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Studies on impact of the alien Red King Crab (*Paralithodes camtschaticus*) on the shallow water benthic communities of the Barents Sea

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Summary

The red king crab *Paralithodes camtschaticus* (Tilesius, 1815) was introduced in the Barents Sea from the North Pacific in 1961–1969 to establish a fishery. Currently the crab inhabits an area from Kolguyev Island in the east to Sørøya in the west, and the total number of adults exceeds 40 million. The crab is a large generalist predator, so its potential impact on native bottom communities is expected to be high. The goal of this study was to review our publications related to the possible impact of the red king crab on the shallow water benthic communities of the Kola Peninsula inlets. First, we reviewed field and experimental data on feeding ecology of different size groups of the crab. Secondly, we examined the data on the benthic communities' structure in the bays. Finally, assess possible changes in the community structure caused by the red king crab predation. The crab diet includes about 100 species of invertebrates, algae, and fish remnants. Diet of juveniles varied in three studied areas, but bivalve and gastropod mollusks dominated. Experiments on the juvenile feeding showed their positive selection for ophiuroids. Caught prey was usually not completely consumed. Food losses decreased from 50 to 60% in crabs with 35–40 mm carapace width (CW) to 25% in crabs with 70–80 mm CW. Within and between bays trends in the benthic community structure related to the crab density were revealed. Generally, proportion of the stations with disturbed community structure decreased eastward from 80% in the Kola Bay to 18% in the Dolgaja Bay and it was negligible in the Dal'nezelenzkaja Bay. This pattern coincides with the juvenile crab density decreasing eastward. On a smaller scale in the Kola Bay we observed a negative correlation between biomass of macrozoobenthos and juvenile crab density, which was likely related to the crab predation. Comparison of the new data obtained in 2006 with the detailed survey of soft bottom macrobenthos conducted in 1990 in Dolgaja Bay showed a decrease of the diversity of soft bottom communities as well as in species richness, density and biomass of bivalves. Our data demonstrate that the proposed impact of the crab on the bottom communities of the Barents Sea is not as dramatic as have been expected from its high feeding activity and wide diet. We hypothesize that the crab omnivory distributes its predation pressure among various groups of organisms and prevents elimination of particular species or taxa.

Introduction

The red king crab *Paralithodes camtschaticus* (Tilesius, 1815) was introduced in the Barents Sea from the North Pacific in 1961–1969 to establish a fishery (Orlov and Ivanov, 1978). Currently the crab inhabits the area from Kolguyev Island and Goose bank in the east to Sørøya in the west and has become numerous in coastal waters. The total number of adults was estimated as 40–50 million in the 2003–2005 in the Russian part of the Barents Sea (Sokolov and Milyutin, 2008) and as 3.5 million along the Finmark coast of Norway in 2003 (Hjelset et al. 2003). In 2003 the juvenile number only in the Russian part of the Sea was assessed as 55.1 million without young of the year (Sokolov and Milyutin, 2006a). Because the crab is a large generalist predator (Marukawa, 1933; Logvinovich, 1945; Tarverdieva, 1976; Jewett and Feder, 1982; Pavlova, 2007), it is expected to significantly impact native benthic communities. The impact of invasive species on natural ecosystems has been attributed to their interactions with native species and their effects on habitats and ecosystems (Williamson, 1996). Very few attempts have been made to assess an impact of the crab on populations of native species and communities. The red king crab was suggested to affect native populations of Iceland scallops, sea urchins, capelins through direct predation (Gudimov et al., 2003; Anisimova et al., 2005; Jørgensen, 2005). It can also compete with commercial fish (haddock, cod) and modify bottom communities (Anisimova et al., 2005).

Taking into account the crab stomach content and population sizes of the crab and sea urchins, Gudimov et al. (2003) roughly calculated that crabs eliminated approximately 15% of the entire stock of the coastal population of sea urchins *Strongylocentrotus* spp. The potential impact of the invader on the commercial scallop *Chlamys islandica* was examined by Jørgensen (2005) and Jørgensen and Primicerio (2007) who experimentally showed that all crab size classes preferred scallops. They suggested that scallop beds with rich associated fauna are less vulnerable to the crab predation than the beds with few associated species. This hypothesis was supported by the stomach content analysis of crabs feeding on the intact and disturbed scallop beds (Anisimova et al., 2005). This study demonstrated a low scallop occurrence and proportion of scallops in the crab diet on the intact scallop beds. In contrast, on the disturbed scallop beds these indices were significantly higher due to the crab foraging on wastes of the scallop processing and individuals damaged by dredging.

