, fig. 1]. Telson elongate, linguiform; its apex with row of subequal spines, shorter or equal in length to large spines of lateral margin of telson, usually much shorter [pl. VI, fig. 7]) .... 2. ***Xenacanthomysis*** (p. 51)

4(3). Male antennule has ordinary shape: without spiny knob-like processes on second and third segments of peduncle and without striated shell-like processes on inner flagellum (pl. VII, fig. 2; XVI, fig. 2). Exopod of male pleopod 4 relatively thin, slender, always straight at base, 1–5-segmented (pl. VII, fig. 5; VIII, fig. 2; IX, fig. 5; XVI, fig. 5).

5(6). Female marsupium consists of 3 pairs of well-developed oostegites. Exopod of fourth pleopod of male 4–5-segmented (pl. VII, fig. 5). (Male pleopod 3 biramous; exopod 4-segmented; endopod unsegmented, but relatively long: it comprises 1/2–2/3 of exopod length (pl. VII, fig. 4). Telson elongate, linguiform, with broadly rounded apex, bearing 2 pairs of spines; outer pair much longer than inner one [pl. VII, fig. 7]) ..... 3. ***Stilomysis*** (p. 52)

6(5). Female marsupium consists of 2 pairs of well-developed oostegites. Exopod of fourth pleopod of male 2- to 3-segmented, or unsegmented (pl. VIII, fig. 2; IX, fig. 5; XVI, fig. 5).

7(8). Exopod of fourth pleopod of male 3-segmented: third distal segment very small, ratio of length of first (basal) segment of exopod to lengths of second and third (distal) segments is 23:5:1 (pl. VIII, fig. 2). (Antennal scale elongate, with rounded apex, 5.4–10 times as long as broad (pl. VIII, fig. 1). Tergites of distal thoracic segment and all abdominal segments smooth, without transverse furrows. Telson elongate, longuiform, with rounded apex, bearing 2 pairs of spines; outer pair twice as long as inner one; spines on distal third of telson gathered in 5–10 groups [pl. VIII, fig. 4]) ..... 4. ***Disacanthomysis*** (p. 53)

8(7). Exopod of fourth pleopod of male 2-segmented or unsegmented (pl. IX, fig. 5; XVI, fig. 5).

9(10). Antennal scale with pointed apex (pl. IX, fig. 1). (Exopod of fourth pleopod of male 2-segmented [pl. IX, fig. 5]) ..... 5. ***Neomysis*** (p. 54)

10(9). Antennal scale with rounded apex (pl. XIII, figs. 1, 5; XVI, fig. 3).

11(16). Exopod of fourth pleopod of male 2-segmented (pl. XIII, figs. 2–6; XIV, fig. 3).

12(15). Tergites of distal thoracic segment and all abdominal segments smooth, without transverse furrows (pl. IX, fig. 4).

13(14). Telson elongate, triangular, with truncated apex (pl. XIII, fig. 4). (Antennal scale 3.4–5.8 times as long as broad (pl. XIII, fig. 1); 6–38 spines situated on ventral side of endopod of uropods, near statocyst (pl. XIII, fig. 3); spines grouped on distal 2/3 of lateral margin of telson) ..... 6. ***Boreoacanthomysis*** (p. 58)

14(13). Telson elongate, linguiform, with rounded apex (pl. XIII, figs. 8–9). (Antennal scale 3.4–5.4 times as long as broad (pl. XIII, fig. 5); ventral side of endopod of uropods armed with 14–31 spines situated along major part of inner margin from statocyst to apex; spines on lateral margin of telson gradually increase in length towards apex, not grouped) ..... 7. ***Hemiacanthomysis*** (p. 59)

15(12). Tergites of distal thoracic segment and of all abdominal segments with transverse furrows (pl. XIV, fig. 2; XV, fig. 2) .....8. ***Exacanthomysis*** (p. 60)

16(11). Exopod of fourth pleopods of male unsegmented (pl. XVI, fig. 5) ..... 9. ***Paracanthomysis*** (p. 61)

1. Genus ***Inusitatomysis*** Ii, 1940

Type species: *Inusitatomysis insolita* Ii, 1940.

Eye flattened; cornea bud-shaped, situated along outer margin (Pl. V, fig. 1). Labrum without anterior process (Pl. V, fig. 4). Antennal scale lanceolate; outer margin saw-toothed, without setae. Carpus and propodus of thoracopods 3–8 joined obliquely. Female marsupium consists of 3 pairs of oostegites. Male pleopods 1–3 and 5, as well

as all female pleopods, rudimentary, in shape of narrow undivided plates. Exopod of male pleopod 4 rudimentary, in shape of very small lobe fused full length with endopod; endopod very much elongate, consists of 8–11 segments (Pl. V, fig. 6). Telson trapezoid, with V-shaped cleft on apex, at bottom of which 2 plumose setae situated; lateral margins of cleft saw-toothed; telson bears spines over entire length of lateral margins.

There is only one species in the genus.

1. ***Inusitatomysis insolita*** Ii, 1940
(Pl. V, figs. 1–8)

Ii, 1940: 163–167 (*Inusitatomysis insolita*); Banner, 1948: 67 (*Inusitatomysis* sp.); Tattersall, 1951: 160–162 (*Inusitatomysis serrata*); Bacescu & Gleye, 1979: 131–133 (*Inusitatomysis californica*).

Description. Antennal scale 3–4.5 times as long as broad; outer margin armed with 4–9 spines; distal spine far from reaching apex of scale. Endopod of male pleopod 4 long, extends to basal part of telson; first segment longest of all others taken together with terminal setae. Inner margin of endopod of uropod provided with 1 spine near statocyst. Telson 1.6–2.4 times as long as broad at base; spines on lateral margin subequal, except for distal pair, being about twice longer than others; cleft depth comprises 0.1–0.2 of telson length. Maximum length of females 22.6 mm, maximum length of males 21.3 mm.

Distribution. *I. insolita* is a widespread Pacific boreal species. It is distributed from the Korea Strait, Shikotan Island (Kurils), and the south of California (33°21'N) to Bering Island. The records from the Sea of Okhotsk have only been off the Kuril Islands and in Terpeniya Bay. In the Russian waters of the Sea of Japan it is found in Peter the Great Bay and in the Tatar Strait near the coast of Sakhalin.

Habitat and breeding. *I. insolita* is a sublittoral species. It occurs in depths from 25 to 260 m, predominantly between 50 and 160 m, in the Sea of Japan in depths from 25 to 125 m. It is found in waters with a temperature from -1.7° to +10°C and a salinity of 30–34.8‰. The species occurs mainly over sand and muddy sand, sometimes mixed with stones. There are no records for breeding.

2. Genus ***Xenacanthomysis*** Holmquist, 1980

Type species: *Neomysis pseudomacropsis* Tattersall, 1933.

Eye with relatively long stalk, cylindrical. Anterior margin of carapace evenly rounded (Pl. VI, 8). Second and third segments of male antennular peduncle provided with spiny knob-like processes; inner flagellum with row of striated shell-like processes. Antennal scale lanceolate, with rounded apex, armed only with setae along whole length of its margin. Labrum elongate, heart-shaped with short acute anterior process. Female marsupium consists of 2 pairs of ordinary oostegites. All female pleopods and all pleopods, except for pleopods 4, of males rudimentary, plate-shaped, and unsegmented. Exopod of male pleopod 4 robust, strongly curved at base, 1- to 3-segmented, articulations often rudimentary, partial; outer margin armed with 5–7 long setae; two terminal setae plumose, long, strong, curved; endopod short, unsegmented.

Telson elongate, linguiform; apex broadly rounded, bears row of subequal spines, as long as or often noticeably shorter than large spines on lateral margin.

The genus consists of only one species.

1. ***Xenacanthomysis pseudomacropsis*** (Tattersall, 1933)
(Pl. VI, figs. 1–8)

Tattersall, 1933: 194–197 (*Neomysis pseydomacropsis*); Ii, 1936: 589 (*Acanthomysis pseudomacropsis*); Holmqiust, 1980: 501–510 (*Xenacanthomysis pseudomacropsis*).

Description. Eyes widely spaced; cornea spherical. Antennal scale 8.3 times (in juveniles) to 4.5 times as long as broad. Carpo-propodus of endopod of thoracopods 3–8 consists of 5 (in juveniles) to 6–9 subjoints. Exopod of male fourth pleopod 4 to 6.7 times longer than endopod. Endopod of uropod armed with one, or sometimes two spines situated near statocyst. Telson 2.6–3.3 times as long as broad at base. Its lateral margins bear 32 (in juveniles) to 60 spines, which on distal 1/2–3/4 of lateral margins (excluding apical part) gathered in 4–8 indistinct groups (one or several small spines followed by larger spine). Maximum length of females 20.2 mm, of males 18.2 mm.

Distribution. *X. pseudomacropsis* is a widespread Pacific boreal species. It is distributed from the coast of the North Korea, the central part of the coast of Honshu on the Sea of Japan side, from Shikotan Island (Kurils) and the Strait of Juan de Fuca to Point Barrow (northern part of Alaska). In the Russian waters of the Sea of Japan it is found in Peter the Great Bay and in the Tatar Strait.

Habitat and breeding. *X. pseudomacropsis* is a sublittoral species. It is found at depths from 0 to 104 m, usually to 50–70 m, in the Sea of Japan recorded at 0–80 m. It occurs at a temperature from -1.5° to +18°C and a salinity of 28–34.3‰, predominantly over sand, rarer over muddy sand or silt, occasionally mixed with rocks. Females with embryos were recorded in the Sea of Japan in May (embryos at stages I–II) and in July (stages II–III), the number of embryos ranging from 21 to 35.

3. Genus ***Stilomysis*** Norman, 1892.

Type species: *Mysis grandis* Goes, 1864.

Eye large, with trapezoid stalk. Cornea almost spherical, slightly flattened dorsoventrally (pl. VII, fig. 1). Antennal scale elongate, lanceolate, with rounded apex, 2-segmented; margins covered only with setae (pl. VII, fig. 3). Marsupium consists of 3 pairs of oostegites. All female pleopods and male pleopods 1, 2 and 5 reduced to plate. Male pleopods 3 and 4 biramous; endopod one-segmented; exopod of pleopod 3 short, consists of 4–5 segments; exopod of pleopod 4 long, consists of 4–5 segments, relatively thin, basal segment longest, straight. Telson elongate, linguiform, with rounded apex, not cleft.

The genus comprises three species. Only one species was recorded in the northern part of the Sea of Japan.

1. ***Stilomysis grandis*** (Goes, 1864)
(Pl. VII, figs. 1–7)

Goes, 1864: 176 (*Mysis grandis*); G.O. Sars, 1879: 106 (*Mysideis grandis*); Norman, 1892: 148 (*Stilomysis grandis*).

Description. Antennal scale 4.3–9.4 times as long as broad. Carpo-propodus of thoracopods 2–8 consists of 3 to 5 subjoints (in northwestern Pacific mysids, usually of 3 segments). Exopod of pleopod 3 of male 1.5–2.3 times longer than endopod. Exopod of pleopod 4 of male 3.7–7.8 times longer than endopod; basal segment slightly longer than all other segments of exopod together with terminal seta. Inner margin of endopod of uropod bears row of 20 to 56 spines, extending from statocyst almost to apex. Telson with relatively broadly rounded apex, 2.0–2.75 times as long as broad at base. Lateral margin of telson covered with numerous (38–73) spines, gradually increasing in length towards apex, or gathered in indistinct groups. Apex of telson armed with 2 pairs of spines, outer one 1.5–3 times longer than inner one. Maximum length of females 39.9 mm, of males 41.2 mm.

Distribution. *S. grandis* is an amphiboreal-arctic species. It is found in the Pacific Ocean and the adjacent Arctic regions from British Columbia, the Tatar Strait and Iturup Island of the Kurils (crosspiece of Kasatka Bay) to the Chukchi Sea (67°20.9′N, 164°58.4′W). In the North Atlantic and in the Arctic it occurs from Labrador Peninsula and northern Norway to the western coast of the Novaya Zemlya Archipelago and the border between the Krasnaya Armiya Strait (Severnaya Zemlya Archipelago) and the Laptev Sea. The species is found in the Sea of Japan in the Tatar Strait: from Moneron Island (46°08.2′N) to 49°40′N.

Habitat and breeding. *S. grandis* is a sublittoral-upper bathyal species. Its depth range is from 0 to 402 m, predominantly from 25 to 200 m; in the Sea of Japan recorded at depths from 89 to 175 m. It occurs in waters with a temperature from -1.8° to +8.1°C and a salinity of 30 to 35‰ over sandy or silty bottoms, rarer over stony bottoms. There are no records for the breeding of this species in the Sea of Japan.

Remarks. *Stilomysis major* Tattersall, 1951 from the southern part of the Sea of Japan is closely related to *S. grandis*, differing from it in the more elongate antennal scale (10 times as long as broad) having very narrowly rounded apex, and in the more narrowly rounded apex of the telson: the ratio of the telson width at the apex to the same at the base is 1/30–1/20 (in *S. grandis* 1/6–1/10); the lateral margin of the telson is armed with up to 84 spines. There is one more related species, *S. camtschatica* Marukawa, 1928, but it is likely to be a dwarf form of *S. grandis*.

4. Genus ***Disacanthomysis*** Holmquist, 1981

Type species: *Orientomysis dybowskii* Derjavin, 1913.

Eye large, stalk trapezoid. Antennal scale elongate, 2-segmented, with setae all along margin. Labrum with long, sharp anterior process. Female marsupiums composed of 2 pairs of well-developed oostegites. All male pleopods except for pair 4 and all female pleopods rudimentary, plate-shaped, relatively short, except for pleopods 5 in males. Male pleopod 5 elongate, slightly shorter than pleopod 4, with row of lateral setae and strong, long terminal seta. Male pleopod 4 biramous with one-segmented endopod, about as long as 1/2 of 3-segmented exopod; basal segment of exopod longest; distal segment very small: approximate ratio of lengths of segments 23:5:1. Each segment of exopod armed with 1–2 simple distal setae; distal segment additionally with two strong plumose setae. Endopod of uropod with row of spines on small lobe at inner ventral margin near statocyst. Telson linguiform; lateral spines situated on its distal third, gathered in distinct groups; rounded apex bears 2 pairs of spines.

There is one species in the genus.

1. ***Disacanthomysis dybowskii*** (Derjavin, 1913)
(Pl. VIII, figs 1–4)

Derjavin, 1913: 203 (*Orientomysis dybowskii*); Ii, 1936: 589, 597–600 (*Acanthomysis dybowskii*); Holmquist, 1981b: 410 (*Disacanthomysis dybowskii*).

Description. Antennal scale 5.4–10 times as long as broad. Carpo-propodus of endopod of thoracopods 5–8 consists of 5–8 subjoints. Endopod of uropod provided with lobe on ventral side near statocyst; lobe armed with 10 (in juveniles) to 11–18 spines. Telson 2–3 times as long as broad at base; spines on distal third of its lateral margin gathered in 5–10 distinct groups; apex with 2 pairs of spines, outer pair twice longer than inner one, and about as long as large spines on lateral margin. Maximum length of females 30.6 mm, of males 23.1 mm.

Distribution. *D. dybowskii* is a widespread Pacific boreal species, distributed from the Korea Strait and the Strait of Juan de Fuca to the southern regions of the Chukchi Sea (67°45′N, 164°19′W). In the Russian waters of the Sea of Japan it is found in Peter the Great Bay and in the Tatar Strait.

Habitat and breeding. *D. dybowskii* is a sublittoral species; its depth range is from 8 to 140 m, mostly to 60 m. It occurs in waters with a temperature from -1.8° to +19°C and a salinity of 28–34.8‰, over sandy silt, rarer over pebbles or sand. In the Sea of Japan females with embryos were recorded in June and August. The number of embryos varies from 41 to 52.

5. Genus ***Neomysis*** Czerniavsky, 1882

Type species: *Mysis integer* Leach, 1815.

Eye large, with cylindrical or trapezoid stalk. Antennal scale arrow-shaped, with pointed apex, 2-segmented. Marsupium consists of 2 pairs of oostegites. All female pleopods and male pleopods 1–3 and 5 rudimentary, plate-shaped. Male pleopod 4 biramous, with one-segmented endopod and long, relatively thin, two-segmented exopod, basal segment of which long and straight, distal one short, with pair of strong serrate terminal setae. Telson entire, not cleft, triangular with truncated or rounded apex (pl. IX, fig. 7; X, fig. 6).

This genus comprises 17 species, four of which were registered in the northern part of the Sea of Japan.

KEY TO THE SPECIES OF THE GENUS NEOMYSIS

1(6). Apex of telson broadly or narrowly truncated (pl. IX, fig. 7; X, fig. 6).

2(5). Spines on distal third of lateral margin of telson shorter than distances between their bases, thereby seeming widely spaced (pl. IX, fig. 7; X, fig. 6). Tergites of distal segment of thorax and of all abdominal segments smooth, without furrows (pl. IX, fig. 4).

3(4). Truncated apex of telson less than 1/7 as broad as base of telson (pl. IX, fig. 7). Rostral plate rectangular, with rounded distal corners (pl. IX, fig. 3) .... *1.* ***N. rayii*** (p. 55)

4(3). Truncated apex of telson more than 1/7 as broad as base of telson (pl. X, fig. 6). Rostral plate triangular, with rounded or, rarer, pointed apex (pl. X, figs. 2, 3) .... *2.* ***N. awatschensis*** (p. 56)

5(2). Spines on distal third of lateral margin of telson longer than distances between their bases, thereby seeming appressed to each other (pl. XI, fig. 6). Tergites of distal segment of thorax and segments 1–5 of abdomen with 2–3 shallow transverse furrows (pl. XI, fig. 3). (Apex of telson with two pairs of spines; outer pair twice as long as inner one .....*3.* ***N. czerniawskii*** (p. 56)

6(1). Apex of telson rounded (pl. XII, figs. 5, 6). (Spines on distal third of lateral margin of telson longer than distances between them, thereby seeming appressed to each other. Apex of telson with 2–3 pairs of equal spines. Tergites of distal segment of thorax and all abdominal segments smooth, without furrows) ....*4.* ***N. mirabilis*** (p. 57)

1. ***Neomysis rayii*** (Murdoch, 1885)
(Pl. I, figs. 1, 2; IX, figs. 1–7)

Murdoch, 1885: 519 (*Mysis rayii*); Holmes, 1900: 223 (*Neomysis franciscorum*); Zimmer, 1904: 470 (*Neomysis rayii*); Derjavin, 1913: 198 (*Neomysis toion*); Schmitt, 1919: 6 (*Neomysis franciscana*).

Description. Antennal scale long, 9.5–13.6 times as long as broad. Anterior margin of carapace with rectangular rostral plate, having rounded distolateral corners. Carpo-propodus of each of thoracopods 5–8 consists of 7–10 (in juveniles) to 19–21 subjoints. Exopod of male fourth pleopods 1.5–2.7 times as long as endopod; basal (proximal) segment of exopod 3.7–8.5 times longer than distal one. Small lobe situated on ventral side of endopod of uropod between statocyst and inner margin, armed with 17–22 (in juveniles) to 56 spines. Telson triangular, with narrow truncated apex: apex width 7.5–12 times less than base width; telson 2.6–3.3 times as long as broad at base; lengths of spines on distal third of lateral margin less than distances between them; apex armed with 2 pairs of spines: inner spines 3–5 times shorter than outer ones, the latter usually longer than longest spines on lateral margin. Maximum length of females 42.1 mm, of males 39.0 mm.

Distribution. *N. rayii* is a Pacific subtropical-boreal species. It is distributed from San-Francisco (California) and Tianjin (Gulf of Pohai) to Beechey Point (northern coast of Alaska) and the Long Strait. In the Sea of Japan it is found in the Tatar Strait and in Possjet Bay.

Habitat and breeding. *N. rayii* is a sublittoral species, with a depth range from 0 to 79 m, mostly to 50 m, in the Sea of Japan from 2 to 78 m. It is found in waters with a temperature from -1.7° to +25°C and a salinity from 15 to 34.3‰, over sand and muddy sand, rarer over boulders, pebbles, or silt. There are no records for the breeding of this species in the Sea of Japan.

2. ***Neomysis awatschensis*** (Brandt, 1851)
(Pl. X, figs. 1–6)

Brandt, 1851: 126 (*Mysis awatschensis*); Czerniavsky, 1882b: 30 (*Heteromysis intermedia*); Zimmer, 1904: 468 (*Neomysis awatschensis*); 1904: 469 (*Neomysis intermedia*); Nakazawa, 1910: 248 (*Neomysis nigra*); Marukawa, 1928: 6 (*Neomysis isaza*).

Description. Antennal scale 5–9.4 times as long as broad. Anterior margin of carapace produced into small triangular plate with rounded or pointed apex. Carpopropodus of each of thoracopods 5–8 consists of 3–6 (in juveniles) to 6–9 subjoints. Exopod of pleopod 4 of male 3 to 6.7 times longer than endopod; basal (proximal) segment of exopod 1.6–5.6 times longer than distal one. Ventral side of endopod of uropod with lobe between statocyst and inner margin, bearing from 10–16 (in juveniles) to 15–30 spines. Telson triangular with broad truncated apex: width of telson at apex 2.3–5.8 times less than width of telson at base; telson 1.75–4.0 times as long as broad at base; its lateral margin armed with 12–18 spines, as long as or shorter than distances between them; apex with 2 pairs of spines: outer ones 3 times as long as inner ones and about 1.5 times as long as longest spines on lateral margin. Maximum length of female body 18.1 mm, of male body 14.3 mm.

Distribution. *N. awatschensis* is a West Pacific subtropical-boreal species. It is distributed from the mouth of the Yangtze River (China), the northern coast of the South China Sea (China), and Shikoku Island (Japan) to Anadyr and Bristol bays and the north-western coast of Alaska (Chukchi Sea – 68˚24′N), also in the boreal fauna refugia in the Arctic: the lower course of the Chaun River (western part of Chukchi Peninsula) and in the Makkenzie River delta (north-western Canada); often occurs in the lower course of rivers: in the Amur River to the mouth of the Ussuri River. The records for the Sea of Japan are from De-Kastri Bay, Sovetskaya Gavan Bay (Konstantinovskaya Bight), Olga (in the river mouth) and Possjet bays (Ekspeditsiya and Novgorodskaya Bights, the lower course of the Gladkaya River).

Habitat and breeding. *N. awatschensis* is an estuarine-freshwater and high sublittoral species. Its depth range is 0–11 m, in the Sea of Japan from 0 to 3 m. It is found in waters with a temperature from -1° to +26°C and a salinity range of 0–27‰, mostly over sandy bottoms, rarer over other types of bottoms (from boulders and gravel to silt). Females with stage I–III embryos were recorded in Possjet Bay from July till September. The number of embryos varies from 6 to 29.

3. ***Neomysis czerniawskii*** Derjavin, 1913
(Pl. XI, figs. 1–6)

Derjavin, 1913: 199 (*Neomysis czerniawskii*); Schmitt, 1919: 6 (in part) (*Neomysis andersoni)*.

Description. Antennal scale 9–15 times as long as broad. Anterior margin of carapace with rostral plate; apex broadly rounded. Carpo-propodus of each of thoracopods 5–8 consists of 5–6 (in juveniles) to 7–12 subjoints. Tergites of distal thoracic segment and first to fifth abdominal segments with 2–3 shallow transverse furrows. Exopod of pleopod 4 of male 2.1–4 times as long as endopod; basal (proximal) segment of exopod 4.5–6 times as long as distal one. Ventral side of endopod of uropods

provided with lobe between statocyst and inner margin, armed with 13 to 41 spines. Telson elongate, triangular, with slightly truncated apex; telson 2.5–3.3 times as long as broad at base; lateral margin with 27 to 44 spines, gathered in 6–11 groups on distal half; 2 pairs of spines situated on apex; outer pair twice longer than inner one, almost as long as longest spines on lateral margin. Maximum length of female body 20.4 mm, of male body 19.1 mm.

Distribution. *N. czerniawskii* is a West Pacific subtropical-boreal species. It is distributed from the coast of Shandong Peninsula and the south of Hokkaido Island (Japan) to Alaska Peninsula and Kotzebue Bay (north-western Alaska). In the Sea of Japan it has been recorded in Peter the Great Bay (Possjet Bay, 42°37′N, 131°06′E) and in De-Kastri Bay (Observatoriya Island).

Habitat and breeding. *N. czerniawskii* is a high sublittoral species, found in depths from 0 to 31 m, throughout its area of distribution, as well as in the Sea of Japan. It occurs in waters with a temperature from -1° to +26°C and a salinity of 19.67–30‰, over sandy bottoms. There are no records for the breeding of this species in the Sea of Japan.

4. ***Neomysis mirabilis*** (Czerniavsky, 1882)
(Pl. XII, figs. 1–6)

Czerniavsky, 1882b: 33 (*Heteromysis mirabilis*); Zimmer, 1904: 468 (*Neomysis mirabilis*); Schmitt, 1919: 6 (in part) (*Neomysis andersoni*); Ii, 1936: 581 (*Neomysis nakazawai*).

Description. Antennal scale 8.7–15 times as long as broad. Anterior margin of carapace evenly rounded or with small triangular rostral plate having rounded apex. Carpo-propodus of endopod of thoracopods 5–8 consists of 7–8 (in juveniles) to 15 subjoints. Exopod of pleopod 4 of male 2.3–3.2 times as long as endopod; basal (proximal) segment 2.6–6 times as long as distal one. Ventral side of endopod of uropod with lobe between statocyst and inner margin, armed with 29–69 spines. Telson elongate, triangular, with rounded apex, sharply tapers in distal half or third, 2.4–3.5 times as long as broad at base. Lateral margins of telson with 33 to 50 spines, almost evenly increasing towards apex or gathered in 6–9 distinct groups (these two varieties also have transitional forms). Apex of telson armed with 2 to 3 pairs of equal spines. Maximum length of female body 35.5 mm, of male body 37.5 mm.

Distribution. *N. mirabilis* is a West Pacific widely dispersed boreal species, found from Wŏnsan (Korea) and the northern Japan (40°N) to the Bering Sea coast of Alaska (65°N) and the north-eastern coast of Kamchatka (61°30′N). It seems to be ubiquitous in the northern Sea of Japan: recorded from various parts of Peter the Great Bay, the Tatar Strait, and Vladimir Bay.

Habitat and breeding. *N. mirabilis* is a sublittoral species. In the area of its distribution, as well as in the Sea of Japan it occurs at depths from 0 to 140 m, mostly to 30 m, at a temperature from -1.6° to +24°C and a salinity of 15–34.3‰, predominantly over sand or muddy sand, rarer over boulders and pebbles, or over silt. Females with 6 to 76 embryos in the marsupiums were registered in the Sea of Japan March through September. *N. mirabilis* is one of the most abundant species in the coastal waters of the Sea of Japan.

6. Genus ***Boreoacanthomysis*** Fukuoka et Murano, 2004

Type species: *Mysis schrencki* Czerniavsky, 1882.

Carapace produced anteriorly into relatively short triangular rostral plate with almost pointed or narrowly rounded apex. Eyes well developed, trapezoid, slightly depressed dorsoventrally. Labrum with short anterior spiniform process. Antennal scale lanceolate, with rounded apex, armed with setae all along its outer and inner margins; subapical suture present. Marsupium composed of 2 pairs of well-developed oostegites. Tergites of free thoracic segments and all abdominal segments smooth, without transverse furrows or any transverse rows of spines and setae. First to third and fifth pleopods of male and all pleopods of female uniramous, reduced to unsegmented plate, increasing in length from first to fifth; fifth pleopod of male not reaching middle of last abdominal segment. Fourth pleopod of male biramous; endopod reduced to unsegmented lobe; exopod long, almost straight, 2-segmented, proximal segment long, armed on each distal corner with seta (occasionally without one or both setae); distal segment short, armed with 2 long, strong, subequal terminal setae and short setae on distal corners (occasionally without one or both of these setae). Endopod of uropod armed with numerous, densely set spines on ventral surface near inner margin in statocyst region. Telson elongate, linguiform or triangular, with narrow apex; lateral margins armed on anterior 1/3–1/2 with almost equal spines set rather sparsely and on posterior 2/3–1/2 with grouped spines set densely, each group consisting of one large spine and one-three smaller ones; apex with 2 pairs of spines, outer spines much longer than inner ones.

The genus comprises one species.

1. ***Boreoacanthomysis schrencki*** (Czerniavsky, 1882) (Pl. XIII, figs. 1–4)

Czerniavsky, 1882b: 20 (*Mysis schrencki*); Derjavin, 1913: 198 (*Orientomysis schrencki*); Ii, 1936: 589 (*Acanthomysis schrencki*); Holmquist, 1981b: 408 (*Pacifacanthomysis schrencki*); Fukuoka, Murano, 2004: 2137–2143 (*Boreoacanthomysis schrencki*).

Description. Antennal scale 3.4–5.8 times as long as broad. Carpo-propodus of endopod of thoracopods 5–8 consists of 3 (in juveniles) to 4–6 subjoints. Exopod of fourth pleopod of male (with terminal setae) 3.0–4.0 times as long as endopod; basal (proximal) segment 3–6 times as long as distal one. Endopod of uropod armed with 6–8 (in juveniles) to 38 spines on ventral lobe placed near statocyst. Telson with slightly truncated apex, 2.1–3.5 times as long as broad at base; inner spines on its apex 2–3 times as short as outer ones. Maximum length of female body 18.5 mm, of male body 14.6 mm.

Distribution. *B. schrencki* is a West Pacific widespread boreal species. It is distributed from Possjet Bay (Sea of Japan) and the eastern coast of Hokkaido Island to Paramushir Island (Kurils) and the northern coast of the Sea of Okhotsk. In the Sea of Japan it occurs in Peter the Great Bay and in the Tatar Strait.

Habitat and breeding. This is a sublittoral species, vertically distributed from 0 to 80 m, mostly to 25 m. It occurs in waters with a temperature from -1.2° to +21.4°C and a salinity between 29.5 and 34.3‰, predominantly over rocks and boulders or sandy silt, rarer over gravel with pebbles or silt. Females bearing embryos were rec-

orded in the Sea of Japan for May and August-September. The number of embryos varies between 17 and 68.

7. Genus ***Hemiacanthomysis*** Fukuoka et Murano, 2002

Type species: *Acanthomysis dimorpha* Ii, 1936.

Carapace anteriorly produced to relatively short triangular rostral plate. Eyes well developed, trapezoid, slightly depressed dorsoventrally. Labrum with comparatively long anterior spiniform process. Antennal scale lanceolate, with rounded apex, setose all along length of inner and outer margins; subapical suture present. Marsupium consists of 2 pairs of well-developed oostegites. Tergites of free thoracic segments and of all abdominal segments smooth, without transverse furrows or transverse rows of spines or setae. First to third and fifth male pleopods and all female pleopods uniramous, reduced to unsegmented plate, increasing in length from first to fifth. Fourth pleopod of male biramous; endopod reduced to unsegmented lobe; exopod long, almost straight, 2-segmented; proximal segment long, armed on each distal corner with seta (occasionally without one or both setae), distal segment short, armed with two long, strong subequal terminal setae and one short seta on distal corner, or without this seta. Endopod or uropod armed with spines throughout length of inner margin from statocyst almost to apex. Telson elongate, triangular, with narrowly rounded apex or linguiform, with lateral margins bearing subequal spines.

The genus comprises one species.

1. ***Hemiacanthomysis dimorpha*** (Ii, 1936) (Pl. XIII, figs. 5–9).

Ii, 1936: 593 (*Acanthomysis dimorpha*); Fukuoka & Murano, 2002: 210–214 (*Hemiacanthomysis dimorpha*).

Description. Antennal scale 3.4–5.4 times as long as broad. Carpo-propodus of endopod of thoracopods 5–8 consists of 3–5 (in juveniles) to 4–7 subjoints. Exopod of fourth pleopod of male 3 (in immature males) to 1.3 times as long as endopod; basal (proximal) segment of exopod 4–7 times as long as distal one. Inner margin of endopod of uropod armed with row of 14 (in juveniles) to 31 spines extending from statocyst almost to apex. Telson 1.4–2.7 times as long as broad at base; apex armed with 3–4 pairs of equal spines in females, with 2 pairs of spines in males; outer pair twice longer than inner one or than lateral spines. Maximum length of females 25.7 mm, of males 17.6 mm.

Distribution. *H. dimorpha* is a West Pacific widespread boreal species. It is distributed from the Korea Strait to the northern Bering Sea: Tkachen Bay (64°25′N; 172°48′W). It has been recorded from the Sea of Japan near the Korea Strait and in the Tatar Strait.

Habitat and breeding. The species is sublittoral, vertically distributed from 10 to 140 m, in the Sea of Japan from 10 to 104 m. It occurs in waters with a temperature range between -1.7° and +19°C and a salinity range between 28.44 and 34.5‰, over sand, silt, gravel with pebbles, rarer over clay. Females with embryos were registered in the Sea of Japan July through August. The number of embryos ranges from 13 to 49.

8. Genus ***Exacanthomysis*** Holmquist, 1981

Type species: *Acanthomysis davisi* Banner, 1948.

Carapace anteriorly produced into pointed triangular rostral plate. Labrum with relatively long anterior spiniform process. Antennal scale lanceolate, with rounded apex, setose all along length of margins; subapical suture present. Marsupium composed of 2 pairs of well-developed oostegites. Tergites of free thoracic segments and of all abdominal segments with 2–3, occasionally with 4 transverse dorsolateral furrows, in some specimens breaking dorsally. First to third and fifth male pleopods and all female pleopods uniramous, reduced to unsegmented plate. Fourth pleopod of male biramous, relatively short; endopod at least half as long as exopod; exopod 2-segmented; proximal segment straight, with one small and one large simple setae on distal corners or sometimes without them; distal segment with one very small seta or without it and with two strong subequal terminal setae. Endopod of uropod with relatively short row of spines on ventral surface between inner margin and statocyst. Telson elongate, triangular; lateral margins with numerous spines, grouped on distal 1/2–2/3 of these margins: each large spine followed by one or several smaller spines.

Remarks. Making morphological analysis of the species belonging formerly to the genus *Acanthomysis*, Holmquist (1981a, b) did not manage to define a genus for *A. stelleri* and *A. borealis* due to the poor condition of available specimens. Besides, the specimens, which she had in her disposal, identified by Derjavin as *A. stelleri*, proved to be *A. borealis*. It has been determined now based on rather sizeable collections (20 samples, 268 specimens of *A. stelleri* and 35 samples, 662 specimens of *A. borealis*) that these species agree with the diagnosis of the genus *Exacanthomysis* and may be included in it. The only different character in *A. borealis* is the apex of the telson, which is not narrowly truncated as in the other related species, but narrowly rounded. However, it may be considered as a distinguishing character at a species level.

KEY TO THE SPECIES OF THE GENUS EXACANTHOMYSIS

1(2). Telson elongate, triangular, with slightly truncated apex (pl. XIV, fig. 5) .... ***E. stelleri*** (p. 60)

2(1). Telson elongate, triangular, with rounded apex (pl. XV, fig. 5) .... ***E. borealis*** (p. 61)

1. ***Exacanthomysis stelleri*** (Derjavin, 1913) (Pl. XIV, figs. 1–5).

Derjavin, 1913: 202 (*Orientomysis stelleri*); Ii, 1936: 589 (*Acanthomysis stelleri*); Holmquist, 1981a: 260 (*Exacanthomysis arctopacifica*); Murano, 1991: 81–86 (*Exacanthomysis japonica*).

Description. Antennal scale straight, 4–5.7 (in juveniles up to 8.6) times as long as broad. Carpo-propodus of endopod of thoracopods 5–8 with 4–7 subjoints. Exopod of pleopod 4 of male 1.3–3.3 times as long as endopod; basal (proximal) segment of exopod 3–6 times as long as distal one. Endopod of uropod armed with 4–5 (in juveniles) to 5–11 spines on ventral surface close to statocyst. Telson elongate, triangular,

with slightly truncated apex, abruptly tapering in distal 1/3, spines on distal 1/2–2/3 of lateral margin gathered in 8–14 distinct groups; apex with 2 pairs of spines; outer twice as long as inner and equal to, usually shorter than large spines on lateral margin. Maximum length of females 24.4 mm, of males 25.2 mm .

Distribution. *E. stelleri* is a West Pacific widespread boreal species. It is distributed from Possjet Bay (Sea of Japan) and Hokkaido Island to Kodiak Island and the southern part of the Chukchi Sea, excluding the northern and western areas of the Sea of Okhotsk. It is found in the Sea of Japan in Peter the Great Bay and in the Tatar Strait.

Habitat and breeding. The species is sublittoral, vertically distributed from 0 to 104 m, mostly to 25 m. It occurs in waters with a temperature range from –1.5° to +21.2°C and a salinity range from 27 to 34.5‰, over sandy, rarer over silty bottoms. There are no records for the breeding of this species in the Sea of Japan.

2. ***Exacanthomysis borealis*** (Banner, 1954) (Pl. XV, figs. 1–7).

Banner, 1954: 135 (*Acanthomysis borealis*); Holmquist, 1981a: 251–256 (*Acanthomysis stelleri*).

Description. Antennal scale slightly S-shaped, 5.4–9.3 times as long as broad. Carpo-propodus of endopod of thoracopods 5–8 consists of 5–8 subjoints. Exopod of pleopod 4 of male 2–3 times as long as endopod; basal (proximal) segment of exopod 4.6–6 times as long as distal one. Number of spines on ventral side of endopod of uropod near statocyst varies from 3 (in juveniles) to 6. Telson elongate, triangular, with narrowly rounded apex, abruptly tapering in distal third; spines on distal half of lateral margin gathered in 8–12 groups; apex with 2 pairs of spines: outer spines almost equal in length to adjacent lateral ones and slightly (in females) or twice (in males) longer than inner ones. Maximum length of males and females 18.5 mm.

Distribution. *E. borealis* is a West Pacific widespread boreal species, distributed from Possjet Bay (Sea of Japan), Zeleny Island (Malaya Kurilskaya Gryada = Small Kurile Islands) to Kodiak Island, Bristol Bay and the eastern coast of Kamchatka (61°N). In the Sea of Japan it is found in Peter the Great Bay and in the Tatar Strait.

Habitat and breeding. *E. borealis* is a sublittoral species; its depth range is from 0 to 104 m, mostly from 25 to 100 m, in the Sea of Japan from 9 to 104 m. It occurs in waters with a temperature from -1° to +18°C and a salinity of 28–34.5‰, over rocks, boulders, sand and silt. Females with embryos were recorded in the Sea of Japan in August. The number of embryos varies from 20 to 65.

9. Genus ***Paracanthomysis*** Ii, 1936

Type species: *Paracanthomysis hispida* Ii, 1936.

Eyes large, spherical. Antennal scale lanceolate, with rounded apex, 2-segmented, bears only setae on margins. Female marsupium consists of 2 pairs of oostegites. All pleopods, except for fourth pleopods of male rudimentary, one-segmented, plate-like. Fourth pleopod of male biramous, with short one-segmented endopod and long one-segmented exopod, bearing 2 long serrate terminal setae; distal 1/3–1/4 of

exopod with one simple lateral seta. Telson entire, linguiform; or elongate, triangular, with rounded apex.

One of three species of this genus is known from the northern part of the Sea of Japan.

1. ***Paracanthomysis shikhotaniensis*** Petryashov, 1983 (Pl. XVI, figs. 1–7)

Petryashov, 1983: 125–128 (*Paracanthomysis shikhotaniensis*); Takahashi & Murano, 1986: 61–65 (*Paracanthomysis spadix*).

Description. In male, outer flagellum of antennule 2 times as broad as inner one, curved horn-like at base; inner flagellum has ordinary form. In females inner flagellum of antennule lanceolate, 2.5 times as broad as outer one, and about 2–2.5 times as long as peduncle; outer flagellum has ordinary form. Antennal scale 7–12 times as long as broad (in juveniles 10–12 times as long as broad). Carpo-propodus of endopod of thoracopods 3–8 consists of 4 (in juveniles) to 5–7 subjoints. Tergites of distal thoracic segment and all abdominal segments smooth, without furrows or spines. Exopod of pleopod 4 of male 2.8 (in young males) to 8.6 times as long as endopod. Ventral side of endopod of uropod, near statocyst, bears 3 (in juveniles) to 4–7 spines. Telson elongate, linguiform, 2–3.3 times as long as broad at base; spines on distal half of lateral margin, excluding its apical part, gathered in 3–10 distinct groups; spines on apical part of lateral margin almost equal; apex with 2 pairs of spines: inner pair slightly shorter than outer one, outer spines almost as long as adjacent lateral spines. Maximum length of females 27.1 mm, of males 22.6 mm.

Distribution. *P. shikhotaniensis* is a West Pacific widespread boreal species, distributed from the north-eastern Japan and Possjet Bay (Sea of Japan) to Korf Bay (Bering Sea); no one specimen has been recorded off the northern and western coast of the Sea of Okhotsk. In the Sea of Japan it is found in Peter the Great Bay and in the Tatar Strait.

Habitat and breeding. *P. shikhotaniensis* is a high sublittoral species; its depth range is from 0 to 21.5 m. It occurs in waters with a temperature from -1.5° to +22.6°C and a salinity of 30–34‰, over rocks, rarer over boulders and gravel, sand, or muddy sand. It is most abundant near rocks and capes with strong surf. Females with embryos were recorded in the Sea of Japan for May, July, and August. The number of embryos ranges from 8 to 54.

References

Bacescu, M. & L.G. Gleye. 1979. New Mysidacea from the Californian waters // Trav. Mus. Hist. Nat. Grigore Antipa. V. 20. P. 131–141.

Banner, A.H. 1948. A taxonomic study of the Mysidacea and Euphausiacea (Crustacea) of the northeastern Pacific. Part II. Mysidacea, from tribe Mysini through subfamily Mysidellinae // Trans. Roy. Can. Inst. V. 27. P. 65–124.

Banner, A.H. 1954. New records of Mysidacea and Euphausiacea from the northeastern Pacific and adjacent areas // Pacif. Sci. V. 8. P. 125–139.

Brandt, F. 1851. Th. Middendorffs Riese in den aussersten Norden und Osten Sibiriens // Zoologie. Bd 2, N 1. S. 79–148.

Czerniavsky, V. 1882a. Monographia Mysidarum imprimis imperii Rossici. Fascicle I // Travaux de la Societe imperiale des Naturalistes de St. Peterbourg, V. 12. P. 1–170.

Czerniavsky, V. 1882b. Monographia Mysidarum imprimis imperii. Rossici. Fascicle II // Travaux de la Societe imperiale des Naturalistes de St. Peterbourg, V. 13. P. 1–85.

Derjavin, A.N. 1913. Neue Mysiden von der Kuste der Halbinsel Kamtschatka // Zool. Anz. Bd 43. S. 197–204.

Fukuoka, K. & M. Murano. 2002. A New Genus, *Hemiacanthomysis*, for *Acanthomysis dimorpha* (Crustacea: Mysidacea: Mysidae)// Species Diversity. V. 7. P. 209–215.

Fukuoka, K. & M. Murano. 2004. A new genus for *Acanthomysis schrencki* (Czerniavsky, 1882) (Crustacea: Mysida: Mysidae) with the first description of the male // J. Nat. Histor. V. 38. P. 2135–2143.

Goes, A. 1864. Crustacea decapoda podophthalma marina Sueciae, interpositis speciebus Norvegicus aliisque vicinis enumerat // Ofvers. K. Vetensk. Akad. Forhandl. Stockholm. V. 20. P. 161–180.

Gordan, J. 1957. A bibliography of the order Mysidacea // Bull. Amer. Mus. Nat. Hist. V. 112, N 4. P. 281–393.

Hanamura, Y. 1997. Review of the taxonomy and biogeography of shallow-water mysids of the genus *Archaeomysis* (Crustacea: Mysidacea) in the North Pacific Ocean // J. Nat. Hist. V. 31. P. 669–711.

Holmes, S.J. 1894. Notes on west American Crustacean // Proc. California Acad. Sci. Ser. 2. V. 4. P. 563–588.

Holmes, S.J. 1900. California stalk-eyed Crustacea // Occ. Pap. Calif. Acad. Sci. N 7. P. 1–262.

Holmquist, C. 1975. A revision of the species *Archaemysis grebnitzkii* Czerniavsky and *A. maculata* (Holmes) (Crustacea, Mysidacea) // Zool. Jb., Syst. Bd 102. S. 51–71.

Holmquist, C. 1980. *Xenacanthomysis* – a new genus for the species known as *Acantomysis pseudomacropsis* (W.M. Tattersall, 1933) (Crustacea, Mysidacea) // Zool. Jb., Syst. Bd 107. S. 501–510.

Holmquist, C. 1981a. *Exacanthomysis* gen. nov., another detachment from the genus *Acanthomysis* Czerniavsky (Crustacea, Mysidacea) // Zool. Jb., Syst. Bd 108. S. 247–263.

Holmquist, C. 1981b. The genus *Acanthomysis* Czerniavsky, 1882 (Crustacea, Mysidacea) // Zool. Jb. Syst. Bd 108. S. 386–415.

Ii, N. 1936. Studies on Japanese Mysidacea. I. Descriptions of new and some already known species belonging to the genera *Neomysis*, *Acanthomysis* and *Proneomysis* // Japan. J. Zool. V. 6. P. 577–619.

Ii, N. 1940. Studies on Japanese Mysidacea. 4. Descriptions of three new species belonging to tribe Mysini // Japan. J. Zool. V. 9. P. 153–173.

