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Decapod Crustaceans of the Southwest Kamchatka Shelf: R/V "Professor Levanidov" collection in June 1996

Десятиногие ракообразные (Crustacea: Decapoda) южной части западно-камчатского шельфа: по сборам на НИС "Профессор Леванидов" в июне 1996 г.

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KEY WORDS: Decapod crustaceans, fauna, Sea of Okhotsk, West Kamchatka, protandric hermaphroditism.

КЛЮЧЕВЫЕ СЛОВА: десятиногие ракообразные, фауна, Охотское море, Западная Камчатка, протерандрический гермафродитизм.

ABSTRACT: Thirty two decapod species (ca. 6100 specimens) were collected using a bottom trawl in the southern part of the Kamchatka shelf at depth between 20 and 300 m. Two species, e.g. *Argis ochotensis* Komai, 1997 and *Spirontocaris brevidigitata* Kobjakova, 1935 were recorded in the area for the first time, while the latter species was found for the first time in the entire Sea of Okhotsk. New material provide evidence that the latter species and *Spirontocaris spinus* intermedia are both well separated from *Spirontocaris spinus*, contrary to earlier synonimization by Hayashi [1977]. The most common species in the region investigated were *Chionoecets bairdi*, *Chionoecetes opilio*, *Paralithodes camtschaticus*, *Pagurus trigonocheirus*, *Labidochirus splendescens*, and *Hyas coarctatus alutaceus*. All these species but *Chionoecetes bairdi* are widely ranged in the Sea of Okhotsk. *Paralithodes camtschaticus* and *Chionoecetes bairdi* were most abundunt species in the shallow waters. *Pandalus borealis eous* and *Chionoecetes opilio* dominated in trawl catches in the depth range of 200-300 m to the north of 52º00′N. The entire decapod fauna of the West Kamchatka shelf includes 50 species. Remarks on morphological variation, size composition and the presence of ovigerous females are given for most species. External sexual characters in *Crangon communis* were studied in details in order to clear whether this species is a protandric hermaphrodite. No apparent transitional specimens were recorded.

РЕЗЮМЕ: Последняя по времени сводка данных о десятиногих ракообразных Охотского моря [Виноградов, 1947] включает 91 вид и подвид. Однако по сложившимся в то время в СССР условиям исследователи в большинстве случаев не имели возможности публиковать сведения о положении станций [Иванов, 1992] и, следовательно, точном местонахождении различных видов. Часть этих материалов в последствии была утеряна. Поэтому многие данные о распространении различных видов десятиногих ракообразных в российских дальневосточных морях требуют дополнения и уточнения.

Из всех районов Охотского моря карцинологами наиболее активно изучался шельф Западной Камчатки. Пристальное внимание к этой части моря связано преимущественно с западнокамчатской популяцией камчатского краба, сильно эксплуатируемой на протяжении последних десятилетий. Распределение и биология других промысловых видов этого района изучали в значительно меньшей степени. Что касается непромысловых ракообразных то их изучением в последние годы практически не занимались. Обстановка в значительной степени осложняется почти полным отсутствием научно-исследовательских работ на специализированных судах. В этой связи довольно полная бентосная съемка южной части западнокамчатского шельфа, проведенная ТИНРО-Центром при участии ВНИРО на НИС "Проф. Леванидов" в июле 1996 г. представляет несомненный интерес.

Тридцать два вида (около 6100 экземпляров) декапод было собрано в южной части западнокамчатского шельфа на глубине от 20 до 300 м. Два вида *Argis ochotensis* и *Spirontocaris brevidigitata* отмечены для западнокамчатского шельфа впервые, последний впервые для Охотского моря в целом. На новом материале показано, что как этот последний вид, так и *Spirontocaris spinus intermedia* хорошо обособлены от *Spirontocaris spinus*, и не являются его синонимами, как ранее предполагалось Hayashi [1977]. Вся фауна декапод западнокамчатского шель-

фа включает 50 видов. Наиболее обычными видами региона были*Chionoecets bairdi*, *Chionoecetes opilio*, *Paralithodes camtschaticus*, *Pagurus trigonocheirus*, *Labidochirus splendescens* и*Hyas coarctatus alutaceus*. Все эти виды кроме *Ch. bairdi* широко распространены в Охотском море. *P. camtschaticus* и *Ch. bairdi* были наиболее многочисленны на мелководье. *Pandalus borealis eous* и *Chionoecetes opilio* доминировало в траловых уловах на глубине от 200 до 300 м. Для всех обнаруженных видов приведены данные по изменчивости, размерному составу, встречаемости яйценосных самок.

Детально исследованы вторичные половые признаки *Crangon communis* для выяснения вопроса, является ли данный вид протерандрическим гермафродитом. Особи с переходами от признаков самцов к признакам самок не обнаружены.

Introduction

Studies on the decapod crustaceans in the Sea of Okhotsk have a rather long history. The first account of the Decapoda from the North-western Pacific including the Sea of Okhotsk was published by Brandt [1851]. Important papers which contain description of new species from the Sea of Okhotsk, regional faunistic records and updates are those by Brajnikov [1907], Rathbun [1924, 1925, 1930, 1932], Kobjakova [1936, 1935], Makarov [1938], McLaughlin [1974], Hayashi [1977]. Up to now the most comprehensive review of the decapod fauna of the Sea of Okhotsk was presented by Vinogradov [1947] who listed 91 species and subspecies. Due to restrictions which existed in the USSR prior to the 1990s, Vinogradov's publication could not contain the data on stations positions [Ivanov, 1992]. Later, considerable part of the station data was lost and this is the reason why distribution data for the Sea of Okhotsk decapods require re-consideration.

Within the Sea of Okhotsk, the West Kamchatka shelf remains the most extensively studied area. A persistent attention to this waters is due to a very abundant local stock of red king crab,*Paralithodes camtschaticus* (Tilesius, 1815) heavily exploited in recent years. The papers by Vinogradov [1945, 1946, 1947, 1969], Rodin [1967, 1969, 1985], and Chekunova [1969] built up the basis of recent studies on population structure, migrations and reproduction of red king crab on the West Kamchatka shelf. Larval biology of several species was treated by Makarov [1966]. Distribution and biology of other species in this area have been poorly studied while recent investigations of non-commercial species are totally lacking. Also special trawl surveys became rare in the 1990s. A detailed benthic survey conducted by the expedition on R/V "Professor Levanidov" in July 1996 brought an extensive material which extends our knowledge of the decapod fauna in the region.

The present study is focused at occurrence, distribution, morphological variability and biological characteristics of mostly non-commercial species of the Decapoda from the shelf of West Kamchatka. Abundance and distribution pattern of most important commercial species, e.g. blue king crab,*Paralithodes platypus* (Brandt, 1851), red king crab, and tanner crabs, *Chionoecetes bairdi* Rathbun, 1902 and *Chionocoetes opilio* (O. Fabricius, 1788) are out of the scope of this paper.

Materials and Methods

Most of 6100 specimens of 32 species of Decapoda were collected during the expedition of the Pacific Research Centre for Marine Fisheries and oceanography (TINRO-Centre, Vladivostok) and the Russian Federal Institute for Marine Fisheries and Oceanology (VNIRO, Moscow) on board R/V "Professor Levanidov" in the southeastern part of the Sea of Okhotsk (51°10′–54°00′N). Ninety eight stations at depth from 20 to 300 m, were sampled between July, 1 and 20 in 1996. Samples were obtained by an otter-trawl (28 m flat bottom trawl) with a mesh size of 45 mm supplied with a panel of 30 mm mesh net lining the cod end, and additionally by a dredge. The dredge had a mesh size of 10 mm and a rectangular mouth opening (120x40cm). All hauls lasted 30 minutes. The stations are listed in the appendix.

All decapod specimens were measured and sexed. After that most of specimens of non-commercial species (about 3300 animals) were preserved in buffered 10% seawater formalin solution and later transferred to 70% ethyl alcohol.

The carapace length (CL), from the base of eyestalk to the posterior mid-dorsal edge of carapace was measured to the nearest 0.1 mm for the shrimps. The maximum carapace width (CW) was measured to the nearest 1 mm for the crabs. The maximal shield length (SL) from the base of eyestalk to the posterior mid-dorsal point was measured in the hermit crabs. Shrimp specimens were sexed by examination of the endopodite of the first two pair of pleopods. The position of gonopore was used for the sex determination of hermit crabs. Crab specimens were sexed by examination of the abdomen and first two pair of pleopods. All preserved specimens are deposited in the Zoological Museum of Moscow State University (ZMMU).

Bottom water temperature was measured with a deep-sea protected reversing thermometer and bathythermograph.

List of Decapoda collected by R/V "Prof. Levanidov"

Family Pandalidae Haworth, 1825
- Genus *Pandalus* Leach, 1814
  - *Pandalus borealis eous* Makarov, 1935
  - *Pandalus goniurus* Stimpson, 1860

Family Hippolytidae Bate, 1888
- Genus *Eualus* Thallwitz, 1892
  - *Eualus fabricii* (Kröyer, 1841)
  - *Eualus macilentus* (Kröyer, 1842)
  - *Eualus pusiolus* (Kröyer, 1841)
- Genus *Lebbeus* White, 1847
  - *Lebbeus groenlandicus* (Fabricius, 1775)
- Genus *Spirontocaris* Bate, 1888
  - *Spirontocaris brevidigitata* Kobjakova, 1935
  - *Spirontocaris intermedia* Makarov in Kobjakova, 1936
  - *Spirontocaris murdochi* Rathbun, 1902

Family Crangonidae Haworth, 1825
Genus Argis Kröyer, 1842
Argis dentata (Rathbun, 1902)
Argis lar (Owen, 1839)
Argis ovifer (Rathbun, 1902)
Argis cf. *ochotensis* Komai, 1997
Genus *Crangon* Fabricius, 1798
Crangon septemspinosa Say, 1818
Crangon communis (Rathbun, 1902)
Crangon dalli (Rathbun, 1902)
Genus *Mesocrangon* Zarenkov, 1965
Mesocrangon intermedia (Stimpson, 1860)
Genus *Sclerocrangon* G.O. Sars, 1883
Sclerocrangon salebrosa Owen, 1839
Family Paguridae Latreille, 1803
Genus *Labidochirus* Benedict, 1892
Labidochirus splendescens (Owen, 1839)
Genus *Pagurus* Fabricius, 1775
Pagurus capillatus (Benedict, 1892)
Pagurus rathbuni (Benedict, 1892)
Pagurus trigonocheirus (Stimpson, 1858)
Pagurus brandti (Benedict, 1892)
Family Lithodidae Samouelle, 1819
Subfamily Lithodinae Ortmann, 1901
Genus *Paralithodes* Brandt, 1849
Paralithodes camtschaticus (Tilesius, 1815)
Paralithodes platypus Brandt, 1850
Genus *Lithodes* Latreille, 1806
Lithodes aequispinus Benedict, 1894
Family Majidae Samouelle, 1819
Genus *Chionoecetes* Kröyer, 1838
Chionoecetes opilio (O. Fabricius, 1788)
Chionoecetes bairdi Rathbun, 1902
Genus *Hyas* Leach, 1814
Hyas coarctatus alutaceus Brandt, 1851.
Genus *Oregonia* Dana, 1851
Oregonia gracilis Dana, 1851
Family Atelecyclidae Ortmann, 1893
Genus *Erimacrus* Benedict, 1892
Erimacrus isenbeckii (Brandt, 1848)
Genus *Telmessus* White, 1846
Telmessus cheiragonus (Tilesius, 1812)

Systematics

FAMILY PANDALIDAE HAWORTH, 1825

Genus *Pandalus* Leach, 1814

Pandalus goniurus Stimpson, 1860
Fig. 1.

MATERIAL EXAMINED. 155 ♂♂ (CL 7.4–19.1 mm), 183 non-ovigerous ♀♀ (CL 10.2–28.5 mm), 64 intersexes (CL 9.2–20.3 mm).

LOCALITY. Hauls # 6, 9, 10, 17, 18, 19, 20, 30, 33, 34, 37, 39, 40, 47, 48, 49, 50, 52, 53, 54, 55, 58; Dredge # 4, 11, 12, 14, 16, 17, 18, 24, 25, 33, 34, 37, 38, 39, 41, 44.

REMARKS ON MORPHOLOGY. Rostrum is 1.29–2.27 times as long as carapace, armed with 8–11 spines: 3 or 4 of them on the carapace posterior to the level of orbital margin, and 1 or 2 toothlike spines near the apex of rostrum (Fig. 1h). The ventral margin of rostrum has 6–7 teeth. Scaphocerite is 4.1–5.9 times as long as wide, the distolateral tooth not extending or distinctly overreaching distal margin of lamina (Fig. 1d–g). Median projection on the third abdominal somite is more or less prominent (Fig. 1b, c).

DISTRIBUTION. North Pacific from the southern part of Chukchi Sea to the Peter the Great Bay (Sea of Japan) and to Puget Sound [Makarov, 1941; Butler, 1980; Komai, 1999]; 5–450 m [Butler, 1980].

In the reference area *P. goniurus* was collected at depth between 52 and 294, on mud and sand, (water temperature 0.21–2.02°C and salinity 32.6–33.38 p.p.t.).

BIOLOGY. CL of females reaches to 25.5 mm, those of males to 19.1 mm. Specimens in the West Kamchatka region were in general larger, than those recorded by Butler [1964, 1980] near the western coast of North America (CL 16.5 and 13.1 mm respectively).

Most of females were ovigerous (79.8%). The percentage of morphologically transitional specimens (15.9%) was relatively low.

This species frequently occurred together with *Chionoecetes opilio*, *C. bairdi*, *Hyas coarctatus*, *Labidochirus splendescens*, *Pagurus trigonocheirus*, and *Crangon communis*.

Pandalus borealis eous Makarov, 1935
Figs. 2, 3.

MATERIAL EXAMINED. 118 ♂♂ (CL 8.8–25.5 mm), 56 transitional (CL 16.5–27.5 mm), 98 non-ovigerous ♀♀ (CL 9.3–33.8 mm), 19 ovigerous females (CL 27–33 mm).

LOCALITY. Haul # 6, 8, 19, 24, 26, 31, 32, 36, 37, 43, 45, 49, 55, 56.

REMARKS ON MORPHOLOGY. Rostrum is 1.39–2.42 times as long as the carapace length, armed nearly throughout its length with 15–24 spines, including 4–5 spines on the carapace posterior to the level of orbital margin, and a small teeth near the apex of rostrum. The ventral margin of rostrum is armed with 7 or 8 teeth. Rostrum is usually proportionally longer in small specimens than in larger ones (Fig. 3).

Scaphocerite is 3.7–5.8 times as long as wide, the distolateral tooth usually distinctly overreaches the distal margin of lamina, but several specimens have scaphocerite with distolateral tooth not extending to the anterior margin of lamina. Small specimens usually have proportionally slender scaphocerite than larger ones.

The third abdominal somite usually has an acute prominent median projection. The median projection of the third somite in few (ca. 10%) specimens in our collection is rounded and relatively small.

Makarov [1935] described a new subspecies *P. borealis eous* based on the differences in the shape of the distal margin of scaphocerite and the relative length of rostrum. Several authors [Kobjakova, 1936, 1937; Vinogradov, 1947, 1950; Zarenkov, 1960] accepted a subspecific status of the Pacific populations of *Pandalus borealis*. Squires [1992] examined a few specimens from the British Columbia and Newfoundland and recognized the Pacific form as a good species, *P. eous*. By arguing that Pacific specimens are distinct from the *P. borealis* in the two particulars (the relative length of rostrum and the shape of the median projection of the third abdominal somite) Komai [1999] accepted the species rank of the Pacific form.

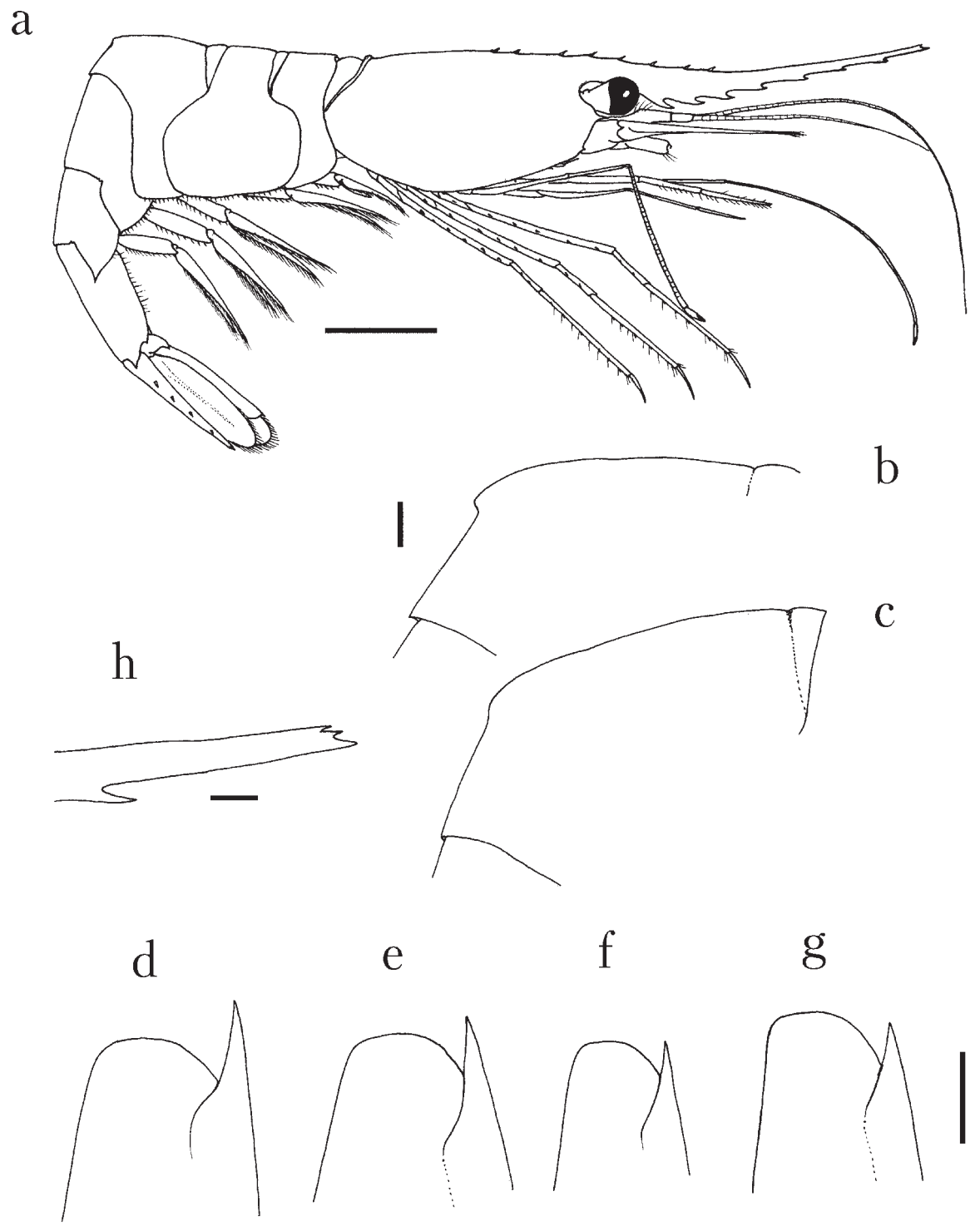

Fig. 1. *Pandalus goniurus* Stimpson, 1860: a — entire animal in lateral view; b, c — dorsal margin of third abdominal somite in lateral view; d–g — distal part of scaphocerite; h — apex of rostrum. a, b, e — non-ovigerous ♀ (CL 19.8 mm); c — non-ovigerous ♀ (CL 19.4 mm); d, h — transitional (CL 19.5 mm); f — ♂ (CL 15.4 mm); g — transitional (CL 17.8 mm). Scale 1 cm (a), 1 mm (b–h).

Рис. 1. *Pandalus goniurus* Stimpson, 1860: a — общий вид сбоку; b, c — спинная поверхность третьего сегмента абдомена (вид сбоку); d–g — форма передней части скафоцерита; h — форма конца рострума. a, b, e — самка без яиц (ДК 19,8 мм); c — самка без яиц (ДК 19,4 мм); d, h — переходная особь (ДК 19,5 мм); f — самец (ДК 15,4 мм); g — переходная особь (ДК 17,8 мм). Масштаб 1 см (a), 1 мм (b–h).

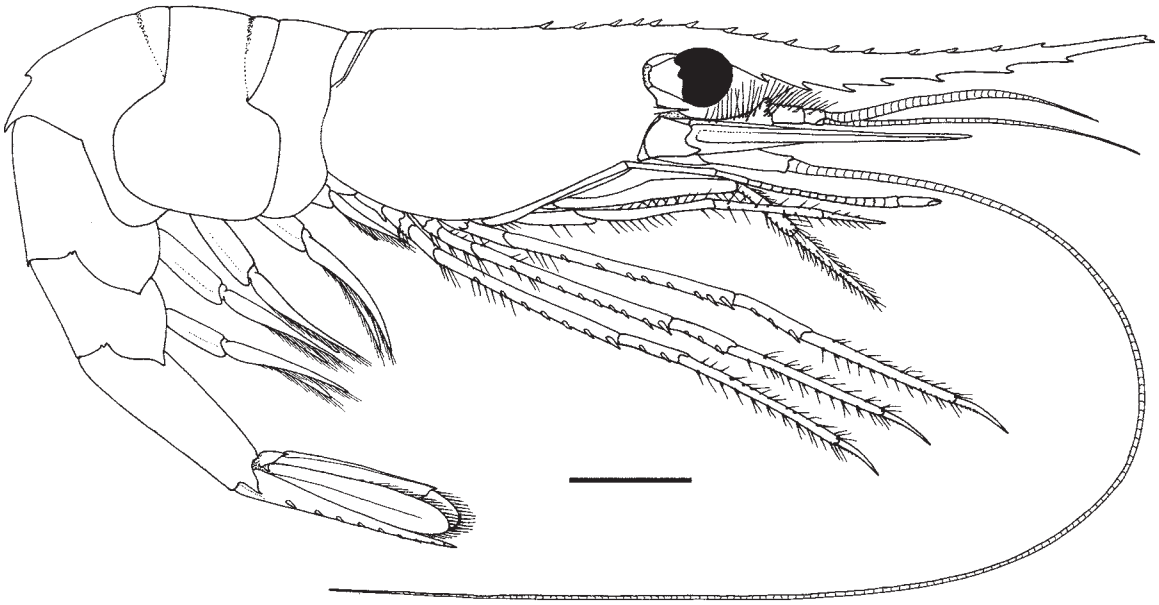

Fig. 2. *Pandalus borealis eous* Makarov, 1935. Non-ovigerous ♀ (CL 25 mm). Entire animal in lateral view. Scale 1 cm.
Рис. 2. *Pandalus borealis eous* Makarov, 1935. Общий вид сбоку самки без яиц (ДК 25 mm). Масштаб 1 см.

