Protistology 2 (2), 105-122 (2001)

Protistology

Foraminifera of the Laptev Sea

Tatiana G. Lukina

Laboratory of Marine Research, Zoological Institute of the Russian Academy of Sciences, St.Petersburg, Russia

Summary

As a result of processing material of 6 Arctic expeditions Foraminifera fauna from the entire Laptev Sea within the limits of a wide range of depths (from 8 up to 3171 m) and salinity of bottom water (from 11 up to 35 per mille) was investigated. One hundred and thirty species were identified, of which 62 species are forms with agglutinated shell, and more than a half of species are noted for the given area for the first time.

Key words: recent benthic Foraminifera, taxonomy, horizontal and vertical distribution

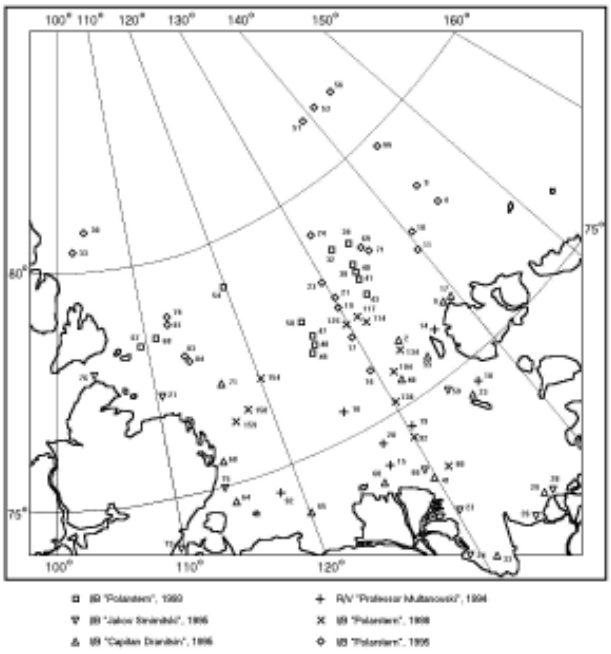
Introduction

Foraminifera are among the most common taxa of marine benthos of worldwide distribution and have an important role in the trophic chain of the entire biocenosis. Apart from that Foraminifera are excellent indicators of the degree of anthropogenous impact on the hydrological regime of the studied water area.

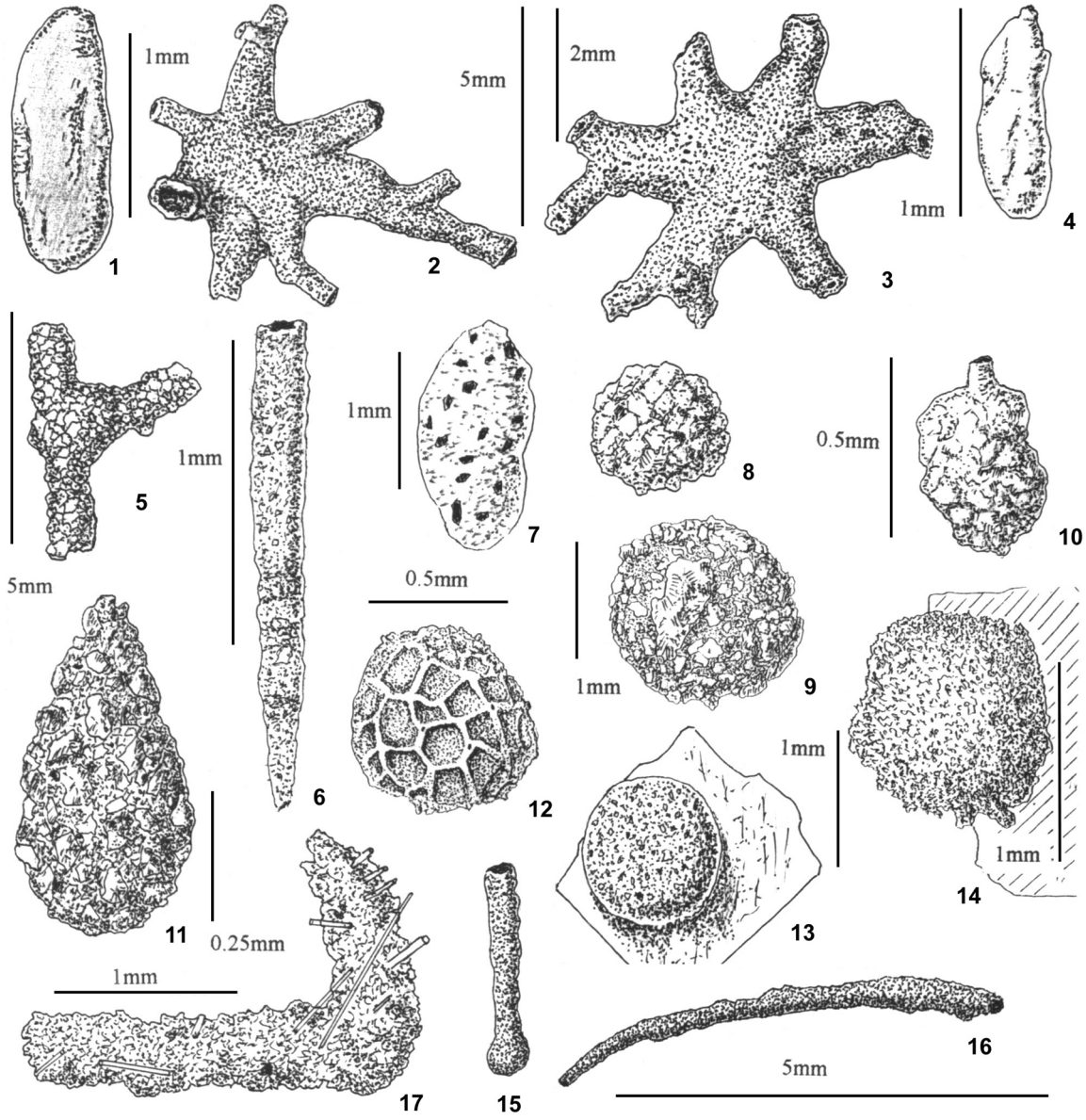
At present only scanty and fragmentary information is available on species composition of Foraminifera of the Laptev Sea. Thus, the work of Z.G. Stschedrina (1936) contains information on the presence of 4 species within the limits of the section passing from the Severnaya Zemlya Archipelago up to the mouth of the Lena River. Moreover, data on species composition of Foraminifera fauna of the Laptev Sea are available in the publication by American researchers R.Todd and D.Low (1966) (39 species) and in the work by S.V.Tamanova (1970) (24 species).

