ISSN 1063-0740, Russian Journal of Marine Biology, 2011, Vol. 37, No. 3, pp. 165–176. © Pleiades Publishing, Ltd., 2011.
Original Russian Text © V.G. Chavtur, E.R. Mazdygan, 2011, published in Biologiya Morya.

PLANKTONOLOGY

Composition and Distribution of Pelagic Ostracods (Ostracoda: Myodocopa) in the Somov and Ross Seas and Adjacent Waters of the Southern Ocean

V. G. Chavtur[a, b] and E. R. Mazdygan[a]

[a] *Institute of Marine Biology, Far East Branch, Russian Academy of Sciences, Vladivostok, 690041 Russia*
[b] *Far East Federal University, Vladivostok, 690050 Russia*
e-mail: vchavtur@imb.dvo.ru

Received: November 25, 2010

Abstract—The study of materials collected by Russian expeditions and literature data showed that the pelagic ostracod fauna of the Somov Sea, which lies south of the Antarctic Divergence (AD), is an impoverished complex of the fauna of the Australian–New Zealand Antarctic sector. While to the north of the AD the ostracod fauna includes species introduced from waters of the subantarctic and tropical–subtropical structures, ostracods of the Somov Sea are mainly typical Antarctic species. To the north and south of the AD, ostracod abundance and species richness are highest in the depth range of 200–500 m (especially at 300–400 m). *Austrinoecia isocheira* is the most common species in the Somov Sea and *Alacia hettacra* in the adjacent northern region. The more southerly Ross Sea has harsher environmental conditions than the Somov Sea and its ostracod fauna is a more impoverished complex of mainly Antarctic species. *Alacia belgicae* and *A. isocheira* are the dominant species in the Ross Sea, with their highest abundances at 200–300 m depths. The proportion of *A. hettacra* in the Ross Sea taxocene decreases southwards. The taxonomical composition and biogeographical structure of ostracod faunas change in the AD region at the northern boundaries of both seas.

Keywords: Ostracoda, Halocyprididae, Cypridinidae, latitudinal and vertical distribution, Somov and Ross Seas, Southern Ocean, Antarctic.

DOI: 10.1134/S1063074011030047

The first information on the pelagic ostracod fauna of seas in Australian–New Zealand sector of the Antarctic was published at the beginning of the 20th century [10, 15]. In the materials collected in the Ross Sea by British expeditions aboard the *Discovery* (1901–1904) and *Terra Nova* research vessels the following species were recorded: *Alacia belgicae, A. hettacra, Boroecia antipoda, Gaussicia edentata, Conchoecissa imbricate*, and *Pseudoconchoecia serrulat* (here and below we use the modern spelling of Latin names for the ostracod species; their respective authors are listed in Table 2).

The next time information about this area appeared was more than half a century later. After the treatment of materials of expeditions aboard the *Eltanin* RV (cruises 27, 32, 51, and 57) the ostracod list of the Ross Sea was supplemented with *Austrinoecia isocheira, Metaconchoecia skogsbergi, Proceroecia brachyaskos*, and *Archiconchoecemma simula* and two new species, *Deeveyoecia arcuata* and *Archiconchoecetta bidens* were described from the area adjacent to the northern border of the Ross Sea [16]. The first data were also presented on the Halocyprididae fauna of the Somov Sea and adjacent areas and the following species were listed: *A. hettacra, B. antipoda*, *M. skogsbergi, A. isocheira, P. brachyaskos, A. simula, Conchoecilla chuni, Obtusoecia antarctica*, *Discoconchoecia* aff. *elegans*, *P. serrulata, Conchoecissa symmetrica, Muelleroecia macromm*, and *Vityazoecia lunata* (the first six species were found in the Somov Sea) [17]. It is pertinent to note that in the mid-1970s a paper was published describing the bioluminescence of *A. belgicae* in the surface water layer of the Ross Sea [26].

In the 1970s and 1980s the Australian–New Zealand sector of the Antarctic was surveyed by Russian expeditions aboard the *Dmitrii Mendeleev*, *Mys Tikhii*, *Mys Yunona*, and *Professor Deryugin* research vessels. The collected materials were partially examined and data were published concerning the composition and the latitudinal and vertical distributions of ostracods [8, 9]. In the late 1980s (1987–1988 and 1989–1990) Italian expeditions worked in the Ross Sea and adjacent waters [11–13, 18, 21–25]. As well as previously known ostracods, one new species, *Proceroecia rivoltella* was recorded in the samples [13]. Finally, *Atlas of Southern Ocean Planktonic Ostracods* was recently compiled [14]. This is a comprehensive and well-illustrated treatise that contains maps of the

Table 1. Materials used in the project

Expedition	Year	Number of		Maximum depth of sampling, m	Sampling gear
		stations	samples		
Somov Sea and adjacent northwardly located waters up to 60°S					
Ob' ice breaker	1956	1	1	2000	C-100
Dmitrii Mendeleev RV	1976	8	48	1500	BJN, OJN
Mys Tikhii RV	1981	68	149	2480	BJN
Mys Yunona RV	1981	8	12	500	BJN
Mys Yunona RV	1983	2	2	100	BJN
Ross Sea and adjacent northwardly located waters up to 60°S					
Mys Yunona RV	1981	19	24	500	BJN
Mys Yunona RV	1983	9	16	500	BJN
Total		115	252		

Note: C-100 is a conical net with a mouth area of 1 m^2; BJN (big Juday net) is a Juday net with mouth area of 0.1 m^2. OJN (oceanic Juday net) is an oceanic model of the Juday net with a mouth area of 0.5 m^2.

species distribution, including the Somov and Ross seas, as well as drawings of the shells and soft bodies of ostracods.

Thus, on the one hand, the knowledge accumulated to date about the pelagic ostracod fauna of the Ross Sea is sufficient, to a certain degree, to reveal its spatial organization (although, these data still need to be supplemented). On the other hand, the size and quality of information about the ostracods of the Somov Sea allows us to get only some rough ideas about their fauna. The present paper is based on original results of studies on ostracods from the Somov Sea and adjacent waters; the original and literature data concerning the Ross Sea are used here only for comparison.

MATERIALS AND METHODS

The materials for the project were found in the collections of Russian scientific expeditions that worked in the 1950–1980s in the Australian–New Zealand sector of the Antarctic (Table 1). Altogether, 252 samples were examined, which were collected at 115 stations located in the Somov and Ross seas and adjacent water areas northward of these seas. Most the stations were located in the Somov Sea and northward of the latter (Fig. 1). Plankton sampling on the *Mys Tikhii* and *Mys Yunona* RVs was performed along standard horizons accepted in Pacific Fisheries Research Center, as follows: 0–25, 25–50 (more often 0–50), 50–100, 100–200, 200–500, and, rarely, also 500–1000 m deep. On the *Dmitrii Mendeleev* RV the horizons were the same in the depth range of 0–200 m; deeper on they were as follows: 200–300, 300–400, 400–500, 500–1000, and 1000–1500 m deep. On the *Ob'* icebreaker non-closing nets were used for material sampling (only total catches). Altogether 19 ostracod species were found and identified belonging to 14 genera of the family Halocyprididae (Fig. 2; Table 2).

