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Monitoring of Macro-Zoobenthos in the Lena River Mouth

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Summary: According to monitoring data gained between 1982-1992, macrobenthos in the Tiksi Bay is characterized by low indices of the total abundance, biomass and taxonomic diversity. 30 macrobenthic species have been recorded in the Tiksi Bay. The bottom biocenoses within the estuarine-arctic water mass consist of widespread eurybiontic boreal-arctic and brackish-water species. The maximal number of species was observed at a depth of 8.5 m. The maximum biomass was recorded on muddy grounds. The studied bottom fauna is characterized by a high population density (from 1160-600 ind./m²) and low biomass of 15.5-22.4 g/m².

The predominant benthic animals of the main Lena River channel 4.7 km upstream Stolb Island are Chironomidae, Plecoptera and Oligochaeta. In total, 48 species of macrobenthos were registered here. In spring the average density of macrozoobenthos in the channel is 680, in summer 770, in autumn 720 and in winter 380 ind./m², with the average biomass varying between 2.9 g/m² in spring, 7.06 in summer, 4.4 in autumn, and 2.6 in winter.

Zusammenfassung: Langzeitstudien in der Tiksibucht zwischen 1982 und 1992 haben gezeigt, dass das Makrobenthos nur eine geringe absolute Individuendichte, Biomasse und taxonomische Diversität aufweist. 30 makrobenthische Arten wurden dort beobachtet. Die Biozönose in der ästuarin-arktischen Wassermasse besteht aus weit verbreiteten eurybiontischen, boreal-arktischen Arten und Brackwasserarten. Die höchste Artenzahl wurde in 8,5 m Tiefe beobachtet. Die höchste Biomasse befand sich auf schlammigem Untergrund. Die untersuchte Bodenfauna ist durch eine hohe Populationsdichte von 1160 Ind./m² und eine niedrige Biomasse gekennzeichnet.

Im Hauptstrom der Lena, 4,7 km oberhalb der Insel Stolb, sind Chironomideen die vorherrschenden Benthosbewohner. Insgesamt wurden dort 48 benthische Arten identifiziert. Im Frühling beträgt die mittlere Dichte des Makrozoobenthos im Fluss 680 Ind./m²; die mittlere Biomasse variiert zwischen 2-9 g/m².

INTRODUCTION

The Lena River is one of the largest Asian rivers. At its mouth, the Lena River forms an extensive delta covering an area of 32,000 km² crossed by numerous channels. Freshwater discharge from the Lena River is highly variable throughout the year.

Hardly any information is available on the bottom fauna of the Lena River mouth and Tiksi Bay (POPOV 1932, DERJUGIN 1932). Macrobenthos in the vicinity of the Lena Delta was collected during an expedition organized by the Zoological Institute of the USSR Academy of Sciences in 1973 (GOLIKOV et al. 1990).

During the TRANSDRIFT expedition 1993-1995 benthos samples were taken in coastal waters between 9-15 m water depth (PETRYASHOV 1994, SIRENKO et al. 1995). The distribution and abundance of zoobenthos in the Lena River mouth are recorded each year by the Tiksi Hydrometeorological Department (GUKOV 1989, 1990, 1991, 1992, GUKOV & TSIBULSKY 1990, ABRAMOVA & GUKOV 1990a).

This article summarizes the results of a five-years study of the macrobenthic fauna in the Tiksi Bay and in the Lena River main channel, 4.7 km upstream the Stolb Island (Fig. 1). Only little hydrobiological information was available for the Tiksi Bay prior to its selection as sea harbor. Regular data are necessary to assess the impact on the fauna of the Laptev Sea by the industrial development. Data on biogenic elements in the investigated area were collected. This information is important for estimating the water ecosystem conditions as a whole.

STUDY SITES

The Lena River is one of the largest rivers in the world. It originates in the vicinity of Lake Baikal running over 4,420 km before discharging into the Laptev Sea at the high latitude of 72 °N. The vast catchment area comprises 2,490 million km². In the course of a year, the Lena River transports more than 510 km³ of water across its delta into the Laptev Sea at an average of 16,300 m³ s⁻¹. Fifteen million tons of sediment per year form and continuously reshape the delta, a network of larger and smaller channels and lakes, as well as 1,500 islands of different size.

Tiksi Bay is an inlet facing the Kharaulakh Mountain System of Northern Yakutia. Until 1988, it had a water surface of 249 km². The mean annual air temperature in the Lena River mouth area is around -20 °C, ranging from -52 to +32 °C; the mean annual water temperature is around 0.5 °C. The salinity in Tiksi Bay usually varies from almost 0 to 16 psu due to considerable freshwater runoff of the Lena River.

The bottom is predominantly composed of grey clayish mud and aleurite-clay mud, with a small admixture of sandy material. The yellow mud occurs in the eastern part of the bay. In fact, all sediments within the Tiksi Bay are exclusively fine-grained, because the input of the Lena River significantly influences sedimentation. Only near the coast and on Brusnev Island the bottom consists of stones and sand. The concentration of dissolved oxygen in this area is more than 10 ml/l.

