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Composition of the abyssal infauna of the Kuril–Kamchatka area (NW Pacific) collected with a box corer

Viola Fischer [a,*], Angelika Brandt [a]

[a] Zoological Institute and Zoological Museum, Biocenter Grindel, University of Hamburg, Martin-Luther-King-Platz 3, 20146 Hamburg, Germany

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ABSTRACT

During the German–Russian KuramBio (Kuril–Kamchatka Biodiversity Studies) expedition with the RV *Sonne* from July to September 2012, a 0.25 m^2 box corer was used to sample the benthic fauna of the Kuril–Kamchatka area. 23 cores were deployed at 12 stations, and in total 36,648 individuals could be identified from a combined surface area of 5.75 m^2. Total faunal densities ranged from 1024 to 16,592 ind. m^{-2}, respectively, for the macrofauna from 436 to 3520 ind. m^{-2}. The fauna was dominated by Nematoda (65%), even though this group and other meiofaunal taxa were only partially retained by the 300 μm screen that was used as the smallest screen for this study. The remaining part of the fauna was dominated by polychaetes (23%), followed by peracarid crustaceans (6%) and molluscs (3%). Most of the collected taxa occurred very patchily. Over 80% of the animals were extracted from the upper 2 centimeters of the sediment. Compared to other regions of the Pacific the density of the benthic fauna was unusually high. At the upper slope of the continental margin of the trench and at the southern part of the area the benthic fauna was most taxon rich. Station 3 from the continental slope of the trench was also most rich in terms of faunal density (total numbers of ind. m^{-2}), followed by the station 11 and 12 from that the southernmost part of the abyss. Although the Kuril–Kamchatka area has been sampled on several expeditions during the last century, and some studies on the biomass of the benthic fauna have been published, this study offers the first quantitative community analysis of the benthic fauna in terms of abundance and taxon richness.

1. Introduction

The deep sea covers around 60% of the earth's surface (Rex and Etter, 2010). Even though the deep ocean floor is the largest ecosystem on earth, it is also the least explored (Smith and Demopoulos, 2003) and only little is known about the deep-sea fauna. Since the 1950s increasing effort has been undertaken to identify the deep-sea fauna and determine the factors affecting its diversity (Hessler and Jumars, 1974; Levin et al., 2001; Rex and Etter, 2010; Thistle et al., 1985). An important innovation was the development of effective sampling gear and quantitative sampling methods (Hessler and Sanders, 1967; Sanders et al., 1965). Modern quantitative samples were mainly taken in the Atlantic and Arctic oceans, the Mediterranean Sea and the northeastern Pacific and most of the analyzed faunal communities were sampled in oligotrophic regions (Rex and Etter, 2010).

The Kuril–Kamchatka Trench and the adjacent abyssal plain (referred to in the following as "Kuril–Kamchatka area") are situated in the northwestern Pacific, a region of high surface productivity, especially during the summer period (Zenkevich, 1963). The deep waters are characterized by a high amount of dissolved oxygen and show comparatively uniform hydrological properties (Bogorov, 1972; Nan'niti and Akamatsu, 1966; Zenkevich, 1963). The upper water masses of the northwestern Pacific are mainly influenced by two currents; the Oyashio (Kurile Current) and the Kuroshio (Kurile Countercurrent) (Mitsuzawa and Holloway, 1998; Qiu, 2001; Zenkevich, 1963). The Oyashio is a cold Subarctic current which is flowing from the Arctic Ocean southwards into the Pacific. The Kuroshio starts off the east coast of Taiwan and transports warm tropical waters northwards (Mann and Lazier, 2009; Qiu, 2001). Besides these two currents, the study area is partly influenced by the currents that flow through the Bussol and the Krusenstern Straits from the Sea of Okhotsk through the Kuril Islands into the Oyashio (Belkin and Cornillon, 2003; Tyler, 2002; Zenkevich, 1963). The deep waters of the area are characterized by two bottom currents; the deep boundary current on the landward side of the trench, which flows southwestwards along the slope into the Japan Trench, and the trench-countercurrent on the oceanward side, which flows northeastwards along the slope (Mitsuzawa and Holloway, 1998).

The region has already been investigated in the last century during expeditions with the RV *Vityaz* in 1949, 1953 and 1966. A

* Corresponding author.
E-mail address: viola.fischer@uni-hamburg.de (V. Fischer).

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lot of publications resulted from these expeditions, dealing with the analysis of physical and chemical factors of the region, the topography of the trench, surface productivity and vertical plankton distribution. These publications are summarized in two books (Bogorov, 1972; Zenkevich, 1963). The benthic fauna has also been described in many publications; in terms of biomass (Filatova, 1977; Zenkevich and Filatova, 1958) or for some taxa and mostly on the species level (e.g. for Foraminifera (Saidova, 1970); Polychaeta (Kupriyanova, 1993; Levenstein, 1971; Uschakov, 1982; Ushakov, 1974; Ushakov and Pavlovskiĭ, 1965); Tanaidacea (Kudinova-Pasternak, 1970, 1977); Isopoda (Birstein, 1963, 1970a, b, 1971; Kussakin, 1971); Amphipoda (Birstein and Vinogradov, 1970; Vinogradov, 1970) and Bivalvia (Filatova, 1971)).