Material and Methods

This paper was based upon material collected during the joint Russian-German expedition in the framework of the project «System of the Laptev Sea»: r/v «Professor Multanovskiy», 5 - 22.09. 1994, r/v «Kapitan Dranitsyn», 8 - 23.10. 1995, r/v «Polarstern», 2 - 20.09. 1993, 24.07 - 7.09. 1995, 1 - 18.08. 1998 and Russian-American expedition: r/v «Jakov Smirnitskiy», 15.08 - 8.09. 1995 (see map). Quantitative meiobenthos samples were sorted out and examined only from samples collected during voyages of vessels «Professor Multanovsky» (7 stations), «Kapitan Dranitsyn» (14 stations), «Yakov Smirnistsky» (10 stations) and «Polarstern» 1998 (11 stations) from depths



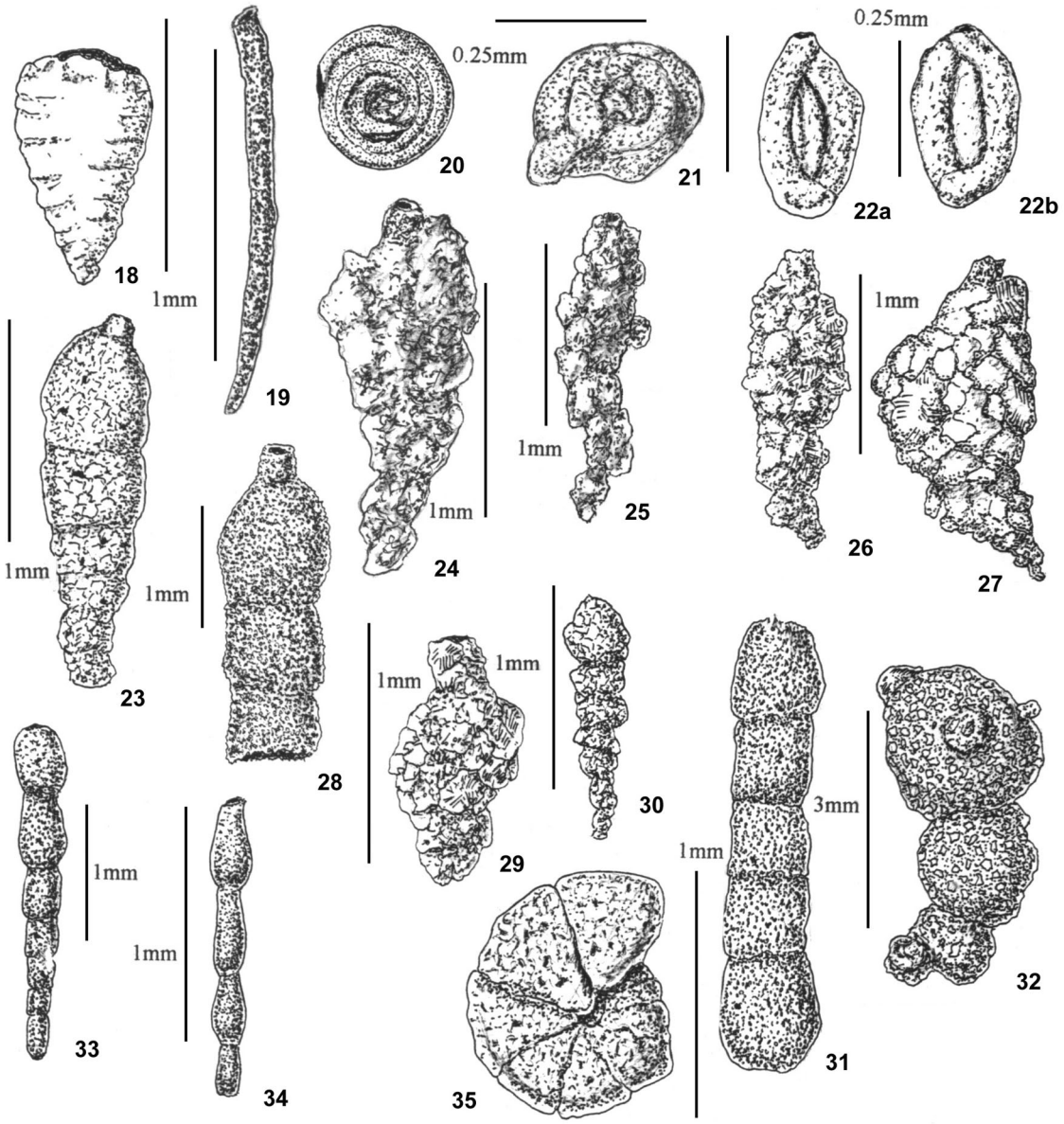
© 2001 by Russia, Protistology



Figs 1-17. Foraminifera species found in the Laptev Sea. **1 -** *Allogromia sp.* (M., st.92, dep.34m); **2 -** *Astrorhiza arenaria* Norman (P.98, st.117, dep. 79m); **3 -** *Astrorhiza limicola* Sandahl (P.95, st.4, dep.54m); **4 -** *Pelosina variabilis* Brady (M., st.14/24, dep.20m); **5 -** *Rhabdammina abyssorum* Sars (P.93, st.62, dep. 101m); **6 -** *Rhabdammina aff. discreta* Brady (P.93, st.49, dep. 280 m); **7 -** *Psammosphaera bowmanni* Heron-Allen and Earland (M., st.15/41, dep. 13,5m); **8 -** *Psammosphaera fusca* Schulze (P.98, st.158, dep.67m); **9 -** *Saccammina sphaerica* Brady (P.93, st.47, dep.1079m); **10 -** *Lagenammina difflugiformis* (Brady) (D., st.41, dep. 24m); **11 -** *Lagenammina difflugiformis* (Brady) (P.98, st.158, dep.67m); **12 -** *Thurammina favosa* Flint (P.95, st.81, dep. 535m); **13 -** *Tholosina bulla* (Brady) (P.93, st.43, dep. 55m); **14 -** *Tholosina vesicularis* (Brady) (P.93, st.32, dep. 3028m); **15, 16 -** *Hyperammina elongata* Brady (P.98, st.117, dep. 79m); **17 -** *Saccorhiza ramosa* (Brady) (P.98, st.159, dep. 57m).

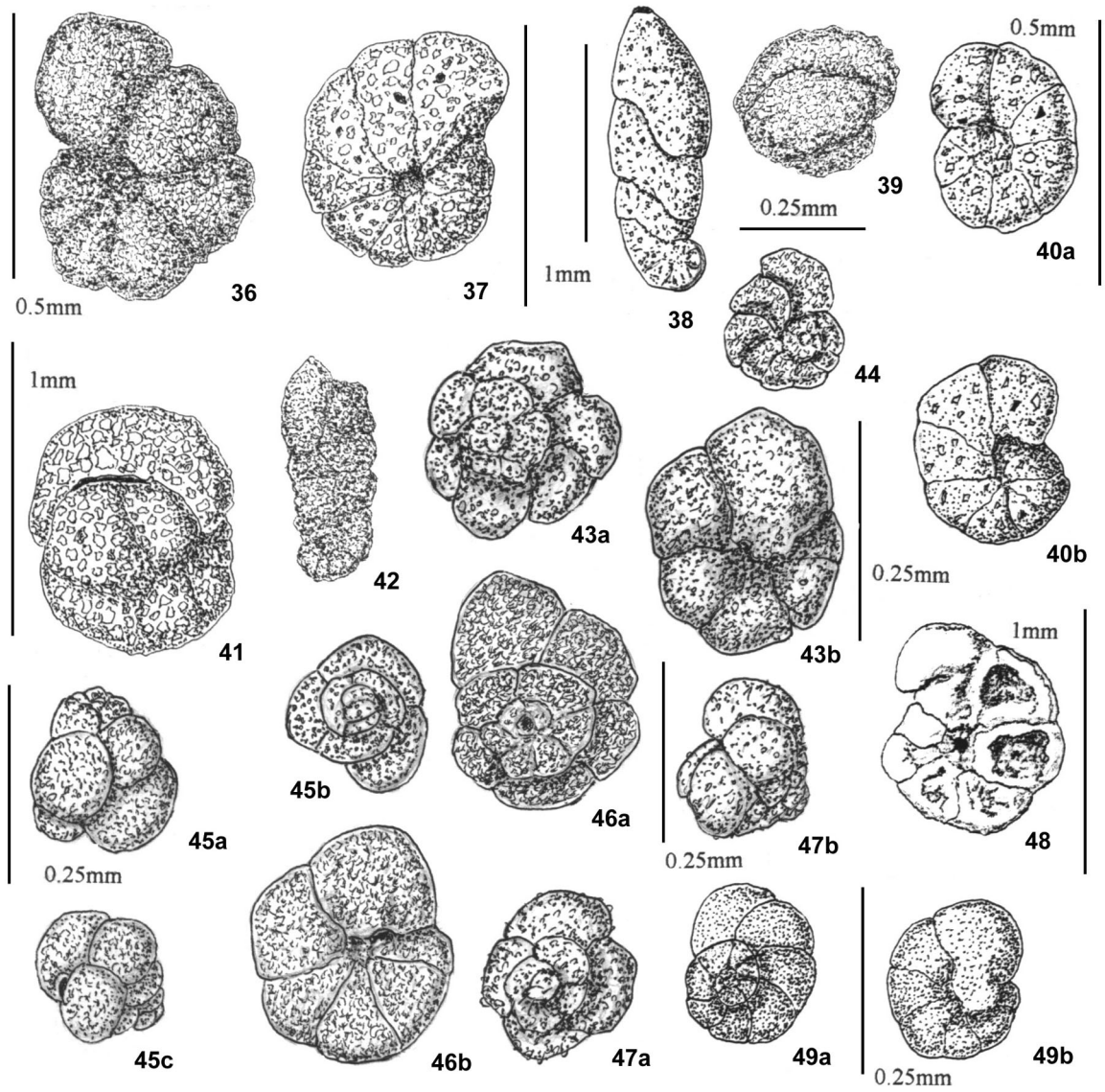
8 to 267 m. The rest of material (r/v Polarstern, 1993, 13 stations and «Polarstern», 1995, 21 stations) was obtained as a result of examination of macrobenthos bottom grab samples partly washed. For this circumstance possibly the most minute fraction of Foraminifera fauna after examination of this material is represented incompletely.