All calculations were made and diagrams were constructed using Microsoft Excel (MS Office). The maps were created with Ocean Data View 3.2.3 software.

The terminology of pelagial zonation is provided here following Vinogradov [4]. In calculations of the ostracod population density per unit of water volume we did not take any catchability coefficients into account.

In this paper we accept the following borders of the Somov Sea: on the east of the sea, from Cape Ader (170°E) to the Balleny Islands and then to the northwest up to 162°E, in the zone of Antarctic Divergence (AD, approximately 64°–65°S); on the north, along the AD and on the west, along 150°E longitude [2, 5]. The names, latitudinal distribution, depths of water masses, and hydrological parameters in the Somov Sea are provided here following Arsen'ev et al. [1].

RESULTS AND DISCUSSION

Ostracod fauna of the Somov Sea and the adjacent northwardly water area comprised only members of the family Halocyprididae and consisted of 17 (?21) species belonging to 12 (?15) genera (Table 2). In terms of species number it was significantly richer than the fauna of the central Arctic, where the environmental conditions are equally severe [3] and even more rich than fauna of Russian Far-Eastern seas [7]. Besides cold-water species, the ostracod fauna of this region included allochthonous ostracods brought by deep-sea waters from northwardly located water areas.

To the south the species number decreased insignificantly, from 16 species at 60°S to 10 species recorded at the Antarctic coast. In the AD zone that separates the Somov Sea from northwardly located

Table 2. Species composition of pelagic ostracod fauna in the Somov and Ross seas and adjacent water areas

Species	Area			
	1	2	3	4
Alacia hettacra (Müller, 1906)	+x	+x	+x	+x
Alacia belgicae (Müller, 1906)	+	–	+x	+x
Boroecia antipoda (Müller, 1906)	+x	+x	x	+x
Obtusoecia antarctica (Müller, 1906)	+	+x	–	+x
Discoconchoecia aff. *elegans* (Sars, 1865)	–	+x	–	+x
Metaconchoecia skogsbergi (Iles, 1953)	+x	+x	x	+x
Metaconchoecia australis (Gooday, 1981)	+	+	–	+
Metaconchoecia sp. A	–	+	–	–
Metaconchoecia sp.	+	+	–	–
Muelleroecia macromma (Müller, 1906)	–	?x[1]	–	x
Vityazoecia lunata (Deevey, 1978)	–	?x[1]	–	x
Austrinoecia isocheira (Müller, 1906)	+x	+x	+x	+x
Paraconchoecia cf. *cophopiga* (Müller, 1906)	–	?+	–	–
Pseudoconchoecia serrulata (Claus, 1874)	+	+x	x	+x
Conchoecissa symmetrica (Müller, 1906)	–	+x	–	+x
Conchoecissa imbricata (Müller, 1906)	–	–	x[3]	x
Conchoecilla chuni (Müller, 1906)	–	+x	–	+x
Proceroecia rivoltella McKenzie, Benassi, 1994	?x[1]	–	–	x
Proceroecia brachyaskos (Müller, 1906)	+x	+x	x	x
Proceroecia aff. *vityazi* (Rudjakov, 1962)	+	–	–	–
Loricoecia cf. *ctenophora* (Müller, 1906)	–	+	–	–
Archiconchoecemma simula (Deevey, 1982)	+x	–	?x[2]	x
Archiconchoecetta bidens (Deevey, 1982)	–	–	–	?x[2]
Deeveyoecia arcuata (Deevey, 1978)	–	–	–	x
Conchoecia magna Claus, 1874	–	–	–	+
Conchoecia parvidentata Müller, 1906	–	–	–	+
Paramollicia major (Müller, 1906)	–	–	–	x
Gaussicia edentata (Müller, 1906)	–	–	–	x
Gigantocypris muelleri Skogsberg, 1920	–	–	–	x
Total number of species:	13(?14)	14(?17)	8(?9)	23(?24)

[1]Found at the eastern border of the sea.
[2]Found at the northern border of the sea.
[3]According to Deevey [17] this species was erroneously identified for this area by Barney [10].

Note: Areas: 1, Somov Sea; 2, water area located to the north of the Somov Sea (up to 60°S); 3, Ross Sea; 4, water area located to the north of the Ross Sea (up to 60°S); "+," original data; "x," literature data; "?," anticipated findings of the species.

water area a mixture was observed of typical Antarctic fauna and fauna of the Subantarctic. Such species as *Discoconchoecia* aff. *elegans*, *Conchoecilla chuni, Conchoecissa symmetrica, Paraconchoeci* cf. *cophopiga, Loricoecia* cf. *ctenophore*, and *Metaconchoecia* sp. A. did not penetrate southward of the AD. Northward of the AD we never encountered *Alacia belgicae*, a typical element of the fauna of Antarctic waters, which, obviously, also comprised *Proceroecia* aff. *vityazi* and *P. rivoltella*. Thus, in higher latitudes the taxonomical and biogeographical structure of ostracod fauna changed; this was especially noticeable in the AD zone (Table 3), where the relatively warm-water fauna was replaced with the cold-water one (Fig. 3).

At greater depths the qualitative composition of Halocyprididae fauna changed and the number of species increased, reaching the maximum values in the upper mesopelagial zone, in the layer 200–500 m deep (especially in the layer 200–300 m deep) (Table 4). The confinement of the greatest species diversity to