Since the *Vityaz* expeditions, the deep sea of the Kuril–Kamchatka area has not been revisited until the KuramBio (Kuril–Kamchatka Biodiversity Studies) expedition in 2012.

The present study provides the first quantitative description of the community composition of the benthic macrofauna of the Kuril–Kamchatka area, in terms of abundance and taxon richness, on the class and order level.

It is part of the KuramBio project during which the benthic deep-sea fauna was sampled with different gear types using standardized deployment.

One of the aims of this project is to give a detailed, quantitative description of the Kuril–Kamchatka area´s abyssal community, including the fauna of all size classes.

2. Material and methods

2.1. Study area

The joint German–Russian expedition KuramBio to the Kuril–Kamchatka Trench and its adjacent abyssal plain took place on board of the RV *Sonne* between July 21st and September 07th 2012. During this expedition 23 box corer deployments were taken at 12 stations between ~34°–48°N and 147–157°E (Fig. 1). Ten stations were sampled between 4869 and 5413 m depth on the abyssal plain and two stations between 4977 and 5768 m depth at the upper margin of the trench (Table 1).

2.2. Deployment of the box corer and sample treatment

A box corer 2500 (USNEL SPADE corer) with a sampling area of 0.25 m^2 was used to sample the benthic fauna of the area. At 11 stations two replicates were taken. These replicates (in the following defined as cores) were subsequently numbered (*x*-4 and *x*-5). Table 1 gives information about the depth and

Table 1
Station data from the box corer deployments.

Date	Core	Latitude	Longitude	Depth[m]
7/29/2012	1-4	43°58′20N	157°19′78E	5406
7/29/2012	1-5	43°58′19N	157°19′77E	5401
8/2/2012	2-4	46°14′01N	155°33′08E	4870
8/2/2012	2-5	46°14′02N	155°33′06E	4869
8/5/2012	3-4	47°14′30N	154°42′35E	4980
8/5/2012	3-5	47°14′31N	154°42′31E	4977
8/7/2012	4-4	46°58′01N	154°32′47E	5768
8/7/2012	4-5	46°58′04N	154°35′50E	5766
8/10/2012	5-4	43°35′00N	153°58′00E	5386
8/10/2012	5-5	43°34′97N	153°58′01E	5378
8/13/2012	6-4	42°29′03N	153°59′84E	5296
8/13/2012	6-5	42°29′04N	153°59′84E	5299
8/17/2012	7-4	43°02′32N	152°59′10E	5222
8/17/2012	7-5	43°02′05N	152°59′11E	5225
8/20/2012	8-4	42°14′61N	151°43′49E	5130
8/20/2012	8-5	42°14′62N	151°43′62E	5129
8/23/2012	9-4	40°35′04N	150°59′93E	5403
8/23/2012	9-5	40°35′03N	151°00′01E	5412
8/26/2012	10-4	41°12′02N	150°05′70E	5249
8/26/2012	10-5	41°12′01N	150°05′71E	5250
8/29/2012	11-4	40°12′91N	148°06′06E	5348
8/29/2012	11-5	40°12′86N	148°06′02E	5350
9/1/2012	12-2	39°43′36N	147°09′99E	5229