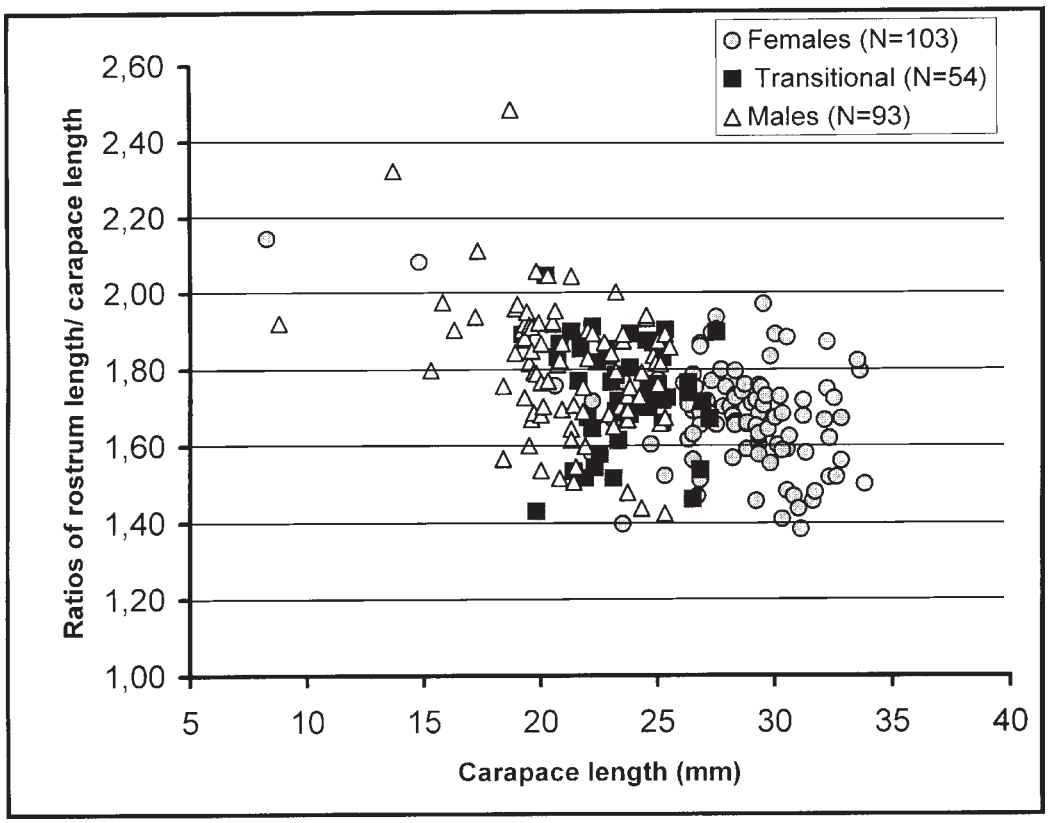

Fig. 3. Carapace length *vs.* ratio of rostrum length/carapace length of *Pandalus borealis eous* Makarov, 1935.
Рис. 3. График изменения отношения длины рострума к длине карапакса с увеличением размера особи у *Pandalus borealis eous* Makarov, 1935.

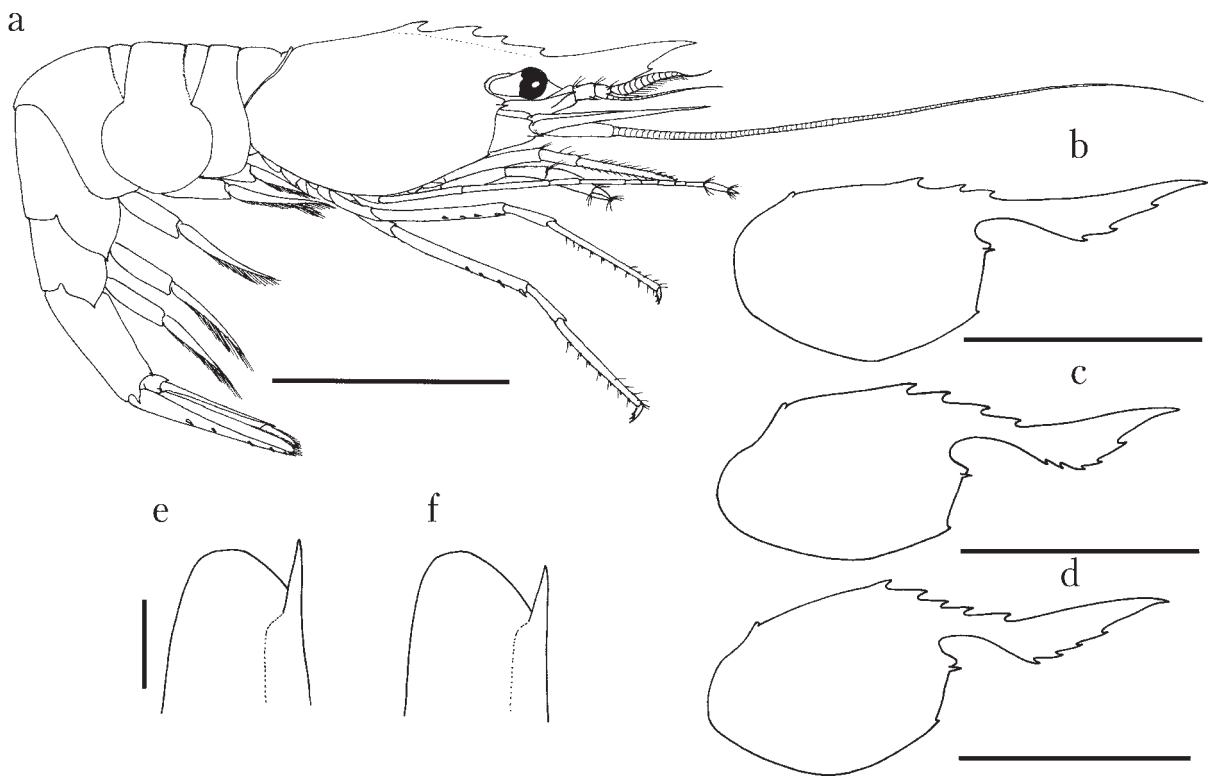

Fig. 4. *Eualus fabricii* (Kröyer, 1841): a — entire animal in lateral view; b–d — shape of rostrum and carapace; e, f — distal part of scaphocerite. a, c, e — non-ovigerous ♀ (CL 7.7 mm); b — non-ovigerous ♀ (CL 7.8 mm); d, f — non-ovigerous ♀ (CL 7.6 mm). Scale 1 cm (a–d), 1 mm (e, f).

Рис. 4. *Eualus fabricii* (Kröyer, 1841): a — общий вид сбоку; b–d — форма рострума и карапакса (вид сбоку); e, f — форма передней части скафоцерита. a, c, e — самка без яиц (ДК 7,7 мм); b — самка без яиц (ДК 7,8 mm); d, f — самка без яиц (ДК 7,6 мм). Масштаб 1 см (a–d), 1 мм (e, f).

Sokolov [1997] compared numerous specimens from the North-East Atlantic and the North-West Pacific and failed to find diagnostic characters which are good enough to distinguish between populations from these areas. As shown earlier, the ratio of rostrum length/ carapace length of the Pacific specimens is the same as in the typical form. Thus raising the rank of Pacific populations to a separate species is not sufficiently substantiated.

DISTRIBUTION. The Pacific subspecies is widely distributed from the southern part of the Chukchi Sea to Puget Sound, Washington State and to the Peter the Great Bay (Sea of Japan); 10–1380 m [Vinogradov, 1950; Butler, 1980; Komai, 1999]. In the reference area *P. borealis eous* was one of the most common species of Decapoda at depth between 200 and 300 m (temperature 0.41–1.83°C, salinity 32.74–33.39 p.p.t.)

BIOLOGY. CL in females and males in the West Kamchatka region amount respectively to 33.8 mm and 25.5 mm. Specimens in the West Kamchatka region were in general larger than those recorded by Butler [1964, 1980] near the western coast of North America.

Eight size groups determined by modal size were present. Most females (88.9%) were ovigerous. The percentage of transitional specimens (24.8%) was relatively high.

Cohabitant species were mostly *Chionoecetes opilio*, *Argis ochotensis*, *Pagurus trigonocheirus*, and *Crangon communis*.

FAMILY HIPPOLYTIDAE BATE, 1888

Genus *Eualus* Thallwitz, 1892

Eualus fabricii (Kröyer, 1841)
Fig. 4.

MATERIAL. 6 ♀♀ (CL from 7.6 to 10.3 mm)
LOCALITY. Haul # 39, 40, 52; Dredge # 17, 18.

REMARKS ON MORPHOLOGY. Rostrum armed with 3–5 spines, including spines on the carapace posterior to the level of orbital margin (Fig. 4b–d). Scaphocerite has the disto-lateral teeth either not extending beyond or overreaching the distal margin of the lamina (Fig. 4e, f).

DISTRIBUTION: North Pacific from the Chukchi Sea to the Sea of Japan and to British Columbia; North Atlantic from the Hudson Bay, Foxe Basin and west Greenland to Cape Cod; 4–275 m [Squires, 1990]; up to 630 [Butler, 1980]. In the references area *E. fabricii* was collected at depth between 51 and 80 m (water temperature 0.44–1.84°C and salinity 32.57–32.9 p.p.t.).

BIOLOGY. All females were mature and had well developed gonads. Other species of decapod taken in the same catches were *Chionoecetes opilio*, *Hyas coarctatus*, *Pandalus goniurus*, *Labidochirus splendescens*, *Neocrangon dalli, Sclerocrangon salebrosa*.

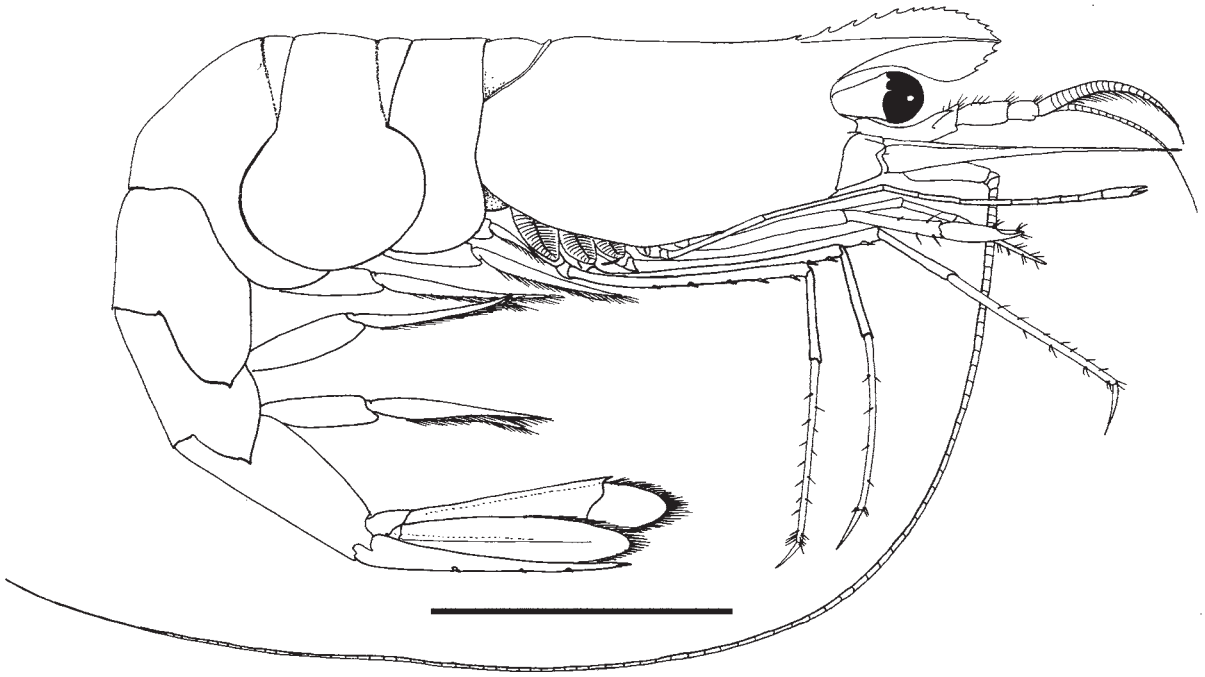

Fig. 5. *Eualus macilentus* (Kröyer, 1842). Non-ovigerous ♀ (CL 10.5 mm). Entire animal in lateral view. Scale 1 cm.
Рис. 5. *Eualus macilentus* (Kröyer, 1842). Общий вид самки сбоку (ДК 10,5 мм). Масштаб 1 см.

Eualus macilentus (Kröyer, 1842)
Fig. 5.

MATERIAL. 3 ♂♂ (CL from 5.0 to 7.8 mm), 10 non-ovigerous ♀♀ (CL from 4.0 to 10.5 mm).

LOCALITY. Haul #6, 47, 51, 52; Dredge # 25, 33, 37, 39, 40.

DISTRIBUTION. North Pacific from Chukchi Sea to the Peter the Great Bay (Sea of Japan) and to the Bristol Bay (Alaska) [Vinogradov, 1950]; in the West Atlantic from Hudson Bay, Fox Channel and Greenland to Nova Scotia; 55–540 m [Squires, 1990]. The northernmost record is in the Chukchi Sea at 72º56′N [Sivertsen, 1932].

In the references area shrimps were found between 55 and 200 m depths, within a water temperature range of 0.21–1.53ºC and a salinity range of 32.67–33.59 p.p.t.

Cohabitant species included *Pandalus goniurus*, *Hyas coarctatus*, *Labidochirus splendescens*, and *Pagurus trigonocheirus*.

Eualus pusiolus (Kröyer, 1841)
Fig. 6.

MATERIAL. 1 ♂ (CL 3.2 mm)

LOCALITY. Dredge # 43.

DISTRIBUTION. North Pacific from Bering Sea to British Columbia and Washington in North-West America and to the Sea of Japan in Asia [Butler, 1980; Williams, 1984; Squires, 1990]; Arctic region and North Atlantic from the Barents Sea to Channel Islands and Catalonian coast of Spain (Mediterranean) in Europe, and from Gulf of St. Lawrence to Virginia in North–East [Williams, 1984; Squires, 1990]; 0–500 m [Holthuis, 1947].

A single specimen was caught at 85 m depth, water temperature was 0.44ºC and salinity equaled to 32.7 p.p.t.

Genus *Lebbeus* White, 1847

Lebbeus groenlandicus (Fabricius, 1775)
Fig. 7.

MATERIAL. 2 ♂♂ (CL 13.2 and 13.7 mm).

LOCALITY. Haul # 40, 52.

VARIABILITY. Squires [1990] noted that the abdominal pleurae of the shrimps from the Eastern Canadian coast have 3, 1, 2, 2, 2, 1 ventral spines on respectively 1st to 6th somites. In the Sea of Okhotsk shrimps have not less than two spines on the pleurae 1–5 [Vinogradov, 1950]. Our two males have pleurae 1–5 with 2–5 spines as it was noted by Vinogradov [1950].

DISTRIBUTION. Southern part of the Chukchi Sea through the Bering Sea to Puget Sound and to Vladivostok (Sea of Japan); Hudson Bay to Greenland and south to Rhode Island; Arctic Canada and Alaska [Squires, 1990]. Depth 2–314 m [Williams & Wigley, 1977; Squires, 1990], up to 518 m [Butler, 1980].

The species usually present in the same catches comprised of *Chionoecetes bairdi*, *Neocrangon dalli*, *Pandalus goniurus*, *Hyas coarctatus*, *Sclerocrangon salebrosa*, and *Spirontocaris murdochi*.

Genus *Spirontocaris* Bate, 1888

Spirontocaris murdochi Rathbun, 1902
Fig 8.

MATERIAL. 14 ♂♂ (CL 4−9 mm), 119 non-ovigerous ♀♀ (CL 4.1−10.2 mm), 3 ovigerous ♀♀ (8.9−10.3 mm).

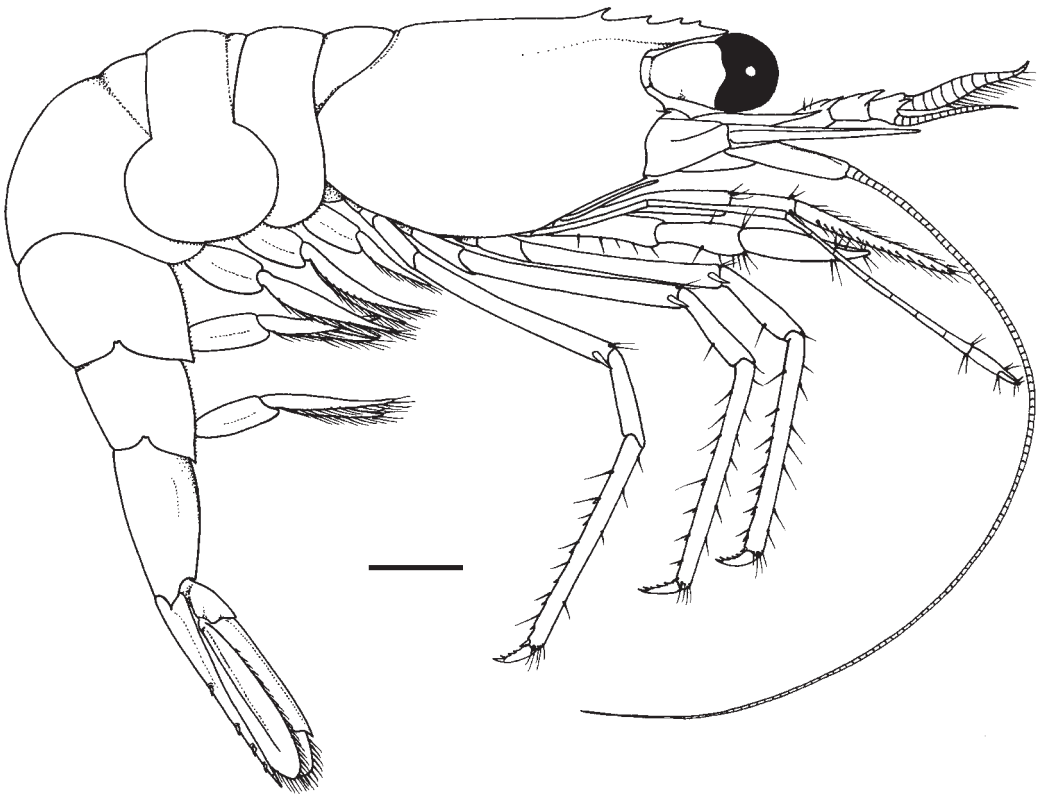

Fig. 6. *Eualus pusiolus* (Krøyer, 1841). ♂ (CL 3.2 mm). Entire animal in lateral view. Scale 1 mm.
Рис. 6. *Eualus pusiolus* (Krøyer, 1841). Общий вид самца сбоку (ДК 3,2 мм). Масштаб 1 мм.

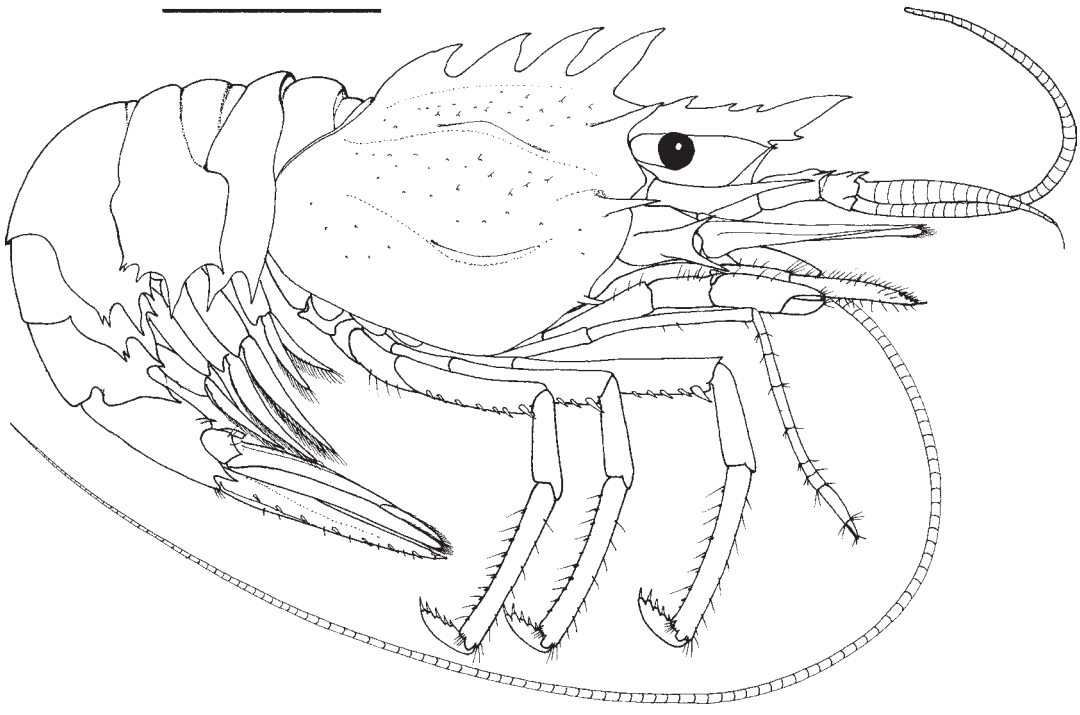

Fig. 7. *Lebbeus groenlandicus* (Fabricius, 1775). ♂ (CL 13.7 mm). Entire animal in lateral view. Scale 1 cm.
Рис. 7. *Lebbeus groenlandicus* (Fabricius, 1775). Общий вид самца сбоку (ДК 13,7 мм). Масштаб 1 см.

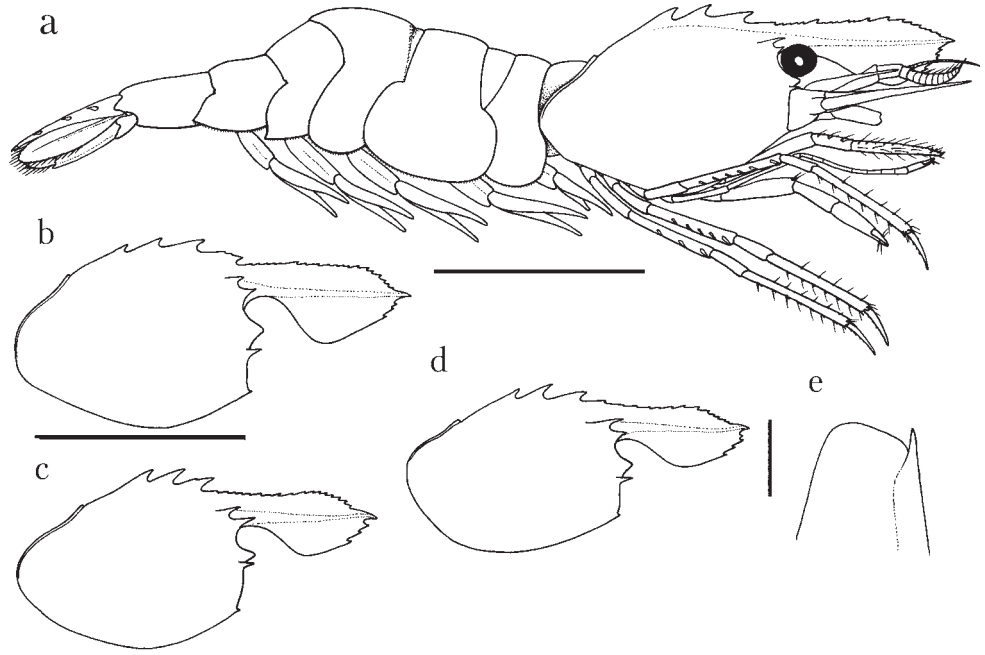

Fig. 8. *Spirontocaris murdochi* Rathbun, 1902: a — entire animal in lateral view; b–d — shape of the rostrum; e — distal part of scaphocerite. a, e — non-ovigerous ♀ (CL 9.1 mm); b — non-ovigerous ♀ (CL 8.8 mm); c — non-ovigerous ♀ (CL 8.7 mm); d — non-ovigerous ♀ (CL 8 mm). Scale 1 cm (a–d), 1 mm (e).