In summer (August-September) minimum salinity coincides with maximum water temperatures. Maximum salinity was recorded in March-April, while minimum water temperatures were observed during the winter months (December-January) observed during winter months (December-January). The general transport direction of sediments as they enter Tiksi Bay

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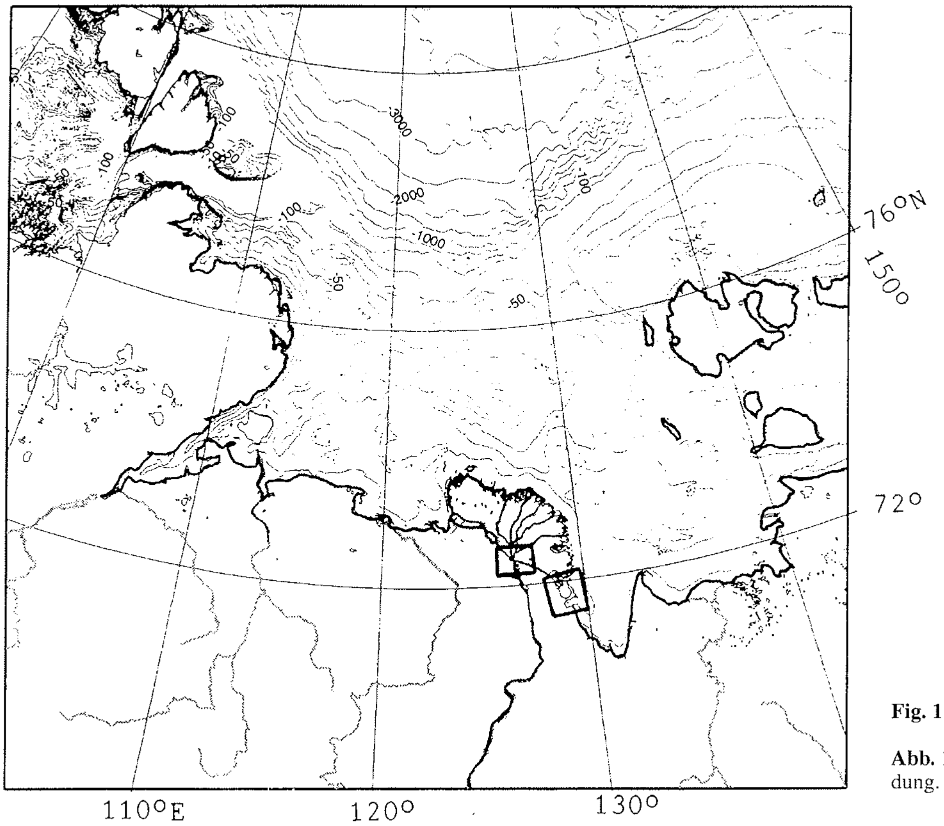

Fig. 1: Working areas in the Lena River mouth.

Abb. 1: Untersuchungsgebiet an der Lena-Mündung.

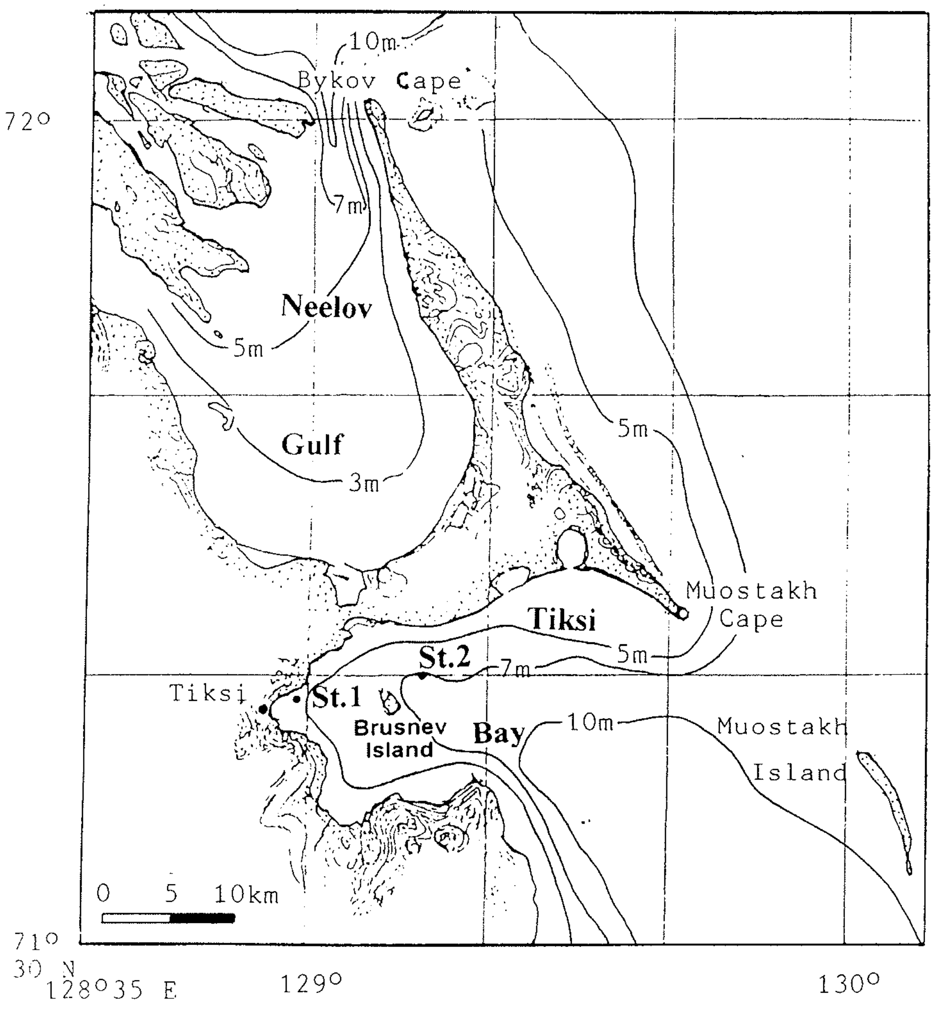

Fig. 2: Map of the study area in the Tiksi Bay.