The only attempt to assess the effect of red king crab on bottom communities through long term monitoring of the Motovsky Bay (Anisimova et al., 2005) revealed a steady decrease in biomass of sipunculids, echinoderms and bivalves, the preferred food of the red king crab. Their results indicated a modification in the community structure. However, negative changes were found only in the open part of the Bay that was intensively disturbed by trawling. The changes seem to be the result of both crab foraging and commercial fishing (Anisimova et al., 2005).

Density of juvenile crabs and females, two most abundant groups in the coastal shallow waters, decreased eastward (Sokolov and Milyutin, 2006a; b; Pavlova, 2008; Dvoretskij, A. G. unpubl. data). One can expect that impact of the crab on the benthic communities should be higher in the localities with high crab density than in those where the crab density is low. Accordingly, we selected three inlets along the Kola Peninsula coast: the Kola Bay situated in the western part of the area, the Dolgaja Bay in the middle part, and the Dal'nezelenetskaja Bay in the eastern part (Fig. 1) and studied benthic communities in these bays. To evaluate the current state of the communities we applied ABC method (Warwick, 1986), suggested that the changes in the benthic communities' structure under the crab impact may be similar to the changes under a pollution impact. Additionally we studied possible effects of the crab activity by comparing the community structure in the localities within the same community with different density of juvenile crabs (Kola Bay), and by the comparing the current state of the communities with their structure of period when the density of crab was low (Dolgaja Bay, Anisimova, Frolova 1994). The results of the field surveys and lab experimental studies of the crabs diet and selectivity were used as a tool for the analysis of changes in the benthic community structure and evaluation of crab's role in these changes. Our data on the benthic community structure, field and lab experimental data on juvenile crabs diet and feeding selectivity were published in Russian journals, books, a PhD thesis (Rzhavsky and Pereladov, 2003; Rzhavsky et al., 2004, 2006; Britayev et al., 2006a; Britayev et al., 2006b; Britayev et al., 2007, Britayev et al., 2010; Pavlova, 2007, 2008; Pavlova and Rzhavsky, 2006; Pavlova et al., 2004, 2007).

The goal of this study was to review our most important publications related to the possible impact of the red king crab on the shallow water benthic communities in the Kola Peninsula inlets. Initially we discuss field and lab experimental data on the feeding ecology of different size groups of the crab. Then we consider the data on the benthic community structure in the bays. Finally, we attempt to assess possible changes in the community structure supposedly caused by red king crab predation.

Feeding ecology

Diet, field studies

Diet of juvenile crabs in Varangerfjord, Kola Bay and Dal'nezelenetskaja Bay includes approximately 100 species of invertebrates, tunicates, fishes and fish eggs, algae, detritus (Rzhavsky and Pereladov, 2003; Britayev et al., 2007; Pavlova, 2008). Diet of juveniles varied in three studied areas, though bivalve and gastropod mollusks predominated everywhere (Fig 2). The other dominated groups were polychaetes, foraminifers and ophiuroids.

Pianka's index of similarity (Pianka, 1973) between species composition of bottom communities and the prey composition of crabs varied from 0.35 to 0.59. Similarity was higher for hard bottom communities than for soft bottom ones (0.38–0.59 vs 0.35–0.39). However, the diversity of the crab prey was lower on hard substrates. High values of the index suggest the correlation of the crab diet with the community structure. Unexpectedly, species richness of bivalves and gastropods in the digestive tract of 3–4 – year old juveniles sampled from soft bottom communities was higher than their richness in the grab samples taken in the same sites (Pavlova et al., 2004; Rzhavsky et al., 2006; Britayev et al., 2007). This is likely related to the crab feeding selectivity and / or the imperfection of the sampling tool.

Comparison of the juvenile crabs' diet of different size [carapace width (CW) 9–73 mm] demonstrated that diversity of prey usually increased with the juvenile size, while the role of some small animals, e.g. foraminifers and ophiuroids in their feeding decreased (Table 1). In the diet of the largest size groups of juveniles (CW 75–115 mm) foraminifers disappeared and ophiuroids became rare and crabs started to consume starfishes and sea urchins as an alternative source of the calcium-rich food (Pavlova, 2008). Our results corroborated the observations for the North Pacific crab populations (Takeuchi, 1967; Tarverdieva, 1974) that diversity of food items increases with the size of juveniles. On the contrary, low diversity of prey of appropriate size in the community may lead to a particular situation when diversity of diet decreased in the largest size group of juveniles (Kola Bay, Pavlova, 2008).