Рис. 8. *Spirontocaris murdochi* Rathbun, 1902: a — общий вид сбоку; b–d — форма карапакса и рострума (вид сбоку); e — форма передней части скафоцерита. a, e — самка без яиц (ДК 9,1 mm); b — самка без яиц (ДК 8,8 mm); c — самка без яиц (ДК 8,7 mm); d — самка без яиц (ДК 8 mm). Масштаб 1 см (a–d), 1 мм (e).

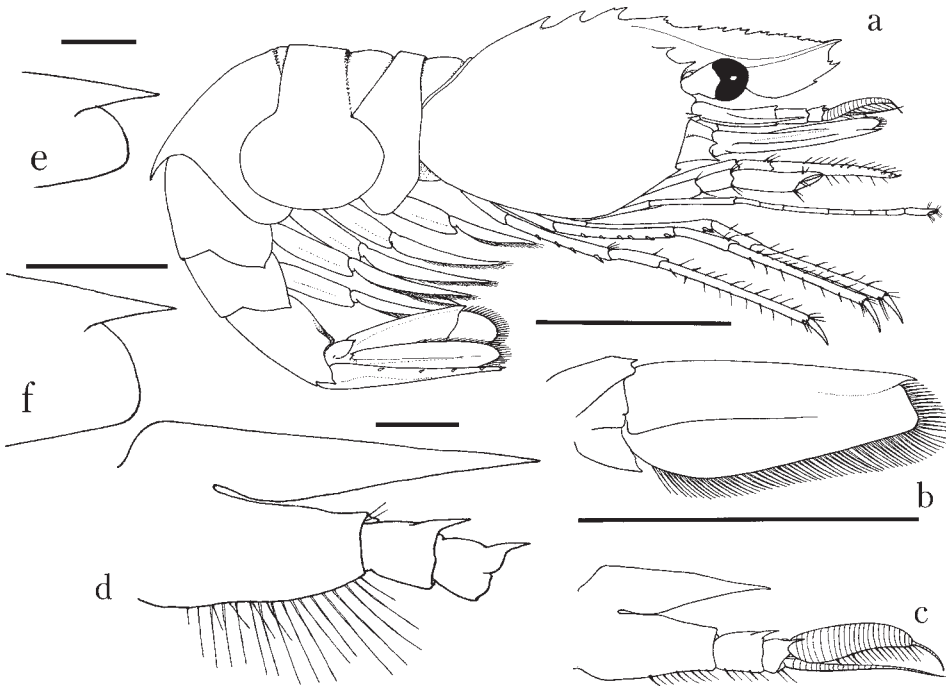

Fig. 9. *Spirontocaris spinus intermedia* Makarov, 1941(a–c) and *Spirontocaris spinus* (d–f): a — entire animal in lateral view; b — scaphocerite; c — antennule; d — antennular peduncle; e, f — distal part of scaphocerite. a–d — non-ovigerous ♀♀ (CL 11.7 mm); e — ♂ (CL 9.5 mm); f — non-ovigerous ♀ (CL 11 mm). Scale 1 cm (a–c), 1 mm (d–f).

Рис. 9. *Spirontocaris intermedia* Makarov, 1941(a–c) and *S. spinus* (d–f): a — общий вид *S. intermedia* сбоку; b — форма скафоцерита *S. intermedia*; c — первая антенна *S. intermedia*; d — форма стебелька первой антенны *S. spinus*; e, f — форма передней части скафоцерита *S. spinus*. a–d — самка без яиц (ДК 11,7 мм); e — самец (ДК 9,5 мм); f — самка без яиц (ДК 11 мм). Масштаб 1 см (a–c), 1 мм (d–f).

LOCALITY. Haul # 30, 34, 38, 39, 40, 42, 47, 51, 52, 53, 54, 58; Dredge # 17, 18, 24, 33, 34, 37, 38, 39, 43, 44, 45.

REMARKS ON MORPHOLOGY. The shapes of rostrum and middorsal spines vary considerably (Fig. 8b–d). Rostrum is armed with 12–19 irregular teeth on the upper margin and with 3–6 teeth on the lower margin. The dorsal carina of carapace with 3 or 4 large spines. The anteriormost middorsal spine of carapace sometimes has 1–2 accessory spinules. The midaxis is straight in all examined specimens, except three females. These three shrimps (CL 8–9 mm) have midaxis slightly curved upward. The ratio "propodus length/ dactylus length" varies between 2.3 and 3.1 in females and between 1.4 and 2.5 in males.

DISTRIBUTION. Arctic coast of Alaska, the Chukchi Sea through the Bering Sea to the Sea of Japan [Kobjakova, 1937; Vinogradov, 1950; Hayashi, 1977].

In the references area shrimps were found at depth between 51 and 152 m (water temperature 0.24–1.84ºC and salinity 32.57–33.59 p.p.t.).

BIOLOGY. The percentage of ovigerous females was low (2.4%), but most other females (61%) were with eggs ready to be laid. This species was frequently co-occurred with *Hyas coarctatus*, *Labidochirus splendescens*, *Pagurus trigonocheirus*, *Pandalus goniurus*, and *Argis lar*.

Spirontocaris intermedia Makarov in Kobjakova, 1936

Fig. 9a–c.

MATERIAL. 6 non-ovigerous ♀♀ (CL 8.1−10.9 mm).

LOCALITY. Haul # 32, 43.

REMARKS ON MORPHOLOGY. The shape of rostrum varies consideraly. In all specimens examined, a large tooth is present on the lower margin of rostrum, which extends anteriorly nearly to the tip of rostral midaxis. Midaxis is straight or slightly curved upward. The middorsal carina of carapace is armed with 3 to 5 large spines. The anteriormost one or two teeth are armed with a few secondary teeth. The upper margin of rostrum with many (12–18) small irregular teeth. Stylocerite reaches to or slightly projects beyond the second segment of antennular peduncle (Fig. 9c). The ratio of the propodus length to dactylus length is 3.2–4.1.

DISCUSSION. Makarov [1941] described a new subspecies *S. spinus intermedia* based on the numerous specimens from the Bering and the Chukchi seas. However, a diagnosis of this subspecies was given in the paper by Kobjakova [1936] with the reference to Makarov's unpublished paper. Russian authors [e.g. Kobjakova, 1937; Vinogradov, 1947, 1950] accepted this taxon. Kobjakova [1937] separated the Pacific subspecies from the typical *S. spinus* (Sowerby, 1805) by the following characters: 1) low carapace carina; 2) less produced posterodorsal margin of the third abdominal somite; 3) longer rostrum; 4) shape of the second abdominal pleura; 5) longer sixth abdominal somite.

Hayashi [1977] did not recognize this subspecies. He examined 17 specimens from the Sea of Japan and the Sea of Okhotsk and 5 specimens of *S. spinus* from the Atlantic coast of Canada and concluded that most diagnostic characters of the Pacific subspecies which were used by Kobjakova [1937] are poorly expressed and variable.

However, the present study indicates that there are another differences between typical *S. spinus* and the Pacific counterpart, which were discussed neither by Kobjakova [1936, 1937] nor Hayashi [1977]. I examined 223 specimens (60 ♂♂ and 163 ♀♀) of *S. spinus* from the Norwegian and the Barents Seas from the ZMMU collection. The Pacific form is distinct from the Atlantic *S. spinus* in the following particulars: 1) stylocerite reaches to or is slightly produces beyond the second segment of antennular peduncle in the Pacific specimens (Fig. 9c) while in the *S. spinus* stylocerite is distinctly overreaching antennular peduncle (Fig 9d); 2) in the Pacific shrimps distolateral tooth of scaphocerite reaches only the distal margin of the blade (Fig. 9b) while in the *S. spinus* the distolateral tooth distinctly overreaches the blade (Fig. 9e, f). Makarov [1941] used the former character to separate a new subspecies and Vinogradov [1950] utilized the latter in the identification key. These two characters do not vary in all examined specimens.

Five specimens of *S. spinus* from the Atlantic coast of Canada which were studied by Hayashi [1977] had stylocerite not extending beyond the second segment of the antennular peduncle. Squires [1990] noted that *S. spinus* have "stylocerite with attenuate sharp point reaching farther than distal 3rd article". In our material all specimens from the North Atlantic have a long slylocerite, and the specimens from the Sea of Okhotsk always have a short one. Otherwise Makarov [1966] noted, that the larvae of the Pacific form could be distinctly separated from the larvae of the other *Spirontocaris* species. Therefore, the concept of *S. spinus* in the North Atlantic and the related Pacific species *S. intermedia* is rather well substantiated.

DISTRIBUTION. From the Chukchi Sea to the Sea of Okhotsk and to Kodjak; 27–230 m depth [Vinogradov, 1950].

In the shelf of West Kamchatka shrimps were collected at depth between 150 and 245 m (water temperature between 0.79 and 1.67ºC and salinity 32.87–33.36 p.p.t.).

BIOLOGY. CL in females reaches to 10.9 mm. All examined females were with prolipherated oocytes clearly visible through carapace. Other species of decapod taken in the same catches were *Chionoecetes opilio*, *C. bairdi*, *Pagurus trigonocheirus*, and *Argis ochotensis*.

Spirontocaris brevidigitata Kobjakova, 1935

Fig. 10.

MATERIAL. 14 non-ovigerous ♀♀ (CL from 6.2 to 12.9 mm), 2 ♂♂ (CL from 5.8 to 6.5 mm).

LOCALITY. Haul # 30, 31, 39, 49.

REMARKS ON MORPHOLOGY. The midaxis of rostrum is slightly curved upward (Fig. 10a, b). The middorsal carina of carapace is armed with 4 to 5 large spines. The anteriormost rostral tooth is armed with 1 to 2 secondary teeth. The upper margin of rostrum is armed with 6 to 9 teeth. Sometimes dorsal teeth of rostrum armed with one-two small secondary teeth (Fig. 10a). The ratio of the propodus length to dactylus length ranges 3.0 and 4.12.

DISCUSSION. Kobjakova [1935] described *S. brevidigitata* from the Sea of Japan and Vinogradov [1947, 1950] later accepted this taxon. Hayashi [1977] considered *S. brevidigitata* as a junior synonym of *Spirontocaris spinus*. These two species may be separated, however, by the following characters: 1) in *S. spinus* stylocerite distinctly extends beyond the antennular peduncle (Fig. 9d), while in *S. brevidigitata* stylocerite only reaches the third segment of antennular peduncle (Fig. 10d); 2) in *S. spinus* a large tooth is present on the lower margin of rostrum, which extends anteriorly to the tip of the rostrum midaxis, while in *S. brevidigitata* the midaxis distinctly overreaches the teeth on the lower margin of rostrum (Fig. 10a, b); 3) in *S. spinus* there are much more small teeth on the upper margin of rostrum than in *S. brevidigitata*; 4). in

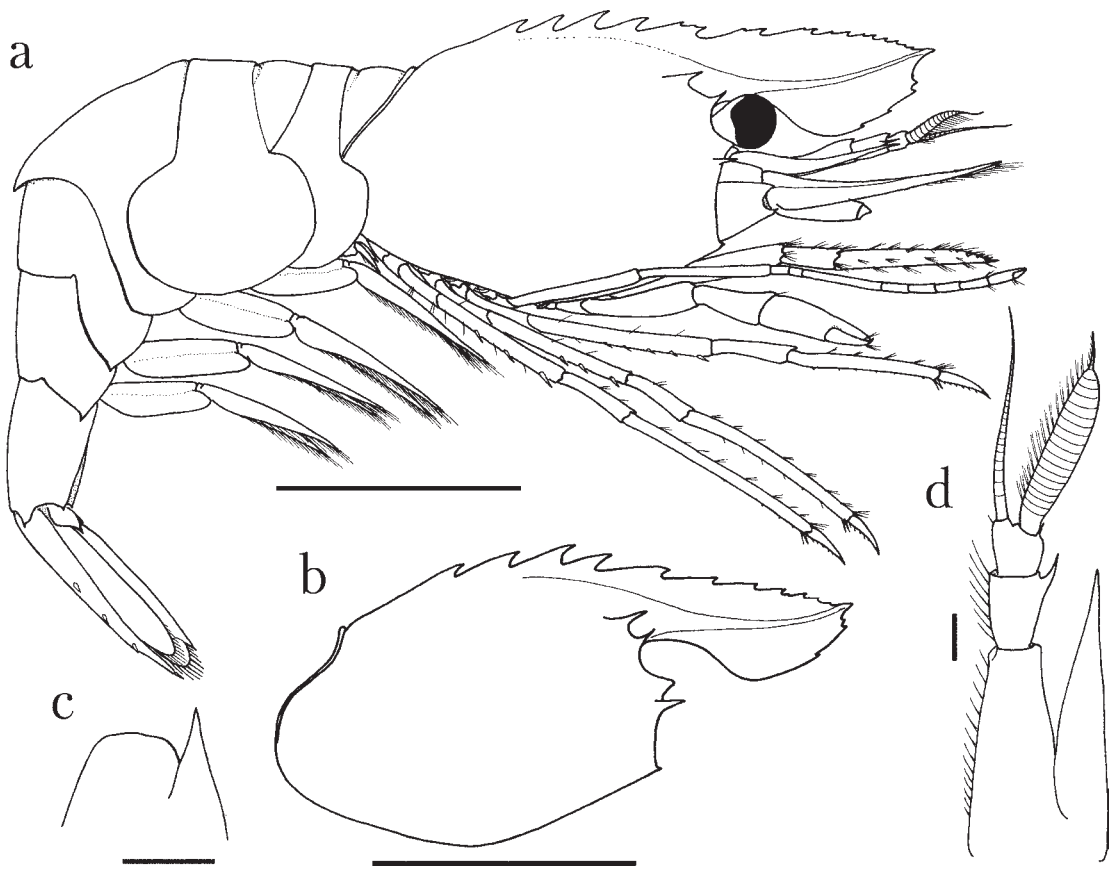

Fig. 10. *Spirontocaris brevidigitata* Kobjakova, 1935, non-ovigerous ♀: a — entire animal in lateral view; b — shape of rostrum and carapace; c — distal part of scaphocerite; d — antennule. a, c, d — CL 11.8 mm; b — CL 9.3 mm. Scale 1 cm (a, b), 1 mm (c, d).

Рис. 10. *Spirontocaris brevidigitata* Kobjakova, 1935, самка без яиц: a — общий вид сбоку; b — форма рострума и карапакса (вид сбоку); c — форма переднего края скафоцерита; d — первая антенна. a, d, c — ДК 11,8 мм; b — ДК 9,3 мм. Масштаб 1 см (a, b), 1 мм (c, d).

S. brevidigitata the posterodorsal margin of the third somite is less produced than in *S. spinus*.

S. brevidigitata differs from *S. spinus intermedia* in the shape of rostrum and the number of teeth on its upper margin.

DISTRIBUTION. Sea of Japan [Kobjakova, 1937; Vinogradov, 1950]. Our records of this species in the Sea of Okhotsk considerably widen the range of *S. brevidigitata*. The bathymetric range of *S. brevidigitata* ranges between 60 (present study) and 1380 m [Kobjakova, 1937].

Off West Kamchatka the species occurs at the depth range from 60 to 251 m (water temperature 0.97–1.55ºC and salinity 32.38–33.23 p.p.t.).

BIOLOGY. Most of the collected females (88%) were with prolipherated oocytes. The species cohabitant were *Chionoecetes opilio*, *C. bairdi*, *Pagurus trigonocheirus*, *Crangon communis*, and *Argis ochotensis*.

FAMILY CRANGONIDAE HAWORTH, 1825

Genus *Argis* Kröyer, 1842

Argis dentata (Rathbun, 1902)

MATERIAL. 2 non-ovigerous ♀♀ (CL 18.7 and 19.2 mm), 1 ovigerous ♀ (CL 20.8 mm).

LOCALITY. Haul # 3

REMARKS ON MORPHOLOGY. The ratio of the palm of first pereiopod length to width varies from 3.9 to 4.8. As it was noted by Komai [1997], the armature of the fourth abdominal pleuron is variable. Two females, which were collected near West Kamchatka, have broadly rounded pleurae of the fourth abdominal somite. Fourth abdominal pleurone of the third female bears a small sharp posteroventral tooth.

DISTRIBUTION. Arctic Ocean from the Cambridge Bay through the Beaufort Sea and the Bering Sea to San Juan Islands (Washington) in the East Pacific [Butler, 1980; Squires, 1990] and to the southeast coast of Kamchatka and the Sea of Okhotsk in the Western Pacific [Komai, 1997]; from the Canadian Arctic and northwestern Greenland to Nova Scotia in the North Atlantic [Squires, 1990]; subtidal to about 200 m [Komai, 1997]. In the references area the species was found at 20 m depth (water temperature 6.24ºC and salinity 32.6 p.p.t).

Argis lar (Owen, 1839)

MATERIAL. 143 non-ovigerous♀♀ (CL from 6.1 to 24.3 mm), 51 ovigerous♀♀ (CL from 15.8 to 24 mm), 51 ♂♂ (CL 7.0−14.3 mm).

LOCALITY. Haul 3, 6, 30, 34, 39, 40, 42, 45, 48, 51, 53, 54; Dredge # 4, 11, 17, 24, 25, 29, 33, 37, 38, 39, 42, 43, 44, 45.

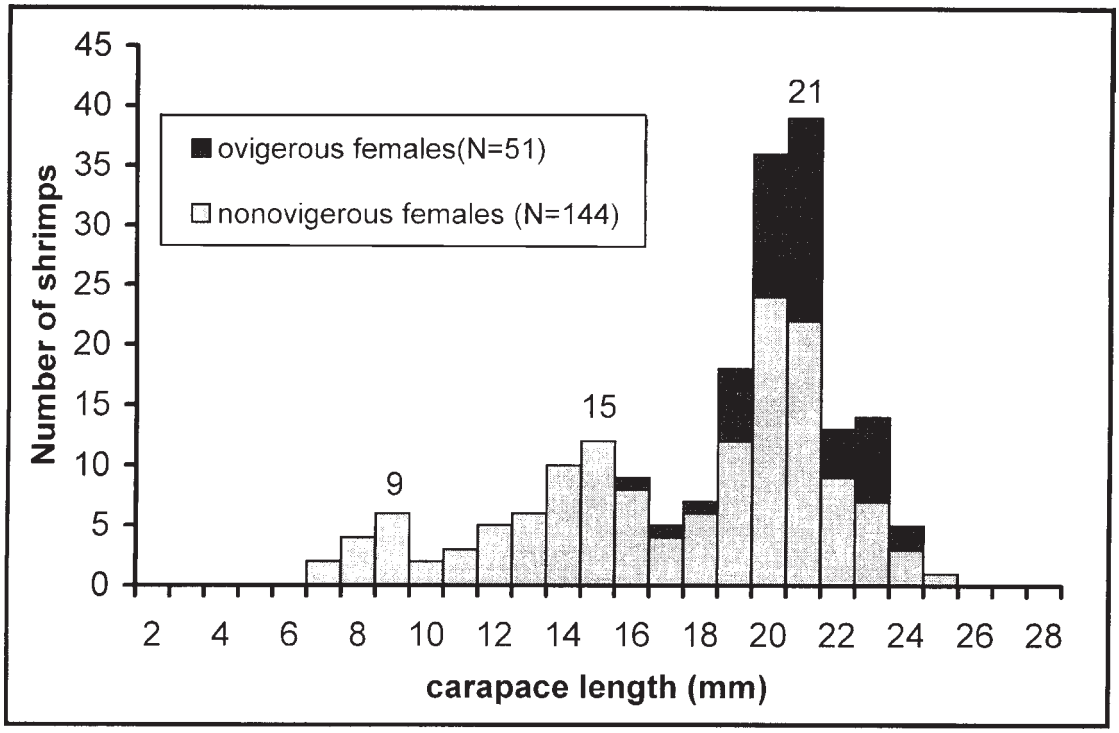

Fig. 11. *Argis lar* (Owen, 1839). Carapace length frequency distributions of females; the number of specimens in parentheses.
Рис. 11. Гистограмма размерного состава самок *Argis lar* (Owen, 1839). В скобках указано число особей.

VARIABILITY. The ratios of the propodus length to width in the 1st pereiopod varies from 3.9 to 4.8 in females and from 2.95 to 4.12 in males. The armature of the fourth abdominal pleuron is variable: in the overwhelming majority of specimens the fourth pleurone is rounded, but in one specimen (CL 9.3 mm) the fourth pleurone has a small posteroventral tooth, in another female (CL 18.8 mm) pleuron was produced on the left side and has a proximo-ventral tooth on the right side.

DISTRIBUTION. The North Pacific only: from Point Barrow through the Bering Sea to Sitka and to Peter the Great Bay (Sea of Japan) [Makarov, 1941; Butler, 1980]; 0–400 m depth [Vinogradov, 1950]. In the references area the species was common at depth between 51 and 295 m (water temperature 0.21–1.87ºC and salinity 32.57–33.39 p.p.t.).

BIOLOGY. Large-size females with CL from 18.0 to 23.5 mm dominated in the samples. Three clear-cut size groups with CL modes of respectively 9, 15 and 21 mm can be detected in the carapace length frequency distribution (Fig. 11). The mimimum CL of ovigerous females is 14.8 mm. Ca. 26% of females were ovigerous.

Co-occurring species were mostly *Pandalus goniurus*, *Chionoecetes opilio*, *Hyas coarctatus*, *Pagurus trigonocheirus*, *Labidochirus splendescens*, and *Spirontocaris murdochi*.

Argis ovifer (Rathbun, 1902)

MATERIAL. 5 non-ovigerous ♀♀ (CL 16.7−19.3 mm)
LOCALITY. Haul # 17, 30, 33.

VARIABILITY. The ratios of the palm of first pereiopod length to width varies between 3.3 to 3.6.

DISTRIBUTION. From the North Pacific only: from the Bering Sea to the Queen Charlotte Sound, British Columbia along the America coast [Butler, 1980; Komai, 1997] and to the Sea of Okhotsk along the Asian coast; 100–293 m [Makarov, 1941; Vinogradov, 1947; 1950; Komai, 1997]. In the references area the species was collected at depth between 60 and 147 m (water temperature 1.15–2.02ºC and salinity 32.73–33.97 p.p.t.).

BIOLOGY. CL in females reaches to 19.3 mm. The species frequently occures with *Hyas coarctatus*, *Pagurus trigonocheirus*, *Pandalus goniurus*, and *Paralithodes camtschaticus*.

Argis cf. *ochotensis* Komai, 1997

MATERIAL. 11 ovigerous ♀♀ (CL 24.1−28.2 mm), 34 non-ovigerous ♀♀ (CL 9.3−27.8 mm), 12 ♂♂ (CL 6.5−26.2 mm).
LOCALITY. Haul # 9, 31, 32, 37, 43, 45, 49, 56.

REMARKS ON MORPHOLOGY. The ratio of the palm of the first pereiopod length to width ranges between 4.13 and 5.38 in females and from 3.75 and 5.14 in males. The number of articles composing the outer flagellum varies from 15 to 25 in females and 19–22 in males. The ratio of the scaphocerite length to width varies from 2.41 to 3.36 in females and from 2 to 2.63 in males.