Ii, N. 1964. Fauna Japonica. Mysidacea. Biogeogr. Soc. Jap. 610 p.

Martin, J.W. & G.E. Davis. 2001. An updated classification of the recent Crustacea // Nat. Hist. Mus. Los Angeles County, Sci Ser. N 39. P. 1–124.

Marukawa, H. 1928. Uber neue 5 Arten der Schizopoden // Annot. Oceanogr. Res. V. 2, N l. P. 1–6.

Mauchline, J. 1980. The biology of mysids and euphausiids // Adv. Mar. Biol. V. 18. 677 p.

Murano, M. 1991. Two new species of the tribe Mysini (Crustacea, Mysidacea) and a new record of *Acanthomysis quadrispinosa* from Japan // Bull. Nat. Sci. Mus., Tokyo. V. 17, N 2. P. 81–91.

Murano, M. 1999. Mysidacea // South Atlantic Zooplankton. Leiden: Backhuys Publishers. P. 1099–1140.

Murdoch, J. 1885. Description of seven new species of Crustacea and one worm from Arctic Alaska // Proc. U. S. Natl. Mus. V. 7. P. 518–522.

Nakazawa, K. 1910. Notes of Japanese Schizopoda // Annot. Zool. Japan. V. 7. P. 247–261.

Norman, A.M. 1892. On British Mysidae, a family of Crustacea Schizopoda // Ann. Mag. Nat. Hist. Ser. 6. V. 10. P. 143–166.

Nouvel, H., Casanova, J.-P. & J.-P. Lagardere. 1999. Ordre des Mysidaces (Mysidacea Boas 1883) // Traite de Zoologie. T. III, fas. IIIA. Crustaces Peracarides. Memor. Inst. Oceanograph. N 19. P. 39–86.

Ortmann, A.E. 1908. Schizopod crustaceans in the U. S. National Museum. Schizopods from Alaska // Proc. U. S. Natl. Mus. V. 34. P. 1–10.

Petryashov, V.V. 1983. *Paracanthomysis shikhotaniensis* sp.n. (Crustacea, Mysidacea) from the coast of Shikotan Island // Zool. Zhurnal. V. 62, N 1. P. 125–128. (In Russian).

Petryashov, V.V. 2005. Biogeographical division of the North Pacific sublittoral and upper bathyal zones by the fauna of Mysidacea and Anomura (Crustacea) // Biologiya Morya. V. 31, N 4. P. 233–250. (In Russian).

Sars, G.O. 1879. Carcinologische Bidrag till Norges Fauna. 1. Monographic over de ved Norges Kyster forekommende Mysider. Part 3. Christiania. 131 p.

Schmitt, W.L. 1919. Schizopod crustaceans // Report of the Canadian Arctic expedition 1913–18. Ottawa. V. 7. Crustacea. Part B. P. 1–8.

Smith, S.I. 1879. The stalk-eyed crustaceans of the Atlantic coast of North America north of Cape Cod // Trans. Connecticut Acad. Arts. Sci. V. 5. P. 27–136.

Takahashi, K. & M. Murano. 1986. A new species of the genus *Paracanthomysis* (Crustacea, Mysidacea) from northeastern Japan // Bull. Nat. Sci. Mus., Tokyo. V. 12, N 2. P. 61–66.

Taniguchi, A. 1969. Mysidacca and Euphausiacea collected in the south-east of Hokkaido, Japan // Bull. Fac. Fish. Hokkaido Univ. V. 20. P. 43–59.

Tattersall, W.M. 1933. Euphausiacea and Mysidacea from western Canada // Contrib. Canadian Biol. Fish. New Ser. V. 8, N 15. P. 183–205.

Tattersall, W.M. 1951. A review of the Mysidacea of the United States National Museum // Bull. U. S. Nat. Mus. N 201. 292 p.

Tchindonova, J.G. 1981. New data on systematic position of some deep-sea mysids (Mysidacea, Crustacea) and their distribution in the World Ocean // Biology of the Pacific Ocean depths: Proceedings of the XIV Pacific Science Congress (Khabarovsk, August 1979). Section “Marine Biology”. Issue 1. Vladivostok. P. 24–33.

Zimmer, C. 1904. Die Arctischen Schizopoden // Fauna Arctica. Bd 3, N 3. S. 415–492.

Zimmer, C. 1927. Mysidacea // Handbuch der Zoologie. Berlin; Leipzig. Bd 3. S. 607–650.

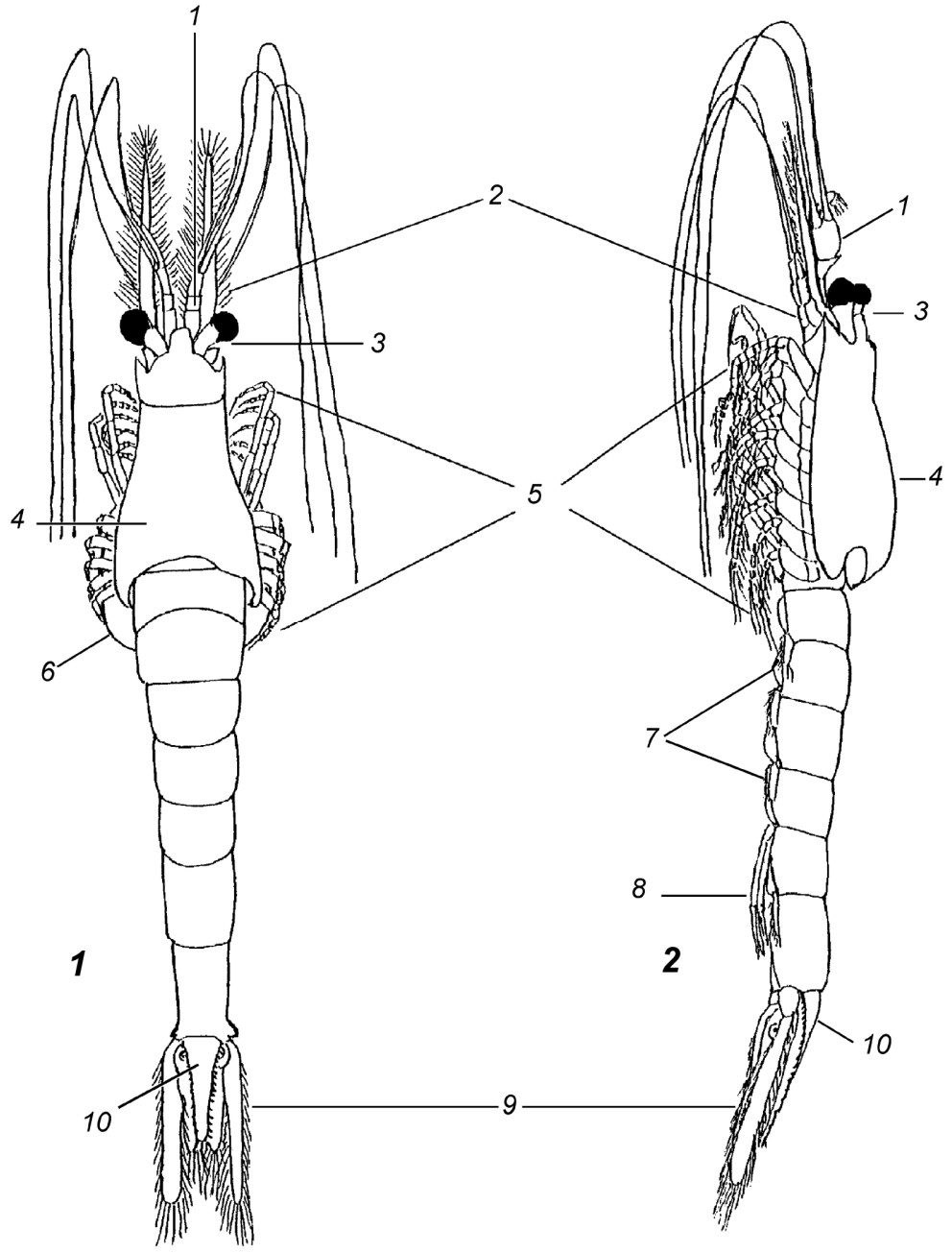


Plate I. Full-length view of *Neomysis rayii*, female (1) and male (2), general morphology: 1 – antennules (antennae I); 2 – antennae (antennae II); 3 – eyes; 4 – carapace; 5 – thoracopods; 6 – marsupium; 7 – pleopods 1–3; 8 – male pleopods 4; 9 – uropods; 10 – telson

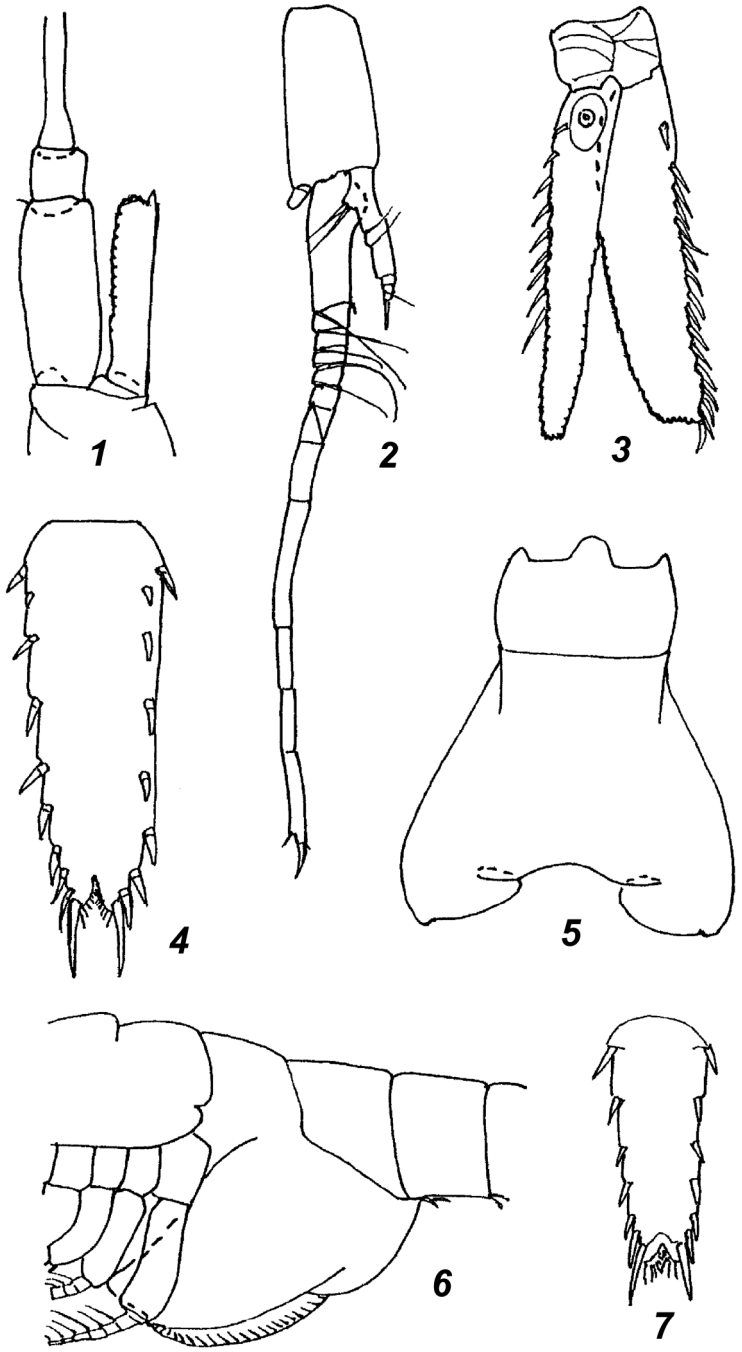


Plate II. *Archaeomysis grebnitzkii* (1–4 – specimens collected off the coast of Bering Island, 5–7 – specimens collected off the coast of Peter the Great Bay): 1 – antenna; 2 – male pleopod 3; 3 – uropod, ventral view; 4 – telson; 5 – carapace, dorsal view; 6 – female marsupium, composed of oostegites and epimeral lamellae of first abdominal segment; 7 – telson

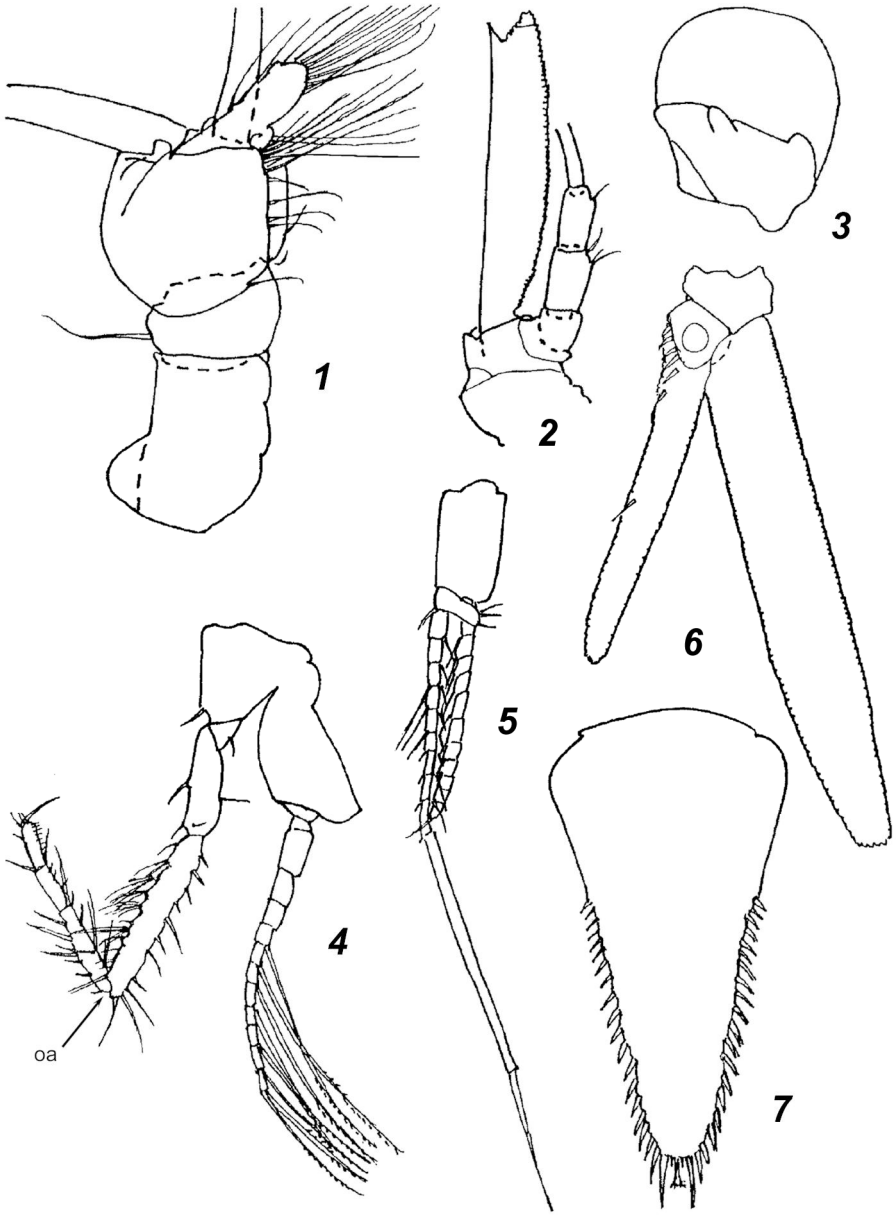


Plate III. *Holmesiella anomala*: 1 – male antennules; 2 – antennae; 3 – eye; 4 – thoracopod 6 (*oa* – oblique articulation); 5 – male pleopod 4; 6 – uropod, ventral view; 7 – telson

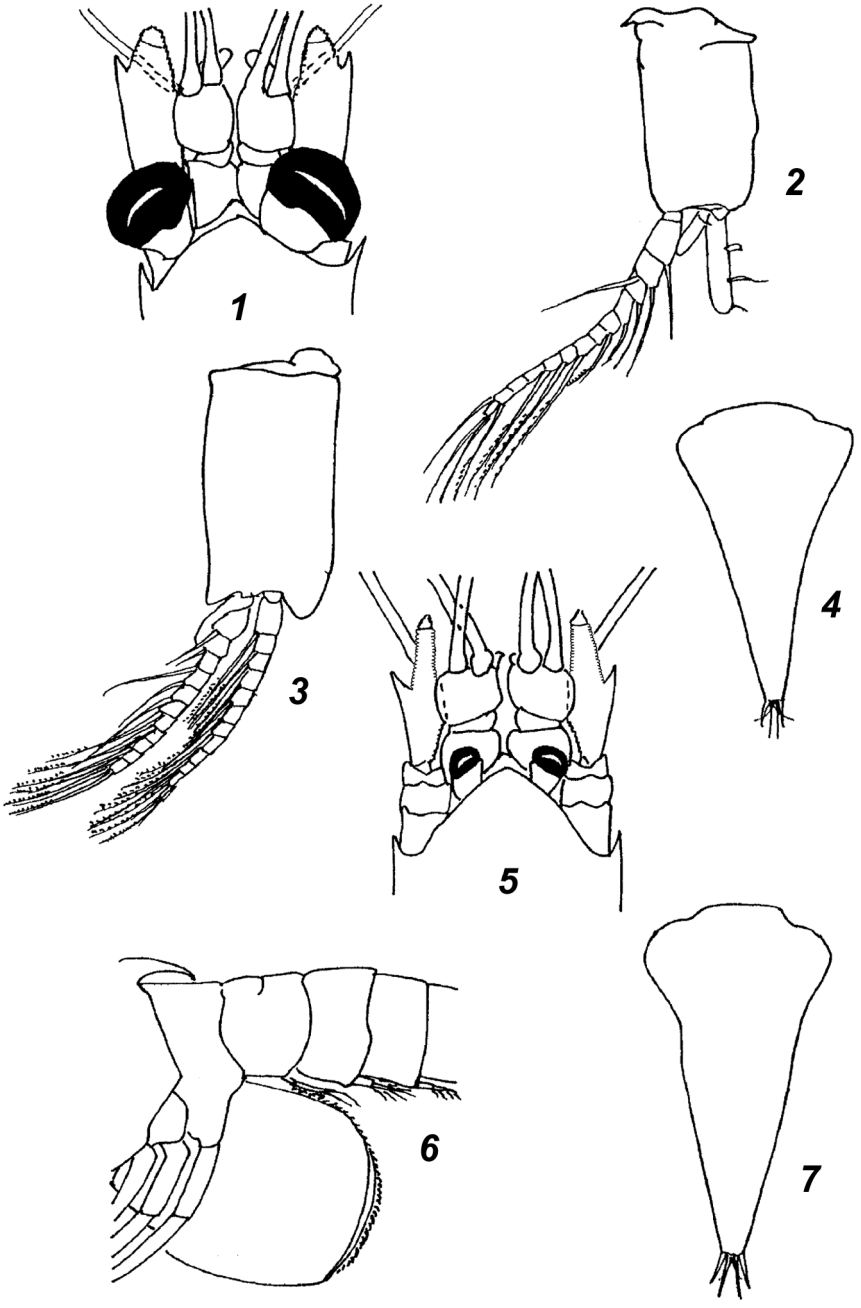


Plate IV. *Meterythrops robusta* (1–4): 1 – male cephalon and anterior margin of carapace; 2 – male pleopod 1; 3 – male pleopod 2; 4 – telson; *Meterythrops microphthalma* (5–7): 5 – male cephalon and anterior margin of carapace; 6 – female marsupium, composed only of oostegites; 7 – telson

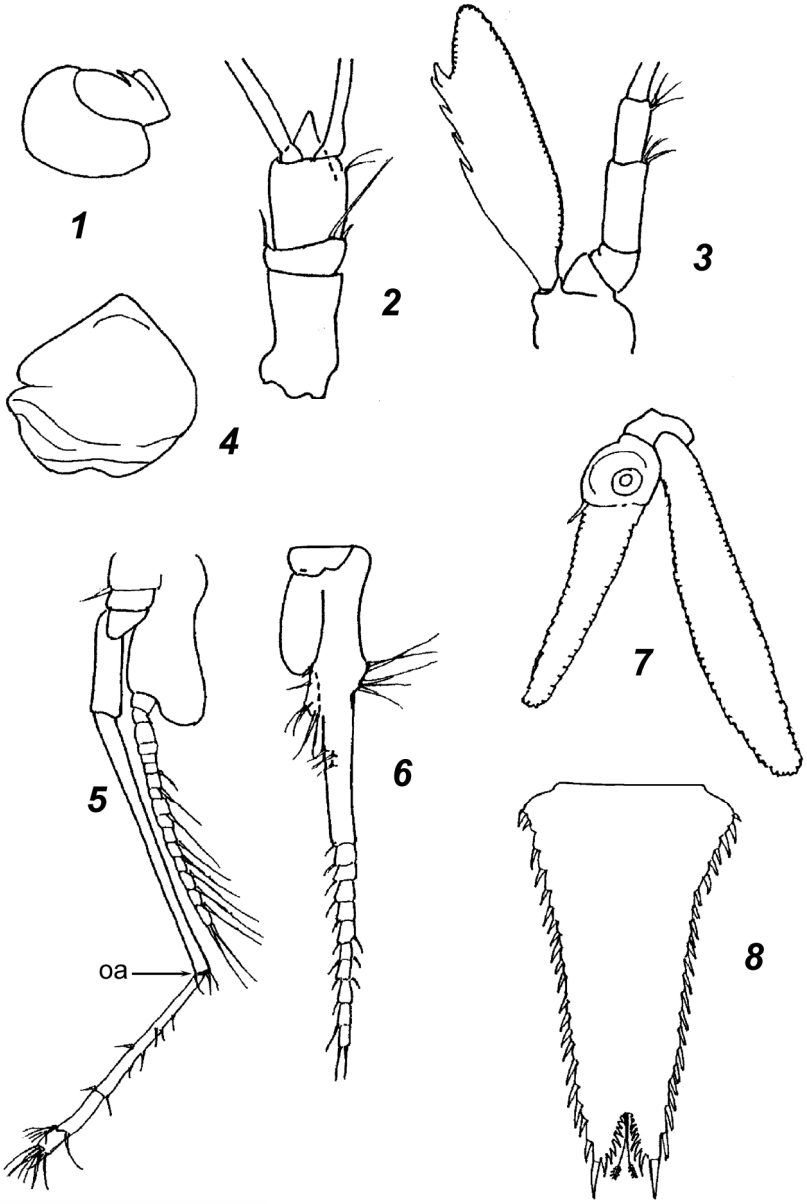


Plate V. *Inusitatomysis insolita*: 1 – eye; 2 – male antennule; 3 – antenna; 4 – labrum; 5 – thoracopod 3 (*oa* – oblique articulation); 6 – male pleopod 4; 7 – uropod, ventral view; 8 – telson

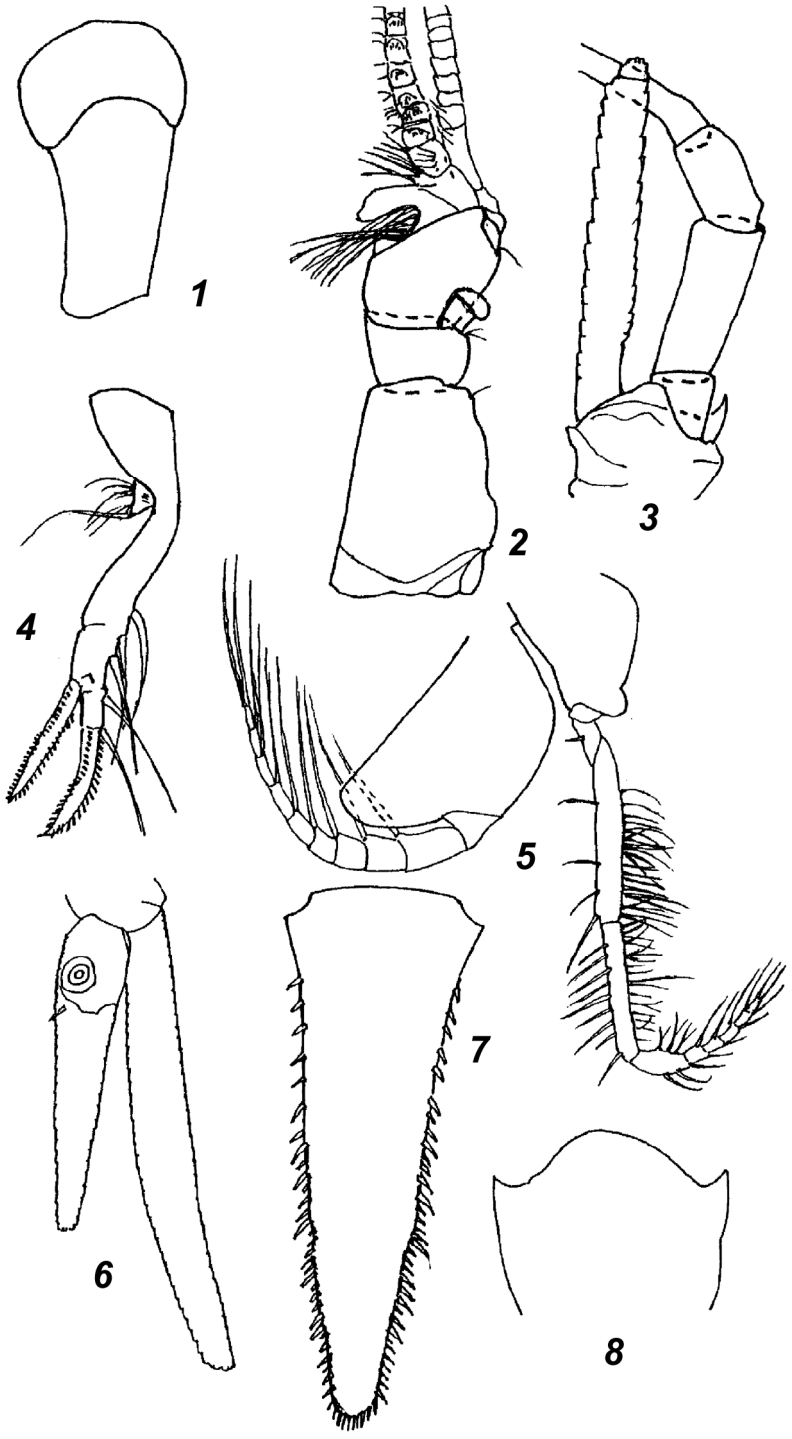


Plate VI. *Xenacanthomysis pseudomacropsis*: 1 – eye; 2 – male antennule; 3 – antenna; 4 – male pleopod 4; 5 – thoracopod 5; 6 – uropod, ventral view; 7 – telson; 8 – anterior margin of carapace

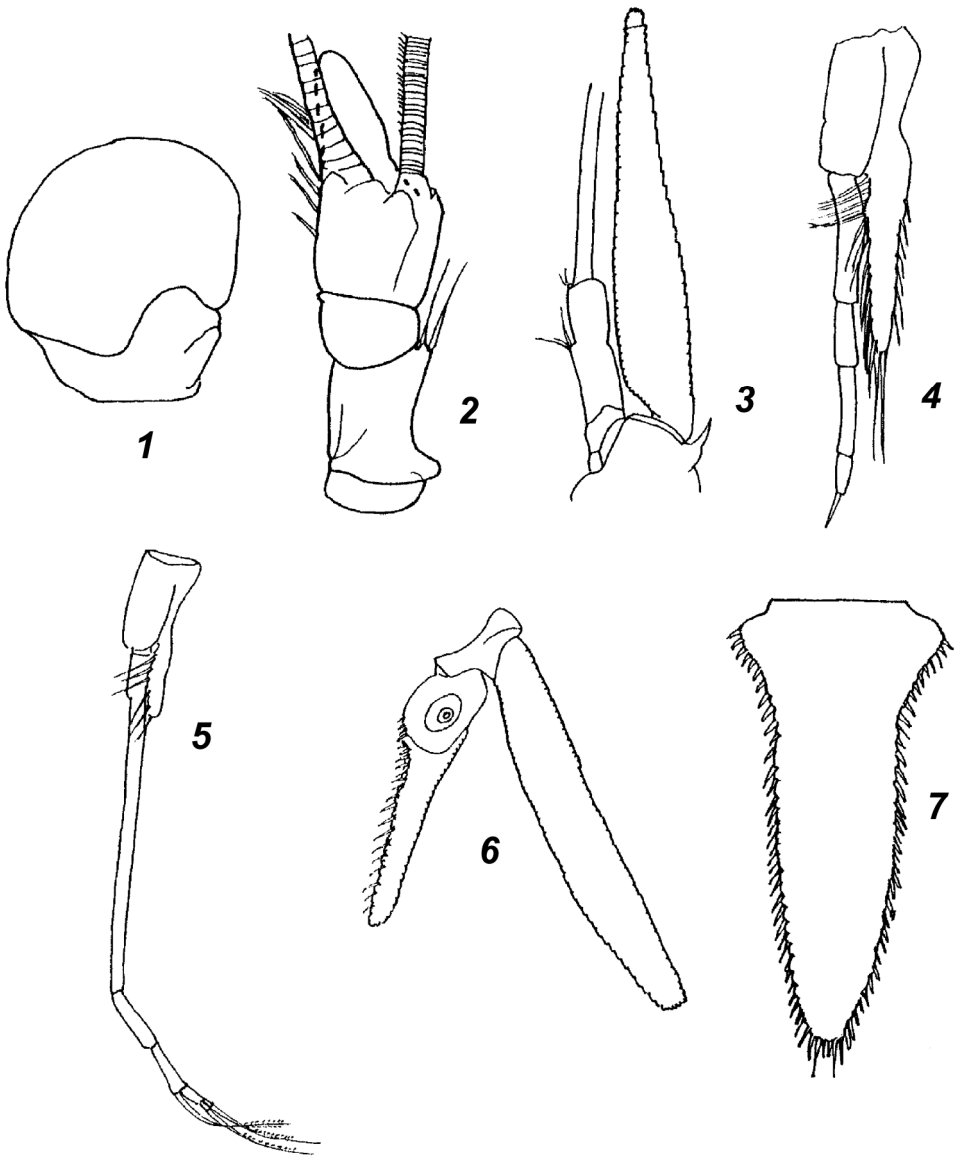


Plate VII. *Stilomysis grandis*: 1 – eye; 2 – male antennule; 3 – antenna; 4 – male pleopod 3; 5 – male pleopod 4; 6 – uropod, ventral view; 7 – telson

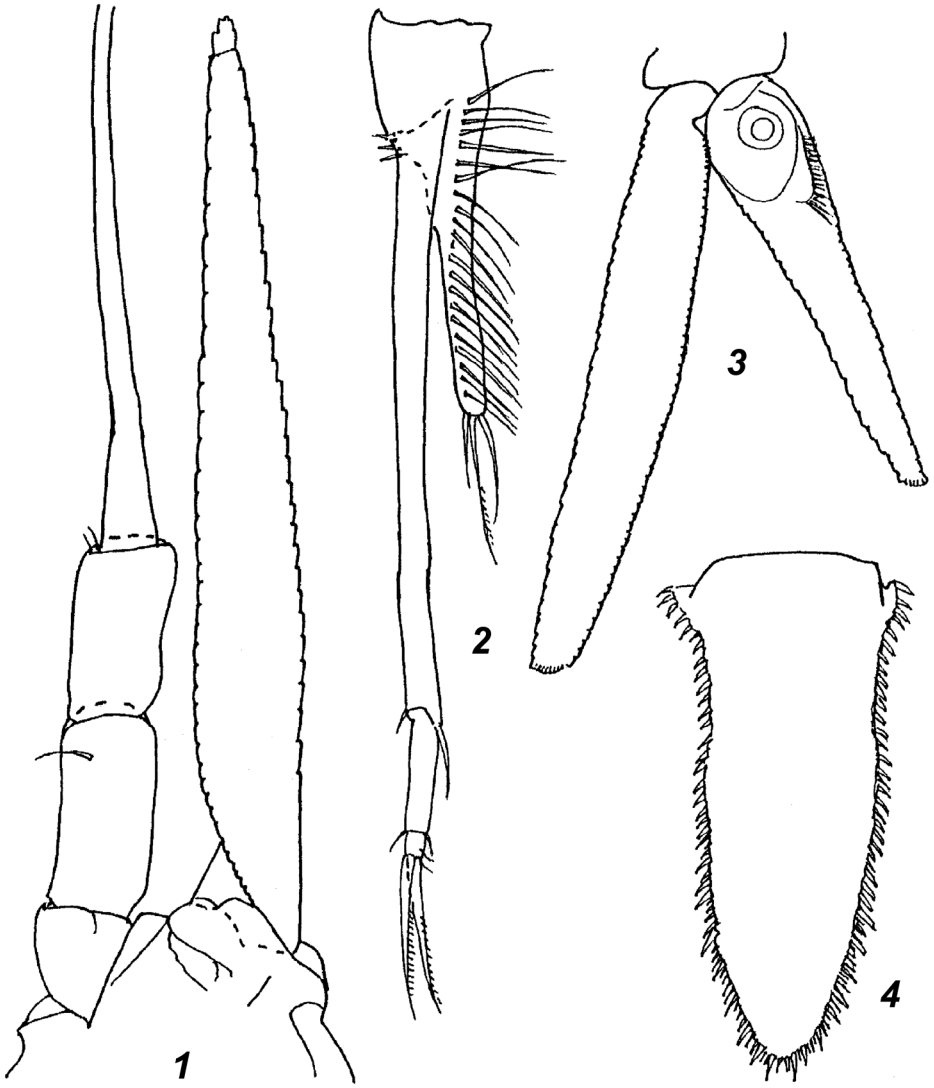


Plate VIII. *Disacanthomysis dybowskii*: 1 – antenna; 2 – male pleopod 4; 3 – uropod, ventral view; 4 – telson

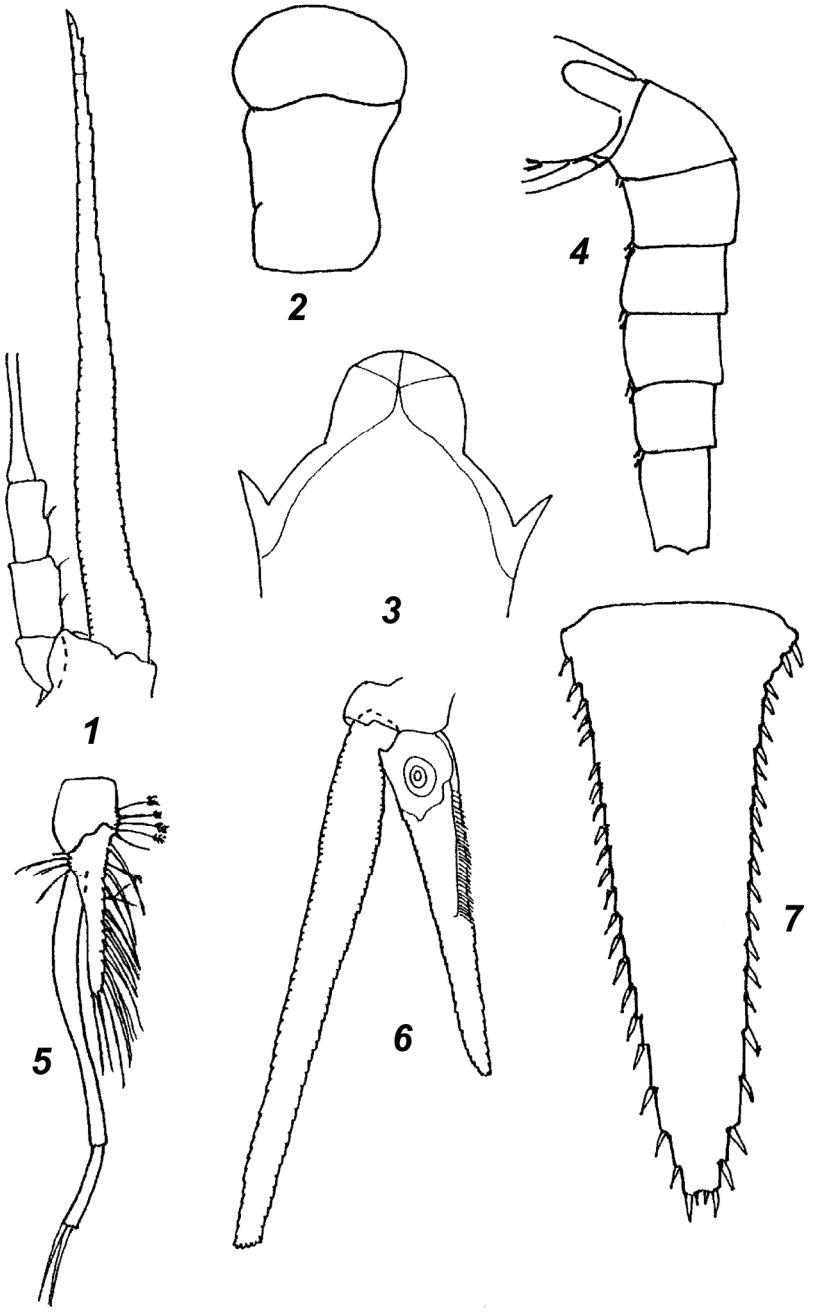


Plate IX. *Neomysis rayii*: 1 – antenna; 2 – eye; 3 – anterior margin of carapace; 4 – distal segment of thorax and all abdominal segments; 5 – male pleopod 4; 6 – uropod, ventral view; 7 – telson

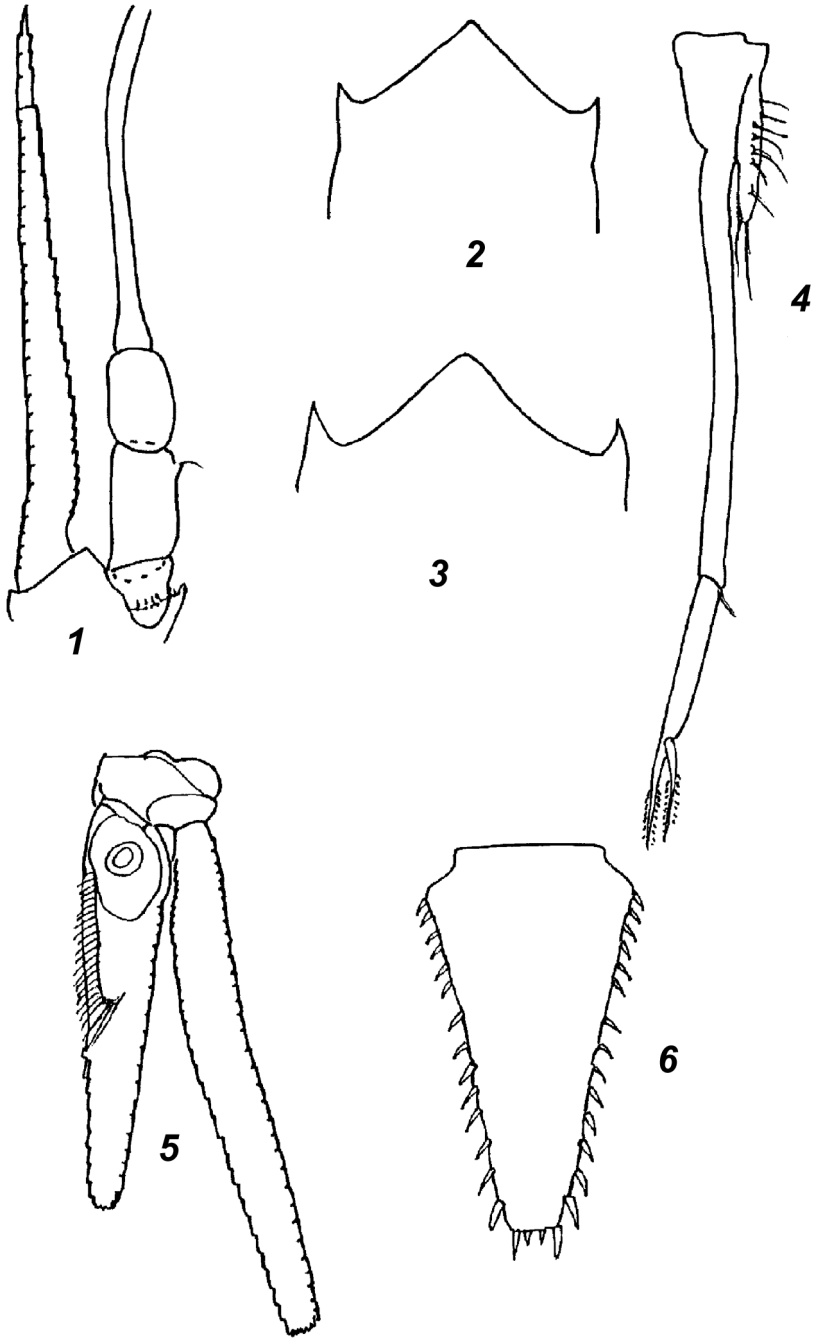


Plate X. *Neomysis awatschensis*: 1 – antenna; 2 – anterior margin of carapace (*f. typica*); 3 – anterior margin of carapace (*f. intermedia*); 4 – male pleopod 4; 5 – uropod, ventral view; 6 – telson

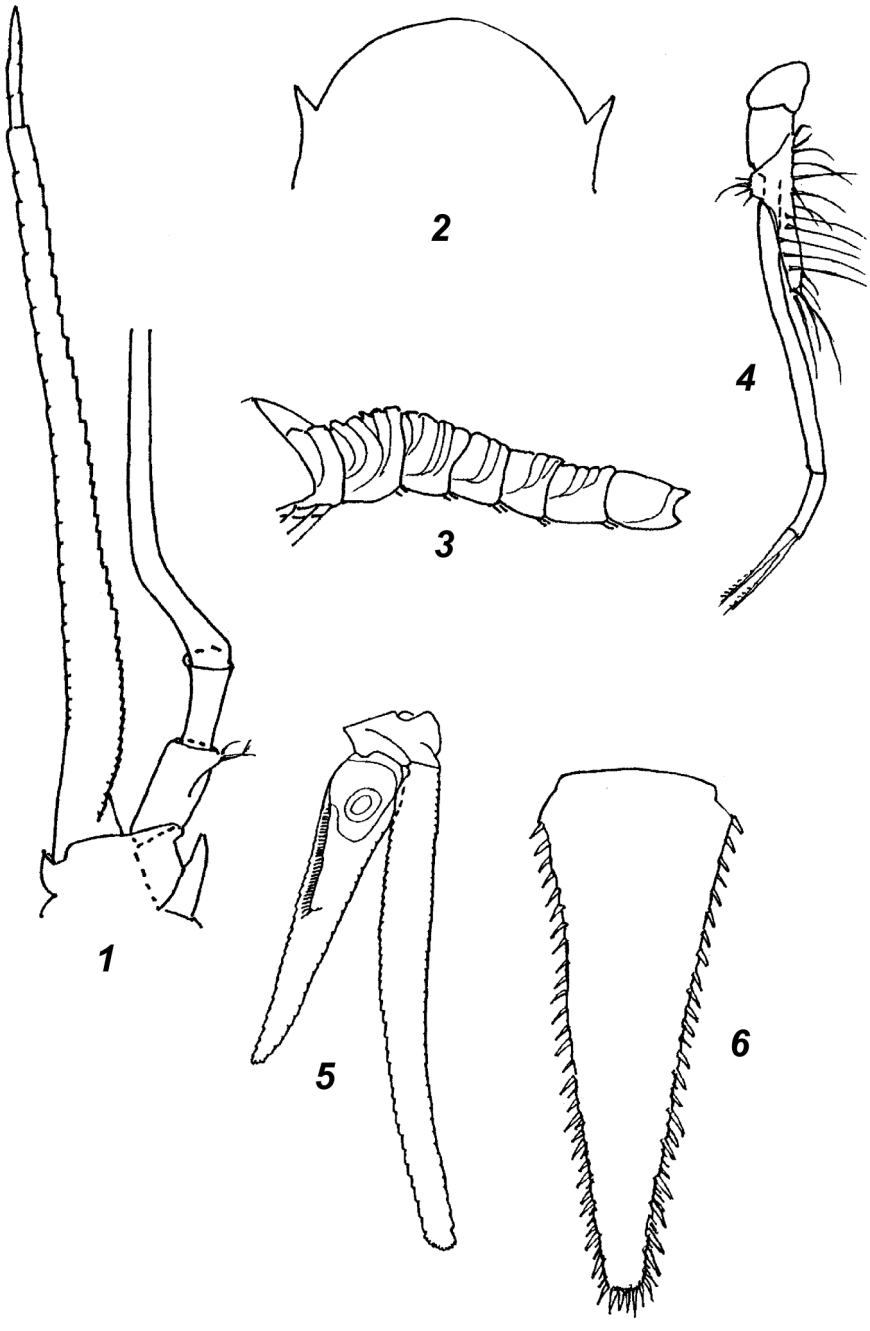


Plate XI. *Neomysis czerniawskii*: 1 – antenna; 2 – anterior margin of carapace; 3 – distal segment of thorax and all abdominal segments; 4 – male pleopod 4; 5 – uropod, ventral view; 6 – telson

