New records of deep-water shrimps of the genus *Pandalopsis* with a description of *P. zarenkovi* spec. nov. (Crustacea: Decapoda: Pandalidae) from the Bering Sea

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Key words: Crustacea; Decapoda; Caridea; Pandalidae; *Pandalopsis*; new species; Bering Sea.
A collection of pandalid shrimps was obtained from trawl catch in the western Bering Sea at a depth of 362 m off the Navarin Cape in June 1999. There were two species of *Pandalopsis* in the collection, *P. dispar* and a new species, *P. zarenkovi* spec. nov., which is described herein. The diagnostic characters of the new species are discussed in relation to related congeners. The side-stripe shrimp, *P. dispar,* has been recorded for the first time in the Russian waters. This species is fished commercially as a by-catch of *Pandalus borealis*.

Introduction

The North Pacific seems to be an area of radiation of pandalid shrimps, particularly of the genus *Pandalopsis*. This genus comprises 15 species of which only one is known to occur outside the North Pacific (Komai, 1994). Those species of the genus *Pandalus* which produce large eggs are known to have rather limited areas of distribution (Rothlisberg, 1980). Similarly, the ranges of *Pandalopsis* species, which all carry large eggs, seem to be limited even though most of the *Pandalopsis* species inhabit the bathyal zone where environmental characteristics do not vary as much as they do on the shelf. Rather few *Pandalopsis* specimens are present in museum collections.

During the trip of the F/V '*Vulkannyi*' in June 1999, two species of the genus *Pandalopsis* were caught off the Cape Navarin, the western Bering Sea. One of them was attributed to *P. dispar*. This species is common in the Gulf of Alaska and British Columbia but has not yet been recorded off the Asian coast. The second species did not conform to any known species and is here described as new.

Materials and Methods

The *Pandalopsis* specimens were collected during experimental trawl fishing of a VNIRO expedition on board the fishing vessel "*Vulkannyi*" in the western Bering Sea. Samples were obtained by otter-trawl (44 m flat shrimp trawl) with 45 mm mesh size (knot to knot) and a panel of 20 mm mesh net lining the cod end. Specimens were fixed in buffered 10% formalin seawater solution and preserved in 70% ethyl alcohol.

The carapace length (CL), from the base of eyestalk to the posterior mid-dorsal edge of carapace, and postorbital body length (BL), from orbital edge to tip of telson, were measured to the nearest 0.1 mm for the CL and to the nearest 1 mm for the BL. The specimens were sexed by examination of the endopodite of the first two pairs of pleopods. Shrimp specimens examined in this study are deposited in the Zoological

Museum of Moscow State University (ZM MSU), and the Nationaal Natuurhistorisch Museum, Leiden, The Netherlands (was Rijksmuseum van Natuurlijke Historie (RMNH)).

Pandalopsis zarenkovi spec. nov.
(figs. 1-3)

Material examined.— Holotype, ovigerous female, CL 33.2 mm (ZM MSU No. MA 5234); Paratypes: male, CL 32.8 mm (No. MA 5235); 4 males, CL 30-32.3 mm (No. MA 5236); 1 intersex, CL 31.6 mm (RMNH D 48611); 3 ovigerous females, CL 33.2-34.1 mm (No. MA 5236); 1 non-ovigerous female, CL 31.3 mm (RMNH D 48611): Bering Sea, 61°43.4′N 177°37.8′W; 15.vi.1999; depth 362 m; commercial otter-trawl; fishing vessel "*Vulkannyi*" Sta. 23.

Description of holotype.— Carapace smooth. Rostrum strongly curved upward, 1.48 times as long as carapace length; dorsal margin armed with 14 movable spines, 8 on carapace posterior to level of orbital margin, 6 in proximal half of rostrum; slightly more than distal half without spines; tip trifid; posteriormost spine situated slightly anterior to level of midlength of carapace. Ventral margin of rostrum armed with 13 acute teeth, posteriormost tooth smaller than preceding one (Fig.1a-c). No small patch of short setae near posterodorsal edge of carapace.

Strong antennal spine presents just below orbital angle. Pterygostomial spine small. No other spines on carapace (fig.1a).

Abdomen smooth. Sixth abdominal somite 0.52 times as long as carapace length, 1.88 times as long as proximal depth. Pleurae of fourth and fifth abdominal segments with one posteroventral tooth each (figs.1a, 2a). Telson (fig. 2b) 0.78 times as long as carapace, armed with 8 pairs of dorsolateral spines. Posterior tip of telson convex, armed with two pairs of terminal spines.