DISCUSSION. Our specimens resemble both *A. ochotensis* and *A. toyamaensis* [Yokoya, 1933] by the follow characters: 1) the posterodorsal margin of the fifth abdominal somite produced posteriorly in form of an acute tooth; 2) carapace with two median spines; 3) the submedian carinae on the sixth abdominal somite nearly parallel; 4) the propodus of the female 1st pereiopod being more than 4 times as long as wide; 5) rostrum with an acute or subacute apex; 6) the propodi of the 3rd to the 5th pereiopods lacking extensor lateral ridge, and 7) scaphocerite being than 2.4 times as long as wide. The present

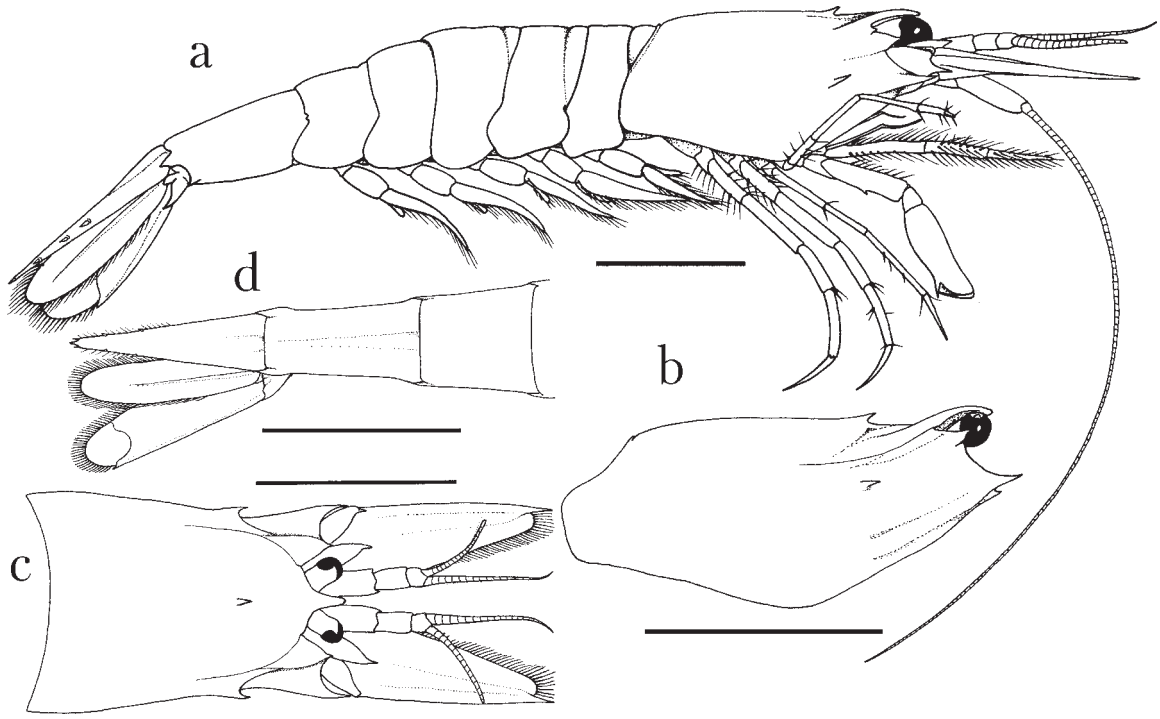

Fig. 12. *Crangon septemspinosa* Say, 1818. Non-ovigerous ♀ (CL 12.8 mm): a — entire animal in lateral view; b — carapace in lateral view; c — carapace in dorsal view; d — telson and sixth abdominal segment in dorsal view. Scale 1 cm.

Рис. 12. *Crangon septemspinosa* Say, 1818. Самка без яиц (ДК 12,8 мм): a — общий вид сбоку; b — форма карапакса (вид сбоку); c — форма карапакса (вид сверху); d — форма тельсона и шестого сегмента абдомена (вид сверху). Масштаб 1 см.

material differ from *A. toyamaensis* by a long stylocerite (in *A. toyamaensis* the stylocerite does not reach to the middle of the proximal segment of antennular peduncle, while in our specimens it is produced beyond it) and by the coloration of living specimens (in our specimens the body is generally light brown, without tints on the pleural margins of the first to fifth abdominal somite which are usually present in *A. toyamaensis* [Komai, 1997]). The sculpture of the body integument is relatively stronger in *A. toyamaensis* than in our specimens.

DISTRIBUTION. Sea of Okhotsk; depth greater than 600 m [Komai, 1997]. In the references area the shrimps were found at depth between 150 and 295 m (water temperature 0.79–1.81ºC and salinity 32.87–33.36 p.p.t.).

BIOLOGY. CL in females reaches up to 28.2 mm, in males it amounts up to 26.2 mm. Large females dominated in the samples. Ca. 25% of females were ovigerous.

Common co-occuring species were *Chionoecetes opilio*, *Labidochirus splendescens*, *Pagurus trigonocheirus*, *Pandalus borealis*, and *Crangon communis*.

Genus *Crangon* Fabricius, 1798

Crangon septemspinosa Say, 1818
Fig. 12.

MATERIAL. 1 non-ovigerous ♀ (CL 12.8 mm)

LOCALITY. Dredge # 20

DISTRIBUTION. From the Gulf of St. Lawrence to east Florida in North Atlantic; from the Arctic coast of Alaska to Shumagin Islands and from the northern part of the Sea of Okhotsk to Peter the Great Bay in the North Pacific [Vinogradov, 1950]. Distributed in the depth range of 0–27 m in North Pacific [Vinogradov, 1950] and between 0 and 90 m in North Atlantic [Squires, 1990]. Our single specimen was collected at depth 22 m (water temperature 4.72ºC, salinity 32.21 p.p.t.).

Crangon communis (Rathbun, 1902)
Fig. 13–16.

MATERIAL. 52 ♂♂ (CL 5.1−14.9 mm), 12 ovigerous ♀♀ (CL 11.5−13.8 mm), 102 non-ovigerous ♀♀ (CL 8−16.4 mm).

LOCALITY. Trawl # 6, 18, 30, 31, 36, 37, 38, 39, 42, 43, 45, 47, 49, 50, 51, 54, 55, 56, 58; Dredge # 9, 14, 16, 17, 24, 25, 27, 28, 29, 34, 35, 38, 39, 43, 44.

VARIABILITY. Rostrum usually extends beyond eyes (Fig. 13b, c), but in a 30% of specimens it does not reach eyes (Fig. 13a). Most of our specimens have unarmed pleurae of the 4th abdominal somite. In three specimens 4th pleura has proximo-ventral tooth.

DISTRIBUTION. From 71º17′N (Chukchi Sea) [Makarov, 1941], through Bering Sea to San Diego in North America and to Peter the Great Bay and Eastern coast of Honshu Island (Sea of Japan); 16–1537 m depth [Butler, 1980].

In the references area shrimps were found at depth between 37 and 295 m, (water temperature 0.21–2.8ºC and salinity 32.66–33.39 p.p.t.).

BIOLOGY. Females dominated in the catches. Small-size females (CL <9 mm) were scarce (Fig. 16b). The size distributions of males and females show that males dominated in small-size groups and females prevailed in large-size groups (Fig. 16). The scarcity of small females suggests a possible case of protandric hermaphroditism which was supposed for

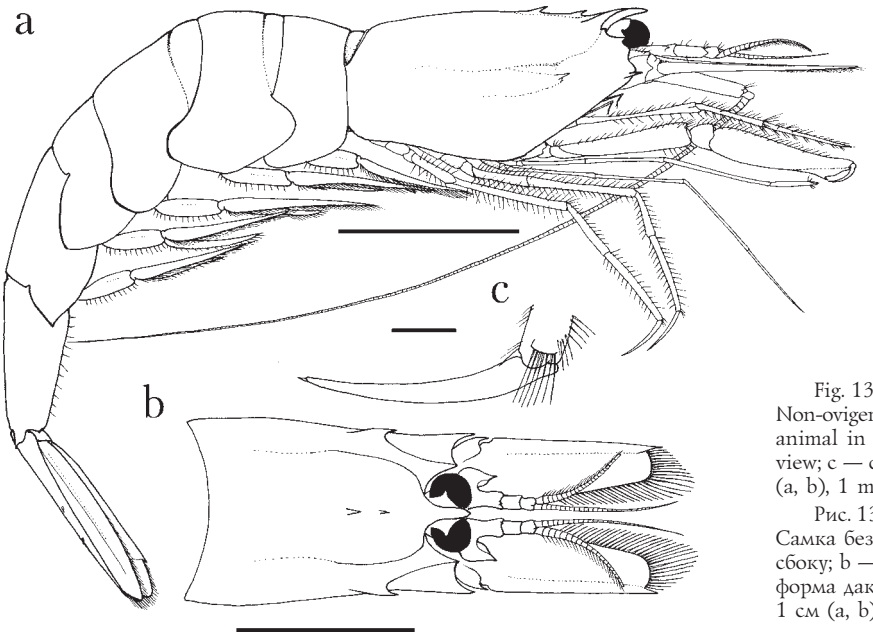

Fig. 13. *Crangon communis* (Rathbun, 1902). Non-ovigerous ♀ (CL 13.7 mm): a — entire animal in lateral view; b — carapace in dorsal view; c — dactylus of fifth pereiopod. Scale 1 cm (a, b), 1 mm (c).

Рис. 13. *Crangon communis* (Rathbun, 1902). Самка без яиц (ДК 13,7 мм): a — общий вид сбоку; b — форма карапакса (вид сверху); c — форма дактилюса пятого переопода. Масштаб 1 см (a, b), 1 мм (c).

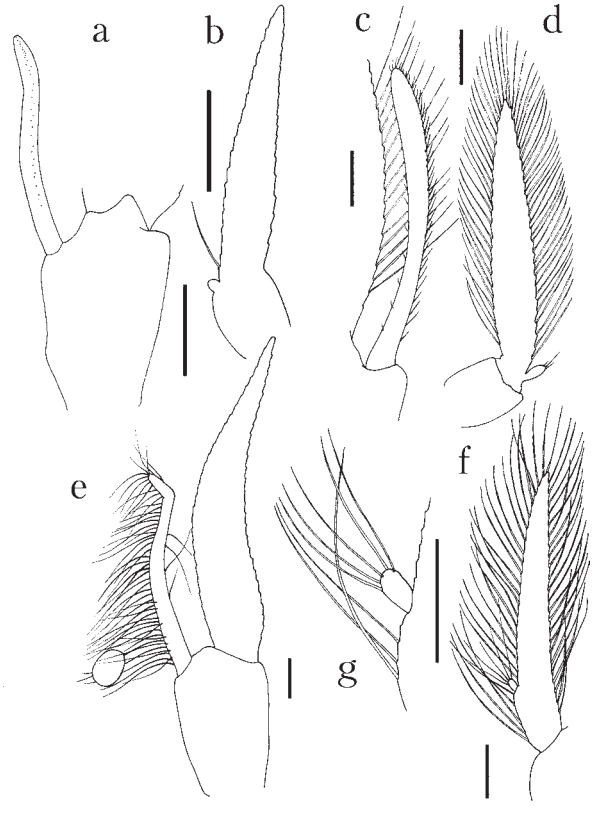

Fig. 14. First (a, c, e) and second endopodite (b, d, f) and *a. interna* on the second endopodite of females *Crangon communis* (Rathbun, 1902): a, b — non-ovigerous ♀ (CL 8.7 mm); c, d — non-ovigerous ♀ (CL 13.7 mm); e–g — ovigerous ♀ (CL 12.8 mm). Scale 1 mm.

Рис. 14. Форма эндоподитов первой (a, c, e) и второй пары плеопод (b, d, f) и *a. interna* на втором эндоподите самок *Crangon communis* (Rathbun, 1902): a, b — самка без яиц (ДК 8,7 мм); c, d — самка без яиц (ДК 13,7 мм); e–g — самка с яйцами на плеоподах (ДК 12,8 мм). Масштаб 1 мм.

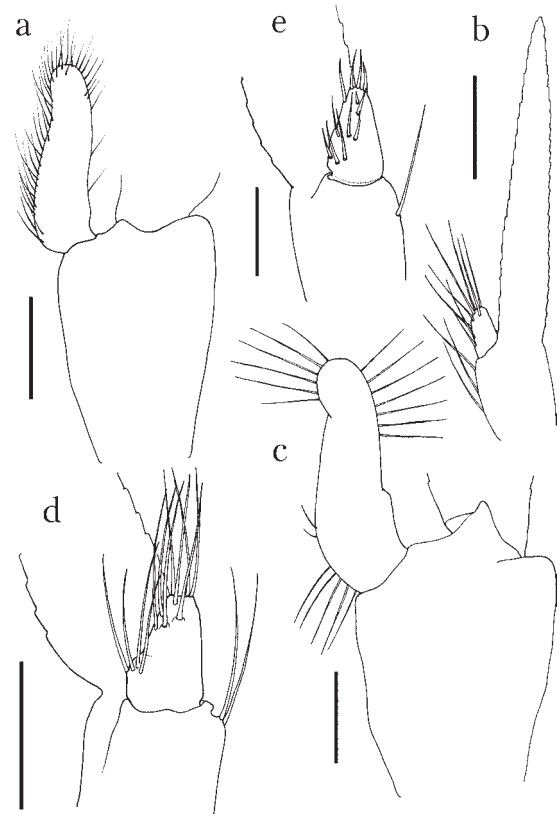

Fig. 15. First endopodite (a, c) and *a. masculina* (b, d, e) of males *Crangon communis* (Rathbun, 1902): a, b — CL 8.5 mm; c, d — CL 9.7 mm; e — CL 14 mm. Scale 1 mm.

Рис. 15. Форма эндоподита первых плеопод (a, c) и *a. masculina* (b, d, e) у самцов *Crangon communis* (Rathbun, 1902): a, b — ДК 8,5 мм; c, d — ДК 9,7 мм; e — ДК 14 мм. Масштаб 1 мм.

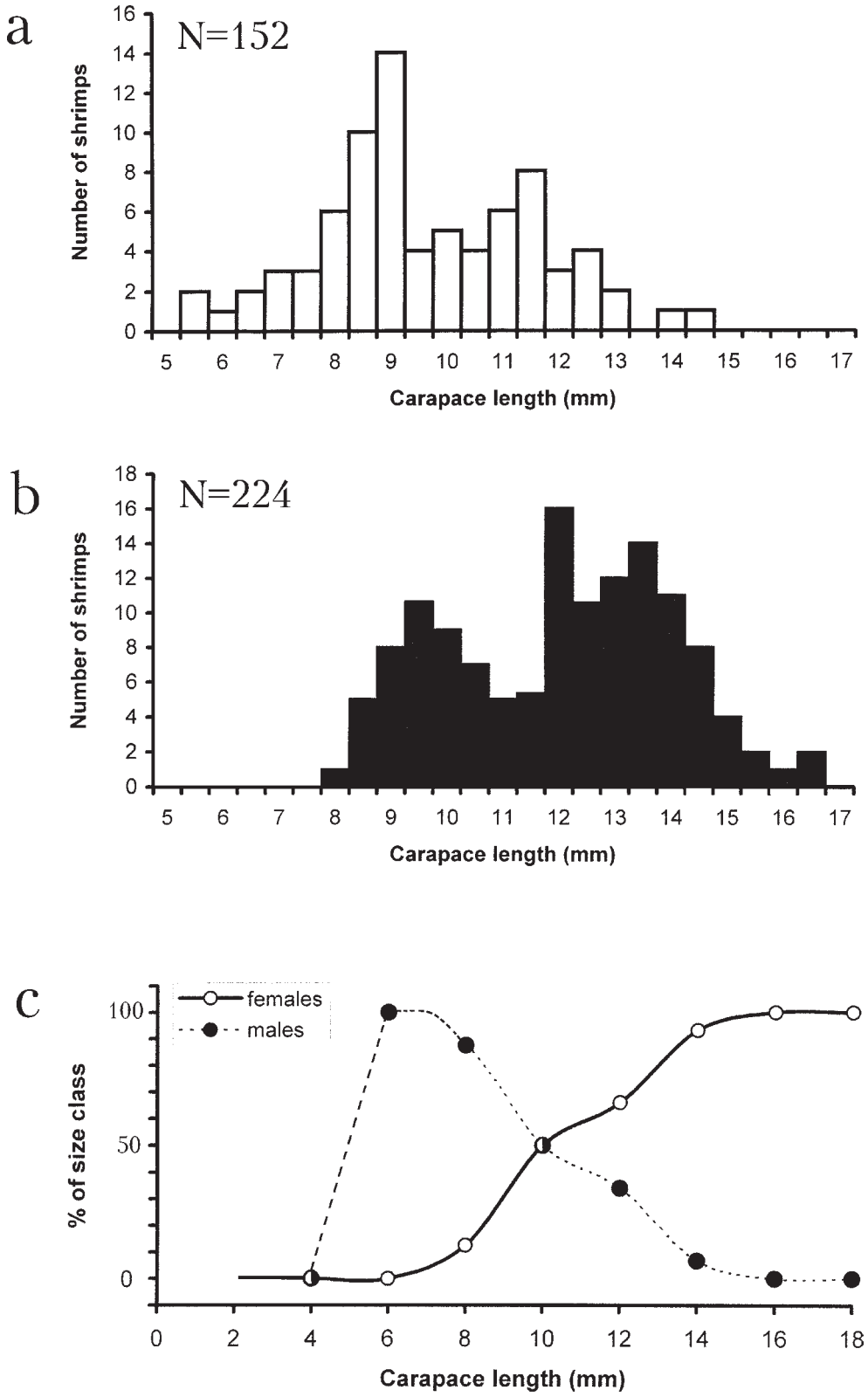

Fig. 16. Carapace length frequency distribution of males (a) and females (b) *Crangon communis* (Rathbun, 1902) and size specific sex ratio of shrimp samples at July 1996.

Рис. 16. Гистограммы размерного состава самцов (a) и самок (b) *Crangon communis* (Rathbun, 1902) и кривые доли особей разных полов в пробах в июле 1996 г.

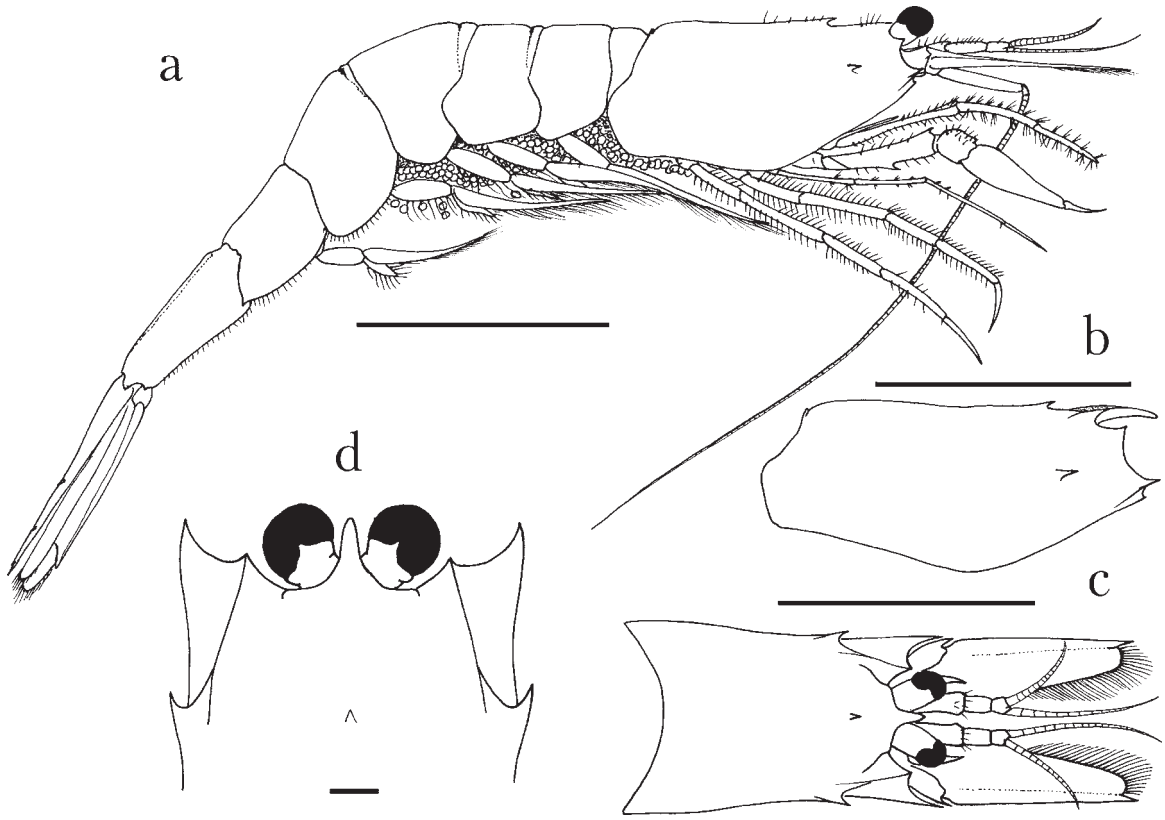

Fig. 17. *Crangon dalli* (Rathbun, 1902): a — entire animal in lateral view; b–c — carapace in lateral (b) and dorsal (c) views; d — anterior part of carapace in dorsal view. a, c — ovigerous ♀ (CL 10.3 mm); b, d — non-ovigerous ♀ (CL 13.5 mm). Scale 1 cm (a–c), 1 mm (d).

Рис. 17. *Crangon dalli* (Rathbun, 1902): a — общий вид сбоку; b — форма карапакса (вид сбоку); c — форма передней части карапакса (вид сверху); d — форма карапакса (вид сверху). a, c — самка с яйцами на плеоподах (ДК 10,3 мм); b, d — самка без яиц (ДК 13,5 мм). Масштаб 1 см (a–c), 1 мм (d).

some crangonid species [Fréchette et al., 1970; Boddeke et al. 1991]. The graph of size specific sex ratio (Fig. 16c) shows the rapid decrease in the percentage of males in the classes greater than 10 mm and scarcity of females below this size.

Figures 14 and 15 show the development of secondary sexual characters of females and males respectively. The endopodite of the first pleopod gradually increases in size throughout the life of females (Fig. 14a, c, e). Small females with CL 8–9 mm have only rudiments of setae on the first endopodite. Ovigerous females have endopodite of first pleopod with long and feathery setae adapted for the attachment of eggs (Fig. 14e).

Appendix interna on the endopodite of the second pleopod of a small female looks like a small projection without any setae (Fig. 14b), *a. interna* of large females bearing few short (Fig. 14d) or long setae (Fig. 14g).

Endopodite of the first pleopod of males is relatively short and broad (Fig. 15 a, c). *Appendix masculina* of males with CL 7–10 mm bears long and stout setae (Fig. 15b, d). Several large males (cl 13.5–14 mm) have *a. masculina* with short, reduced setae (Fig. 15e). However no apparent morphological intersexes (transitional specimens) were recorded. Therefore the differences in size distribution of males and females may have an explanation other than protandry, e.g. different growth rates of males and females or differences of distribution of males and females, and the question must be left to more detailed surveys, and to histological investigation of the gonads.

The percentage of ovigerous females was rather low (10.5%).

Cohabitant species were *Chionoecetes bairdi*, *Hyas coarctatus*, and *A. lar*.

Crangon dalli (Rathbun, 1902)
Fig. 17, 18.

MATERIAL. 99 ♂♂ (CL 7.4–11.1 mm), 75 ovigerous ♀♀ (CL 8.5–14.5 mm), 61 non-ovigerous ♀♀ (CL 7.3–13.4 mm)

LOCALITY. Haul # 3, 13, 39, 40, 52, 53; Dredge # 1, 2, 7, 8, 9, 10, 19, 20, 23, 25, 33, 37, 45.

REMARKS ON MORPHOLOGY. Ca. 70% of specimens have the rostrum extending beyond the base of cornea (Fig. 17d); the rostrum in other shrimps is not reaching of the basis of cornea (Fig. 17c). The ratio of the scaphocerite length to width ranges betwen 2.5 and 3.9 in both sexes.

DISTRIBUTION. From the Chukchi Sea, through the Bering Sea to Puget Sound and Peter the Great Bay; 3–630 m depth [Butler, 1980].

In the West Kamchatka area *C. dalli* was most common shrimp species at depth between 19 and 60 m. Only twice this shrimps were found deeper (85 and 100 m). Bottom water temperature in the area of collection ranged between 0.44 and 6.24ºC and salinity was in the range of 32.56 to 33.59 p.p.t.