Material examined covers the entire Laptev Sea from coastal shallow areas to 81° 12.7°N, from 8 to 3171 m, at salinity 11-35 per mille.



Figs 18-35. Foraminifera species found in the Laptev Sea. **18 -** *Hippocrepina indivisa* Parker (P.98, st.159, dep. 57m); **19 -** *Jaculella acuta* Brady (Sm., st.75, dep. 43 m); **20 -** *Ammodiscus catinus* Hoglund (P.98, st.159, dep. 57 m); **21 -** *Ammodiscus gullmarensis* Hoglund (P.98, st.154, dep. 267 m); **22 a, b -** *Silicosigmoilina groenlandica* (Cushman) (P.98, st.158, dep. 67 m); **23 -** *Nodulina dentaliniformis* Brady (M., st.17/24, dep. 20m); **24 -** *Reophax bilocularis* Flint (Sm., st.75, dep. 43 m); **25 -** *Reophax bradyi* Bronnimann and Whittaker (P.93, st.38, dep. 1038 m); **26 -** *Reophax bradyi* Bronnimann and Whittaker (P.98, st.158, dep. 67 m); **27 -** *Reophax curtus* Cushman (M., st.92, dep. 34m); **28 -** *Reophax sabulosus* Brady (P.95, st.69, dep. 984 m); **29 -** *Reophax subfusiformis* Earland (D., st.41, dep. 24m); **30 -** *Cuneata arctica* (Brady) (P.98, st.158, dep. 67m); **31 -** *Archimerismus subnodosa* Brady (P.95, st.12, dep. 45m); **32 -** *Hormosina globulifera* Brady (P.93, st.47, dep. 1079m); **33 -** *Pseudonodosinella nodulosa* (Brady) (P.93, st.38, dep. 1038m); **34 -** *Reophanus ovicula* (Brady) (P.93, st.39, dep. 526m); **35 -** *Cribrostomoides subglobosum* (G.O.Sars) (P.98, st. 58, dep. 67m).

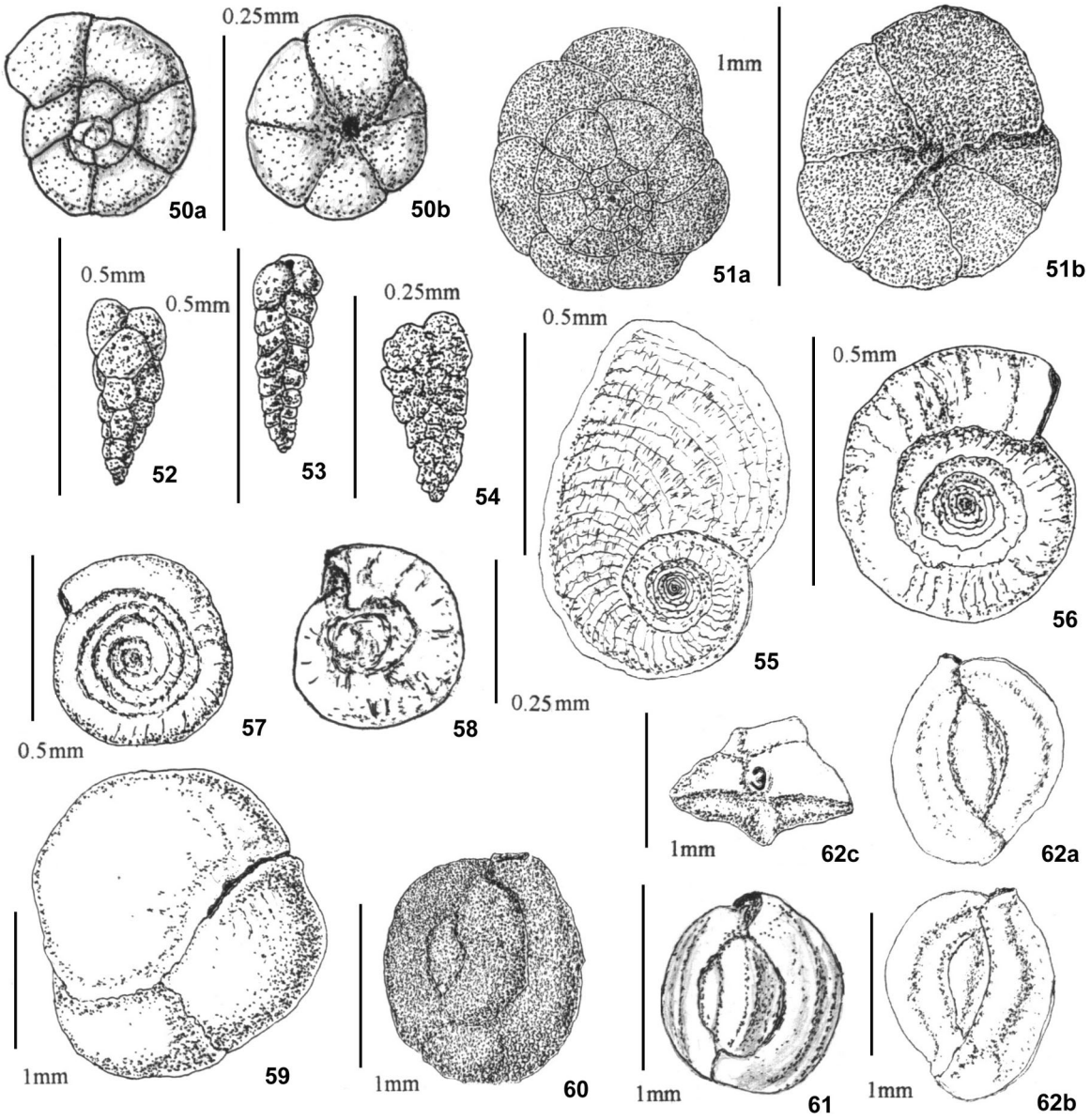
The taxonomic study is based upon the classification proposed by American authors Alfred R.Loeblich, Jr. and Helen Tappan, 1987. In processing the material Foraminifera shells were partly stained using rose Bengal for the purpose of revealing Foraminifera containing plasma. On the average living Foraminifera constitute approximately 40% of the total number of shells found.