Abb. 2: Lage der Stationen in der Tiksi-Bucht.

is to the east. High sedimentation rates within most of the shelf area result in poorly consolidated sediments with high water content. However, only inconsiderable amounts of sediments accumulate in the estuarine zone, probably because of scouring by strong bottom currents and frequent autumn storm waves.

The objective of this study was to provide a seasonal description of the macrobenthos present at two stations in Tiksi Bay (Fig. 2) and at one in the main Lena River channels (Fig. 3). Samples were obtained from the Bulunkan Inlet, a small embayment in the western part of the Bay, and near the small Brusnev Island located in the western part of the Bay. The average water depth in the western part of the bay is 4 m; whereas in the central part of Tiksi Bay it is 8.5 m. Station 1 is situated in the Buluncan Inlet and station 2 at the eastern side of the Brusnev Island (Tab. 1).

METHODS

Sampling from the ship (pilot-ship „BRIZ") was conducted each year in July, August and September. Winter samples were collected from ice-holes in January, March and May. From each area the fauna was collected with a Peterson grab (0.025 m^2) from 1988 to 1992.

The sediment was removed and washed through a series of sieves; the smallest mesh-size was 1.5 mm. Samples were preserved in 4 % neutralized formalin. The animals were sorted and counted in the laboratory after staining. Biomass is given as total wet weights.

RESULTS

Important modifications of the physical and chemical characteristics of the water are due to the mixing of fresh and salt water. The influence of the Lena River discharge is spread in the surface waters in the whole Tiksi Bay. For example, the salinity of the bottom water ranged from 3-26.7 psu during 1994. A three-layer stratification can be observed. The upper layer (0-9 m) is occupied by turbid, transformed Lena River water. In depths from 10-15 m sea waters with low turbidity are found. The most turbid waters (with a salinity of about 16-20 psu) were found near the bottom. During this period the temperature of the bottom water ranged from –1.2 to +2.3 °C. In summer salinity coincided with maximum water temperatures. Maximum salinities occurred in March (26.7 psu) while minimum water temperatures were recorded during January (-1.2 °C).

During winter 1994, the oxygen concentration at the sea surface varied only between 12.02 (station 1) and 14.88 ml/l (station 2), and the change in surface layer saturation did not exceed 5 %. The mean value was 99.2 % and the standard deviation 1.5 %. The maximum oxygen saturation is usually observed near the Brusnev Island in Tiksi Bay at station 2 (105-110 %). The oxygen concentration in the surface layers varied between 10.70 (station 2) and 12.37 ml/l (station 1) during summer. Seasonal variations show quite different ranges from one nutrient to another.

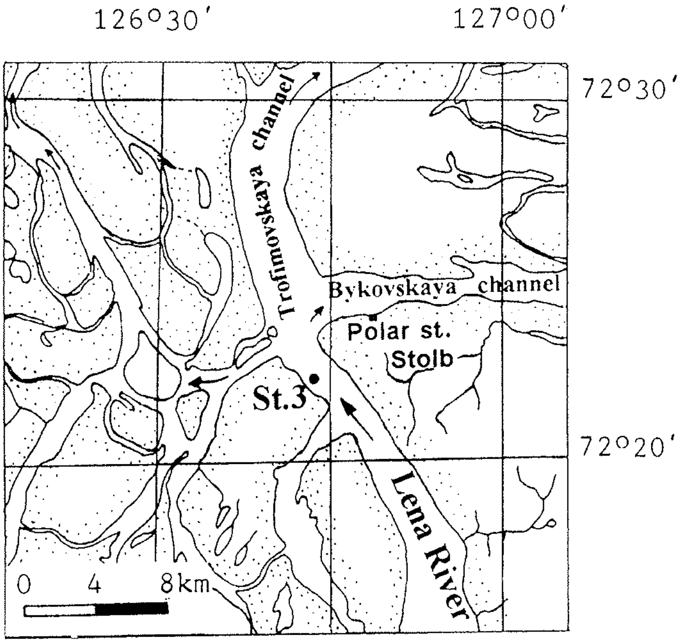

Fig. 3: Map of the study area of station 3 in the Lena River mouth near Stolb Island.

Abb. 3: Lage der Station 3 im Untersuchungsgebiet in der Lena-Mündung nahe der Insel Stolb.