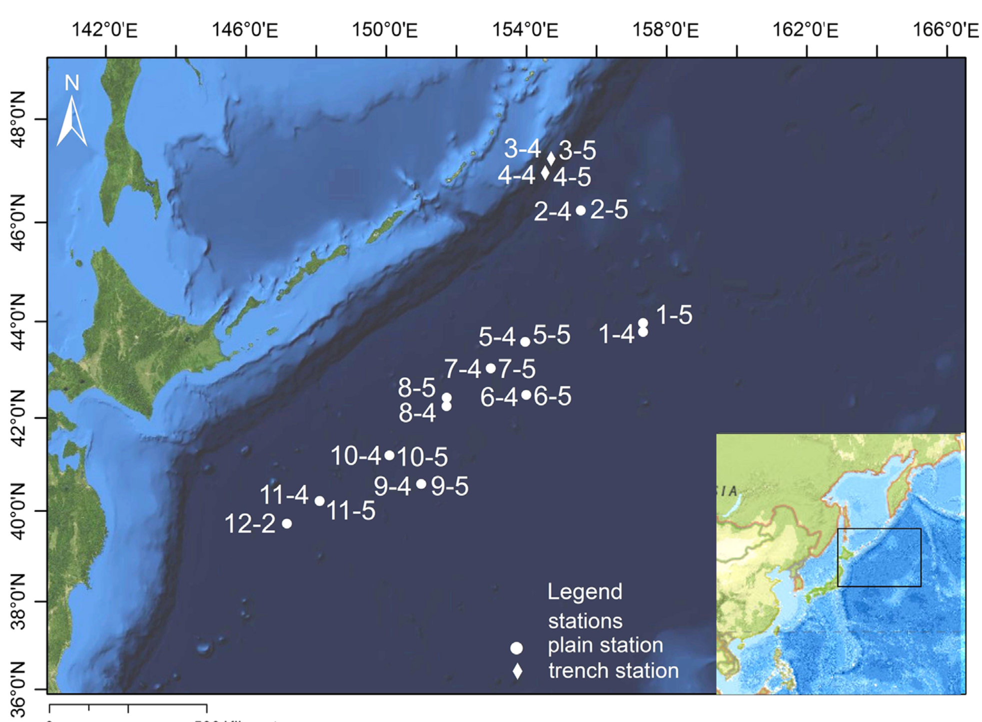

Fig. 1. Station map showing BC stations and deployed cores, sampled in the Kuril–Kamchatka area.

coordinates of all stations and cores. The sample of each core was divided into two subsamples (0–2 cm and 2–20 cm sediment depth). The upper layer was carefully washed in cooled sea water and sieved through sieves of 1000, 500 and 300 μm mesh sizes. The sediment of the lower layer was sieved in buckets with seawater over a 500 μm screen. At 11 stations, the samples of the first core were fixed in 4% formaldehyde and after 48 h transferred to 70% ethanol. For logistic reasons only one box corer was deployed at station 12 (12-2) and the sample was fixed in 96% ethanol. Some of the samples were sorted on board but most of the material was sorted in the laboratory of the Zoological Museum in Hamburg using Leica M50, Leica MS5 and Wild M5A stereomicroscopes. Up to now the taxonomic identification of the fauna is done on the level of class and order. The different taxa will be worked up on species level by specialists in future.

2.3. Classification of the examined community

The box-corer fauna includes both macrofauna and meiofauna. Meiofauna is typically defined by size;—between 45 and 300 μm (Giere, 2008). The smallest mesh used in this study was 300 μm, therefore meiofauna is only partly retained. Nevertheless, the samples include some taxa that are commonly counted as typical meiofauna; Nematoda, Copepoda, Ostracoda, Tardigrada and Kinorhyncha (e.g. Hessler and Jumars, 1974; Rex and Etter, 2010; Snider et al., 1984). These taxa will not be part of the analyses of the study (for detailed description of the meiofauna read Schmidt and Martínez-Arbizu, 2014). The remaining taxa are reported as macrofauna, although representatives of some of those taxa can fall into the meiofaunal size range in the deep sea (Rex and Etter, 2010; Rex et al. 2006). The number of individuals is given in the standard unit (ind. m^{-2}), calculated from total numbers per core.

This study is focused on metazoan taxa. Therefore taxa like Foraminifera, Radiolaria and other protozoans were not counted and extracted, although they were present in high numbers in each sample (for an analyzes of the Foraminifera read Lejzerovicz, F. in this volume). Colonial taxa represented by Porifera and Bryozoa were also not counted, although they occurred in all cores, because they were too fragmented to detect the number of specimens. They are reported as taxon being present but were excluded from the community analysis.

2.4. Community analyses

The software PRIMER version 6.1.6 was used for the data analyses (Clarke and Gorley, 2006). A cluster analysis was performed to identify the community structure in the study area. Square-root transformed total abundance and macrofaunal abundance data per core of all taxa identified (except colonial taxa) were used for the analysis. Resemblance was done by Bray Curtis similarity (Bray and Curtis, 1957). Correlation-analyses between faunal abundance (total fauna, meiofauna, macrofauna) and depth as well as other parameters (e.g. percentage of sand or clay (unpublished data), latitude and longitude) were done with the software Microsoft Excel 2010. Standard deviations (SD) were also calculated in Microsoft Excel 2010.

3. Results

3.1. Community composition and faunal abundances

In total 36,648 individuals belonging to 39 different supraspecific taxa could be identified from the 23 cores that had a combined surface area of 5.75 m^{-2} (Table 1). The mean total faunal abundance was calculated as 6374 ± 4603 ind. m^{-2}. The majority of the individuals (84%) were found in the upper 2 centimeters of the sediment.

Meiofauna was only partially retained by the 300 μm screen, but dominated the benthic fauna with a mean of 75 ± 4% (27,834 of the collected animals); with Nematoda as the dominant meiofaunal taxon (87 ± 11%).

Macrofauna made up 25% of the benthic fauna (8811 of the collected animals). Macrofaunal densities lay between 436 and 3520 ind. m^{-2} (Table 2). The lowest abundance of macrofauna was found at the stations 1 (552 ± 164) and 6 (724 ± 102 ind. m^{-2}). By far the highest macrofaunal abundance in terms of total numbers was found at station 3 from the upper margin of the landwards slope of the Kuril–Kamchatka Trench (3036 ± 684 ind. m^{-2}). The mean density of the macrofauna was calculated as 1532 ± 732 ind. m^{-2}.