Figs 36-49. Foraminifera species found in the Laptev Sea. **36 -** *Haplophragmoides jeffreysi* (Williamson) (P.98, st.158, dep. 67m); **37 -** *Labrospira crassimargo* (Norman) (P.98, st.158, dep. 67m); **38 -** *Ammotium cassis* (Parker) (P.98, st.159, dep. 57m); **39 -** *Adercotryma glomerata* (Brady) (P.98, st.158, dep. 67m); **40 a, b -** *Recurvoides contortus* Earland (P.98, st.159, dep. 57m); **41 -** *Recurvoides laevigatum* Hoglund (P.95, st.23, dep. 2371m); **42 -** *Spiroplectammina biformis* (Parker and Jones) (P.98, st.158, dep. 67m); **43 a, b -** *Portatrochammina bipolaris* Bronnimann and Whittaker (P.98, st.154, dep. 267m); **44 -** *Portatrochammina bipolaris* (P.98, st.158, dep. 67m); **45 a, b, c -** *Tritaxis bullata* (Hoglund) (P.98, st.154, dep. 267m); **46 a, b -** *Trochammina inflata* (Montagu) (P.98, st.154, dep. 267m); **47 a, b -** *Trochamminopsis pussilus* Hoglund (P.98, st.154, dep. 267m); **48 -** *Jadammina macrescens* (Brady) (Sm., st.28, dep. 10m); **49 a, b -** *Trochamminula lobata* (Cushman) (M., st.15/41, dep. 14m).