Station	depth (m)	Sediment composition (mm)	(%)
1 71° 39'N 128° 52'E	4.2	>0.05	26.00
		0.01-0.05	19.25
		<0.01	54.75
2 71° 40'N 129° 04'E	8.5	>0.05	2.25
		0.01-0.05	13.25
		<0.01	84.50
3 72° 22'N 126°44'E	4.0	>1.00	4.25
		0.50-1.00	47.50
		0.25-0.50	46.50
		0.05-0.25	1.50
		<0.05	0.25

Tab. 1: Sediment composition at the three stations near the Lena River mouth.

Tab. 1: Korngrößenverteilung der Sedimente der drei Dauerstationen im Bereich der Lena-Mündung.

From April to September dissolved silica carried by brackish water is rapidly consumed in all parts of the sea (BUYNEVICH et al. 1980, PIVOVAROV & SMAGIN 1995).

Quite different variations according to the season and to the biogenic components were considered. The largest variations were observed for total dissolved nitrogen whose concentration varied from 0.098 mg/l in October to 0.410 mg/l in January. Nutrient concentrations were highest in winter and decreased in late spring. A slightly dissolved total phosphorus

Component	mean	max	Surface water mean	Bottom water mean
Station 1				
P_{total}	0.017	0.240	0.015	0.020
N_{total}	0.242	0.410	0.246	0.064
NH_4	0.064	0.214	0.062	0.064
Oxygen	12.30	14.00	13.65	11.050
Station 2				
P_{total}	0.017	0.640	0.015	0.020
N_{total}	0.242	0.073	0.246	0.064
NH_4	0.064	0.214	0.062	0.040
Oxygen	12.39	14.88	13.60	11.000
Station 3				
P_{total}	0.017	0.09	0.015	0.020
N_{total}	0.242	0.730	0.246	0.052
NH_4	0.064	0.214	0.062	0.0642
Oxygen	13.35	13.56	13.65	12.02

Tab. 2: Dissolved biogenic components and oxygen near the Lena River mouth, collected in 1994 (concentrations in mg/l).

Tab. 2: Gelöste biogene Komponenten und Sauerstoff nahe der Lena-Mündung, Probenahme 1994 (Konzentrationen in mg/l).

deficit was observed for low salinity surface waters for each season, except in spring. In all seasons the behavior of nutrients was practically conservative from the mouth of the Lena River to Tiksi Bay (Tab. 2). The largest variations were observed for totally dissolved nitrogen, the concentration of which varied in the surface layers from 0.410 mg/l in January (station 1) to 0.08 in October (station 2). Higher values (0.260) occurred near the Lena River mouth (station 3), corresponding to higher river flow values in this location, in comparison to other stations. In Tiksi Bay the mean value of nitrogen was 0.242 mg/l (Tab. 2). The large amount of nitrogen discharged in the Lena River mouth persists in the lower part of the Bykovskaya channel, which may be considered as partially eutrophied. Concentrations gradually decrease with increasing distance from the mouth of the Bykovskaya Channel. Nitrogen is probably never limited in the study areas. Due to nitrification in the presence of oxygen amounts of nitrogen are always elevated. In fact, due to the importance of denitrification in the deeper (anaerobic) parts of Buor-Khaya Gulf, this amount would actually increase when the water quality would improve to such an extent that the river gets aerobic near the coast. During 1994 the concentrations of dissolved total phosphorus were almost completely used up in the Lena River outflow zone. In May 1994 the mean concentration of phosphorus in the surface layers of Tiksi Bay water was 0.010 mg/l (station 2) which is half of the bottom water concentration at this time. During winter the dissolved total phosphorus behaves conservatively, the concentration of which in the surface layers of Tiksi Bay water varied from 0.0074-0.030 mg/l. Maximum concentrations of about 0.64 mg/l were observed in May (station 2) in the surface layer. The mean value of phosphorus in Tiksi Bay was 0.017 mg/l. Ammonia has the widest variation range from 0.214 mg/l in March (station 2) to 0.009 mg/l in January (station 1). Areas of high ammonia concentration commonly correspond to low dissolved oxygen values: 4 mg O_2/l (SIDOROV & GUKOV 1992). Bottom water in the Buor-Khaya Gulf is characterized by higher ammonia loads than observed in surface waters. The increase of the ammonia load varies between 0.016-0.068 mg/l in Tiksi Bay for all summer and autumn samples, where a remarkable stratification of waters is observed, leading to very mixed bottom water. The mean value of ammonia was 0.064 mg/l in Tiksi Bay. Seasonal variations in the ammonia concentration are due to mineralization in the deeper areas of Tiksi Bay and Buor-Khaya Bay.

Seasonal examinations of macrobenthos in Tiksi Bay revealed a maximum abundance in late summer (August-September). The abundance (Fig. 4), the biomass (Fig. 5) and species diversity of macrozoobenthos are relatively low. In Tiksi Bay the biomass of dominant species biocoenoses varies considerably from winter to summer, as illustrated by Figure 6, showing the biomass values of *Cyrtodaria kurriana* and *Portlandia aestuariorum*.

Bivalve molluscs are important components of bottom biocenosis in this area. The maximum specimens observed were 27 mm in height and 36 mm in length. The proportion of clams of the prereproductive age class with a shell length less than 8 mm was relatively high (60 %). The oldest clam examined was 7 years old and 12 mm long. The number of comparatively large old aged individuals was low (30 %).