Few existing observations on the juvenile crab diet both in the North Pacific (Tarverdieva, 1974; Dew, 1990) and in the Barents Sea (Sennikov and Matjushkin, 2001; Matjushkin, 2001; Tarverdieva, 2003) suggest a variety of their preferred food items that include ophiuroids, starfishes, sponges, bival-

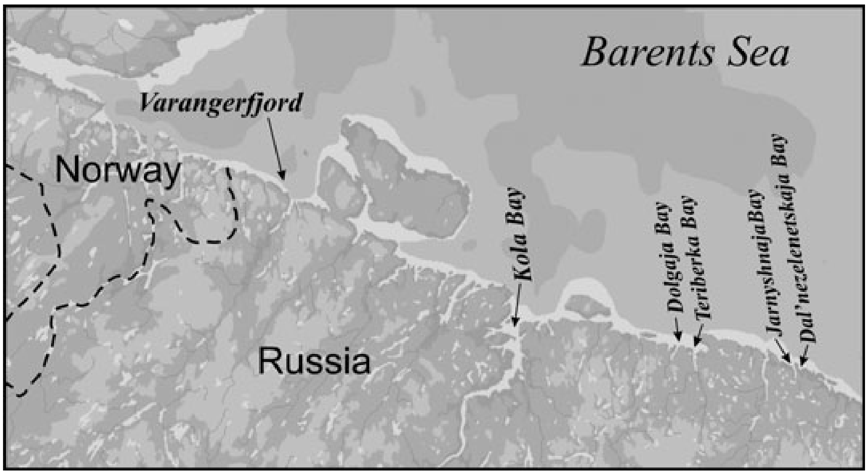

Fig. 1. Map showing the northern coast of Kola Peninsula with studied inlets

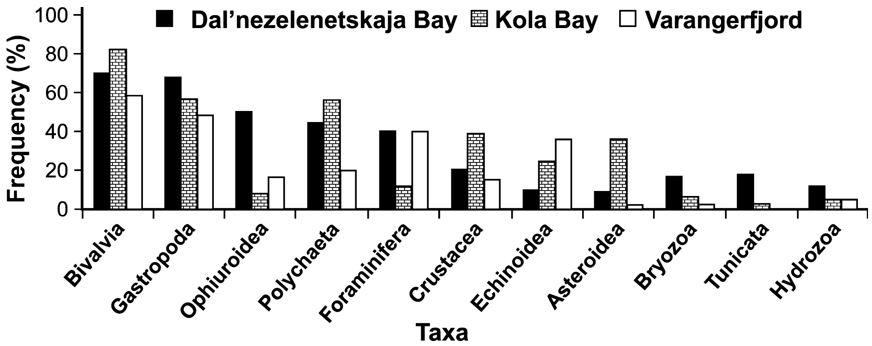

Fig. 2. Diet of the red king crab juveniles in different bays. The data based on the digestive tracts studies

Table 1
Prey of juvenile red king crab in the Dal'nezelenetskaja Bay ranged in accordance with their frequency of occurrence. Digestive tract analyses

Age, year (CW, mm)		
1+ (9–12)	2+ (24–42)	3+ (47–63)
Bivalvia	Bivalvia	Gastropoda
Foraminifera	Foraminifera	Bivalvia
Algae	Algae	Polychaeta
Ophiuroidea	Ophiuroidea	Algae
Hydrozoa	Gastropoda	Foraminífera
Polychaeta	Bryozoa	Ophiuroidea
Gastropoda	Hydrozoa	Tunicata
	Crustacea	Hydrozoa
	Polychaeta	Fishes
	Tunicata	Bryozoa
	Polyplacophora	Crustacea
		Echinoidea
		Asteroidea

ves and foraminifers. Data of Tarverdieva (2003) for Teriberka Bay agree with our observations on the mollusk prevalence, while Matjushkin (2001) reported that foraminifers, bivalves, echinoderms and algae were groups dominated in the diet of juvenile crabs on the hard bottom in the Ura Bay. The later agrees in general with our observations, but differs in the order of dominance.

Food selection and prey consumption, experimental studies

Laboratory experiments conducted in July–August 2003–2006 at the field station 'Dal'nezelenetskaja' of Murmansk Marine Biological Institute Institute (Pavlova, 2007, 2008; Pavlova et al., 2004, 2007 and others) demonstrated that in general crabs preferred ophiuroids, while larger crabs tended to prefer bivalves and gastropods (Fig. 3). Ivlev's index of electivity (Ivlev, 1961) used for quantitative estimation of the food selectivity was positive for ophiuroids, negative for starfishes and sea urchins, and varied from positive to negative values for bivalves and gastropods. It was higher for the larger size groups of crab for gastropods, starfishes and sea urchins indicating that selectivity of juveniles feeding changes as their size increases (Pavlova, 2008).