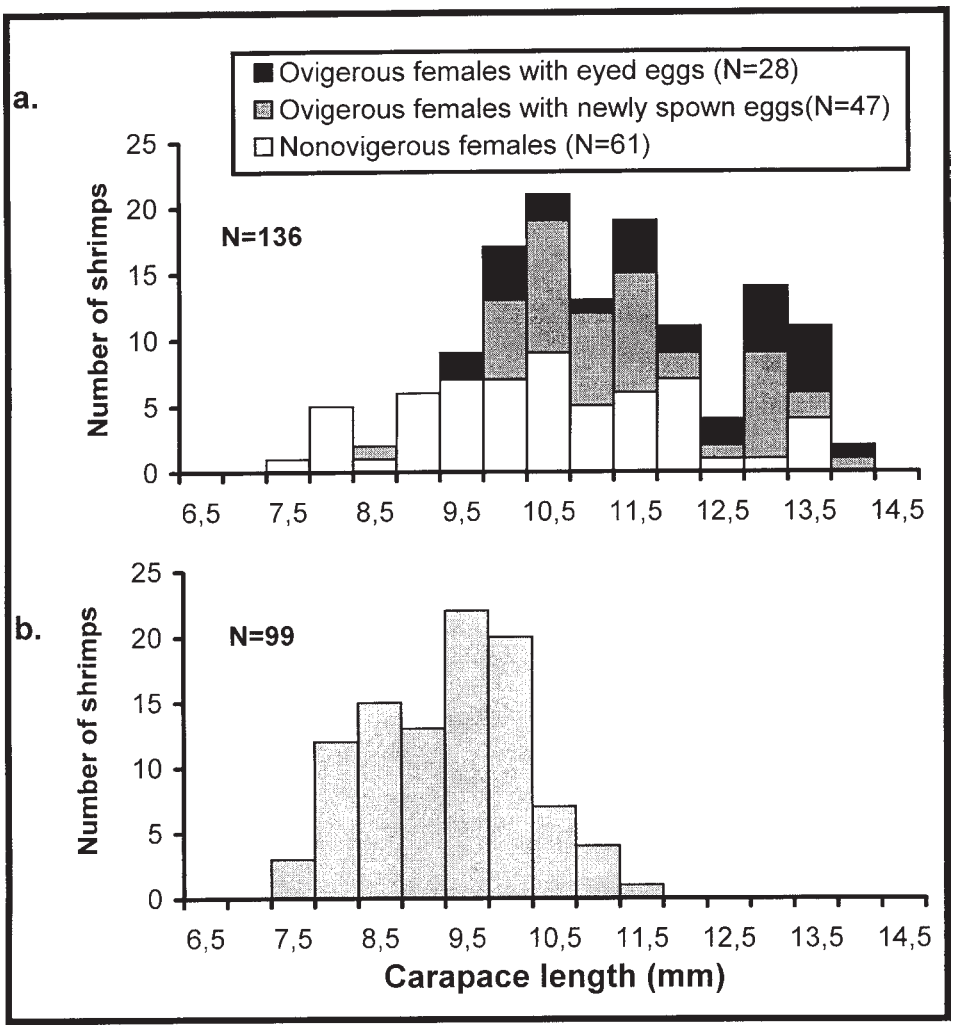

Fig. 18. Carapace length frequency distribution of *Crangon dalli*: a — ♀♀; b — ♂♂.
Рис. 18. Гистограмма размерного состава *Crangon dalli*: a — самки; b — самцы.

BIOLOGY. The maximum CL in females was 14.5 mm, in males it reached 11.1 mm. The minimum length at maturity in females was 8.3 mm. Large-size females dominated in samples (Fig. 18). The majority of large-size females with CL more than 10 mm (ca. 60%) were ovigerous. Ca. 37% of ovigerous females had developed embryos (eyed eggs), other ovigerous females were with newly released eggs.

Only one clear-cut size group with a mode at 9.5 mm was detected in carapace length frequency distribution of males (Fig. 18a). In females several modal groups can be detected (Fig. 18a).

The species commonly present together with *Crangon dalli* were *Chionoecetes bairdi*, *Hyas coarctatus*, and *Argis lar*.

Genus *Mesocrangon* Zarenkov, 1965

Mesocrangon intermedia (Stimpson, 1860)
Fig. 19.

MATERIAL. 2 ♂♂ (CL 4.1 and 4.9 mm), 25 non-ovigerous ♀♀ (CL 7.1–9.1 mm)

LOCALITY. Haul # 34, 39, 40, 42, 51, 52, 53, 54; Dredge # 14, 33, 37, 38.

DISTRIBUTION. From St. Lawrence Island (Bering Sea) to the Peter the Great Bay (Sea of Japan) and Yokohama; 15–400 m depth [Vinogradov, 1950].

In the references area the shrimps were collected at 51–191 m depth (usually 51–85 m depth), at water temperature 0.34–1.73ºC and salinity 32.57–33.59 p.p.t.

BIOLOGY. Males were found only at one station at 56 m depth. Ca. 25% of females had proliferated oocytes well visible under carapace. The present species frequently occurred together with *Pandalus goniurus*, *Chionoecetes opilio*, *Labidochirus splendescens*, and *Argis lar*.

Genus *Sclerocrangon* G.O. Sars, 1883

Sclerocrangon salebrosa Owen, 1839
Fig. 20.

MATERIAL. 26 ♂♂ (CL 6–21.5 mm), 1 ovigerous ♀ (CL 30 mm), 23 non-ovigerous ♀♀ (CL 11.8–30.3 mm).

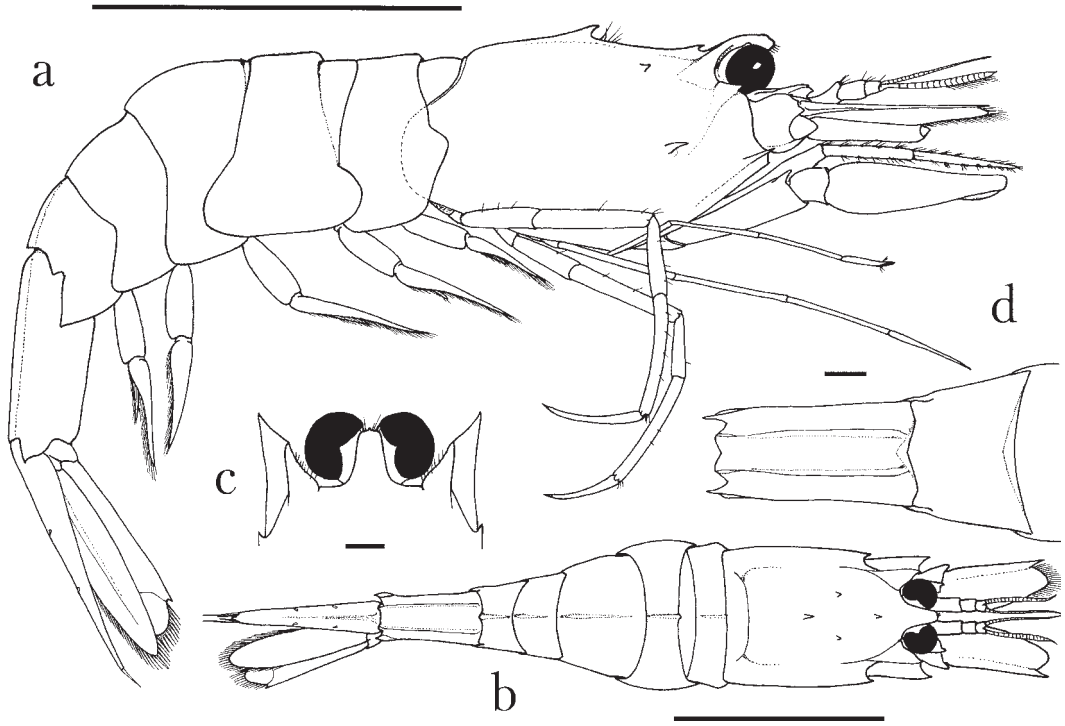

Fig. 19. *Mesocrangon intermedia* (Stimpson, 1860): a — entire animal in lateral view; b — entire animal in dorsal view; c — anterior part of carapace in dorsal view; d — sixth abdominal segment in dorsal view. a, b — non-ovigerous ♀ (CL 7.1 mm); c — non-ovigerous ♀ (CL 7.4 mm); d — non-ovigerous female (CL 8.8 mm). Scale 1 cm (a, b), 1 mm (c, d).

Рис. 19. *Mesocrangon intermedia* (Stimpson, 1860): a — общий вид сбоку; b — общий вид сверху; c — передняя часть карапакса (вид сверху); d — форма шестого сегмента абдомена (вид сверху). a, b — самка без яиц (ДК 7,1 мм); c — самка без яиц (ДК 7,4 мм); d — самка без яиц (ДК 8,8 мм). Масштаб 1 см (a, b), 1 мм (c, d).

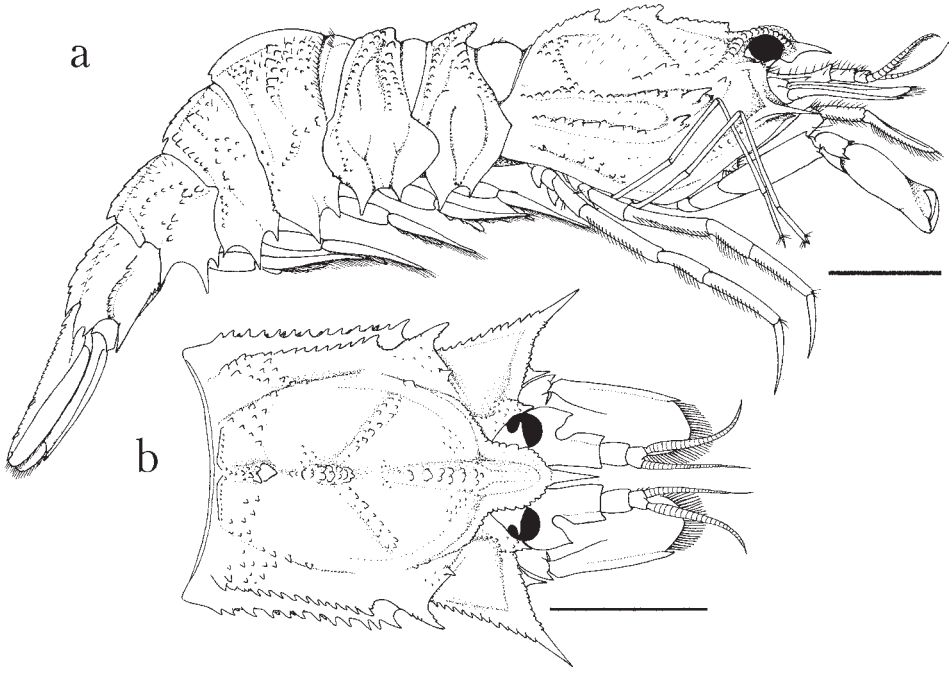

Fig. 20. *Sclerocrangon salebrosa* Owen, 1839. Non-ovigerous ♀ (CL 20.8 mm): a — entire animal in lateral view; b — carapace in dorsal view. Scale 1 cm.

Рис. 20. *Sclerocrangon salebrosa* Owen, 1839. Самка без яиц (ДК 20,8 мм): a — общий вид сбоку; b — форма карапакса (вид сверху). Масштаб 1 см.

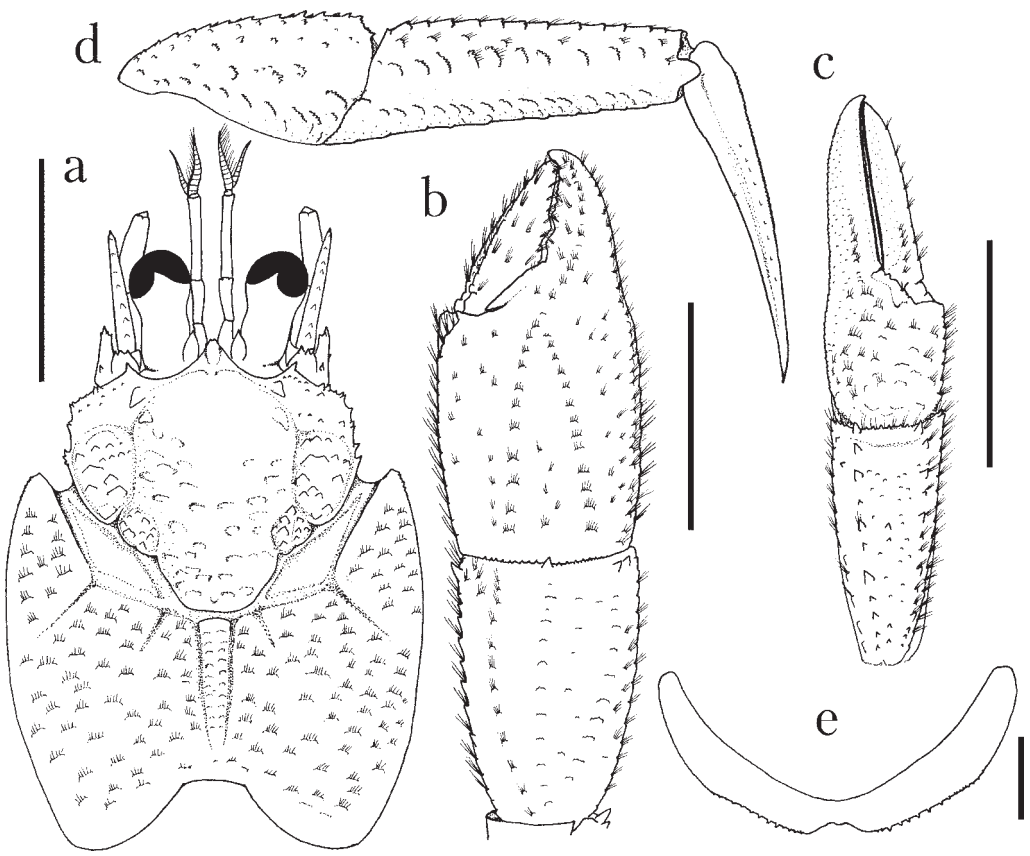

Fig. 21. *Labidochirus splendescens* (Owen, 1839). ♂ (SL 10.3 mm): a — carapace; b — right chela and carpus in dorsal view; c — left chela and carpus in dorsal view; d — dactylus, propodus and carpus of left third pereiopod; e — telson. Scale 1 cm (a–d), 1 mm (e).

Рис. 21. *Labidochirus splendescens* (Owen, 1839). Самец (ДЩ 10,3 мм): a — форма щитка; b — форма клешни и карпуса (вид сверху); c — форма левой клешни и карпуса (вид сверху); d — дактилюс, проподус и карпус третьего переопода; e — форма тельсона. Масштаб 1 см (a–d), 1 мм (e).

LOCALITY. Haul # 39, 40, 52, 53, 55; Dredge # 33, 37, 45.

DISTRIBUTION. From the western Bering Sea to Peter the Great Bay; 10–250 m depth [Vinogradov, 1950]. In the references area the shrimps were collected at depth from 51 to 100 m (water temperature 0.44–1.31ºC and salinity 32.57–33.59 p.p.t.).

Common co-habitant species were *Chionoecetes opilio*, *Hyas coarctatus*, *Labidochirus splendescens*, *Argis lar*, and *Spirontocaris murdochi*.

FAMILY PAGURIDAE LATREILLE, 1803

Genus *Labidochirus* Benedict, 1892

Labidochirus splendescens (Owen, 1839)
Fig. 21, 22.

MATERIAL. 173 ♂♂ (SL 2.3–13.8 mm), 15 ovigerous ♀♀ (CL 6–8.4 mm), 69 non-ovigerous ♀♀ (2.4–12.3 mm).

LOCALITY. Haul # 1, 5, 9, 11, 17, 18, 19, 20, 24, 29, 30, 34, 37, 38, 39, 40, 41, 42, 43, 47, 49, 50, 51, 52, 53, 54; Dredge # 6, 11, 13, 14, 16, 17, 18, 24, 25, 27, 29, 33, 34, 35, 38, 39, 43, 44, 45.

REMARKS ON MORPHOLOGY. Rostrum terminates in 2 to 4 small denticles (Fig. 21a, 22b, c). Ocular peduncles are short, less than the half SL in large specimens (Fig. 21a). In small animals the ocular peduncles are relatively long, about or slightly more than one-half SL (Fig. 22a). The shape of the right chelae varies: dactyli in small specimens usually are subequal to the palm length (Fig. 22d, e), in larger males the dactyli ussually comprises three fourths of the palm length (Fig. 21b).

DISTRIBUTION. Arctic Ocean (Chukchi Sea) from the Kolyma River to Point Barrow [Makarov, 1941]; from the Bering Sea to the Sea of Okhotsk and the Sea of Japan along the Asian coast and from the Gulf of Alaska to Washington and Puget Sound along the American coast; subtidal to 412 m [McLaughlin, 1974].

In the West Kamchatka area *L. splendescens* is one of the most common species. It was found between 30 and 294 m depth (water temperature 0.21–4.93ºC and salinity 32.56–33.37 p.p.t.).

BIOLOGY. The fraction of ovigerous females (ca. 16%) was relatively low. Size (SL) of ovigerous females varies from 6 to 10 mm.

In the catches this species was commonly found together with *Chionoecetes opilio*, *Hyas coarctatus*, *Pagurus trigonocheirus*, *Crangon communis*, *Pandalus goniurus*, and *Argis lar*.

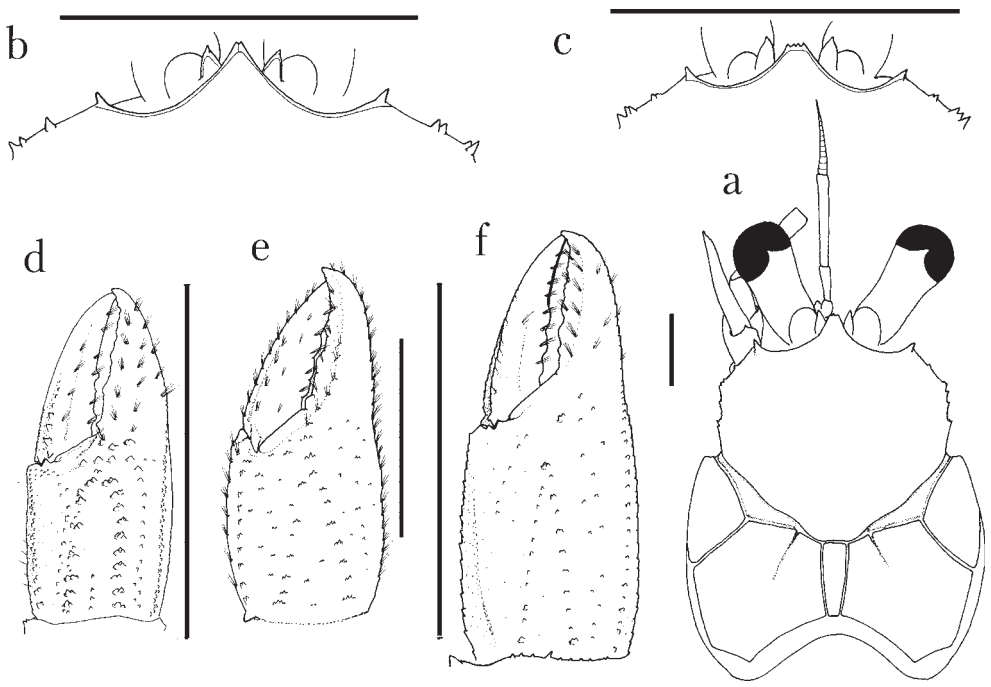

Fig. 22. *Labidochirus splendescens* (Owen, 1839): a — carapace; b, c — anterior part of shield; d–f — right chela in dorsal view. a — ♂ (SL 2.9 mm); b — ♂ (SL 11.3 mm); c — ovigerous ♀ (SL 7.8 mm); d — ♂ (SL 7 mm); e — ♂ (SL 8.3 mm); f — ♂ (SL 10.7 mm). Scale 1 mm (a), 1 cm (b–f).

Рис. 22. *Labidochirus splendescens* (Owen, 1839): a — форма щитка (вид сверху); b, c — форма передней части щитка (вид сверху); d–f — форма левой клешни (вид сверху). a — самец (ДЩ 2,9 мм); b — самец (ДЩ 11,3 мм); c — самка с яйцами (ДЩ 7,8 мм); d — самец (ДЩ 7 мм); e — самец (ДЩ 8,3 мм); f — самец (ДЩ 10,7 мм). Масштаб 1 мм (a), 1 см (b–f).

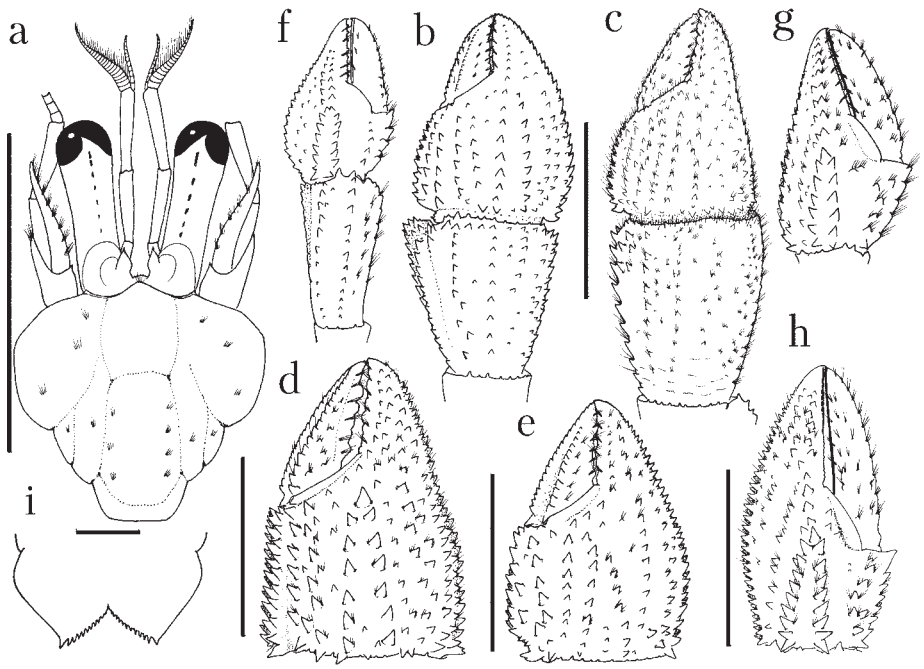

Fig. 23. *Pagurus capillatus* (Benedict, 1892): a — shield; b–e — right chela in dorsal view; f–h — left chela in dorsal view; i — telson. a, b, f, i — non-ovigerous ♀ (SL 8.2 mm); c, g — non-ovigerous ♀ (SL 12.4 mm); d — ovigerous ♀ (SL 10.4 mm); e — ovigerous ♀ (SL 10 mm); h — ♂ (SL 14.3 mm). Scale 1 cm (a–h), 1 mm (i).

Рис. 23. *Pagurus capillatus* (Benedict, 1892): a — форма щитка (вид сверху); b–d — форма правой клешни (вид сверху); f-h - форма левой клешни (вид сверху); i — форма тельсона. a, b, f, i — самка без яиц (ДЩ 8,2 мм); c, g — самка без яиц (ДЩ 12,4 мм); d — самка с яйцами (ДЩ 10,4 мм); e — самка с яйцами (ДЩ 10 мм); h — самец (ДЩ 14,3 мм). Масштаб 1 см (a–h), 1 мм (i).