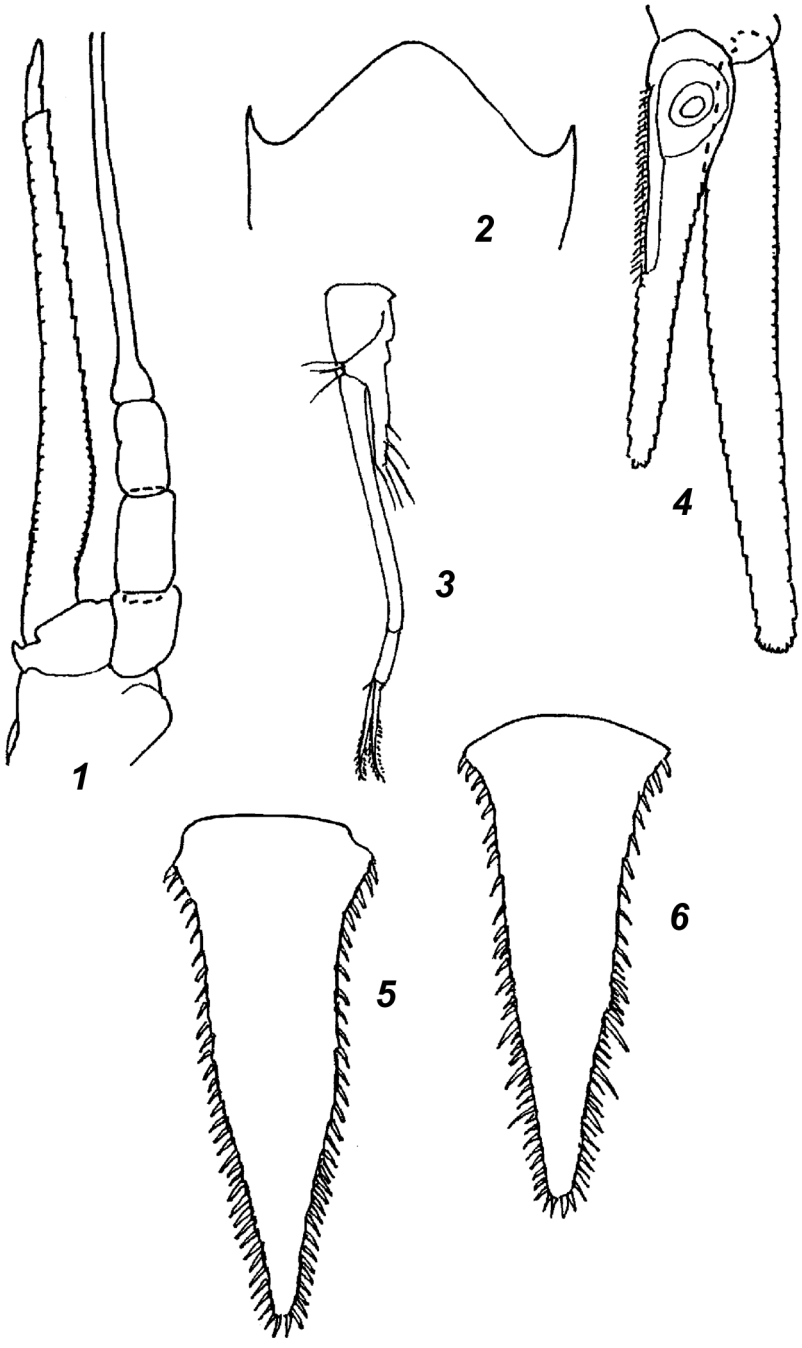


Plate XII. *Neomysis mirabilis*: 1 – antenna; 2 – anterior margin of carapace; 3 – male pleopod 4; 4 – uropod, ventral view; 5 – telson (*f. typica*); 6 – telson (*f. nakazawai*)

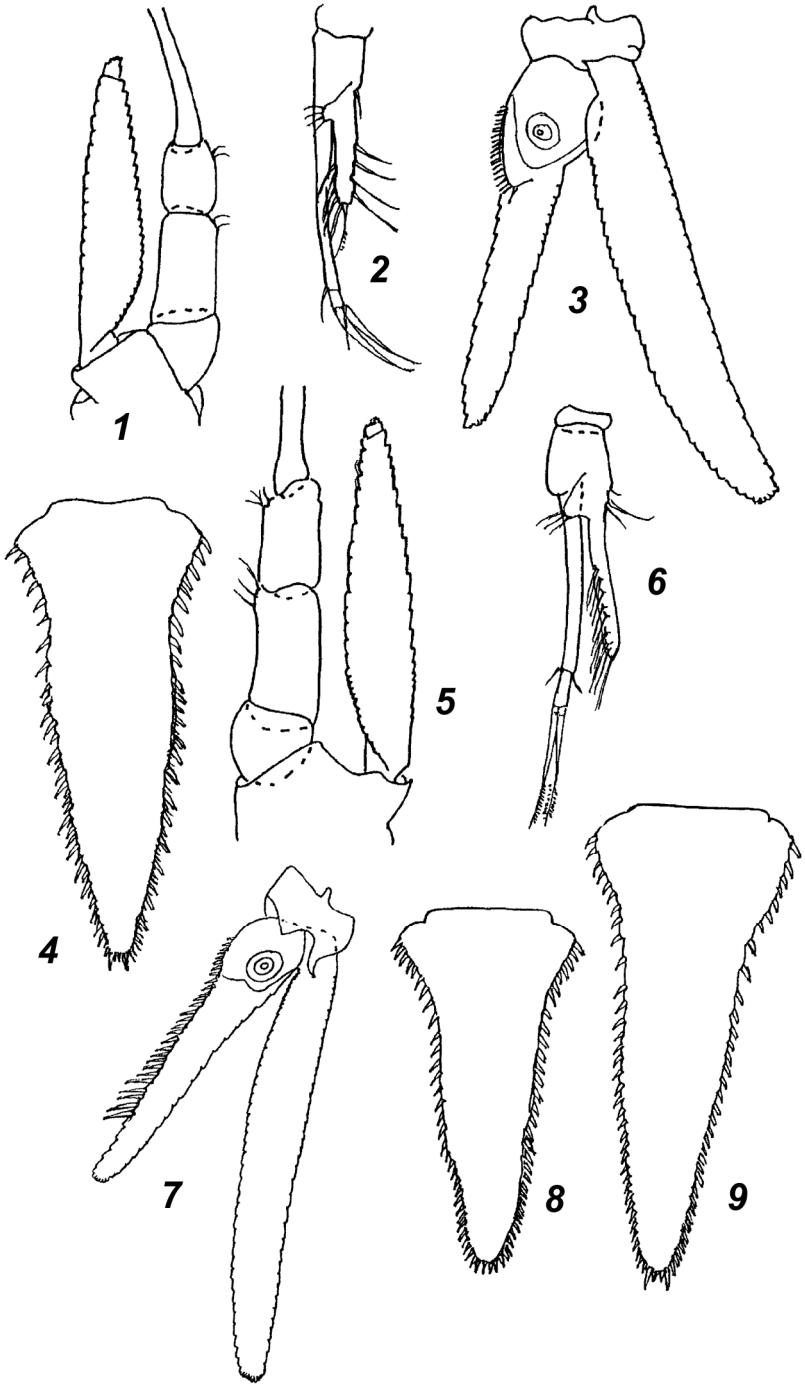


Plate XIII. *Boreoacanthomysis schrencki* (1–4): 1 – antenna; 2 – male pleopod 4; 3 – uropod, ventral view; 4 – telson. *Hemiacanthomysis dimorpha* (5–9): 5 – antenna; 6 – male pleopod 4; 7 – uropod, ventral view; 8 – female telson; 9 – male telson

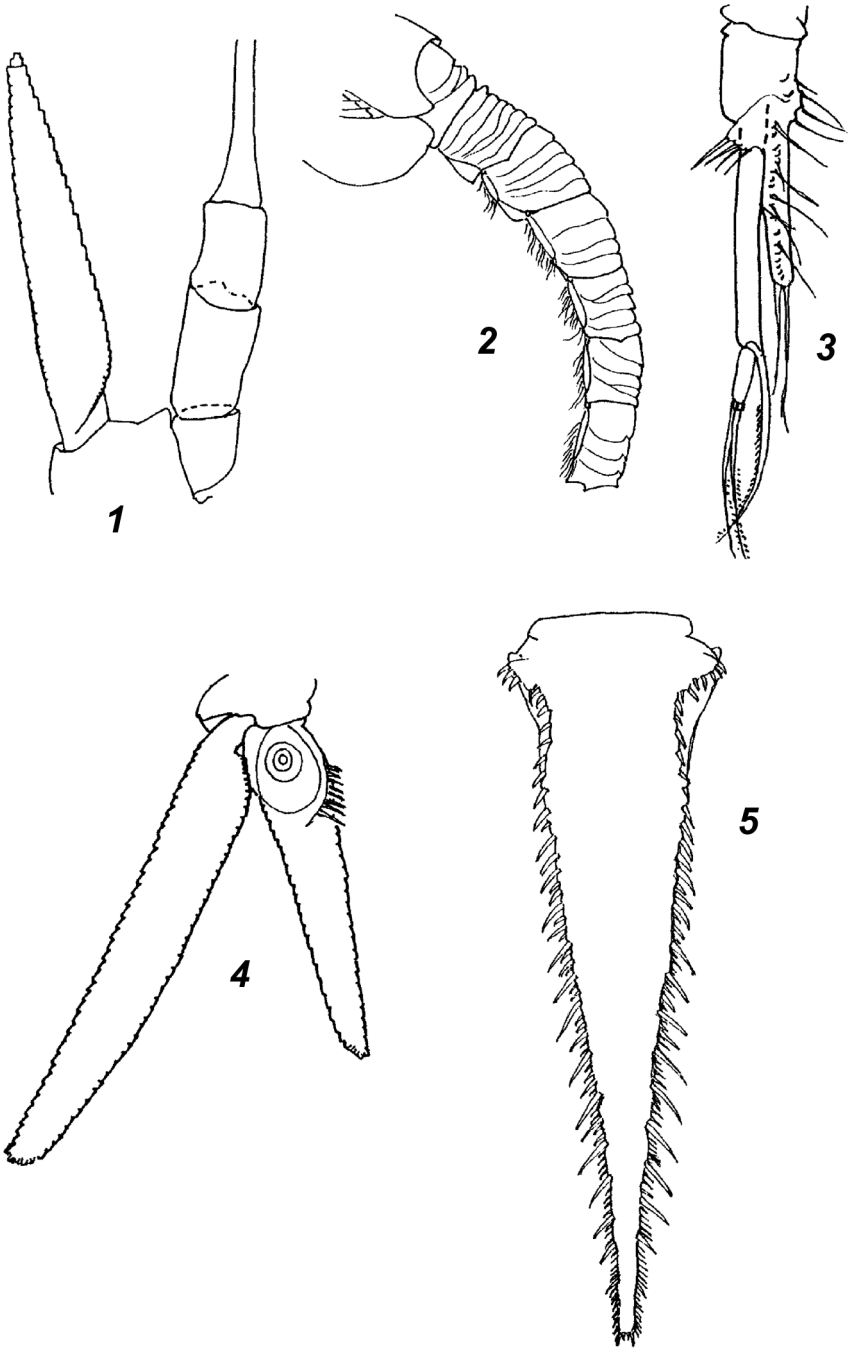


Plate XIV. *Exacanthomysis stelleri*: 1 – antenna; 2 – distal segment of thorax and all abdominal segments; 3 – male pleopod 4; 4 – uropod, ventral view; 5 – telson

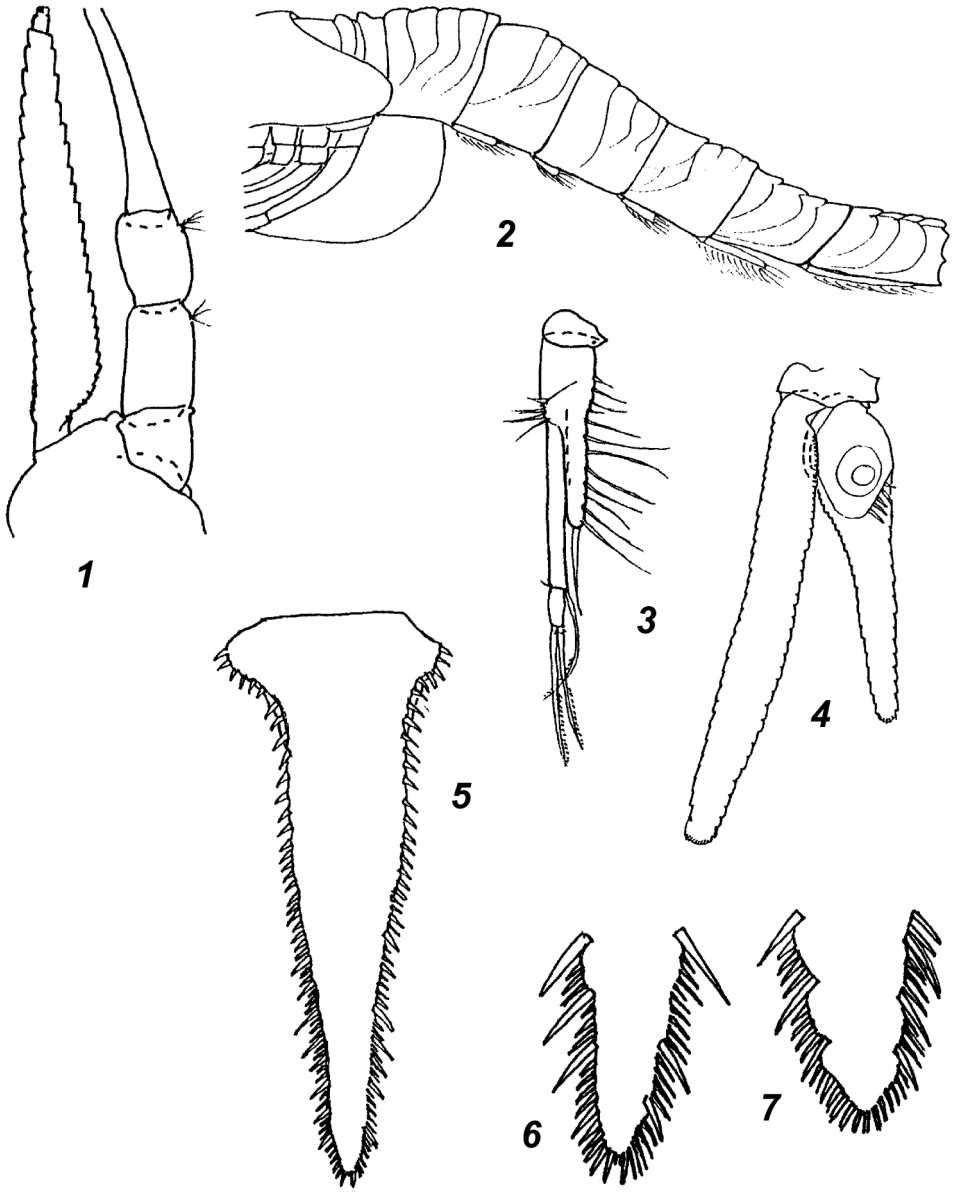


Plate XV. *Exacanthomysis borealis*: 1 – antenna; 2 – distal segment of thorax and all abdominal segments; 3 – male pleopod 4; 4 – uropod, ventral view; 5 – male telson; 6 – apex of male telson; 7 – apex of female telson

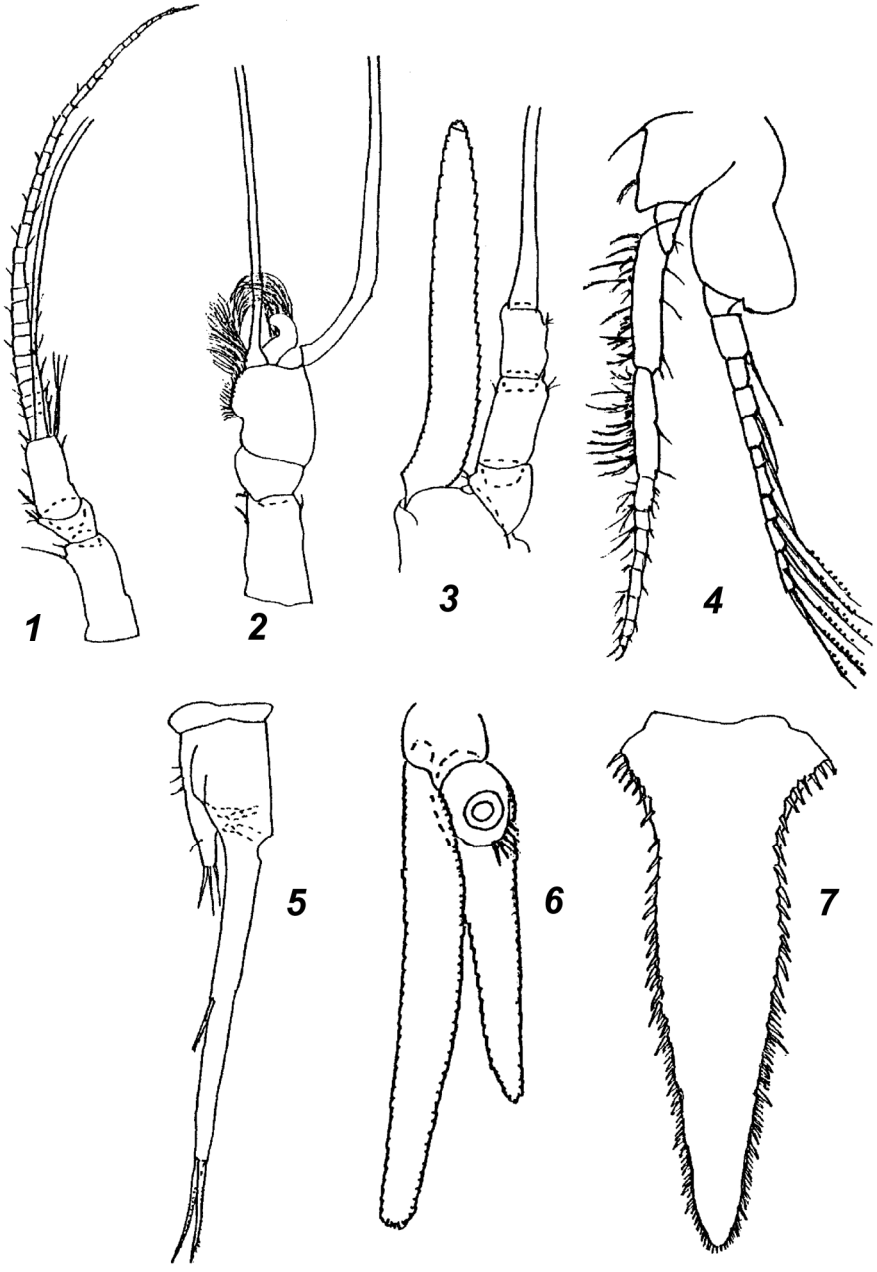


Plate XVI. *Paracanthomysis shikhotaniensis*: 1 – female antennule; 2 – male antennule; 3 – antenna; 4 – thoracopod 7; 5 – male pleopod 4; 6 – uropod, ventral view; 7 – telson

Order EUPHAUSIACEA Dana, 1883

Viktor V. Petryashov, Artur G. Porodin, Boris M. Borisov

General characteristics

Euphausiids are shrimplike higher crustaceans of the superorder Eucarida. They are also known as krill. The body is divided into two tagmata (cephalothorax and abdomen) and is composed of five segments of the head, eight thoracic, six abdominal segments, and the telson (pl. I, figs. 1–4). The eyes are stalked, faceted, usually well developed, with the cornea in some species divided into two lobes. Most part of the head and thorax, except for the bases of the thoracopods with the gills, is covered by a carapace, dorsally fused with the thoracic segments. Each antennule (antenna 1) consists of a three-segmented peduncle and two many-segmented flagella. In many genera the antennular peduncle, beside setae, may bear tubercles, spines, and lappets. Each antenna (antenna 2) consists of a one-segmented (as a result of the fusion of three segments) protopod, an exopod (antennal scale, or squama), and an endopod with a three-segmented peduncle and many-segmented flagellum. There are eight pairs of the thoracopods. They are biramous (exo- and endopod), relatively similar in arrangement, and not transformed into maxillipeds. One or two distal pairs are shortened (family Bentheuphausiidae) or reduced (family Euphausiidae). In the forms with bilobed eyes the second and/or third pairs of the thoracopods are transformed into elongated grasping organs. The coxapodites of the thoracopods bear epipods, forming gills on their outer side, and small blade-shaped endites, best developed on the first thoracopods, on their inner side. There are five pairs of pleopods on the abdomen. They are well-developed both in males and females, natatory, biramous, with similar arrangement. Pleopods 1 and 2 in males are provided with a copulatory organ (petasma). The sixth abdominal segment has a pair of flattened biramous (both rami are one-segmented) uropods. The uropods in combination with the telson form a tailfan. The species of the family Euphausiidae have light-emitting organs (photophores). There are usually ten of them, two on the lower parts of the eye-stalks, four on the bases of the thoracopods 2 and 7, and four on the first to fourth abdominal segments between the pleopods. The species of the genus *Stylocheiron* are provided with only five photophores: one on each eye-stalk and on the bases of the thoracopods 7, and one on the first abdominal segment.

Euphausiids are exclusively marine crustaceans living in the pelagic zone, in depths from 0 to 5000 m, sometimes going down to the bottom. At present two families of euphausiids are known (Euphausiidae and Bentheuphausiidae), which include 11 genera and 86 species. Euphausiids occur in all the oceans, with the species diversity being widest in tropical and subtropical waters. Only one family, Euphausiidae, is represented in the Sea of Japan.

Biology. Euphausiids are usually omnivorous, main types of feeding are predation and filtration. Their ontogenetic development is commonly divided into four periods, viz.: embryonic, larval, juvenile, and adult. Euphausiids have internal fertilization; round eggs are laid in portions; the process of reproduction takes place in the pelagic zone. Nauplii (stages I–III) (pl. III, fig. 1), like the next stage, metanauplii

(pl. III, figs. 2, 7–9), do not feed. Feeding begins not earlier than the stage of calyptopis I (pl. III, fig. 3). The calyptopis phase (C) is divided into three stages (CI, CII [pl. III, figs. 4, 10], and CIII). Calyptopis 3 after molting transforms into a furcilia (F0), a stage without the pleopods (pl. III, figs. 5, 11). Endo and Komaki (1979) proposed a formula describing the development of a furcilia at successive stages.

F(0): larva without pleopods; F(n): larva with 4 or less pairs of pleopods; F(5N): larva with 5 pairs of glabrous pleopods (pl. III, fig. 6); F(sn): larva with less than 5 pairs of glabrous and feathery pleopods; F(SN): larva with 5 pairs of glabrous and feathery pleopods; F(6Tsp) or F(7Tsp): larva with 5 pairs of feathery pleopods and 6 or 7 terminal spines at telson's end; F(4Tsp) or F(5Tsp): terminal spines in larva reduce from 6–7 to 4–5; F(2Tsp) or F(3Tsp): terminal spines in larva reduce from 6–7 to 2–3; F(1Tsp): larva with only one terminal spine.

The adult form is distinguished by the appearance of outer sexual characters. We have determined that the genital system in *E. pacifica* appears at a size of 6–7 mm, and in the species of the genus *Thysanoessa* at 7–10 mm. After breeding, the gonads of males and females reduce to their juvenile form, and in males some elements of the petasma also partially reduce. The oocytes which have not been laid are resorbed (Pogodin & Saprykina, 1981a, b).

Role in ecosystems. In spite of relatively small number of species, euphausiids inhabit all the oceans of the world. Though the species diversity is wider in tropical and subtropical waters, huge abundance and high biomass of euphausiids are particular for temperate and cold waters, providing food source for baleen whales, birds, and almost all commercially valuable pelagic fish. Euphausiids constitute from 22.2% (in winter) to 8.4% (in autumn) of the whole zooplankton biomass in the epipelagic zone of the northwestern Sea of Japan (Dolganova, 2000). More than ten thousand tons only of the krill *Euphausia pacifica* have been annually caught in the coastal zone of Japan since 1950–1960s (Komaki, 1967). It is used in that country for making food products, for bait, as a main component of mixed fodder, and as food for cultured trout, carp, and shrimps.

Methods of catching and fixation. Euphausiids are caught with large horizontal or vertical plankton nets and pelagic trawls. They can be fixed in 75% ethanol or in 4–6% formalin, the latter being preferable.

Unpublished data collected by B. Borisov were used for characterizing the biology and ecology of the Sea of Japan euphausiids. Data on species composition and distribution of euphausiids in the central and southern parts of the Sea of Japan were taken from Dr. M. Araki's manuscript of dissertation (1971), which was sent to A.G. Pogodin by Dr. T. Ikeda.

Main references: Boden et al., 1955; Ponomarjeva, 1963; Lomakina, 1978; Mauchline, 1980; Baker et al., 1990.

Systematic part

Family **EUPHAUSIIDAE** Holt & Tattersall, 1905

Eyes well developed. Thoracopods 8 and sometimes 7 more or less reduced; pleopods 1 and 2 in males with petasma.

The family Euphausiidae comprises ten genera. Ten species of five genera (*Euphausia*, *Thysanoessa*, *Pseudeuphausia*, *Nematoscelis*, and *Stylocheiron*) occur in the Sea of Japan (Ponomarjeva, 1963; Araki, 1971; Lomakina, 1978; Pogodin, 1981). Four species belonging to two genera were found in the Russian waters of the Sea of Japan, namely: *Euphausia pacifica*, *Thysanoessa inermis*, *T. raschii*, and *T. longipes*. Finds of two more species, *Euphausia similis* and *Thysanoessa inspinata* (Adrianov & Kussakin, 1998) have not been proved by our data.

KEY TO THE GENERA OF THE FAMILY EUPHAUSIIDAE

1(2). Exopod of thoracopod 7 well developed, but short. (Frontal plate of rostrum well developed) ..... 1. ***Thysanoessa*** (p. 83)

2(1). Exopod of thoracopod 7 rudimentary, in shape of small one-segmented setaceous plate. (Frontal plate of rostrum absent) ..... 2. ***Euphausia*** (p. 86)

Genus ***Thysanoessa*** Brandt, 1851

Type species: *Thysanoessa longipes* Brandt, 1851.

Frontal plate of rostrum long, narrow, sharply pointed. Carapace with keel running from its middle to anterior region. Eyes with (bilobed) or without constriction, rounded; bilobed eyes pyriform; upper lobe narrower than lower one. Thoracopods 1–6 with full complement of normally developed segments. Species with bilobed eyes have long inflated endopods of thoracopods 2, thus modifying this pair of limbs into grasping organs. Thoracopod 7 with normally developed, but short exopod; endopod of this thoracopod consists of 1–2 segments in females and absent in males. Thoracopod 8 rudimentary, consisting only of small, thin 1–2 segmented exopod.

Three species of ten comprising this genus occur in the Sea of Japan.

KEY TO THE SPECIES OF THE GENUS THYSANOESSA

1(4). Tergites of abdomen smooth, without sharp keels. (Posterior margin of one or two terminal segments of abdomen occasionally with small spine).

2(3). Lower margin of carapace without spine. Posterior margin of tergite of abdominal segment 6 and sometimes also segment 5 with small spine. Eyes without constriction, in juveniles usually with constriction in upper anterior part .... 1. ***T. inermis*** (p. 84)

3(2). Lower margin of carapace with anterior spine. Tergites of all abdominal segments smooth, without spines. Faceted part of eye round, without constriction ..... 2. ***T. raschii*** (p. 85)

4(1). Tergites of abdominal segments 3–5 with keels ending in spines. (Eyes bilobed, pyriform, constriction transverse, upper lobe narrower than lower one. Posterior margin of each abdominal segment 3–5 with spine. Lower part of carapace with median spine) ..... 3. ***T. longipes*** (p. 85)

1. ***Thysanoessa inermis*** (Kroyer, 1846)
(Pl. I, fig. 1; II, fig. 1)

Kroyer, 1846: pl. 7, figs. 2,3 (*Thysanopoda inermis*, *T. neglecta*); G.O. Sars, 1883: 51–52 (*Euphausia inermis*, *Thysanoessa borealis*); Hansen, 1911: 8; Lomakina, 1978: 183–185, figs. 112, 113; Baker et al., 1990: p. 74, fig. 9b (*Thysanoessa inermis*).

Description. Frontal plate of rostrum long, reaching end of first segment of antennular peduncle, lanceolate, with pointed tip. Eyes without (*forma inermis*) or with constriction; upper lobe narrower (*f. neglecta*). Carapace without lateral spine. Thoracopods identical in arrangement (*f. inermis*), or thoracopods 2 modified into grasping organs (*f. neglecta*) due to elongated segments 4 and 5 and inflated basal segments. Distal 6th abdominal segment shorter than 2 penultimate segments (4 and 5) taken together; its posterior end with small mid-dorsal spine pointed backward. Fifth abdominal segment often with similar spine.

Length of body in euphausiids from northern part of Sea of Japan up to 34 mm.

Remarks. The studies of the North Atlantic euphausiid fauna showed that *forma neglecta* is a stage of *T. inermis*, represented by late larval stages and juveniles. Adult specimens of *f. neglecta* are very rare and have not been recorded in the Northern Pacific, particularly in the Sea of Japan (Lomakina, 1978).

Nemoto (1966) discovered a phenomenon of wedgewise change of the rate of specimens with spines at the end of fifth and sixth abdominal segments. The percentage of specimens with two spines decreases westward, from 75% in Alaska Bay to 16% in the Sea of Okhotsk. He also reports single finds of specimens with spines on abdominal segments 6, 5, and 4.

Distribution. *T. inermis* is a widespread boreal-arctic species. In the northwestern part of the Pacific Ocean it has not been recorded south of 37˚ N in the Sea of Japan and the Pacific side of the South Kuril Islands. In the northeastern part of the Pacific Ocean the species has not been recorded south of 52˚ N. In the Atlantic Ocean it is found north of 39˚ N near the American coasts, in the La Manche and Skagerrak straits. In the Arctic *T. inermis* is possibly circumpolar, found in all seas of Russia, in the Beaufort Sea, in the east of the Canadian part of the Arctic, and around Greenland.

In the Sea of Japan the southern boundary of the distributional range of this species lies north of 37˚ N near the continent and 39˚ N near the Japan coast. In the Tatar Strait it occurs to 51˚ N. The densest swarms of this species were observed in the eastern half of the sea near the northern Hokkaido and the South Sakhalin in spring.

Habitat and breeding. *T. inermis* is an epi- to mesopelagic species, in the Sea of Japan found to depths around 1000 m (Vinogradov, 1968). Spring pre-breeding and breeding assemblages begin to accumulate near the northern Hokkaido in the second half of March, with maximum concentration in the near-surface layer. Then assemblages move northward, to the coastal zone of the southwestern Sakhalin up to Iliynsky shoal (about 48˚ N). Phenological wave passes over the eastern part of the sea northward from Hokkaido to 50˚ N from March to late May-early June. In Peter the Great Bay mass breeding of *T. inermis* begins in the second to third decade of April. Diameter of egg capsules 600–925 µm, perivitelline space well developed (80–86% of the whole egg volume).

Euphausiids of this species feed on meso- and microzooplankton, phytoplankton, and if food is scarce, on detritus and other euphausiids.

2. ***Thysanoessa raschii*** (M. Sars, 1864)
(Pl. I, fig. 2; II, figs. 2, 5)

M. Sars, 1864: 83 (*Thysanopoda raschii*), G.O. Sars, 1883: 51 (*Euphausia raschii*); Hansen, 1911: 42; Lomakina, 1978: 185–187, fig. 114; Baker et al., 1990: p. 72, fig. 8a (*Thysanoessa raschii*).

Description. Frontal plate of rostrum broad, slightly shorter than basal segment of antennular peduncle; tip slightly blunt in males, pointed in females. Eyes round, without constriction. Lateral margin of carapace with small anterior spine. All thoracopods identical in arrangement. Abdominal segments smooth, without spines and dorsal keels.

Euphausiids from northern part of Sea of Japan with maximum length of body 29 mm (Pogodin, Gorbatenko, 1984).

Distribution. *T. raschii* is a widespread boreal-arctic species. In the Pacific Ocean it occurs north of 40˚ N near the coasts of Asia and north of 45˚ N near the British Columbia. In the Atlantic Ocean it was found north of 40˚ N off the coasts of America and the northern coast of Great Britain. In the Arctic it is possibly circumpolar, found near the western coast of Greenland and from the Spitsbergen and the Norwegian Sea eastward to the Beaufort Sea. In the Sea of Japan the species has not been recorded south of 43˚ N. In spring the population penetrates as far as the most northern part of shallow-water area of the Tatar Strait.

Habitat and breeding. *T. raschii* is a neritic, epipelagic species. It usually occurs in depths to 200 m, more deep-water finds are rare. These euphausiids mainly feed on meso- and microzooplankton; in spring and autumn on phytoplankton; and, if food is scarce, on detritus. In the population of the northern Tatar Strait the breeding process begins in April and proceeds till late July or even early August, depending on mean temperature of a year. Diameter of eggs 350–500 µm, perivitelline space narrow.

3. ***Thysanoessa longipes*** Brandt, 1851
(Pl. I, fig. 3; II, fig. 3; III, figs. 7–11)

Brandt, 1851: 128; Lomakina, 1978: 176–178, fig. 106, 107; Baker et al., 1990: p. 68, fig. 3b (*Thysanoessa longipes*); Marukawa, 1928: 4 (*T. armata*).

Description. Frontal plate of rostrum long, narrow, with pointed tip and median keel, stretching to anterior region of carapace. Eyes with transverse constriction, upper lobe noticeably smaller. Lateral margin of carapace with spine placed slightly past its midpoint. Endopod of thoracopod 2 elongated, almost equal to antennule; its segment 6 with lateral setae on both sides; segment 7 short and broad, with 4 strong setae. Each tergite of abdominal segments 3–5 with well-expressed dorsal keel; keel on segment 3 ends in robust spine; keels on other tergites with smaller spines. Tergite of abdominal segment 6 without keel, its distal margin sometimes with small spine. Euphausiids from northern part of Sea of Japan with maximum length of body 34 mm.

Distribution. *T. longipes* is a Pacific widespread boreal species. It is distributed north of 34°N near the Asian coast and north of 38°24′N near the American coast up to Point Barrow (Chukchi Sea). In the Sea of Japan the southern boundary of the distributional area stretches from the Korean coast (36–37°N) to Wakasa Bay (around

35°45′N) of Honshu Island. In the Tatar Strait this relatively deep-water species appears at 50°N in spring, and moves slightly southward in summer.

Habitat and breeding. *T. longipes* is an epi- to mesopelagic species, which inhabits the Sea of Japan to depths of about 2000 m. In the cold-water part of the sea it occurs from 100 to 2000 m of depth in the daytime and from the surface to 1700 m at night. Breeding in the Sea of Japan have not been studied, in the southern part of the Sea of Okhotsk this species breeds from March till June (Afanasiev, 1985). Endo and Komaki (1979) described the larval stages of *T. longipes*, beginning from calyptopis I and to the last instar of a furcilia, as well as a postlarval larva. The material used for these studies was collected from a water layer of 0 to 150 m depth. The samples examined contained neither eggs, nor nauplii or metanauplii which could belong to *T. longipes*. Due to this fact the conclusion was made that the species breeds in depths more than 150 m. One of the authors (B.M. Borisov) managed to identify a metanauplius of *T. longipes* from the central part of the Sea of Japan (pl. III, figs. 7–11).

Euphausiids of this species mostly feed on meso- and macrozooplankton (copepods, chaetognaths, and euphausiids), but occasionally eat phytoplankton and protozoa.

2. Genus ***Euphausia*** Dana, 1852

Type species: *Euphausia superba* Dana, 1852.

Frontal plate of rostrum usually well developed, triangular, with acute tip; rarer short, rudimentary, sometimes absent. Eyes round, without constriction. Thoracopods 7 and 8 rudimentary, only with exopod in shape of small one-segmented setaceous plate; endopod absolutely reduced. Other thoracopods have normal arrangement, similar with each other.

The genus comprises 32 species. Three species occur in the Sea of Japan, though in the Russian waters of this sea only one species, *E. pacifica*, has been found.

1. ***Euphausia pacifica*** Hansen, 1911
(Pl. I, fig. 4; II, figs. 4, 6, 7; III, figs. 1–6)

Hansen, 1911: 28; Lomakina, 1978: 129–130, fig. 70; Baker et al., 1990: p. 64, fig. 22a, 23b.

Description. Rostrum without frontal plate, anterior margin of carapace in shape of obtuse angle, sometimes with slightly rounded end. Carapace without keel, lateral margin with median spine. Eyes without constriction, like in *T. raschii*, of normal size and almost round in shape. Basal segment of antennule with small flat tubercle, sharply pointed and directed obliquely upward; upper part of segment slightly flattened and bears row of short setae with tips curved forward. Dorsal side of abdominal segments without keels and spines. Length of body up to 25 mm.

Distribution. *E. pacifica* is a Pacific widespread boreal species, also penetrating northern subtropical regions. It is distributed north of 33–34°N near the Asian coasts, of 38–40°N in high seas, and of 26°N near the American coast. In the Sea of Okhotsk it has been recorded only in the southern half and in the Bering Sea only in the southwestern half. In the Sea of Japan the species is ubiquitous, distributed from the Tsushima Strait to the most northern shallow-water region of the Tatar Strait.

Habitat and breeding. *E. pacifica* is an epi- to mesopelagic species, in the Sea of Japan inhabiting depths to 1000 m (Vinogradov, 1968). Diurnal vertical migrations are observed in euphausiids 8 mm long and larger. In the cold-water regions of the sea assemblages are densest at depths of 200–300 m in the daytime and from the surface to 150 m at night. In the warm-water regions assemblages are densest at depths from 300 to 400 m in the daytime. Considerable density of assemblages is registered to depths of 600–650 m. Young euphausiids with body length up to 7–8 mm remain in the upper 100-m layer day and night.

From February to April *E. pacifica* breeds, and the phenological wave of near-surface assemblages of pre-breeding and breeding krill moves from the southwestern part of Honshu Island northward to Hokkaido. Euphausiids gather in assemblages at a near-surface temperature of 6–7 °C and disseminate when temperature reaches 16 °C (Komaki, 1967). This is the main period of intensive inshore krill fishery in Japan. In the eastern region of the sea the phenological wave starts in February and moves from south to north. Breeding begins in the northern half of the Tatar Strait only in July, when water warms up to 13–14 °C, it is most intensive in August-September and ends in mid-October (Pogodin, 1981, 1990). There are almost no data on *E. pacifica* breeding in the coastal waters of Primorye. One of the authors (B.M. Borisov) found the eggs of *E. pacifica* in Amursky Bay (Peter the Great Bay) on November 17, 2004. According to A.G. Pogodin's data (1982) the diameter of *E. pacifica* egg capsules range from 425 to 625 µm, and according to B.M. Borisov's unpublished data the diameter is 370 to 530 µm (at the diameter of egg capsules equal to 530 µm, the diameter of an embryo was 340 µm).

The diet of these euphausiids includes wide range of objects; their preference is for meso- and microzooplankton, whereas phytoplankton and detritus are consumed rarer.

References

Adrianov, A.V. & O.G. Kussakin. 1998. A chek-list of the biota of Peter the Great Bay of the Sea of Japan. Vladivostok: Dalnauka. 350 p. (In Russian).

Afanasiev, N.N. 1985. Macroplankton of the northern Sea of Okhotsk: Avtoref. Diss… Kand. Biol. Nauk. Moscow: IOAN SSSR. 25 p. (In Russian).

Araki, M. 1971. [Ecology of the Euphausiid distribution in the Sea of Japan and Suruga Bay. The manuscript of dissertation (In Japanese). 66 p., 55 figs.]

Baker, A. de C., Brinton, B.P., & E. Brinton. 1990. A practical guide to the Euphausiids of the world. London: British natural history museum. 96 p.

Boden, B.P., Johnson, M.W., & E. Brinton. 1955. The Euphausiacea (Crustacea) of the North Pacific // Bull. Scripps Inst. Oceanogr. V. 6(8). P. 287–400.

Brandt, F. 1851. Krebse // Middendorff A.Th.v., Reise in den äussersten Norden und Osten Sibiriens während der Jahre 1843 und 1844. V. 2, Zool. (1). S. 79–148.

Dolganova, N.T. 2000. The composition, seasonal and interannual dynamics of the plankton of the northwestern Sea of Japan: Avtoref. Diss… Kand. Biol. Nauk. Vladivostok: TINRO-tsentr. 23 p.

Endo, Y. & Y. Komaki. 1979. Larval stages of euphausiids with descriptions of those of *Thysanoessa longipes* Brandt // Bull. Jap. Sea reg. Fish. Res. Lab. V. 30. P. 97–110.

Hansen, H.J. 1911. The genera and species of the order Euphausiacea, with account of remarkable variation // Bull. Inst. Oceanogr. Monaco. N 210. P. 1–54.

Komaki, Y. 1967. On the surface swarming of euphausiid crustacean // Pacif. Sci. V. 21. P. 433–448.

Kroyer, H. 1846. Atlas des Crustacés. Voyage de la Commission scientifique du Nord en Scandinavie, en Laponie, au Spitzberg et aux Feröe pendant les anneés 1838–1840, sur la corvette La Recherche commandée par M. Fabvre. Publ. par ordre du Roi sous la direction de M.M. Paul Gaimard.

Lomakina, N.B. 1978. Euphausiids of the world (Euphausiacea). Opredeliteli po Faune SSSR. Izd. ZIN AN SSSR. V. 118. 223 p. (In Russian).

Marukawa, H. 1928. Über neue 5 Arten der Schizopoden // Annot. Oceanogr. Res., Tokyo. V. 2. P. 1–6.

Mauchline, J. 1980. The biology of mysids and euphausiids //Adv. Mar. Biol. V. 18. 677 p.

Nemoto, T. 1966. *Thysanoessa* euphausiids, comparative morphology, allomorphosis and ecology // Sci. Rep. Whales. Res. Inst., Tokio. N 20. P. 109–155.

Pogodin, A.G. 1981. Breeding of euphausiids (Euphausiacea, Crustacea) in the northern part of the Tatar Strait // Genetika i Razmnozhenie Morskikh Zhivotnykh. (Materialy XIV Kongressa TNA, Khabarovsk, 1979). Vladivostok: Izd. DVNTs AN SSSR. P. 196–203. (In Russian).

Pogodin, A.G. 1982. Some stages of *Euphausia pacifica* development // Biologiya Morya. N 2. P. 72–75. (In Russian).

Pogodin, A.G. 1990. Speed of growth of *Euphausia pacifica* in the northern Sea of Japan // Biologia Morskogo Planktona. Vladivostok: Izd. DVO AN SSSR. P. 92–101. (In Russian).

Pogodin, A.G. & K.M. Gorbatenko. 1984. Species composition, distribution, sexual and size & age structure of euphausiids in the northern Tatar Strait. Vladivostok: TINRO. 16 p. Dep. TsNIITEIRKh 21 05. 1984. N 589 rkh-84. 16 p. (In Russian).

Pogodin, A.G. & M.I. Saprykina. 1981a. On the Euphausiid reproduction in the waters of the northern Tatar Strait in June–September 1973 // Izv. TINRO. V. 105. P. 33–41. (In Russian).

Pogodin, A.G. & M.I. Saprykina. 1981b. On the life cycle of euphausiids in the northern Tatar Strait // Tezisy Dokladov 4-go Siezda VBGO. Kiev: Naukova Dumka, Ch. 1. P. 88–90. (In Russian).

Ponomarjeva, L.A. 1955. The euphausiids of the Kurile-Kamchatka Trench // Trudy IOAN SSSR. V. 12. P. 288–297. (In Russian).

Ponomarjeva, L.A. 1963. Euphausiids of the Northern Pacific, their distribution and abundant species ecology. Moscow. 142 p. (In Russian).

Sars, G.O. 1883. Oversigt of Norges Crustaceer med forelobige Bemaerkninger over de nye eller mindre bekjendt Arter I (Podophthalmata - Cumacea - Isopoda - Amphipoda) // Forhandl. Vidensk. Selsk. Forh., Christiania. N 18. P. 1–124.

Sars, M.Hr. 1864. Sars gav nogle tillaeg till sine i et foregaaende Møde meddeelte lagttagelser over de maerkvaedige, paa Bugsiden af Thysanopoda beliggende Sandseredskaber, or anmeldte ved samme Leilighed Opdagelsen af to nye norske Arter af denne Krebs–dyrsia egt. // Forh. Vidensk Selsk. Krišt. P. 79–84.

Vinogradov, M.E. 1968. Vertical distribution of oceanic zooplankton. Moscow: Nauka. 320 p. (In Russian).