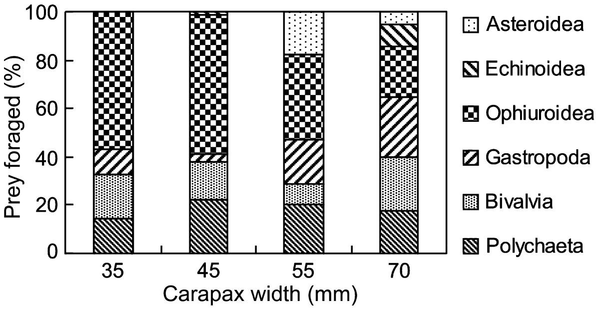

Fig. 3. Selectivity of the food in experiments for different size groups of the red king crabs

Gross daily prey consumption increased rapidly with the increasing crab size (coefficient of correlation $r = 0.97$, Fig. 4). At the same time, the ratio of the caught prey to the crab weight gradually decreased from 14.0 to 19.6% for crabs with CW 20–40 mm to 8.0–8.2% for largest crabs (CW 70–80 mm, $r = -0.75$).

Net daily prey consumption (the weight of ingested prey) was lower than the weight of the caught prey (Fig. 4). It increased with the increasing crab sizes ($r = 0.99$). The ratio of the ingested prey to the crab weight gradually decreased from 7 to 9% for crabs with CW 30–40 mm to 6% for the largest crabs (CW 70–80 mm, $r = -0.88$).

The obvious difference between prey caught and ingested was caused by food losses and rejecting of the prey hard parts (fragments of mollusks shell and skeleton of sea urchins). Small crabs more often damaged prey and did not ingest it completely. The amount of lost food decreased with crab size from 50 to 60% of prey caught for crabs with CW 35–40 mm to 25% for crabs with CW 70–80 mm ($r = 0.98$).

There was a discrepancy between our field survey data (preference for mollusks) and the results of our laboratory experiments where preference to ophiuroids was observed. Calcium-rich echinoderms, especially ophiuroids, play an important role in the diet of small crabs with high frequency of molting (Logvinovich, 1945; Takeuchi, 1967, Tarverdieva, 1974). In the field ophiuroids were also preferred but less available prey than mollusks. Ophiuroids are abundant on hard substrates where they hide well in various refuges such as rock crevices and algal rhizoids (Britayev et al., 2007), but are rare on soft substrates (Rzhavsky et al., 2006; Britayev et al., 2009).

An impact of the red king crab on the communities of the Barents Sea was estimated via the amount of food consumed throughout a year by Gerasimova and Kochanov (1997) and Gudimov et al. (2003). However, their results seem to be an underestimation because they considered only energy demands of crabs and ignored the losses of damaged but not ingested prey. For juvenile crabs such losses can reach 50–60% of the biomass of the caught prey (Pavlova, 2008). It means that if food losses are considered in energy budget estimations, estimated impact of crab might be higher than it was previously considered, especially for smallest crabs.

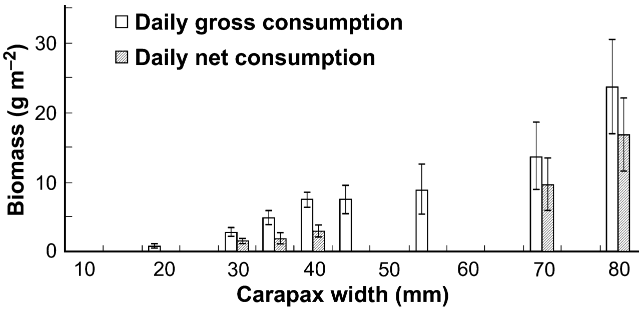

Fig. 4. Experimental data on the daily gross consumption and daily net consumption for different size groups of the red king crabs

Current state of soft bottom communities in the areas with different density of crab population

Kola Bay

Crab density in this bay was relatively high, about 4.95 individuals per 100 m^2 (Sokolov and Milyutin, 2006b) and 2.00 (0.04–5.5) individuals per 100 m^2 (Pavlova, 2008).