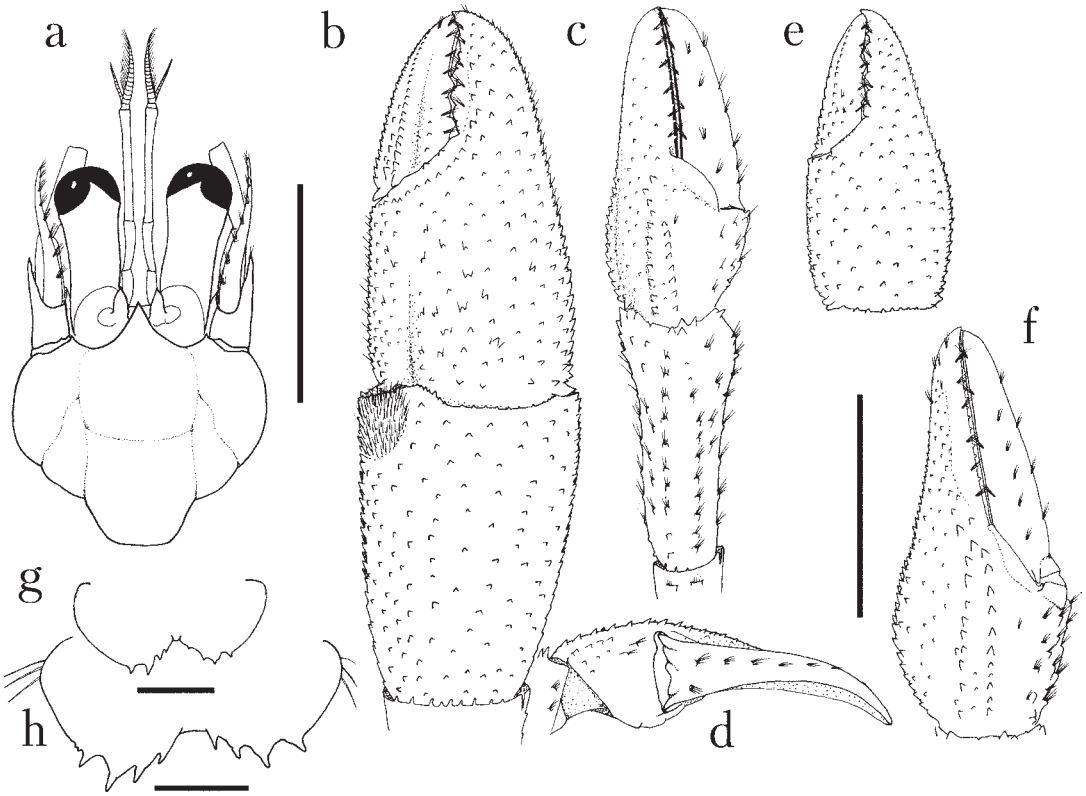

Fig. 24. *Pagurus rathbuni* (Benedict, 1892): a — shield; b — right chela and carpus in dorsal view; c — left chela and carpus in dorsal view; d — left chela in lateral view; e — right chela in dorsal view; f — left chela in dorsal view; g, h — telson. a–d — ♂ (SL 10.8 mm); e — ♂ (SL 8.1 mm); f — ♂ (SL 12.5 mm); g — ♂ (SL 8.1 mm); h — ♂ (SL 11.5 mm). Scale 1 cm (a–f), 1 mm (g, h).

Рис. 24. *Pagurus rathbuni* (Benedict, 1892): a — форма щитка (вид сверху); b — форма правой клешни и карпуса (вид сверху); c — форма левой клешни и карпуса (вид сверху); d — форма левой клешни (вид сбоку); e — форма правой клешни (вид сверху); f — форма левой клешни (вид сверху); g, h — форма тельсона. a–d — самец (ДЩ 10,8 мм); e — самец (ДЩ 8,1 мм); f — самец (ДЩ 12,5 мм); g — самец (ДЩ 8,1 мм); h — самец (ДЩ 11,5 мм). Масштаб 1 см (a–f), 1 мм (g, h).

Genus *Pagurus* Fabricius, 1775

Pagurus capillatus (Benedict, 1892)
Fig. 23.

MATERIAL. 20 ♂♂ (SL 6.7–15.7 mm), 6 ovigerous ♀♀ (SL 7.1–10.8 mm), 8 non-ovigerous ♀♀ (SL 6.7–11.5 mm).

LOCALITY. Haul # 1, 3, 13, 15, 16; Dredge # 19, 20.

REMARKS ON MORPHOLOGY. The palm of the right chela varies in shape from prominent oval to nearly triangular (Fig. 23b–e). The left cheliped is moderately short (Fig. 23f–h).

Distribution. From southern part of the Chukchi Sea, through the Bering Sea southward to the Sea of Japan and North Korea in Asian coast and from Bering Sea to California in American coast [Makarov, 1938, McLaughlin, 1974]; 4–432 m depth [McLaughlin, 1974].

In the references area the present species occurred between 19 and 43 m depth (water temperature 2.54–6.24ºC and salinity 32.31–32.65 p.p.t.).

Other decapod crustacean species occasionally co-occurring with *P. capillatus* were *Chionoecetes bairdi* and *Crangon dalli*.

Pagurus rathbuni (Benedict, 1892)
Fig. 24.

MATERIAL. 11 ♂♂ (SL 7.1–12.2 mm), 1 non-ovigerous ♀ (SL 6.9 mm).

LOCALITY. Haul # 6, 20, 36, 49.

DISTRIBUTION. In the Arctic Ocean from the mouth of Kolyma River to Point Barrow [Makarov, 1938], southward through the Bering Sea to the Peter the Great Bay [Vinogradov, 1950] and Niigata [Miyake et al., 1962]; 9 to 210 m [McLaughlin, 1974].

P. rathbuni was collected by R/V "Prof. Levanidov" only at depth between 200 and 300 m depth (water temperature 1.22–1.83ºC and salinity 33.15–33.39 p.p.t.). Thus the known vertical range of *P. rathbuni* is extended to 300 meters.

Frequently co-occuring species were *Chionoecetes opilio*, *Pandalus goniurus*, and *Crangon communis*.

Pagurus trigonocheirus (Stimpson, 1858)
Fig. 25, 26.

MATERIAL. 155 ♂♂ (SL 1.4–19.8 mm), 2 ovigerous ♀♀ (SL 13.2 and 13.8 mm), 123 non-ovigerous ♀♀ (SL 1.7–13.6 mm).

LOCALITY. Haul # 3, 6, 9, 11, 12, 16, 17, 18, 19, 24, 31, 33, 37, 38, 39, 40, 41, 42, 43, 47, 50, 52, 53, 54, 56; Dredge # 3, 10, 11, 12, 13, 14, 15, 16, 17, 24, 25, 28, 29, 33, 34, 37, 39, 42, 43, 44.

REMARKS ON MORPHOLOGY. Variability in the most important characters of *P. trigonocheirus* in the reference area was discussed by Sokolov [1998]. The ratio of the right cheliped palm width to length varies from 0.87 to 1.63 in males and from 0.9 to 1.75 in females. There is a weak

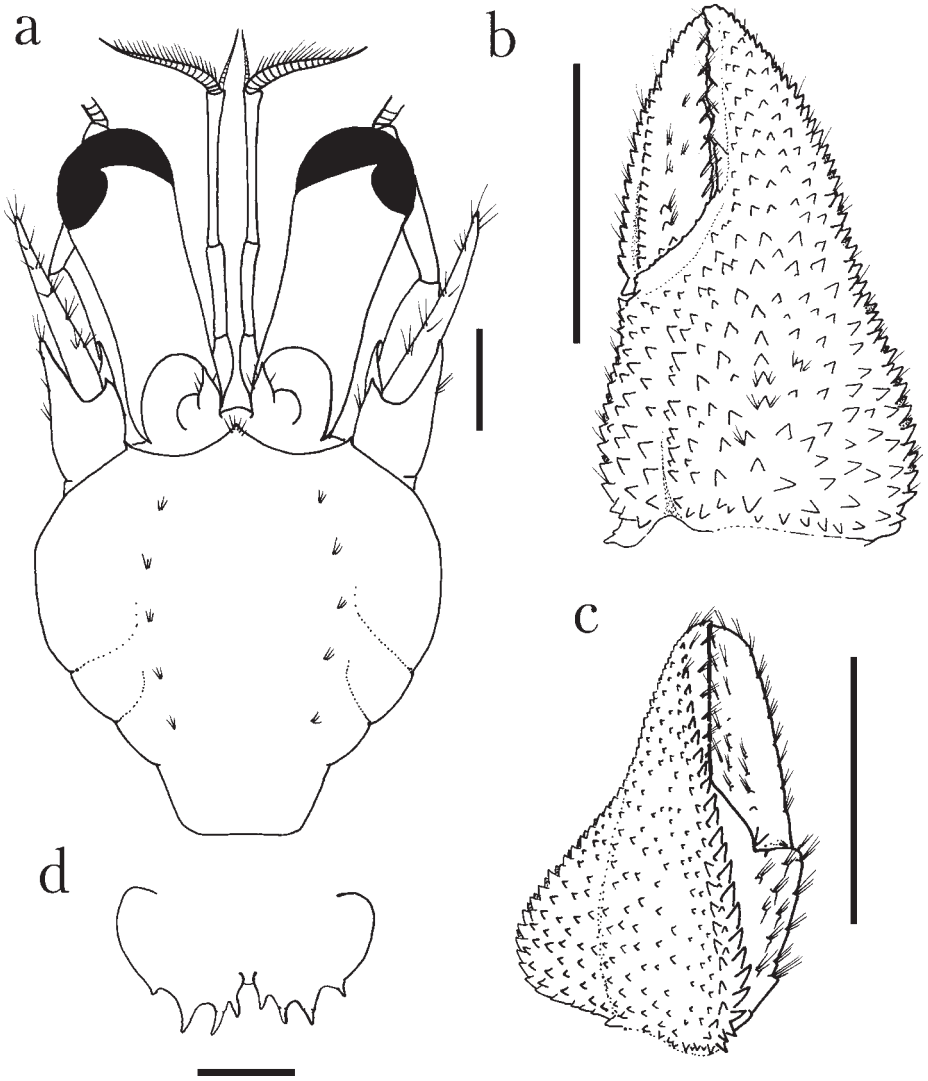

Fig. 25. *Pagurus trigonocheirus* (Stimpson, 1858). ♂ (SL 13.3 mm): a — shield; b — right chela; c — left chela; d — telson. Scale 1 cm (b, c), 1 mm (a, d).

Рис. 25. *Pagurus trigonocheirus* (Stimpson, 1858). Самец (ДЩ 13,3 мм): a — форма щитка (вид сверху); b — форма правой клешни; c — форма левой клешни; d — форма тельсона. Масштаб 1 см (b, c), 1 мм (a, d).

negative correlation between SL and palm width/length ratio (Fig. 26).

DISTRIBUTION. From the southern Chukchi Sea [Makarov, 1938] southward to Korea and Japan [Vinogradov, 1947] and from Point Barrow to the Pribilov Islands and the Aleutians Islands [McLaughlin, 1974]; subtidal to 182 m [Vinogradov, 1947; McLaughlin, 1974].

In the references area the species was collected at the depth between 20 and 250 m (water temperature 0.21–6.24ºC and salinity 32.57–33.59 p.p.t.). Our records indicate a deeper occurence of *P. trigonocheirus* than known previously (180 m).

BIOLOGY. Large-size males (SL 10–18 mm) and small-size females (SL 1.7–7 mm) dominated in the samples. The percentage of ovigerous females was low (1.6%). Other species present in the same catches were *Chionoecetes bairdi*, *C. opilio*, *Hyas coarctatus*, *Labidochirus splendescens*, *Crangon communis*, *Pandalus goniurus*, and *Argis lar*.

Pagurus brandti (Benedict, 1892)
Fig. 26, 27.

MATERIAL. 35 ♂♂ (SL 6.3−18.9 mm), 7 non-ovigerous ♀♀ (SL 3.4−16.1 mm).

LOCALITY. Haul # 10, 20, 30, 38, 48, 49, 55, 56; Dredge # 4, 34, 43.

REMARKS ON MORPHOLOGY. The ratio of the right cheliped palm width to length varies from 1.68 to 2 in males and from 1.63 to 1.92 in females.

DISCUSSION. *Pagurus brandti* is distinguished from *P. trigonocheirus* by the differences in the shape of the left chela and the morphology of telson [McLaughlin, 1974; Ivanov, 1979a], and by larval morphology [Ivanov, 1979b]. Besides of this, *P. trigonocheirus* is separated from *P. brandti* by having a more slender and longer palm of the right cheliped; in fact, there is no overlap between these

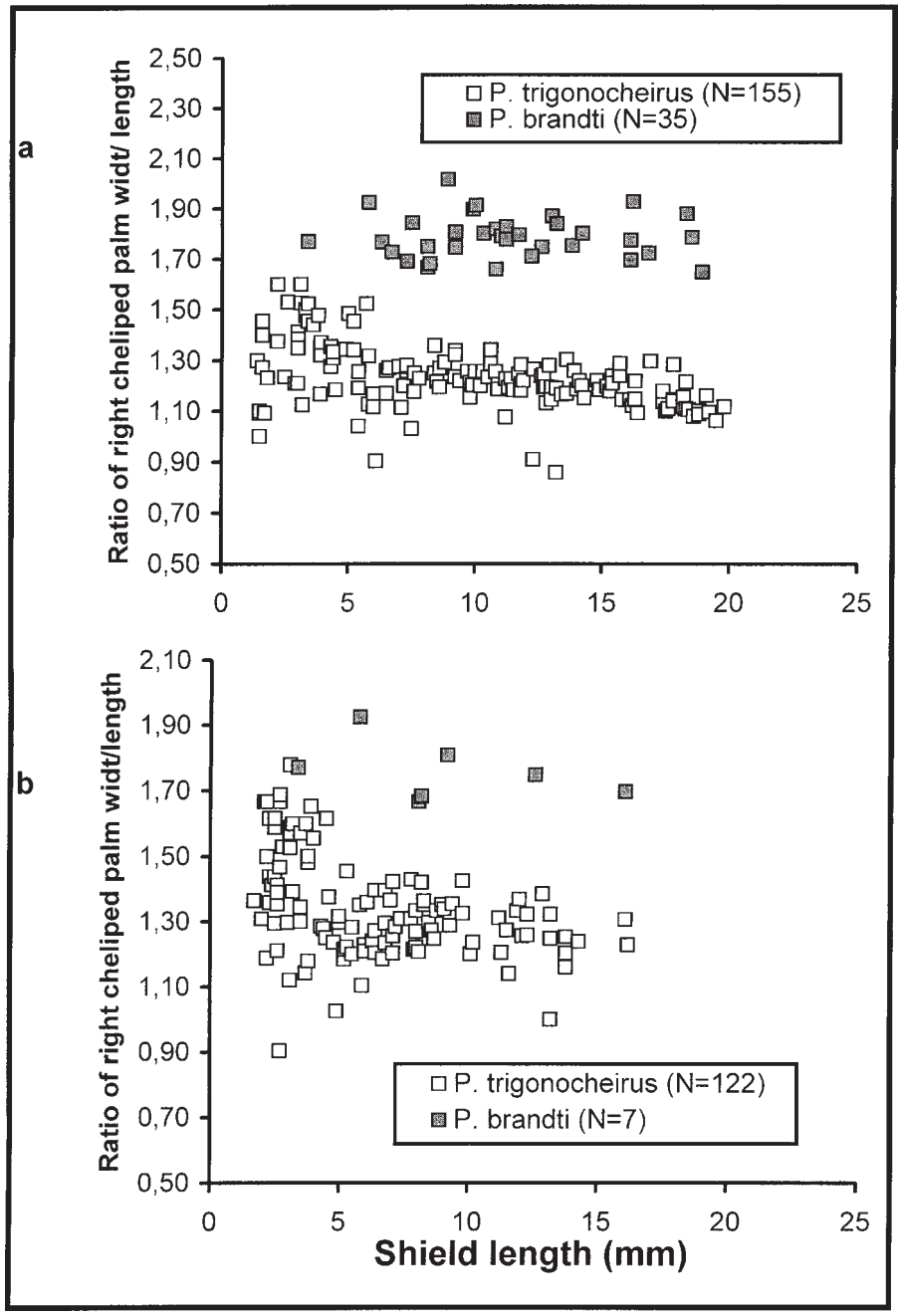

Fig. 26. Shield length *vs.* ratio of right cheliped palm width/length in *Pagurus trigonocheirus* and *P. brandti*: a — ♂♂; b — ♀♀.

Рис. 26. Графики изменения отношения длины клешни к ее ширине с увеличением размеров у *Pagurus trigonocheirus* и *P. brandti*: a — самцы; b — самки.

species in the right palm width to length ratio throughout the size range (Fig. 26).

DISTRIBUTION. Chukchi Sea, Bering Sea [McLaughlin, 1974; Ivanov, 1979a], Sea of Okhotsk; depth 59–294 m [Sokolov, 1998]. In the West Kamchatka area the species was collected the water temperature range from 0.24 to 1.73ºC, salinity ranged from 32.6 to 33.38 p.p.t.

Other species present in the catches along with *P. brandti* were *Chionoecetes opilio*, *Pandalus goniurus*, *Crangon communis*, and *Labidochirus splendescens*.

FAMILY LITHODIDAE SAMOUELLE, 1819

Subfamily Lithodinae Ortmann, 1901

Genus *Paralithodes* Brandt, 1849

Paralithodes camtschaticus (Tilesius, 1815)

LOCALITY. Haul # 1, 3, 4, 5, 6, 10, 11, 13, 14, 15, 16, 17, 18, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 33, 34, 37, 38, 39, 40,

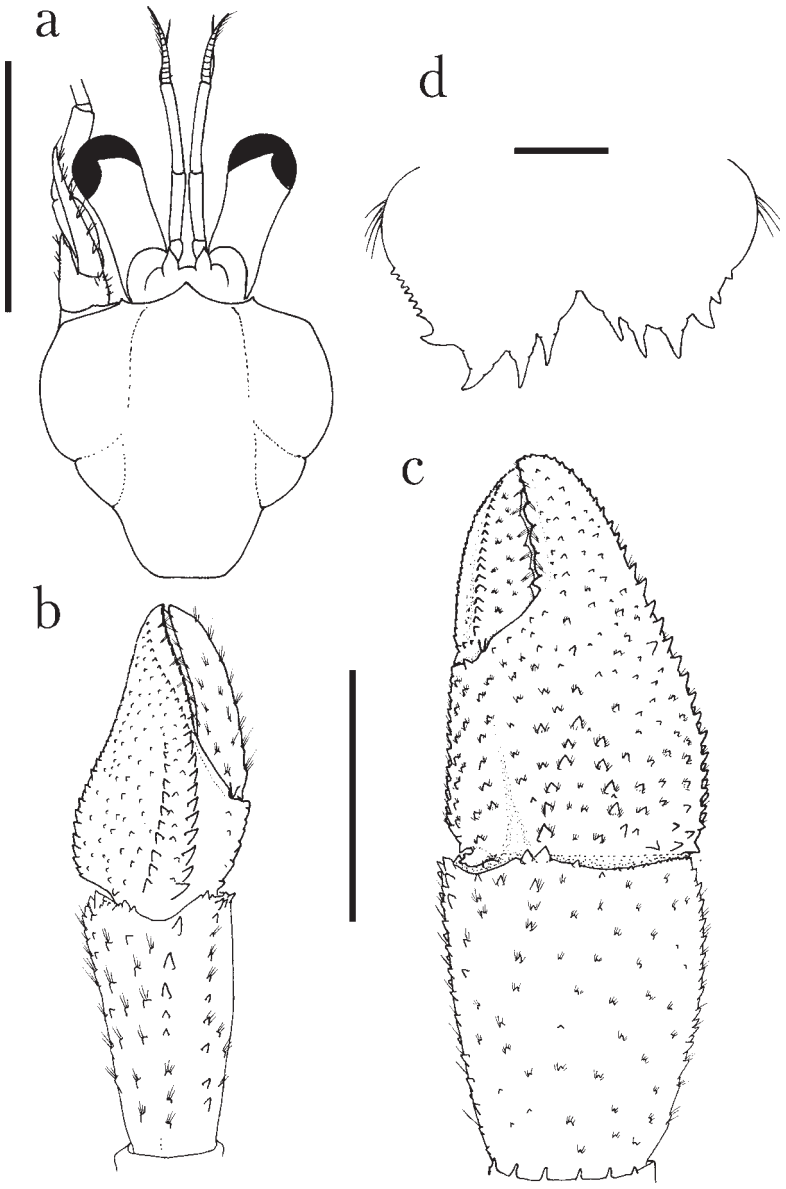

Fig. 27. *Pagurus brandti* (Benedict, 1892). ♂ (SL 11.5 mm): a — shield; b — left chela and carpus in dorsal view; c — right chela and carpus in dorsal view; d — telson. Scale 1 cm (a–c), 1 mm (d).

Рис. 27. *Pagurus brandti* (Benedict, 1892). Самец (ДЩ 11.5 мм): a — форма щитка; b — форма правой клешни и карпуса; c — форма левой клешни и карпуса; d — форма тельсона. Масштаб 1 см (a–c), 1 мм (d).

41, 42, 43, 44, 45, 46, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58; Dredges # 9, 10, 11, 20, 39, 44.

DISTRIBUTION. From the eastern Olutorsky Bay [Ivanov, 2000] and the Penzhinskaya Guba (Sea of Okhotsk) to the East coast of Korea and Honshu Island in the northwestern Pacific, from Norton Sound to Queen Charlotte Islands in the northeastern Pacific [Vinogradov, 1946]; 4–510 m [Klitin, 1996]. *P. camtschaticus* has been introduced in the North Atlantic in the 1960s and now this species is common in Barents Sea [Orlov and Ivanov, 1978; Kuzmin & Olsen, 1994; Kuzmin *et al*., 1996].

In the references area crabs were collected at depth from 19 to 295 m (water temperature 0.21–6.24ºC and salinity 32.2–33.39 p.p.t.). The species was most abundant at depth between 19 and 50 m.

BIOLOGY. Large-size males with CW 110–210 mm dominated in the trawl catches. Female crabs were rare (4% of collected specimens). Ca. 95 % of females were ovigerous.

Paralithodes platypus Brandt, 1850

MATERIAL. 19 ♂♂ (CW 105–155 mm), 1 non-ovigerous ♀ (CW 104 mm).

LOCALITY. Haul # 10, 17, 18, 30, 38, 41, 47, 48, 51, 52, 53.

DISTRIBUTION. From the Bering Straight and the northern Part of the Sea of Okhotsk to Peter the Great Bay along the Asian coast and from Point Barrow to northern British Columbia [Ivanov, 2001]; 12–500 m [Makarov, 1941].

In the references area this species was found at depth between 52 and 114 m (water temperature 0.21–2.02ºC and salinity 32.57–33.15 p.p.t.)

Other species present in the same catches were *Chionoecetes bairdi*, *Hyas coarctatus*, *Labidochirus splendescens*, *Pagurus trigonocheirus*, *Pandalus goniurus*, and *Paralithodes camtschaticus*.

Genus *Lithodes* Latreille, 1806

Lithodes aequispinus Benedict, 1894

MATERIAL. 97 ♂♂ (CW 101−170 mm), 55 ovigerous ♀♀ (CW 101−150 mm), 15 non-ovigerous ♀♀ (CW 86−110 mm).

LOCALITY. Haul # 26, 32, 33, 34, 36, 43, 44, 45, 46, 47, 49, 55.