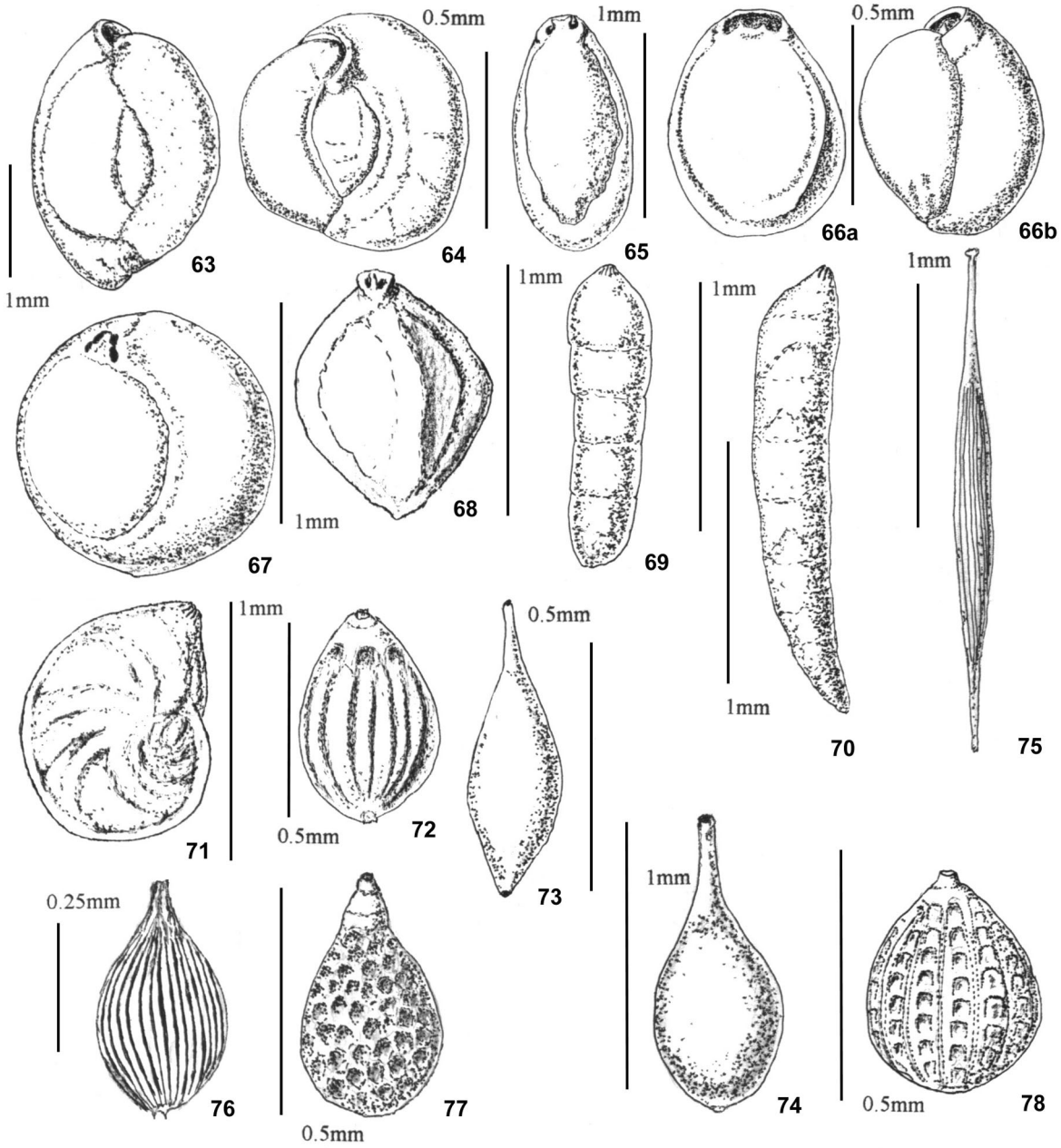
Description of the environment

The Laptev Sea occupying central position among the Arctic seas of Russia may serve as the most convenient model for the study of processes occurring in the marginal seas of the Arctic Ocean. The peculiar character of the hydrological regime, topography of sea is determined by five large rivers fall into it. These are rivers Khatanga, Olenek and Anabar in the western part and rivers Lena and Yana in the eastern part. Approximately 868 km^3 of freshwater enter the Laptev Sea (sediments 164 km^3, river flow 766.7 km^3 minus evaporation km^3) (Kochetov S.V. et al., 1994). A small trench Sadko with depths to 3385 m cuts into the Laptev



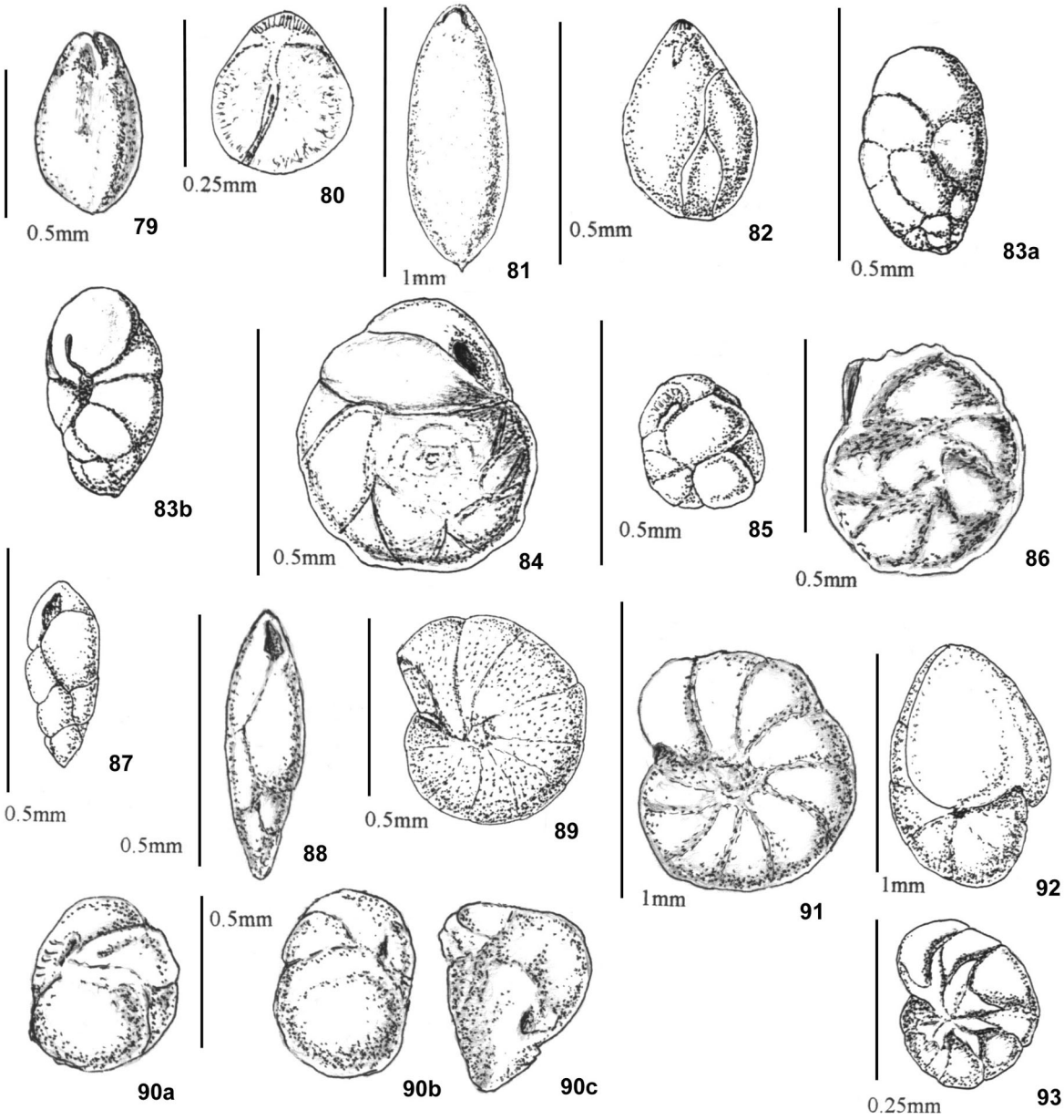
Figs 50-62. Foraminifera species found in the Laptev Sea. **50 a, b -** *Deuterammina grisea* (Earland) (P.98, st.154, dep. 267m); **51 a, b -** *Deuterammina rotaliformis* (Heron-Allen and Earland) (Sm., st.23, dep. 8m); **52 -** *Verneuilinulla advena* (Cushman) (P.98, st.159, dep. 57m); **53 -** *Textularia earlandi* Parker (P.98, st.158, dep. 67m); **54 -** *Textularia torguata* Parker (P.98, st.158, dep. 67m); **55 -** *Cornuspira foliacea* (Philippi) (P.95, st.64, dep. 37m); **56 -** *Cornuspira foliacea* (Philippi) (M., st.92, dep. 34m); **57 -** *Cornuspira involvens* (Reuss) (M., st.92, dep.34 m); **58 -** *Gordiospira arctica* Cushman (P.98, st.80, dep. 24m); **59 -** *Planispirinoides bucculentus* (Brady) (P.93, st.39, dep. 526m); **60 -** *Quinqueloculina agglutinata* (Cushman) (P.95, st.4, dep. 54m); **61 -** *Quinqueloculina arctica* Cushman (P.93, st.32, dep. 3028m); **62 a, b, c -** *Quinqueloculina lamarckiana* D'Orbigny (P.95, st.64, dep. 37m).