Antennular peduncle (fig.1d) reaching midlength of scaphocerite; stylocerite broadly rounded. Lower margin of basal segment armed with small spine (fig.1e). Basal segment 1.1 times longer than combined distal segments, penultimate segment about 1.2 times length of distal segment. Outer antennular flagellum short, about 0.7 times carapace length, composed of 72 articles. Inner antennular flagellum extending slightly beyond rostrum, 1.1 times as long as carapace length.

Scaphocerite (fig.1f) 4.1 times as long as its greatest width, 0.77 times as long as carapace length, anterior margin rounded; distolateral tooth projecting well beyond anterior margin of lamina. Antennal flagellum long, 5.4 times as long as carapace length.

Mouth parts not examined.

Third maxilliped moderately stout, almost reaching distal end of scaphocerite (fig.1a).

All pereiopods except fifth with epipods (fig.3a-c).

First pereiopod (fig.3a) short, reaching midlength of scaphocerite, dactylus slightly shorter than propodus, 0.7 times as long as carpus.

Second pereiopod (fig.3b) long and slender, overreaching scaphocerite with half of propodus length. Fingers of chela, 0.6 times palm length. Carpus as long as ischium, 2.3 times longer than merus, subdivided into 17 articles.

Posterior three pairs of pereiopods relatively long. Third pereiopod (fig. 3c) overreaching scaphocerite by dactylus and fourth of propodus length. Dactylus (fig. 3e) 0.2 times as long as propodus, with 6 spinules on flexor margin, distal third of flexor