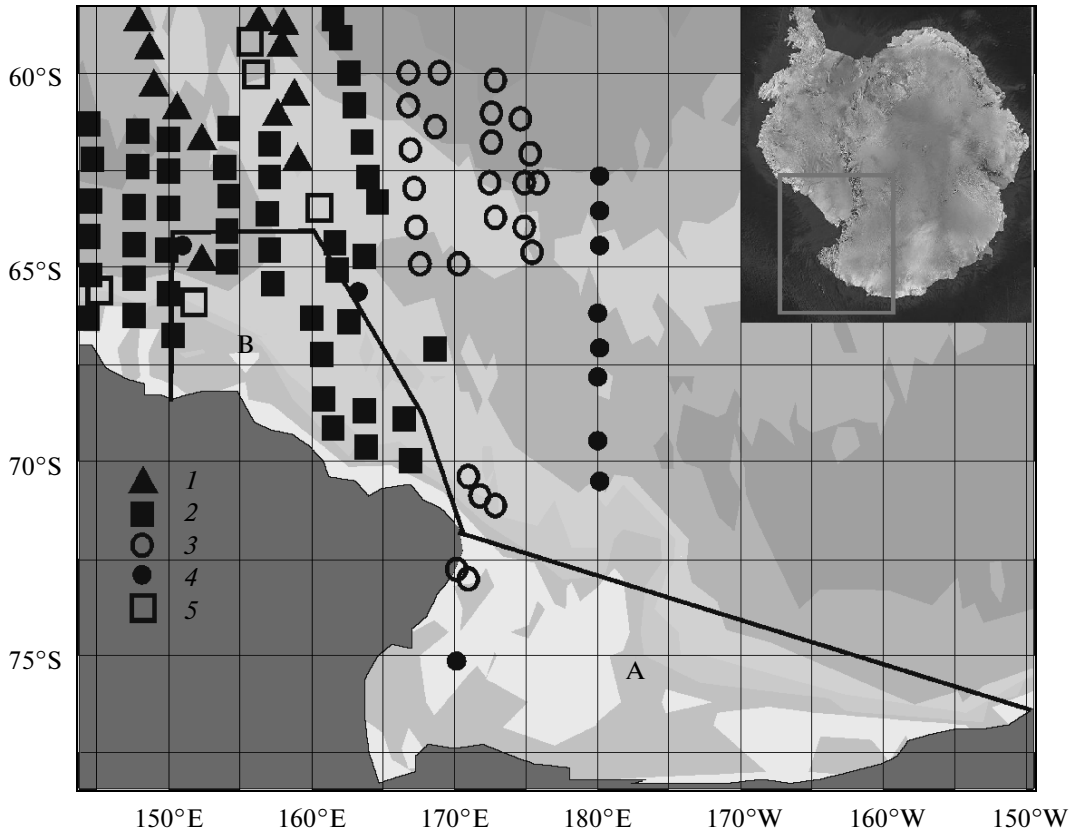

Fig. 1. Geographical position of the Ross Sea (A) and Somov Sea (B) and stations performed by scientific expeditions: 1, *Dmitrii Mendeleev* RV, 16th cruise, 1976; 2, *Mys Tikhii* RV, 1981; 3, *Mys Yunona* RV, 1981; 4, *Mys Yunona* RV, 1983; 5, *Ob'* ice breaker, first cruise, 1956.

these particular layers (to the upper deep-sea water mass of North Atlantic origin) could obviously be explained by significant warming of these waters (Table 5). Relatively warm waters (from 1.43°C at AD to 3.10°C at 60°S) were also recorded in the antarctic surface water mass (summer modification) northward of the the AD (the upper layer of about 60–75 m); however, they were almost lacking ostracods due to desalination. In depths deeper than 500 m the species number decreased. Such a distribution pattern was observed at both sides of the AD (Fig. 4). Not many samples were collected from depths deeper than 1000 m and just a few ones were collected from depths down to 2000 and 2500 m; therefore, it is reasonable to expect that supplementary observations would displace the vertical position of species diversity maximum in the Somov Sea toward bathypelagial zone, as has been shown previously for the entire Pacific sector of the Antarctic in general [9].

One part of the Southern Ocean northward of the AD (from 64°–65°S to 60°S) was occupied by waters of antarctic structure and was subdivided vertically into the following water masses: antarctic surface mass of summer modification (from the surface down to 60–75 m deep); antarctic subsurface of winter modification (down to 100 m at the AD and down to 800 m at the northern border of the sea); upper deep-sea (350 m at the AD and 800 m at the northern border of the sea); lower deep-sea (approximately down to 2000–2500 m); and bottom water mass located deeper on.

According to our data, the fauna of Halocyprididae of this region comprised 14 (?17) species belonging to 11 (?14) genera; in the upper 500-m layer the most common species was *Alacia hettacra*; while *Boroecia antipoda* and *Metaconchoecia* sp. A were numerous at greater depths. The major background species among the ostracods of these waters was *A. hettacra*, which occupied all the upper and most productive layers of the sea. A great density of this species was recorded not only in this area, but also to the south, up to the coast of the Antarctica (Table 6).

In desalination and relatively warm surface Antarctic water masses (during summer stratification of waters) in the upper 25-meter layer of ostracods only *A. hettacra* with a density of 1000–1200 species per 1000 m^3 was found. At greater depths, besides this kind, *Pseudoconchoecia serrulata* and *D.* aff. *eleganse* were found. The average density of ostracods is here 2500 species per 1000 m^3 (Table 7).