Sea in the north. In the southern part the surface of sea bottom is indented by submarine paleovalleys situated opposite mouths of rivers falling into the sea. The major part of the sea is occupied by shallow water shelf zone with depths to 50 m. Thus, an abrupt overfall of depths may be observed in the Laptev Sea. In the southern part average depths do not reach beyond the limits of 15-20 m, whereas northern boundaries of the sea pass above the ocean bed with depths in excess of 2000 m. Abrupt overfall of depths at the continental slope divides the sea into the northern deep water part and southern shallow part along the latitude of Vilkitsky Strait. Isobath of 200 m is regarded as boundary of the shelf.



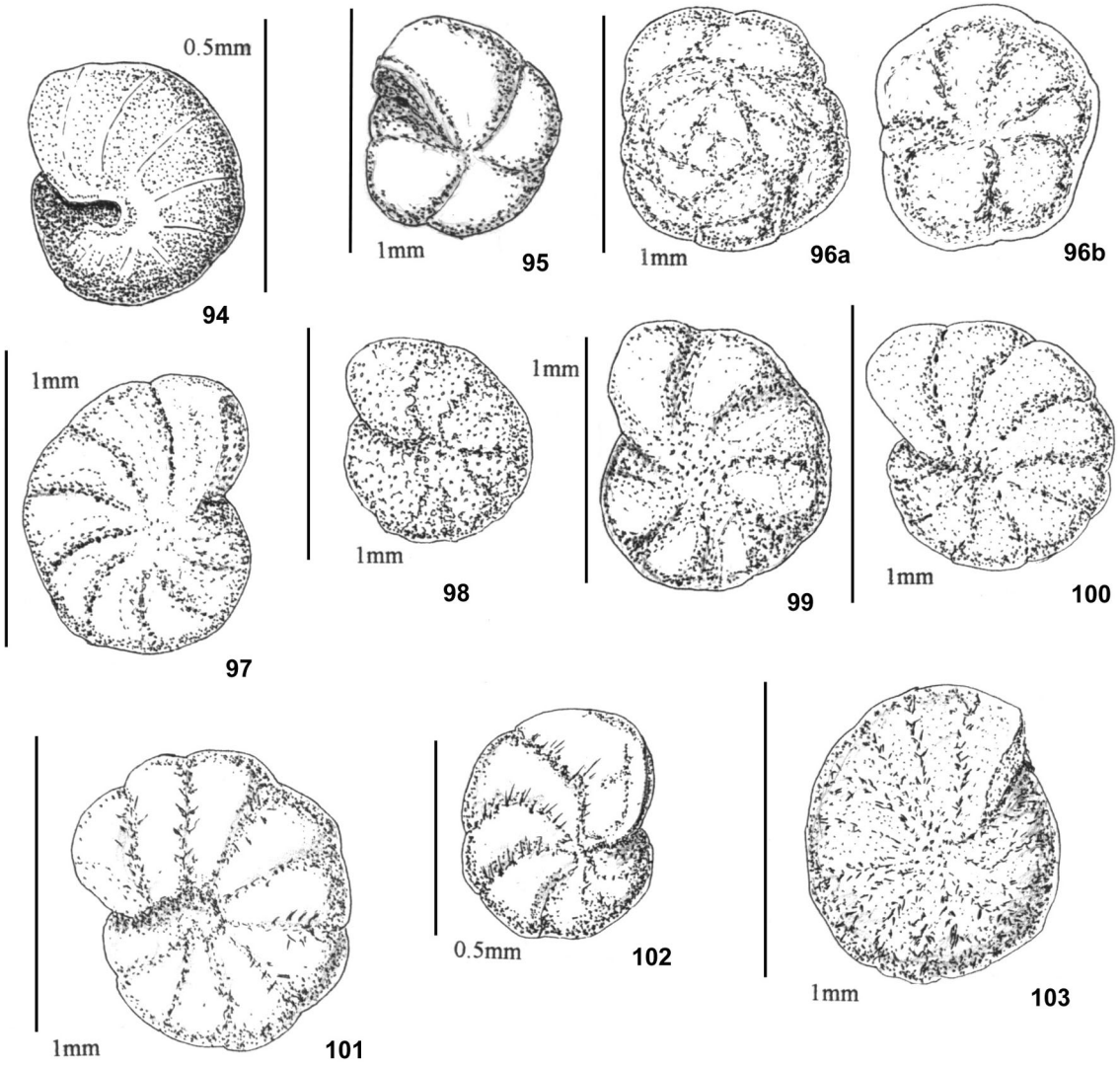
Figs 63-78. Foraminifera species found in the Laptev Sea. **63.** *Quinqueloculina seminulum* (Linne) (P.95, st.81, dep. 535m); **64 -** *Miliolinella hauerinoides* (Rhumbler) (M., st.92, dep. 34m); **65 -** *Pyrgo elongata* (D'Orbigny) (P.95, st.81, dep. 535m); **66 a, b -** *Pyrgo williamsoni* (Silvestri) (M., st.92, dep. 34m); **67 -** *Pyrgoella sphaera* (D'Orbigny) (P.95, st.81, dep. 535m); **68 -** *Triloculina trichedra* Loeblich and Tappan (P.95, st.81, dep. 535m); **69 -** *Dentalina baggi* Galloway and Wissler (P.95, st.12, dep. 45m); **70 -** *Dentalina frobischerensis* Loeblich and Tappan (P.95, st.62, dep. 243m); **71 -** *Astacolus hyalacrulus* Loeblich and Tappan (P.95, st.81, dep. 535m); **72 -** *Lagena apiopleura* Loeblich and Tappan (D., st.17, dep. 18m); **73 -** *Lagena gracillima* (Seguenza) (P.98, st.159, dep. 57m); **74 -** *Lagena laevis* (Montagu) (P.95, st.84, dep. 101m); **75 -** *Lagena mollis* Cushman (P.95, st.81, dep. 535m); **76 -** *Lagena striata* (D'Orbigny) (P.95, st.81, dep. 535m); **77 -** *Favulina hexagona* (Williamson) (P.95, st.81, dep. 535m); 7**8 -** *Favulina melo* (D'Orbigny) (M., st.92, dep. 34m).