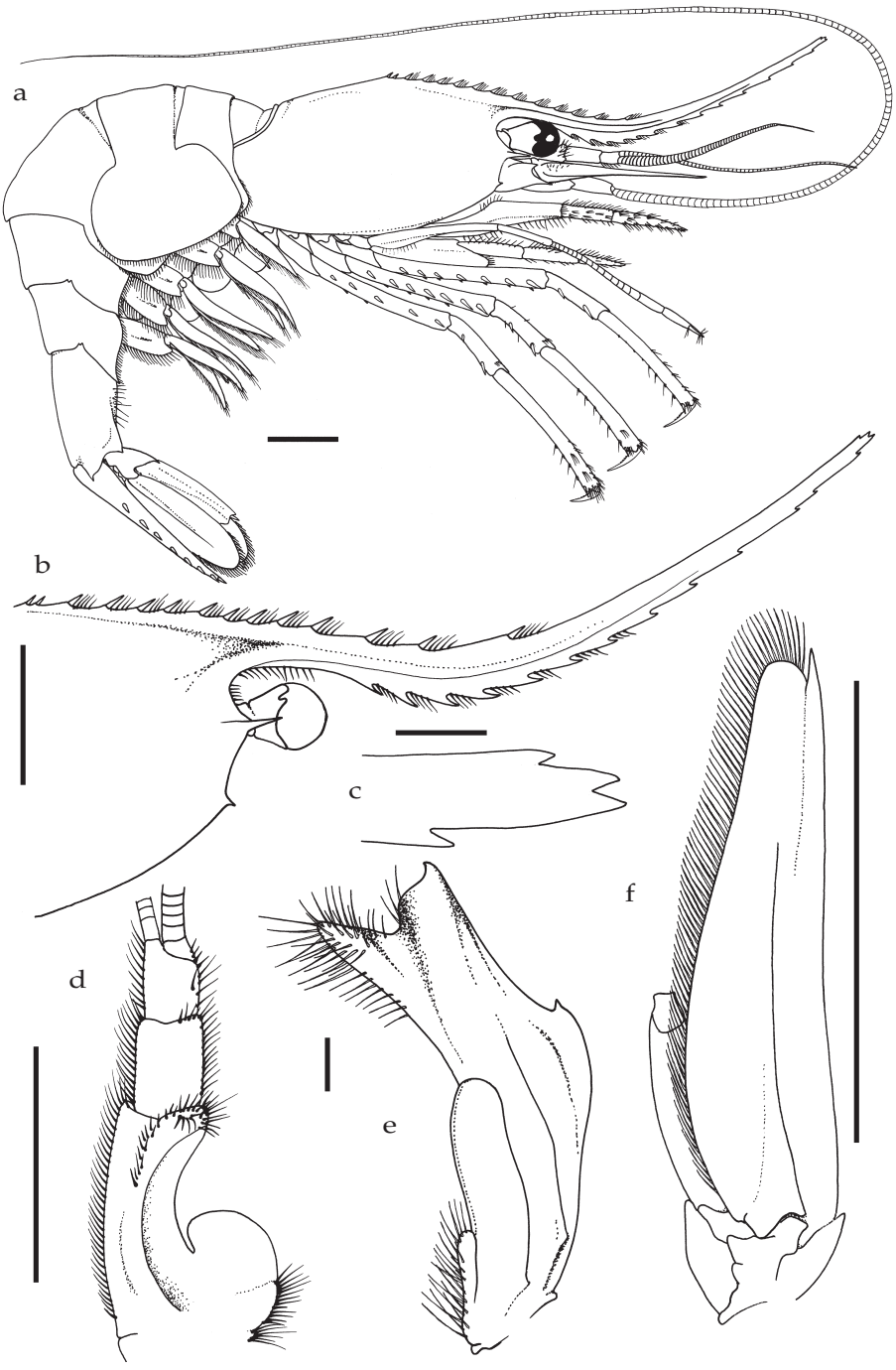

Fig. 1. *Pandalopsis zarenkovi* spec. nov., holotype, ovigerous female, CL 33.2 mm. a, lateral view; b, rostrum; c, tip of rostrum; d, antennular peduncle, dorsal; e, basal segment antennular peduncle, lateral view; f, scaphocerite. Scale a, b, d, f = 1 cm; c, e = 1 mm.