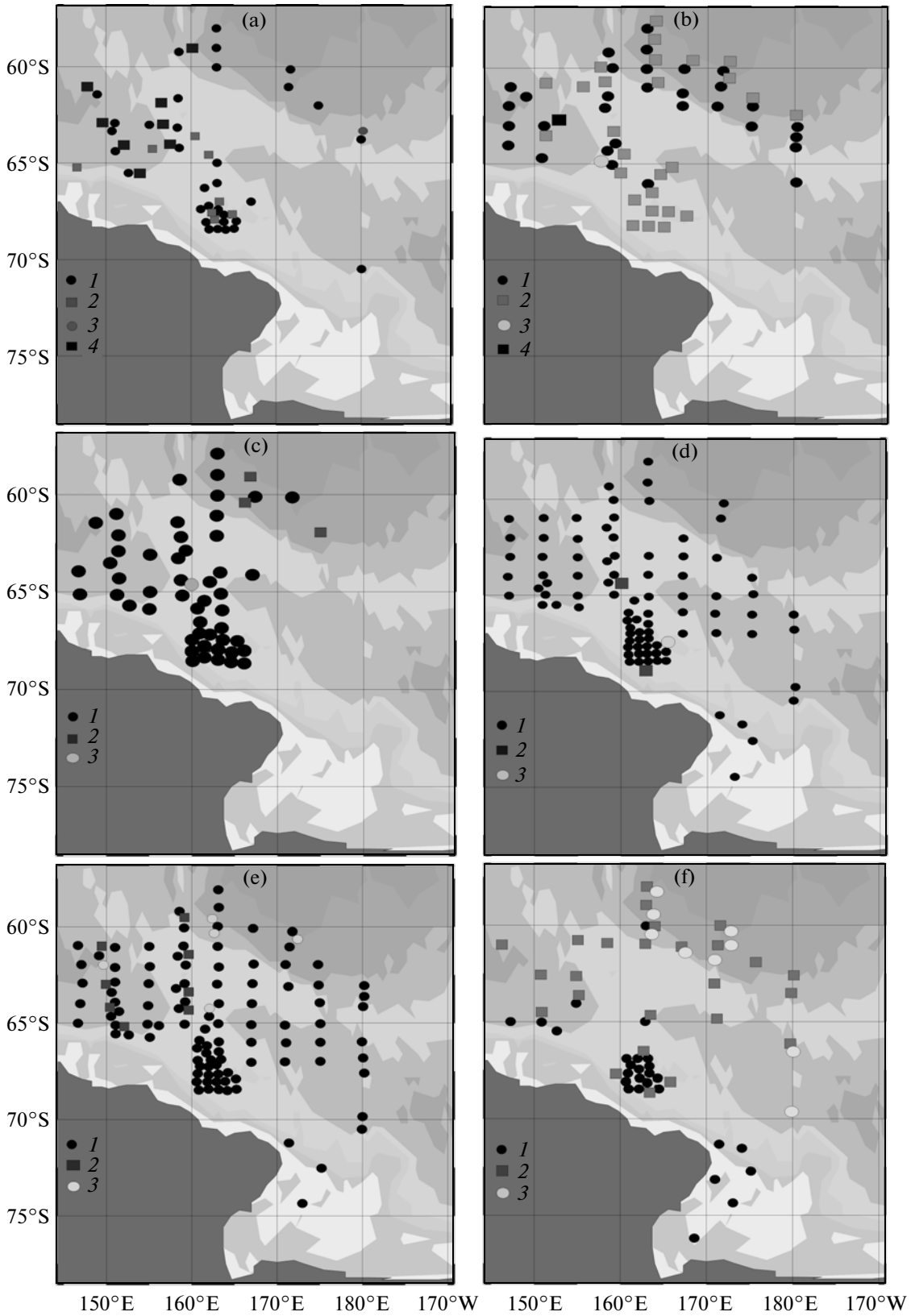

Fig. 2. Distribution of species in the surveyed region (our data). a) *1*, *Metaconchoecia australis*; *2*, *M. skogsbergi*; *3*, *Conchoecia parvidentata*; *4*, *Metaconchoecia* sp. A; b) *1*, *Discoconchoecia* aff. *elegans*; *2*, *Pseudoconchoecia serrulata*; *3*, *Metaconchoecia* sp.; *4*, *Paraconchoecia* cf. *cophopiga*; c) *1*, *Boroecia antipoda*; *2*, *Conchoecia magna*; *3*, *Loricoecia* cf. *ctenophore*; d) *1*, *Austrinoecia isocheira*; *2*, *Proceroecia* aff. *vityazi*; *3*, *Archiconchoecemma simula*; e) *1*, *Alacia hettacra*; *2*, *Proceroecia brachyaskos*; *3*, *Conchoecissa symmetrica*; f) *1*, *Alacia belgicae*; *2*, *Obtusoecia Antarctica*; *3*, *Conchoecilla chuni*.

Table 3. Latitudinal distribution of pelagic ostracods in the Somov Sea and northwardly located adjacent water area (up to 60°S)

Species	68°	67°	66°	65°	64°	63°	62°	61°	60°	BC
Alacia hettacra	+	+	+x	+x	+x	+x	+x	+x	+x	An
A. belgicae	+	+	+	+	–	–	–	–	–	An
Boroecia antipoda	+	+	+	+x	+	+	+	+	+x	An
Obtusoecia antarctica	+	+	?+	+	+	+	x	+	+	N–An
Discoconchoecia aff. *elegans*	–	–	–	–	+	?+	+x	+x	+x	?N–An
Austrinoecia isocheira	+	+	+	+x	+x	+x	+x	+x	+x	An
Vityazoecia lunata	–	–	–	–	–	–	–	–	x	?N–An
Muelleroecia macromma	–	–	–	–	–	–	–	–	x	WD
Metaconchoecia skogsbergi	+	+	+	+	+x	+	?	?	x	WD
M. australis	+	+	?+	?+	?+	?+	?+	?+	+	N–An
Metaconchoecia sp. A	–	–	–	+	+	+	?+	+	+	?An
Metaconchoecia sp.	–	–	–	+	+	+	–	–	–	?
Proceroecia brachyaskos	–	–	–	+	+x	+	?+	?+	?+	WD
Pseudoconchoecia serrulata	+	+	+	+	+	+	?+	+	+x	WD
Paraconchoecia cf. *cophopiga*	–	–	–	–	+	?+	?+	?+	?+	T–St
Conchoecilla chuni	–	–	–	–	–	–	–	+	+	N
Conchoecissa symmetrica	–	–	–	–	+	?+	?+	?+	x	WD
Proceroecia rivoltella	–	–	?x	?x	–	–	–	–	–	?An
Proceroecia aff. *vityazi*	+	+	?+	?+	+	–	–	–	–	An
Loricoecia cf. *ctenophora*	–	–	–	–	+	?+	?+	?+	?+	T–St
Archiconchoecemma simula	+	–	–	x	–	–	–	–	–	?An

Note: "+," original data; "x," literature data; "?," anticipated findings of the species. BC, biogeographical characteristics of species; An, antarctic; N, notal; N–An, notal–antarctic; T–St, tropical–subtropical; WD, widely distributed (tropical–antarctic or boreal–antarctic).

The cold antarctic subsurface water mass, where the water temperature from south to north changes from –0.68 to 0.30°C (Table 5) was inhabited by the same ostracod species, but their qualitative indexes were significantly smaller (Tables 7 and 8). This layer was dominated by *A. hettacra*, as it was in the case in the surface water layer, and the relative abundance of this species in taxocenosis ranged from 42 to 100%.

The strength and temperature of the upper deep-sea water mass (of North Atlantic origin) that enters the surveyed region with Antarctic Circumpolar Current changed from 350 m and 1.98°C at AD to 800 m and 2.07°C at the northern border of the sea, respectively. Despite the fact that an oxygen deficiency (3.96 ml/l) was revealed there, it is in this water mass that the maximum of species diversity (Fig. 3) and greatest values of ostracod population density were recorded (Tables 7 and 8). As in the case in the water masses located above, *A. hettacra* was the dominating species. However, the proportion of this species in taxocenosis decreased toward greater depths, falling from 90 to 30–20%; in contrast, the relative proportions of *D.* aff. *elegans* and *B. antipoda* increased (Table 9).

As layer-by-layer catches were performed only down to 1500 m (Table 4), we can discuss the ostracod fauna only as applied to the upper part of the lower deep-sea water mass. The water temperature in this layer was somewhat lower (1.44–1.74°C in the "core" of the water mass), while the salinity was somewhat higher (34.76–34.79‰); therefore, the water density was greater than in the preceding layer. These facts explain the deeper location of this water mass. It was highly saturated with dissolved oxygen (4.75 ml/l); however, in these depths both qualitative (Fig. 4) and quantitative indices of Halocyprididae fauna came down (Tables 7 and 8). First of all, it is pertinent to note the absence of *A. hettacra*, an antarctic species that is common for these latitudes. On the other hand, typical deep-sea ostracods *B. antipoda, Proceroecia brachyaskos* and *Metaconchoecia* sp. A appeared there and played a significant role. It is conceivable that the lower layer of the bottom water mass could be inhabited by *Muelleroecia macromma* and *Vityazoecia lunata*, which were found by Deevey [17] in materials obtained from the area of 60°04′S to 170°53′E, from the depth of 3660 m.