3.2. Composition of the macrofauna

Altogether the macrofauna was dominated by Polychaeta (65%), followed by Peracarida (18%), Mollusca (8%) and Echinodermata (1%). The remaining 8%, summed as “others” include all other collected taxa (Fig. 2A). Within the Peracarida, Tanaidacea were most abundant (48%), followed by Isopoda (28%) and Amphipoda (22%) (Fig. 2C). Except for core 5-5 where Isopoda were not found, these taxa occurred in all cores. Cumacea and Mysidacea were also found, but occurred very patchily (2%). As shown in Fig. 2D, Mollusca were clearly dominated by Bivalvia (64%) which occurred in every core and were most abundant in terms of total numbers at station 12-2 (240 ind. m^{-2}) and the only representatives of Mollusca collected from the cores 3-5 and 6-5 (Fig. 3).

Some of the dominant macrofaunal taxa were found in the highest abundance in core 3-4 from the upper margin of the slope. Like Polychaeta (2036 ind. m^{-2}), Isopoda (216 ind. m^{-2}), Tanaidacea (436 ind. m^{-2}), Aplacophora (40 ind. m^{-2}) and Scyphozoa (112 ind. m^{-2}) (Table 2 and Fig. 3).

3.3. Taxonomic richness

The number of macrofaunal taxa per core ranged from 7 to 18 with a mean of 13 ± 3.4 (Table 2) and was sometimes even varying strongly between the two cores taken at one station. The most taxon rich fauna was collected from the abyssal stations 12 (18 taxa), 11 (16 ± 1 taxa) and 7 (16 ± 3 taxa) and from station 4 from the trench slope (17 ± 0 taxa). The poorest fauna in terms of taxonomic richness was reported from station 6 (9 ± 2 taxa), 5 (11 ± 2 taxa) and 1 (11 ± 1 taxa).

3.4. Community analysis

The Bray–Curtis Cluster Analysis of the macrofaunal taxa shows two clusters (Fig. 4). The stations from the upper margin of the trench (3 and 4) and the southernmost stations 11 and 12, as well as the fauna of core 7-4 clustered together. These stations were characterized by the highest macrofaunal abundance. They have a similarity of 69% and, except core 7-4, the two cores of one station always cluster together. The highest similarity inside this cluster was detected between the cores 11-4 and 11-5 (83%). The second cluster covers all other cores from the abyssal plain. Only at two stations the cores clustered together (2 and 8) with 82 and 79%. The cores that show the lowest abundance of macrofauna are the same as for the entire fauna and are clustered closely together in the second cluster.

Table 2
Numerical abundances by taxon and total densities and taxon richness per core of the benthic infauna of the Kuril–Kamchatka area.

Core	1-4	1-5	2-4	2-5	3-4	3-5	4-4	4-5	5-4	5-5	6-4	6-5	7-4	7-5	8-4	8-5	9-4	9-5	10-4	10-5	11-4	11-5	12-2	Total
Phylum/class/order																								
Porifera	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	**n.c.**
Cnidaria	**1**															**1**					**1**			**3**
Anthozoa							17						1						1	2	1		5	**27**
Hydrozoa					14		13	3					2	2		1	2		1	1				**39**
Scyphozoa		1			28		1	3	2		7		7				1		2		6	2	11	**71**
Ctenophora									4															**4**
Nemertea	13		1	4	5	38	10	3		41		7		4			1	2	1	12	2	1	1	**146**
Cephalorhyncha																								**0**
Kinorhyncha			22	2				3	1	0			21				4		1	2	11	2	3	**72**
Priapulida					1														1			1	1	**4**
Nematoda	80	210	1576	697	2,248	1274	450	1169	181	449	167	200	827	592	466	436	1,870	993	884	612	1978	3503	3,343	**24,205**
Mollusca																								**0**
Aplacophora	4		2		10		1	1	3	2	2		4	5	1	3	4	5	6	3	6	3	3	**68**
Bivalvia	4	7	16	13	46	30	15	12	11	8	8	7	44	14	12	10	16	23	22	16	36	37	60	**467**
Gastropoda	2	3	3	1	1			18	2	27	2		8	2	2	2	2	2	2	3	2	1	6	**91**
Scaphopoda	4	1	3	2				1	1				5	4				7	10	5	29	14	13	**99**
Sipuncula			6	4	2		7	4		2			7	1	6	2	1	1		1		2	1	**47**
Echiura							1						1		1						1	1		**5**
Annelida																								
Polychaeta	59	126	292	263	509	446	330	218	159	228	85	127	346	251	221	177	218	136	197	303	157	462	327	**5,637**
Pogonophora	1			1	66	19	30	44			1				1		1	5			73	50	8	**300**
Oligochaeta				10			6							2		3	4							**25**
Hirudinea							1																	**1**
Tardigrada									1															**1**
Arthropoda																								
Ostracoda	6	3	18	4	7	8	2	5	4	9	8	6	36	6	2	6	31	5	16	4	21	52	40	**299**
Maxillopoda																								
s/cl Copepoda harp.	30	66	270	120	190	45	29	96	30	99	50	49	163	51	52	44	223	111	114	132	92	115	122	**2293**
s/cl Copepoda cala	30	41	17	98	37	8	32	88	65	32	17	9	222	121	18	2	3	10	2	22	5	30	55	**964**
Malacostraca																								
Amphipoda	4	8	4	15	31	20	45	16	51	12	7	15	17	6	39	4	6	16	13	14	11	9	6	**369**
Isopoda	3	10	22	21	54	30	15	15	12		30	20	11	9	2	3	31	29	30	48	17	14	35	**461**
Tanaidacea	13	9	14	9	108	55	19	17	13	16	20	22	27	31	23	21	79	60	50	40	33	42	78	**799**
Cumacea		1	1	2	3								1				2	1	1		1	5	4	**22**
Mysidacea			1		1									2						1				**5**
Decapoda																	2						1	**3**
Euphausiacea								2	1															**3**
Arachnida																								
s/cl Acari								1			1		1											**3**
Bryozoa	x	x			x		x	x			x			x						x		x		**n.c**
Echinodermata																								
Asteroidea																		1		1				**2**
Crinoidea			1		1																			**2**
Ophiouridea																				1				**1**
Echinoidea			1				1	1					1											**4**
Holothuroidea	2	1	1	1			3	4	1	1		1	5			3	1	1			15	23	13	**76**
Chaetognatha													12	1										**13**
Chordata																								
Salpida																							12	**12**
Ascidia																			3			2		**5**
N taxa	**18**	**16**	**21**	**19**	**22**	**12**	**23**	**24**	**19**	**14**	**16**	**12**	**23**	**20**	**14**	**15**	**22**	**19**	**21**	**22**	**21**	**24**	**24**	
numbers/core	**256**	**487**	**2271**	**1267**	**3,362**	**1973**	**1028**	**1724**	**542**	**926**	**405**	**463**	**1769**	**1104**	**846**	**718**	**2,502**	**1408**	**1357**	**1223**	**2498**	**4,371**	**4,148**	**36648**
numbers/m²	**1024**	**1948**	**9084**	**5068**	**13,448**	**7892**	**4112**	**6896**	**2168**	**3704**	**1620**	**1852**	**7076**	**4416**	**3384**	**2872**	**10,008**	**5632**	**5428**	**4892**	**9992**	**17,484**	**16,592**	

