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Benthic habitats in the Tikhaya Bight (the Hooker Island, Franz Josef Land)

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ABSTRACT

Benthic habitats of Tikhaya Bight (Hooker Island, Franz Josef Land, High Arctic) were studied by using SCUBA equipment (diving quantitative method) and Van Veen grabs. Three main communities have been described. A *Gammarus setosus*-macroalgae community, probably seasonal, developed above 5 meters depth, had a relatively low diversity with biomass 7.6±0.9 g/m^2 and abundance 135±40 ind/m^2; a mixed bivalves-amphipods-bryozoan community (*Serripes groenlandicus*, *Mya truncata*, *Haploops laevis, Alcyonidium disciforme)* occured in muddy bottoms with some interspersed boulders between 7 and 30 m depth; it included 101 taxons, had a relatively high biomass 152.3±114.2 g/m^2 and abundance 1600±940 ind/m^2. A bivalve-dominated community with *Musculus niger* and *Yoldia hyperborean* inhabited depth of 67–72 m, included 38 taxons and was characterized by high density of abundance and biomass – 670±295 ind/m^2 and 356.1±57.1 g/m^2, respectively. Comparison with the previous data obtained 20 years ago at the depth 7–30 m, showed that, possibly, the retreat of the glacier under the influence of increasing temperature in the environment and increased runoff of melt water, washes away clay deposits which led to siltation of the bottom in the bay and caused degradation of kelp, which was partially replaced by invertebrate communities inherent in silted soils.

Keywords: benthic communities, community shifts, long-term monitoring, Franz Josef Land, Arctic Ocean

Места обитания бентоса в бухте Тихая (о. Гукера, Земля Франца-Иосифа)

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РЕЗЮМЕ

Места обитания бентоса в бухте Тихая (о. Гукера, Земля Франца-Иосифа, Арктика) были изучены с использованием легководолазного снаряжения (водолазным количественным методом) и дночерпателя Ван-Вина. Описаны три основных бентосных сообщества: вероятно сезонное сообщество амфипод *Gammarus setosus* и относительно мелких макроводорослей, развивается на глубинах до 5 метров, со сравнительно низким видовым разнообразием – 6 таксонов, невысокой биомассой – 7.6±0.9 г/м^2 и плотностью поселений – 135±40 экз/м^2; смешанное сообщество двустворчатых моллюсков, амфипод и мшанок (*Serripes groenlandicus*, *Mya truncata*, *Haploops laevis, Alcyonidium disciforme)*, на заиленном грунте с редкими валунами в диапазоне глубин от 7 до 30 м, включающее в свой состав 101 таксон, дающее относительно высокую плотность поселений и биомассу – 1600±940 экз/м^2 и 152.3±114.2 г/м^2 соответственно и сообщество, обитающее на глинисто-алевритовых грунтах, найденное на максимально обследованных глубинах (67–72 м), имеющее в доминантах двустворчатых моллюсков *Musculus niger* и

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Yoldia hyperborea, насчитывающее в своем составе 38 таксонов, характеризуется высокими плотностью поселений и биомассой – 670±295 экз/м^2 и 356.1±57.1 г/м^2 соответственно. Сравнение наших данных с предыдущими, полученными на глубинах 7–30 м 20-ю годами ранее, показало, что, возможно, происходящее под воздействием повышающейся температуры среды отступление ледника и сток талых вод, выносят мелкие глинистые отложения, что приводит к заилению дна бухты и вызывает деградацию ламинарий, которые частично заменяются на сообщества беспозвоночных, присущие заиленным грунтам.

Ключевые слова: бентосные сообщества, изменения в сообществах, многолетний мониторинг, Земля Франца-Иосифа, Северный Ледовитый океан

INTRODUCTION

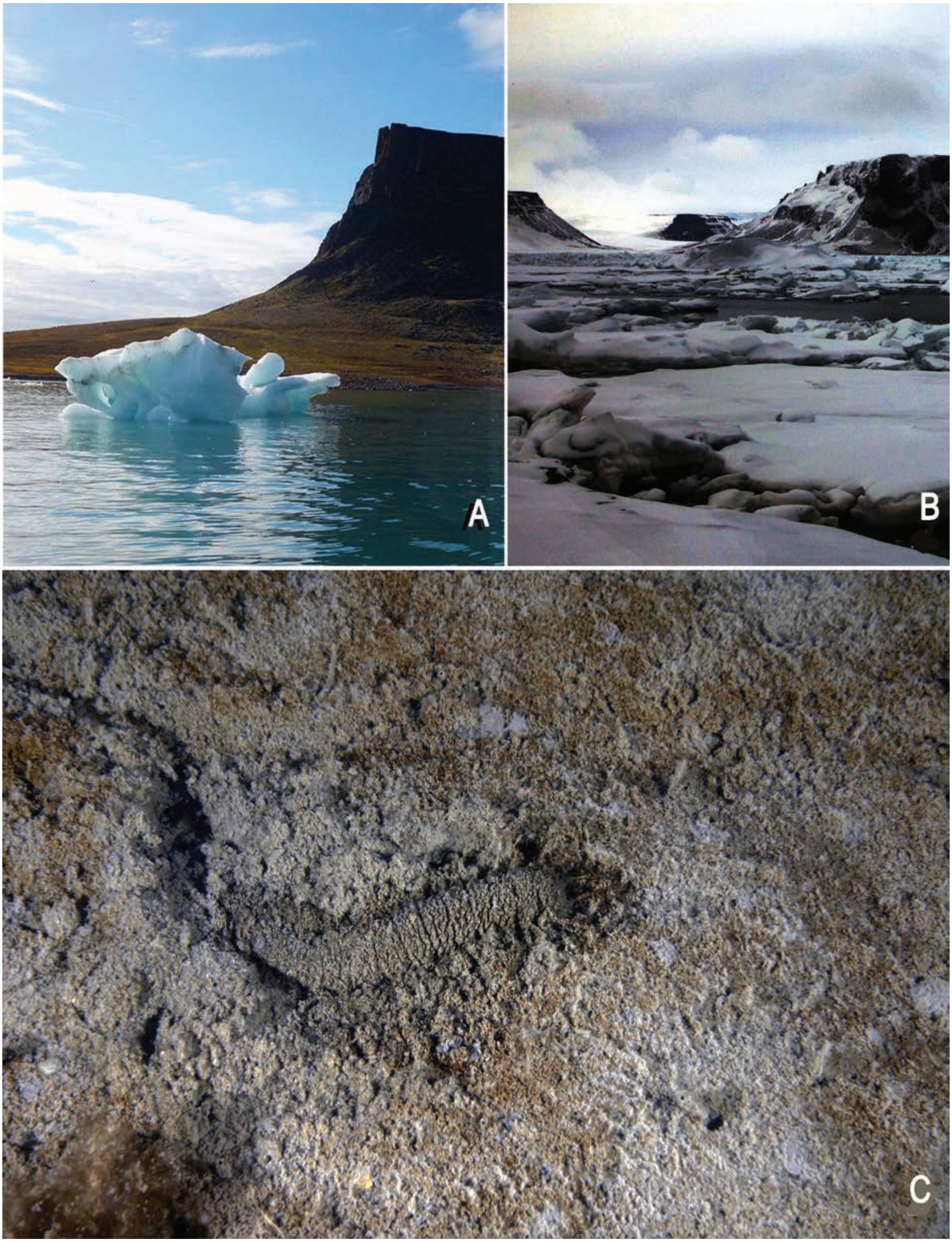
Arctic Seas are experiencing long-term changes whether as a result of long-term cyclic climate fluctuations, or as a result of the global warming trend. The northernmost parts of the Arctic is suffering from important environmental and biotic changes (Golikov and Scarlato, 1989; Beuchel et al. 2006; Berge et al., 2009; Bluhm et al. 2009; Kędraet al. 2010), but due to their remote location cannot be monitored easily.