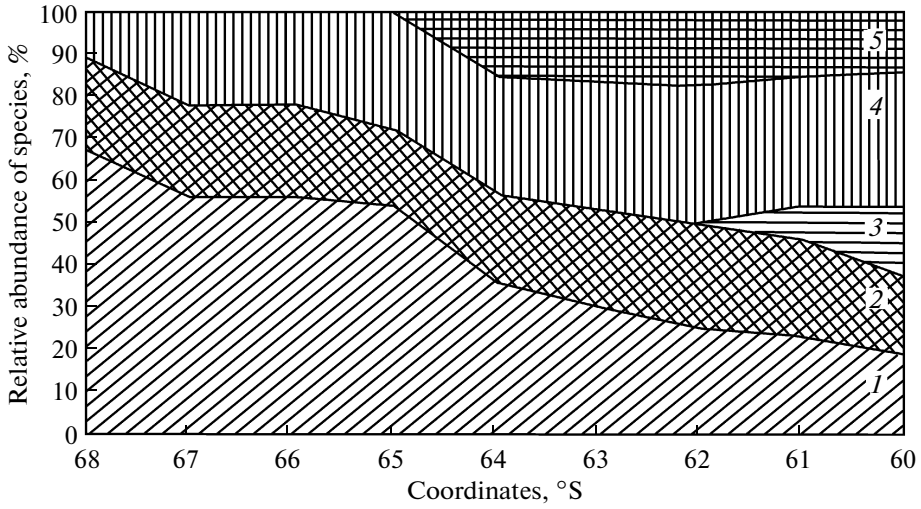

Fig. 3. Changes in biogeographical structure of Halocyprididae fauna in different latitudes of the Somov Sea and adjacent area up to 60°S (according the following materials: *Dmitrii Mendeleev* RV, 16th cruise, 1976; *Mys Tikhii* RV, 1981; *Mys Yunona* RV, 1981 and 1983; *Ob'* ice breaker, first cruise, 1956). Biogeographical complexes: *1*, antarctic; *2*, notal-antarctic; *3*, notal; *4*, widely distributed; *5*, tropical-subtropical.

The area southward of the Antarctic Divergence (the Somov Sea) was occupied by waters of antarctic structure, as in the case in the above-discussed water area, and it was subdivided vertically into the same water masses; however, environmental conditions there were even more severe. Southward of the AD, in the antarctic surface water mass, the temperature sharply came down toward greater depths (down to –0.93°C), while salinity ranged from 32.64 to 34.00‰. This layer was inhabited by only *A. hettacra* (as in the case to the north of the AD), but the population density of this species was very small (Table 8).

In the antarctic subsurface water mass the water temperature was even lower (down to –1.23°C in the "core"). As well as *A. hettacra*, this area was also inhabited by *Austrinoecia isocheira*, a typical antarctic species that was the most common and abundant species in deep-sea waters southward of the AD (Table 10).

The greatest indices of ostracod density, as in the case in the area to the north of the AD, were recorded within the upper deep-sea water mass. The water temperature in this layer was higher (reaching 0.92°C in the "core"). However, the major contribution to the overall density was provided not by *A. hettacra*, but by *A. isocheira*, the species confined to colder waters (Table 9). In these depths the greatest species number was observed, although the species diversity was still smaller than in the respective northwardly located area (Fig. 4). *B. antipoda, P. serrulata*, and an endemic species, *A. belgicae*, the most cryophilous species and a biological indicator of waters around the Antarctica, were common in this layer.

Deeper than 400–500 m both abundance indices of ostracods (Tables 7 and 8) and their species diversity

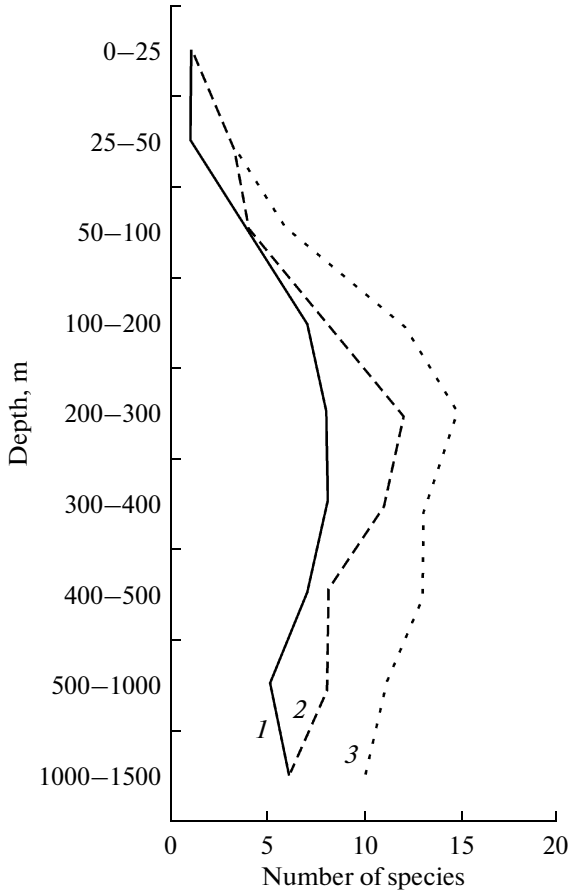

Fig. 4. Changes in species number of pelagic ostracods in different depths of the Somov Sea and adjacent area up to 60°S (according the following materials: *Dmitrii Mendeleev* RV, 1976; *Mys Tikhii* RV, 1981; *Mys Yunona* RV, 1981 and 1983). *1*, to the south off 64°–65°S; *2*, to the north off 64°–65°S; *3*, overall values for these two regions.

Table 4. Vertical distribution of pelagic ostracods in the Somov Sea and northwardly located adjacent water area (up to 60°S) (using the following materials: *Ob'* ice breaker, 1956; *Dmitrii Mendeleev* RV, 1976; *Mys Tikhii* RV, 1981; *Mys Yunona* RV, 1981, 1983; the data of Deevey [17] and Benassi *et al.* [13]