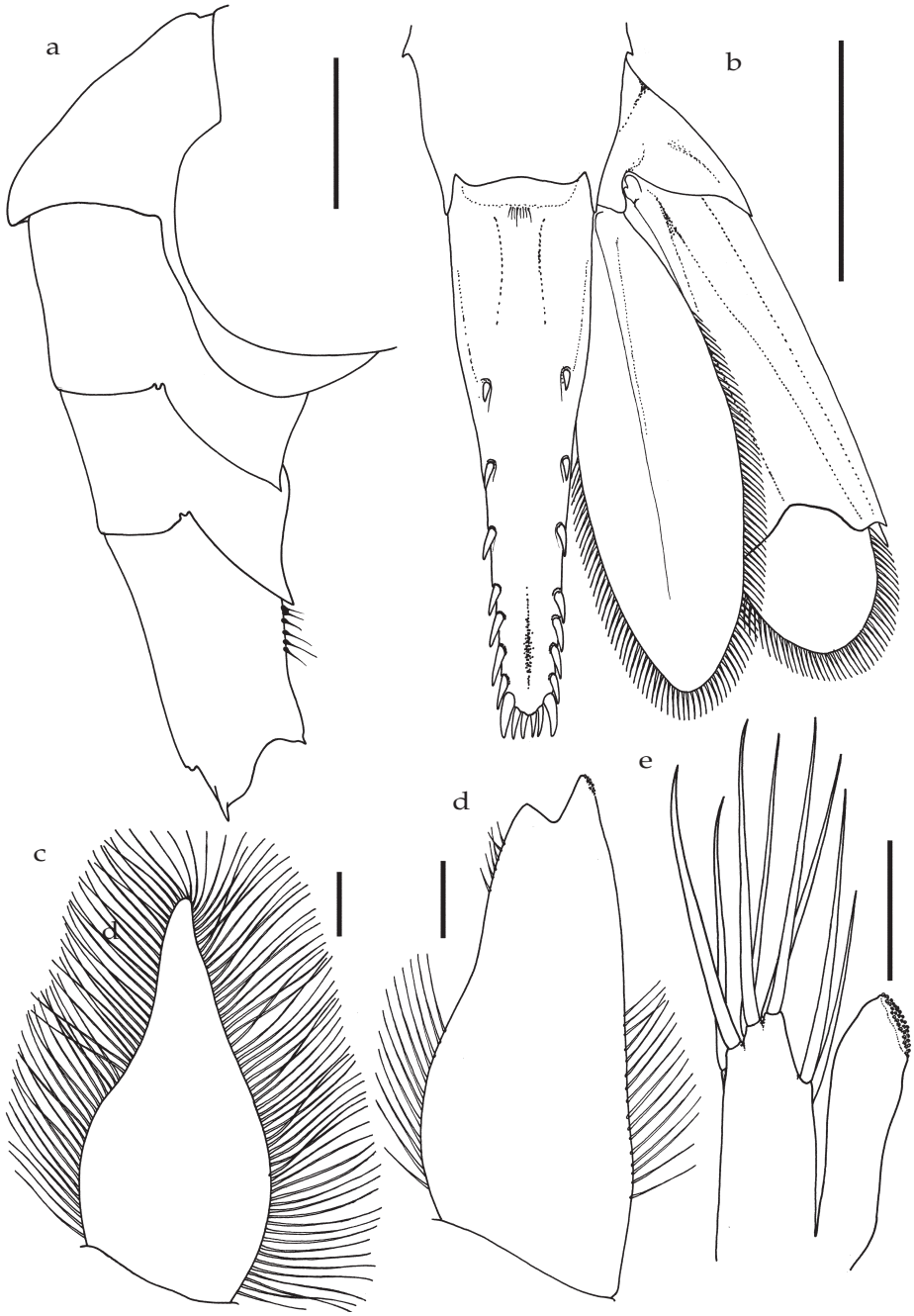

Fig. 2. *Pandalopsis zarenkovi* spec. nov., a, abdominal somites, lateral view; b, telson and uropods; c, female endopod of pleopod 1; d, male endopod of pleopod 1; e, appendices masculine and interna of pleopod 2 of male. a-c, holotype, ovigerous female, CL 33.2 mm; d,e, male, CL 32.8 mm. Scale a, b = 1 cm; c-e = 1 mm.