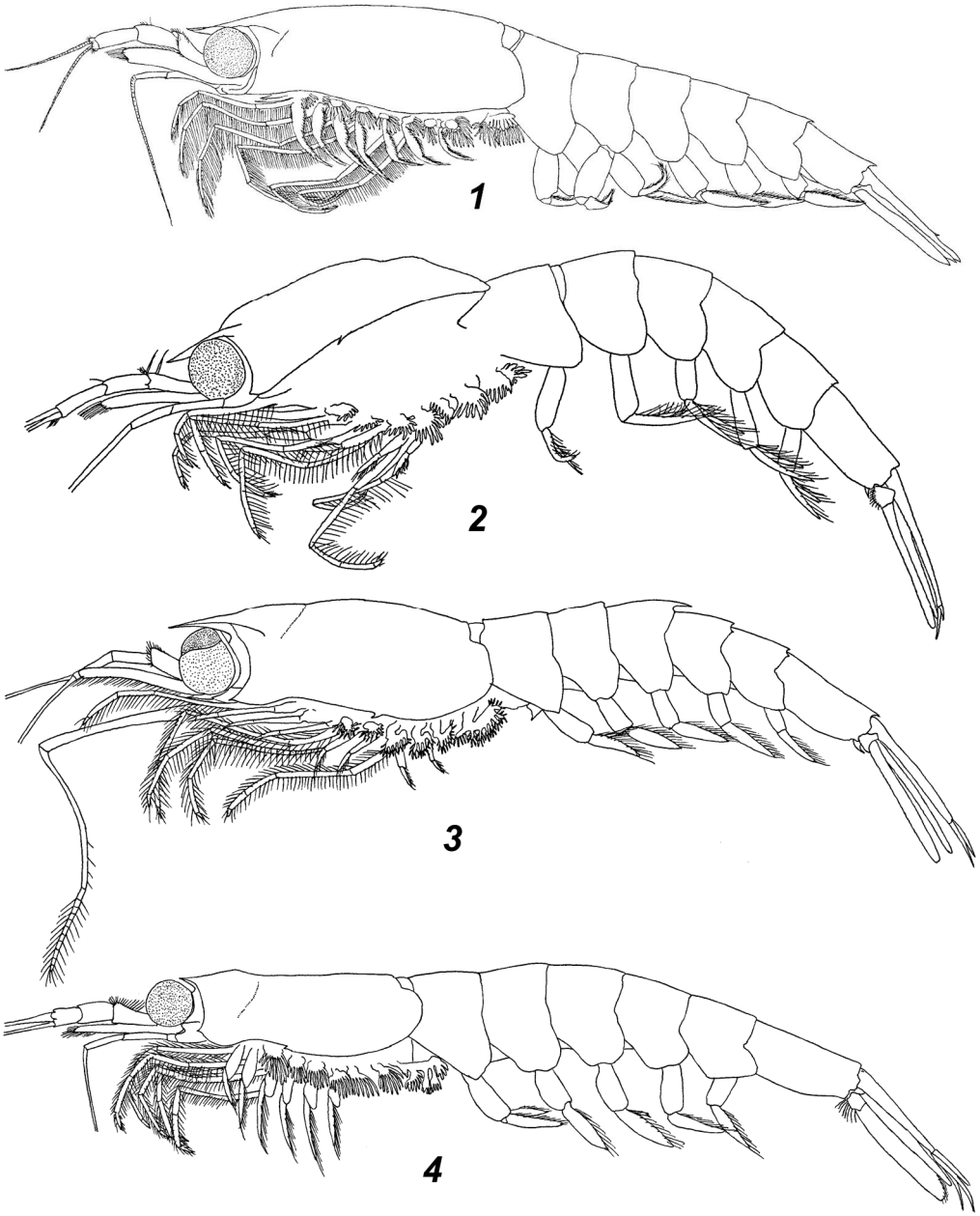


Plate I. Full-length lateral view: 1 – *Thysanoessa inermis*; 2 – *T. raschii*; 3 – *T. longipes*; 4 – *Euphausia pacifica*

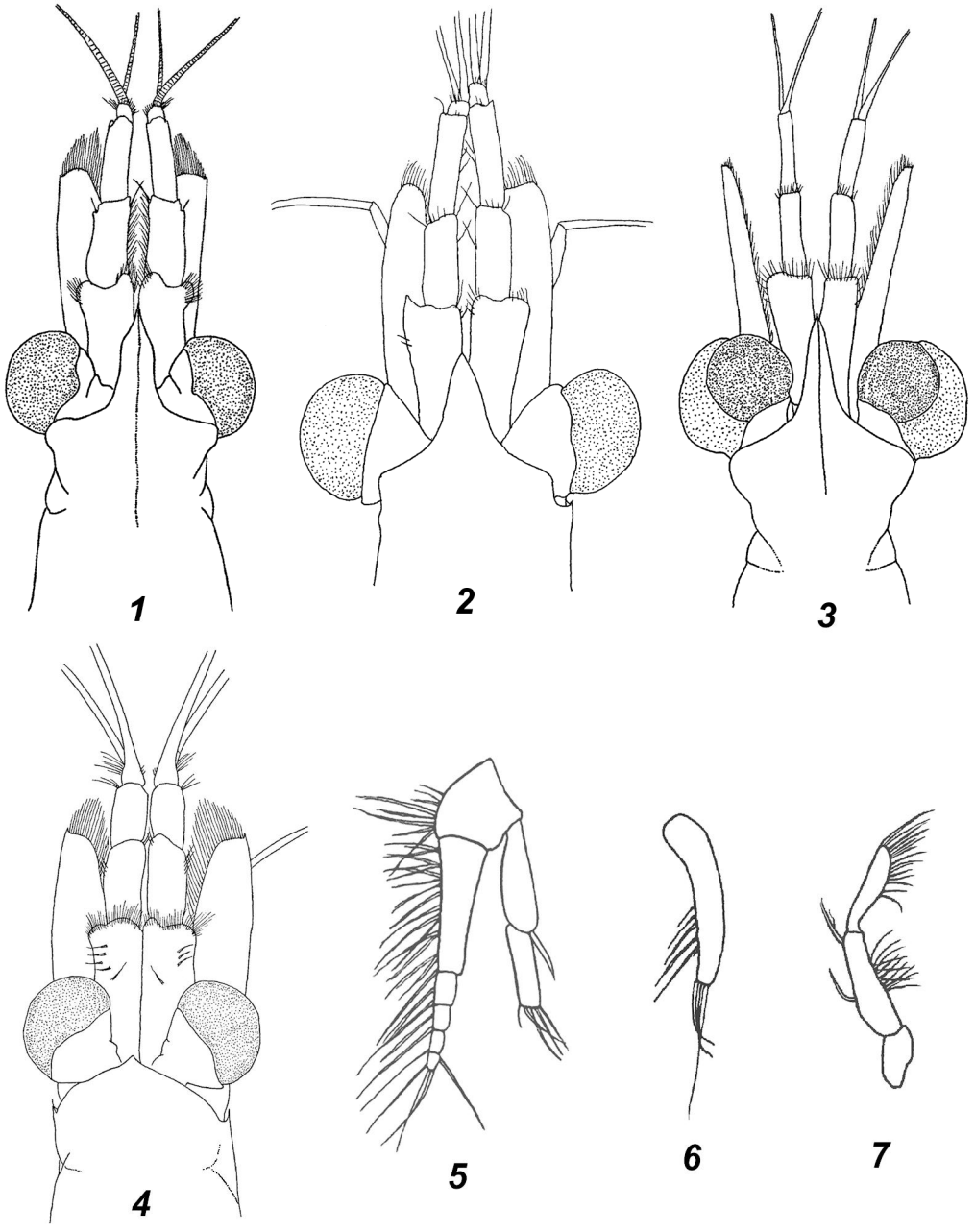


Plate II. Dorsal view of anterior part of body (1–4), thoracopods 7 (5, 6), palp of mandible (7): 1 – *Thysanoessa inermis*; 2, 5 – *T. raschii*; 3 – *T. longipes*; 4, 6, 7 – *Euphausia pacifica*

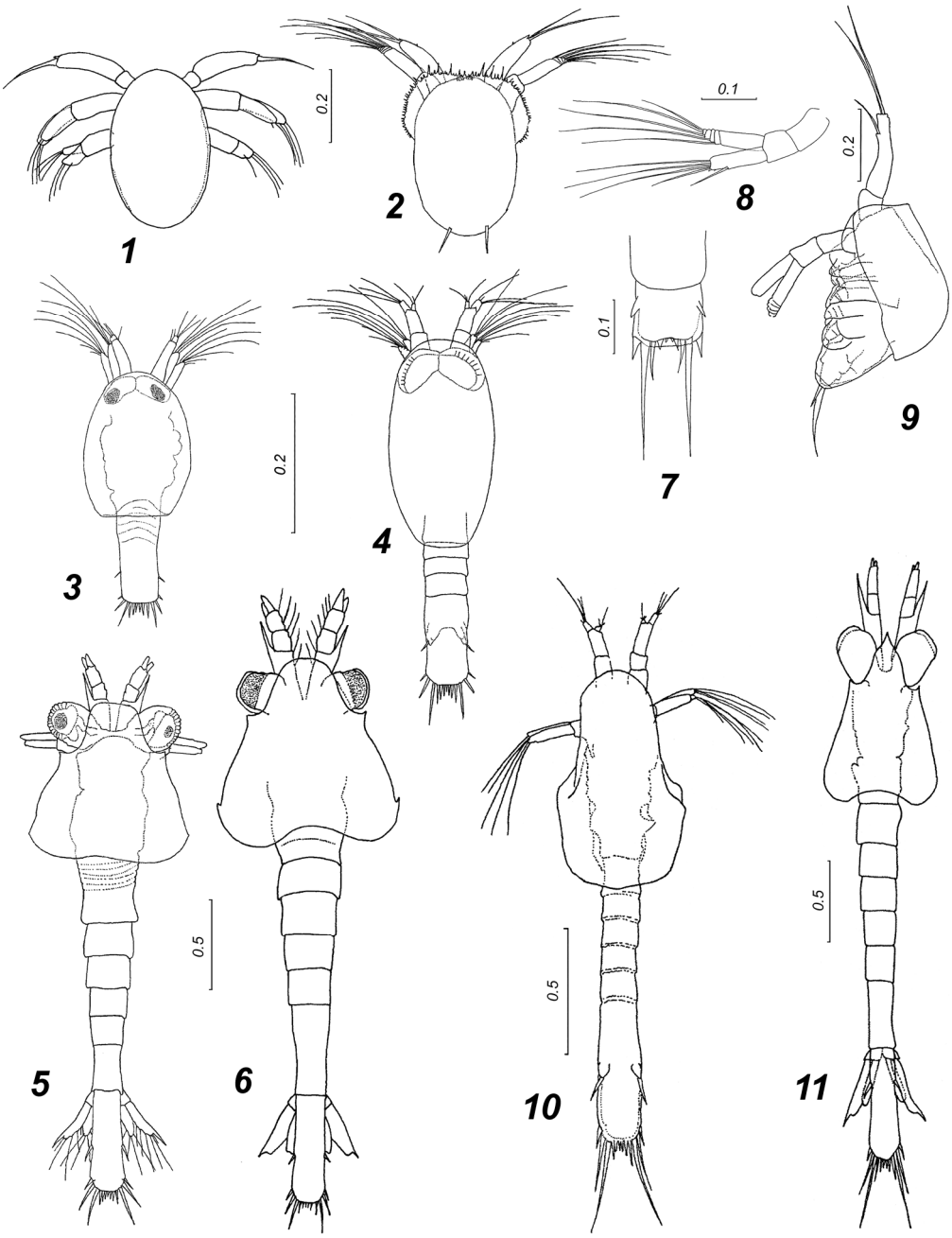


Plate III. Larval stages of *Euphausia pacifica* (1–6) and *Thysanoessa longipes* (7–11): 1 – nauplius (N1); 2, 7–9 – metanauplius (7 – abdomen, dorsal view, 8 – antenna, 9 – lateral view); 3 – calyptopis I; 4, 10 – calyptopis II; 5, 11 – furcilia (F0); 6 – furcilia (5N)

SUBPHYLUM CHELICERATA HEYMONS, 1901[1]

CLASS PYCNOGONIDA Brunnich, 1764

Elena P. Turpaeva

General characteristics

The class Pycnogonida (the later accepted names are Pantopoda, or Podosomata) includes peculiar, exclusively marine animals which combine morphological features of the Crustacea and the Chelicerata. Owing to some exterior resemblance to terrestrial spiders they got the name "sea spiders". In the pycnogonids some features of primitive organization are preserved, and this class represents an independent group, like the Chelicerata or the Mandibulata (Dunlop & Arango, 2004).

The bodies of the pycnogonids, living in the Sea of Japan, consist of a four-segmented trunk, proboscis, small abdomen, and seven pairs of appendages (pl. I, fig. 1). Some species have segmented trunks, in others, segments of trunks are fused. Every segment has a pair of lateral processes with which the legs articulate. The first (cephalic or ocular) segment has in addition small processes for the first, second, and third pairs of appendages, as well as a protruding proboscis. There is an ocular tubercle on the dorsal side of the cephalic segment, bearing four eyes – a pair of anterior and a pair of posterior ones. Segment 4 bears a protruding abdomen with an anal opening on its end.

The pycnogonids' appendages consist of segments. The first pair of appendages (chelifori) of the Sea of Japan pycnogonids usually consist of two segments: the straight cylindrical first segment (scape) and the second segment (chela) consisting of a broadened proximal part (palm) with two fingers – movable and immovable (pl. I, fig. 2). Appendages of such a type serve for grasping and holding of prey, but in some species these appendages are reduced. The second pair of appendages (palpi) is tactile organs; the number of segments of this pair ranges from one to ten (the species of the genus *Nymphonella* have up to 20 segments). The third pair of appendages (ovigers) in males is assigned to bear progeny, and both male and female ovigers also serve for cleaning the body of sessile organisms living on it (hydroids, alcionarii, bryozoans and others). The oviger consists of five-ten segments, the seventh to tenth ones are armed with thin flat compound spines with toothed or smooth edges, and the tenth one of many species has a small claw on its end.

The next four pairs of appendages are legs. The legs of all pycnogonids consist of eight segments, every one of which have its own name or named by its number (first, second, third, etc.). The first three segments, usually short, are called coxae. The next three segments are long: the fourth segment is a femur, the fifth and sixth segments form a tibia (they are called tibia 1 and tibia 2 correspondingly). Relatively short seventh and eighth segments form a tarsus; the seventh segment (called the tarsus

[1] In the last decade specialists oppose the class Pycnogonida to the rest of the chelicerates (Euchelicerata) or regard it as a sister group to all other modern arthropods (Euarthropoda) – *Editorial note*.

proper) may be straight or calyciform; the eighth segment (propodus) may be straight or slightly curved; it bears a main, or terminal claw and a pair of auxiliary claws on its end. There are several basal spines on the sole of the eighth segment's ventral side. Some species have a small protrusion (heel) with large spines at the proximal part of the sole.

The digestive system of the pycnogonids consists of a pharynx (foregut), mid-intestine, and a hind-intestine. The pharynx is situated inside the proboscis that has a triangular mouth, provided with three cutting plates ("lips"), on its end. There is a so called "filter" at the proximal part of the pharynx. The "filter" is a net of chitinous threads, densely interlaced with one another, which holds back large particles coming through the mouth. The mid-intestine is situated in the trunk; it is quite short, but has many branches (diverticula), supplying nutrients to legs. The hind-intestine is very short and has no outgrowths. It extends through the abdomen and opens through the anus.

There is no blood-vascular system, but there are lacunae through which liquid circulates, transporting nutrients from the diverticula of the intestine to the muscles.

The nervous system of the pycnogonids consists of two anterior ganglia (suprapharyngeal and subpharyngeal) innervating the eyes and the first to third pairs of appendages and of a chain of four ganglia innervating every segment of the trunk; nerves extending to the legs also originate from these ganglia.

The reproductive system of the most pycnogonid species consists of a U-shaped tube, lateral outgrowths of which extend inside the first, second, third and fourth segments of the legs, where germ-cells mature. Pycnogonids are dioecious animals. Sexual pores are situated on the second coxae of the legs on their ventral sides, females having such pores on all legs, males – on the third and fourth legs.

Usually females are larger than males; their trunks are more robust. The males in most species have thinner trunks, relatively more elongated and having stronger armature of spines and setae. Males of the families Nymphonidae, Ammotheidae, Callipallenidae have longer ovigers than females, the fifth segments (the longest segments of these appendages) are noticeably curved. As for the families Phoxichilidiidae and Pycnogonidae, only males have ovigers.

During the period of breeding males wind mucous cords with eggs round their ovigers. The eggs stick together by the secretion of the male's cement glands situated on the dorsal sides of the femurs. Growing larvae stay on the male's body for quite a long time and seemingly feed on the organisms living on its surface. Larvae of the most species parasitize on hydroids.

Adult pycnogonids are free-living animals, some species are ectoparasites. They feed on soft tissues of hydroids, sea anemones, jelly-fishes, sponges, corals and, more seldom, on mollusks, starfishes, and sea urchins; they also feed on benthic protistans (Komokiacea).

The sea spiders are benthic animals that sometimes are able to swim. They can be caught by bottom trawls, dredges, sometimes they got into benthic traps; they may rarely be taken by plankton nets and other pelagic fishing gear. The pycnogonids should be preserved in 70% alcohol, or at least in neutralized formalin. Preparation in some cases is necessary for the identification of a species. During this process appendages should be separated as whole units or divided into segments, without destruction of the adjoining segments, because the correlation between the lengths of segments may be important for identification.

The class Pycnogonida is currently divided into no larger taxa than families. The section on sea spiders is based on the taxonomic system proposed by Schimkewitsch (1929) with minor later additions and changes (Hilton, 1942a,b; Hedgpeth, 1948; Pushkin, 1993). Ten families are established within the class, namely: Ammotheidae, Nymphonidae, Callipallenidae, Phoxichiliidae, Austrodecidae, Colossendeidae, Decolopodidae, Rhynchothoracidae, Endeidae, and Pycnogonidae.

At present there are 50 species of the pycnogonids registered for the Sea of Japan, belonging to 17 genera and 6 families, of which 21 species of 7 genera and 4 families occur in the Russian waters of the Sea of Japan. The taxa which have not yet been found in this region are marked with an asterisk (*).

Systematic part

KEY TO THE FAMILIES OF THE CLASS PYCNOGONIDA

1(8). Adults have chelifores; in some species chelifores reduced to small buds.

2(5). Both sexes have palps, consisting of 5 to 10, or 20 segments.

3(4). Chelifore strong, longer than proboscis, with 2 segments; fingers of chela have teeth or tubercles on inner margin; palp consists of 4–7 segments .... I. **Nymphonidae** (p. 94)

4(3). Chelifore feeble, shorter than proboscis, with 1–3 segments; fingers of chela reduced, or not reduced, but without teeth on inner margin; palp of both sexes consists of 8–10, or 20 segments ..... II. **Ammotheidae** (p. 105)

5(2). Palp absent, or consists of 1–4 segments.

6(7). Both sexes have ovigers composed of 9–10 segments, with compound spines on 4 distal segments .....*III. **Callipallenidae** (p. 119)

7(6). Only males have ovigers composed of 5–6 segments .... IV. **Phoxichilidiidae** (p. 122)

8(1). Adults without chelifores.

9(10). Palp consists of 8–9 segments; oviger of both sexes consists of 10 segments, with claw and several rows of compound spines ....*V. **Colossendeidae** (p. 127)

10(9). Palps absent; ovigers absent or present only in males, with 7–9 segments .... VI. **Pycnogonidae** (p. 129)

I. Family **NYMPHONIDAE** Wilson, 1878

Trunk elongated and divided into segments (excluding the genus *Paranymphon*); segment 1 with broad anterior part and narrow middle one, forming neck. Chelifore long, 2-segmented, with well-developed chela. Palp longer than proboscis, consists of 4–7 segments. Oviger of both sexes consists of 10 segments, segments 7 to 10 have compound spines placed in single row. 4–6 pairs of legs present.

Only one genus of this family is represented in the Sea of Japan.

1. Genus ***Nymphon*** Fabricius, 1794

Type species: *Pycnogonum grossipes* Fabricius, 1780.

Trunk elongated, cylindrical, smooth, appendages usually covered with setae; segment 1 long, moderately broadened anteriorly, neck well-expressed; lateral processes separated by intervals. Ocular tubercle situated on posterior part of neck. Abdomen cylindrical. Chelifore covered with setae; scape slender, cylindrical, longer than proboscis; chela broader than scape, fingers shorter or longer than palm, usually with teeth on inner margin. Palp consists of 5 segments, segments 2 and 3 usually long, segments 4 and 5 shorter, with thick setae. Oviger 10-segmented, segments 4 and 5 longest, 4 distal segments short, with row of compound spines, terminal claw with teeth on inner margin. Legs several times longer than trunk, femur and both tibia longest of all segments, tarsus varies in length, propodus longer or shorter than tarsus, propodus armed with short spines and setae and in most species also has longer basal spines on proximal, medial, or distal part of sole or along entire sole surface. Main claw well-developed, auxiliary claws vary in length, absent in some species.

There are 13 known species of *Nymphon* in the Sea of Japan, 8 of which occur in the Russian waters.

KEY TO THE SPECIES OF THE GENUS NYMPHON

1(26). Auxiliary claws present.
2(13). Compound spines of oviger serrate, with one pair of lateral teeth.
3(6). Propodal sole armed with large, strong spines, less or equal to propodal diameter in length, situated proximally or distributed over entire sole.
4(5). Proboscis slightly shorter than cephalic segment of trunk; segment 2 of palp shorter than segment 3; ocular tubercle tall, with pointed top .... 1. ***N. grossipes*** (p. 96)
5(4). Proboscis much shorter than cephalic segment; segment 2 of palp equal to segment 3 or longer; ocular tubercle low, with pointed or flat top and small lateral tubercles ..... 2. ***N. brevirostre*** (p. 97)
6(3). Large spines on propodal sole poorly developed or absent.
7(12). Neck slender, long, more than half length of cephalic segment; segments 4 and 5 of palp almost equal in length; spines on propodus hardly noticeable, placed medially, in groups of 2–3 spines.
8(9). 2 tall tubercles in shape of truncated cones situated on cephalic segment near chelifores' bases ..... 3. ***N. striatum*** (p. 98)
9(8). Anterior part of cephalic segment without tubercles .... 4. ***N. longitarse*** (p. 99)
10(11). Ocular tubercle with rounded top, auxiliary claws very small .... ***N. longitarse longitarse***
11(10). Ocular tubercle cylindrical, with conical pointed apex; auxiliary claws reach middle of main claw ..... * ***N. longitarse elongatum*** (p. 99)
12(7). Neck relatively short and thick; segment 4 of palp much shorter than segment 5; no large spines on propodal sole .....* ***N. longitarse brevicollis*** (p. 100)
13(2). Compound spines with 1, 2, or more pairs of lateral teeth, no serration.

14(15). Compound spines with 1 pair of large lateral teeth; propodus armed with 6–7 spines distributed over entire sole ..... 5. ***N. bisseratum*** (p. 100)
15(14). Compound spines with 2 or more pairs of lateral teeth.
16(19). Fingers of chela longer than palm, almost straight, only tips curved.
17(18). Processes of ovigers situated on proximal part of neck, just in front of lateral processes of 1st legs ..... **N. japonicum* (p. 101)
18(17). Processes of ovigers situated on anterior part of neck at place where cephalic segment expands ..... **N. micropedes* (p. 101)
19(16). Fingers of chela falciform.
20(23). Fingers of chela thin, equal in length to palm.
21(22). Propodal sole armed with small spinules of equal size .... **N. kodanii* (p. 101)
22(21). Propodal sole armed with spinules and several (3–6) large spines, situated medially and distally ..... 6. ***N. hodgsoni*** (p. 102)
23(20). Fingers of chela shorter than palm.
24(25). Trunk and appendages covered with peculiar bifurcate setae; neck long, processes of ovigers situated on sides of neck, at small distance from lateral processes of 1st legs; 12–15 large spines along length of propodal sole .... **N. stocki* (p. 102)
25(24). Trunk with long simple setae on lateral processes and leg segments; neck short, thick; processes of ovigers in contact with 1st legs lateral processes; fingers of chela in adults with small tubercles on inner margin, no teeth, in juveniles fingers of chela with dense short blunt teeth; propodal sole armed with row of spinules and 4–6 large spines, situated medially and distally .... 7. ***N. braschnikowi*** (p. 103)
26(1). Auxiliary claws absent.
27(28). Palp 3 times longer than proboscis, with segments 4 and 5 equal in length; compound spines serrate, with one pair of lateral teeth; tarsus longer than propodus, main claw shorter than propodus .... 8. ***N. uniunguiculatum*** (p. 104)
28(27). Palp 2 times longer than proboscis; its segment 4 shorter or occasionally almost equal to segment 5; compound spines with several large lateral teeth; tarsus and propodus almost equal; main claw equal to propodus or longer ....**N. albatrossi* (p. 104)

1. *Nymphon grossipes* (Fabricius, 1780)
(Pl. II, figs. 1–6)

Schimkewitsch, 1930: 400–415, figs. 101–106; Losina-Losinsky, 1961: 69–70; Utinomi, 1971: 318, Turpaeva, 2004a: 1087–1088, figs. 1, 1–4.

Description. Trunk slender, smooth; segment 1 almost as long as all other segments combined, greatly expanded anteriorly; neck thin. Lateral processes long, separated by more than their diameters. Ocular tubercle tall, cylindrical, with conical pointed apex; eyes large, pigmented. Proboscis cylindrical, as long as segment 1 of trunk. Abdomen straight, slightly longer than 4th lateral processes. Chelifore strong; scape longer than proboscis; chela as long as scape, with short setae; fingers short,

thick, in some specimens 2 times shorter than palm, with equal teeth on inner margin. Palp almost 1.5 times longer than proboscis; its segment 2 shorter than segment 3; segment 4 almost twice shorter than segment 5; distal segments densely covered with setae. Oviger long (male oviger 1.5 times longer than trunk), thin; segments 4 and 5 longest, slightly broadened distally; segments 6–10 combined shorter than segment 5; compound spines thin, denticulate, with one pair of large lateral teeth. Legs 4 times longer than trunk; coxae short; femur slightly longer than tibia 1; tibia 2 1/3 longer than femur; tarsus usually longer than propodus, but may also be shorter (especially in juveniles); propodus slightly curved, with one row of spinules and 4–8 large spines proximally and often also medially on sole; main claw strong, curved, slightly longer than half of propodus; auxiliary claws as long as half of main one. Body length 6 mm, width – 54 mm.

Geographical distribution. *N. grossipes* is a circumpolar arctic-boreal species. In the Pacific Ocean it inhabits the Bering Sea, Sea of Okhotsk and the northern part of the Sea of Japan (near the South Sakhalin). It also occurs on the Pacific side of the shelf zones of the Kuril and Japan islands.

Vertical distribution. *N. grossipes* is found in depths from 4 to 1466 m. In the seas of the Russian Far East it has been found between 20 and 592 m of depth.

Remarks. The species varies greatly, especially towards the borders of its geographical range. Thus, for example, in the Pacific Ocean, east of Honshu Island, *N. heterospinum* was found (Hedgpeth, 1949), which Losina-Losinsky (1961) and later Hedgpeth (1963), assigned to *N. grossipes*. Hedgpeth also considers *N. nigrognatum* Hilton, 1942, found off Vancouver Island, and *N. oculospinum* Hilton, 1942, found in the Gulf of California, to be the forms of *N. grossipes*. Losina-Losinsky, in his studies of the specimens from Far Eastern seas (1961), notes that there are transitional forms between *N. grossipes* and *N. mixtum* Kroyer.

2. ***Nymphon brevirostre*** Hodge, 1863
(Pl. II, figs. 7–13)

Schimkewitsch, 1930: 392–400, figs. 98, 99; Losina-Losinsky, 1961: 51 (pl. 1), 67–69; Hedgpeth, 1949: 235 (tabl. 1), 242 (tabl. 2), 246, 248; Turpaeva, 2004a: 1086.

Description. Trunk small, but robust, cylindrical, almost smooth; segment 1 equal to segments 2 and 3, anterior part rather broadened, neck short. Ocular tubercle low, in shape of truncated cone, with two lateral bumps (“shoulders”). Proboscis cylindrical, rounded on top, shorter than segment 1 of trunk. Abdomen straight, short. Chelifore strong, with sparse setae; scape and chela equal in length, as long as proboscis or slightly shorter; fingers shorter than palm, both armed similarly. Palp thin, short, slightly longer than scape of chelifore; segment 2 as long as segment 3 or slightly longer; segment 4 shorter than segment 5. Oviger has normal length, compound spines lanceolate, serrate, with one pair of lateral teeth. Legs slightly more than 3 times longer than trunk, with sparse short setae; 2nd coxa 1.5 times longer than each of 2 others; femur and tibia 1 almost equal; tibia 2 longest; tarsus shorter than propodus, propodus gently curved, with several large spines proximally and medially on sole; main claw as long as 1/3 to 1/2 of propodus, strong; auxiliary claws equal to half of main claw or shorter. Body length about 5 mm.

Geographical distribution. *N. brevirostre* is a circumpolar arctic-boreal species. It is greatly variable; 9 subspecies were found in the Arctic region (Losina-Losinsky, 1935; Turpaeva, 2004a). In the Far Eastern seas of Russia it occurs in the Bering Sea, Sea of Okhotsk, and the northern part of the Sea of Japan, where it was recorded near the western coast of the South Sakhalin and in the Tatar Strait. A subspecies *N. brevirostre kurilensis* Losina-Losinsky, 1961 occurs in the Pacific Ocean on the shelf surrounding the Kuril Islands. In the Sea of Okhotsk, near the Yamskie Islands *N. brevirostre ochoticum* Turpaeva, 2004 has been recently described. On the North-American shelf two forms were found, described as *N. microcollis* Hilton, 1942 and *N. gracile* Hilton, 1942, but Hedgpeth (1949) considers them forms of *N. brevirostre*.

Vertical distribution. The species is distributed from the littoral zone to a depth of 677 m.

3. ***Nymphon striatum*** Losina-Losinsky, 1929
(Pl. III, figs. 7–12)

Losina-Losinsky, 1929: 538–340, fig. 1; 1933: 64–67, fig. 13; 1961: 59; Nesis, 1967: 248; 1976: 77, fig. 178; Hong, Kim, 1987: 139, 160–161; Nakamura & Child, 1991: 61–62; Nakamura, 1994: 15; Turpaeva, 2004a: 1092–1093.

Description. Trunk elongated, slender; lateral processes separated by twice their own diameters. Cephalic segment equal in length to rest part of trunk; neck very long, thin, in large specimens reaches half length of cephalic segment; neck of juveniles slightly shorter. Anterior part of segment 1 broadened; 2 tall tubercles in shape of truncated cone situated near frontal margin. Proboscis cylindrical, 1.5 to 2 times shorter than segment 1. Abdomen short, slightly expanded medially, erected almost vertically. Chelifore moderately long; scape longer than proboscis; chela slightly shorter than scape; fingers with curved tips, slightly shorter than palm. Palp thin; its segment 2 slightly longer than segment 3, segments 4 and 5 equal in length, or segment 5 slightly longer. Male oviger 1.5 times longer than trunk; female oviger slightly shorter than trunk; segment 4 longest; compound spines serrate, with one pair of lateral teeth. Legs 3.5 to 5 times longer than trunk, thin, with sparse long setae; femur slightly shorter than tibia 1; tibia 1 shorter than tibia 2; length of tarsus varies: large specimens' tarsus twice longer than propodus, juveniles' tarsus almost equal to propodus; propodal sole armed with one row of spinules, among which 2–3, rarer 5, large spines situated medially, sometimes large spines absent. Main claw heavy, slightly curved distally, shorter than half of propodus; auxiliary claws slightly shorter than half of main one. Body length about 8 mm.

Geographical distribution. *N. striatum* is known only from the Far Eastern seas. It occurs off the north-eastern coast of the Korea Peninsular, near Hokkaido Island, the eastern coast of Japan and in Toyama Bay; it is also found near the Pacific Ocean sides of Shikotan and Kunashir islands (the Kurils) and in the south of the Sea of Okhotsk. In the Sea of Japan it was recorded near the coast of Primorsky Region (from Possjet Bay to De-Kastri Bay) and the south-western coast of Sakhalin Island.

Vertical distribution. The species is sublittoral; it occurs at depths of 1–180 m.

4. ***Nymphon longitarse longitarse*** Kroyer, 1844–1845
(Pl. IV, figs. 1–5)

Schimkewitsch, 1930: 434–451, figs. 118–120; Losina-Losinsky, 1935: 15, 30–31; 1961: 65; Hedgpeth, 1949: 247–248; 1963: 1330–1331; Utinomi, 1971: 318–319 (*Nymphon longitarse*).

Description. Trunk thin, smooth; cephalic segment longer than three others combined, slightly expanded anteriorly; neck very long and thin; lateral processes rather long, divided by broad intervals. Proboscis cylindrical, almost 1.5 times shorter than cephalic segment. Ocular tubercle cylindrical with conical rounded top; eyes large, pigmented. Abdomen short, straight. Chelifore thin; scape longer than proboscis; chela slightly shorter than scape; fingers almost equal in length to palm, tips curved. Palp longer than proboscis; segments 2 and 3 equal; segment 4 slightly shorter than segment 5; segment 5 lanceolate, only slightly shorter than segment 3. Male oviger more than 1/5 longer than trunk; segments 4 and 5 equal in length; compound spines small, lanceolate, denticulate, with one pair of lateral teeth. Legs very thin and long, with short sparse setae; 2nd coxa almost equal in length to 1st and 3rd coxae combined; femur in females slightly swollen; tibia 1 longer than femur and shorter than thin and very long tibia 2; tarsus almost twice longer than propodus; propodal sole with row of thin short spinules, usually 2–3 larger spines situated medially among them. Losina-Losinsky (1935) noticed, that such "large" spines often barely different from others, or even specimen may have these spines on some legs and do not have them on others. Main claw twice shorter than propodus, almost straight, gently curved distally; auxiliary claws very small. Adult body length about 7 mm, width about 60 mm.

Geographical distribution. *Nymphon longitarse longitarse* is a widespread circumpolar boreal arctic subspecies. It is distributed in the Barents, White, Norwegian and Greenland seas, Baffin Bay and the Davis Strait, in the north-western part of the Atlantic Ocean near the eastern coast of the North America up to latitude 40˚ N, also in the Bering Sea, Sea of Okhotsk, Sea of Japan (Peter the Great Bay, Olga Bay, the western coast of Sakhalin), and near the Kuril Islands. It mostly inhabits the sublittoral zone.

****Nymphon longitarse elongatum*** Hilton, 1942
(Pl. IV, figs. 12–15)

Hilton, 1942a: 5; Hedgpeth, 1949: 251–252, fig. 22; Hong, Kim, 1987: 158, fig. 15 (*Nymphon elongatum*).

Description. This subspecies differs from nominative species in tall ocular tubercle with conical top and lateral tubercles, in shorter fingers of chela, and longer tarsus of leg (2.5 as long as propodus).

Geographical distribution. *N. longitarse elongatum* occurs in the north-western part of the Pacific Ocean, in the eastern part of the Sea of Japan (Toyama Bay), near the north-western coast of the Korea Peninsula and in the East China Sea at depths from 16 to 1600 m.

**Nymphon longitarse brevicollis* Losina-Losinsky, 1929
(Pl. IV, figs. 6–11)

Losina-Losinsky, 1933: 68–69; 1935: 30–34, fig. 4; 1961: 65–66; Hedgpeth, 1949: 248; 1963: 1331 (*Nymphon longitarse brevicollis*).

Description. This subspecies differs from nominative species in more compact trunk. Neck shorter and thicker, shorter than half of cephalic segment; ocular tubercle low, with flat top; proboscis only 1.5 times as short as cephalic segment of trunk. Legs not as thin as in *N. longitarse longitarse*, but of same length; tarsus only 1.5 times longer than propodus; usually propodal sole lacks larger spines; auxiliary claws noticeably longer and reach 1/3 of main claw. Palp rather long; its segment 4 noticeably, sometimes even twice, shorter than segment 5, but in some specimens these segments may be almost equal, like those in *N. longitarse longitarse.*

Geographical distribution. This subspecies is mainly high arctic, but also occurs near Sakhalin Island (at the Terpenyia Bay entrance) and on the Pacific Ocean side of the South Kuril Islands. In some regions *N. longitarse brevicollis* is found along with *N. longitarse longitarse.*

5. *Nymphon bisseratum* Losina-Losinsky, 1961
(Pl. III, figs. 1–6)

Losina-Losinsky, 1961: 66, fig. 4.

Description. Trunk robust, smooth; lateral processes separated by less than their own diameters, longer than trunk width, slightly expanded distally; each with several long setae dorsally on distal margins. Cephalic segment equal to or longer than another part of trunk, slightly broadened anteriorly; neck elongated. Ocular tubercle low, with rounded top, situated near base of neck, opposite oviger implantation; eyes large, pigmented. Proboscis cylindrical, noticeably shorter than cephalic segment. Abdomen long, reaches as far as distal edge of 1st coxae of 4th legs. Chelifore feeble; scape equal to proboscis and to chela, fingers equal to palm in length, gently curved, bearing small teeth. Palp 1.5 times longer than proboscis; its segments 2 and 3 equal; segment 4 twice shorter than segment 5; both distal segments covered with short setae. Compound spines of oviger with rounded tips and with only one pair of lateral teeth. Strong legs covered with setae; 2nd coxa longer than 1st and 3rd combined; tibia 1 longer than femur; tibia 2 much longer than tibia 1; tarsus slightly shorter than propodus. Main claw almost 3 times shorter than propodus; auxiliary claws longer than half of main claw. Propodal sole bears 6–7 large spines medially and distally and several spinules between them. Measurements of only one specimen available: trunk length 7.25 mm, proboscis 1.5 mm, palp 2.2 mm, leg 21.4 mm.

Geographical distribution. The only specimen was caught in the Sea of Japan near the western coast of the South Sakhalin, near the town of Nevelsk, at a depth of 101 m.

**Nymphon japonicum* Ortmann, 1891
(Pl. VI, figs. 1–8)

Ortmann, 1891: 158–159, pl. 24, fig. 1; Hedgpeth, 1949: 249, fig. 20; Hong & Kim, 1987: 158–160, fig. 16; Nakamura, 1987: 5–6, fig. 3.

Description. Trunk elongated, segmented; lateral processes 1.5 times longer than their diameters, separated by almost as long as their lengths. Neck 3 times as long as broad, anterior part of segment 1 only twice broader than neck width. Oviger implantations in contact with 1st lateral processes. Ocular tubercle low, with rounded top, situated near neck base; eyes pigmented. Proboscis cylindrical, 1.5 times shorter than cephalic segment. Abdomen straight, reaches beyond distal margins of 4th lateral processes, protrudes obliquely upward. Chelifore strong; scape cylindrical, longer than proboscis, evenly armed with sparse setae and row of setae on distal margin; chela shorter than scape; fingers longer than palm, almost straight, with curved tips. Large specimens have 30 large teeth on immovable finger and 35 smaller teeth on movable one. In juveniles immovable finger armed with 19–32, movable finger, with 27–40 teeth. Palp thin; segment 2 longest; segment 3 longer than segment 5; segment 5 greatly longer than segment 4. Oviger: 5th segment longest, 1.5 times longer than 4th one; both segments armed with short setae; segment 6 three times shorter than segment 5, evenly covered with setae; compound spines bear 3 pairs of lateral teeth; terminal claw only slightly shorter than terminal segment, armed with 7 teeth on inner margin. Legs long; 2nd coxa longer than 1st and 3rd combined; femur shorter than tibia 1, whereas tibia 1 noticeably (almost 1.5 times) shorter than tibia 2; tarsus and propodus subequal; large spines sparsely distributed over propodal sole. Main claw less than half of propodus; auxiliary claws longer than half of main one.

Geographical distribution. *N. japonicum* is distributed along the eastern and western coasts of Japan, in the western part of the Tsugaru Strait, off the south-eastern coast of the Korea Peninsula and in the Korea Strait. Distribution pattern of *N. japonicum* suggests that the species penetrates as far as the north-eastern part of the Sea of Japan.

Vertical distribution. It occurs at depths of 30–439 m.

**Nymphon micropedes* Hedgpeth, 1949
(Pl. VII, figs. 1–5)

Hedgpeth, 1949: 254–256, fig. 24.

N. micropedes is known from the Pacific shelf of the northern part of Honshu Island, from Suruga Bay to the Tsugaru Strait. The known bathymetric range is 85–923 m.

**Nymphon kodanii* Hedgpeth, 1949
(Pl. VII, figs. 6–10)

Hedgpeth, 1949: 252–254, fig. 23; Turpaeva, 2004b: 1230–1231, figs. 1, 9–12.

N. kodanii is distributed near the western coasts of Honshu and Kyushu islands (south of 40°N) and in the eastern part of the Sea of Japan at depths from 140 to 1200 m.

6. ***Nymphon hodgsoni*** Schimkewitsch, 1913
(Pl. V, figs. 1–6)

Schimkewitsch, 1913: 244–248, figs. 15–25; 1930: 512–517, figs. 155a, 156a, 158, 160–166; Losina-Losinsky, 1933: 71; 1961: 63; Hedgpeth, 1949: 250–251, fig. 21; Turpaeva, 2004b: 1234–1235, fig. 4.

Description. Trunk robust, elongated, smooth; only distal margins of lateral processes armed with short setae. Lateral processes approximately 1.2–1.4 times as long as broad, separated by not more than half their own diameters. Cephalic segment longer than another part of trunk; anterior part twice broader than neck, with small processes of chelifores, palps and ovigers; neck short; oviger processes in contact with lateral processes of 1st legs. Ocular tubercle low, with rounded top, slightly bent backwards; eyes large; posterior pair larger than anterior one. Proboscis straight, cylindrical, equal in length to cephalic segment. Abdomen straight, longer than fourth lateral processes, protruded obliquely upward. Chelifore slightly shorter than trunk; scape shorter than proboscis, expanded mid-distally; chela longer than scape; fingers bearing long teeth placed at angle to palm, gently curved, their thin tips cross; length of fingers as a whole equal to length of palm, but immovable finger much shorter than movable one. Palp rather thin; its segment 2 slightly longer than segment 3; oval segment 4 about 1.5 times as long as broad; segment 5 straight, lanceolate, 2.5 times longer than segment 4. Oviger more than twice longer than trunk; its segment 4 almost straight, equal to segments 1 to 3 combined; in males segment 5 longest, expanded distally and curved proximally; 4 distal segments subequal; claw twice shorter than terminal segment, thin, with 9 long teeth on inner margin. Compound spines bear 3–4 pairs of lateral teeth. Legs strong, 6 or more times longer than trunk; coxa 2 slightly expanded distally, equal in length to coxae 1 and 3 combined; femur longer than all coxae combined; tibia 1 slightly longer than femur; tibia 2 one and half times longer than tibia 1. Distal segments of legs noticeably thinner than other segments; tarsus slightly shorter than propodus; propodal sole provided with row of small spines and several larger spines on distal half. Main claw thin, curved, slightly shorter than half of propodus; auxiliary claws 3.5 times shorter than main one. All appendages covered with setae, longest setae on legs. Measurements of male: trunk 8.55 mm; proboscis 4.6 mm; chelifore 8.2 mm; palp 7.3 mm; oviger 19.3 mm; third leg 53.5 mm. Measurements of female: trunk 3.55 mm; proboscis 1.45 mm; chelifore 3.55 mm; palp 2.8 mm; oviger 5.05 mm; third leg 15.25 mm.

Geographical distribution. The species inhabits the Sea of Okhotsk, also found in the Pacific Ocean near the Kuril Islands and in the northern part of the Sea of Japan (near the western coast of Sakhalin and Plastun Bight). It has not been recorded south of latitude 43°N.

Vertical distribution. It occurs at depths from 42 to 1530 m.

****Nymphon stocki*** Utinomi, 1956
(Pl. VIII, figs. 1–5)

Utinomi, 1955: 10–13, figs. 6, 7; 1971: 321.

The species was found near the western coast of Japan, near Goto Island (Toyama Bay), at a depth of 324 m and north of Noto Island at a depth of 123 m.

7. ***Nymphon braschnikowi*** (Schimkewitsch, 1906)
(Pl. V, figs. 7–14)

Schimkewitsch, 1906: 248–251, pl. I, figs. 2b, 3b, 4b, 5a, 6a; Hedgpeth, 1949: 250, fig. 21a, c; Losina-Losinsky, 1961: 62; Turpaeva, 2001: 77–79, fig. 2; 2004b: 1232–1234, fig. 3.

Description. Trunk robust, elongated, completely segmented. Lateral processes broad, slightly more long than broad; separated by 3–4 times less than their own diameters. Cephalic segment greatly expanded anteriorly; neck well developed, bears small processes of chelifores. Processes of ovigers in close contact with 1st legs lateral processes, almost as long in diameter as 3/4 length of neck. Ocular tubercle more broad than tall, with flat top and large poorly pigmented eyes. Segments II and III of trunk subequal in length, segment IV half shorter than each of them. Proboscis robust, cylindrical, slightly shorter than cephalic segment, protruded obliquely downward. Chelifore strong; scape slightly swollen distally, shorter than proboscis; chela longer than scape; palm almost straight, thicker than scape and equal to it in length. Fingers heavy, far shorter than palm; immovable finger short, straight, wedge-shaped; movable finger longer than immovable one, curved proximally; both fingers bear very short, blunt, closely set teeth on inner margins. Palp 1.5 times shorter than chelifore; segment 2 longest; distal segments broad, rounded, their combined length slightly less than segment 3 length; segment 5 one and half times longer than its width. Oviger twice longer than trunk; segments 4 and 5 equal in length and longest of all others; 3 distal segments equal to one another. Compound spines curved, bear 3–4 pairs of lateral teeth. Terminal claw twice shorter than segment 10, straight, with very densely set small blunt denticles on inner margin. Legs robust, seven times longer than trunk; coxae short; coxa 2 strongly expanded distally, asymmetrical; coxa 3 equal to coxa 1, also asymmetrical; femur and tibia 1 equal; tibia 2 one and half times longer than each of them; tarsus and propodus short; tarsus twice as long as broad, propodus 1.5 times longer than tarsus, almost straight; propodal sole bears row of short setae and 5–6 spines, equal in length to half of propodus width or less, situated medially and distally. Main claw almost straight, shorter than half of propodus; auxiliary claws small, shorter than 1/4 of main claw. Females differ from males in secondary characters: they have large genital pores on all legs and poorer armature, but bear short tough setae on frontal margin of trunk, distally on lateral processes, and on all appendages. Measurements of female: trunk 7.2 mm, proboscis 3.5 mm, abdomen 1.8 mm, chelifore 7.7 mm, palp 4.8 mm, oviger 15.1 mm, 3rd leg 50.9 mm.