Franz Josef Land is the northernmost archipelago from Eurasia (79°–82°N, 43°–67°E), situated in the NE Barents Sea. It consists of 191 islands (Grosvald et al. 1973) and is currently included in the Russian Arctic National Park. Although the Archipelago is not easily accessible, the knowledge of the benthic communities dates back to the end of the XIXth century (Riddley, 1881; Miers, 1881; Carpenter, 1898, Waters 1900), with other studies covering the XXth century (Augener, 1913; Golikov and Averincev, 1971, 1977; Golikov and Scarlato, 1977, 1989; Golikov et.al., 1994) and even the XXIst century (Bluhm et.al., 2009; Dahle et.al., 2009). The collected data still suggests that the diversity of the Archipelago significantly exceeds those from many regions of the Canadian and near-Asian sector of the Arctic as it has been detected by several studies focused on different groups of organisms: Ushakov (1932), Antsulevich (1986) on hydroids; Annenkova (1932), Khlebovich (1964), Averincev (1977a, 1977b) on Polychaeta; Kluge (1964), Androsova (1977) on Bryozoa; Carpenter (1898) on sea spiders (Pantopoda); Golikov (1964) on Gastropoda and Scaphopoda; Minichev (1977) on Gastropoda; Matveeva (1977), Miloslavskaya (1977) on bivalves; Gorbunov (1932b), Menshutkina (1977) on Decapoda; Chislenko (1977) on Harpacticoidea; Bushueva (1977), Tzvetkova (1977) on Amphipoda; Zimina and Lyubina (2009) on benthic crustaceans; Grieg (1930; 1935), Gorbunov (1932a), Baranova (1977) on Echinodermata; Zezina (1977) on brachiopods; Zhiubikas (1977) on sea anemones; Lukina (1977) on Foraminifera; etc.

According to observations of A.N. Golikov and V.G. Averincev (1971, 1977) in September–October 1970, climatic conditions of Franz Joseph Land had been extremely severe. Ice covered the sea for a most of the year. Near Victoria and Hayes Islands, in the middle of the archipelago, the sea had been free of ice cover for 1–1.5 months. In the north, at Rudolf Island, pack ice was present all the year round, in summer more often in the form of moving ice fields. Bays constantly had been under a continuous ice cover. At the bottom, up to the depth of 2–3 m, the influence of a mobile pack ice was well defined. Deep furrow sin ground produced by icebergs was distinctly marked down to 30 m depth. On the areas affected by the mobile ice or icebergs the bottom communities were harshly disturbed. In summer 2013, we made an expedition during an exceptionally warm year (from 27 July to 28 August) when there hadn't been pack ice at all (Fig 1A–C). Satellite observations showed that in August the ice fields were present only in the far north, more than 100 miles away from Rudolf Island.

Here we aim to compare our data with those from previous samplings at Tikhaya Bight at Hooker Island in order to define possible changes in the marine fauna of this bay after the important environmental changes that have occurred during last 50 years. G.P. Gorbunov described the qualitative composition of the marine fauna of Tikhaya Bight by dredging and bottom trawling aboard the steam icebreaker «Georgy Sedov» in 1929 (Annenkova, 1932;

Fig. 1. A – The beach at the Rubini Rock above our transect in the Tikhaya Bight, August 1, 2013; extraordinarily warm year. Photo by O.N. Savinkin. **B** – The coast in the Tikhaya Bight in hydrological summer, September 31, 2014; the year with more ordinary weather conditions. Photo by Dr. M.V. Gavrilo. **C** – Epibenthal polychaete worm *Brada villosa*, on loose muddy sediments in the Tikhaya Bight, at the place of previous macrophyte community. Photo by O.N. Savinkin.