Taxon	Depth, m									
	0–25	25–50	50–100	100–200	200–300	300–400	400–500	500–1000	1000–1500	0–4000
Alacia hettacra	+	+	+	+	+	+	+	+	–	+[4]
Pseudoconchoecia serrulata	–	+	+	+	+	–	–	–	–	–
Discoconchoecia aff. *elegans*	–	+	?	+	+	+	+	+	+	–
Austrinoecia isocheira	–	–	+	+	+	+	+	+	+	–
Alacia belgicae	–	–	+	+	+	+	+	–	–	–
Obtusoecia antarctica	–	–	+	+	+	+	+	–	–	–
Metaconchoecia sp. A	–	–	–	+	?	?	?	+	+	–
Metaconchoecia sp.	–	–	–	+	?	?	?	+	+	–
Metaconchoecia skogsbergi	–	–	–	+	+	+	+	–	–	+[4]
Boroecia antipoda	–	–	–	+	+	+	+	+	+	+[4]
Metaconchoecia australis	–	–	–	+	+	+	+	+	+	–
Conchoecilla chuni	–	–	–	+	+	–	–	–	–	–
Loricoecia cf. *ctenophore*	–	–	–	–	+[1]	+[1]	+[1]	–	–	–
Proceroecia brachyaskos	–	–	–	–	+	+	+	+	+	–
Conchoecissa symmetrica	–	–	–	–	+[1]	+[1]	+[1]	+	–	+[4]
Proceroecia rivoltella	–	–	–	–	–	–	–	+[3]	–	–
Proceroecia aff. *vityazi*	–	–	–	–	–	–	–	–	+	+[4]
Archiconchoecemma simula	–	–	–	–	–	–	–	–	+[2]	–
Paraconchoecia cf. *cophopiga*	–	–	–	–	–	–	–	–	+	–
Muelleroecia macromma	–	–	–	–	–	–	–	–	–	?+[5]
Vityazoecia lunata	–	–	–	–	–	–	–	–	–	?+[5]
Total	1	3	6	12	15	13	13	11	10	7

[1]200–500 m layer; [2]1015–1786 m layer; [3]800–1000 m layer; [4]total catch, 0–2000 m; [5]3660 m.
Note: "+," the species was found; "?," anticipated findings of the species.

Table 5. Water temperature (°C) in different depths of the Somov Sea and adjacent waters (according the materials of the *Dmitrii Mendeleev* RV, 1976)

Sampling horizon, m	Stn. number and coordinates (southern latitude, eastern longitude)							
	1314, 59°13′–158°32′	1316, 61°34′–158°18′	1317, 63°01′–158°24′	1318, 64°13′–158°31′	1321, 65°30′–152°32′	1322, 64°21′–154°11′	1323, 63°19′–150°04′	1324, 61°29′–148°53′
0	03.14	02.29	01.50	00.71	–	–	01.43	02.82
10	03.17	02.27	–	00.69	–	–	01.44	02.84
20	03.05	02.25	01.36	00.60	–	–	01.44	02.80
30	02.93	02.12	01.05	00.00	–	–	01.38	02.76
50	02.44	01.70	–00.21	–00.82	–	–	–00.68	02.30
75	00.72	00.04	00.13	00.30	–	–	00.07	–00.34
100	00.08	–00.09	00.85	00.72	–	–	01.15	–00.62
125	00.23	00.00	01.10	00.86	–	–	01.82	–00.42
150	01.14	00.48	01.17	00.99	–	–	01.93	00.80
200	01.92	01.68	01.30	01.02	–	–	01.92	01.82
250	02.05	01.82	01.33	–	–	–	01.95	02.05
300	02.03	01.82	01.35	01.27	–	–	01.97	02.07
400	02.02	01.79	01.30	01.28	–	–	01.91	02.18
500	02.00	01.71	01.24	01.20	–	–	01.86	02.11
600	01.93	01.68	01.19	01.03	–	–	01.80	02.09
800	01.80	01.48	01.06	00.97	–	–	01.67	02.00
1000	01.60	01.35	00.86	00.88	–	–	01.48	01.75
1200	01.50	01.12	00.73	00.68	–	–	01.30	01.68
1500	01.20	00.91	00.48	00.48	–	–	01.07	01.37
2000	00.80	00.57	00.17	00.30	–	–	00.38	00.98
2500	00.51	–	00.15	–	–	–	00.26	00.66

Note: "–," no data.

Table 6. Latitudinal and vertical distribution of mean density (specimens/1000 m^3) of *Alacia hettacra* in the Somov Sea and northwardly located adjacent area (up to 61°S) (according the materials of *Mys Tikhii* RV, 1981)

Sampling horizon, m	68°	67°	66°	65°	64°	63°	62°	61°
0–100	240	260	0	827	–	–	182	0
100–200	638	503	118	642	391	502	785	374
200–500	538	605	555	304	269	108	249	118

Table 7. Mean total density (specimens/1000 m^3) of ostracods of the family Halocyprididae in different depths in the Somov Sea and northwardly located adjacent area (up to 61°S) (according the materials of *Mys Tikhii* RV, 1981)

Depth, m	Southward of the AD[1]	Northward of the AD	Entire water area[2]
0–25	–	1200(1)	1200(1)
25–50	–	2533(3)	2533(3)
5–100	200(1)[3]	900(2)	1300(4)
0–100	1004.5(8)	1495.5(2)	947(11)
100–200	2205(21)	923(21)	1448(51)
200–500	4120(25)	1092(21)	2173(63)
500–1000	199(2)	–	199(2)
1000–2000	18(2)	–	18(2)

[1]Antarctic Divergence (AD) (approximately 64°–65°S); [2]taking the AD zone into account; [3]the number of samples is in parentheses.

Table 8. Mean total density (specimens/1000 m^3) of ostracods of the family Halocyprididae in different depths in the Somov Sea and northwardly located adjacent area (up to 60°S) (according the materials of *Dmitrii Mendeleev* RV, 1976)

Depth, m	Southward of the AD[1] (Stn. 1321)	Northward of the AD (Stns. 1314–1318, 1323, 1324)	Entire water area (Stns. 1314–1324)[2]
0–25	400	–	400(1)
25–50	160	1200(1)[3]	680(2)
50–100	200	800(1)	500(2)
100–200	600	300(1)	850(3)
200–300	1400	550(3)	600(5)
300–400	1100	1183(6)	1125(8)
400–500	200	460(5)	388(7)
500–1000	188	247(6)	238(8)
1000–1500	120	152(5)	129(7)

[1]Antarctic Divergence (AD) (approximately 64°–65°S); [2]taking AD zone into account; [3]the number of samples is in parentheses.

(Fig. 4) decreased strikingly. Along with the above-listed species, the lower deep-sea water mass was also inhabited by *Metaconchoecia australis, P.* aff. *vityazi*, *Archiconchoecemma simula* and *D* aff. *elegans*, i.e., the species introduced from lower latitudes.

The ostracod fauna of the Somov Sea showed a more pronounced cold-water pattern. Northward of the AD the major background ostracod species was *A. hettacra*, whereas to the south the cryophilous *A. isocheira* was dominating. On the other hand, in both northern and southern regions the maximum qualitative and quantitative indices of the fauna were recorded in the mesopelagial zone (the upper deep-sea water mass), where the water temperature never fell below zero.