DISTRIBUTION. From the Bering Sea to the Sea of Okhotsk and Pacific coast of Northern Hokkaido [Takeda, 1982] and to the Aleutian Islands and southern British Columbia [Jamieson and Sloan, 1985]; 100–800 m.

In the references area the species was collected at depth between 100 and 300 m (water temperature 0.21–1.81ºC and salinity 32.67–33.39 p.p.t.).

BIOLOGY. Large-size males with CW 130–160 mm dominated in catches. Females were recorded rather frequently (in ca. 42% of catches). Specimens with orange colored eggs dominated among recorded ovigerous females. This species frequently occurred together with *Chionoecetes opilio*, *Hyas coarctatus*, *Pandalus borealis*, *Labidochirus splendescens*, and *Paralithodes camtschaticus*.

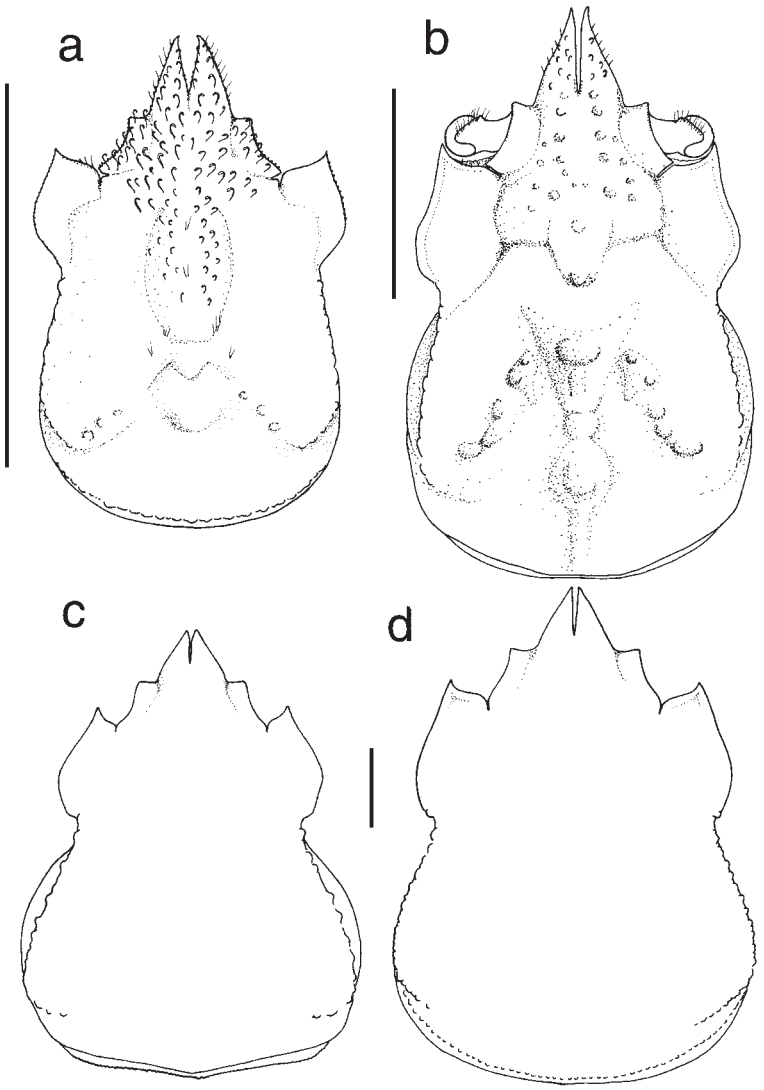

Fig. 28. *Hyas coarctatus alutaceus*, males. Shape of carapace in dorsal view: a — ♂ (CW 8.1 mm); b — ♂ (CW 17.5 mm); c — ♂ (CW 43.9 mm); d — ♂ (CW 49.2 mm). Scale 1cm.

Рис. 28. *Hyas coarctatus alutaceus*. Форма карапакса (вид сверху): a — самец (ШК 8,1 мм); b — самец (ШК 17,5 мм); c — самец (ШК 43,9 мм); d — самец (ШК 49,2 мм). Масштаб 1 см.

FAMILY MAJIDAE SAMOUELLE, 1819

Genus *Chionoecetes* Kröyer, 1838

Chionoecetes opilio (O. Fabricius, 1788)

MATERIAL. 593 ♂♂ (CW 2.8−135 mm), 5 ovigerous ♀♀ (CW 60−75 mm), 159 non-ovigerous ♀♀ (CW 12.1−80 mm).

LOCALITY. Haul # 6, 8, 9, 19, 20, 21, 24, 26, 27, 30, 31, 32, 33, 34, 36, 37, 38, 39, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 55, 56; Dredge # 7, 10, 11, 13, 14, 16, 17, 24, 26, 27, 29, 33, 34, 35, 37, 38, 42, 43, 44, 45.

REMARKS ON MORPHOLOGY. Variability of the most principal characters of *C. opilio* in the references area was discussed by Sokolov[2001]. Sex and size compositions of *C. opilio* based on materials of R/V "Prof. Levanidov" were described earlier [Ivanov & Sokolov, 1997].

DISTRIBUTION. From the Wrangel Island to Point Barrow in the Arctic Ocean; from the Bering Sea to the Sea of Okhotsk and the Sea of Japan, and to British Columbia in the North Pacific [Makarov, 1941; Fedoseev & Slizkin, 1988]; from Greenland to the Gulf of Maine [Squires, 1990] in the Western Atlantic and in the Barents Sea in the Eastern Atlantic [Kuzmin *et al*., 1996]; 7–1000 m [Vinogradov, 1950].

In the references area these crabs were common at depth between 20 and 300 m (most frequently at 100–300 m depth), at water temperature ranging from 0.21 to 3.94ºC and salinity between 32.2 and 33.39 p.p.t.

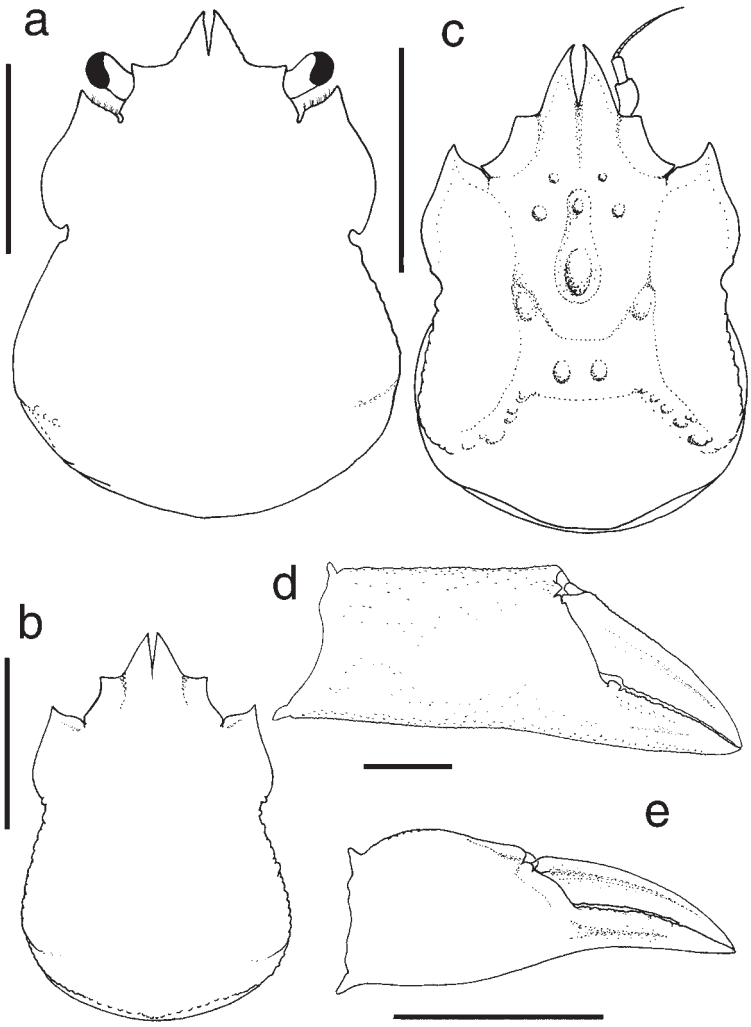

Fig. 29. *Hyas coarctatus alutaceus*: a–c — shape of female carapace in dorsal view; d, e — right chela. a — non-ovigerous ♀ (CW 28.1 mm); b — non-ovigerous ♀ (CW 15.7 mm); c — non-ovigerous ♀ (CW 15.7 mm); d — ♂ (CW 63.2 mm); e — non-ovigerous ♀ (CW 36.2 mm). Scale 1 cm.

Рис. 29. *Hyas coarctatus alutaceus*: a–c — форма карапакса (вид сверху); d, e — форма клешни. a — самка без яиц (ШК 28,1 мм); b — самка без яиц (ШК 15,7 мм); d — самка без яиц (ШК 15,7 мм); d — самец (ШК 63,2 мм); e — самка без яиц (ШК 36,2 мм). Масштаб 1 см.

The decapod species present in the same catches with *C. opilio* were *Pagururs trigonocheirus*, *Labidochirus splendescens*, *Crangon communis*, *Hyas coarctatus*, and *Argis lar*.

Chionoecetes bairdi Rathbun, 1902

LOCALITY. Haul # 1, 2, 3, 4, 5, 6, 8, 11, 12, 13, 14, 15, 16, 17, 19, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 34, 35, 38, 39, 40, 41, 42, 43, 44, 47, 48, 49, 51, 52, 53, 54; Dredge # 1, 7, 8, 9, 10, 11, 14, 15, 17, 18, 19, 20, 24, 25, 33, 35, 37, 39, 43.

DISTRIBUTION. From the southern Bering Sea to the Aleutian Islands and Oregon, and from the Cape Navarin [Slizkin, 1982, 1990] to 59º50′N in the northeastern Sea of Okhotsk [Sokolov, 2001]; 20–415 m [Slizkin, 1982].

In the references area *C. bairdi* were common at depth between 20 and 300 m (at 40–100 m depth this species dominated in catches) south of 53ºN, and only a few specimens were found at north of 53ºN. Water temperature in the place of collection varied from 0.34 to 6.24ºC, salinity was in the range of 32.2 to 33.37 p.p.t.

Other decapod species obtained in the same catches were *Paralithodes camtschaticus*, *Hyas coarctatus*, *Labidochirus splendescens*, *Pagurus trigonocheirus*, *Pandalus goniurus*.

Genus *Hyas* Leach, 1814

Hyas coarctatus alutaceus Brandt, 1851

Fig. 28–30.

MATERIAL. 189 ♂♂ (CW 2.8–84.2 mm), 46 ovigerous ♀♀ (CW 16.7–53.5 mm), 112 non-ovigerous ♀♀ (CW 3–47.5 mm).

LOCALITY. Houl # 12, 14, 15, 17, 18, 23, 29, 30, 34, 40, 41, 42, 43, 52, 53, 58; Dredge # 8, 12, 13, 17, 24, 28, 29, 33, 34, 35, 39, 44.

REMARKS ON MORPHOLOGY. The Pacific subspecies *alutaceus* differs from the nominal Atlantic subspecies in the following characters: 1) in the Pacific subspecies carapace is wider and more rounded posteriorly, with fewer and smaller tubercles or ridges; 2) rostrum is shorter and wider in the Pacific specimens than in the Atlantic population (CL 7.1–9.3 times greater than the rostrum length in *H. coarctatus alutaceus*, while in the nominal subspecies it is only 4.5–6.4 times greater) [Squires, 1990].

The shape of rostrum and carapace of males and females varies being strongly related to size/ age (Fig. 28, 29a–c). Large-size males and females, as a rule, have a relatively shorter rostrum and wider carapace than small specimens. The ratio of carapace length to rostrum length ranges from 3.4 to 6.7 in the small crabs with CW 2.8–10.0 mm; and from 3.7 to 13.0 in the males and females of CW 10–30 mm; it falls between 5 and 14 in the specimens with CW 30–50 mm, and between 7 and 15 in almost all large-size males with CW greater than 60 mm (Fig. 30c).

The number and size of the tubercles and the ridges on the dorsal surface of the carapace varies in different specimens. Mature males can be well separated from the females and immature males by the shape of chela (Fig. 29d, e).

DISTRIBUTION. North Pacific and adjacent areas of the Arctic Ocean only [Squires, 1990]. From the Bennet Island to the Beaufort Sea in the Arctic Ocean; from the Bering Sea to the La Perouse Strait in the North Pacific; subtidal to 1650 m [Vinogradov, 1950].

H. coarcatatus alutaceus is one of the most common species in the West Kamchatka area. This species was found at depth between 21 and 155 m (water temperature 0.34–5.18ºC and salinity 32.35–33.21 p.p.t.).

BIOLOGY. Small-size specimens with CW<25 mm dominated in dredge catches. Four modal groups with mean CW of respectively 8, 30, 32, 43, and 62 mm were detected in the

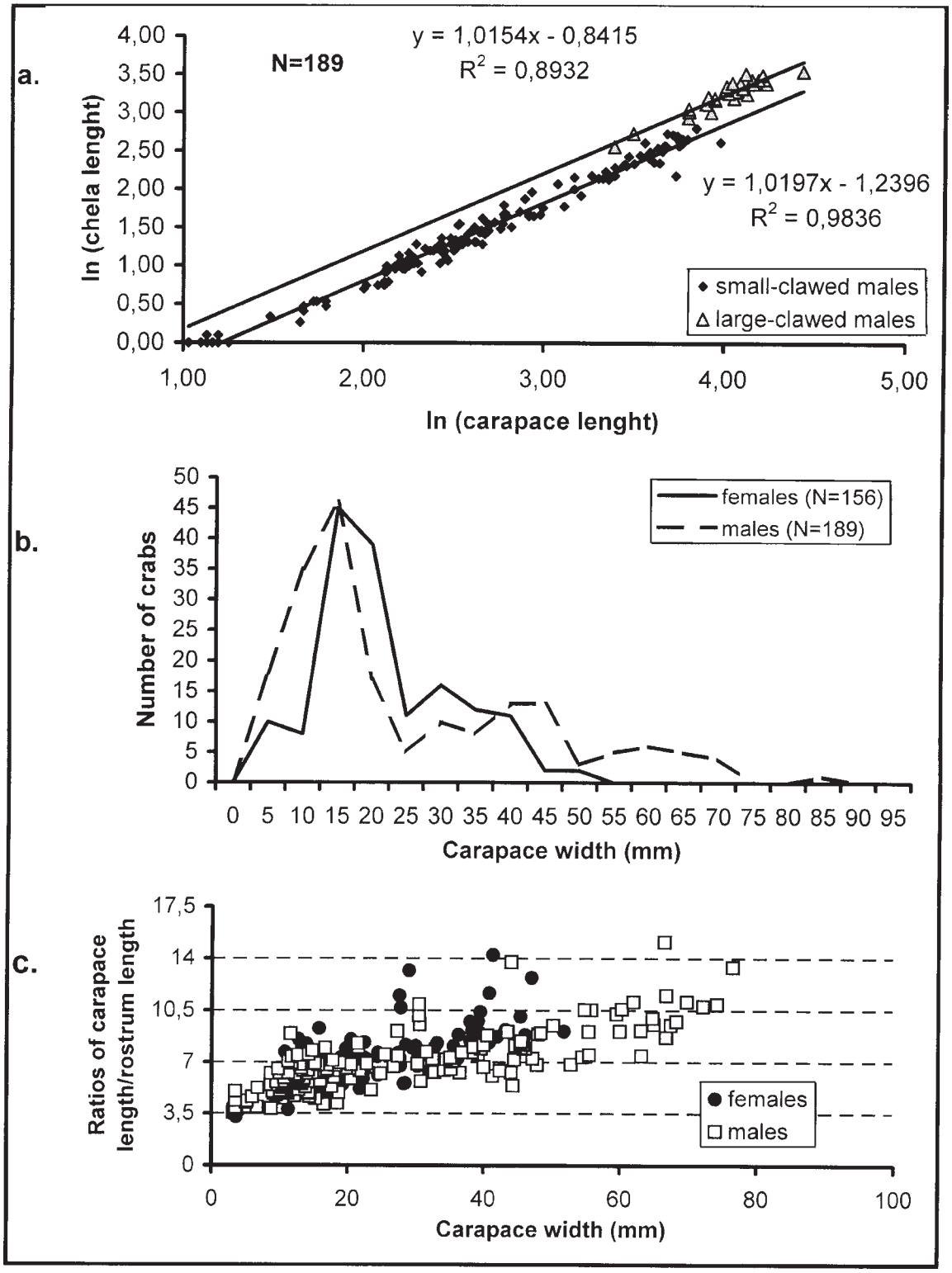

Fig. 30. *Hyas coarctatus alutaceus*: a — relationship between chela length and carapace length in "large-clawed" and "small-clawed" males; b — carapace width frequency distributions of males and females; c — carapace width *vs.* ratio of carapace length/rostrum length.

Рис. 30. *Hyas coarctatus alutaceus*: a — отношение длины карапакса и длины клешни в логарифмической зависимости; b — графики размерного состава самцов и самок; c — график изменения отношения длины рострума к длине карапакса с увеличением ширины карапакса.

carapace width frequency distributions (Fig. 30b). The percentage of ovigerous females was relatively low (29%). Crabs with bright orange eggs dominated amongst ovigerous females. Other ovigerous females (about 15%) were with developed embryos.

Small-clawed and large-clawed males were recorded in catches (Fig. 30a). Large-clawed males dominated among large-size specimens with CW exceeding 55 mm. The minimum size (CW) of large-clawed males was 29.7 mm, the maximum size of small-clawed males was 53.5 mm. The relation between chelae length (Y) and CW (X) for large-clawed males (morphometrically mature) and small-clawed (adolescent) males can be described as follows: $\ln Y = 1.0154 \ln X - 0.8415$, $R^2 = 0.8932$ and $\ln Y = 1.0197 \ln X - 1.2396$, $R^2 = 0.9836$, respectively. The proportion of large-clawed males in catches was 14.3%.

The species occured together with *Chionoecetes opilio*, *C. bairdi*, *Pandalus goniurus*, *Pagurus trigonocheirus*, *Labidochirus splendescens*, *Argis lar*, and *Crangon communis*.

Genus *Oregonia* Dana, 1851

Oregonia gracilis Dana, 1851

Fig. 31.

MATERIAL. 12 ♂♂ (CW 8.1–29.4 mm), 3 ovigerous ♀♀ (CW 19.2–24.5 mm), 6 non-ovigerous ♀♀ (CW 6.3–20.7 mm).

LOCALITY. Houl # 18, 29, 30; Dredge # 4, 10, 11, 17, 18, 24.

DISTRIBUTION. From the Commander Islands to Inubo Zaki (Japan) and Chefoo (China) and from the Nunivak Island to California [Vinogradov, 1950], but no records in the western Sea of Okhotsk and in the Primorie Region (northwestern Sea of Japan) are known; subtidal to 390 m depth [Vinogradov, 1950].

Crabs were collected by R/V "Prof. Levanidov" at depth from 51 to 180 m (water temperature 1.22–2.15ºC and salinity 32.72–33.08 p.p.t.).

BIOLOGY. Five large-clawed (Fig. 31b) and seven small-clawed (Fig. 31d) males were caught. Ca. 30% of females had orange eggs. Other decapod species present in catches together with this species were *Hyas coarctatus, Chionoecetes bairdi, Labidochirus splendescens, Pagurus trigonocheirus*, and *Pandalus goniurus*.

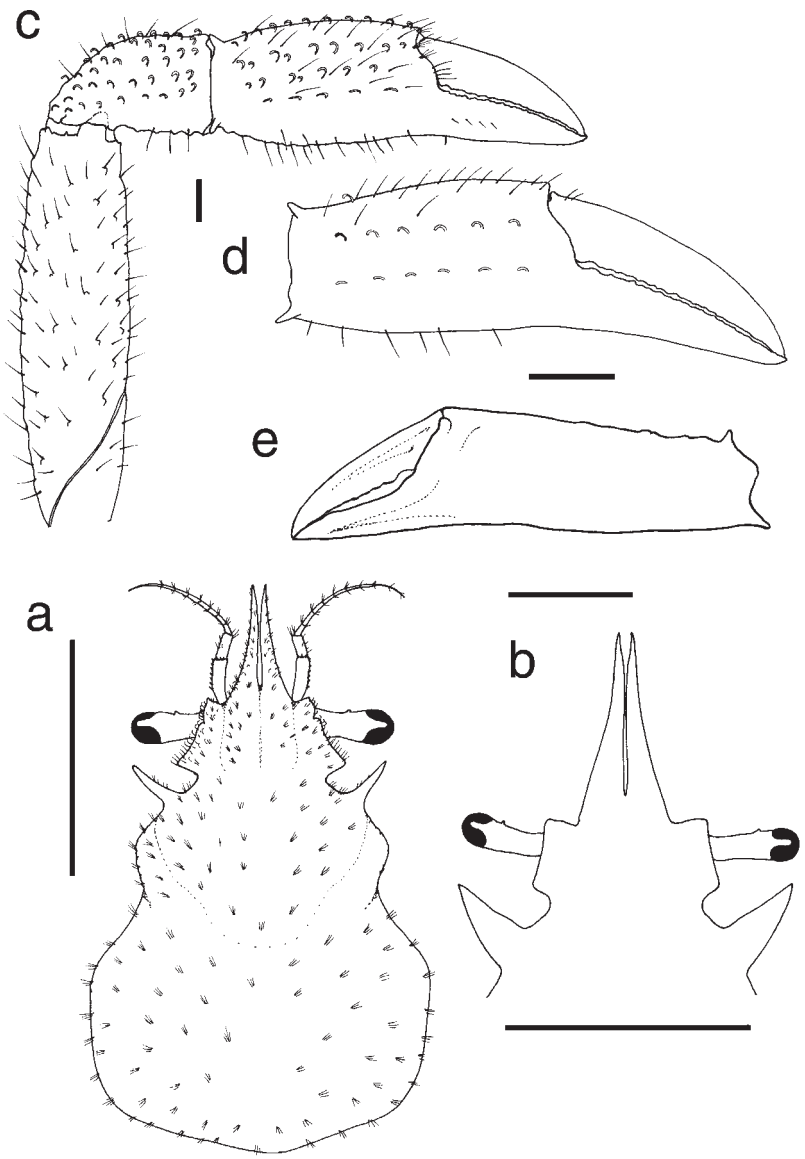

Fig. 31. *Oregonia gracilis* Dana, 1851: a — carapace in dorsal view; b — anterior part of carapace; c — right cheliped in dorsal view; d — right chela; e — left chela. a, c — non-ovigerous ♀ (CW 14.8 mm); b — non-ovigerous ♀ (CW 22.8 mm); d — ♂ (CW 8.1 mm); e — ♂ (CW 26.7 mm). Scale 1 cm (a, e), 1 mm (b–d).

Рис. 31. *Oregonia gracilis* Dana, 1851: a — форма карапакса и рострума (вид сверху); b — форма передней части карапакса; c — форма правого первого переопода; d — форма клешни; e — форма клешни. a, c — самка без яиц (ШК 14,8 мм); b — самка без яиц (ШК 22,8 мм); d — самец (ШК 8,1 мм); e — самец (ШК 26,7 мм). Масштаб 1 см (a, e), 1 мм (b–d).

FAMILY ATELECYCLIDAE ORTMANN, 1893

Genus *Erimacrus* Benedict, 1892

Erimacrus isenbeckii (Brandt, 1848)

MATERIAL. 125 ♂♂ (CW 51–145 mm); 5 non-ovigerous ♀♀ (CW 41–118 mm).

LOCALITY. Haul # 1, 2, 12, 13, 14, 15, 16, 17, 21, 22, 23, 24, 27, 28, 29, 41, 42, 53; Dredge # 20.