A
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C

Gorbunov, 1932a, 1932b; Ushakov, 1932). A second expedition performed by Polish hydrobiologists used dredges that provided quantitative data on the benthos distribution and the first descriptions of bottom communities (Weslawski and Zajaczkowski, 1992). The third expedition performed in 1990, included Russian, Norwegian and Polish specialists, also with dredging, provided a more accurate description of benthic communities at Tikhaya Bight and other parts of the archipelago (Averintsev, 1992, 1993, 1994; Luppova et al., 1994).

MATERIAL AND METHODS

The sampling stations were situated along of a transect at Tikhaya Bight, eastwards of Rubini Rock, close to the neck connecting this rock to Hooker island (Fig. 2). We tried to repeat the sampling at the same sites sampled by Averintsev (1993, 1994). Sampling was performed using the pyramidal evaluation method of the quantitative benthos distribution (Golikov et al., 1964; Golikov and Averincev, 1971, 1977; Averincev et al., 1982; Averintsev, 1994). At first the divers located the different habitats and organisms, which afterwards were sampled quantitatively using frames, from the areas ranging from a few tens of square meters (for the large and rare organisms) to 0.1 m^2 (for collection of the small and uniformly distributed organisms). Mega- and macrobenthos had been accounted by means of 10 quantitative samples by habitat, using the Gruzov's toothed diver bottom-grab (frames of 0.25 m^2 and 1 m^2) (see its description in Golikov et al., 1964). In addition, 3 qualitative samples have been taken, and 6 samples with

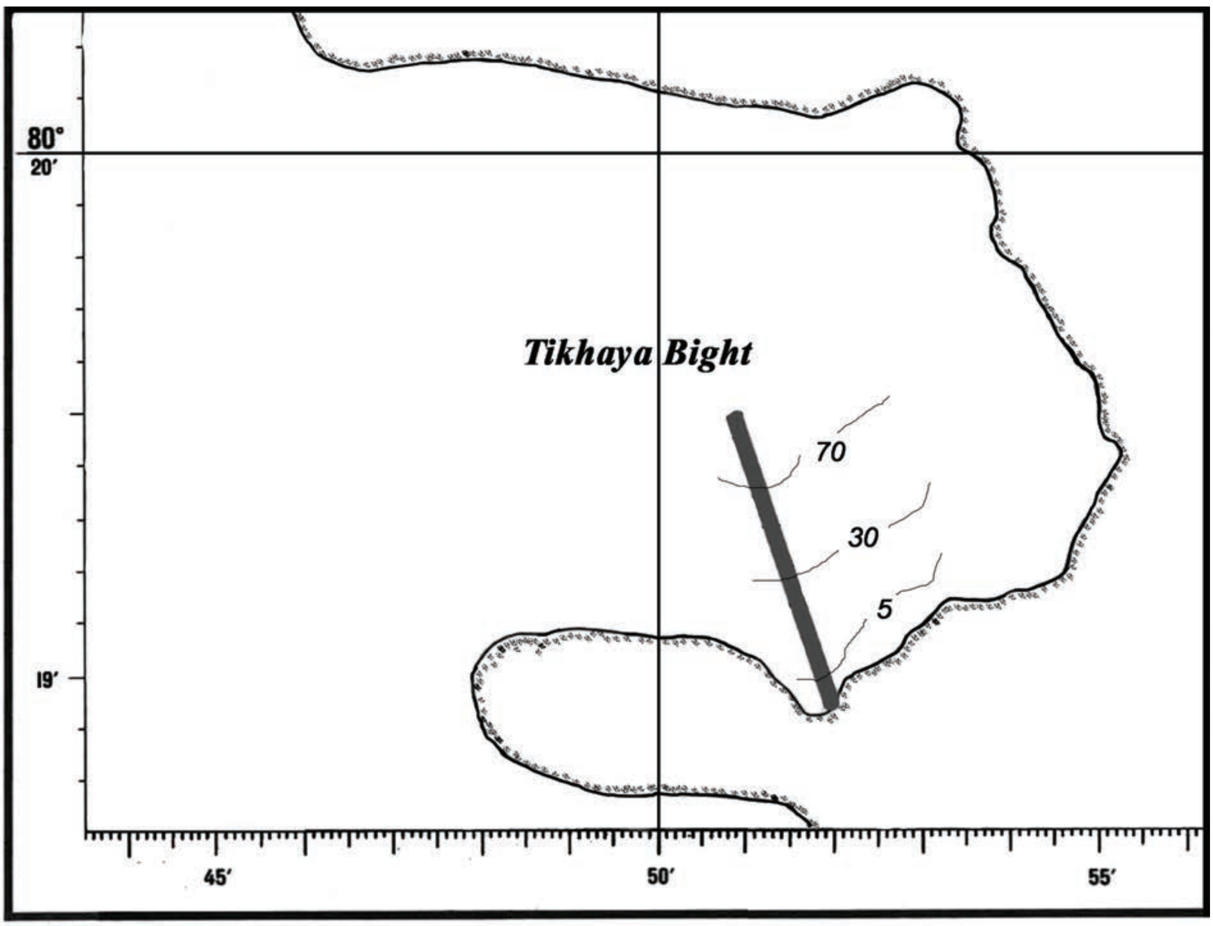


Fig. 2. Position of our transect in the Tikhaya Bight (the Hooker Island), examined earlier by Gorbunov in 1929, and in 1990th by Polish hydrobiologists and international expedition.

van Veen bottom-grab with a gripping area of 0.1 m^2. The divers also made underwater pictures of benthic communities and associated fauna. Collected fauna had been sorted in the lab, identified to species level and quantified both in abundance (in specimens/m^2), and wet weight biomass (in g/m^2).

RESULTS

Three different communities had been presented along the transect (Fig. 3).