In the Ross Sea, as in the case in the Somov Sea, the ostracod fauna consisted of a small number of mostly cold-water, typical antarctic species (Table 2). However, in the Ross Sea the ostracod fauna was even more depleted, as this area is located in higher latitudes and is more remote from the AD. The most common and abundant species in these waters were *A. belgicae, A. isocheira* and *A. hettacra* [12, 22]. The surface waters in the northernmost part of the sea (the upper 20–50-m layer) were inhabited by only *A. hettacra*; in southern areas *A. hettacra* was replaced with *A. belgicae*. The greatest number of species in the Ross Sea were recorded in deep waters [12, 17, 22]. As in the case in the Somov Sea, the proportion of *A. hettacra* in taxocenosis of the Ross Sea decreased from north to south, whereas the relative abundance of *A. belgicae* and *A. isocheira* increased toward the south [12]. A similar picture was also observed in the Atlantic sector of the Antarctic, where the greatest indices of overall ostracod density were also recorded in the mesopelagial zone (Fig. 5) ([20] and our unpublished data: materials of *Akademik Kurchatov* RV, 11th cruise; *Dmitrii Mendeleev* RV, 43rd cruise; and *Polarstern* RV, 69th cruise).

According to the existing information about the distribution of ostracods in the Ross Sea and adjacent

Table 9. Relative proportions (mean population density values, %) of certain ostracod species of the family Halocyprididae in the Somov Sea and northwardly located adjacent area (up to 60°S) (according the materials of *Dmitrii Mendeleev* RV, 1976)

Depth, m	Southward of the AD				Northward of the AD						
	Ah	Ai	Pb	Others	Ah	Ai	Pb	MA	Ba	De	Others
0–25	100	–	–	–	–	–	–	–	–	–	–
25–50	100	–	–	–	100	–	–	–	–	–	–
50–100	–	100	–	–	100	–	–	–	–	–	–
100–200	53	36	3	3	92	8	–	–	–	–	–
200–300	33	56	–	11	54	15	8	–	–	23	–
300–400	11	78	11	–	68	1	14	–	–	14	3
400–500	20	60	20	–	34	7	–	–	33	26	–
500–1000	6	53	35	6	4	4	21	23	40	8	3
1000–1500	–	–	100	–	–	–	18	52	20	4	6

Note: AD, Antarctic Divergence; Ah, *Alacia hettacra*; Ai, *Austrinoecia isocheira*; Pb, *Proceroecia brachyaskos*; MA, *Metaconchoecia* sp. A; Ba, *Boroecia antipoda*; De, *Discoconchoecia* aff. *elegans*.

Table 10. Latitudinal and vertical distribution of mean density (specimens/1000 m^3) of *Austrinoecia isocheira* in the Somov Sea and northwardly located adjacent area (up to 60°S) (according the materials of *Mys Tikhii* RV, 1981)

Sampling horizon, m	68°	67°	66°	65°	64°	63°	62°	61°
0–25	–	–	–	–	–	–	–	0
25–50	–	–	–	–	–	–	0	0
50–100	0	–	–	1000	–	–	0	–
0–100	260	218	0	0	–	–	45	0
100–200	1387	1227	449	334	686	389	116	108
200–500	2445	3942	1918	1183	791	179	292	72
500–1000	196	130	–	–	–	–	–	–
1000–2000	0	–	7	–	–	–	–	–

northwardly located water area [17], both the taxonomic composition and biogeographical structure of this group changed in the narrow latitudinal range of 63°–65°S. These are exactly the latitudes where the AD passes in this sector of the Antarctic [2, 6]. Such species as *Obtusoecia antarctica, D.* aff. *elegans*, *Paramollicia major, Gaussicia edentata, P. serrulata, C. symmetrica*, and *C. chuni* did not penetrate to the south of the AD, whereas *A. isocheira* and *A. belgicae* never occurred to the north of it. Between the AD and the Antarctic coast there were almost no changes in the composition of ostracods. Among eight species recorded in the Ross Sea, six species reached 77°–78°S; these were *P. brachyaskos, Metaconchoecia skogsbergi, A. isocheira, B. antipoda, A. belgicae*, and *A. hettacra* [17]. The greater species diversity of ostracods recorded in the northern region adjacent to the Ross Sea could obviously be due to the greater number, length, and depth of catches performed in the former area.

Thus, the fauna of pelagic ostracods of the Somov Sea delimited on the north by the Antarctic Divergence is a depleted faunal complex of the Australian–New Zealand sector of the Southern Ocean. To the north of the AD the ostracod fauna comprises species introduced from the waters of subantarctic and tropical–subtropical structures, whereas the fauna of the Somov Sea consists primarily of typical antarctic species. In the AD zone the biogeographical pattern of the ostracod fauna changes. To the north and south of the AD (in the Somov Sea and the adjacent northwardly located water area) the greatest indices of species diversity and abundance were recorded within the upper deep-sea water mass, in the 200–500 m layer (especially in the 300–400 m layer). The most numerous background species in the Somov Sea and to the north of the AD were *A. isocheira* and *A. hettacra* respectively.

The Ross Sea, which is located farther to the south and is characterized by more severe conditions com-

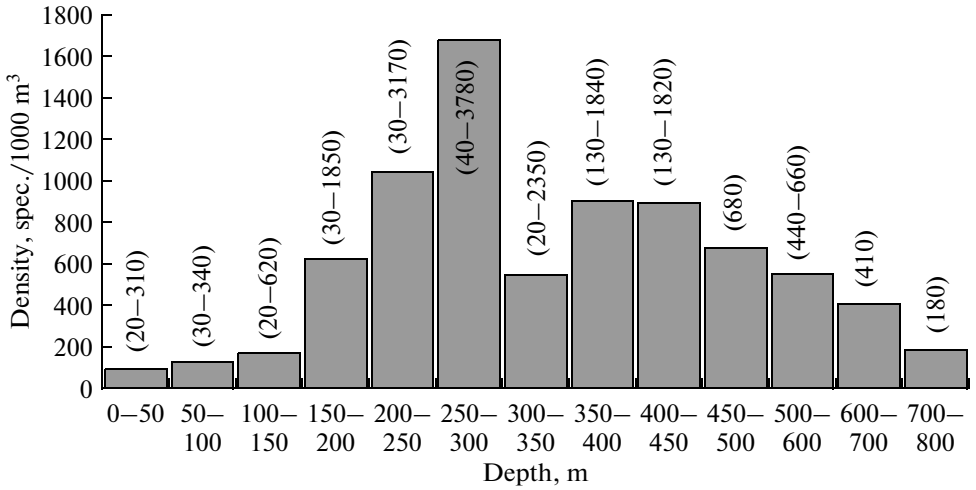

Fig. 5. Changes in total ostracod density (specimens/1000 m^3) in the Ross Sea (According Benassi *et al.* [12]). In parentheses the ranges of density values are provided.

pared with the Somov Sea, is inhabited by an even more depleted complex of primarily antarctic species. The most abundant species in the Ross Sea were *A. belgicae* and *A. isocheira*; they developed the densest aggregations in the 200–300 m layer. The proportion of *A. hettacra* decreased from northern to southern border of the sea. In the AD zone (63°–65°S) qualitative changes took place in the composition and structure of the ostracod fauna.

ACKNOWLEDGMENTS

The project was partially supported by Far-Eastern Branch of Russian Academy of Sciences (grant nos. 09-I-P23-01 and 09-I-P15-03).