Soft bottom communities were studied at four sites arranged along the main axis of the Bay from its mouth to the inner part at the depth range from 5 to 20 m mainly in November 2005 (Pavlova, 2008), with some additional data were obtained in February 2006 (Pavlova, 2008). The total number of animal species found here were 65 with polychaetes dominating in richness. In the middle part of the studied area at the depths of 5–6 m on the gravel and pebble with the silted sand we distinguished a community where *Balanus crenatus* dominated in terms of biomass. However, approximately 90% of the studied area was occupied by the community with the dominant spionid polychaete *Laonice cirrata*. This *Laonice cirrata* community was found at the depths of 2–20 m on silty and sandy grounds with clay, gravel and pebble on some stations. Sixty five taxa were identified here to the species level with polychaetes dominating in terms of species richness, density and biomass (Table 3). The total mean faunal density and biomass in this community was 7479.1 ± 1070.6 (468.6–19375.0) individuals m^{-2} and 40.1 ± 6.1 (3.8–109.2) g m^{-2} respectively.

The ABC method demonstrated that on 80% of stations the biomass and the numbers curves are located close together and cross or in some stations the numbers curve lie above the biomass curve (Fig. 7) indicating moderate and severe pollution respectively according to Warwick (1986). There was no relationship between distribution of these stations with the crab distribution (Pavlova, 2008).

The mean biomass of benthic organisms in this community varied among four studied sites. It was the highest in the inner part of the bay and gradually decreased to its mouth (Fig. 5). This change in the biomass correlated negatively ($r = -0.922$) with mean density of juvenile crabs (Fig. 5). This correlation is unlikely to be related to the hydrology that was similar in all studied sites or anthropogenic impact because its level did not vary markedly along this area (Yurjeva, 2005). Thus, the most reasonable cause of the biomass decrease to the mouth was the feeding activity of the juvenile red king crabs. Unfortunately, data needed for the long term comparison are absent.

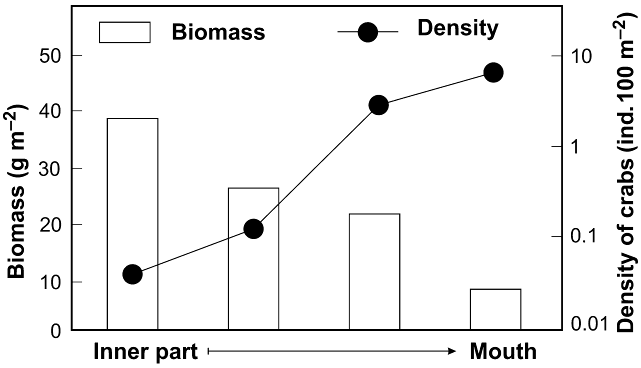

Fig. 5. Changes of the red king crab density and biomass of zoobenthos in the *Laonice cirrata* community in the Kola Bay

Table 2
Density of juvenile crab in the coastal area of Kola Peninsula, mean (minimum and maximum) individuals per 100 m^2

	Kola Bay	Dolgaja and Teriberka Bays	Dal'nezelenetskaja Bay
Our data (2002–2007)	2 (0.04–5.50)	0.63	0.19 (0.07–0.40)
Sokolov and Milyutin (2006b)	4.95	5.40	0.15

Dolgaja Bay

According to our unpublished observations the juvenile crab density in this bay was 0.63 individuals per 100 m^2 (Table 2), though it was much higher (5.4 individuals per 100 m^2), in the neighboring Teriberka Bay situated to the east of Dolgaja Bay (Sokolov and Milyutin, 2006b).

Soft bottom communities in this area were studied by Britayev et al. (2009) at the depths of 15–95 m in August 2006. This bay was mostly occupied by the soft bottom communities. The total species number was 156 with polychaetes dominating in terms of species richness, density and biomass (Table 4). We distinguished here three benthic communities: (i) The commu-

Table 3
The species richness of the main taxa, their mean density and biomass in the community of *Laonice cirrata* of the Kola Bay (from Pavlova, 2008; modified)

Taxa	Number of species	Density (ind. m^{-2})	Biomass (g m^{-2})
Nemertini	+	27	0.8
Polychaeta	36	6740	24.0
Crustacea	7	30	0.2
Bivalvia	11	452	14.5
Gastropoda	7	89	0.2
Echinodermata	2	136	0.3

Table 4
The species richness of the main taxa, their mean density and biomass in the soft-bottom communities of the Dolgaja Bay (from Britayev et al., 2007; modified)