The intertidal zone was occupied by rocky-stony or pebble beaches inhabited by amphipods. The shallow subtidal zone until the depth 5 m was covered by pebbles and small stones hosting a community dominated by amphipods (*Gammarus setosus*) and brown alga *Petalonia fascia*, with biomass of the dominating species of 4.08±1.46 and 1.00±0.36 g/m^2 respectively (Table 1). The community held 20% of widespread boreal-arctic species, 40% of highboreal-arctic species and 40% of subtropical-boreal-arctic species (Fig. 4A). Species density and biomass of the community were reduced (115±16 ind/m^2 and 7.6±0.9 g/m^2) and dominated by nektobenthic amphipods.

Bivalves (*Serripes groenlandicus* + *Mya truncata*), amphipods (*Haploops laevis*) and bryozoans (*Alcyonidium disciforme*) were abundant between 7 and 30 m on clayey silt with stones, pebbles and grav-

Table 1. Seasonal community of amphipods and algae at depth 3–5 m.

Organisms	Taxon	Trophic group	Biogeographical group	*N* (ind/m^2)	*B* (g wet wt/m^2)
Algae					
Petalonia fascia	Ph	A	sub-a	–	**1.00±0.36**
Urospora penicilliformis	Ch	A	sub-a	–	0.05±0.02
Acrosiphonia sp.	Ch	A	–	–	0.05±0.02
Nektobenthos					
Gammarus setosus	Am	D	hb-a	85±30	**4.08±1.46**
Onisimus litoralis	Am	Cr	hb-a	28±10	**1.97±0.70**
Anonyx nugax	Am	Cr	wb-a	2±0.7	0.44±0.16

Note: Phaeophyta – Ph; Chlorophyta – Ch; Amphipoda – Am; A – autotrophic; D – detritophage; Cr – carnivorous.

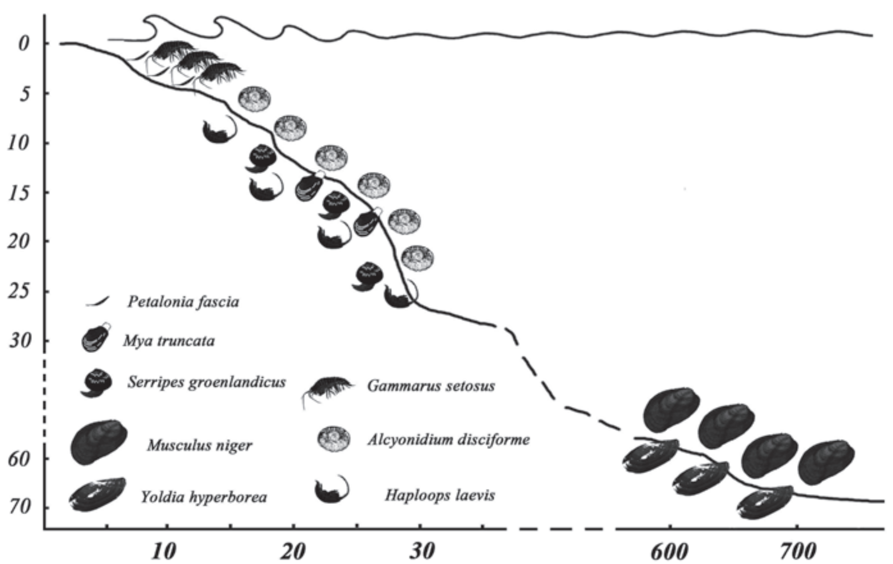
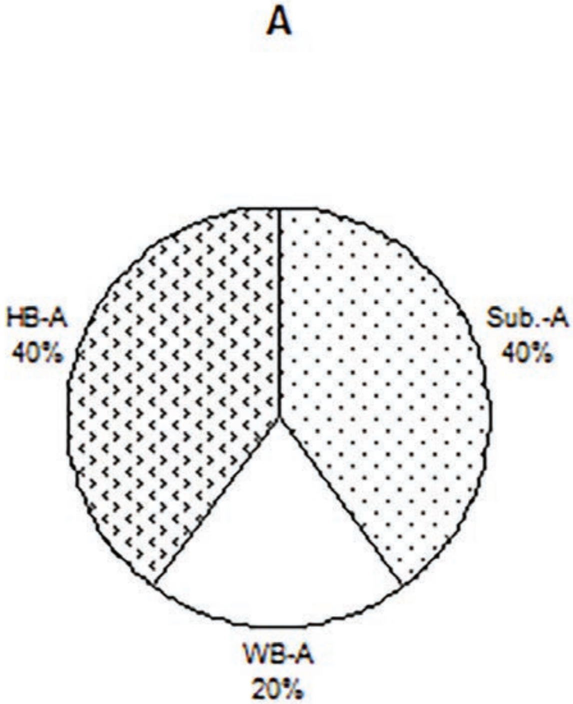
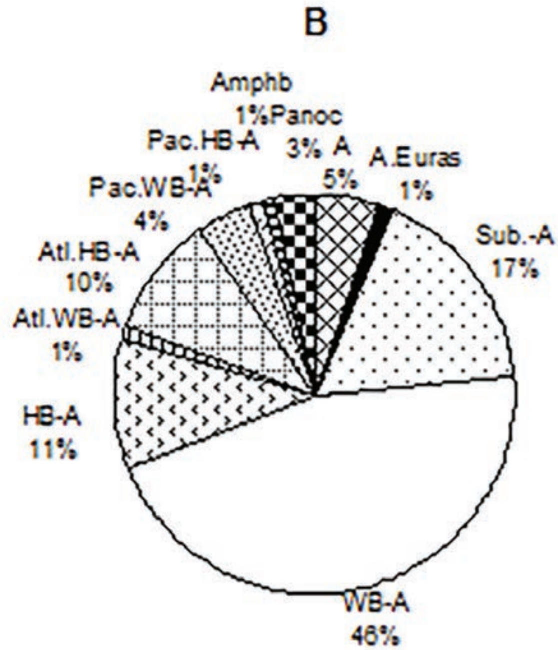


Fig. 3. Benthic communities observed in 2013 on transect eastward of the Rubini Rock in the Tikhaya Bight, the Hooker Island. Abscissa, distance from coastline, ordinate, depth, meters.