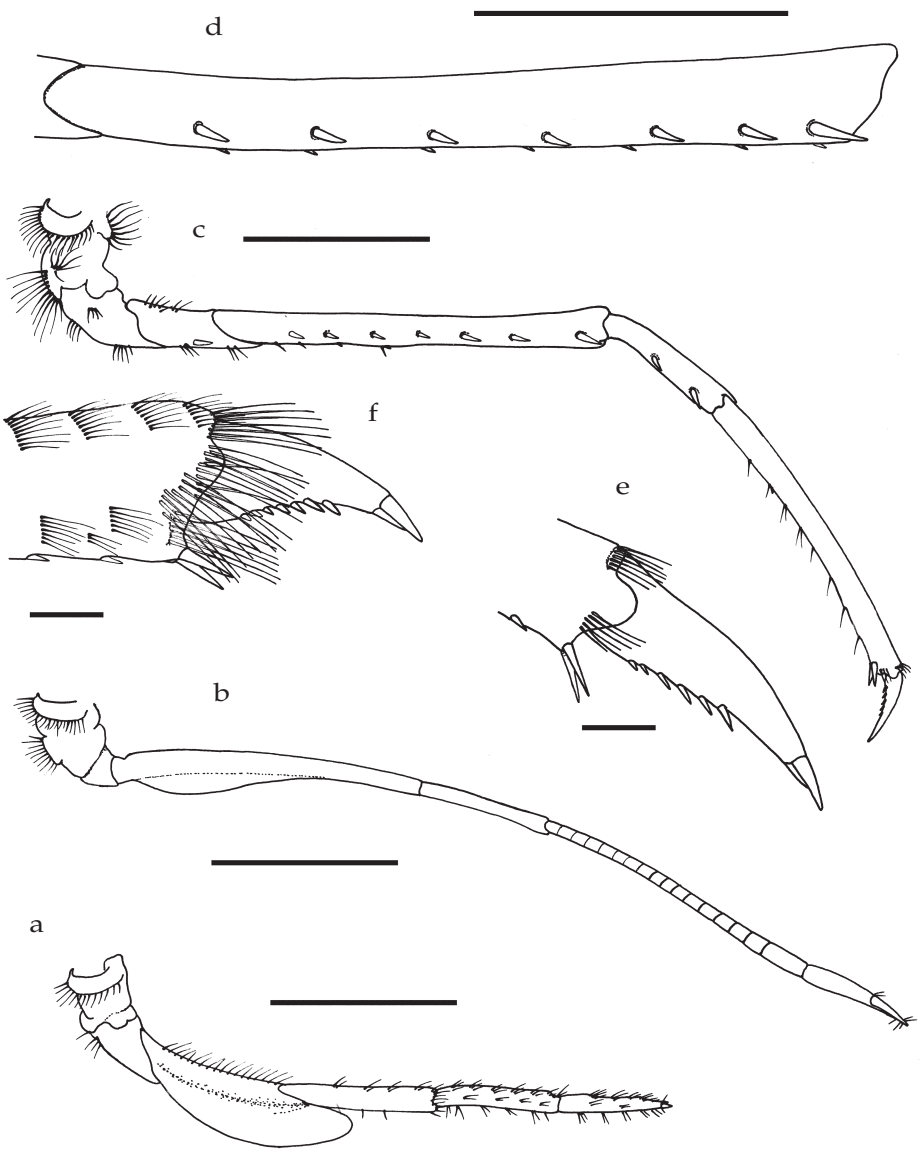

Fig. 3. *Pandalopsis zarenkovi* spec. nov., holotype, ovigerous female, CL 33.2 mm. a, pereiopod 1; b, pereiopod 2; c, pereiopod 3; d, merus of pereiopod 3; e, dactylus of pereiopod 3; f, dactylus of pereiopod 5. Scale a-d = 1 cm; e, f = 1 mm.

margin lacking spinules. Carpus half length of propodus, with 2 lateral spines. Merus 2.5 times as long as carpus, armed with 7 lateral spines and 7 mesial spines (fig. 3d).

Fourth pereiopod similar to third, overreaching scaphocerite with dactylus.

Fifth pereiopod reaching end of scaphocerite. Dactylus (fig. 3f) short, 0.6 times as long as dactylus of third pereiopod, with 7 spinules on flexor margin, distal 0.25 of

flexor margin lacking spinules. Merus armed with mesial and lateral rows of spines. Five spines in lateral row and 4 spines in mesial row.

Endopod of first pleopod tapering in distal third (fig. 2c).

Mean size of eggs eyed are 5.1 x 3.5 mm.

Size.— CL 33.2 mm, BL 124 mm.

Coloration in life.— Pink with violet tint on upper side of cephalothorax and abdomen; rostrum with white band subapically; anterior 5 abdominal somites with obscure white bands; sixth abdominal somite with broad white lateral stripe; antennular and antennal flagella with red and white bands; scaphocerite with whitish lateral margin; lateral surface of merus, carpus, and proximal three-fourths of propodus of pereiopods 3-5 white. (Similar in color to *P*. cf. *longirostris* in Komai, 1994).

Notes on paratypes.—The length of the rostrum varies between 1.41-1.50 of the carapace length. The lower margins of the rostra are armed with 10-14 spines. The number of carpal articles of the second pereiopods ranged from 10 to 14. The meri of pereiopod 3 are armed with 7-8 lateral and 7 mesial spines, and those of pereiopods 5 with 5-6 lateral and 4-5 mesial spines.

Etymology.— The specific name *zarenkovi* is derived from the surname of the Russian carcinologist Dr N.A. Zarenkov, Moscow State University, in recognition of his contribution to carcinology of the Russian Far Eastern Seas.

Remarks.— This species resembles *P. miyakei* Hayashi, 1986, *P. ampla* Bate, 1888, *P. ochotensis* Kobjakova, 1936, *P. coccinata* Urita, 1941, and *P. longirostris* Rathbun, 1902, by the smooth carapace and small posteriormost ventral spine of the rostrum (posteriormost ventral spine smaller than the preceding spine).

The new species resembles *P. miyakei* Hayashi, 1986 in having 6 or more dorsal spines on the carapace and a short outer antennular flagellum. It differ in the following characters: (1) the new species the posteriormost dorsal spine is situated in the half of the carapace while it is situated in the posterior half in *P. miyakei*; (2) the new species has more numerous dorsolateral spines on the telson (7-8 pairs versus 5 pairs in *P. miyakei*); (3) the new species has the distal 0.33-0.25 of the flexor margins of the dactyli of pereiopods 3-5 unarmed (except for the pair of terminal joint spines), while in *P. miyakei* the entire flexor margins of the dactyli are armed with accessory spinules; (4) the new species can be distinguished from *P. miyakei* by the coloration when alive (in *P. miyakei* there is no a white band behind the apical end of the rostrum and there are no white bands on the antennular and antennal flagella, which are present in the new species); (5) *P. miyakei* is known from the Pacific coast of southern Japan and the East China Sea (Komai, 1994) while the new species has been caught in the north-western Bering Sea.