Small individuals of Bivalvia and Polychaeta occur at both stations 1 and 2 during August-September. Mobile organisms are abundant in March-May. All species are able to tolerate long-term salinity decreases. Six species of Polychaeta are common: *Ampharete vega, Sphaerodoropsis minuta, Scoloplos armiger, Tereellides stroemi, Micronephthys minuta, Marenzellaria wireni*. The share of Polychaeta in the biocenosis is 1 % in biomass and nearly 23 % in species diversity.

Ten species of Amphipoda were found, 8 species at station 1 and 10 species at station 2. Two species of Oligochaeta were

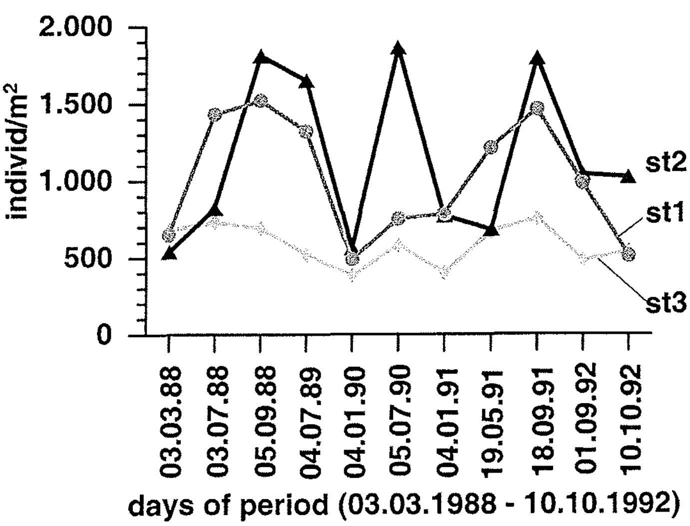

Fig. 4: Total abundance of macrobenthos for the period 1988-1992 in the Lena River mouth area.

Abb. 4: Gesamthäufigeit des Macrobenthos in der Lena-Mündung 1988-1992.

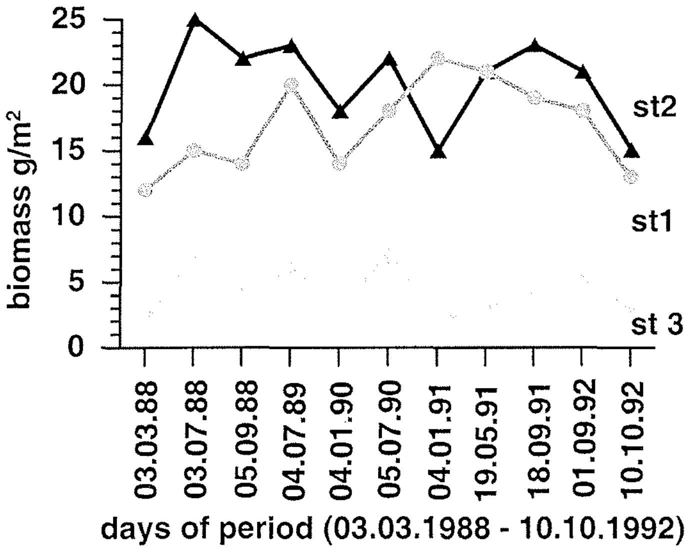

Fig. 5: Total biomass of macrobenthos for the period 1988-1992 in the Lena River mouth area.

Abb. 5: Gesamtbiomasse des Macrobenthos in der Lena-Mündung 1988-1992.

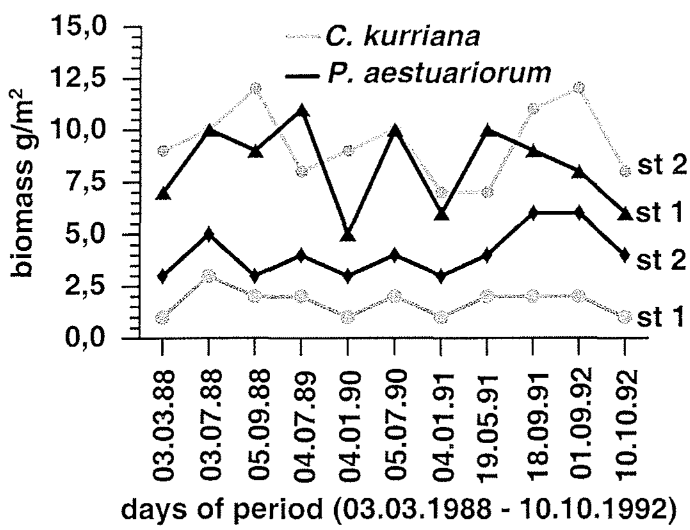

Fig. 6: Biomass of the bivalves molluscs *Portlandia aestuariorum* and *Cyrtodaria kurriana* for the period 1988-1992 in the Tiksi Bay.

Abb. 6: Biomasse der Muscheln *Portlandia aestuariorum* und *Cyrtodaria kurriana* in der Tiksi-Bucht 1988-1992.

reported from station 1 and three from station 2, including *Tubifex tubifex* as indicator of polluted water. *Saduria entomon glacialis* (Isopoda), three species of gastropods (with *Cylichna occulta* being the most abundant), *Halicryptus spinulosus* (Priapulida), *Diastylis sulcata* (Cumacea) are considerably less abundant.