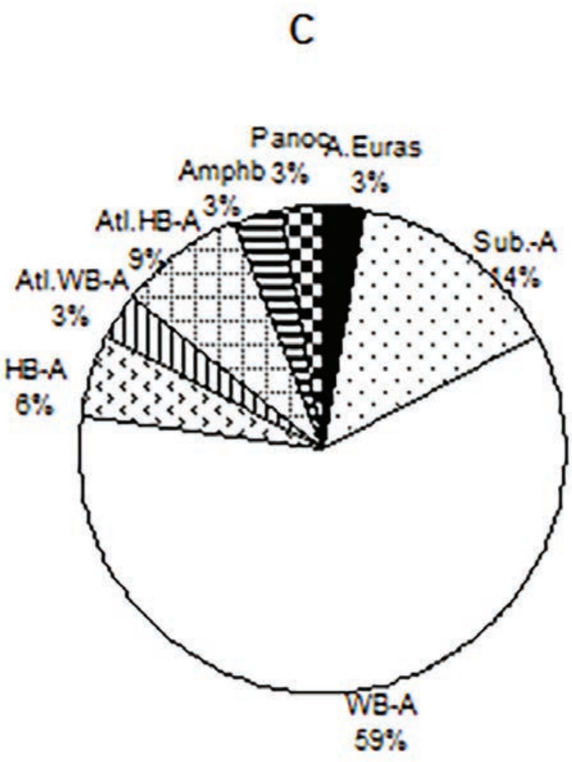


Fig. 4 A–C. A ratio of biogeographical groups in benthic communities along of our transect from the shoreline up to the depth of 72 m. (**A**, 3–5 m; **B**, 7–28 m; **C**, 67–72 m). A – Arctic species. A.Euras – Arctic-Eurasian species. Amphb – Amphiboreal species. Atl.HB-A – Atlantic High Boreal Arctic species. Atl. WB-A – Atlantic Widespread Boreal Arctic species. HB-A – High Boreal Arctic species. Pac.WB-A – Pacific Widespread Boreal Arctic species. Pac.HB-A – Pacific High Boreal Arctic species. Panoc – Panoceanic species. Sub.-A – Subtropical-Boreal-Arctic species. WB-A – Widespread Boreal Arctic species.

el, with biomass values of 41.76±32.8, 23.61±21.03, 21.87±18.6 and 15.08±5.64 g/m^2 respectively (Table 2). Widespread boreal-arctic species dominated the community (46%), followed by subtropical-boreal-arctic (17%), highboreal-arctic species (11%) followed by other biogeographic groups (Fig. 4B). Species density and biomass had been much higher than in the previous community (1495±7 ind/m^2 and 151.6±0.8 g/m^2.There were 15 nektobenthic species, the amphipod *Gammarus setosus* (34±21 specimens/m^2), the most abundant one, also holded the greatest biomass (1.19±1.0 g/m^2). Nektobenthic species density and biomass was 65±3 ind/m^2 and 3.74±0.23 g/m^2 respectively. There were found 32 epifaunal taxa, bryozoan ring-shaped colonies of *Alcyonidium disciforme* which dominated both by biomass and abundance. Small polychaete worms (18 species) and gastropods (5 species) demonstrated the highest

Table 2. Community of bivalves at the depth 7–28 m.

Organisms	Taxon	Trophic group	Biogeographical group	*N* (ind/m²)	*B* (g wet wt/m²)
Nectobenthos					
Gammarus setosus	Am	D	hb-a	34±21.2	1.19±1.0
Quasimelita formosa	Am	D	hb-a	9.5±3.3	0.63±0.5
Acanthostepheia malmgreni	Am	D	hb-a	1.1±0.7	0.56±0.42
Calathura brachiata	Is	Cr	wb-a	3.3±2.9	0.46±0.4
Diastylis rathkei	Cu	D	wb-a	5.6±2.1	0.36±0.16
Pontoporeia femorata	Am	D	wb-a	6.2±4.1	0.33±0.28
Diastylis edwardsi	Cu	D	a.	30±25	0.18±0.13
Diastylis scorpioides	Cu	D	a.	1.7±1.4	0.13±0.11
Atylus carinatus	Am	D	hb-a	1.5±0.5	0.1±0.08
Aceroides latipes	Am	D	hb-a	0.7±0.4	0.05±0.04
Rozinante fragilis	Am	D	hb-a	1.5±0.5	0.03±0.02
Rostroculodes borealis	Am	D	wb-a	1.6±0.5	0.02±0.018
Anonyx nugax	Am	Cr	wb-a	0.05±0.03	0.01±0.007
Onisimus barentsi	Am	Cr	Atl.hb-a	0.05±0.03	0.0005±0.0004
Acanthonotozoma inflatum	Am	D	hb-a	0.05±0.03	0.0004±0.0003
Epifauna					
Alcyonidium disciforme	Bry	S	a-euroas.	58.1±35.6	**15.08±5.64**
Harmothoe imbricata	Po	Cr	sub-a	3.8±1.35	2.26±2.11
Ophiocten sericeum	Oph	D	Atl.hb-a	7.6±2.47	1.26±0.77
Bylgides annenkovae	Po	Cr	Atl.hb-a	1.7±1.67	1.05±1.0
Eteone longa	Po	Cr	sub-a	49.3±40.3	0.81±0.7
Buccinum cyaneum	Ga	Cr	Atl.hb-a	0.1±0.08	0.80±0.7
Hiatella arctica	Bi	S	sub-a	2.5±2.1	0.75±0.65
Ophiura robusta	Oph	D	Atl.hb-a	5.0±4.3	0.75±0.65
Cnemidocarpa rhizopus	Asc	S	Atl.hb-a	8.8±7.76	0.69±0.5
Phyllodoce groenlandica	Po	Cr	wb-a	4.6±1.85	0.64±0.29
Musculus discors	Bi	S	wb-a	1.8±1.63	0.51±0.45
Cryptonatica affinis	Ga	Cr	wb-a	0.1±0.07	0.30±0.25
Scoletoma fragilis	Po	Cr	wb-a	5.2±2.79	0.29±0.17
Asteroidea gen. sp. (juv.)	Ast	Cr	–	1.3±1.25	0.25±0.23
Abyssoninoe hibernica	Po	Cr	Atl.hb-a	27.1±13.55	0.19±0.13
Onchidiopsis sp.	Ga	Cr	–	0.1±0.007	0.19±0.17
Eteone spetsbergensis	Po	Cr	amphb.	2.6±2.47	0.18±0.17
Nereis zonata	Po	Cr	sub-a	0.8±0.7	0.17±0.16
Opistobranchia gen. sp.	Ga	Cr	–	2.8±2.57	0.16±0.15
Bylgides elegans	Po	Cr	hb-a	1.1±0.79	0.15±0.12
Laonice cirrata	Po	D	sub-a	3.3±2.36	0.11±0.07
Ehlersia oerstedi	Po	Cr	P.wb-a	5.8±2.5	0.07±0.04
Bylgides groenlandica	Po	Cr	hb-a	1.7±1.67	0.06±0.055
Paraninoe minuta	Po	Cr	wb-a	1.7±1.67	0.06±0.056
Velutina schneideri	Ga	Cr	wb-a	0.01±0.007	0.05±0.04
Lyonsia arenosa	Bi	S	wb-a	0.5±0.46	0.05±0.046
Circeis spirillum	Po	S	wb-a	44.6±32.64	0.05±0.04