Taxa	Number of species	Density (ind. m^{-2})	Biomass (g m^{-2})
Nemertini	3	8	2.7
Polychaeta	78	290	148.7
Crustacea	35	68	24.0
Polyplacophora	2	18	2.6
Bivalvia	16	60	40
Gastropoda	8	6	0.7
Echinodermata	7	19	2.1

nity of polychaete *Spiochaetopterus typicus*, barnacles *Balanus balanus* and *B. crenatus* dominating by biomass occupied the most part of the bay (Fig. 6b). It occurred at the depths of 15–95 m on various substrates, sandy silt or silted sand mixed with gravel, stones and empty mollusk shells. There were 112 species, including 57 polychaetes. The total mean density was 455.0 ± 50.7 (80–1248) individuals m^{-2} and biomass was 258.4 ± 40.5 (8.0–545.2) g m^{-2}. (ii) The community of barnacles *Balanus balanus* and *B. crenatus* dominated by biomass. It occupied the shallow water bank in the eastern part of the Bay at the depths of 23–43 m on silt mixed with sand, pebbles, stones and empty mollusk shells. There were 72 species in this community, including 26 species of polychaetes. The total mean density was 246.3 ± 77.1 (100–724) individuals m^{-2} and biomass 216.2 ± 48.3 (39.76–487.72) g m^{-2}. (iii) The third community was found at only station in the entrance of the bay at the depth 30–31 m on the sand with gravel. The dominating species were polychaetes *Glycera capitata, Polydora quadrilobata* and *Ophelia limacina*. It included 13 species, including 10 polychaetes. The total mean density was 252.0 ± 111.5 (72–456) individuals m^{-2} and biomass 3.6 ± 1.8 (1.7–7.2) g m^{-2}. The distribution of these communities is shown in Fig. 6.

The results of the ABC method demonstrated that at most stations the biomass curve lies above the numbers curve. Only at three stations (18% of stations) curves of numbers and biomass intersect indicating a moderate level of disturbance (Fig. 7). One of these stations was in the inner part of the bay in the vicinity of river mouth and two others were in the eastern part of the Bay at a shallow water bank.

Comparison of our data with the observations made 16 years ago (Anisimova and Frolova, 1994) revealed a decrease in community diversity. We found only three soft-bottom communities in Dolgaja Bay five observed by previous researches (Fig. 6a). The main changes concerned two widespread communities described in 1990. One of them was dominated by *Balanus balanus*, and the other was dominated by *Balanus balanus,* bivalve *Astarte crenata,* and polychaete *Spiochaetopterus typicus*. These two communities have been displaced by the community of *S. typicus, B. balanus* and *B. crenatus*. This displacement was caused by a sharp decrease of density and biomass of the bivalves *A. crenata* and *M. calcarea* that dominated or subdominated in 1990 and nearly disappeared in 2006. Two shallow water communities found in 1990 in the eastern part of the bay, one dominated by calcareous algae, and the other dominated by bivalve *Ciliatocardium ciliatum* and polychaete *S. typicus*, were replaced by the community of *B. balanus* and *B. crenatus*. These changes were likely a result of the *C. ciliatum* disappearance.

However, mean biomass in the Bay did not change markedly; it was 226.8 (±45.9) g m^{-2} in 1990 (without calcareous algae) and 257.0 ± 22.1 g m^{-2} in 2006.

Comparison of the overall species richness in 1990 and 2006 revealed 144 and 141 species respectively (without occasional and doubtful species, Britayev et al., 2009) with 84 species identical (Jakkar and Serensen indexes of similarity were 0.42 and 0.59 respectively). The comparison of bivalves richness in 1990 with 2006, revealed a decrease in species richness from 24 in 1990 to 16 in 2006 with only 12 species identical. In other words, 12 species of bivalves disappeared during 16 years, among them *Nicania montague*, *Yoldia amigdalea hyperborea* and *Yoldiella lenticula* that were common in 1990. The decrease in the species richness was accompanied by the decreasing frequency and density of other bivalves such as *Astarte crenata* and *Ciliatocardium ciliatum* that had dominated earlier.

Dal'nezelenetskaja Bay

Crab density in this bay was lowest in the studied area and varied from 0.15 to 0.19 (0.07–0.4) individuals per 100 m^2 (Sokolov and Milyutin, 2006b; unpubl. data) (Table 2).

Soft bottoms communities were studied here at the depths of 3–20 m in August 2003 (Rzhavsky et al., 2006; Britayev et al., 2007). All stations fall in one of the three groups: dominating by biomass bivalve *Macoma calcarea,* polychaete *Cistenides granulata,* or *Nephtys pente*. However, species composition within these groups is so similar that we consider them as variations of the *M. calcarea* community that is very common in the North Atlantic. In total, approximately 80 species were found here. Polychaetes dominated in terms of species richness (36 species) density, and biomass (Table 5). The total mean density and biomass was 1301.1 ± 84.4 (40–6880) individuals m^{-2} and 48.2 ± 5.7 (0.3–210.2) g m^{-2} respectively. The ABC method demonstrated that for all the stations the cumulative biomass curve lies above the numbers curve indicating an undisturbed state of the community (Fig. 7). Data for the long term comparison are absent.