At station 1, 23 species of macrozoobenthos have been registered (Tab. 3). The highest abundance and biomass were observed during a short period in August 1990 (1,510 ind./m^2 and 20.5 g/m^2, respectively). The total abundance at station 1 averaged 1,160 ind./m^2 and the total biomass 15.55 g/m^2. The number of oligochaetes varied from 40-50 ind./m^2. A low abundance of Cumacea, Gastropoda and Priapulida was characteristic for the whole year. At the end of August and the beginning of September the bottom precipitation of plankton larvae, particularly of bivalve mollusk takes place. Sediments at this station are composed of aleurite clay, the pelite fraction comprises 54.75 % (Tab. 1). Amphipods amount to 49.1 % of the total density, bivalves to 21.5 % and polychaets to 12.9 %, respectively. With regard to density, *Portlandia aestuariorum, Pontoporeia femorata, P. affinis* appeared to be the most important species. Their contribution to the total density of the biocoenose is 20.6, 30.1 and 7.7 %, respectively. With regard to biomass, *P. aestuariorum* (51.4 %), *Pontoporeia femorata* (20.6 %), *P. affinis* (11.57 %) and *C. kurriana* (10.2 %) were the most important species.

The fauna at station 2 is dominated by deposit feeders. The species *Ampharete vega, Terebellides stroemi* (Polychaeta), *Halicryptus spinulosus* (Priapulida), were numerous in winter (up to 28.2 % of biomass) and in summer (up to 22.6 %). Sediments at this station are represented by clayish mud, the pelite fraction accounts for 84.50 %. Deposit feeders, especially the bivalves *P. aestuariorum* are dominant at station 1, while *C. kurriana* is dominant at station 2.

At station 2 near Brusnev Island, the abundance of benthic macrofauna reached a maximum of 2200 ind./m^2 in August 1990. The total biomass at station 2 averaged 22.43 g/m^2. The total abundance at the same station averaged 1,600 ind./m^2. Totally, 30 macrobenthic species have been registered (Tab. 3). The bivalves *P. aestuariorum* and *C. kurriana* occupy the central part of Tiksi Bay. Their average biomass at station 2 is 4.02 and 9.68 g/m^2, respectively, the abundance is 30 and 270 ind./m^2. The abundance of polychaetes varied from 10-160 ind./m^2 (Tab. 3). With regard to their density, *C. kurriana* (16.8 % of total), *Onisimus birulai* (10 %), *Ampharete vega* (10 %) and *P. affinis* (6.8 %) appeared to be the most important species. With regard to their biomass, *C. kurriana* (43.1 % of total), *P. aestuariorum* (17.9 %) and *P. affinis* (13.8 %) were the most important species.

During 10 years, from August 1982 till September 1992, 65 species and forms of macrobenthos were found in the Lena Delta and, especially in the Lena River main channel, 4.7 km upstream the Stolb Island (station 3), 48 were found. Chironomidae, Plecoptera and Oligochaeta dominated the bottom fauna (Tab. 4).

The average abundance and biomass (in brackets) of zoobenthos is 680 (2.9) in spring, 770 (7.06) in summer, 720 (4.4) in autumn and 380 (2.6) ind. (g)/m^2 in winter. For comparison with Tiksi Bay, the seasonal dynamic of macrobenthos abundance and biomass is given from 1988-1992 (Figs. 4 and 5).

Favorable conditions for the development of large forms of Chironomidae existed in the years with low runoff. In spring Chironomidae were most abundant, mainly the species *Cryptochironomus rolli* , *Chironomus dorsalis, Polypedillum breviantennatum*. The development of Chironomidae continues from the beginning of July until the middle of August with its maximum at the end of July. In the second part of May, the organisms reach their maximum development. The abundance of zoobenthos is becoming high again during the autumn period.