Table 2. *Continued.*

Organisms	Taxon	Trophic group	Biogeographical group	*N* (ind/m²)	*B* (g wet wt/m²)
Pholoe longa	Po	Cr	wb-a	15.9±8.89	0.01±0.005
Phyllodoce citrina	Po	Cr	wb-a	0.1±0.09	0.01±0.009
Nereimyra aphroditoides	Po	Cr	P.hb-a	3.6±2.25	0.01±0.003
Hydroidea gen. sp.	Hy	S	–	–	0.004±0.003
Micronephtys neotena	Po	Cr	Atl.hb-a	1.3±1.25	0.003±0.0025
Infauna					
Serripes groenlandicus	Bi	S	wb-a	9.0±5.25	**41.76±32.8**
Mya truncata	Bi	S	wb-a	5.5±2.08	**23.61±21.03**
Haploops laevis	Am	D	hb-a	154.5±69.3	**21.87±18.6**
Astarte borealis	Bi	S	wb-a	5.0±4.5	8.88±7.90
Priapulus caudatus	Pri	D	bip..	11.7±3.3	8.40±3.92
Macoma moesta	Bi	D	P.wb-a	37.9±13.74	2.66±1.55
Brada inhabilis	Po	D	wb-a	0.9±0.81	1.69±1.51
Dipolydora quadrilobata	Po	D	wb-a	419.5±235.9	1.50±0.82
Artacama proboscidea	Po	D	wb-a	17.5±.6.93	1.46±0.73
Brada villosa	Po	D	wb-a	5.1±1.1	1.39±0.75
Thyasira gouldi	Bi	S	wb-a	40.0±32.4	1.12±0.92
Nuculana pernula	Bi	S	Atl.wb-a	3.3±3.0	1.00±0.95
Thyasira flexuosa	Bi	S	sub-a	27.6±26.1	0.96±0.86
Maldane sarsi	Po	D	wb-a	63.3±30.94	0.84±0.65
Euchone papilosa	Po	S	wb-a	4.3±3.92	0.63±0.61
Ampharete finmarchica	Po	D	wb-a	0.8±0.73	0.39±0.3
Spio arctica	Po	D	wb-a	45.5±25.38	0.32±0.15
Nemertini gen. sp.	Ne	Cr	–	5.0±1.31	0.31±0.1
Terebellides williamsae	Po	D	wb-a	20.9±12.21	0.30±0.23
Apistobranchus tullbergi	Po	D	wb-a	83.1±67.52	0.26±0.2
Scoloplos acutus	Po	D	wb-a	20.9±7.62	0.22±0.09
Ophelia limacina	Po	D	sub-a	53.8±53.75	0.18±0.17
Axinopsida orbiculata	Bi	D	wb-a	11.9±10.2	0.15±0.1
Axionice flexuosa	Po	D	P.wb-a	6.5±3.13	0.13±0.08
Chone duneri	Po	S	sub-a	1.7±1.67	0.13±0.12
Thyasira sarsi	Bi	S	sub-a	5.1±1.1	0.12±0.03
Diplocirrus longisetosus	Po	D	sub-a	5.2±3.2	0.12±0.08
Proclea graffi	Po	D	wb-a	5.0±0.48	0.09±0.08
Chaetozone cf. *setosa*	Po	D	panoc.	9.2±3.4	0.07±0.04
Heteromastus filiformis	Po	D	sub-a	4.2±4.17	0.06±0.05
Ampharete borealis	Po	D	P.hb-a	0.6±0.05	0.06±0.05
Ophelina cylindricaudata	Po	D	wb-a	17.6±17.47	0.06±0.05
Flabelligera affinis	Po	D	sub-a	1.9±1.78	0.05±0.04
Aricidea nolani	Po	D	wb-a	24.6±12.1	0.04±0.01
Liocyma fluctuosa	Bi	S	wb-a	1.2±1.1	0.03±0.02
Galathowenia oculata	Po	D	sub-a	0.8±0.7	0.02±0.01