As for juveniles, their chelae also bear short wedge-shaped fingers. Distal segments of palp shorter than segment 3. Auxiliary claws on legs hardly noticeable. 2nd coxa in male juveniles almost 3 times longer than 1st coxa, while tarsus more than twice shorter than propodus.

Geographical distribution. *N. braschnikowi* occurs in the Sea of Okhotsk, on the shelf zone of the Kuril Islands; it has also been recorded in the Sea of Japan near Sakhalin Island. The finding of this species near the southern coast of Hokkaido Island, reported by Hedgpeth, is doubtless. Judging by its appearance (Hedgpeth, 1949, fig. 21), the specimen found must be identified as *N. hodgsoni*.

Vertical distribution. The distribution range is between 26 and 120 m.

8. ***Nymphon uniunguiculatum*** Losina-Losinsky, 1933
(Pl. VI, figs. 9–16)

Losina-Losinsky, 1933: 62–64, fig. 12; 1961: 72; Hedgpeth, 1949: 263, fig. 29; Kim, 1984: 534, fig. 3a–f; Hong & Kim, 1987: 161; Turpaeva, 2004a: 1096.

Description. Trunk smooth; cephalic segment longer than three other segments combined; anterior part of it greatly expanded; neck slender, tapering toward base. Lateral processes long, twice as long as broad; intervals between them equal or longer than their own diameters. Proboscis cylindrical, considerably shorter than cephalic segment. Ocular tubercle low, cylindrical, with flat top and two bumps on sides; eyes large. Abdomen short, pointed obliquely upward. Chelifore almost 3 times longer than proboscis; scape much longer than proboscis, thin; chela thin, too, slightly shorter than scape; palm almost cylindrical; fingers slightly shorter than palm, thin, bearing numerous densely placed teeth on inner margins. Palp very thin, 3 times longer than proboscis, like chelifore; segment 2 longest; segment 3 slightly shorter; equal segments 4 and 5 slightly shorter than segment 3. Oviger in males twice longer than trunk; segment 5 longest, segments 7 to 10 almost equal in length, bearing well-developed densely set lanceolate, serrate compound spines, having two lateral teeth each. Compound spines on distal ends of segments often without lateral teeth. Terminal claw with small denticles. Legs thin, male legs 7 times longer than trunk, bearing few setae; 1st coxa shortest; 2nd coxa 4 times longer than 1st one, having distal projection with genital pore; 3rd coxa more than 1.5 times longer than 1st one; femur much shorter than tibia 1; female femur expanded; tibia 1 shorter than tibia 2; tarsus in males almost 4 times (in females – 3 times) shorter than tibia 2; propodus 1.5 times shorter than tarsus; tarsus and propodus both thin and straight. Propodal sole covered with minute setules, devoid of even small spines. Main claw slightly longer than half of propodus, no auxiliary claws. Measurements of male (holotype): trunk 5.3 mm, proboscis 1.75 mm, chelifore 5.05 mm, palp 5.15 mm, 3rd leg 37.5 mm. Female (paratype) larger than male: trunk 6.15 mm, chelifore 5.95 mm, palp 6.3 mm, 3rd leg 51.05 mm.

Geographical distribution. In the Russian waters of the Sea of Japan *N. uniunguiculatum* is found in Peter the Great Bay. It also occurs near the coasts of Hokkaido and Honshu islands, the north-western coast of Korea, and off the South Kurils.

Vertical distribution. The species has been recorded at depths of 150–770 m.

****Nymphon albatrossi*** Hedgpeth, 1949
(Pl. VIII, figs. 6–10)

Hedgpeth, 1949: 263–266, fig. 30.

N. albatrossi occurs in the south-eastern part of the Sea of Japan near the western coast of Honshu Island, from Toyama Bay to the Korea Strait, also south and west of Kyushu Island in depths from 150 to 800 m.

II. Family **AMMOTHEIDAE** Dohrn, 1881

The family combines rather different forms of sea spiders, having compact or elongated trunk, segmented or unsegmented. Chelifore consists of 1, 2, or 3 segments, poorly developed and usually shorter than proboscis, with feeble or reduced fingers, completely absent in some species. Palp often longer than proboscis, consisting of 6–10 (even 20) segments. Both males and females have 10-segmented oviger, with or without terminal claw, with compound spines, placed in rows or irregularly, or with common flat spines. Four pairs of legs present. Males have genital pores on 3rd and 4th legs, females on all legs.

KEY TO THE GENERA OF THE FAMILY AMMOTHEIDAE

1(4). Trunk compact, disk-shaped, unsegmented or not completely segmented (in some specimens segmentation may be complete); lateral processes placed in contact or radiate out from trunk like rays.

2(3). Chelifore 2-segmented; palp 8–9 segmented; coxa 1 of leg bears one tall dorso-distal tubercle ..... 1. ***Achelia*** (p. 105)

3(2). Chelifore usually in shape of rudimentary buds; palp consists of 4–7 segments; coxa 1 of leg lacks dorso-distal tubercle .....****Tanystylum*** (p. 114)

4(1). Trunk elongated, segmented; lateral processes separated by broad intervals.

5(6). Chelifore consists of one segment, very small; segment 7 of oviger curved, with tuft of setae on convex side; segment 8 implanted on side of segment 7 .... 2. ***Lecythorhynchus*** (p. 115)

6(5). Chelifore consists of 2–3 segments; segment 7 of oviger not curved; segment 8 implanted on it distally.

7(8). Palp consists of 18–20 segments, distal part of it looking like whip; distal ends of 1st legs also whip-shaped ..... ****Nymphonella*** (p. 116)

8(7). Palp consists of 9–10 segments; all legs identical, without whip-shaped ends.

9(10). Anterior part of cephalic segment covers implantations of chelifores hood-like; segment 2 of oviger longest; proboscis oval ..... 3. ***Cilunculus*** (p. 117)

10(9). Anterior part of cephalic segment does not cover implantations of chelifores; segment 2 of oviger much shorter than segment 4; proboscis with one or two constrictions, separating its medial oviform part from proximal and distal conical parts ..... ****Ascorhynchus*** (p. 118)

1. Genus ***Achelia*** Hodge, 1864

Type species: *Achelia ehinata* Hodge, 1864

Trunk short, shield-shaped, unsegmented, partially segmented, or, very rarely, completely segmented. Anterior part of cephalic segment has two lateral angles; lateral processes in contact or separated by small intervals, having different width in males and females. Ocular tubercle situated on anterior part of cephalic segment; eyes well-developed. Proboscis heavy, often oval, spindle-shaped, sometimes cylindrical. Abdomen fused with distal segment of trunk, usually long. Chelifore short, consists of

2 segments; adults have vestigial chelae with reduced fingers or without them. Palp consists of 6–8 segments, usually longer than proboscis. Oviger consists of 10 segments, male oviger longer than female one, bearing few compound spines placed irregularly, or bearing simple spines placed similarly. Legs short, covered with tubercles and spines; femur distally bears conical process, larger in males, having opening of cement gland on top in males; tarsus small, caliciform; propodus more or less curved; in most species propodal sole provided with large spines proximally and small spines medially and distally. Main claw usually large, curved; auxiliary claws usually smaller than main one. Males have genital pores on special process (genital spur), situated on coxa 2 of legs 3 and 4.

KEY TO THE SPECIES OF THE GENUS ACHELIA

1(14). Trunk unsegmented, without articulation lines.

2(3). Propodal sole lacks isolated large spines; lateral processes in males long, thin, separated by intervals, expanding distally; no compound spines on oviger .... 1. ***A. borealis*** (p. 107)

3(2). Propodal sole bears large spines.

4(5). Dorsal side of trunk has two tubercles, placed one after another, with spines on tops; in adults abdomen base rises over trunk surface, making it saddle-shaped ..... 2. ***A. bituberculata*** (p. 108)

5(4). Dorsal side of trunk smooth and even, without any tubercles.

6(7). Proboscis twice shorter than trunk, almost cylindrical, with rounded tip ..... **A. brevirostris*** (p. 108)

7(6). Proboscis robust, almost equal to trunk in length, oval, spindle-shaped, or pyriform.

8(9). Ocular tubercle cylindrical, tall, with conical top bearing small eyes; chelifores, palps and legs bear long spines, covered with short thin setae .... **A. latifrons*** (p. 109)

9(8). Ocular tubercle low, conical; eyes situated in its middle part; all appendages bear long spines without setae.

10(11). Two small tubercles with apical spines on frontal margin of trunk and at distal angles of lateral processes; proboscis oval; chelifore longer than half of proboscis; scape bears medial tubercle with spine on top .... 3. ***A. kurilensis*** (p. 109)

11(10). Frontal margin of trunk smooth; each lateral process in adults bears one small tubercle without spines (juveniles may lack such tubercles, or may have 2 tubercles with apical spines on each lateral process); proboscis has another shape; chelifore much shorter than half of proboscis.

12(13). Proboscis spindle-shaped; propodus strong, noticeably curved; main claw heavy, reaching past middle of propodus; auxiliary claws slightly longer than half of main claw ..... 4. ***A. alaskensis*** (p. 110)

13(12). Proboscis pyriform, consisting of conical basal part and large oviform part; propodus relatively thin, curved; main claw curved, reaching middle of propodus; auxiliary claws hardly reach middle of main claw .... 5. ***A. gracilipes*** (p. 111)

14(1). Trunk completely or partially segmented.

15(18). Trunk completely segmented, all segments separated.

16(17). Ocular tubercle conical, eyes situated in middle of it, proboscis relatively slender, almost cylindrical ..... 6. ***A. segmentata*** (p. 111)

17(16). Ocular tubercle very tall, cylindrical, eyes situated at its top; proboscis oval, swollen medially ..... **A. superba*** (p. 112)

18(15). Trunk not completely segmented, no articulation line between segments 3 and 4.

19(20). Ocular tubercle tall, cylindrical; two conical tubercles with truncated tops bearing spines situated dorsally on frontal margin of trunk, on ends of lateral processes and 1st coxae of legs ..... 7. ***A. echinata orientalis*** (p. 113)

20(19). Ocular tubercle low, conical, frontal margin smooth, lateral processes bear 2–3 tubercles with spines on tops ..... 8. ***A. kamtschatica*** (p. 114)

1. ***Achelia borealis*** (Schimkewitsch, 1895)
(Pl. IX, figs. 1–5)

Schimkewitsch, 1895: 36–40, pl. 2, figs. a–b; 1930: 139–144, figs. 34–37 (*Ammothea borealis*); Losina-Losinsky, 1933: 57–59, fig. 9 (*Ammothea borealis* var. *japonica*); Losina-Losinsky, 1961: 52 (*Achelia borealis* spp. *japonica*); Hedgpeth, 1949: 286–287, fig. 41 k–m (*Achelia borealis*).

Description. Trunk elongated, unsegmented, smooth. Cephalic segment small, without tubercles. Lateral processes long, twice as long as broad, separated by intervals, broadening distally; each has small tubercle without spine on anterior distal angle. Proboscis oval, slightly shorter than trunk. Ocular tubercle tall, cylindrical, with flat top, situated near frontal margin; eyes pigmented, placed almost on top. Abdomen almost 1/5 longer than trunk, swollen in distal half, tapered towards end. Chelifore slightly longer than half of proboscis; scape cylindrical; chela vestigial, without fingers. Palp 8- segmented, longer than proboscis; segment 2 longest; segment 4 shorter; other segments short; segments 7 and 8 shortest. Oviger twice as long as trunk; segment 10 bears two compound spines; segments 7 to 9 bear 1–2 simple spines. Legs thin, 6 times longer than trunk; coxa 1 bears tubercle with small spine, as tall as 3/4 of coxal length; other segments without tubercles and spines, armed only with setae. Tibia 1 longest; propodus almost straight, long, slender, without heel and isolated large spines; smaller spinules scattered over entire surface of sole. Main claw almost 4 times shorter than propodus; auxiliary claws slightly shorter than main one. Measurements of male: trunk 1.4 mm, proboscis 1.2 mm, chelifore 0.6 mm, palp 2.8 mm, 2nd leg 8.2 mm, propodus 0.9 mm, main claw 0.2 mm.

Geographical distribution. *A. borealis* is a boreal-arctic species. The subspecies *A. borealis japonica* (Losina-Losinsky) has been recorded for Peter the Great Bay (the Sea of Japan). The nominative subspecies occurs in the White and Kara seas, in the straits of the New Land Archipelago.

Vertical distribution. It was found in Peter the Great Bay at a depth of 130 m. Vertical distribution of the nominative subspecies ranges from 6 to 40 m depth.

2. ***Achelia bituberculata*** Hedgpeth, 1949
(Pl. XI, figs. 1–6)

Hedgpeth, 1949: 287–289, fig. 41a–g; Nakamura & Child, 1983: 6–7; Kim, 1984: 537, fig. 6a–i; Kim & Hong, 1986: 46; Nakamura, 1987: 18–19, pl. 16 (*Achelia bituberculata*); Utinomi, 1951: 163, fig. 2; 1954: 18–20, fig. 6; 1971: 330 (*Achelia ohshimai*).

Description. Trunk compact, rounded, unsegmented; mid-dorsal line bears 2 tall tubercles having 2–3 tops with spines near abdomen base. Lateral processes contiguous; several tubercles with spines situated on each lateral process dorsodistally. Same tubercles with spines situated near frontal margin of trunk. Ocular tubercle tall, with flattened top and pigmented eyes. Proboscis large, oval, elongated, almost equal to trunk length. Abdomen long, swollen in basal part, extended almost horizontally, reaching beyond distal ends of 1st coxae of 4th legs. In adults abdomen tuberculated and slightly curved upward, so that trunk looks saddle-shaped in lateral view. Chelifore 3–4 times shorter than proboscis; scape cylindrical, almost 4 times longer than its diameter, with tubercles on dorsal side and distal end; chela small, globular. Palp 8-segmented; segment 2 longest, almost 6 times as long as broad; segment 4 with dorsal swellings bearing stiff setae. Oviger 10-segmented; segments 4 and 5 in males almost twice longer than segment 3; segment 6 bearing 2 simple spines pointed to proximal end of segment; distal segments bear compound spines: 2 on segment 10, and 1–3 (number differs from specimen to specimen) on other segments. Legs armed with strong spines, situated on small tubercles; coxa 2 in males bears long genital spur on ventral side; femur longest of all segments, bears tubercle with cement gland opening on dorsal side; propodus robust, almost equal in length to tibia 2, noticeably curved, bears 3 large spines on sole proximally. Main claw slightly longer than half of propodus, strong, curved; auxiliary claws slightly longer than half of main one. Measurements of holotype: trunk 1.5 mm, proboscis 1.25 mm, abdomen 0.6 mm, 3rd leg 4.63 mm.

Geographical distribution. The species occurs near the Pacific coast of Japan, near the Korean Peninsula in the Sea of Japan and the East China Sea, also in Peter the Great Bay.

Habitat. *A. bituberculata* is a littoral and high sublittoral species, recorded to a depth of 75 m. It was found in Peter the Great Bay among the fouling of special experimental plates.

****Achelia brevirostris*** Losina-Losinsky, 1961
(Pl. IX, figs. 6–11)

Losina-Losinsky, 1961: 95–97, fig. 19; Nakamura & Child, 1991: 3–5, fig. 1a–f; Child, 1995: 3.

Description. Trunk rounded, unsegmented. Lateral processes robust, placed in contact. Low tubercles without spines on angles of lateral processes and of frontal margin of trunk. Ocular tubercle low, with conical top, situated near anterior margin of cephalic segment; eyes in middle part of tubercle. Proboscis twice shorter than trunk, rather slender, pointed downward. Abdomen long, robust, slightly curved upward. Chelifore with vestigial chelas lacking fingers, almost twice shorter than proboscis. Palp 8-segmented; segment 2 longest; segment 4 slightly shorter than segment 2; other

segments short, cylindrical; 4 distal segments covered with dense short setae. Oviger not longer than trunk; segment 4 longest; segment 5 shorter; segment 3 even shorter; other segments short; segment 10 bears two compound spines; segment 9 bears one compound spine. Legs twice longer than trunk, with sparse short setae; each coxa 2 of 3rd and 4th legs ventrally bears tall conical tubercle with genital pore; femur greatly expanded distally, bears projection with spine on margin of dorsal side; tibiae 1 and 2 equal, longer than femur; propodus quite robust, curved, bears 3 large spines on sole proximally. Main claw almost equal to propodus in length, slightly curved; auxiliary claws small, similar to basal spines on sole. Trunk length of adult specimens 1.4–1.5 mm.

Remarks. The above given diagnosis is the one of *A. brevirostris*, a holotype of which was found in the Sea of Okhotsk, near the South Sakhalin (Tyuleniy Island), at a depth of 48 m. Specimens from other places, assigned to this species, differ from the holotype in the less compact trunks, taller ocular tubercles and presence of tubercles on distal margins of lateral processes. Specimens collected near Japan, from depths to 479 m, have longer palps, relatively short main claws, and longer auxiliary claws (Nakamura & Child, 1991; Child, 1995).

The distribution pattern of *A. brevirostris* presupposes that the species may occur in the northern part of the Sea of Japan.

Achelia latifrons (Cole, 1904)
(Pl. X, figs. 13–15)

Cole, 1904: 263–266, pl. 11, fig. 3, pl. 16, figs. 1–9, pl. 17, figs. 1–3 (*Ammothea latifrons*); Kim & Hong, 1986: 46–48, fig. 8 (*Achelia latifrons*); Nakamura & Child, 1983: 8–10, fig. 2 (*Achelia orpax*).

A. latifrons is widespread on the continental shelf of the Northern Pacific. It has been recorded off California at a depth of 650 m, in the Bering Sea near the Pribilof and Unalaska islands, in Sagami Bay at a depth of 30 m, and in the Korea Strait. It has not been registered in the Sea of Japan yet, but in future may be found in its southern part.

3. ***Achelia kurilensis*** Losina-Losinsky, 1961
(Pl. X, figs. 1–7)

Losina-Losinsky, 1961: 98–100, fig. 21; Nesis, 1967: 249.

Description. Trunk disk-shaped, unsegmented. Anterior part of cephalic segment short, bears two tubercles with spines on tops. Lateral processes broad, placed in contact, each bears two rather tall tubercles with spines distally, of which posterior tubercle larger, situated near middle of distal margin. Ocular tubercle cylindrical, with rounded apex; eyes near apex. Proboscis oval, as long as trunk. Abdomen almost equal to trunk, swollen distally, with several large setae on dorsal side. Chelifore slightly longer than 1/2 of proboscis; scape long, with 3 tubercles on medial part and 3 thin spines on distal margin; chela small, globular. Palp 6–8 segmented; in holotype (male) palp 6-segmented, as long as proboscis, with segment 4 longest; in paratype (female) palp 8-segmented, with segment 2 longest; distal segments sparsely covered with

setae. Oviger relatively short; oviger in males shorter than whole trunk; oviger in females shorter than 1/2 of trunk length. Segments 4 and 5 of male oviger longest; segment 7 of irregular shape with long setae; segment 8 bears one compound spine; segment 10 rounded, very small. Legs 4.5–5 times as long as trunk; coxa 1 bears tall tubercle on dorsal side; laterally coxa 1 armed with setae and spines; similar setae and spines on all other segments; femur bears tubercle with spine on distal end; tibia 2 in males bears tubercles with spines, while female tibia 2 lacks them; femur, tibiae 1 and 2 subequal in males, while in females femur longer than both tibiae; propodus curved; heel absent; sole bears several thin setae and, proximally, 3 relatively large spines. Main claw slightly longer than half of propodus, auxiliary claws longer than half of main one. Measurements: trunk 1.08 mm, proboscis 1.08 mm, abdomen 1.06 mm, chelifore 0.64 mm, palp 1.06 mm, oviger 2.08 mm, leg 5.14 mm.

Geographical distribution. Type locality is Kunashir Island. *A. kurilensis* is found in the Sea of Japan in Peter the Great Bay (Sivuchya and Vityaz Bays), and also near the South Sakhalin.

Vertical distribution. It occurs in the littoral and high sublittoral zones to a depth of 20 m.

4. ***Achelia alaskensis*** (Cole, 1904)
(Pl. X, figs 8–12)

Cole, 1904: 266–268, pl. 12, fig. 4, pl. 17, figs. 4–12; Schimkewitsch, 1929: 151–156, figs. 42–45; Losina-Losinsky, 1933: 60, fig. 10 (*Ammothea alaskensis*); Losina-Losinsky, 1961: 91 (*Achelia alaskensis*).

Description. Trunk globular, unsegmented; anterior part of cephalic segment square, expanded at place of chelifore and palp implantations. Lateral processes as long as trunk width, expanded distally, contiguous; each bears one small tubercle with short spine on distal margins of dorsal side. Ocular tubercle low, conical or cylindrical with conical apex; eyes large, situated in middle of tubercle. Proboscis as long as trunk, spindle-shaped, convex dorsally and almost straight ventrally. Abdomen long, slender, with tapered distal end, reaching middle of coxa 1 of 4th leg, bears 3–4 spinules and several long setae on dorsal side. Chelifore shorter than 1/2 of proboscis; scape with triangular projection on end; chela small, globular. Palp 8-segmented; segments 2 and 4 longest, subequal; 4 distal segments small, rounded, ventrally armed with strong dense setae. Oviger in females as long as palp; all its segments relatively short and broad; segment 7 bears one compound spine; segments 8 through 10 bear 2 compound spines each. Oviger in males twice as long as in females; segments 3 to 6 elongated and rather thin; number of compound spines equal to that in females. Legs strong, especially in females; coxa 1 short, with tall conical tubercle on dorsal side; male coxa 2 bears tall genital spur ventrally; femur, tibiae 1, and 2 equal, bear tubercles with spines on dorsal sides, each of these 3 segments nearly as long as all 3 coxae combined; propodus robust, curved, without heel, sole bears several small spinules and, proximally, 3 large spines. Main claw heavy, gently curved, reaching beyond half of propodus; auxiliary claws as long as 1/2 of main one. Body length of male 3 mm, width 13 mm.

Remarks. *A. alaskensis* bears a very strong resemblance to *A. gracilis*. Main differences between these two species are in the shapes of proboscis and propodus.

However, these differences sometimes are barely perceptible, and in such cases it is hard to distinguish these species.

Geographical distribution. *A. alaskensis* is distributed along Alaska and Kamchatka shores, near the Commander Islands and in the Tatar Strait.

Vertical distribution. The species is sublittoral, occurring to a depth of 180 m.

5. ***Achelia gracilipes*** (Cole, 1904)
(Pl. XII, figs. 1–5)

Cole, 1904: 269–270, pl. 12, fig. 5, pl. 18, figs. 1–6 (*Ammothea gracilipes*); Losina-Losinsky, 1933: 60–61, fig. 11 (*Ammothea gracilipes* var. *borealis*); Nesis, 1967: 250 (*Achelia gracilipes*).

Description. Trunk oval, unsegmented; cephalic segment slightly expanded anteriorly; corners rounded, with small unarmed tubercles. Lateral processes contiguous, each bearing small conical tubercle on distal margin of dorsal side. Ocular tubercle low, conical; eyes in its middle part. Proboscis equal to trunk in length, pyriform, consists of short basal part and ovoid distal one. Abdomen rather slender, reaches distal ends of coxae 1 of 4th legs. Chelifore shorter than half of proboscis; scape bears small prominence with spine on distal end; chela as long as half of scape or shorter. Palp 8-segmented, slightly longer than proboscis; segments 2 and 4 equal; segments 5 to 8 short, densely covered with setae on ventral side. Oviger in females equal in length to palp, in males twice as long as palp; segments 4 and 5 longest; segment 7 bears projection covered with setae; other 3 segments small, only segment 10 bears 2 compound spines. Legs about twice as long as trunk, rather slender, especially in males; coxa 1 bears specific finger-shaped projection, almost equal to segment's length; coxa 2 one and half times as long as coxa 1; male coxa 2 of 3rd and 4th legs bears genital spur; femur and both tibiae subequal; female femur broadened; propodus long and rather thin, gently curved and has poorly developed heel with 3 curved spines and row of small spinules on sole. Main claw strong, gently curved, reaching half of propodus; auxiliary claws as long as half of main claw. Legs almost unarmed, having only few setae on coxae 2 and 3. Trunk length 1.5–2 mm, width 8 mm.

Remarks. The specimens collected in the Tatar Strait were referred by Losina-Losinsky to *A. gracilipes* var. *borealis*. They differ from the typical forms in the absence of noticeable tubercles on the anterior margin of the cephalic segment, in the longer abdomen, shorter scape, and larger body (body length – 3 mm, width of body with legs – 11.5 mm).

Geographical distribution. *A. gracilipes* has been recorded along the California shore, off the Commander Islands, near Kamchatka, the South Kurils, and the South Sakhalin (in the Tatar Strait).

Vertical distribution. The species is found in shallow waters (to 5 m depth).

6. ***Achelia segmentata*** Utinomi, 1954
(Pl. XI, figs. 7–11)

Utinomi, 1954: 20, fig. 9; 1971: 330; Nesis, 1967: 249.

Description. Utinomi's collection included only females and juveniles, so the description below is a description of a female.

Trunk smooth, relatively narrow, segmented; cephalic segment broader than its length, with smooth frontal margin. Lateral processes separated by narrow intervals, expanding distally. Ocular tubercle large, conical, situated medially on cephalic segment; eyes small. Proboscis almost cylindrical, slightly shorter than trunk, pointed downward. Abdomen slightly longer than 4th lateral processes, truncated, protruded upward. Chelifore about 3 times shorter than proboscis; scape straight; chela vestigial, with reduced fingers. Palp thin, 9-segmented; 4 proximal segments combined equal in length to proboscis, smooth, unarmed; distal segments short, ventrally covered with setae. Oviger completely absent in some specimens. Legs long, equally thin all along their length, without tubercles or projections, with sparse setae on most segments. All 3 coxae short, coxa 2 longest of them; femur, tibiae 1 and 2 subequal, each one's length almost equal to length of coxae combined; propodus curved, expanded proximally, having small heel with 3 strong short spines. Main claw as long as half of propodus, auxiliary claws as long as 2/3 of main one. Trunk length of largest female 0.88 mm.

Geographical distribution. *A. segmentata* has been recorded near Hokkaido Island and in Peter the Great Bay.

Vertical distribution. This is a sublittoral species. In Peter the Great Bay it has been found to a depth of 20 m.

Achelia superba (Loman, 1911)
(Pl. XII, figs. 6–11)

Loman, 1911: 11–13, pl. I, figs. 14–15; pl. II, figs. 16–24 (*Ammothea superba*); Nakamura, 1987: 21–23, pls. 18, 36; Turpaeva, 1990: 19–20, fig. 2; Child, 1995: 8 (*Achelia superba*).

Description. Trunk compact, but segmented; cephalic segment broad, almost square, as long as half length of trunk; frontal margin slightly concave. Lateral processes slightly longer than width of trunk in its narrowest part, separated by narrow intervals, bear small tubercles on distal angles. Ocular tubercle very tall, cylindrical, situated near frontal margin; eyes small, placed on top. Proboscis large, thick, spindle-shaped. Abdomen long, almost equal to trunk, protruded obliquely upward. Chelifore slender; scape only slightly shorter than trunk and longer than 1/2 of proboscis; chela very small, with immovable reduced fingers. Palp thin, 8-segmented; segment 2 as long as scape, bears tubercle with spine on distal margin; segment 3 very short, also has tubercle with spine; segment 4 almost twice shorter than segment 2, or sometimes as long as 2/3 of segment 2; 4 distal segments very thin, cylindrical; their combined length almost equal to length of segment 2. Oviger in males longer than in females; segment 4 longest; segment 5 as long as 3/4 of segment 4; distal segments elongated, oval (typical shape for whole genus), bear two compound spines each. Legs of average length; coxa 1 has 2–3 small tubercles on distal margin; male coxa 2 bears tall genital spur ventrally near distal margin; femur as long as all coxae combined, has tall process with spine and cement gland opening dorsodistally; tibiae 1 and 2 equal, both thinner and longer than femur; propodus thin, curved, without heel, about as long as half of

tibia 2; propodal sole bears row of small spinules and 2–3 larger spines on proximal part. Main claw thin, longer than half of propodus; auxiliary claws longer than half of main one. Measurements: trunk 1.5 mm, proboscis 2 mm, ocular tubercle almost 1 mm, abdomen 1 mm, male oviger 6 mm, 2nd leg 10 mm.

Geographical distribution. The species is known from the coastal regions of the north-west part of the Pacific Ocean. *A. superba* is distributed off the Pribilof and Aleutian islands, near the coast of Japan, and near Sakhalin Island in the Sea of Okhotsk. There is also a possibility that it may be found in the Tatar Strait.

Vertical distribution. The species is found between 7 and 428 m depth.

7. ***Achelia echinata orientalis*** Losina-Losinsky, 1933 (Pl. XIII, figs. 1–7)

Losina-Losinsky, 1933: 55–57, fig. 8 (*Ammothea echinata* ssp. *orientalis*); Lou, 1936: 19, figs. 7–9, pls. II–IV (*Ammothea* (*Achelia*) *echinata* var. *sinensis*); Nesis, 1967: 249; Nakamura, 1987: 19–21, pls. 17, 35; 1994: 14 (*Achelia echinata sinensis*).

Description. Trunk rounded; segments 1, 2, and 3 divided; segments 3 and 4 fused. Lateral processes placed in contact. Frontal margin of cephalic segment and distal amgles of lateral processes provided with 2 conical truncated tubercles with spines on tops. Ocular tubercle tall, cylindrical, with flat top, bearing tubercle in its centre; eyes near top. Proboscis spindle-shaped, longer or equal to trunk, tapered proximally and distally. Abdomen cylindrical, reaching middle of coxae 2 of 4th legs, curved upward. Chelifore 3 times shorter than proboscis; scape bears tubercle, often bicuspidate and with spines on both tops, on outer distal end; chela small with two tubercles (reduced fingers). Palp 8-segmented, slightly longer than proboscis, thin; segments 2 and 4 longest; segment 2 almost equal in length to scape; segment 4 shorter than scape. Oviger in males much longer than in females; segments 4 and 5 equal and longest of all; other segments short; segments 6 ,7, 8 and 10 armed with 2 compound spines; segment 9, with 1 compound spine (presence of compound spines on segment 6 of oviger – characteristic feature of *A. echinata*). Legs 4 times as long as trunk, strong, with short setae on ventral side and long setae on tubercles of dorsal side; coxa 1 in males provided distally with 2 tubercles with spines, sometimes forked; coxa 2 bears tubercles medially and distally; femur bears dorsodistal process with cement gland duct, pointed forward and armed with spine; femur, tibiae 1 and 2 equal in length; propodus 1.5 times shorter than tibia 2, strong, curved; its dorsal side covered with long setae; sole armed with row of short spines and, proximally, with 3–4 long spines. Main claw twice shorter than propodus; auxiliary claws longer than half of main one.

Remarks. This subspecies differs from the nominative species in the larger size (body length 3–3.5 mm), longer proboscis (which is also more than in North Atlantic specimens tapered proximally and distally), and in the greater number of compound spines on the distal segments of the oviger. Later a subspecies *A. echinata sinensis* (Lou) distributed farther south was described, characterized by another shape of the proboscis, the stronger armature, and another proportions of the palp and long segments of the legs. However, these differences may be considered a result of intraspecies variability, well displayed in the Sagami Bay collection (Nakamura, 1987).

Geographical distribution. *A. echinata orientalis* is distributed near the coasts of Japan, in the Sea of Japan and the Yellow Sea, and near the South Sakhalin. In the Sea of Japan it occurs in Peter the Great Bay.

Vertical distribution. The subspecies is found in the littoral zone to a depth of 130 m (mainly from 0 to 15 m).

8. ***Achelia kamtschatica*** Losina-Losinsky, 1961
(Pl. XIII, figs. 8–13)

Losina-Losinsky, 1961: 92–93, fig. 17.

Description. Trunk almost rounded, not completely segmented. Two posterior segments without articulation lines on dorsal side. Anterior part of cephalic segment short; no tubercles. Broad lateral processes almost in contact, distally provided with 2–3 unarmed or bearing short spines tubercles. Ocular tubercle low, conical, situated near frontal margin, bears large eyes at 1/2 of its height. Proboscis slightly shorter than trunk, thin, tapering from middle to end. Abdomen shorter than proboscis, slightly broadened distally, tapered towards end, reaching distal margin of 4th leg coxa 1. Chelifore almost 3 times shorter than proboscis; scape bears tubercle distally; chela twice as short as scape, oval in outline, without fingers. Palp 8-segmented, slightly longer than proboscis; segment 2 longest; segment 4 slightly shorter than segment 2; other segments short, armed with setae as long as segment's width. Oviger in males almost twice longer than trunk; segment 3 longest; distal segments gradually decrease in length; no compound spines on them. Legs 12 times as long as trunk, armed with sparse short spines; coxa 1 bears dorsodistal tubercle (its height almost equal to coxa's length), and 2–3 lateral tubercles with spines; coxa 2 and femur bear large (but lower than that of coxa 1) tubercle each; femur and tibia 1 equal in length; tibia 2 longer; propodus robust, curved, without heel, having 3 large spines on sole proximally. Main claw longer than half of propodus; auxiliary claws 3 times shorter than main claw. Measurements: trunk 0.90 mm, proboscis 0.72 mm, abdomen 0.50 mm, chelifore 0.27 mm, palp 0.97 mm, oviger 1.65 mm, leg 10.81 mm.

Geographical distribution. The description of *A. kamtschatica* was made using the specimens collected near the southeastern coast of Kamchatka Peninsula (Akhomten and Morzhovaya Bights) at 30–50 m depths. *A. kamtschatika* was also found in the fouling of experimental plates and cages from Alekseev and Vityaz Bights (in Peter the Great Bay), and in the samples taken from the high sublittoral zone of Medny Island (the Commander Islands).

Vertical distribution. The species inhabits the high sublittoral zone.

*Genus ***Tanystylum*** Miers, 1879

Type species: *Nymphon stylygerum* Miers, 1875.

Trunk shield-shaped, flat, unsegmented. Lateral processes broad; placed in contact in some species, separated by narrow intervals in others. Ocular tubercle of various shapes, with well-developed eyes. Proboscis slightly longer than trunk, tapering forward. Chelifores present as rudimentary tubercles, rarely with vestigial chelas. Palp consists of 4–7 segments, slightly longer or shorter than proboscis. Oviger

10-segmented, better developed in males, armed with several not serrate, but sometimes forked spines. Legs strong; tarsus short; propodal sole armed with basal spines proximally and small spinules in front of them. Auxiliary claws always present.

Two species of this genus are found in the Sea of Japan.

KEY TO THE SPECIES OF THE GENUS TANYSTYLUM

1(2). Cephalic segment of trunk separated from 1st lateral processes by 1/2–1/3 their diameters; distal margins of lateral processes provided with 1–2 small tubercles with spines on tops; proboscis broad at base and strongly tapered in distal third; palps 6-segmented ..... ***T. scrutator*** (p. 115)

2(1). Cephalic segment of trunk in close contact with 1st lateral processes; lateral processes bear one short spine each on margins; proboscis broad, cylindrical, slightly tapered on end; palps 5-segmented ..... ***T. ulreungum*** (p. 115)

****Tanystylum scrutator*** Stock, 1954
(Pl. XIV, figs. 1–4)

Stock, 1954: 142–145, fig. 70; Kim & Hong, 1986: 50.

T. scrutator is a sublittoral species. It was originally found near the eastern coast of Japan, later – off the south-eastern coast of Korea.

****Tanystylum ulreungum*** Kim, 1983
(Pl. XIV, figs. 5–8)

Kim, 1983: 467, figs. 1, 2 (*Tanystylum ulreungum*); Nakamura & Child, 1983: 39–41, fig. 13 (*Tanystylum nabetensis*).

These are tiny animals, with span of legs 5.7 mm. The species inhabits the sublittoral zone. It is known from the southern part of the Sea of Japan (Namyang and Ullung-do islands) and from Sagami Bay.

2. Genus ***Lecythorhynchus*** Böhm, 1879

Type species: *Corniger hilgendorfi* Böhm, 1879.

Trunk strong, segmented, with well-developed cephalic segment and lateral processes, separated by relatively small intervals. Ocular tubercle conical, situated slightly forward from centre of cephalic segment. Proboscis shorter than trunk, oval, cylindrical. Abdomen rather long, inserted on anterior margin of caudal trunk segment, fused with trunk. Chelifore in shape of 1-segmented rudimentary bud. Palp 9-segmented; segment 6 attached to segment 5 at angle. Oviger 10-segmented, S-shape curved in males, without curve in females; distal segments bear simple or compound spines, placed irregularly; no terminal claw. Legs almost twice longer than trunk, strong; propodus curved, with isolated basal spines on sole.

Only one species has been recorded in the Sea of Japan.

1. ***Lecythorhynchus marginatus*** Cole, 1904
(Pl. XV, figs. 1–7)

Cole, 1904: 259–262, pl. 11, figs. 1–2, pl. 15, figs. 1–8; Schimkewitsch, 1929: 50–53, figs. 7, 8, 9; Losina-Losinsky, 1933: 61; Stock, 1954: 139, fig. 69 (*Lecythorhynchus marginatus*); 1956: 43–45; Nesis, 1967: 250–251; 1976: 77, fig. 179 (*Lecythorhynchus hilgendorfi*); Nakamura & Child, 1983: 13; Hong & Kim, 1987: 143 (*Ammothea hilgendorfi*).

Description. Trunk strong, almost smooth, segmented. Lateral processes shorter than trunk width, separated by 2–3 times less their own diameters. Cephalic segment shorter than its width, bears small processes of palps and ovigers; its anterior margin slightly juts out over proboscis base. Ocular tubercle relatively tall, cylindrical with conical acutely pointed or rounded apex; eyes large, pigmented. Proboscis almost equal to trunk in length, oval, cylindrical, has constriction separating proximal third of its length. Abdomen rather long, cylindrical, slightly swollen distally, reaching beyond distal ends of coxae 1 of 4th legs. Chelifore 1-segmented, in shape of rounded or conical bud. Palp 9-segmented; segments 2 and 4 longest, equal or segment 2 slightly longer than arcuate segment 4; other segments short; segment 5 ovoid; segment 6 attached to its lateral side, forming strong curve; 4 distal segments armed with short setae. Oviger 10-segmented; male segments 2, 3, 4, and 5 long; segment 6 slightly shorter than segment 5, gently curved; segment 7 arcuate; its convex side bears tall tubercle with tuft of setae; segment 8 attached to segment 7 lateral side; 4 distal segments armed with compound spines. Legs more than twice longer than trunk, bear sparse setae; coxa 2 of all legs in males swollen ventrally; coxa 2 in females swollen only on first 3 pairs of legs; propodus robust, strongly curved; propodal sole usually provided with 5 large spines proximally and row of spinules medially and distally. Main claw strong, curved, equal or longer than half of propodus; auxiliary claws equal or longer than half of main one. Body length of female found in Peter the Great Bay – about 3 mm, width – about 20 mm. Males have smaller size.

Geographical distribution. *L. marginatus* is widespread in the North Pacific. Its range of distribution is from the Californian coast to the Russian Far East, China, Japan, and the Hawaiian Islands. As for the Sea of Japan, it has been recorded in Peter the Great and Possjet bays.

Vertical distribution. This is a common littoral and high sublittoral species, occurring in the littoral zone to a depth of 113 m (near the South Primorye, in 34–40 m depths).

*Genus ***Nymphonella*** Ohshima, 1927

Type species: *Nymphonella tapetis* Ohshima, 1927.

Trunk elongated, well segmented. Chelifore 2-segmented, shorter than proboscis; chela small, vestigial, with reduced fingers devoid of teeth. Palp longer than trunk, consists of 17–20 segments; distal 10 segments thin, short, whip-shaped. Oviger characteristic for family, bears compound spines on distal segments. Distal segments of 1st legs also whip-shaped owing to secondary segmentation of tarsus and propodus; propodus without terminal claw. 2nd, 3rd, and 4th legs 8-segmented, with long slender main claws and without auxiliaries.

Only one species of this genus is known from the Sea of Japan.

**Nymphonella tapetis* Ohshima, 1927
(Pl. XVI, figs. 1, 2)

Ohshima, 1927: 257–263, figs. 1–4; Hedgpeth, 1949: 236, tabl. I; Utinomi, 1971: 331–332.

This species parasitize on bivalve mollusks. In the Sea of Japan it inhabits the high sublittoral zone of the western coast of Japan.

3. Genus *Cilunculus* Loman, 1908

Type species: *Lecythorhynchus armatus* Böhm, 1879.

Trunk elongated, well segmented. Anterior margin of cephalic segment covers peak-like (or hood-like) insertions of chelifores. Ocular tubercle tall, thin, situated near frontal margin. Proboscis oval, with flat apex. Chelifore 2–3-segmented; adult fingers of chela reduced. Oviger 10-segmented, with extremely long segment 2; terminal claw absent. Femur in males provided with thin cement gland duct, pointed distally, often longer than femur's diameter. Auxiliary claws present.

One species of this genus has been recorded in the Sea of Japan.

1. *Cilunculus armatus* (Böhm, 1879)
(Pl. XV, figs. 8–13)

Böhm, 1879b: 141 (*Lecythorhynchus armatus*); Schimkewitsch, 1909: 4, fig. 2 (*Ammothea armata*); Nakamura & Child, 1983: 33; Nakamura, 1987: 33–34, pls. 30, 39 (*Cilunculus armatus*).

Description. Trunk elongated, segmented; each of first 3 segments dorsodistally bear one tall tubercle with several setae. Anterior part of cephalic segment covers 1st lateral processes hood-like. Lateral angles of anterior "hood" bear tubercles with setae, lower than dorsal tubercles. Lateral processes long, separated by less their own diameters. Several small tubercles with rather long spines situated on distal margins of lateral processes. Ocular tubercle situated near anterior margin of cephalic segment, conical, with acutely pointed top, as tall as distal tubercles on trunk segments; no eyes. Proboscis large, elongated, oval, with flat apex, as long as trunk. Abdomen cylindrical, slightly swollen distally, convex dorsally, armed with strong spines on tubercles, reaches middle of 2nd coxae of 4th legs. Chelifore small; scape 2-segmented; segment 1 short; segment 2 twice longer, bearing tubercles with spines on dorsal and lateral sides; chela small, globular, without fingers. Palp 9-segmented; segment 2 longest, 9 times as long as its own diameter; segment 4 about 1/3 shorter than segment 2, with several setae dorsally; 5 distal segments almost equal in length, ventrally armed with dense setae twice or more longer than diameters of these segments. Oviger 10-segmented; segment 2 longest, straight; male segments 6 and 7 covered with long setae distally; segments 8 and 9 bear one compound spine each; segment 10 bears 2 compound spines. Compound spines thin, long, with numerous blunt lateral teeth. Legs armed with numerous setae; coxa 1 bears long setae laterally and dorsally; coxa 2 twice in males and 1.5 times in females longer than coxa 1; femur, tibiae 1 and 2 subequal; cement gland duct thin, long, situated on distal third of femur at angle to femur's end; propodus slender, noticeably curved, about 1.5 times shorter than tibia 2,

bears 4 large spines on sole proximally and about 8 medially and distally. Main claw curved, reaches middle of propodus; auxiliary claws longer than 2/3 of main one.

Geographical distribution. The species has been recorded in the Sea of Okhotsk and the Sea of Japan (west of Sakhalin), also near Japan on the Pacific side (off Hokkaido Island and in Sagami Bay).

Vertical distribution. *C. armatus* occurs in the high sublittoral zone to a depth of 700 m.

*Genus ***Ascorhynchus*** Sars. 1877

Type species: *Ascorhynchus abyssi* Sars, 1877.

Trunk elongated, segmented, smooth or with conical tubercles and setae. Cephalic segment with long neck. Lateral processes long, separated by broad intervals. Ocular tubercle varied in shape; eyes present not in all species. Proboscis large, curved downwards; proximal part thin; distal part pyriform. Abdomen long, slender. Chelifore 2–3-segmented; chela with reduced fingers. Palp 9–10-segmented, thin, longer than proboscis. Oviger 10-segmented; segments 4 and 5 longest; segment 6 also long; segments 7 through 10 bear several rows of compound spines; terminal claw present. Legs long; tarsus short or elongated, but shorter than propodus; propodus lacks basal spines; main claw of various lengths; no auxiliaries.

There are three species of the genus in the Sea of Japan.

KEY TO THE SPECIES OF THE GENUS ASCORHYNCHUS

1(2). Dorsal side of trunk smooth, mid-dorsal line devoid of tubercles .... **A. glaberrimum* (p. 118)

2(1). Tubercles present on trunk, lateral processes, and coxae 1 of legs.

3(4). Coxa 2 bears finger-shaped projections, as long as half diameter to diameter of coxa 2 ..... **A. ramipes* (p. 118)

4(3). Projections on coxa 2 very short ..... **A. glabroides* (p. 119)

**Ascorhynchus glaberrimum* Schimkewitsch, 1913
(Pl. XVII, figs. 1–5)

Schimkewitsch, 1913: 242, pl. 3, figs. 8–14; Nakamura, 1987: 29–30, pls. 25, 26.