Abbreviations: n.c. = not counted, x = present but not counted.

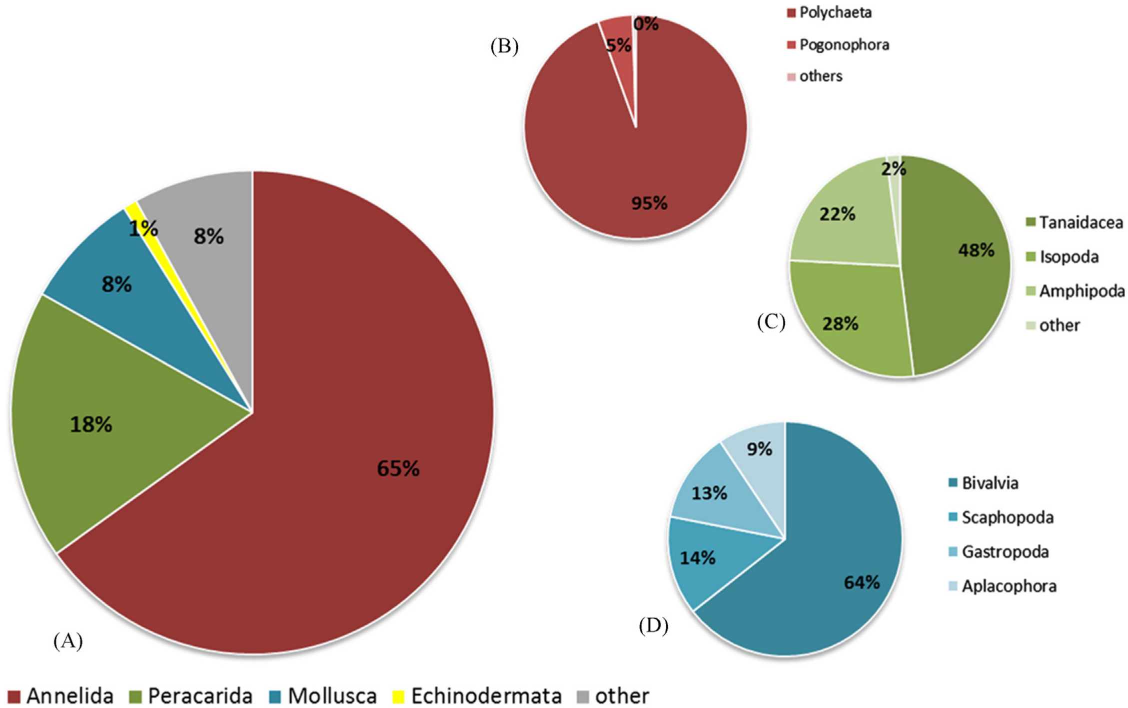

Fig. 2. Percentaged composition of the macrofaunal community by abundance (A), combined with the percentaged composition within the dominant taxon groups (B) Annelida; (C) Peracarida; (D) Mollusca.