Table 2. *Continued.*

Organisms	Taxon	Trophic group	Biogeographical group	*N* (ind/m²)	*B* (g wet wt/m²)
Laphania boecki	Po	D	wb-a	2.9±1.7	0.02±0.01
Lysippe labiata	Po	D	P.wb-a	2.5±2.4	0.02±0.015
Chone murmanica	Po	S	a.	9.3±9.1	0.02±0.015
Chone perseyi	Po	S	a.	9.2±5.3	0.02±0.01
Lumbriclymene minor	Po	D	sub-a	2.5±2.4	0.02±0.015
Marenzelleria wireni	Po	D	a.	7.8±6.7	0.01±0.007
Sphaerodorum flavum	Po	D	wb-a	0.8±0.75	0.01±0.007
Ampharete goeesi	Po	D	wb-a	4.6±2.1	0.01±0.002
Praxillella praetermissa	Po	D	sub-a	1.9±1.88	0.01±0.008
Golfingia vulgaris	Sip	D	wb-a	0.8±0.78	0.004±0.0037
Spio armata	Po	D	wb-a	1.7±1.66	0.003±0.0026
Ampharete acutifrons	Po	D	wb-a	0.04±0.037	0.003±0.0027
Scalibregma inflatum	Po	D	wb-a	0.1±0.08	0.003±0.0028
Levinsenia gracilis	Po	D	panoc.	1.7±1.67	0.002±0.0018
Trichobranchus glacialis	Po	D	wb-a	0.8±0.78	0.002±0.0018
Protodorvillea kefersteini	Po	Cr	sub-a	1.3±0.82	0.001±0.0008
Aphelochaeta sp.	Po	D	–	0.8±0.78	0.001±0.0009
Cossura longicirrata	Po	D	wb-a	0.8±0.78	0.001±0.0009

Note: Isopoda – Is; Cumacea – Cu; Bryozoa – Bry; Polychaeta – Po; Ophiuroidea – Oph; Gastropoda –Ga; Bivalvia –Bi; Ascidiacea – Asc; Asteroidea – Ast; Hydrozoa – Hy; Priapulida –Pri; Nemertini – Ne; Sipunculida – Si; S – suspension feeder.

diversityin this community. The polychaete *Eteone longa* prevailed by number (49±40 ind/m²). Epifaunal species density and biomass was 260±6 ind/m² and 26.9±0.5 g/m⁻² respectively. Infauna included 54 species with the most abundant polychaete *Dipolydora quadrilobata* (420±236 ind/m²). Numerous amphipods *Haploops laevis* found protection against predators near by bivalve tubes. Polychaetes were the most diverse taxonomic group. Infaunal species and biomass was of 1160±13 ind/m² and 121.0±1.8 g/m² respectively.

Bivalves *Musculus niger* and *Yoldia hyperborea* dominated at depths from 69 to 72 m on clayey silt, with the biomass 50.0±5.3 and 53.3±6.7 g/m² respectively (Table 3). Widespread boreal-arctic species dominated the community (59%), followed by subtropical-boreal-arctic species (14%), Atlantic high-boreal-arctic species (9 %) and other groups (Fig. 4C). Pacific species were absent here. Species density was twice lower but biomass was twice higher than in the previous community (697±7 specimens/m² and 363.7±1.3 g/m² respectively. In this community we found 4 nektobenthic species with domination of the isopod *Calathura brachiata* (0.23±0.20 g/m²) and the amphipod *Pontoporea femorata* (0.17±0.13 g/m²). Nektobenthic species density and biomass was 20±4 ind/m² and 0.43±0.11 g/m² respectively. There were presented 14 epifaunal species, mainly polychaetes, bivalves and ophiuroids. The most abundant had been polychaetes *Paraninoe minuta* (77±17 ind/m²), bryozoans *Alcyonidium disciforme* (73±59 ind/m²) and bivalves *Musculus niger* (50±5 ind/m²). The epifaunal species density and biomass was of 337±10 ind/m² and 214.5±2.5 g/m² respectively.

Infauna consisted mainly of small polychaete worms and included 20 species. The most abundant was *Spiochaetopterus typicus* (68±24 ind/m²) followed by the bivalve *Yoldia hyperborea* (53±7 ind/m²). The infaunal species density and biomass was of 340±8 ind/m² and 148.8±1.2g/m².

DISCUSSION

The communities, which we recorded in the Tikhaya Bight are similar with those reported previously from the high Arctic (Golikov & Averincev, 1977; Golikov et al., 1990, 1994, 2009; Petyashov et

Table 3. Community of bivalves at the depth 67–72 m.