Major Taxa	Species	A	B
Station 1			
Nemertini	*Nemertini spp.*	10	0.1
Polychaeta	*Sphaerodoropsis minuta*(W. & B.)	10	0.001
	Micronephthys minuta (Theel)	10	0.07
	Marenzellaria wireni (Migh.)	70	0.09
	Scoloplos armiger (Muller)	20	0.06
	Terebellides stroemi (Sars)	30	0.02
	Ampharete vega (Wiren)	10	0.01
Priapulida	*Halicryptus spinulosus* L.	50	0.05
Oligochaeta	*Lumbriculus sp.*	50	0.02
	Oligochaeta spp.	40	0.001
Bivalvia	*Portlandia aestuariorum* Mossewitsch	240	8.0
	Cyrtodaria kurriana Dunker	10	1.6
Gastropoda	*Retusa pertenuis* (Mighels)	10	0.04
Amphipoda	*Gammarus wilkitzkii* Birula	40	0.006
	Gammaracanthus loricatus (Sabine)	10	0.06
	Pontoporeia affinis(Lindstroem)	90	1.8
	P. femorata (Kroyer)	350	3.2
	Onisimus birulai Gurjanova	40	0.01
	O. plautus Kroyer	10	0.05
	Monoculodes sp.	10	0.02
	Arrhys phyllonyx (M .Sars)	20	0.04
Isopoda	*Saduria entomon glacialis* L.	20	0.3
Cumacea	*Diastylis sulcata* Stuxberg	10	0.01
Total		1160	15.35
Station 2			
Nemertini	*Nemertini spp.*	30	0.01
Polychaeta	*Sphaerodoropsis minuta* (W. & B.)	40	0.001
	Prionospio sp.	50	0.06
	Scoloplos armiger (Muller)	10	0.01
	Terebellides stroemi (Sars)	30	0.02
	Micronephthys minuta Theel	50	0.03
	Marenzellaria wireni	10	0.02
	Ampharete vega (Wiren)	160	0.07
Priapulida	*Halicryptus spinulosus* L.	10	0.03
Oligochaeta	*Tubifex tubifex* Muller	90	0.1
	Lumbriculus sp.	40	0.01
	Oligochaeta spp.	40	0.001
Bivalvia	*Portlandia aestuariorum* Moss.	30	4.02
	Cyrtodaria kurriana (Dunker)	270	9.68
	Thyasira gouldi (Philippi)	110	2.0
Gastropoda	*Oenopota sp.*	30	0.006
	Cylichna occulta (Mighels)	40	0.007
	Retusa pertenuis (Mighels)	20	0.003
Amphipoda	*Gammarus wilkitzkii* Birula	30	0.01
	Gammaracanthus loricatus (Sabine)	50	0.02
	Pontoporeia affinis Lindstroem	110	3.1
	P. femorata (Kroyer)	90	2.6
	Onisimus birulai Gur.	160	0.02
	O. plautus Kroyer	20	0.1
	Monoculodes sp.	10	0.02
	Monoculopsis sp.	10	0.04
	Arrhys phyllonyx (M.Sars)	10	0.02
	Priscillina armata (Boeck)	20	0.04
Isopoda	*Saduria entomon glacialis* L.	20	0.3
Cumacea	*Diastylis sulcata* Stuxberg	10	0.01
Total		1600	22.038

Tab. 3: List of taxa collected in Tiksi Bay. (A) average abundance (ind./m^2); (B) mean biomass (g/m^2).

Tab. 3: Liste der in der Tiksi-Bucht identifizierten Taxa. (A) mittlere Häufigkeit (Ind./m^2), (B) mittlere Biomasse (g/m^2).

Oligochaetes predominate in summer, especially the species *Propappus volki, Tubifex tubifex, Peloscolex ferox, Paranais uncinata* and *Limnodrilus hoffmeisteri*. While the average biomass of Oligochaeta at station 3 is 0.3 g/m^2, it reaches 0.9-4.4 in the biggest channels of the Lena Delta. The average biomass of Chironomidae and of Mollusca is 0.66 (maximum 2.0-6.0) and 0.33 (0.1-1.8) g/m^2, respectively.

The following species are typical for station 3: *Arcynopteryx compacta* (18.7 % of total density and 25.7 % of total biomass), *A. altaica* (10 % and 21.4 %, respectively), *Cricotopus bicinctus, Diura bicaudata, Capnia pigmaeus Zett* (Plecoptera), *Grensia praeterita* (Trichoptera) and bivalves *Sphaerium corneum* and *Pisidium amnicum*. In contrast, *Apatania crymophila* (Trichoptera), *Heptagenia fuscogrisea, H. sulphurea* , *Parameletus chelifer* (Ephemeroptera) occur in the deepest parts of the river. The abundance and biomass of zoobenthic organisms in the Lena Delta increase with the flood and decrease with the amplitude of water level fluctuation.

DISCUSSION

The two study areas Tiksi Bay and main Lena River differed in hydrological and biological characteristics. At a depth of 10-12 m in the eastern part of Tiksi Bay and in Buor-Khaya Bay macrobenthos is represented by brackish-waters and marine euryhaline species, including *Portlandia siliqua* (GUKOV 1989). Near the Brusnev Island (station 2) polychaetes and bivalves were the least abundant in winter and most abundant in July-August. Some differences in species composition and number of individuals appear to be related to the granulometric composition of the sediments. With regard to density, *Pontoporeia femorata, Cyrtodaria kurriana, Portlandia aestuariorum, Ampharete vega* and *Onisimus birulai* are the most important species.

The bottom fauna of the main Lena River channel in the vicinity of the Stolb Island consists of freshwater species including lacustrine ones carried by strong current flows from upstream areas. The dominant bottom organisms at station 3 are Chironomidae and Oligochaeta. The change in the faunal composition and the increase in the species diversity go along with the increase in the amount of sand and gravel in the sediment, which indicates that the granulometric composition of the sediments is a major factor controlling the species' distribution. The highest taxonomic diversity was observed at temperatures from 9 °C to 0 °C on sand bottom (station 3).