A. glaberrimum occurs off the western and eastern coasts of Japan from shallow waters to 300 m depth.

**Ascorhynchus ramipes* (Böhm, 1879)
(Pl. XVII, figs. 6–11)

Böhm, 1879a: 56, fig. 1 (*Gnaptorhynchus ramipes*); Nakamura, 1987: 31–32, pl. 28.

A. ramipes is a widespread species. It inhabits the Indian Ocean, the Gulf of Siam, the East China and Yellow seas, and the Sea of Japan; it also occurs near the western and eastern coasts of Japan in 10–200 m depths.

**Ascorhynchus glabroides* Ortmann, 1891
(Pl. XVI, figs. 3, 4)

Ortmann, 1891: 160, pl. 24, fig. 3a, b; Hedgpeth, 1949: 291, 293; Utinomi, 1971: 333.

A. glabroides provisionally is endemic from the Sea of Japan; it occurs in 70–250 m depths.

*III. Family **CALLIPALLENIDAE** Hilton, 1942

Trunk elongated or compact, segmented or with fused segments. Chelifore 2-segmented; scape straight, cylindrical; chela almost equal to scape, with fingers, or small, vestigial, without fingers. Palp absent or consists of 1–4 segments. Oviger 9–10-segmented in both males and females, provided with compound spines or setae on distal segments.

KEY TO THE GENERA OF THE FAMILY CALLIPALLENIDAE

1(2). Trunk disk-shaped, unsegmented; palp absent; propodal sole bears only 2 spines, of which 1st very large, situated in middle; second spine smaller, situated in front of first one .....****Decachela*** (p. 119)
2(1). Trunk segmented, compact, or elongated.
3(4). Trunk compact; lateral processes placed closely together; chelifore shorter than proboscis; fingers of chela without teeth; palp 3-segmented in both sexes ....****Bradypallene*** (p. 121)
4(3). Trunk elongated; lateral processes separated by intervals; chelifore longer than proboscis; fingers with teeth on inner margins; palp absent or present only in males.
5(6). Palp present only in males, 2-segmented; auxiliary claws absent ....****Propallene*** (p. 121)
6(5). Palp absent in both sexes; auxiliary claws present .....****Callipallene*** (p. 122)

*Genus ***Decachela*** Hilton, 1939

Type species: *Decachela discata* Hilton, 1939.

Animal small, length no more than 3 mm. Trunk disk-shaped, unsegmented, with solid integument. Chelifore short, 2-segmented; chela vestigial, without fingers. No palps. Oviger 10-segmented, with very small distal segments, without compound spines. Proboscis cylindrical. Ocular tubercle low. Legs robust; propodus bears only 2 spines in centre of sole: adults have one very large spine with one smaller spine in front of it; juveniles have both spines equal in length.

There are 2 species in the genus.

KEY TO THE SPECIES OF THE GENUS DECACHELA

1(2). Trunk smooth; lateral processes placed closely together; chelifore only slightly longer than proboscis .....****D. discata*** (p. 120)

2(1). Lateral processes and coxae 1 of legs bear several conical, truncated tubercles, larger ones of which have 2–4 tops; lateral processes separated by narrow intervals; chelifore slightly shorter than proboscis ..... ***D. dogieli*** (p. 120)

****Decachela discata*** Hilton, 1939
(Pl. XVIII, figs. 1, 2)

Hilton, 1939: 34; Hedgpeth, 1949: 280, fig. 37.

Type specimen of this species was found off the Californian coast. Hedgpeth (1949) identified it in the samples collected during the R/V *Albatross'* voyage in 1906 near the western shore of Hokkaido Island at a depth of 100 m.

****Decachela dogieli*** Losina-Losinsky, 1961
(Pl. XVIII, figs. 3–6)

Losina-Losinsky, 1961: 88–90, fig. 16; Hong & Kim, 1987: 155–158, figs. 13, 14.

Description. Trunk of males disk-shaped, with firm opaque integument, unsegmented. Frontal margin of cephalic segment expanded and bears irregular-shaped tubercles without spines. Ocular tubercle low with unpigmented eyes and rounded top, situated medially on anterior part of cephalic segment. Proboscis short, 3 times shorter than trunk, broad, cylindrical; cephalic segment projections overhang base of proboscis. Abdomen more than twice longer than proboscis, cylindrical, reaching beyond distal ends of coxae 2 of 4th legs. Lateral processes broad, placed almost closely together; each provided with several small tubercles in middle and 3 tubercles, some of which with two tops, on distal margin. Chelifore shorter than proboscis; scape robust, bear several tubercles distally; chela vestigial, without fingers. Oviger 10-segmented; segment 1 oval, broader than its own length; segment 3 longest; segments 4 and 5 equal; segments 7 and 8 short and broad; 2 distal segments very small, thin, cylindrical. Legs short, with robust, very short segments; coxa 1 bears several large tubercles, of which one has several tops; coxa 2 ventrally bears tall tubercle with genital pore and, dorsally, several small tubercles with spines; femur has one tall tubercle dorsally and several small ones laterally; tarsus so small that can be seen only from ventral side; propodus slightly shorter than tibia 2; distal end of sole armed with large spine, forming kind of chela in combination with terminal claw; sole also bears small spine in front of large one. Main claw robust, curved, as long as 1/2 of propodus. Measurements of male: trunk 2.0 mm, proboscis 0.63 mm, abdomen 4.12 mm.

Females of *D. dogieli* differ from males in absence of large tubercles on lateral processes and shorter ovigers, distal segments of which armed with only several smooth setae.

Geographical distribution. First specimens of *D. dogieli* were found on the starfish *Pteraster*, taken in the Sea of Okhotsk off the northern tip of Sakhalin Island at a depth of 84 m. Later Hong and Kim (1987) found *D. dogieli* in the Sea of Japan off the Korean coast in the ambulacra of *Pteraster*.

*Genus ***Bradypallene*** Kim & Hong, 1987

Type species: *Bradypallene espina* Kim & Hong, 1987.

Trunk smooth, compact, segmented. Ocular tubercle low, situated on anterior part of cephalic segment. Proboscis robust, with expanded flat apex. Chelifore 2-segmented; chela with fingers; fingers lack teeth. Palp short, 3-segmented in both sexes. Oviger 10-segmented, in both sexes without compound spines and terminal claws. Legs smooth; propodus without heel and spines on sole. Main claw rudimentary; auxiliary claws well developed, slightly longer than main claw; cement gland situated on dorsal side of femur.

The genus is monotypic.

Bradypallene espina Kim & Hong, 1987
(Pl. XIX, figs. 1–4)

Kim & Hong, 1987: 272–276, figs. 1, 2.

Bradypallene espina provisionally is endemic from the Sea of Japan, it was found in the south-western part of this sea, near Ullung-do Island (37˚28′N, 130˚51′E) at depths of 5–7 m.

*Genus ***Propallene*** Schimkewitsch, 1909

Type species: *Pallene longiceps* Böhm, 1879.

Trunk elongated, completely segmented; cephalic segment shorter than 3 others combined; its anterior part moderately expanded; neck of medium length, rather broad. Lateral processes separated by intervals. Ocular tubercle low, situated opposite 1st lateral processes; eyes developed. Abdomen conical, with notch on end. Chelifore 2-segmented; scape almost equal to proboscis, chela oval, elongated; fingers of medium length, thin, with teeth on inner margin. Palp only in males, 2-segmented. Oviger 10-segmented both in males and females; segment 5 in males bears blade-shaped projection distally; 4 distal segments provided with one row of compound spines, each spine denticulate, with larger denticles in basal part and smaller in upper part; no terminal claw. Legs long; male femur bears cement gland pores; tarsus very small; propodus with isolated basal spines; no heel and auxiliary claws. Genital pores on 3rd and 4th legs in males, on all legs in females.

Only one species of this genus is found in the Sea of Japan.

Propallene longiceps (Böhm, 1879)
(Pl. XIX, figs. 5–9)

Böhm, 1879a: 59 (*Pallene longiceps*); Nakamura, 1987: 14, pl. 11 (*Propallene longiceps*).

P. longiceps is an endemic of the Sea of Japan. It is found in depths from the littoral zone to 40 m.

*Genus ***Callipallene*** Flinn, 1929

Type species: *Pallene brevirostris* Jonston, 1837.

Ocular tubercle placed in posterior part of cephalic segment of trunk. Proboscis cylindrical. Chelifore 2-segmented; scape elongated; chela short; fingers armed with teeth on inner margin. Palp absent in both sexes. Segment 5 of oviger distally bears spade-shaped projection. Oviger without claw. Legs with auxiliary claws.

There is one species of the genus in the Sea of Japan.

****Callipallene phantoma amaxana*** (Ohshima, 1933)
(Pl. XIX, figs. 10–12)

Ohshima, 1933: 216–219, figs. 8–12; Hong & Kim, 1987: 153 (*Pallene amaxana*); Utinomi, 1971: 322–323 (*Callipallene phantoma amaxana*).

C. phantoma amaxana has been recorded in the Strait of Malacca and near the coast of Japan, from the high sublittoral zone to 200 m depth.

IV. Family **PHOXICHILIDIIDAE** Sars, 1891

Trunk in most species elongated, in other ones compact, in most species segmented, in others – several or all segments fused. Cephalic segment has short or long projection over base of proboscis, bearing chelifores anteriorly and ocular tubercle dorsally. Proboscis inserts to this projection ventrally. Chelifore shorter or longer than proboscis, 2-segmented, chelas with fingers. Palps absent. Oviger only in males, 5–9-segmented, without terminal claw, with simple spines or without spines.

KEY TO THE GENERA OF THE FAMILY PHOXICHILIDIIDAE

1(2). Chelifore much longer than proboscis ..... 1. ***Pycnosomia*** (p. 122)
2(1). Chelifore equal to proboscis or longer; fingers of chela reach mouth.
3(4). Oviger in males 5-segmented; auxiliary claws well developed .... *****Phoxichilidium*** (p. 124)
4(3). Oviger in males 6-segmented; auxiliary claws rudimentary or absent .... 2. ***Anoplodactylus*** (p. 124)

1. Genus ***Pycnosomia*** Losina-Losinsky, 1961

Type species: *Pycnosoma strongylocentroti* Losina-Losinsky, 1933.

Trunk elongated, cylindrical, with firm integument, without articulation on dorsal side or partially articulated. Cephalic segment broad, square. Ocular tubercle hardly rises over dorsal surface. Proboscis cylindrical. Lateral processes separated by intervals. Abdomen short, thick. Chelifore 2-segmented; fingers of chela much shorter than proboscis. No palps. Oviger only in males, 5-segmented; terminal claw absent. Legs robust, strongly curved, with short segments. Main claw present; auxiliary claws absent. Tubercles with genital pores present in males on coxae 2 of 3rd and 4th legs, in females on all legs.

Originally, Losina-Losinsky (1933) gave this genus name *Pycnosoma*, but replaced it for *Pycnosomia* in his work of 1961, because the name *Pycnosoma* turned out to have been preoccupied (Insecta).

One species of the genus is found in the Sea of Japan.

1. ***Pycnosomia strongylocentroti*** (Losina-Losinsky, 1933) (Pl. XVIII, figs. 7–11)

Losina-Losinsky, 1933: 43–47, fig. 1 (*Pycnosoma strongylocentroti*); Hilton, 1942b: 40 (*Pigrogromitus robustus*); Losina-Losinsky, 1961: 86; Turpaeva, 1994: 133–134 (*Pycnosomia strongylocentroti*).

Description. Trunk robust, elongated, with firm integument. Segments of trunk fused completely or partially on dorsal side, but separated by articulation lines on lateral and ventral sides. Lateral processes about as long as broad, separated by 0.2 to 0.5 their own diameters. Ocular tubercle almost not rising over surface, situated nearer to anterior margin of cephalic segment; eyes well developed, entirely or partially pigmented. Proboscis slender, cylindrical, much longer than half of trunk, directed obliquely downward. Abdomen thick, short, protruded horizontally. Chelifore almost twice shorter than proboscis, smooth; scape cylindrical; chela smaller than scape; fingers without teeth. Oviger 6-segmented, devoid of setae; segment 6 longest; segment 3 shortest, others equal to one another; segment 6 smooth, swollen distally. Legs less than 1.5 times as long as whole body (with proboscis and abdomen), robust, unarmed; femur longest; tibia 1 slightly shorter than femur; tibia 2 shorter than tibia 1; tarsus short, caliciform; propodus as long as tibia 2, robust, curved, with well-developed heel, which bears up to 8 strong, but short spines. Main claw as long as half of propodus, strong, curved. No auxiliary claws. Coxae 2 in both sexes ventrally bear tall tubercles, which are broader in females. Measurements of holotype: trunk 1.75 mm, proboscis 1.65 mm, abdomen 0.6 mm, chelifore 1.25 mm, oviger 2.95 mm, leg 5.47 mm.

Remarks. Recent investigations of supplementary material allows some additions to the foregoing description to be made. Usually the palps are vestigial, in shape of oval tubercles on both sides of the proboscis. The ocular tubercle in the Sea of Japan individuals is relatively tall, up to as tall as half of the diameter of the tubercle at the base. The genital gland is unusual for the pycnogonids. All long segments of the legs are robust and swollen in the middle, especially in females, like at the figure from the Losina-Losinsky's book (1933). In females collected near Iturup Island (Kurils) and in the Sea of Japan maturing egg masses were visible even in tibiae 2 of the legs

Geographical distribution. This species was originally found on the sea urchins *Strongylocentrotus* sp., collected in the northern part of the Sea of Japan (the Tatar Strait) at a depth of 70 m. Later it was recorded in the Bering Sea, near the Aleutian Islands and in the Gulf of California, on the rim of the hydrothermal area Guaymas (Losina-Losinsky, 1961; Turpaeva, 1994). It was found also in Peter the Great Bay on the sea urchin *Strongylocentrotus* cf. *pallidus* at a depth of 155 m.

Vertical distribution. *P. strongylocentroti* occurs in depths from 2 to 2000 m.

*Genus ***Phoxichilidium*** Milne-Edwards, 1840

Type species: *Nymphon coccineum* Jonston, 1828.

Trunk cylindrical, elongated, segmented; cephalic segment has small projection over base of proboscis and bears short processes of ovigers; relatively short lateral processes separated by broad intervals. Proboscis short, cylindrical, attached to ventral side of cephalic segment, pointed obliquely downward. Ocular tubercle situated over proboscis base. Abdomen short. Chelifore well developed, smooth, 2-segmented; scape long, cylindrical; chela shorter than scape; fingers curved, short with smooth inner margin, or longer, with teeth on inner margin. Oviger in males 5-segmented, short, without claw; segment 5 bears 2 rows of hook-shaped spines. Legs rather long; tarsus small; propodus well developed, curved, with basal spines. Main claw large; auxiliary claws present.

One species of the genus is found in the Sea of Japan.

Phoxichilidium ungellatum Hedgpeth, 1949
(Pl. XX, figs. 1–4)

Hedgpeth, 1949: 281–283, fig. 38; Losina-Losinsky, 1961: 52, pl. 1; Turpaeva, 1990: 17–18, fig. 1 (1–3).

P. ungellatum is widely distributed in the north-western part of the Pacific Ocean. It occurs off the Aleutian, Kuril, and Japan islands, in the Sea of Japan near Oki Island, and in Toyama Bay. It is found in depths from 150 to 1000 m.

2. Genus ***Anoplodactylus*** Wilson, 1878

Type species: *Phoxichilidium petiolatum* Kroyer, 1844–1845.

Trunk slender and elongated or robust and compact, distinctly or not distinctly segmented. Cephalic segment projects over base of proboscis. In species with elongated trunk this projection usually thin, long, with expanded anterior part, and lateral processes separated by broad intervals. In species with compact trunk cephalic segment projection short and broad, lateral processes robust, separated by narrow intervals or placed in contact. Ocular tubercle situated near frontal margin, varies in shape and height. Proboscis cylindrical or swollen medially or distally. Abdomen short, in many species shorter than 4th lateral processes, directed obliquely upward. Chelifore 2-segmented; scape straight, rather thin, usually shorter than proboscis; chela may be longer than proboscis, with fingers, in some species armed with irregularly placed teeth. Palps absent or present in shape of small tubercles, or 1-segmented appendages. Oviger 6-segmented (or even 7–9-segmented, see: Schimkewitsch, 1929: 205), short; distal segment very small, well separated from penultimate one, bears setae or small spines. Legs long, slender, covered with setae, in some species with spines; propodus has heel with large or sometimes small spines. Propodal sole bears small spinules; in several species propodal sole bears chitinous cutting lamina, transversely striped, long or short, adjoining main claw with one end. Main claw long, curved or almost straight; auxiliary claws absent, or rudimentary and hardly visible. Genital pores in females on 2nd coxae of all legs, in males on two distal pairs of legs, on tops of tubercles or on flat surface. Cement glands situated on femur,

open through one long or short duct, or through several slits or pores on dorsal side of femur medially or proximally.

One species has been found in the Russian waters of the Sea of Japan. The Key also includes four more species which can be found in this region in future. The record of *Anoplodactylus inermis* for Peter the Great Bay (Turpaeva, 2006) was made by mistake; as it turned out, that male specimen was collected not in the Sea of Japan, but in the Indian Ocean.

KEY TO THE SPECIES OF THE GENUS ANOPLODACTYLUS

1(2). Trunk rounded, unsegmented ..... 1. ***A. pygmaeus*** (p. 125)
2(1). Trunk partially or completely segmented.
3(6). Lateral processes smooth, without tubercles or spines; fingers of chela bear small teeth on inner margins.
4(5). Anterior part of cephalic segment has long narrow projection over base of proboscis; intervals between lateral processes noticeably broader than processes' diameters; proboscis long, cylindrical, with smooth rounded apex; male cement gland opens through short tube in middle of femur ..... ****A. gestiens*** (p. 126)
5(4). Cephalic segment projection short and broad; intervals between lateral processes noticeably narrower than diameters of processes; proboscis short, barrel-shaped, with flat apex, bearing broad conical tubercles; cement gland opens through 5–8 transverse slits situated proximally on dorsal side of femur .... ****A. pycnosoma*** (p. 126)
6(3). Each lateral process bears one tubercle with spine on top on distal margin of dorsal side; fingers of chela without teeth on inner margin.
7(8). Lateral processes placed in contact to each other, sometimes contiguous; legs bear rudimentary auxiliary claws; cement gland opens through very short duct .... ****A. viridintestinalis*** (p. 126)
8(7). Lateral processes separated by about 1/3 their diameters; legs lack auxiliary claws; cement gland opens on top of conical tubercle, as tall as half diameter of femur ..... ****A. carnatus*** (p. 127)

1. ***Anoplodactylus pygmaeus*** (Hodge, 1864)
(Pl. XXII, figs. 1–5)

Hodge, 1864: 116, pl. 13, figs. 16, 17 (*Pallene pygmaea*); Dohrn, 1881: 34, 36, 56, 76, 99, 181–184, pl. 12, figs. 19–22 (*Phoxihilidium exiguum*); Losina-Losinsky, 1929: 551–553, fig. 5; 1933: 47–49, fig. 2; 1961: 52, pl. 1 (*Halosoma derjungini*); Hedgpeth, 1948: 224–225; Stock, 1954: 77; Turpaeva, 2006: 453–454, fig. 5 (*Anoplodactylus pygmaeus*).

Description. Trunk almost rounded, shield-shaped, unsegmented, without setae. Lateral processes contiguous proximally; each bears one tubercle with spine on distal margin. Cephalic segment has short and narrow projection over base of proboscis. Ocular tubercle tall, conical, with "shoulders", situated a little distally from frontal margin of cephalic segment, in its narrow part; eyes oval, pigmented. Proboscis twice shorter than trunk, thick; its length slightly more than its diameter, noticeably broader than frontal part of cephalic segment. Abdomen short, thick, erect. Chelifores relatively long; scapes of both chelifores placed close to each other, reach somewhat

beyond proboscis; chelas much shorter than scapes, directed downward; fingers thin and weak, with minute hair-looking denticles. Both segments of chelifore armed with sparse short setae. Palps in shape of rudimentary tubercles, situated on both sides of cephalic segment. Oviger 6-segmented, slightly longer than proboscis; longest segments 2 and 3 subequal; segment 4 shorter than segment 3; segment 5 shorter than segment 4; segment 6 twice shorter than segment 5, oval, bears brush of simple thin spines ventrally. Legs 2.5 times longer than trunk with proboscis and abdomen; coxa 1 short, expanded distally, on lateral sides bears 2 small tubercles with spines on tops; coxa 2 has small swelling with genital pore ventrally and 2 tubercles with spines dorsally; femur longest of all segments, bears short cement gland duct pointed distally; tibia 1 shorter than femur; tibia 2 shorter than tibia 1; tarsus very small; propodus equal in length to tibia 2, curved, has well-developed heel, bearing 2–3 basal spines; propodal sole bears several small spine-like setules. Main claw strong, reaching up to 2/3 of propodus; auxiliary claws absent. All legs covered with setae, more dense on longest segments; each long segment bearing also one long seta on distal end. Measurements of holotype: body with proboscis and abdomen 1.00 mm, proboscis 0.3 mm, chelifore's scape 0.3 mm, oviger 1.24 mm, 1st leg 2.71 mm.

Geographical distribution. *A. pygmaeus* is a boreal-subtropical species, widespread in the Atlantic Ocean, from Sweden to the western Africa and from Virginia to Florida, in the Mediterranean, Red, Caribbean seas, and the Gulf of Mexico. It has been recorded in the Pacific Ocean without any notice of a site. In the Sea of Japan the species is registered in Peter the Great Bay and in Possjet Bay.

Anoplodactylus gestiens (Ortmann, 1891)
(Pl. XX, figs. 5–8)

Ortmann, 1891: 166, pl. 24, fig. 8a–d (*Phoxichilidium gestiens*); Nakamura, 1987: 15–16, pl. 12 (*Anoplodactylus gestiens*).

A. gestiens provisionally is endemic from the waters surrounding the Japanese Islands. It is distributed mainly along the eastern coast of Japan; it is likely to be found in the eastern part of the Sea of Japan and in Peter the Great Bay. It occurs from the littoral zone to 479 m depth.

Anoplodactylus pycnosoma (Helfer, 1938)
(Pl. XX, figs. 9–12)

Helfer, 1938: 176–177, fig. 7 (*Peritrachia pycnosoma*); Nakamura & Child, 1983: 50; Hong & Kim, 1987: 161 (*Anoplodactylus pycnosoma*).

It is a widespread high sublittoral species. It occurs in the eastern and western parts of the Indian Ocean (near Tanzania and the western part of Australia), near the coast of Japan (Sagami Bay) and in the southern part of the Sea of Japan.

Anoplodactylus viridintestinalis (Cole, 1904)
(Pl. XXI, figs. 1–6)

Cole, 1904: 286, pl. 14, fig. 11, pl. 24, figs. 6–8, pl. 25, figs. 1–4 (*Halosoma viridintestinalis*); Kim, 1986: 3, fig. 2; Kim & Hong, 1986: 44; Hong & Kim, 1987: 161 (*Anoplodactylus viridintestinalis*).

A. viridintestinalis is a littoral and high sublittoral species. It is distributed in the eastern part of the Pacific Ocean from the Californian shore up to Panama. It has also been found in the southern part of the Sea of Japan near Dagelet Island and Hornet Island.

****Anoplodactylus carnatus*** Nakamura & Child, 1983
(Pl. XXI, figs. 7–10)

Nakamura & Child, 1983: 42–44, fig. 14; Nakamura, 1994: 15.

Anoplodactylus carnatus provisionally is endemic from the waters surrounding the Japanese Islands. It was found near the eastern coast of Japan in Suruga and Sagami Bays at depths of 7–15 m, and in the Sea of Japan in the littoral zone of Toyama Bay.

*V. Family **COLOSSENDEIDAE** Hoek, 1881

Trunk segmented or unsegmented, sometimes with traces of articulation lines. Lateral processes separated by intervals. Neck absent. Ocular tubercle situated anteriorly on cephalic segment. Adults usually lack chelifores; in some juveniles 3-segmented chelifores present (adults of some deep-water species have similar 3-segmented chelifores (Turpaeva, 1989). Palp 8–9-segmented. Oviger 10-segmented, with terminal claw and compound spines, placed in several rows on 4 distal segments. Legs long; propodus lacks heel. Coxae 2 of all legs bear genital pores in both males and females.

Two genera are represented in the Sea of Japan. They presumably occur in the Russian waters, too.

KEY TO THE GENERA OF THE FAMILY COLOSSENDEIDAE

1(2). Trunk unsegmented, eyes not developed ..... ****Colossendeis*** (p. 127)
2(1). Trunk segmented, eyes large, pigmented ..... ****Hedgpethia*** (p. 128)

*Genus ***Colossendeis*** Jarzynsky, 1870

Type species: *Colossendeis borealis* Jarzynsky, 1870.

Trunk unsegmented; cephalic segment slightly larger than next segment. Proboscis robust, usually straight, but in some species tapers toward end and may be noticeably longer than trunk. Palp 8–9-segmented. Oviger with false chela, or, more often, has normal shape. Four pairs of legs present; tarsus and propodus equal in length, or tarsus longer; no cement glands on femur; no auxiliary claws.

Hedgpeth (1949) recorded two species of the genus *Colossendeis* in the waters surrounding Japan, namely, *C. nasuta* Hedgpeth and *C. macerrima* Wilson. Hedgpeth erroneously named the latter species *C. japonica* Hoek. Both species were found near the south-western coast of Kyushu Island at 700–800 m depths. Assuming the occurrence of these two species in the deep waters of the Sea of Japan, a key for their identification is given below.

1(2). Ocular tubercle hardly rises over surface; proboscis straight, almost cylindrical; segment 4 of palp longer than segment 2; tarsus longer than propodus .... *****C. macerrima*** (p. 128)

2(1). Ocular tubercle rather tall, conical; proboscis long, swollen medially, tapering noticeably in distal third; segment 4 of palp almost twice shorter than segment 2; tarsus and propodus subequal ..... *****C. nasuta*** (p. 128)

**Colossendeis macerrima* Wilson, 1881
(Pl. XXIII, figs. 1–3)

Wilson, 1881: 246–247, pl. 1, fig. 2, pl. 4, figs. 9–12, pl. 5, fig. 32; Fry & Hedgpeth, 1969: 53, figs. 7, 8; Stock, 1975: 985–987, fig. 11a–b.

C. macerrima are large animals, greatly varied in proportions (Fry & Hedgpeth, 1969). The distribution range is wide: *C. macerrima* occurs in the bathyal zones of the Pacific, Atlantic and Indian Oceans.

**Colossendeis nasuta* Hedgpeth, 1949
(Pl. XXIII, figs. 4–6)

Hedgpeth, 1949: 302–303, fig. 46e–h.

Only one find has been recorded up to now, south-west of Kyushu Island at a depth of 710 m.

*Genus *Hedgpethia* Turpaeva, 1973[2]

Type species: *Colossendeis articulata* Loman, 1908.

Trunk elongated, segmented; segment 1 longest. Lateral processes separated by not more than their diameters. Proboscis robust, much longer than trunk, greatly expanded medially, in some species with short “neck”. Abdomen very small, situated almost ventrally and pointed vertically downward. Chelifores absent; palps and ovigers 10-segmented.

One species is found in the Sea of Japan.

**Hedgpethia californica chitinosa* (Hilton, 1943)
(Pl. XXII, figs. 6–11)

Hilton, 1943: 4; Hedgpeth, 1949: 301, fig. 47e–h; Losina-Losinsky & Turpaeva, 1958: 23–26, fig. 1; Losina-Losinsky, 1961: 109; Nakamura, 1987: 36–37, pl. 33 (*Colossendeis chitinosa*); Turpaeva, 1973: 186–189, pl. 3 (*Hedgpethia californica*).

[2] A.F. Pushkin (1990: Trudy ZIN AN SSSR, V. 218) established the family Hedgpethiidae for the genera *Hedgpethia* and *Rhopalorhynchus*. – *Editorial note*.

Description. Trunk smooth, oval, elongated, segmented. Segments 1–3 of trunk dorsodistally bear chitinous thickenings in shape of ridges with small conical tubercles in middle. Some specimens have small tubercles on sides of frontal margin. Lateral processes shorter than trunk width, separated by less than their own diameters. Ocular tubercle with tall conical top, situated medially on cephalic segment; eyes pigmented, swollen, situated lower than middle of ocular tubercle. Proboscis more than 1.5 times longer than trunk, robust, curved downward, tapered towards both ends, with short "neck". Abdomen very short, pointed downward. Palp 1/3 longer than proboscis, with sparse short setae on distal segments; segment 3 longest; segment 5 about twice shorter than segment 3; of all distal segments segment 6 shortest and segment 8 longest. Oviger 3 times longer than trunk; segments 4 and 6 equal; distal segments short, thick and slightly curved in shape of spiral, bear 7 rows of long lanceolate compound spines ventrally; segment 10 has false chela formed by strong terminal claw and large spine with denticulate edge opposed to it. Legs 8 times longer than trunk; coxae short; femur more than twice longer than trunk; tibia 1 longer and thinner than femur; tibia 2 slightly shorter than femur; tarsus and propodus of almost equal length, straight (in some specimens propodus slightly curved), bear row of short setae on sole. Main claw equal to about 1/4 of propodus length, gently curved; auxiliary claws absent. Measurements: trunk 5.5 mm, proboscis 8.9 mm, palp 14.25 mm, oviger 16.55 mm, 3rd leg 43.5 mm.

Remarks. *C. californica* is a greatly polymorphic species. The variable characters are: the general measurements and proportions of the body, the shape and height of the ocular tubercle, the size of frontal tubercles, and also some other characters. The study of polymorphism in this species made it possible to divide it into three subspecies: *H. claifornica californica*, inhabiting waters off the western coast of the South America, *H. californica bicornis* from the Sea of Okhotsk, and *H. californica chitinosa*.

Geographical distribution. *H. californica chitinosa* is widespread in the north-western part of the Pacific Ocean: in the Bering Sea, off the Aleutian Islands, near the eastern coast of Japan up to the Tsushima Strait, and in the Sea of Japan near Hokkaido Island.

Vertical distribution. It is found in 20–3500 m depths.

VI. Family **PYCNOGONIDAE** Wilson, 1878

Trunk segmented, broad, compact. No chelifores; no palps. Only male oviger with terminal claw and compound spines. Four or five pairs of legs present.

Species of one genus inhabit the Sea of Japan.

1. Genus ***Pycnogonum*** Brunnich, 1764

Type species: *P. littorale* (Stroem, 1762).

Trunk flattened dorsoventrally, often with conical truncated tubercles along mid-dorsal line and on lateral processes. Lateral processes short, separated by small intervals, sometimes placed quite close to each other, but still separated. Proboscis conical or almost conical, smooth, protruded horizontally or obliquely down.

Abdomen cylindrical, pointed horizontally. Ocular tubercle low, situated on anterior margin of cephalic segment. Oviger present not in all species. Legs short, robust, with sparse setae; tarsus very short; propodus curved, without basal spines. Main claw well developed; auxiliary claws small, rudimentary, or absent.

The genus *Pycnogonum* is divided into three subgenera (Stock, 1968):

1. Subgenus ***Pycnogonum***, type species *P. littorale* (Stroem, 1762); oviger in males consists of 8–9 segments, with terminal claw.
2. Subgenus ***Retroviger*** Stock, type species *P. sivertseni* Stock, 1955; oviger in males consists of 4–7 segments, terminal claw absent.
3. Subgenus ***Nulloviger*** Stock, type species *P. africanum* Calman 1938; no ovigers in males.

Two species of the subgenus *Pycnogonum* have been found in the Sea of Japan.

KEY TO THE SPECIES OF THE SUBGENUS PYCNOGONUM

1(2). Mid-dorsal line bears tall tubercles; lateral processes smooth; proboscis narrow, with elongated apex; no auxiliary claws ..... 1. ***P. tenue*** (p. 130)

2(1). Mid-dorsal line bears very low tubercles; lateral processes bear similar low tubercles (mostly conspicuous on 4th lateral processes); proboscis thick, with flattened apex; auxiliary claws very small .....****P. koreanum*** (p. 130)

1. ***Pycnogonum (Pycnogonum) tenue*** Slater, 1879
(Pl. XXIII, figs. 7–9)

Slater, 1879: 283; Schimkewitsch, 1929: 15; Losina-Losinsky, 1961: 53 (*Pycnogonum littorale* var. *tenue*); Kishida, 1927: 989, fig. 1905; Nakamura, 1987: 37, fig. 34 (*Pycnogonum tenue*).

Description. Surface of trunk covered with small rounded tubercles. Trunk completely segmented. Mid-dorsal tubercles tall, armed with several short setae. Lateral processes more broad than long, separated by narrow intervals, smooth. Ocular tubercle rounded; eyes pigmented, 2 anterior eyes larger than 2 posterior ones. Proboscis long, narrow, with elongated apex. Oviger 9-segmented, terminal claw curved, longer than distal segment. Auxiliary claws absent.

Geographical distribution. *P. tenue* occurs mainly in the East China Sea, near the eastern coast of Japan and in the southern part of the Sea of Japan. A subspecies *P. littorale tenue* (Slater) has been found in the Russian waters of the Sea of Japan.

Vertical distribution. The species is distributed in depths of 27–300 m.

****Pycnogonum (Pycnogonum) koreanum*** Kim & Stock, 1984
(Pl. XXIII, figs. 10–12)

Kim & Stock, 1984: 685–687, figs. 1–6; Kim & Hong, 1986: 50; Hong & Kim, 1987: 161.

P. koreanum was originally found in the littoral zone of Ulreung Island (on sandy ground with stones). Later, it was periodically recorded on hard bottoms near the eastern, southern, and western coasts of the South Korea.

References

Böhm, R. 1879a. Ueber zwei neue von Herrn Dr. Hilgendorfi in Japan gessammelte Pycnogoniden // Sitzungsber. Gesselschaft Naturforsch. Feude Berlin. S. 53–60.

Böhm, R. 1879b. Ueber Pycnogoniden // Sitzungsber. Gesselschaft Naturforsch. Freude Berlin. S. 140–142.

Child, C.A. 1995. Pycnogonida of the Western Pacific Islands XI: Collections from the Aleutians and other Bering Sea Islands, Alaska // Smithsonian Contr. Zool. N 596. P. 1–29.

Cole, L.J. 1904. Pycnogonida of the West Coast of North America // Harriman Alaska Expedition. V. 10. P. 249–330.

Dohrn, A. 1881. Die Pantopoden des Golfes von Neapel und der angrenzenden Meeresabschnitte // Monographie der Fauna und Flora des Golfes von Ntapel. V. 3. P. 1–252.

Dunlop, J.A. & C.P. Arango. 2005. Pycnogonid affinities: a review // J. Zool. Syst. Evol. Res. V. 43. P. 8–21.

Fry, W.G. & J.W. Hedgpeth. 1969. The fauna of the Ross Sea. 7. Pycnogonida, 1. Colossendeidae, Pycnogonidae, Endeidae, Ammotheidae // New Zealand Ocean. Inst. Mem. V. 49. P. 1–139.

Hedgpeth, J.W. 1948. The Pycnogonida of the western North Atlantic and Caribbean // Proc. U. S. Nat. Mus. V. 97 (3216). P. 157–342.

Hedgpeth, J.W. 1949. Report on the Pycnogonida collected by the *Albatross* in Japanese Waters in 1900 and 1906 // Proc. U. S. Nat. Museum. V. 98 (3231). P. 233–321.

Hedgpeth, J.W. 1963. Pycnogonida of the North American Arctic // J. Fish. Res. Board of Canada. V. 20. P. 1315–1348.

Helfer, H. 1938. Einige neue Pantopoden aus der Sammlung des Zoologischen Museum in Berlin // Sitzungsber. Gesselschaft Naturforsch. Freude Berlin. Bd 1937. S. 162–185.

Hilton, W.A. 1939. A preliminary list of pycnogonids from the shores of California // J. Entomol. Zool., Pomona College. V. 31. P. 27–35.

Hilton, W.A. 1942a. Pantopoda chiefly from the Pacific. I. Nymphonidae // J. Entomol. Zool., Pomona College. V. 34. P. 3–7.

Hilton W.A. 1942b. Pantopoda (continued). II. Family Callipallenidae // J. Entomol. Zool., Pomona College. V. 34 (2). P. 38–41.

Hilton, W.A. 1943. Pycnogonids from the Pacific. Family Colossendeidae // J. Entomol. Zool., Pomona College. V. 35. P. 2–4.

Hodge, G. 1864. List of the British Pycnogonida, with description of several new species // Annals and Magazine of Natural History. V. 13. P. 113–117.

Hong, J.S. & I.H. Kim. 1987. Korean pycnogonids chiefly based on the collections of the Korean Ocean Research and Development Institute // Korean J. Syst. Zool. V. 3, N 2. P. 137–164.

Kim, I.H. 1983. *Tanystylum ulreungum,* a new pycnogonid species from Korean waters // J. Kangreung Nat. Univ. V. 5. P. 467–471.

Kim, I.H. 1984. Common pycnogonid species from East Sea and South Sea of Korea // J. Kangreung Nat. Univ. V. 7. P. 531–551.

Kim, I.H. 1986. Four pycnogonid species new to Korean fauna // Proc. Nat. Sci. Res. Inst. KANU. V. 2, N 1. P. 1–9.

Kim, I.H. & J.S. Hong. 1986. Korean shallow-water Pycnogonida based on the collections of the Korea Ocean Research and Development Institute // Korean J. Syst. Zool. V. 2, N 2. P. 35–52.

Kim, I.H. & J.S. Hong. 1987. *Bradypallene espina*, new genus and new species, a pycnogonid from the East Sea of Korea (Pycnogonida) // Korean J. Zool. V. 30, N 3. P. 272–276.

Kim, I.H. & J.H. Stock. 1984. A new pycnogonid, *Pycnogonum koreanum*, sp. nov. from the Sea of Japan // J. Nat. Hist. V. 18. P. 685–688.

Kishida, K. 1927. [Pantopoda.] In Nihon Dobutsu Zukan. Hokuryukan. P. 989–990 [In Japanese].

Loman, J.C.C. 1911. Japanische Podostomata: Beiträge zur Naturgeschichte Ostasians, herausgeben von F. Doflein // Abh. Kaiser. Bayerischen Akad. Wissen. (Math.-Naturwiss. Klasse), Suppl. 2. S. 1–18.

Losina-Losinsky, L.K. 1929. Ueber einige neue Formen der Pantopoda // Zool. Jahr. (Syst.). Bd 57. S. 537–544.

Losina-Losinsky, L.K. 1933. Pycnogonida (Pantopoda) of the eastern seas // Issledovaniya Morei SSSR. V. 17. P. 43–80. (In Russian).

Losina-Losinsky, L.K. 1935. Pantopoda of the polar seas within USSR // Materialy po Izucheniyu Arktiki. V. 4. P. 1–140. (In Russian).

Losina-Losinsky, L.K. 1961. Pycnogonida (Pantopoda) of the Far-Eastern seas of the USSR // Issledovaniya Dalnevostochnykh Morei SSSR. V. 7. P. 47–117. (In Russian).

Losina-Losinsky, L.K. & E.P. Turpaeva. 1958. The genus *Colossendeis* (Pantopoda) in the Northern part of the Pacific Ocean // Byulleten Moskovskogo Obschestva Ispytatelei Prirody. V. 63. P. 23–33. (In Russian).

Lou, T.-H. 1936. Sur deux nouvelle varietes de *Pycnogonides recueillies* a Tsing-Tao, dans la baie de Kiao-Chow, Chine // Contr. Institute Zool., National Acad. Peiping. V. 3. P. 1–34.

Nakamura, K. 1987. The sea spiders of Sagami Bay. Ed. by Biological Laboratory Imperial Household of Japan. 43 p.

Nakamura, K. 1994. Pycnogonids from Toyama Bay, Japan // Bull. Toyama Sci. Museum. N 17. P. 13–17.

Nakamura, K. & C.A. Child. 1983. Shallow-water Pycnogonida from the Izu Peninsula, Japan // Smithsonian Contrib. Zool. N 386. P. 1–71.

Nakamura, K. & C.A. Child. 1991. Pycnogonida from waters adjacent to Japan // Smithsonian Contrib. Zool. N 512. P. 1–74.

Nesis, K.N. 1967. Pycnogonida (Pantopoda) of Possjet Bay and South Sakhalin collected by the hydrobiological expedition of the Zoological Institute of the Academy of Sciences of the USSR in 1962–1963 // Issledovaniya Fauny Morei. V. 5 (13). P. 248–251. (In Russian).

Nesis, K.N. 1976. Class Pycnogonida, or Pantopoda // Zhivotnye i Rasteniya Zaliva Petra Velikogo. Leningrad: Nauka. P. 76–77. (In Russian).

Ohshima, H. 1927. *Nimphonella tapetis*, n. g., n. sp. a pycnogon parasitic in a bivalve // Annot. Zool. Japon. V. 11. P. 257–263.

Ohshima, H. 1933. Pycnogonids taken with a tow-net // Annot. Zool. Japan. V. 14. P. 211–220.

Ortmann, A.E. 1891 (1890). Bericht über die von Dr. Döberlein in Japan gesammelten Pycnogoniden // Zool. Jahr. (Syst.). Bd 5. S. 157–168.

Pushkin, A.F. 1993. Pycnogonids of the Southern Ocean // Issledovaniya Fauny Morei. XX (XXX). ZIN RAN. S.-Petersburg & Portorosa (Sicily). V. 8. P. 5–394. (In Russian).

Sars, G.O. 1891. Pycnogonidae // Norwegian North-Atlantic Expedition, 1876–1878 (Zool. 20). P. 1–163.

Schimkewitsch, W.M. 1895. On some forms of the Pantopoda // Trudy S.-Peterburgskogo Obschestva Estestvoispytatelei. V. 25. P. 35–48. (In Russian).

Schimkewitsch, W. 1906. Übersicht der von P. Schmidt und W. Braschnikow in den Ostasiatischen Ufergewässern gesammelten Pantopoden // Ann. Mus. Zool. Acad. Sci. St.-Petersbourg. V. 11. P. 242–252.

Schimkewitsch, W. 1909. Nochmal über die periodicität in dem System der Pantopoden // Zool. Anz. Bd 34. S. 1–13.

Schimkewitsch, W. 1913. Einige neue Pantopoden // An. Mus. Zool. l'Acad. Imper. Sci. St.-Petersbourg. V. 18. P. 240–248.

Schimkewitsch, W.M. 1929. Pycnogonida (Pantopoda) // Fauna SSSR i Sopredelnykh Stran. Leningrad. N 1. P. 1–224. (In Russian).

Schimkewitsch, W.M. 1930. Pycnogonida (Pantopoda) // Fauna SSSR i Sopredelnykh Stran. Leningrad. N 2. P. 125–554. (In Russian).

Slater, H.H. 1879. On a new genus of pycnogon and a variety of *Pycnogonum littorale* from Japan // Ann. Mag. Nat. Hist., Ser. 5. V. 3. P. 281–283.

Stock, J.H. 1954. Pycnogonida from Indo-West-Pacific, Australian and New Zealand Waters. Papers from Dr. Th. Mortensen's Pacific Expedition 1914–1916 // Videnskab. Medd. Dansk Naturhist. Foren. Kjobenhavn. V. 116. P. 1–168.

Stock, J.H. 1956. Pantopoden aus dem Zoologischen Museum Hamburg, 1 // Mitteil. Zool. Mus. Hamburg. Bd 54. S. 33–48.

Stock, J.H. 1968. Pycnogonida collected by the *Galathea* and *Anton Bruun* in the Indian and Pacific Ocean // Videnskab. Medd. Dansk Naturhist. Foren. Kjobenhavn. V. 131. P. 7–65.

Stock, J.H. 1975. Pycnogonida from the continental shelf, slope, and deep sea of the tropical Atlantic and East Pacific // Bull. Mar. Sci. V. 24. P. 957–1092.

Stock, J.H. 1979. *Anoplopdactylus ophiurophilus* n. sp., a sea spider associated with brittle stars in the Seychelles // Bijdragen tot de dierkunde (Contributions to Zoology). V. 48, N 2. P. 156–160.

Turpaeva, E.P. 1973. Pycnogonida (Pantopoda) from the north-western part of the Pacific Ocean // Trudy Instituta Okeanologii AN SSSR. V. 91. P. 173–191. (In Russian).

Turpaeva, E.P. 1989. Some morphological characters of the deep-water Pycnogonida // Trudy Instituta Okeanologii RAN. V. 123. P. 127–133. (In Russian).

Turpaeva, E.P. 1990. Pycnogonida collected from the Pacific side of Honshu Island // Zool. Zhurnal. V. 69, N 9. P. 17–26. (In Russian).

Turpaeva, E.P. 1994. Sea spiders (Pycnogonida) of the North Pacific // Trudy Instituta Okeanologii RAN. V. 131. P. 126–138. (In Russian).

Turpaeva, E.P. 2001. Sea spiders (Pycnogonida) of the Sea of Japan // Sostav i Struktura Morskogo Donnogo Naseleniya. Moscow: Izd-vo VNIRO. P. 69–104. (In Russian).

Turpaeva, E.P. 2004a. Shallow-water sea spiders (Pycnogonida) from the Kuril, Commander and Yamskii islands. 3. Nymphonidae. Report 1 // Zool. Zhurnal. V. 83, N 9. P. 1086–1100. (In Russian).