REFERENCES

1. Arsen'ev, V.S., Leont'ev, V.V., Panfilova, S.G., and Sapozhnikov, V.V., Hydrology and Geochemistry of Australian-New Zealand Region of the Southern Ocean, *Tr. IO AN SSSR,* 1978, vol. 112, pp. 9–29.
2. *Atlas Antarktiki* (Atlas of the Antarctic), Leningrad: GUGK MG SSSR, 1966, vol. 1.
3. Bashmanov, A.G. and Chavtur, V.G., Structure and Distribution of Pelagic Ostracods (Ostracoda: Myodocopa) in the Arctic Ocean, *Russ. J. Mar. Biol.*, 2009, vol. 35, no. 5, pp. 315–328.
4. Vinogradov, M.E., *Vertikal'noe raspredelenie okeanicheskogo zooplanktona* (Vertical Distribution of Ocean Zooplankton), Moscow: Nauka, 1968.
5. Lebedev, V.L., Physical-Geographical Zonation of the World Ocean, *Fizicheskaya geografiya Mirovogo okeana* (Physical Geography of the World Ocean), Leningrad: Nauka, 1980, pp. 313–330.
6. Orlov, A.I., Physical-Geographical Zonation, *Geografiya Mirovogo okeana. Severnyi Ledovityi i Yuzhnyi okeany* (Geography of the World Ocean. Northern and Southern Oceans), Leningrad: Nauka, 1985, pp. 365–376.
7. Chavtur, V.G., Fauna of Pelagic Ostracods of the Family Halocyprididae in the Northwestern Pacific, *Russ. J. Mar. Biol.*, 1977, no. 1, pp. 28–38.
8. Chavtur, V.G. and Kruk, N.V., Vertical Distribution of Pelagic Ostracods (Ostracoda, Halocyprinidae) in the Australian-New Zealand Sector of the Southern Ocean, *Russian Journal of Marine Biology*, 2003a, vol. 29, no. 2, pp. 90–99.
9. Chavtur, V.G. and Kruk, N.V., Latitudinal Distribution of Pelagic Ostracods (Ostracoda, Halocyprinidae) in the Australian-New Zealand Sector of the Southern Ocean, *Russ. J. Mar. Biol.*, 2003b, vol. 29, no. 3, pp. 137–143.
10. Barney, R.W., Crustacea. V. Ostracoda, British Antarctic ("Terra Nova") Expedition, 1910, *Nat. Hist. Rep. Zool.*, 1921, vol. 3, no. 7, pp. 175–190.
11. Benassi, G., Naldi, M., and McKenzie, K.G., Preliminary Research on Species Distribution of Planktonic Ostracods (Halocyprididae) in the Ross Sea, Antarctica, *J. Crust. Biol.*, 1992a, vol. 12, no. 1, pp. 68–78.
12. Benassi, G., Ferrari, I., Gentine, G., et al., Planktonic Ostracoda in the Southern Ocean and in the Ross Sea: 1989–1990 Campaign, *Nat. Sci. Comm. Antarct. Ocean Camp., 1989–1990. Data Rept. II.*, 1992b, pp. 247–300.
13. Benassi, G., Ferrari, I., Menozzi, P., and McKenzie, K.G., Planktonic Ostracods from the Antarctic and Subantarctic Collected by the 1989–1990 Italian Antarctic Expedition, *Rec. Austral. Mus.*, 1994, vol. 46, pp. 25–37.
14. Blachowiak-Samolyk, K. and Angel, M., *An Atlas of Southern Ocean Planktonic Ostracods*, 2004 (http://deep.iopan.gda.pl/ostracoda/ – checked 04.04.2011).
15. Brady, G.S., Crustacea. V. Ostracoda, Reports of National Antarctic Expedition of the SS "Discovery," 1901–1904, *Natur. Hist.*, 1907, vol. 3, pp. 1–9.
16. Deevey, G.B., A Taxonomic and Distributional Study of the Planktonic Ostracods Collected on Three Cruises of the "Eltanin" in the South Pacific of the Antarctic Seas, VIII, *Antarct. Res.*, 1978, vol. 28, no. 3, pp. 43–70.
17. Deevey, G.B., A Faunistic Study of the Planktonic Ostracods (Myodocopa, Halocyprididae) Collected on Eleven Cruises of the "Eltanin" between New Zealand, Australia, the Ross Sea and Southern Indian Ocean, *Biology of the Antarctic Seas*: *Antarctic Res. Ser.*, 1982, vol. 32, pp. 131–167.
18. Ferrari, I., Benassi, G., and McKenzie, K.G., Planktonic Ostracoda from the Western Ross Sea, *Antarctica (Progetto ROSSMIZE): Data Rept.*, 2000, pp. 19–95.
19. Iles, E.J., A Preliminary Report on the Ostracoda of the Benguela Current, *Discovery Rept.*, 1953, vol. 26, pp. 259–279.
20. Kock, R., Ostracoden im Epipelagial vor der antarktischen Halbinsel – ein Beitrag zur Systematik sowie zur Verbreitung und Populationsstruktur unter Berücksichtigung der Nationalität, *Ber. Polarforsch.*, 1992, no. 106, 214 p.
21. McKenzie, K.G., Benassi, G., and Naldi, M., Planktic Ostracoda from the Ross Sea, Antarctica, and the Cretaceous Initiation of Modern Oceans, *Cour. Forsch.-Inst. Senckenberg*, 1990a, pp. 123–333.
22. McKenzie, K.G., Benassi, G., Naldi, M., et al., Report on Planktic Ostracoda from Ross Sea, Antarctica, *Nat. Sci. Comm. Antarct. Ocean Camp., 1987–1988. Data Rept. II.*, 1990b, pp. 171–229.
23. McKenzie, K.G., Ferrari, I., and Benassi, G., Planktonic Ostracoda in the Ross Sea: Their Distribution and Associated Environmental Factors, *Ross Sea Ecology: Italiantartide Expeditions* (1987–1995), Berlin: Springer, 2000, pp. 351–367.
24. McKenzie, K.G., Ferrari, I., Benassi, G., et al., Research on Planktonic Ostracoda of the Southern Ocean, *L'Italia in Antarctide. Aspetti tecnici e ricerche in ecosistemi continentali e marini nell'ambito del Programma Nazionale di Ricerche in Antartide*, Parma, 2001, pp. 99–108.
25. Naldi, M., Benassi, G., Ferrari, I., *et al.*, Distribuzione degli ostracodi planctonici nella Baia di Terra Nova, *Atti del 9th Congresso A. I. O. L.* (*S. Margherita Ligure, 20–23 November, 1990*), Genova, 1992, pp. 613–622.
26. Raymond, J.A. and de Vries, A.L., Bioluminescence in McMurdo Sound, Antarctica, *Limnol. Oceanogr.*, 1976, vol. 21, no. 4, pp. 599–602.