P. zarenkovi spec. nov. differs from *P. ochotensis* and *P. coccinata* in the structure of the dactyli of the ambulatory pereiopods. In our specimens the spines on the flexor margins of the dactyli are distributed along the proximal two-third (at least much more than 0.5 of the length), while in *P. ochotensis* and *P. coccinata* at least the distal half of the flexor margins lacks spines. The dactyli of pereiopod 3-5 in *P. ochotensis* and *P. coccinata* are narrower than in our specimens. The armature of the upper margin of the rostrum also differs in these species from our specimens. *P. ochotensis* can be distinguished from *P. zarenkovi* spec. nov. in (1) having the dorsal rostral spines distributed evenly over the distal half of the dorsal margin while lacking in *P. zarenkovi* spec. nov., (2) the small

patch of short setae on the cardiac region which is absent in *P. zarenkovi* spec. nov., and (3) the longer outer antennular flagellum. *P. coccinata* differs from our specimens by (1) the basally arched rostrum and its shape, (2) the armature of the dactyli of the third and fourth pereiopods, and (3) the shorter disto-lateral tooth of the scaphocerite.

In *P. miyakei*, *P. ampla* and *P. longirostris*, the dactyli of pereiopods 3-5 have spines distributed along the entire flexor margin while in *P. zarenkovi* spec. nov. they only occupy the proximal two-third.

The outer antennular flagella in *P. zarenkovi* spec. nov. is shorter than the carapace length while the flagella in *P. ampla* and *P. longirostris* are much longer, about twice as long as the carapace length.

The characters lead us to recognize the present specimens as belonging to a new species of *Pandalopsis*.

Side-stripe shrimp: *Pandalopsis dispar* Rathbun, 1902

Material examined.— 5 non-ovigerous females, CL 32.3-35.2 mm; 1 ovigerous female, CL 36.3 mm; 9 males, CL 18.7-26.2 mm; 2 intersexes, CL 30.4 and 30.6 mm (ZM MSU No. MA 5237); Bering Sea, 61°18,5'N-175°12,5'E, 12.vi.1999, depth of 340 m; commercial trawl; fishing vessel "*Vulkannyi*" Sta. 1.— 7 non-ovigerous females, CL 30.6-37.3 mm; 3 intersexes, CL 28.8-31.8 mm (ZM MSU No. MA 5237); Bering Sea, 61°03,5'N-179°05,1'W; 28.ix.1999; depth 298 m; commercial trawl; fishing vessel "*Vulkannyi*" Sta. 6. Besides this biological material, field remarks in log-books of the expeditions of the Pacific and All-Russia Institutes of Fisheries and Oceanography (TINRO, Vladivostok, and VNIRO, Moscow) on board of r/v "Krym", "Baksan", "Pelamida", "Adler" in 1963-1974 were used to study distribution of this species off the Russian coast in the Bering Sea.

Distribution in the Bering Sea.— *P. dispar* has never been found in the western Bering Sea until the 1960-s in spite the fact that in the 1930-1950-s this region was surveyed thoroughly by highly competent zoologists (Makarov, 1941; Vinogradov, 1950; Birstein & Vinogradov, 1953; Zarenkov, 1960; and others). Appearance of this species in the sixties may be explained by expansion of its range of distribution to the western Bering Sea due to climatic changes. In the sixties and seventies, *P. dispar* was recorded occasionally in the central (off Pribiloff area, see below) and western parts of the Bering Sea (fig. 4) in TINRO-VNIRO fishery research expeditions, but these observations have never been published. In 1999 (F/V "*Vulkannyi*") the species was recorded between longitudes 173°25.7'E and 179°07.4'W (fig. 4). *P. dispar* was common and the maximum catch was 85 kg per hour trawling.

In the central part of the Bering Sea, where the sidestripe shrimp was rather uncommon (Wolotira *et al*., 1988, fig. 158), *P. dispar* was recorded in the following points/trawl stations:

1. R/V SRTR "*Krym*", 07.02.1963; Sta.19; 57°35'N, 171°23'W; Depth of 100-103 m; 1specimen;
2. R/V SRT "*Baksan*", 18.08.1963; Sta. 55; 58°11,5'N, 171°36'W; Depth of 100 m; off-bottom temperature 2.65°C; few specimens;
3. R/V SRT "*Baksan*", 30.08.1963; Sta. 86; 58°39'N, 172°35'W; Depth of 100 m; off-bottom temperature 2.78°C; few specimens;
4. R/V RT "*Pelamida*", 07.08.1972, Sta. 170; 55°26'N, 177°45'W; Depth of 420 m; off-bottom temperature 1.65°C; 15 kg.