Turpaeva, E.P. 2004b. Shallow-water sea spiders (Pycnogonida) from the Kuril, Commander and Yamskii islands. 3. Nymphonidae. Report 2 // Zool. Zhurnal. V. 83, N 10. P. 1229–1236. (In Russian).

Turpaeva, E.P. 2006. Shallow-water sea spiders (Pycnogonida) from the Kuril, Commander, and Yamskii islands. 4. Phoxchilidiidae family // Zool. Zhurnal. V. 85 (4). P. 448–461 (In Russian).

Utinomi, H. 1951. On some pycnogonids from the sea around Kii Peninsula // Publ. Seto Mar. Biol. Lab. V. 1. P. 159–168.

Utinomi, H. 1954. The fauna of Akkeshi Bay. XIX. Littoral Pycnogonida // Publ. Akkeshi Mar. Biol. Stat. V. 3. P. 1–28.

Utinomi, H. 1955. Report on the Pycnogonida collected by the Soyo-Maru Expedition made on the continental shelf bordering Japan during the years 1926–1930 // Publ. Seto Mar. Biol. Lab. V. 5. P. 1–42.

Utinomi, H. 1971. Records of Pycnogonida from shallow waters of Japan // Publ. Seto Mar. Biol. Lab. V. 18. P. 317–347.

Wilson, E.B. 1881. Report on the Pycnogonida. Reports on the results of dredging, under the supervision of Alexander Agassiz, in the Gulf of Mexico, 1877–78, by the U.S. coast survey steamer *Blake*, etc. // Bull. Mus. Comp. Zool. Harvard, V. 8, N 12. P. 239–256.

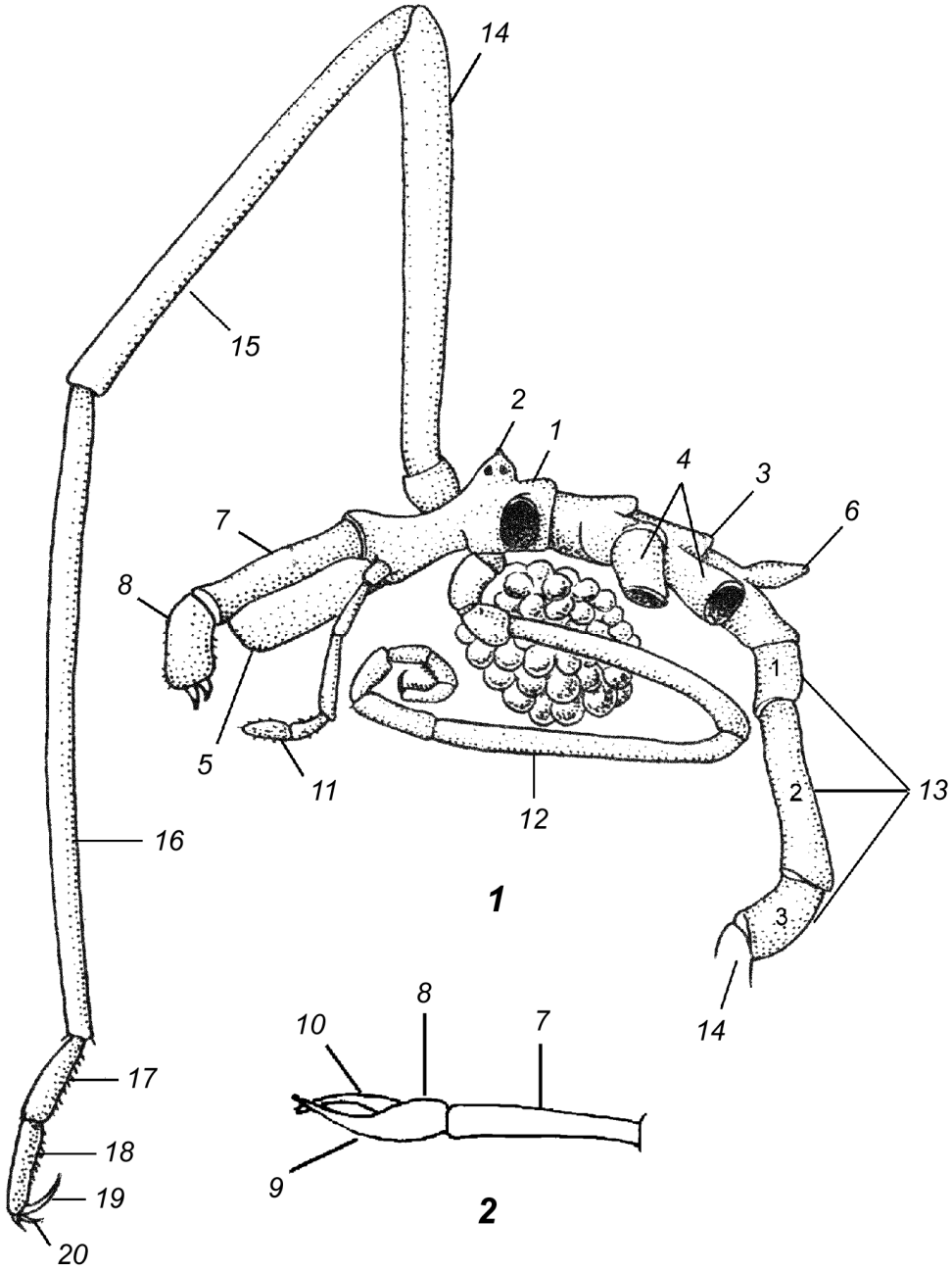


Plate I. Schematic display of the external morphology of Pycnogonida (fig. 1 – body with appendages; fig. 2 – 1st appendage (chelifore). 1 – cephalic segment of body; 2 – ocular tubercle; 3 – dorsal ridge of segment of trunk; 4 – lateral process; 5 – proboscis; 6 – abdomen; 7 – scape; 8 – palm of chela; 9 – immovable finger; 10 – movable finger; 11 – 2nd appendage (palp); 12 – 3rd appendage (oviger); 13 – segments 1–3 of leg (coxae: coxa 1, coxa 2, and coxa 3); 14 – segment 4 of leg (femur); 15 – segment 5 of leg (tibia 1); 16 – segment 6 of leg (tibia 2); 17 – segment 7 of leg (tarsus); 18 – segment 8 of leg (propodus); 19 – main claw; 20 – auxiliary claws

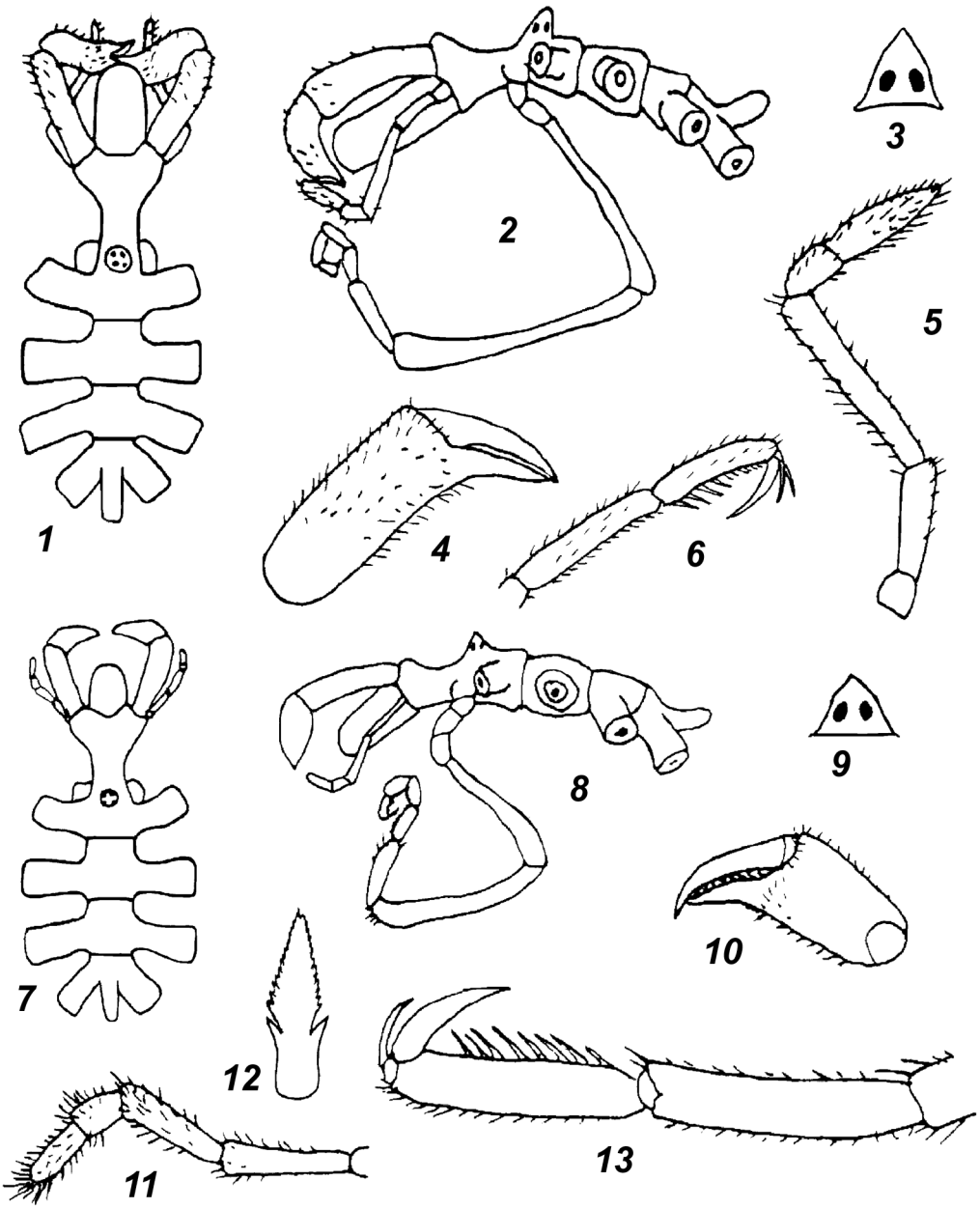
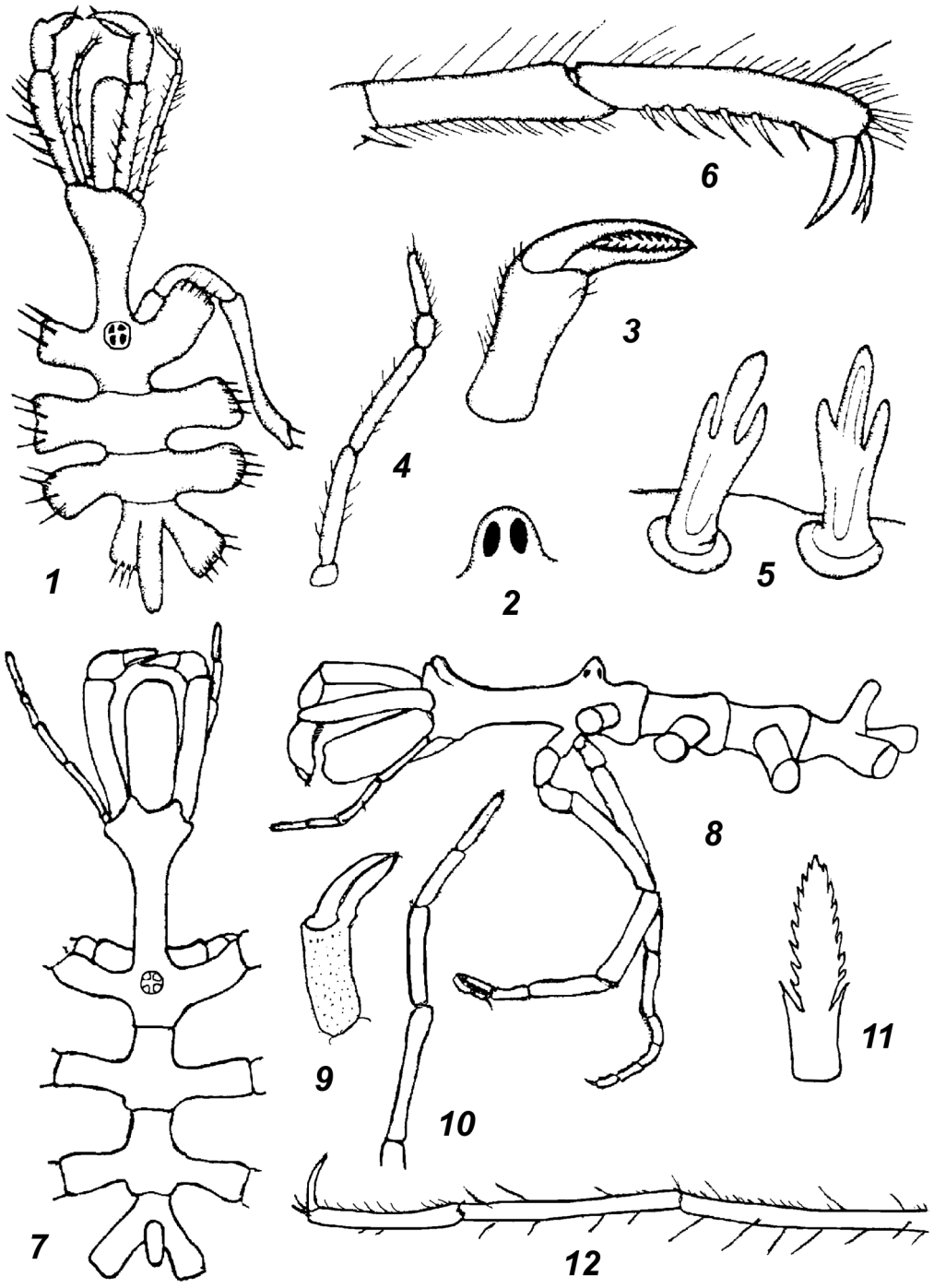


Plate II. *Nymphon grossipes* (from Sars, 1891): 1 – trunk, dorsal view; 2 – trunk, lateral view; 3 – ocular tubercle; 4 – chela; 5 – palp; 6 – distal segments of leg. *Nymphon brevirostre* (from Sars, 1891): 7 – trunk, dorsal view; 8 – trunk, lateral view; 9 – ocular tubercle; 10 – chela; 11 – palp; 12 – compound spine; 13 – distal segments of leg



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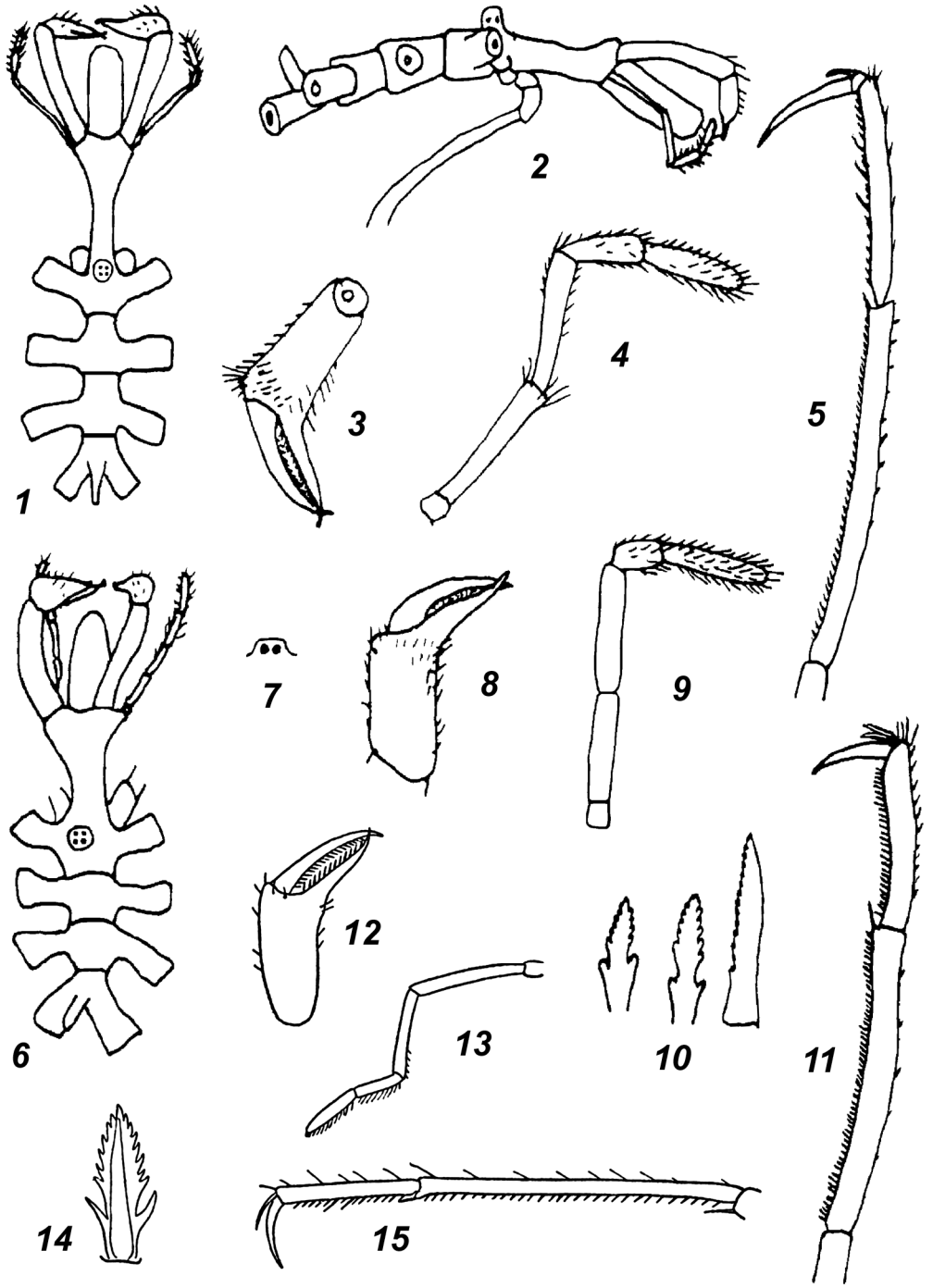
Nymphon striatum (from Losina-Losinsky, 1933): 7 – trunk, dorsal view; 8 – trunk, lateral view; 9 – chela; 10 – palp; 11 – compound spine; 12 – distal segments of leg



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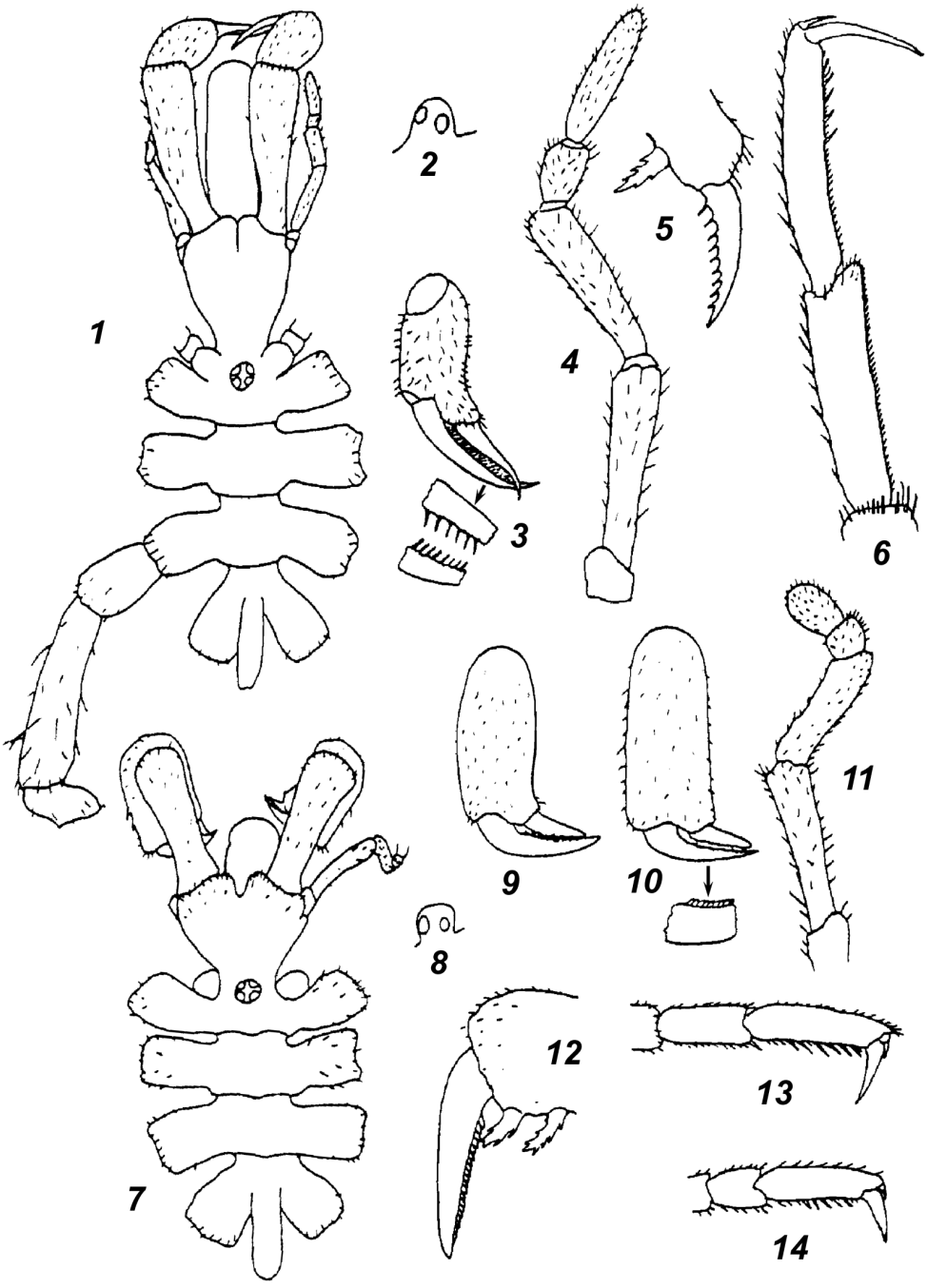
Nymphon longitarse brevicollis (from Losina-Losinsky, 1935): 6 – trunk, dorsal view; 7 – ocular tubercle; 8 – chela; 9 – palp; 10 – compound spines and claw of oviger; 11 – distal segments of leg.
Nymphon longitarse elongatum (from Hedgpeth, 1949): 12 – chela; 13 – palp; 14 – compound spine; 15 – distal segments of leg



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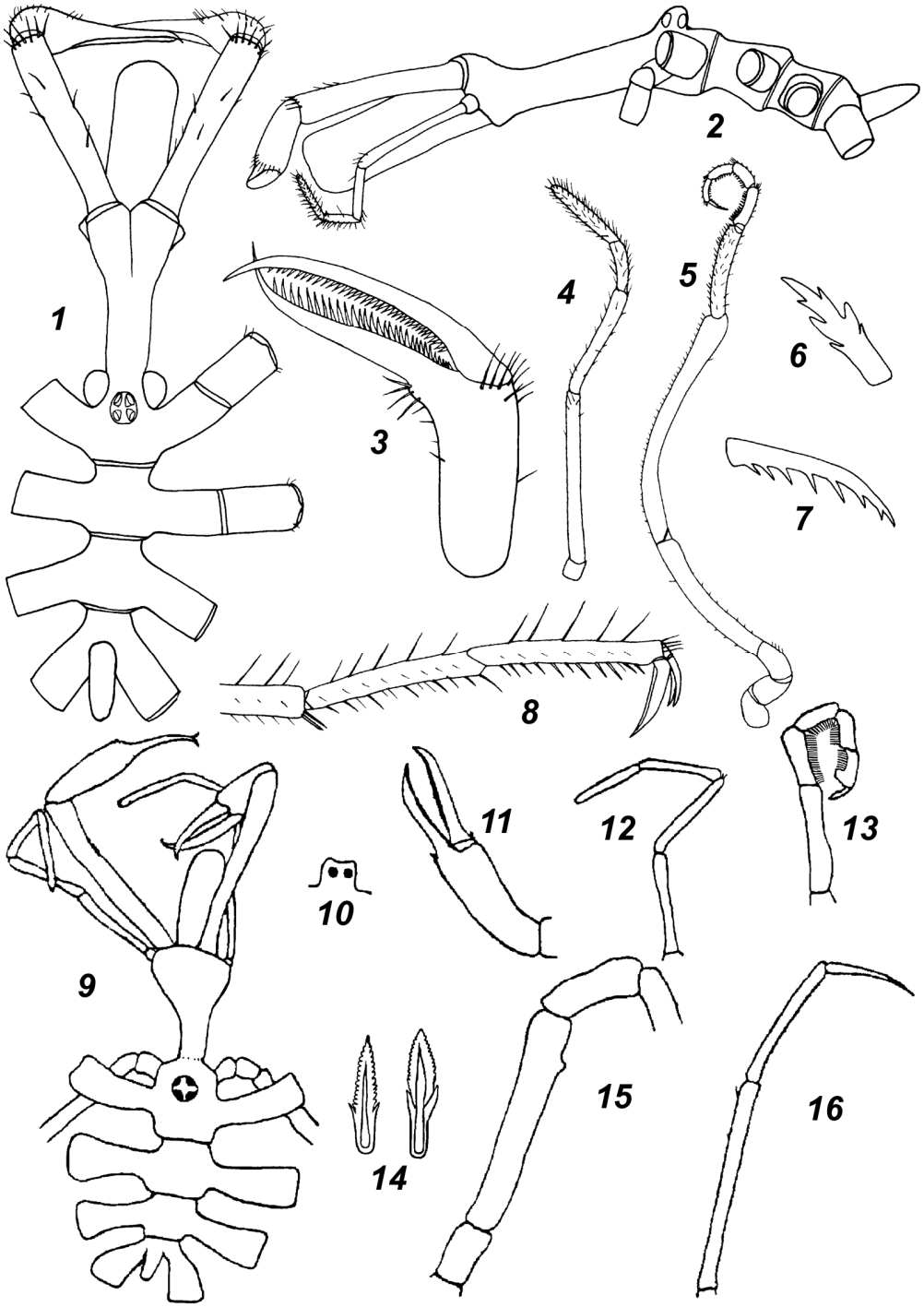

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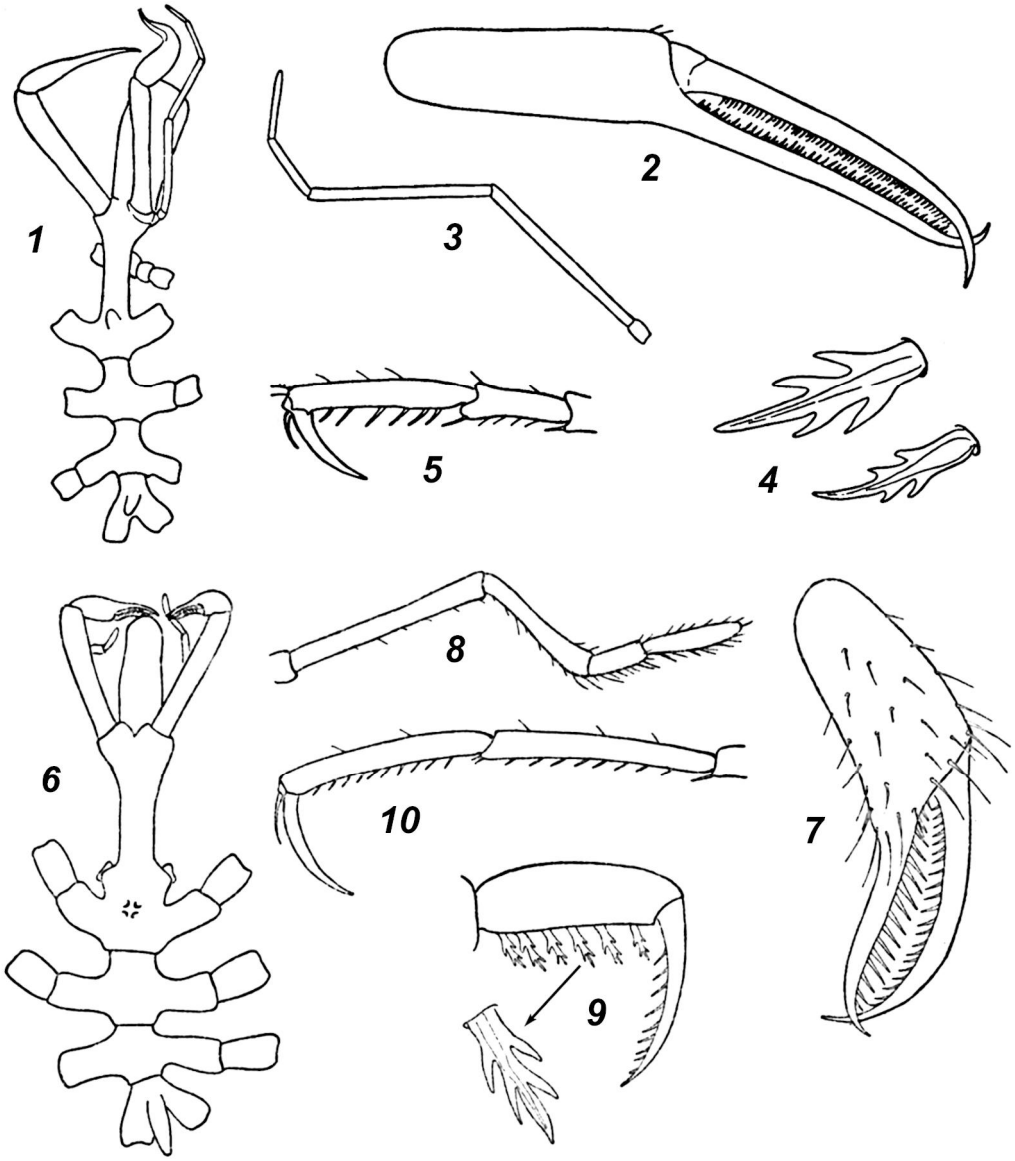

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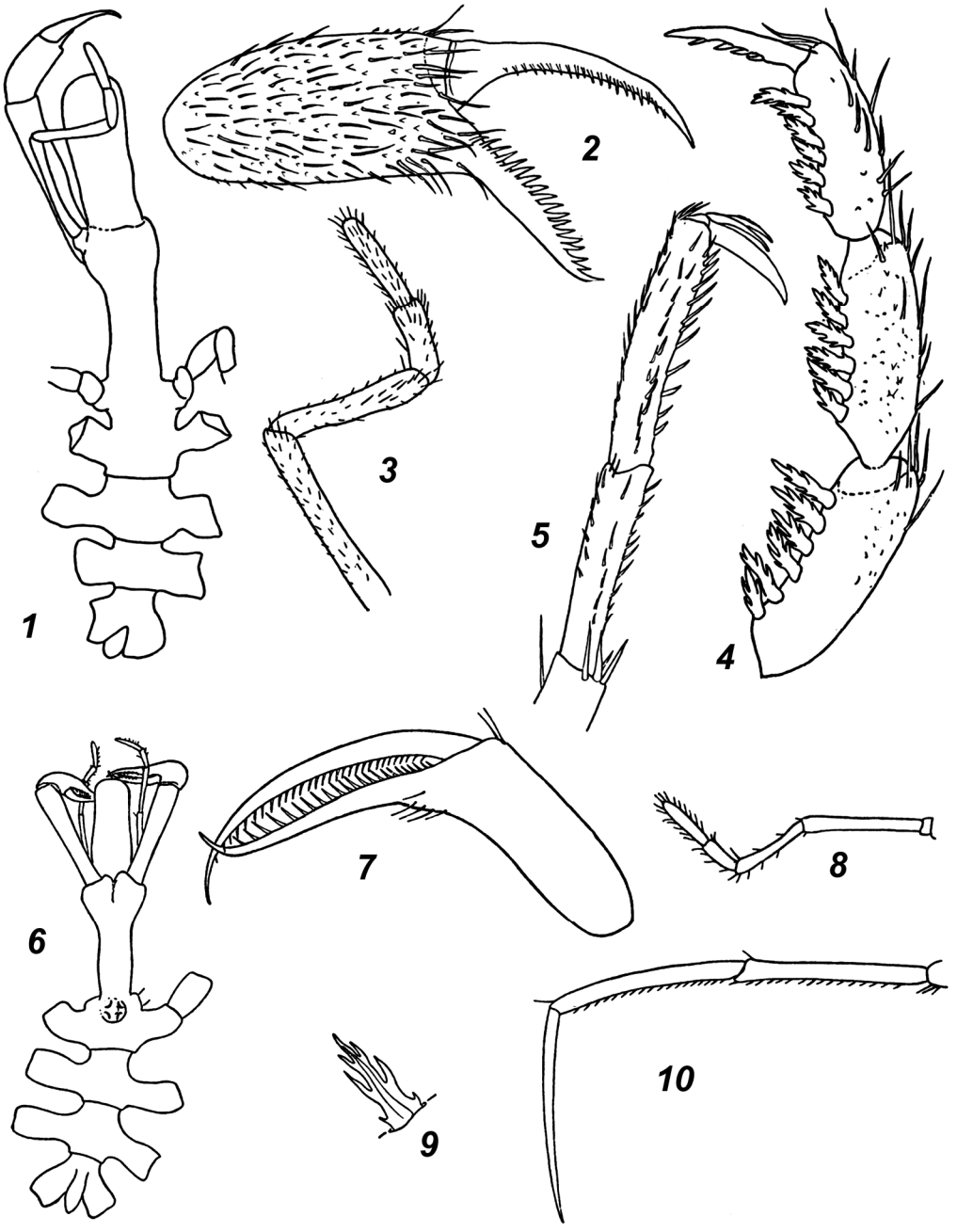

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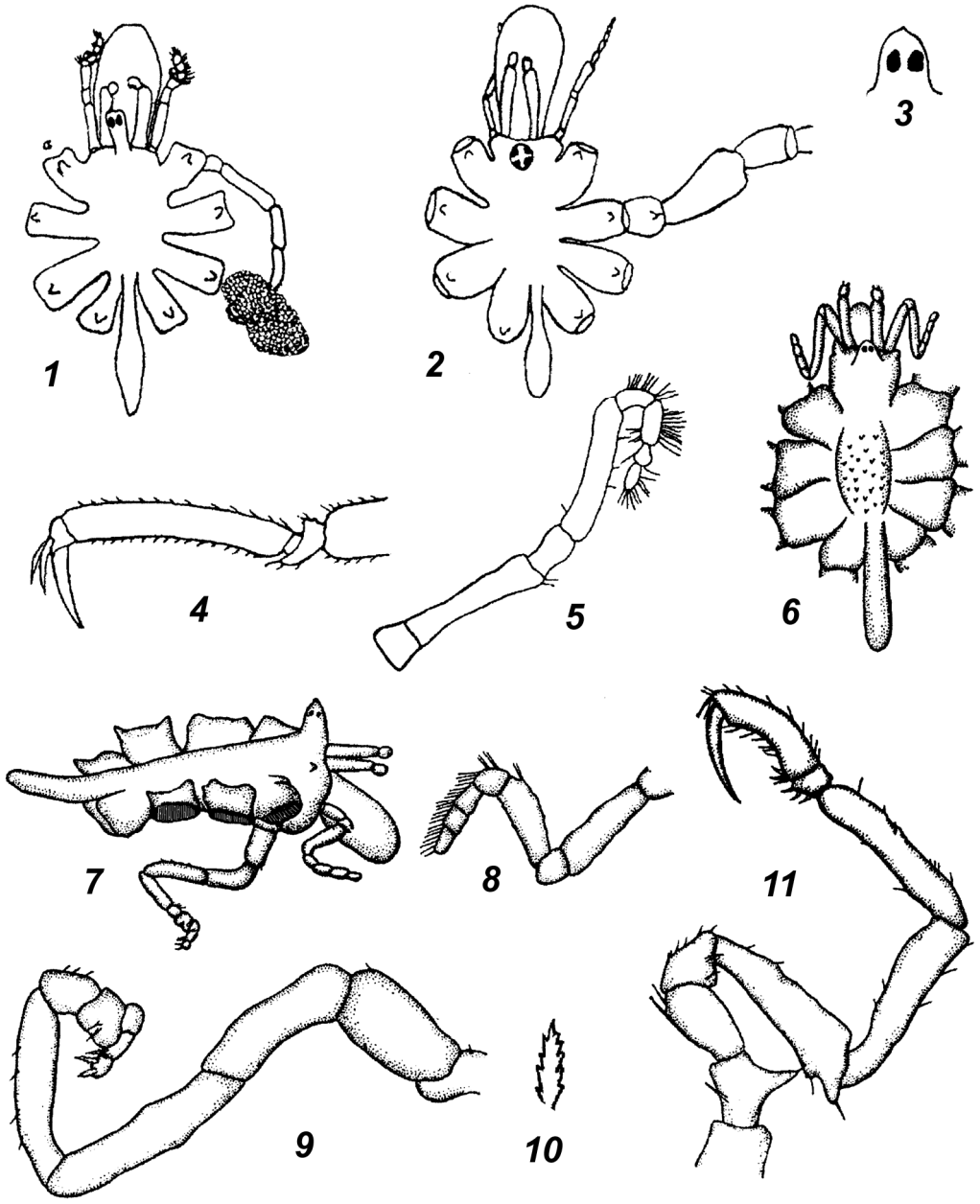

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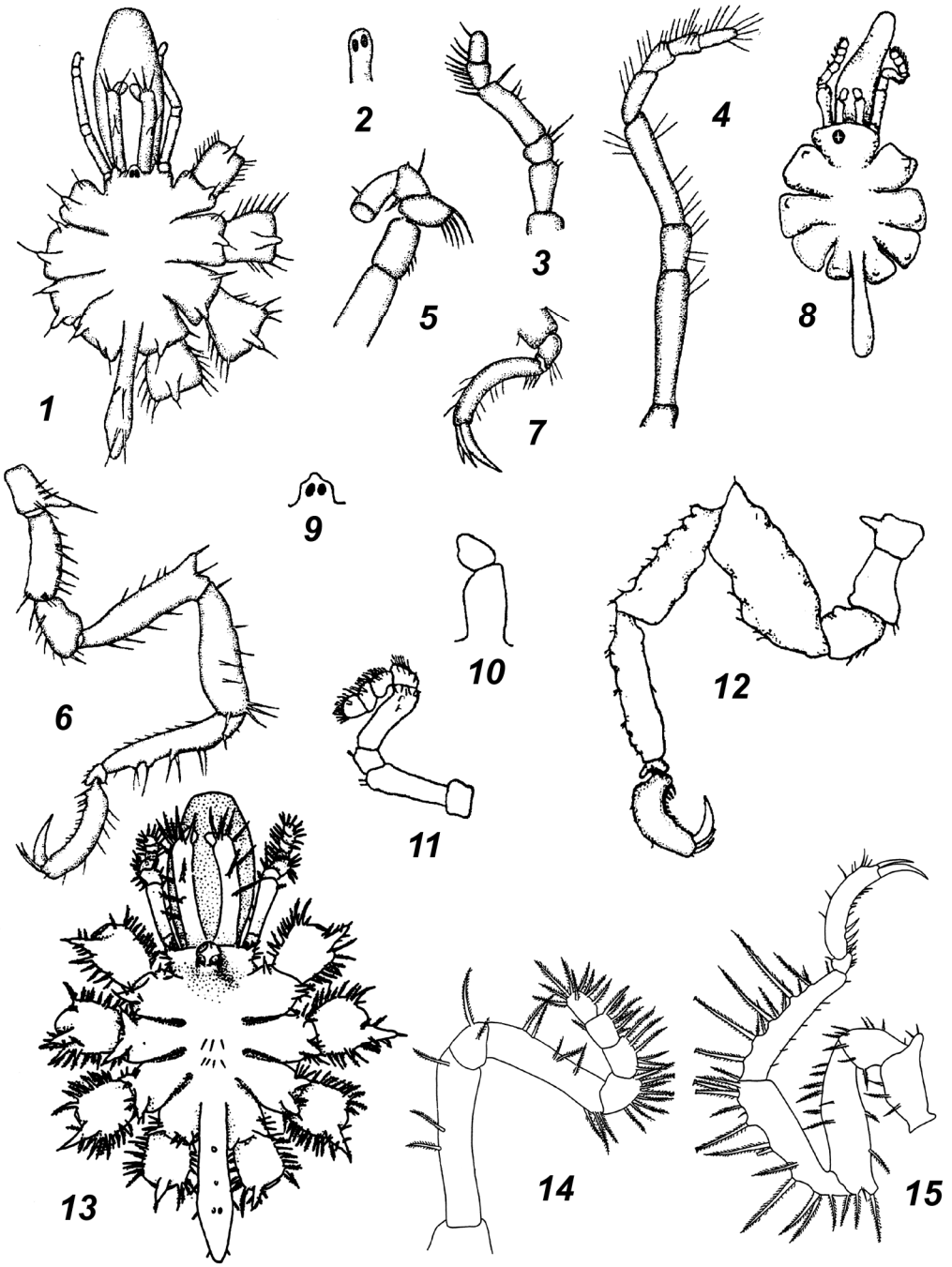

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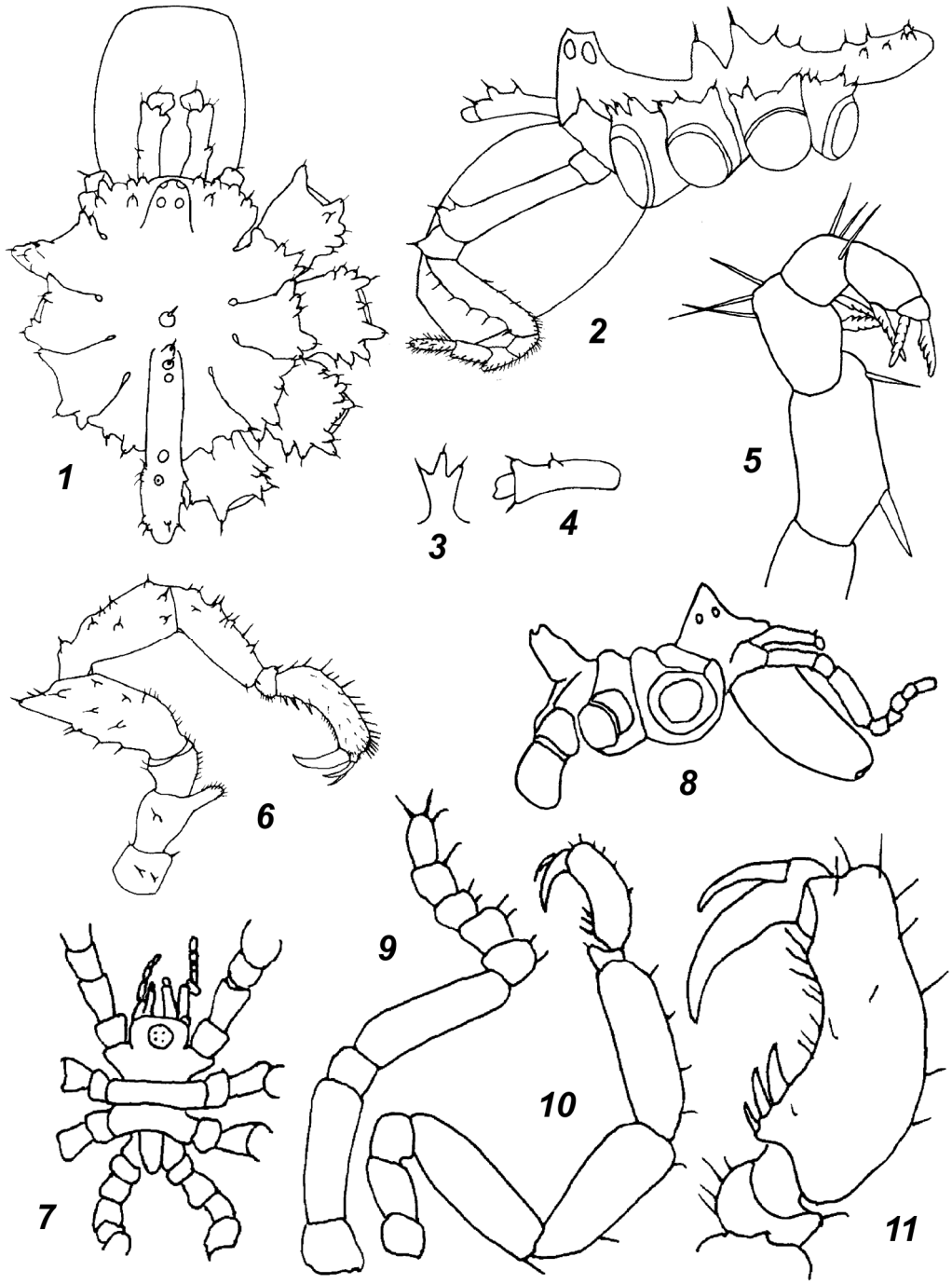