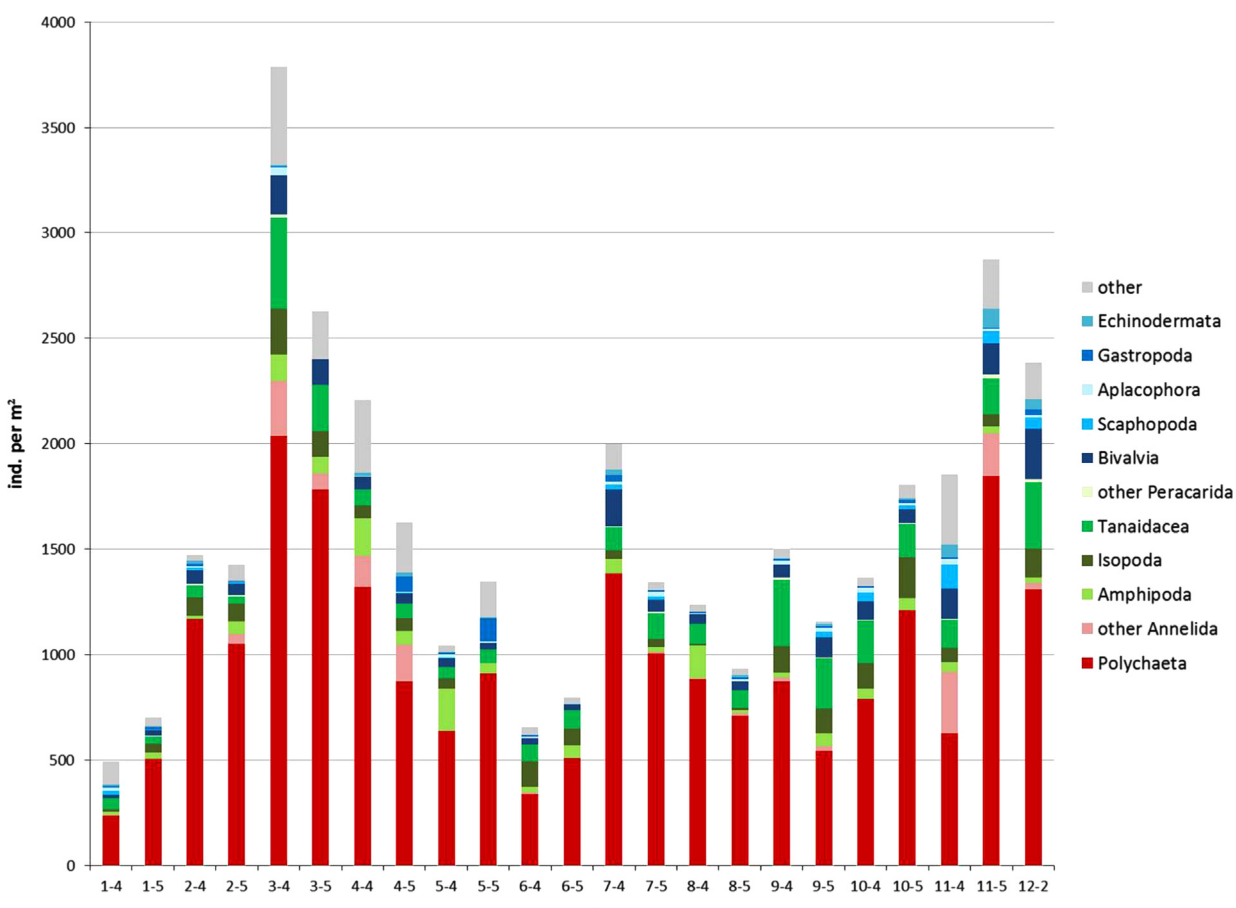

Fig. 3. Abundances of the macrofauna and the most dominant taxa among the study area, given in number of individuals per m^2.