Is benthic community structure in the Barents Sea affected by the crab predation?

Despite the different methods and approaches applied, we observed consistent changes in benthic communities that could

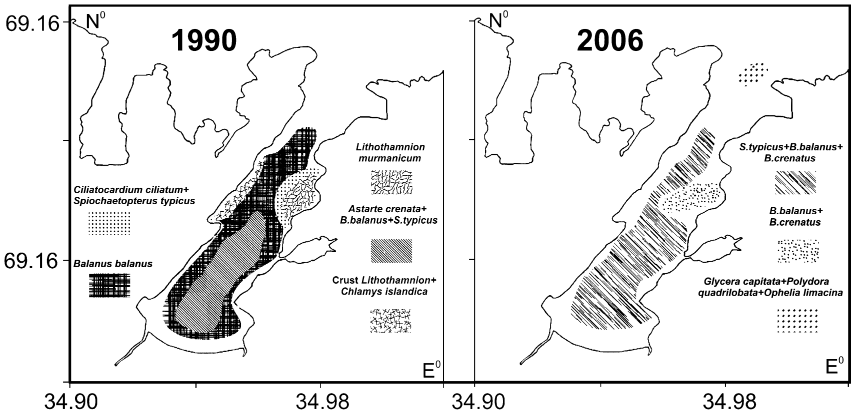

Fig. 6. Comparison of distribution of the soft-bottom communities in the Dolgaja Bay in 1990 and 2006

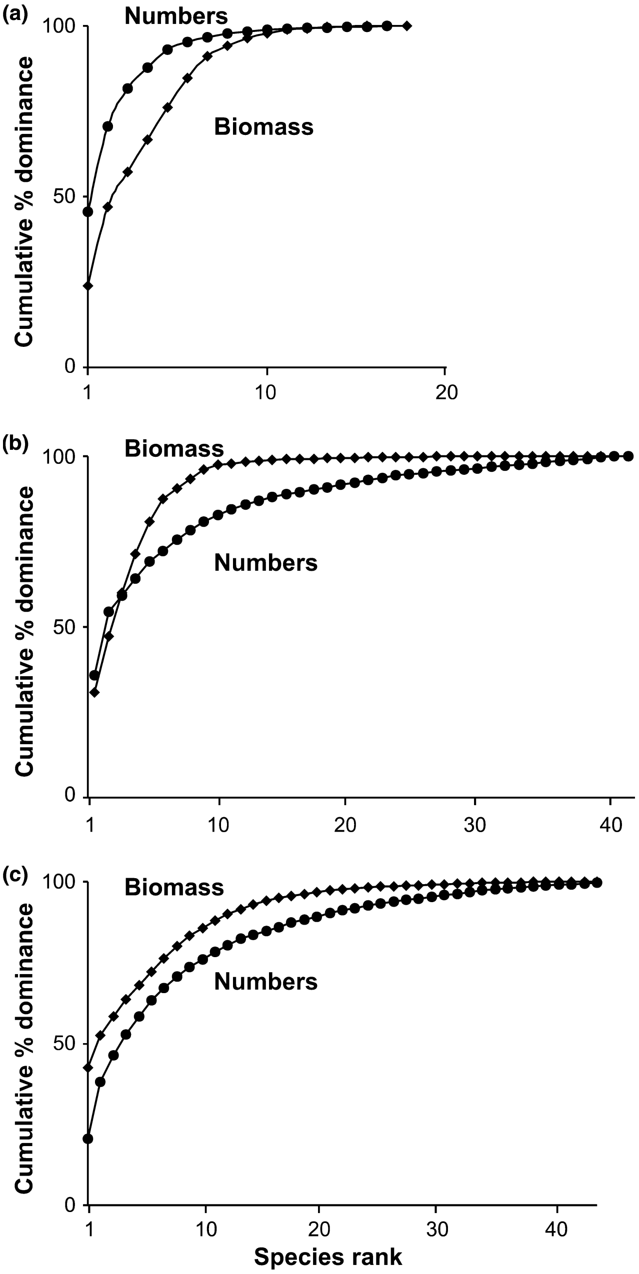

Fig. 7. Examples of result of ABC testing for the soft-bottom communities a. Kola Bay. Biomass curve lies under numbers curve, severe disturbed community. b. Dolgaja Bay, numbers curve crosses biomass curve, moderately disturbed community. c. Dal'nezelenetskaja Bay, numbers curve lies under biomass curve, undisturbed community