The Tiksi Bay has a resemblance to the region of the Ob-Yenisey gulf (PERGAMENT 1944, POPOV 1932). In both regions the dominant species are brackish water species. The distribution patterns of estuarine-Arctic species, like the bivalve *Portlandia aestuariorum*, as well as the amphipod *Gammaracanthus loricatus*, mysid *Mysis relicta* and isopod *Saduria entomon*

Major Taxa	Species	A	B
Station 3			
Trichoptera	*Arctopsyche ladogensis* Kolenati	4	0.06
	Apatania crymophila McL.	8	0.02
	Ceraclea annulicornis Steph.	4	0.04
	Hydropsyche bulgaromanorum Malicky	8	0.06
	Micrasema gelidum McL.	4	0.1
Plecoptera	*Arcynopteryx altaica* Zap-Dulkeit	64	1.25
	A.compacta McL	120	1.25
	Capnea pigmaea Zett.	6	0.08
	Leuctra spp.	0.4	0.06
Ephemer-optera	*Baetis (Acentrella) fenestratus*	0.6	0.04
	Heptagenia (Kageronia) fuscogrisea	40	0.09
	H.sulphurea (Mull.)	20	0.08
	Ephemerella triacantha Tshern.	0.4	0.07
	Ephemerella spp.	0.8	0.05
	Silphonurus(Siphlurella)alternatus Say	10	0.04
Simulidae	*Simulidae spp.*	0.8	0.04
	Prosimulium sp.	0.8	0.08
Chirono-midae	*Ablabesmia gr.lentiginosa* Friez	10	0.06
	Aulodrilus sp.	0.9	0.06
	Chironomus dorsalis Meigen	0.6	0.08
	Cricotopus versidentatus L.	30	0.05
	Cricotopus biformis Edw.	0.8	0.04
	C. bicinctus Edw.	120	0.08
	Cryptochironomus rolli Kirpitshenko	40	0.04
	C.gr.defectus Kieffer	20	0.09
	C.salinarius Kieffer	4	0.02
	Eukiefferiella longicalcar L.	4	0.02
	Endochironomus albipennis L.	8	0.05
	Ilyodrilus hammoniensis L.	0.4	0.01
	Polypedillum breviantennatum Tchern.	0.4	0.01
	Procladius skuse Meigen	0.6	0.02
	Stictochironomus histrio F.	6	0.06
	Synorthocladius sp.	0.8	0.08
	Tanytarsus lobatifrons Edvards	120	0.08
Limoniidae	*Austrolimnophila subpolaris* Sav.	1.6	0.08
	Dicranota (s.str.) yezoensis Al.	2	0.07
	Phylidorea (s.str.) melanura (Lack.)	37.6	0.08
Tipulidae	*T.(Savdchenkovia) convexifrons* Holm.	2	0.04
Culicidae	*Aedes impiger* Walk.	3	0.03
Mollusca	*Pisidium ammicum* Muller	1	0.09
	Sphaerium corneum L.	0.8	0.09
	Gyraulus gredleri Gredler	2	0.09
	Valvata sibirica Middendorff	40	0.10
Oligochaeta	*Limnodrilus hoffmeisteri* (Clap)	0.8	0.06
	Lumbriculus spp.	0.4	0.05
	Paranais uncinata Oerst	1.2	0.09
	Propappus volki Michl.	0.3	0.03
	Tubifex tubifex Mull.	6	0.09
Total		640	3.99

Tab. 4: List of taxa collected at station 3 in Lena River main channel. (A) average abundance (ind./m^2), (B) mean biomass (g/m^2).

Tab. 4: Liste der im Lena-Strom (Station 3) identifizierten taxa. (A) mittlere Häufigkeit (Ind./m^2), (B) mittlere Biomasse g/m^2.

glacialis, occur in the estuaries of the large rivers and are closely bound to very brackish surface waters (estuarine-Arctic waters with salinities of 5-18 psu, that may reach down to depths of 10, rarely 15 m). The same species were found in the mouths of the Anabar, Olenek, Yana and Omoloy rivers (GUKOV 1989, 1991, 1992).

Ecosystems of Tiksi Bay are functioning in the estuary arctic water mass inhabited by widespread boreal-arctic and brackish water species. However, the fresh water species are absent here.

Polychaetes were found in all samples and were subdominant at station 2. There are seven species of polychaetes. Polychaetes in the biocoenoses amount to 1 % of the biomass, 21 % of the abundance and nearly 23 % of the species diversity. The value of fauna changes is apparently related to the bottom water oxygen concentration. The low value of macrobenthos biomass and decrease in species diversity at station 1 corresponds to the minimum of oxygen concentration. The percentage of organic carbon content in the surface sediments of the Tiksi Bay and the adjacent areas in the coastal zone of the Laptev Sea is relatively high and amounts to 1-2 % (YAKOVLEV 1995). Content and distribution of organic carbon in bottom sediments of the Laptev Sea shelf is controlled by currents, tidal movements, dispersive action of storm and bottom topography. The lowest concentration is found at station 3 (1 %), were the proportion of carbonate sand is high, sedimentation rates are low and mineralization of organic matter is effective.

The deficit of the seston feders is a result of high turbidity of the waters. The reduction in the abundance of suspension feeding organisms in muddy sediments was noted by many investigators (DAVIS 1925, THORSON 1957, SANDERS 1958). An increase in the size of the polychaetes from the Lena River to the Polar Basin is the result of higher production in the transparent sea waters (AVERINCEV 1990).

The pollution of the Laptev Sea originates from various sources, such as run-off, shipping and sewage effluents. Investigations of relatively polluted fresh and marine water have revealed that a decrease in concentration of some nutrients occurs in a seaward direction. One of the most polluted parts of the Laptev Sea is the Bulunkan Inlet in the vicinity of the settlement Tiksi (ABRAMOVA & GUKOV 1990b).

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