DISTRIBUTION. Sea of Japan (from 50ºN to Southern part of Honshu Island and Southern part of Korea) [Armetta and Stevens, 1987; Ivanov, 2001], Sea of Okhotsk (in South-East Sakhalin from Aniva Bay to 49º30N [Ivanov, 2001]; Kuril Islands; in the West Kamchatka north to Cape Khayryuzova [Vinogradov, 1947]); in the Eastern Kamchatka from Cape Lopatka to 54º30′N [Ivanov, in press], and in eastern Bering Sea from St. Matthew Island along Alaska Peninsula to Attu Island [Armetta and Stevens, 1987]; 0–350 m depth [Vinogradov, 1950].

The species was common at depth from 19 to 82 m (water temperature 0.34–4.97ºC and salinity 32.2–32.73 p.p.t.). Other species occasionally present in the catches together with this species were *Paralithodes camtschaticus*, *Chionoecetes bairdi*, *Hyas coarctatus*, *Pagurus trigonocheirus*, and *Labidochirus splendescens*.

Genus *Telmessus* White, 1846

Telmessus cheiragonus (Tilesius, 1812)

MATERIAL. 46 ♂♂ (CW 41−80 mm), 1 ovigerous ♀ (CW 53 mm).

LOCALITY. Haul # 14, 15, 21, 27.

DISTRIBUTION. From the nothern Bering Sea to California and to the North Korea and the Hokkaido Island [Makarov, 1941; Vinogradov, 1950]; depth 0–50 m [Vinogradov, 1950].

In the reference area the species was collected at depth between 19 and 21 m (water temperature 3.92–5.18ºC and salinity 32.2–32.52 p.p.t.). Common co-occuring species were *Chionoecetes bairdi*, *Paralithodes camtschaticus*, *Hyas coarctatus,* and *Erimacrus isenbeckii*.

Decapod fauna of the West Kamchatka shelf

Vinogradov [1947] recorded 91 decapod taxa in the Sea of Okhotsk. Since that the following eight decapod species were found in this region: *Paralomis multispina* (Benedict, 1894) and *Lithodes couesi* Benedict, 1894 [Nizyaev, 1992]; *Chionoecetes bairdi* [Slizkin, 1982]; *Pandalopsis coccinata* Urita, 1941 [Komai, 1994]; *Argis ochotensis* Komai, 1997 [Komai, 1997]; *Lebbeus vinogradowi* Zarenkov, 1960 [Zarenkov, 1960]; *Pagurus brandti* [Sokolov, 1998]; and *Spirontocaris brevidigitata* Kobjakova, 1935 (this study).

On the other side Hayashi [1977] synonymized *Spirontocaris makarovi* (Kobjakova, 1936) and *Hetairus brevipes* Kobjakova, 1936 with respectively *Spirontocaris ochotensis* (Brandt, 1851) and *Lebbeus unalaskensis* (Rathbun, 1902). Therefore 97 decapod species are known for the Sea of Okhotsk and 50 species are recorded for the West Kamchatka shelf [Kobjakova, 1958; this study].

The entire collection of R/V "Prof. Levanidov" consists of 18 genera and 33 species/ subspecies. Another 17 taxa which were recorded in this region earlier were not found by this expedition. *Heptacarpus camtschaticus* (Stimpson, 1860), *Spirontocaris ochotensis*, and *Dermaturus mandtii* Brandt, 1850 occur in the Sea of Okhotsk at shallow depth (0–30 m). On the other hand *Argis robusta* (Kobjakova, 1935) were recorded in this region in the deep waters (deeper than 307 m). The following eight species: *Pandalus hypsinotus* Brandt, 1851; *Pandalopsis lamelligera* (Brandt, 1851); *Spirontocaris prionota* (Stimpson, 1864), *S. arcuata* Rathbun, 1902; *Lebbeus shrencki* (Brashnicov, 1907), *Eualus suckleyi* (Stimpson, 1864); *Pagurus undosus* (Benedict, 1892) and *Hapalogaster grebnitzkii* Schalfeew, 1892 rarely occur in the southern part of West Kamchatka shelf [Vinogradov, 1947]. These species were as a rule recorded north to the study area. Although *Argis crassa* (Rathbun, 1902), *Eualus townsendi* (Rathbun, 1902), *Heptacarpus flexus* (Rathbun, 1902) and *Sclerocrangon boreas* (Phipps, 1774) were reported to be rather common species in this part of Sea of Okhotsk [Vinogradov, 1947] but they were not found in the present survey.

Distribution of decapod species in the Southern part of West Kamchatka shelf

Amongst 33 species and subspecies recorded in the present study the most common species were *Chionoecets bairdi*, *Chionoecetes opilio*, *Paralithodes camtschaticus*, *Pagurus trigonocheirus*, *Labidochirus splendescens*, and *Hyas coarctatus alutaceus*. All these species but *Chionoecetes bairdi* are widely ranged in the Sea of Okhotsk. The latter species was recorded there only recently [Slizkin, 1982]. *Paralithodes camtschaticus* and *Chionoecetes bairdi* were most abundant species at the shallow depth. *Pandalus borealis eous* and *Chionoecetes opilio* dominated at the depth from 200 to 300 m to the north of 52º00′N.

The assemblage of the most common species collected by the R/V "Prof. Levanidov" is subdivided into following groups according to the depth of occurence (Fig. 32):

1) shallow water species, e.g. *Telmessus cheiragonus*, *Erimacrus isenbekii* and *Crangon dalli*, which recorded at the depth from 20 to 100 m, but were numerous at depth 20–25 m;

2) species occurred at depth from 20 to 200 m being most common between 60 and 80 m, e.g. *Spirontocaris murdochi*, *Hyas coarctatus alutaceus*, *Mesocrangon intermedia*, and *Pagurus trigonocheirus*;

3) widely distributed species most common at depth from 50 to 100 m, e.g. *Chionoecetes bairdi*, *Paralithodes camtschaticus*, *Argis lar*, *Labidochirus splendescens*, *Pandalus goniurus*, and *Crangon communis*;

4) deep sea species most abundant deeper than 200 m, e.g. *Chionocetes opilio*, *Pandalus borealis eous*, *Lithodes aequispinus*, and *Argis ochotensis*.

Some species of the second and the third groups (*Hyas coarctatus alutaceus*, *Paralithodes camtschaticus*) which occurred at most station within the depth range of 60–70 m (Fig. 32a), were most abundant at shallow water stations (Fig. 32b). Large-size males of *Paralithodes camtschaticus* dominated in the trawls catches and juvenile specimens of *Hyas coarctatus alutaceus* dominated in dredge samples at depth from 20 to 25 m. Mature males

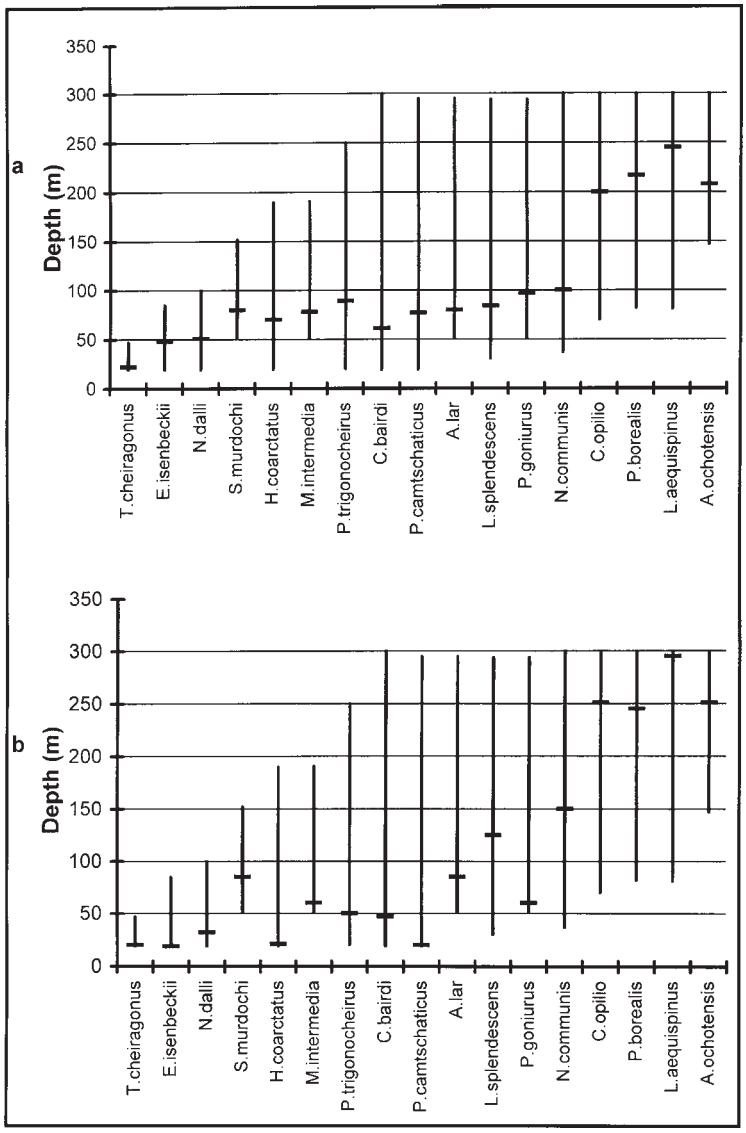

Fig. 32. Distribution of most common species according to depth: a — depth at which species were most common; b — depth at which species were most numerous.

Рис. 32. Распределение по глубинам наиболее массовых видов: a — глубина на которой вид наиболее часто встречался; b — глубина, на которой вид был наиболее многочисленен.

and females of *Hyas coarctatus alutaceus* usually occurred at depth between 60 and 100 m.

The following groups of the most common species may be defined according to temperature preference (Fig. 33):
1) the species which were found in the narrow temperature range being most abundant at water temperature 1.3–1.8ºC, e.g. *Argis ochotensis*, *Pandalus borealis eous*, *Pandalus goniurus*, and *Lithodes aequispinus*;
2) relatively "cold-water" species (*Spirontocaris murdochi*, *Argis lar*, *Mesocrangon intermedia*, *Crangon communis*), which usually occurred at water temperature less than 1ºC;
3) species occurring within a wide temperature ranges, most common and numerous at temperature between 1 and 3ºC (*Chionoecetes opilio*, *Pagurus trigonocheirus*, *Crangon dalli*, *Hyas coarctatus alutaceus*);
4) relatively "warm-water" species (*Paralithodes camtschaticus*, *Erimacrus isenbeckii*, *Telmessus cheiragonus*).

Juvenile specimens of *Hyas coarctatus alutaceus* were most abundant in dredge catches at water temperature 5ºC, but mature specimens of this species usually occurred at water temperature 1–2ºC. *Labidochirus splendescens* was common in relatively warm water (temperature between 3 and 3.2ºC) but the most abundant catches of this secies were obtained at water temperature 1.5ºC.

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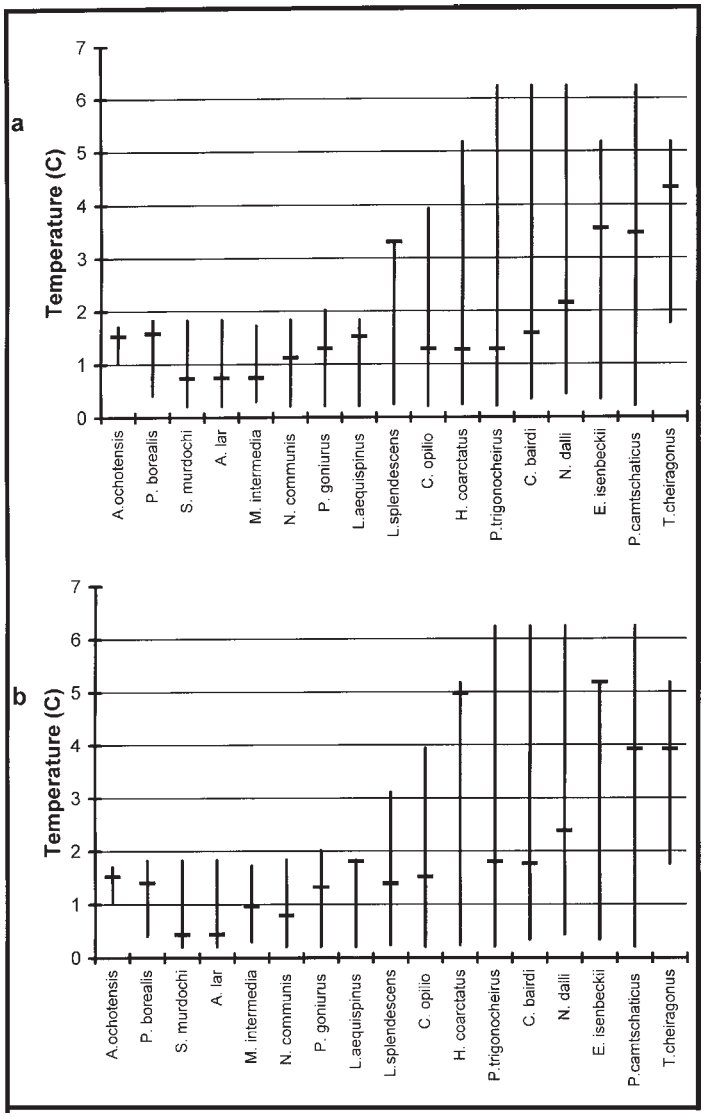

Fig. 33. Distribution of most common species according to bottom water temperature: a — temperature at which species were most common; b — temperature at which species were most numerous.

Рис. 33. Распределение по температуре наиболее обычных видов: a — температура, при которой вид наиболее часто встречался; b — температура, при которой вид был наиболее многочисленен.

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Attachment.
Приложение.

Haul ##					
1.	01.07.96	Depth 30 m	51°17′7N–156°31′3E	T=4.93°	S=32.56
2.	01.07.96	Depth 80 m	51°14′7N–156°29′6E	T=2.148°	S=32.83
3.	02.07.96	Depth 20 m	51°33′7N–156°27′3E	T=6.24°	S=32.6
4.	02.07.96	Depth 40 m	51°32′1N-156°22′1E	T=4.31°	S=32.65
5.	02.07.96	Depth 69 m	51°31′5N–156°17′5E	T=3.12°	S=32.74
6.	02.07.96	Depth 200 m	51°31′7N–156°11′1E	T=1.225°	S=33.15
7.	03.07.96	Depth 100 m	51°31′3N–156°31′3E	T=1.87°	S=32.9
8.	03.07.96	Depth 300 m	51°33′7N–156°07′4E	T=1.63°	S=33.32
9.	04.07.96	Depth 250 m	51°47′5N–155°50′7E	T=1.54°	S=33.3
10.	04.07.96	Depth 152 m	51°45′N–155°57′E	T=1.08°	S=33.15
11.	04.07.96	Depth 84 m	51°45′8N–156°02′9E	T=1.42°	S=32.93
12.	04.07.96	Depth 50 m	51°45′8N–156°17′1E	T=4.22°	S=32.7
13.	05.07.96	Depth 31 m	51°45′N–156°24′E	T=4.57°	S=32.65
14.	05.07.96	Depth 21 m	51°45′N–156°26′E	T=4.97°	S=32.52
15.	05.07.96	Depth 19 m	52°00′N–156°25′E	T=5.18°	S=32.35
16.	05.07.96	Depth 43 m	52°00′N–156°18′E	T=2.54°	S=32.62
17.	05.07.96	Depth 60 m	52°00′N–156°08′E	T=2.025°	S=32.73
18.	06.07.96	Depth 101 m	52°00′N–155°44′E	T=1.22°	S=33.08
19.	06.07.96	Depth 217 m	51°59′N–155°20′E	T=1.58°	S=33.37
20.	06.07.96	Depth 294 m	52°20′N–154°54′8E	T=1.79°	S=33.38
21.	07.07.96	Depth 21 m	52°15′N–156°22′8E	T=3.35°	S=32.5
22.	08.07.96	Depth 31 m	52°15′N–156°18′E	T=2.18°	S=32.56
23.	08.07.96	Depth 52 m	52°15′N–156°02′E	T=1.83°	
24.	09.07.96	Depth 82 m	52°15′N–155°37′5E	T=1.69°	S=32.95
25.	09.07.96	Depth 151 m	52°15′N–155°20′E	T=1.26°	S=33.1
26.	10.07.96	Depth 247 m	52°15′N–154°56′E	T=1.58°	S=33.29
27.	10.07.96	Depth 20 m	52°30′N–156°14′E	T=3.92°	S=32.2
28.	12.07.96	Depth 47 m	52°30′N–155°55′E	T=1.76°	S=32.6
29.	12.07.96	Depth 61 m	52°30′N–155°41′E	T=1.8°	S=32.72
30.	13.07.96	Depth 99 m	52°30′N–155°18′E	T=1.55°	S=32.98
31.	13.07.96	Depth 199 m	52°30′N–154°57′E	T=1.4°	S=33.23
32.	13.07.96	Depth 245 m	52°45′N–154°43′E	T=1.67°	S=33.36
33.	13.07.96	Depth 147 m	52°45′N–155°05′E	T=1.15°	S=32.97
34.	14.07.96	Depth 81 m	52°45′N–155°22′E	T=1.47°	S=32.82
35.	14.07.96	Depth 52 m	52°45′N–155°39′E	T=1.33°	S=32.55
36.	15.07.96	Depth 300 m	53°00′N–154°25′E	T=1.83°	S=33.39
37.	15.07.96	Depth 200 m	53°00′N–154°43′E	T=1.32°	S=33.13
38.	15.07.96	Depth 114 m	53°00′N–155°09′E	T=0.66°	S=32.77
39.	15.07.96	Depth 60 m	53°00′N–155°36′E	T=0.97°	S=32.57
40.	16.07.96	Depth 51 m	53°00′N–155°45′E	T=1.31°	S=32.58
41.	16.07.96	Depth 53 m	53°15′N–155°42′E	T=0.86°	S=32.59

Haul ##

42.	16.07.96	Depth 78 m	53°15′N–155°26′E	T=0.34°	S=32.64
43.	16.07.96	Depth 150 m	53°15′N–154°51′E	T=0.79°	S=32.87
44.	17.07.96	Depth 251 m	53°15′N–154°30′E	T=1.59°	S=33.27
45.	18.07.96	Depth 295 m	53°30′N–154°24′E	T=1.81°	S=33.39
46.	18.07.96	Depth 195 m	53°30′N–154°34′E	T=1.28°	S=33.11
47.	18.07.96	Depth 100 m	53°30′N–155°10′E	T=0.21°	S=32.67
48.	19.07.96	Depth 59 m	53°30′N–155°32′E	T=0.54°	S=32.62
49.	19.07.96	Depth 251 m	53°45′N–154°23′E	T=1.52°	S=33.22
50.	20.07.96	Depth 151 m	53°45′N–154°43′E	T=1.06°	S=32.91
51.	20.07.96	Depth 85 m	53°16′N–155°16′E	T=0.44°	S=32.68
52.	20.07.96	Depth 85 m	53°45′N–155°16′E	T=0.44°	
53.	20.07.96	Depth 52 m	53°45′N–155°31′E	T=0.73°	S=32.64
54.	21.07.96	Depth 61 m	54°00′N–155°22′E	T=0.74°	S=32.66
55.	21.07.96	Depth 100 m	54°00′N–155°01′E	T=0.41°	S=32.74
56.	21.07.96	Depth 200 m	54°00′N–154°28′E	T=1.31°	S=33.13
57.	22.07.96	Depth 52 m	53°01′N–155°43′E	T=1.1°	S=32.59
58.	23.07.96	Depth 152 m	51°45′N–155°56′E	T=1.73°	S=33.09

Dredge ##

1.	01.07.96	Depth 19 m	51°10′N–156°41′E	T=4.67°	S=32.61
2.	01.07.96	Depth 37 m	51°09′2N–156°37′9E	T=4.67°	S=32.62
3.	01.07.96	Depth 76 m	51°10′N–156°26′E	T=2.02°	S=32.92
4.	01.07.96	Depth 180 m	51°10′3N–156°16′5E	T=1.3°	S=33.03
5.	03.07.96	Depth 154 m	51°36′N–156°09′5E	T=1.7°	S=32.9
6.	03.07.96	Depth 72 m	51°36′N–156°14′E	T=2.97°	S=32.24
7.	03.07.96	Depth 52 m	51°35′N–156°18′E	T=3.94°	S=32.6
8.	03.07.96	Depth 28 m	51°35′N–156°25′E	T=4.67°	S=32.65
9.	07.07.96	Depth 37 m	52°00′N–156°20′E	T=2.8°	S=32.68
10.	07.07.96	Depth 51 m	52°00′N–156°10′E	T=2.15°	S=32.73
11.	07.07.96	Depth 77 m	52°00′N–155°51′E	T=1.87°	S=32.86
12.	07.07.96	Depth 110 m	52°00′N–155°40′E	T=1.27°	S=33.15
13.	07.07.96	Depth 155 m	52°00′N–155°37′8E	T=1.31°	S=33.21
14.	07.07.96	Depth 191 m	52°00′N–155°28′E	T=1.5°	S=33.34
15.	09.07.96	Depth 192 m	52°20′N–155°04′E	T=1.3°	S=33.21
16.	09.07.96	Depth 125 m	52°20′N–155°18′5E	T=1.39°	S=32.99
17.	09.07.96	Depth 80 m	52°20′N–155°34′5E	T=1.84°	S=32.9
18.	09.07.96	Depth 54 m	52°20′N–155°54′5E	T=1.83°	S=32.75
19.	09.07.96	Depth 32 m	52°20′N–156°13′E	T=2.39°	S=32.56
20.	09.07.96	Depth 22 m	52°20′N–156°19′E	T=4.72°	S=32.31
23.	14.07.96	Depth 50 m	52o45′N–155°42′E	T=1.42°	S=32.64
24.	14.07.96	Depth 80 m	52°45′N–155°23′E	T=1.47°	S=32.82
25.	14.07.96	Depth 100 m	52°45′N–155°08′E	T=1.53°	S=32.93
26.	14.07.96	Depth 165 m	52°45′N–154°57′E	T=1.23°	S=33.1
27.	17.07.96	Depth 178 m	53°10′N–154°45′E	T=1.01°	S=32.98
28.	17.07.96	Depth 113 m	53°10′N–155°10′E	T=0.43°	S=32.74
29.	17.07.96	Depth 79 m	53°10′N–155°24′5E	T=0.44°	S=32.63
33.	17.07.96	Depth 56 m	53°25′N–155°45′8E	T=0.75°	S=33.59
34.	17.07.96	Depth 95 m	53°25′N–155°15′E	T=0.24°	S=32.65
35.	18.07.96	Depth 190 m	53°25′N–154°38′E	T=1.18°	S=33.06
37.	19.07.96	Depth 55 m	53°35′N–155°35′E	T=0.88°	S=32.61
38.	19.07.96	Depth 70 m	53°35′N–155°25′E	T=0.53°	S=32.66
39.	19.07.96	Depth 94 m	53°35′N–155°11′5E	T=0.3°	S=32.67
40.	19.07.96	Depth 152 m	53°35′N–154°43′6E	T=1.03°	S=32.89
41.	21.07.96	Depth 166 m	54°00′N–154°35′6E	T=1.13°	S=32.98
42.	21.07.96	Depth 127 m	54°00′N–154°52′E	T=0.44°	S=32.75
43.	21.07.96	Depth 85 m	54°00′N–155°06′E	T=0.44°	S=32.7
44.	22.07.96	Depth 65 m	54°00′N–155°20′E	T=0.67°	S=32.68
45.	22.07.96	Depth 53 m	54°00′N–155°30′E	T=0.83°	S=32.64