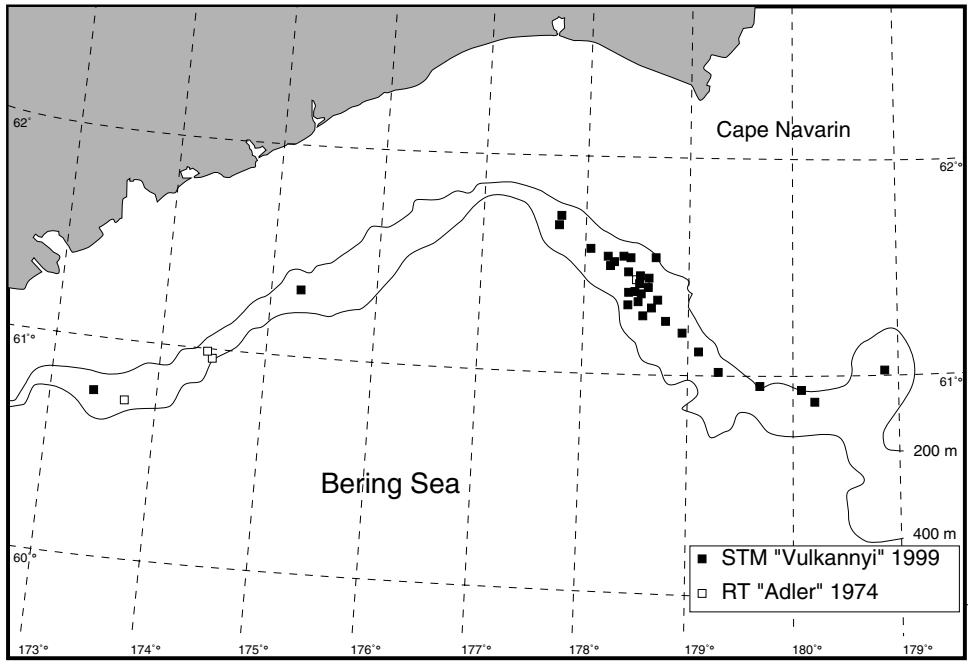

Fig.4. Records of *P. dispar* in the western Bering Sea.

Ecology.—The sidestripe shrimp, *P. dispar*, was recorded in the western Bering Sea at a depth range from 215 to 450 m, with an off-bottom temperature of 2.4 to 3.52ºC. In the central part of the Bering Sea its range was from 100 to 420 m with an off-bottom temperature of 1.65 to 2.78ºC. The northern pink shrimp, *Pandalus borealiseous* Makarov, 1935, was the most common and abundant associated species.

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References

Birstein, Ya.A. & L.G. Vinogradov, 1953. [New data on the decapod fauna of the Bering Sea].— Zoologicheskii Zhurnal **32:** 215-228 (in Russian, with English summary).

Komai, T., 1994. Deep-sea shrimps of the genus *Pandalopsis* (Decapoda: Caridea: Pandalidae) from the Pacific coast of eastern Hokkaido, Japan, with the description of two new species.— J. Crust. Biol. **14** (3): 538-559.

Makarov, V.V., 1941. [The decapod Crustacea of the Bering and the Chukchi Seas].— Issledovanija

dalnevostochnikh morei SSSR **1:** 111-163 (in Russian, with English summary).

Rothlisberg, P.C., 1980. A complete larval description of *Pandalus jordani* Rathbun (Decapoda, Pandalidae) and its relations to the others members of the genus *Pandalus*.— Crustaceana **38** (1): 19-48.

Vinogradov, L.G., 1950. Opredelitel krevetok, rakov i krabov Dalnego Vostoka [Classification of shrimps, crayfishes, and crabs from Far East].— Izvestia TINRO **33**: 179-358 (in Russian).

Wolotira, R.J., T.M. Sample, S.F. Noel & C.R. Iten, 1993. Geographic and bathymetric distributions for many commercially important fishes and shellfishes off the west coast of North America, based on research survey and commercial catch data, 1912-84.— NOAA Tech. Memorandum NMFS-AFSC-6: 1-184.

Zarenkov, N.A., 1960. [Note about some decapod Crustacea of the Okhotsk and Bering Seas].— Trudy Instituta Okeanologii **34:** 343-350 (in Russian).

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