Organisms	Taxon	Trophic group	Biogeographical group	*N* (ind/m²)	*B* (g wet wt m²)
Nectobenthos					
Calathura brachiata	Is	Cr	wb-a	3.3±2.9	0.23±0.20
Pontoporea femorata	Am	D	wb-a	13.3±11.5	0.17±0.13
Eudorella emarginata	Cu	D	wb-a	3.3±2.9	0.02±0.018
Paraphoxus oculatus	Am	D	sub-a	0.3±0.02	0.01±0.007
Epifauna					
Musculus niger	Bi	S	wb-a	50.0±5.3	**135.76±14.1**
Musculus discors	Bi	S	wb-a	33.3±3.5	56.00±6.3
Ophiocten sericeum	Oph	D	Atl.hb-a	30.0±10	5.5±1.44
Ophiocanta bidentata	Oph	D	wb-a	3.3±2.9	3.0±2.5
Alcyonidium disciforme	Bry	S	a-euroas.	73.3±58.5	2.73±2.64
Laonice cirrata	Po	S	sub-a	10.0±5.8	1.87±1.74
Myriotrochus rinkii	Ho	D	hb-a	10.0±5.8	1.83±1.37
Scoletoma minuta	Po	Cr	wb-a	76.7±16.7	1.15±0.33
Hiatella arctica	Bi	S	sub-a	3.3±1.3	0.67±0.32
Ophiura robusta	Oph	D	Atl.hb-a	3.3±2.9	0.57±0.46
Craniella polyura	Por	S	Atl.hb-a	3.3±2.9	0.33±0.29
Cylichna sp.	Ga	Cr	–	6.7±5.8	0.33±0.29
Eteone spetsbergensis	Po	Cr	amphb.	3.3±2.9	0.07±0.06
Pholoe longa	Po	Cr	wb-a	3.3±2.9	0.003±0.0029
Infauna					
Yoldia hyperborea	Bi	S	wb-a	53.3±6.7	**105.33±5.49**
Spiochaetopterus typicus	Po	D	wb-a	66.7±24.1	19.59±9.05
Nuculana pernula	Bi	S	Atl.wb-a	33.3±13.3	17.50±6.80
Thyasira flexuosa	Bi	S	sub-a	26.7±6.7	0.87±0.41
Caudofeviata gen. sp.	Ca	D	–	3.3±2.9	0.78±0.70
Euchone papillosa	Po	S	wb-a	6.7±3.3	0.46±0.34
Terebellides williamsae	Po	D	wb-a	33.3±13.3	0.32±0.17
Maldane sarsi	Po	D	wb-a	10.0±5.8	0.30±0.24
Laphania boecki	Po	D	wb-a	20.0±15.3	0.16±0.12
Spio arctica	Po	D	wb-a	23.3±12.0	0.15±0.07
Heteromastus filiformis	Po	D	sub-a	16.7±16.0	0.11±0.009
Artacama proboscidea	Po	D	wb-a	3.3±2.9	0.10±0.009
Chaetozone cf. *setosa*	Po	D	panoc.	20.0±10.0	0.08±0.01
Ophelina cylindricaudata	Po	D	wb-a	3.3±0.9	0.02±0.019
Haploops laevis	Am	D	hb-a	0.3±0.2	0.01±0.007
Scoloplos acutus	Po	D	wb-a	3.3±2.9	0.01±0.007
Cossura longicirrata	Po	D	wb-a	3.3±2.9	0.01±0.007
Aricidea nolani	Po	D	wb-a	6.7±6.0	0.01±0.007
Sphaerodorum flavum	Po	D	wb-a	3.3±2.9	0.01±0.007
Ampharete sp.	Po	D	–	3.3±2.9	0.003±0.0025

Note: Holothuroidea – Ho; Caudofoveata –Ca; Porifera – Por.

al, 2004). Similarity was registered in the complexes of dominant species, but their quantitative indexes have not coincided especially for shallow communities. So the community of amphipods *Gammarus setosus* + Diatomea gen.sp. at the Cape of Schmidt in the Chukchi Sea had biomass which considerably (approximately in 25 times) exceeded those in a similar community (probably seasonal biocenosis) in the Tikhaya Bight. Perhaps it was related to temporal distinctions in formation of juveniles and required additional researches. At the same time, the similar community located on the lower horizon of the littoral zone on the Rudolf Island (FJL) had resembling structure (20 ind/m^2 and 5.4 g/m^2) with the Tikhaya Bight (85 ind/m^2 and 4.1 g/m^2). The polydominant community, with domination of bivalves *Serripes groenlandica* and *Mya truncata*, amphipoda *Haploops laevis* and pearlworts of *Alcyonidium disciforme*, probably, is original one and was recorded on the stage of an occupation a new well-fitting biotope. However, the species dominated this community had been reported before as those which formed the separate communities in the high Arctic (Golikov, Averincev, 1977; Babkov, Golikov, 1984; Petyashov et al, 2004; Sirenko et al., 2009). The community was dominated by bivalves *Musculus niger* and *Yoldia hyperborea* at the depth from 69 to 72 m, but in the high Arctic it was recorded at the depth about 100 meters. (Sirenko et al., 2009).

According to the descriptions by Weslawski and Zajaczkowski (1992) and Averintsev (1992, 1993, 1994) the sublittoral zone of the Tikhaya Bight demonstrated a distinct zonal distribution of benthic communities, determined by the depth and type of the bottom. At the depths, ranging from 3–5 to 12–15 m, different authors described well-defined seaweed communities, dominated by large brown algae *Saccharina latissima* and *Laminaria solidungula*. According to the observations of these authors, all animals in this community had been associated with the dominant macrophytes. Their existence, in turn, was possible only in the presence of the stony substrate available for the attachment of kelps. The diving hydrobiological transect which had been sampled during our expedition, was deliberately performed at the same place as the transect which was sampled by Averintsev (1992). However, we could not find any kelp belt, although there were still extensive kelp beds dominated by *Saccharina latissima* but also with *Laminaria solidungula*, *Laminaria hyperborea* and *Alaria esculenta* near the Rubini rock and just below it.

Thus, although we did not make any cartographical study, in our opinion significant changes in the distribution of the benthic communities have certainly taken place at least in some parts of Tikhaya Bight. Despite of the intense water flow and vigorous shift of icebergs coming away annually during the warm season from Sedov Glacier, the substantial part of the bight is at the present a subject to siltation. It is very likely that this siltation is associated with the glacial retreat which occurs in many places of the archipelago (Frolov et al., 2005; Milovanova, Novikov and Demianov, 2012), and washes the fine sediments off into the sea. This process is especially strong during the warmest years. Stony areas, where kelp grew 20 years ago, were now mostly covered with a thick layer of silt, which implied a regression of kelp beds and their substitution by muddy bottoms dominated by filter feeders.

The data obtained in this study can be used as a basis for a future monitoring regarding both the changes in species composition and biogeographical groups that will probably take place in the near future because the current warming trend. Due to the existence of historical data Tikhaya Bight can be used as a sampling station for a monitoring of ongoing environmental changes and shifts in composition and spatial distribution of the associated species and habitats/communities. Further cartographical studies of the habitats have to be performed and compared with the raw data obtained by Averintsev (1994) in order to have an accurate view of the changes which occurs at different spatial and temporal levels.

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