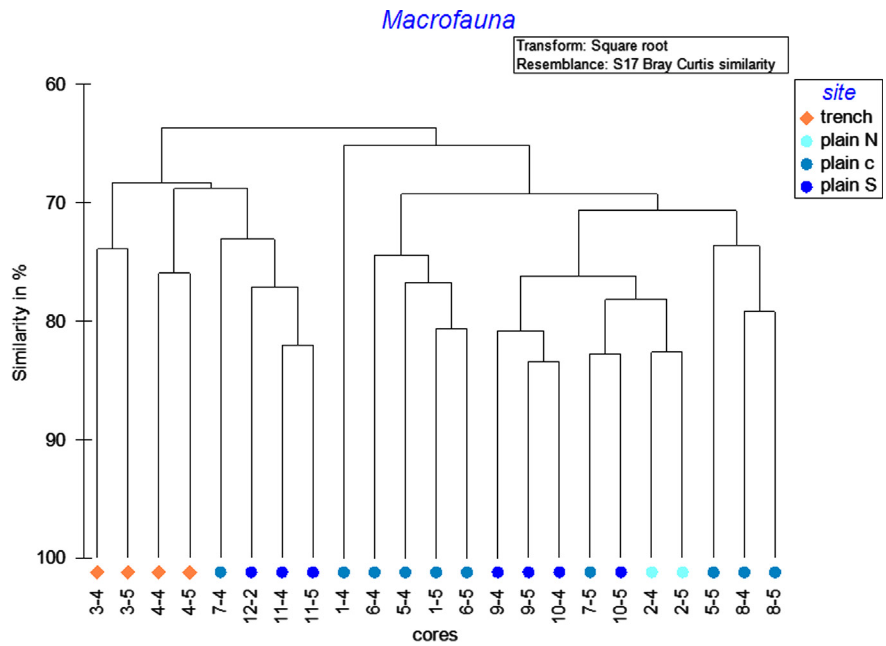

Fig. 4. Cluster diagram, based on the macrofauna, illustrated for every core. Similarities are extracted from the raw data of abundance. Abbreviations: plain c = "central plain stations"; plain N = northernmost station on the plain; plain S = southern plain stations.

Table 3
Comparison of the faunal densities of the Kuril–Kamchatka area with other those detected from other parts of the Pacific.

Author	Year	Gear (50 × 50 cm)	Ocean	Depth [m]	Macrof. Density [ind./m^2]	Meiof. [ind./10 cm^2]
Fischer and Brandt	2012	BC	NW Pacific	4869–5768	436–3520	58–1481
Kojima and Ohta	1989	Okean	NW Pacific	~2600	800–1100	n.c.
Shirayama and Kojima	1994	BC	W Pacific	> 4130	n.c.	475
Hessler and Sanders	1967	BC	CN Pacific	5500–6080	64–180	n.c.
Hessler and Jumars	1975	BC	NE Pacific	5500–5800	84–160	n.c.
Carey and Andrew	1981	BC	NE Pacific	2744–3564	176–1503	n.c.

Abbreviations: BC = box corer; ind. = individuals, n.c. = not counted.

4. Discussion

4.1. General faunal composition

In general, the composition of the benthic fauna of the Kuril–Kamchatka area does not differ from other deep-sea communities in terms of dominant taxa, vertical distribution inside the sediment and the ratio of meiofauna and macrofauna. Filatova (1982) was studying the biomass of the abyssal macrofauna of the Kuril–Kamchatka area. She reported the macrofauna to consist of nematods, polychaetes, echiurideans, sipunculids, bivalves, gastropods, isopods, amphipods, bryozoans, sponges, cnidarians, nemereans and echinodermates. This mainly reflects the dominant taxon groups we found (Table 2). Kojima and Ohta (1989) found out, that the macrobenthos off northeastern Japan between 120 and 2600 m waterdepth mainly belonged to the phyla Nematoda, Mollusca, Annelida, Arthropoda and Echinodermata, like it was the case in our study area. Molluscs consisted of Bivalvia, Gastropoda, Scaphopoda and Solenogastres, but they did not find Caudofoveata. The majority of annelids were polychaetes which were also dominating the macrofauna in terms of abundance and biomass. Arthropoda covered amphipods, tanaidaceans, isopods, cumaceans, ostacods and copepods. As a main difference they found ophiourids to be the dominant taxon of Echinodermata, while the dominant taxon within the echinoderms of the Kuril Kamchatka area were holothurians. Hessler and Jumars (1974) studied the macrofauna inside the Central Pacific at water depths between 5500 and 6080 m. They reported polychaetes to be the dominant macrofaunal taxon by far, followed by tanaidaceans, bivalves and isopods. The other taxa alltogether made up less than 15% and occurred very patchily. These results are very similar to our findings in terms of dominant taxa and abundances (Table 2 and Fig. 2).

The significance of the upper sediment layer (upper 5 centimeters) for the vertical distribution of the benthic fauna has been discussed in several papers (e.g. Aberle and Witte, 2003; Flach and Heip, 1996; Gooday and Turley, 1990; Shirayama and Fukushima, 1995; Snider et al., 1984). Usually around 80% of the sampled macrofauna were found in this layer. This is also true for the Kuril–Kamchatka area where 79% of the macrofauna were found in the upper 2 cm of the sediment, where oxygen and nutrients are available in the highest amounts (Jorissen, 2003).

4.2. Macrofaunal abundance

The community composition of the benthic fauna of the study area was very heterogeneous. Faunal abundance was much higher at the southern part of the Kuril–Kamchatka area than in the central part of the plain area. Compared to other parts of the Pacific, the faunal density in the Kuril–Kamchatka area was unusually high (Table 3).

We did not find parameters that can be detected as responsible factors for the high abundance of the benthic fauna. Correlation-analyses between faunal abundance and depth, latitude, longitude or the amount of sand or clay inside the sediments showed no significant correlation (R^2 between 0.0043 and 0.0251).