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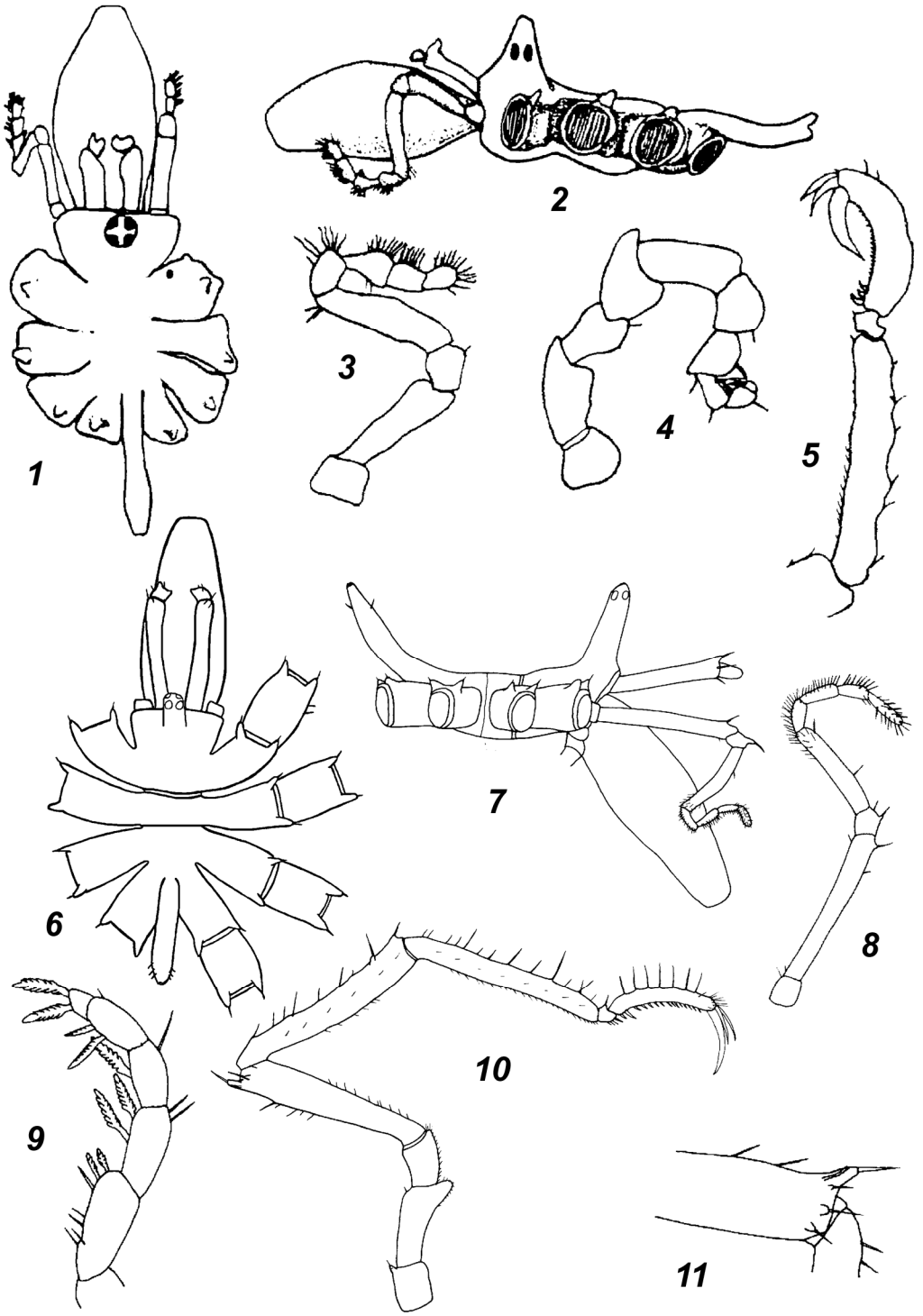

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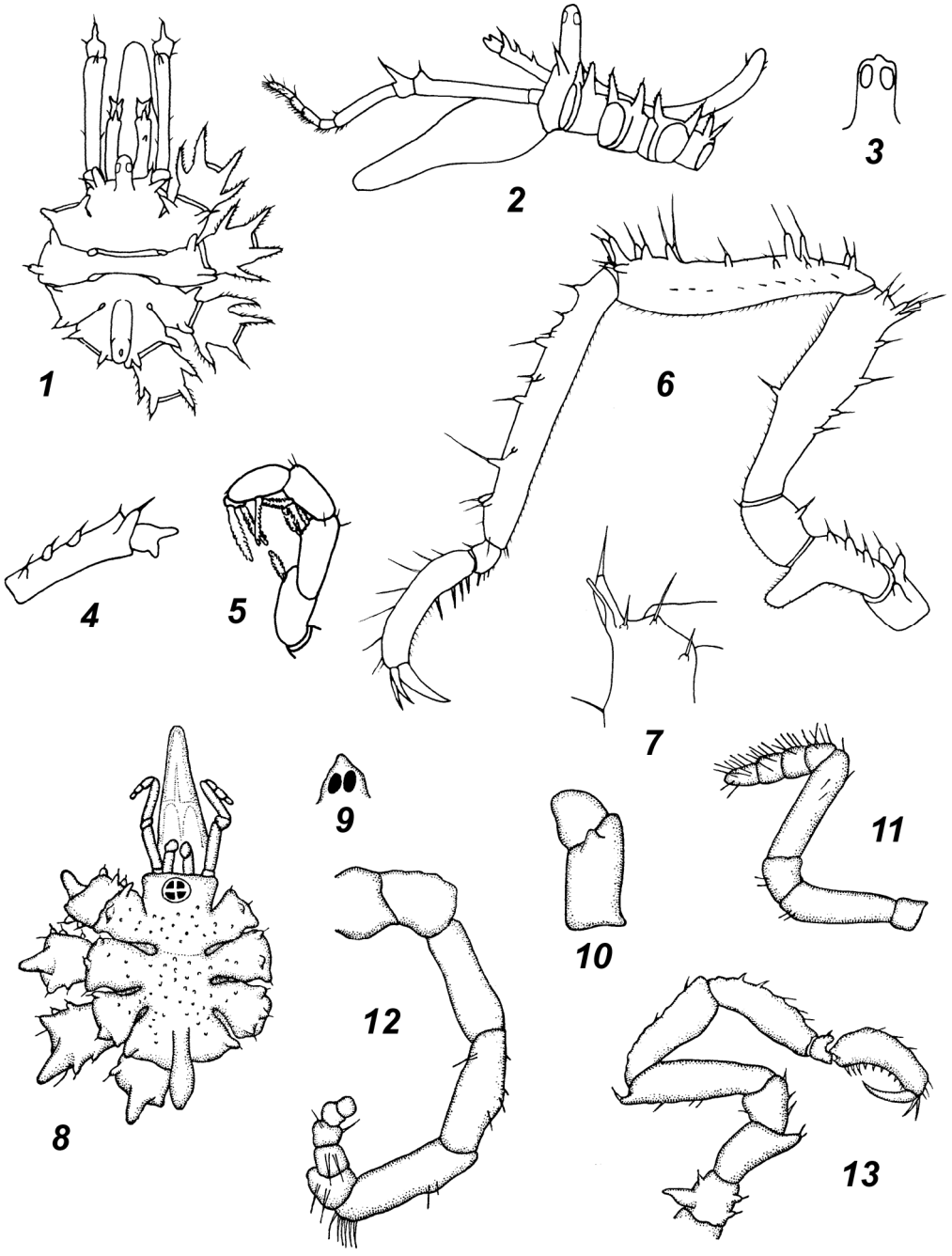

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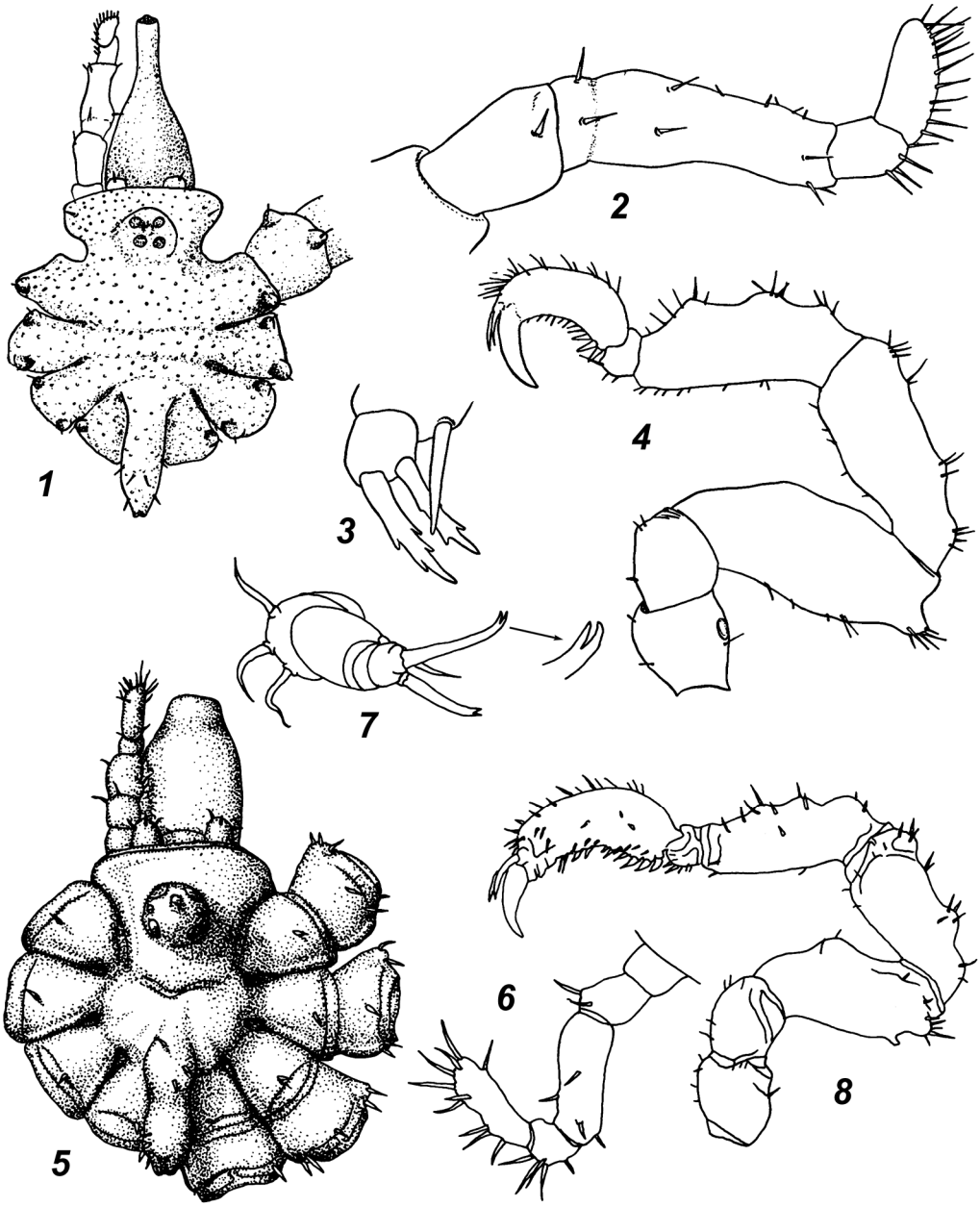

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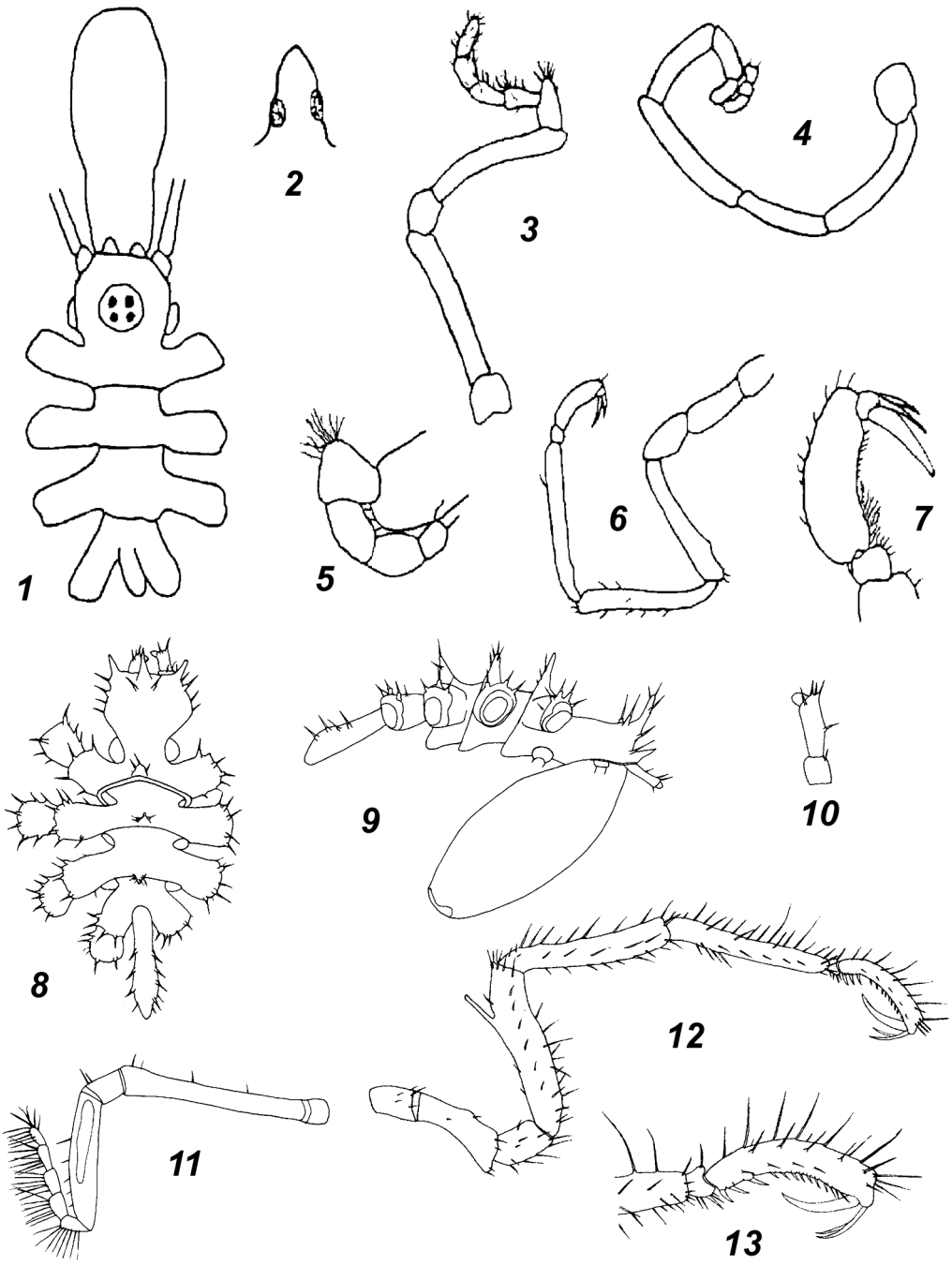

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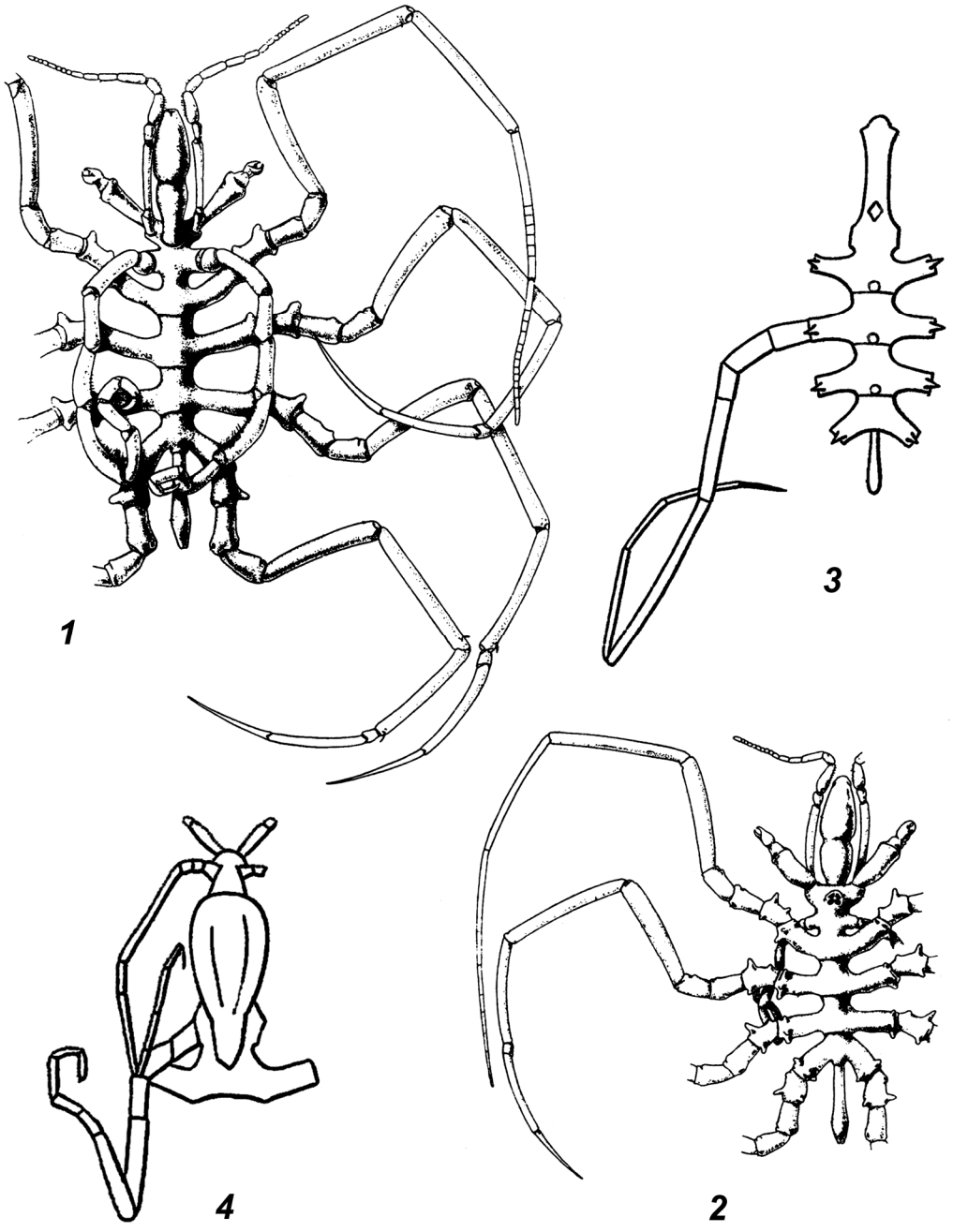

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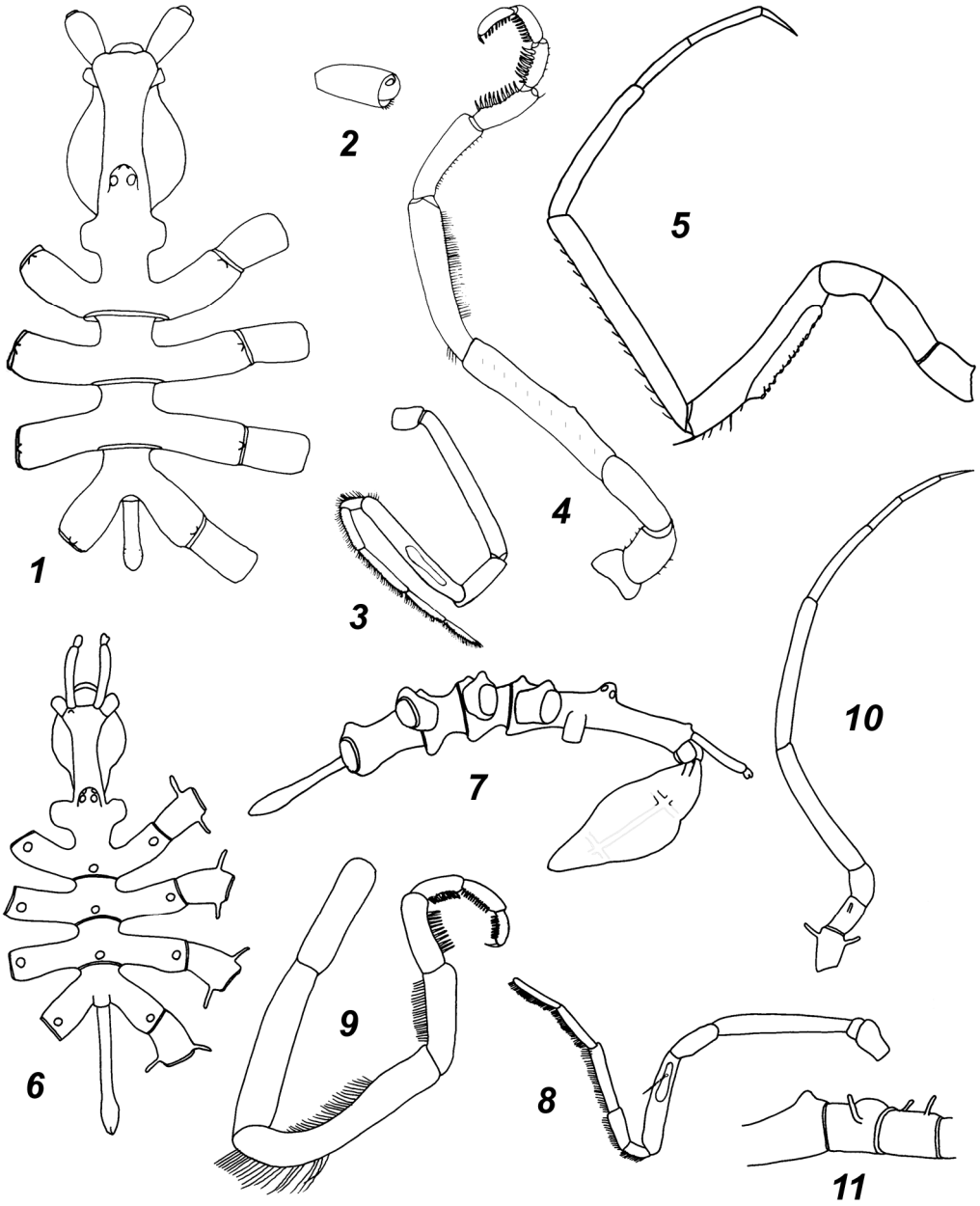

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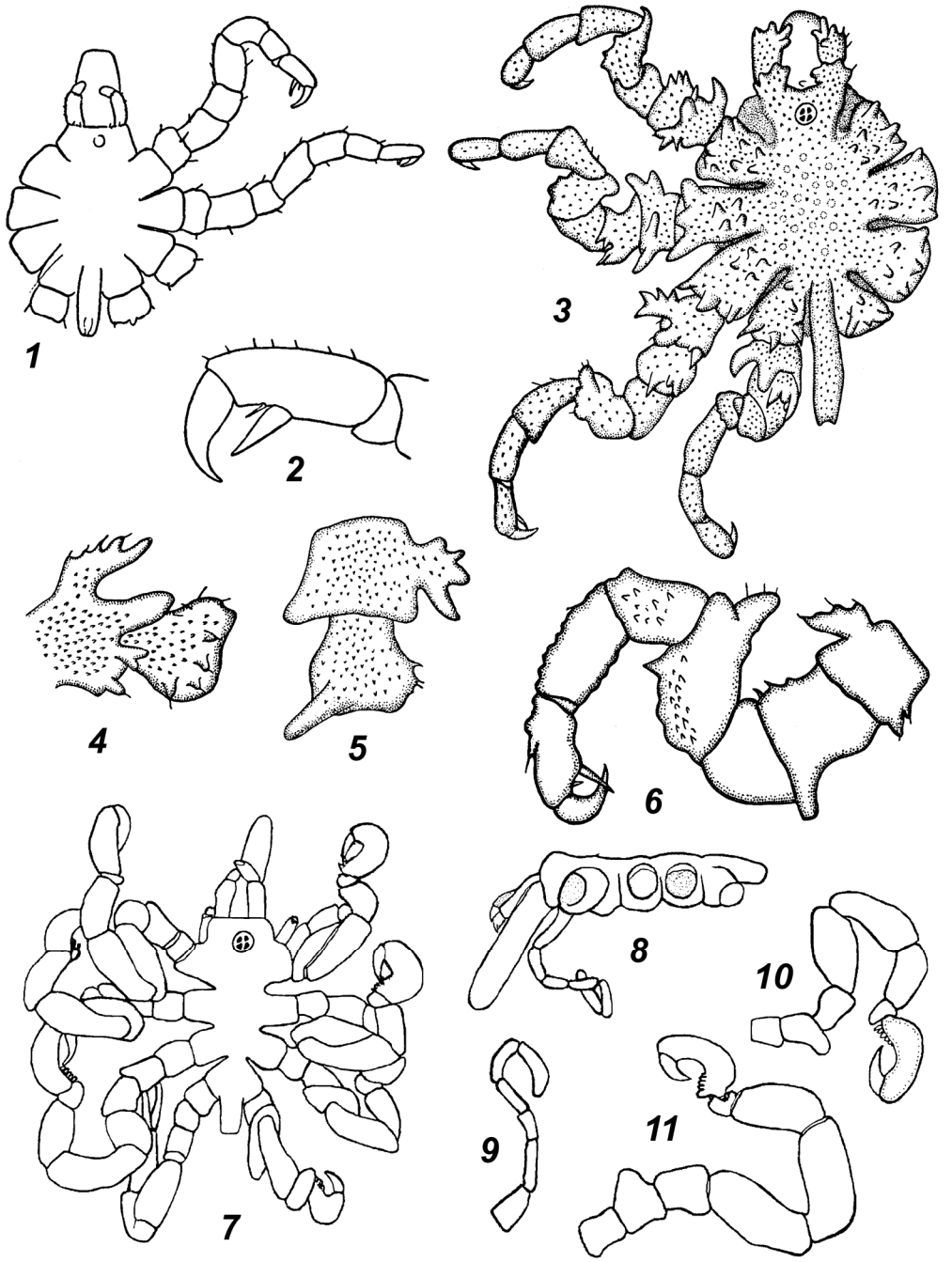

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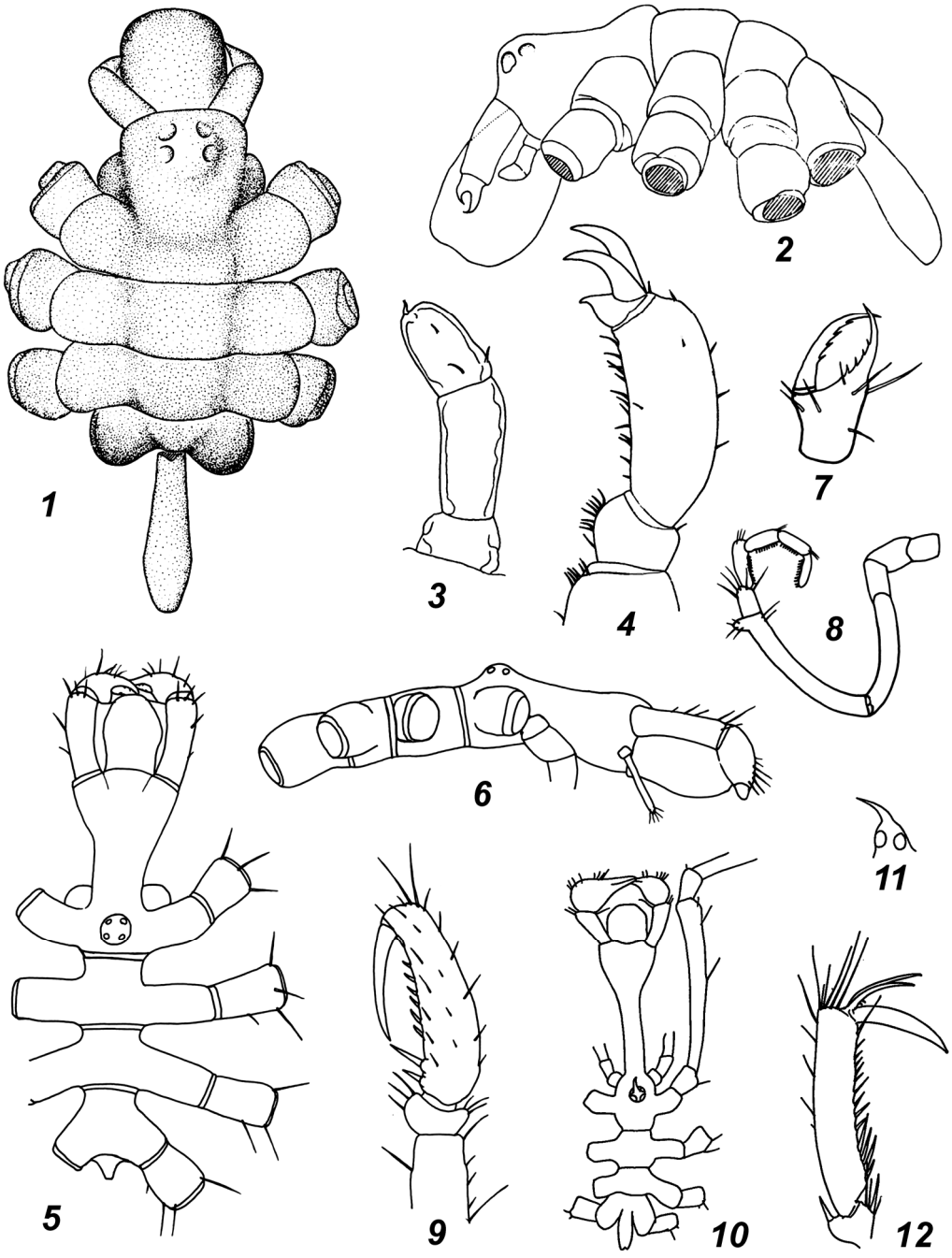

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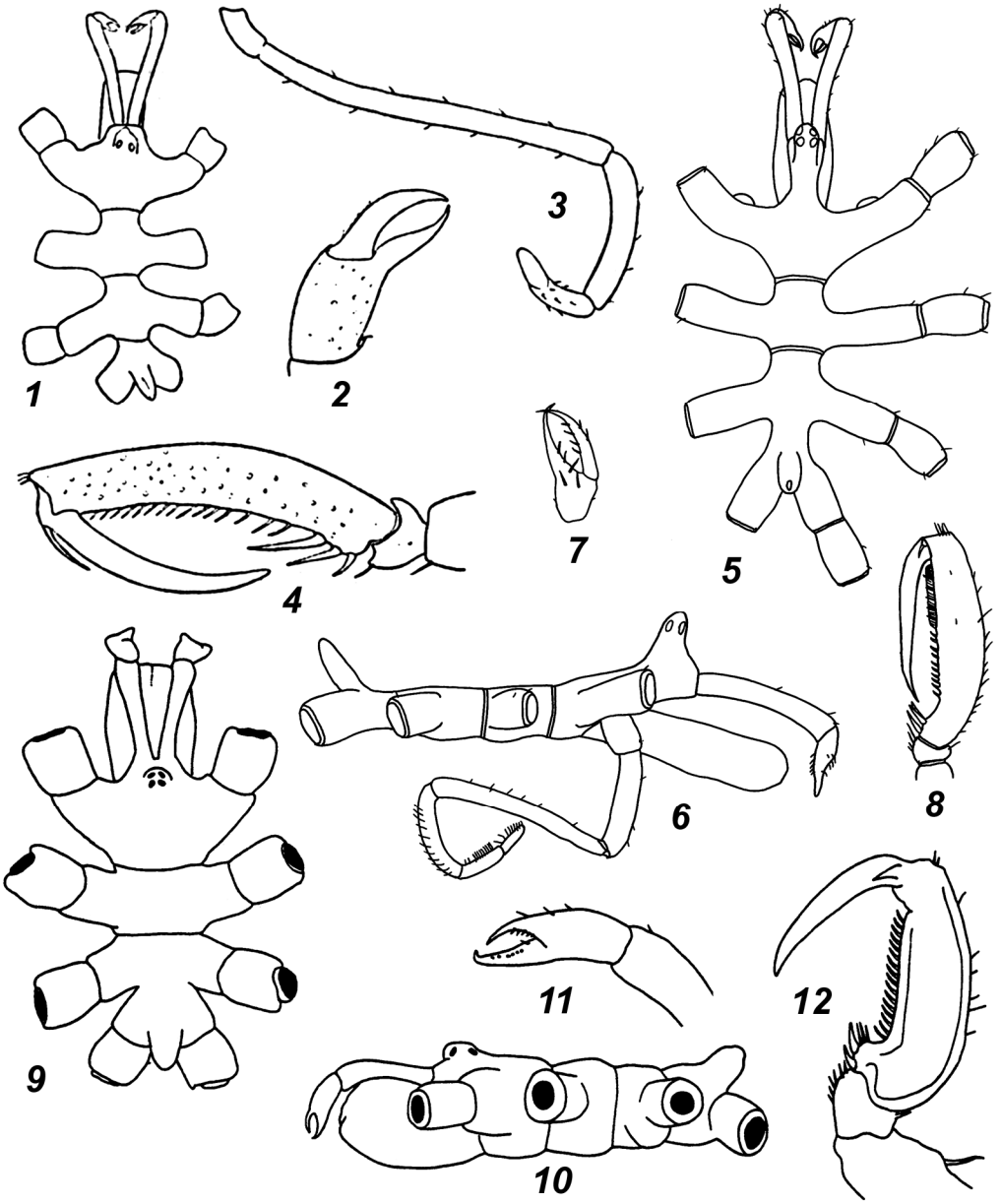

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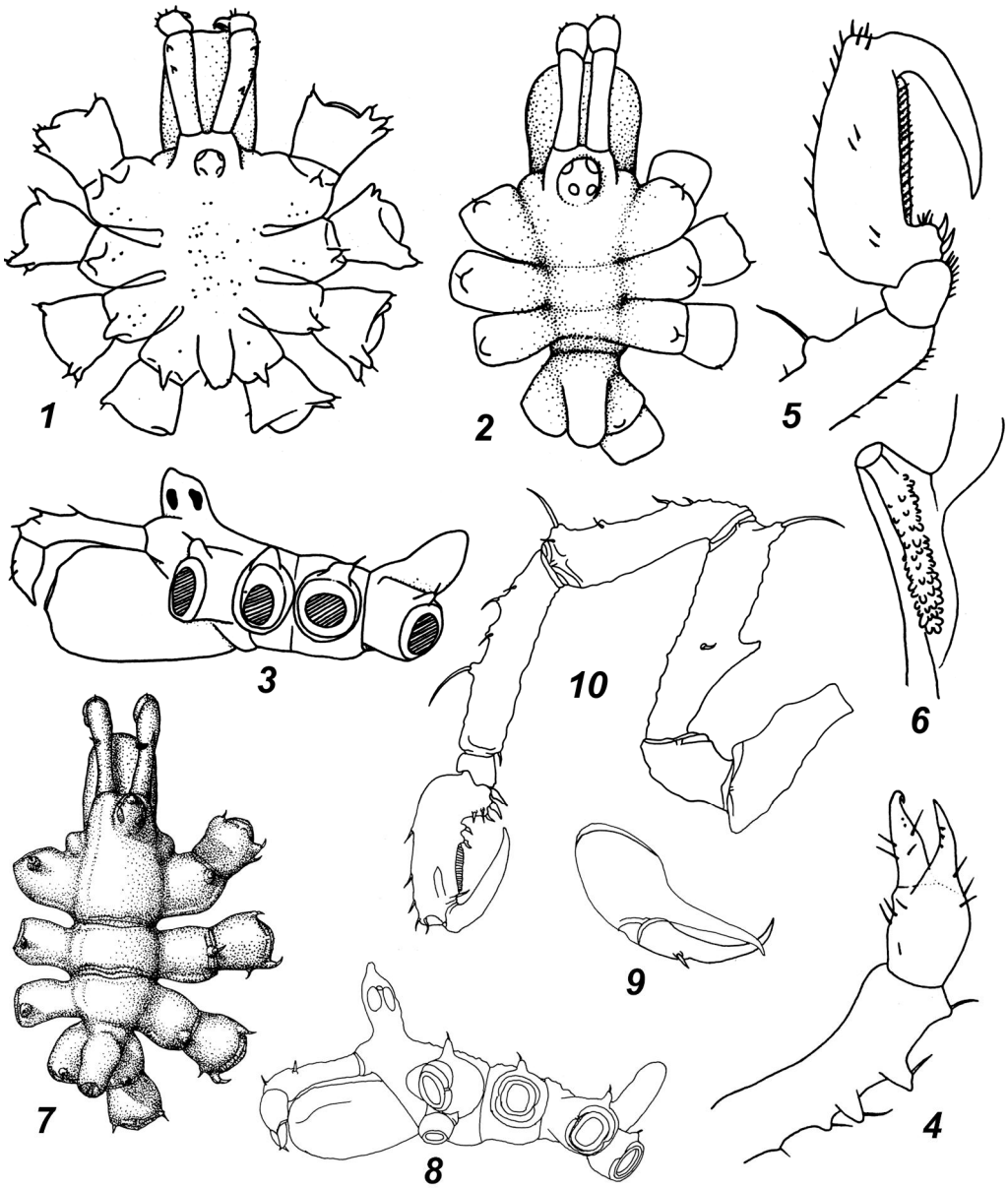

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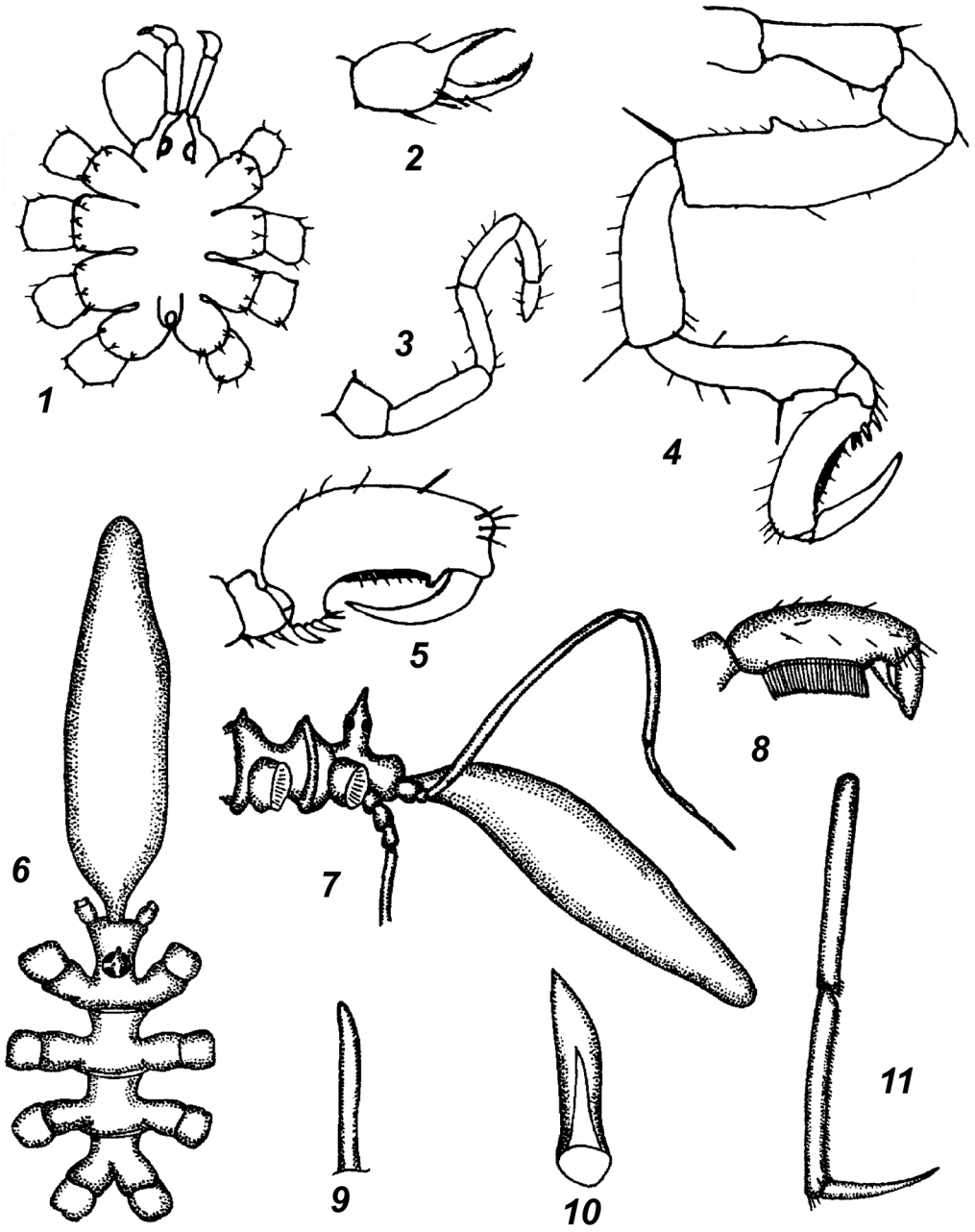

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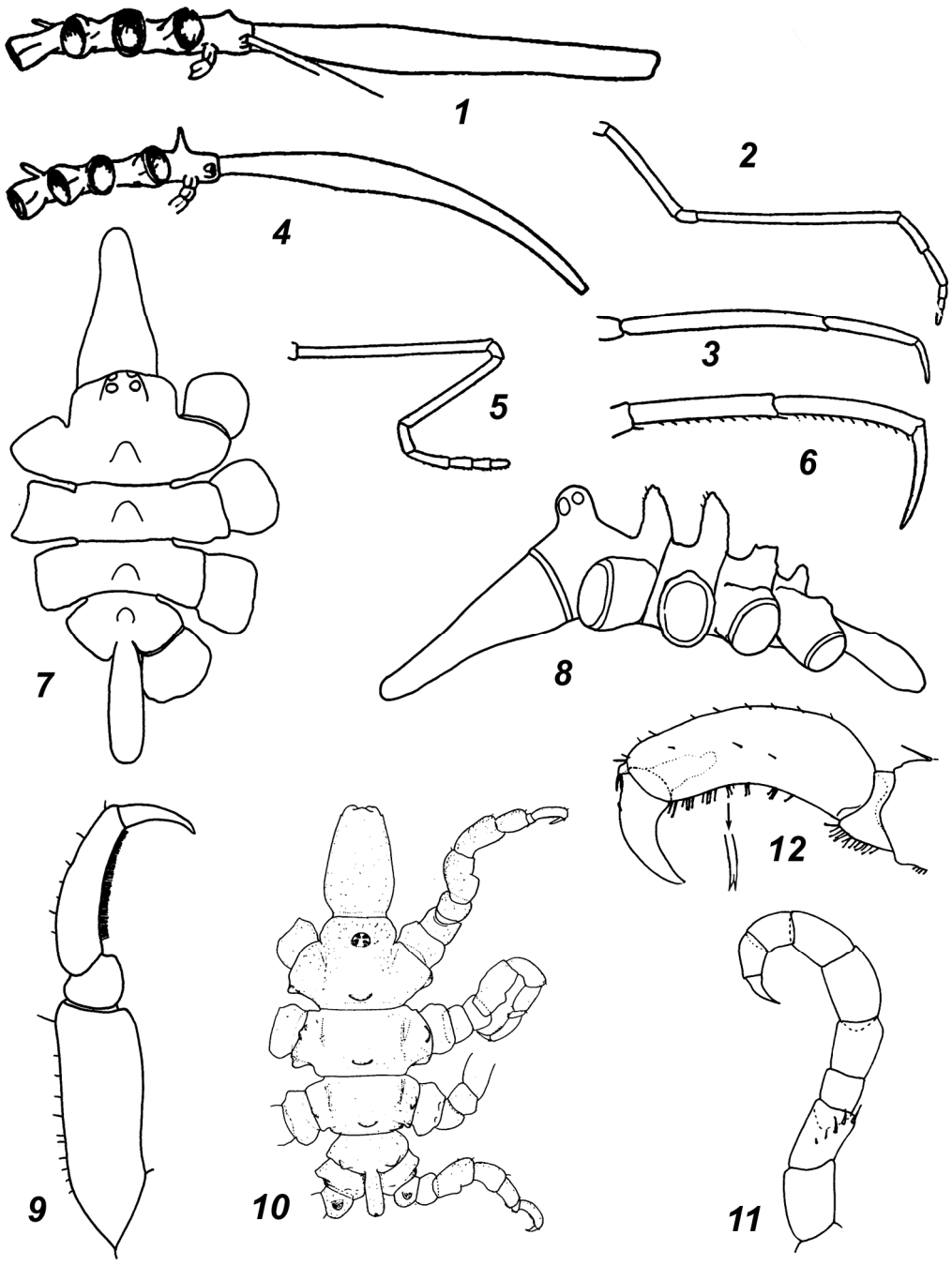

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* Synonims are italicized, and principal taxa from subgenera to families are printed in bold.

Научное издание

БИОТА РОССИЙСКИХ ВОД
ЯПОНСКОГО МОРЯ

Том 1, часть 2

РАКООБРАЗНЫЕ (ВЕТВИСТОУСЫЕ, ТОНКОПАНЦИРНЫЕ, МИЗИДЫ, ЭВФАУЗИИДЫ) И МОРСКИЕ ПАУКИ

Отпечатано с оригинал-макета,
подготовленного в Институте биологии моря ДВО РАН,
минуя редподготовку

Изд. лиц. ИД № 05497 от 01.08.2001 г. Подписано к печати 24.02.2007 г.
Бумага офсетная. Формат 70x108/16. Печать офсетная. Гарнитура «Times New Roman»
Усл.п.л. 15,66. Уч.-изд. л. 13,98. Тираж 300 экз. Заказ 159.

Отпечатано в типографии ФГУП Издательство «Дальнаука» ДВО РАН
690041, г. Владивосток, ул. Радио, 7