Table 5
The species richness of the main taxa, their mean density and biomass in the soft-bottom communities of the Dal'nezelenetskaja Bay (from Britayev et al., 2007; modified)

Taxa	Number of species	Density (ind. m^{-2})	Biomass (g m^{-2})
Nemertini	+	+	+
Polychaeta	36	458	24.7
Crustacea	19	91	11.8
Bivalvia	14	201	13.1
Gastropoda	9	157	7.8
Echinodermata	2	86	2.8

be a result of the red king crab predation. Within and between bays trends in the benthic community structure related to the crab density were revealed. The only method we used in all the three bays was the ABC method (Warwick, 1986). We propose that this ecological method could be used not only to detect disturbances caused by pollution, but also by other factors including predation.

Within the Kola Bay, we found that the most stations were disturbed according to the ABC-criterion. However, there was no correlation between the level of disturbance and the crab density (Pavlova, 2008). Generally, the proportion of the stations with disturbed community structure decreased eastward from 80% in the Kola Bay to 18% in the Dolgaja Bay and it was negligible in the Dal'nezelenzkaja Bay. This coincided with the west – east trend in the decreasing of the crab density (Sokolov and Milyutin, 2006b; unpubl. data).

Eastward decreasing of benthic communities disturbance was also supported by the data obtained using other methods. In the Kola Bay with the highest average crab density that markedly changes along the bay, we analyzed a relationship between crab density and community structure. In the Dolgaja Bay a detailed survey of soft bottom macrobenthos was carried out in 1990 when the crab had been initially recorded there. We repeated this survey to compare the community structure for the period with low crab density (Anisimova and Frolova, 1994; Kuzmin and Gudimova, 2002) with that after the crab density increased considerably (Sokolov and Milyutin, 2006b, 2008; our data). The ABC method only was applied in the Dal'nezelenzkaja Bay, where the crab density was the lowest (Sokolov and Milyutin, 2006b; unpubl. data). Additionally the published data on the long term changes of hard bottom communities of this Bay were used to the analysis of crab impact (Propp, 1971; Britayev et al., 2006a; Britayev et al., 2006b, 2007).

On the within bay scale, we observed the negative correlation between biomass of macrozoobenthos and juvenile crab density in the Kola Bay (Fig. 5), that was likely related to the crab predation. Decrease of the diversity of soft bottom communities and diversity, density and biomass of bivalves in Dolgaja Bay (Britayev et al., 2009) suggests that this resulted from increased crab predation. According to earlier field studies, the bivalves are the most preferred food items of the crab (Zubkova, 1964; Matjushkin, 2001; Rzhavsky and Pereladov, 2003). However, we cannot exclude other possible influences, for example commercial dredging of the scallop *Chlamys islandicus* (our observations). The ABC method applied in the Dal'nezelenzkaja Bay showed that the soft bottom community was undisturbed. Additionally we analyzed the state of the hard bottom communities in the Dal'nezelenzkaja Bay by comparison the results of the survey conducted in early sixties just before the crab was introduced (Propp, 1971) with the results obtained 40 years later (Britayev et al., 2006a; Britayev et al., 2006b, 2007). We discovered that the structure and distribution of the communities were amazingly stable. The minor noted changes concerned the population characteristics of the sea urchin *Strongylocentrotus droebachiensis* prevailed in the hard substrates of the bay. In general, its density decreased, while the biomass increased that could be the result of juvenile crab predation (Rzhavsky et al., 2004; Britayev et al., 2007; Buyanovsky and Rzhavsky, 2007).

The west – east trend in the crab impact observed along the Kola coast is supported by observations in the Motovsky Bay located to the west of the Kola Bay (Anisimova et al., 2005) where density of the crabs was high (Sokolov and Milyutin, 2006a). A decrease of biomass of echinoderms, bivalves and sipunculids during the period of the intensive growth of the crab population suggests that these changes were caused by the crab predation. According to our data on the prey selection by the crab, bivalves and echinoderms are their preferred food items (Rzhavsky and Pereladov, 2003; Britayev et al., 2007; Pavlova, 2008).

Our data demonstrate that the suggested impact of the crab on the bottom communities of the Barents Sea is not as dramatic as one could expect from high feeding activity and wide diet of the crab. There is no evidence that the crab predation resulted in the species elimination or drastic decrease in food resources of commercially important organisms. We hypothesize that the crab omnivory distributes its predation pressure among various groups of organisms and prevent elimination of particular species or taxa.

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