But it is likely that the richness of the bottom fauna is resulting from the highly productive upper water masses. Filatova (1977) found a direct correlation between the biomass of the benthic fauna and the biomass of the plankton in the area between 40°N and 40°S of the Pacific and Sibuet et al. (1989) reported a direct relationship between the abundances of abyssal meiofauna and macrofauna and the trophic input. In general the organic matter, produced by the primary production in the euphotic zone is known to be the main energy source for deep-sea organisms (Gooday, 1988; Gooday and Turley, 1990; Lutz and Schuler, 2002).

The Kuril–Kamchatka area is known to have a high surface production, especially during the summer months (Longhurst et al., 1995; Zenkevich, 1963). One reason for this high primary production is the Oyashio current which provides high nutrient supply to the surface waters whereby the primary production is raised (Zenkevich, 1963). This might allow sufficient vertical flux of organic matter to feed a rich deep-sea fauna. Moreover, some other factors could be responsible for the rich fauna. Terrigenous material like sediment or organic matter can be transported into the trench and the adjacent abyssal area quite fast by currents or simply by rolling down the continental shelf (e.g. Okada, 1989). The Oyashio can cause high tides in some areas of the coast whereby the availability of nutrients can be raised via turbidity currents (Reddy, 2001). These short term currents can transport large amounts of terrigenous and organic material into the area for example through the Bussol Strait and the Krusenstern Strait, as well as via the currents that pass Hokkaido and enter the southern part of the study area. Such input into the trench can be a reason for the high faunal abundances at the continental margin of the trench (station 3 and 4).

The deep boundary current on the landward (western) side of the trench, which flows southwestwards along the slope into the Japan Trench, and the trench-countercurrent on the oceanward side, which flows northeastward along the slope (Mitsuzawa and Holloway, 1998) are steadily reworking the imported material in the trench. Such trench currents can cause an upwelling of fine sediments, organic material and dissolved oxygen (Gardner, 1989) and make these components available for the fauna of the adjacent abyss.

Gooday and Turley (1990) supposed that low rates of food supply, especially with increasing distance from the coast, are one of the main reasons for reduced faunal abundance in the deep sea. Stations 1 and 6 had the greatest distance from the coast and were characterized by the lowest faunal abundances within the study area. Therefore it is likely that the high amount of nutrients on the abyssal plain is decreasing with increasing distance from the trench.

4.3. Taxonomic richness

The Kuril–Kamchatka area is situated between the subarctic Bering Sea in the north and the tropical zone in the south. The cold waters of the Oyashio and the warm waters of the Kuroshio get mixed in the area of investigation (Zenkevich, 1963). Water of the Kuroshio is even flowing through straits between the Kurils into the Sea of Okhotsk (Qiu, 2001). According to Zenkevich (1963) this convergence of the two currents is creating the conditions for zones of heterogeneity. He concluded that the Kuril–Kamchatka area is a mixing zone where boreal and tropical faunas mix and are quite similar in occurrence. In our study we also observed that the faunal distribution of the Kuril–Kamchatka area is very heterogeneous (in terms of taxonomic richness as well as abundance). Faunal densities varied strongly between the stations and often even between the two cores taken at one station (Table 2; Fig. 3). Zenkevich´s hypothesis could be one explanation for the high faunal abundance and taxon richness at the southernmost stations.

4.4. Evaluation of rare taxa

Besides the taxa that are commonly most abundant in deep-sea benthos communities we also collected a high number of taxa that were only represented by one or a few specimens.

In several cases, our study added new records to the taxonomic inventory of the region. One such example is Tardigrada which were previously undocumented for this region (Sirenko, 2013). Only one specimen had been found (and subsequently lost) in 1969 in a bottom grab sample of the *Vityaz* from the Aleutian trench from a depth of 6520 m (Belyaev and Brueggeman, 1989). We confirm their presence, even though also by only one specimen that was found in core 5-4 from 5386 m depth in the upper layer of the sediment. It will be identified to higher taxon level in future.

Ophiouridea were almost missing completely in the box corer samples. We only collected 1 specimen from the core 10-5. The numbers of Decapoda were also very low (3 specimens). The absence in our samples does not mean that these taxa are not present over the area, they occurred, for example in higher amounts in the EBS samples (Brandt et al., this volume) and in the AGT, as well as meiofaunal taxa occurred in higher numbers and with more taxa in samples of the MUC (Schmidt and Martínez-Arbizu, 2014). This shows that it is important to sample an area with different gear to gain a complete insight into the faunal community.

4.5. Outlook

The analysis we present in this study give a first quantitative insight into the community structure, faunal abundances and the taxonomic richness (on the level of class and order) of the benthic macrofauna of the Kuril–Kamchatka area. Most of the collected taxa are currently and will be worked up by specialists to species level. It will be interesting to see how many new species will be found and if there will be evidence for Zenkevich's hypothesis of the mixed fauna on species level. During the KuramBio-expedition the fauna of the trench was sampled at two stations at the upper margin of the continental slope. It would be interesting to sample the trench on both sides at different depths in order to gain a clearer understanding of the faunal community of the area.

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