Structure of waters of the Laptev Sea is formed as a result of inflow of surface Arctic waters, deep Atlantic waters from the Arctic basin and under the influence of continental flow the maximum action of which is particularly pronounced in the south-eastern part of the sea. Situated below the layer of Atlantic waters are deep



Figs 79-93. Foraminifera species found in the Laptev Sea. **79 -** *Fissurina cucurbitasema* Loeblich and Tappan (D., st.17, dep. 18m); **80 -** *Fissurina marginata* (Montagu) (P.98, st.158, dep. 67m); **81 -** *Parafissurina tectulostoma* Loeblich and Tappan (P.95, st.81, dep. 535m); **82 -** *Laryngosigma hyalascidia* Loeblich and Tappan (P.98, st.158, dep. 67m); **83 -** *Robertinoides charlottensis* (Cushman) (P.98, st.158, dep. 67m); **84 -** *Cassidulina teretis* Tappan (P.98, st.158, dep. 67m); **85 -** *Islandiella islandica* (Norvang) (P.98, st.158, dep. 67m); **86 -** *Islandiella norcrossi* (Cushman) (P.95, st.16, dep. 53m); **87 -** *Stainforthia concava* (Hoglund) (P.98, st.158, dep. 67m); **88 -** *Cassidella complanata* (Egger) (P.95, st.81, dep. 535m); **89 -** *Lobatula lobatula* (Walker and Jacob) (M., st.92, dep. 34m); **90 a, b, c -** Rupertina stabilis Wallich (P.98, st.158, dep. 67m); **91 -** *Haynesina orbiculare* (Brady) (M., st.15/41, dep. 14m); **92 -** *Nonionella labradorica* (Dawson) (P.95, st.12, dep. 45m); **93 -** *Astrononion gallowayi* Loeblich and Tappan (P.98, st.158, dep. 67m).

Arctic waters with permanent negative temperature and salinity of approximately 35 per mille. A principle scheme of the Laptev Sea waters circulation particularly in summer time is characterized by entry of large amounts of water through Vilkitsky Strait and Severnaya Zemlya Archipelago straits from the Kara Sea towards the continental coast (Nikiforov and Shpaiher, 1980). Then under the influence of freshened flow of rivers Lena and



Figs 94-103. Foraminifera species found in the Laptev Sea. **94 -** *Melonis barleanum* (Williamson) (P.95, st.84, dep. 101m); **95 -** *Pullenia bulloides* D'Orbigny (P.95, st.81, dep. 535m); **96 a, b -** *Buccella frigida* (Cushman) (P.95, st.17, dep. 18m); **97 -** *Cribroelphidium bartletti* (Cushman) (M., st.92, dep. 34m); **98 -** *Cribroelphidium clavatum* (Cushman) (D., st.48, dep. 40m); **99 -** *Cribroelphidium subarcticum* (Cushman) (M., st.92, dep. 34m); **100 -** *Cribroelphidium subincertum* (Asano) (D., st.48, dep. 40m); **101 -** *Elphidiella arctica* (Parker and Jones) (P.95, st.71, dep. 534m); **102 -** *Elphidiella frigida* (Cushman) (M., st.92, dep. 34m); **103 -** *Elphidiella groenlandica* (Cushman) (P.95, st.4, dep. 54m).

Yana they deviate north-eastwards and through straits of the New Siberian Archipelago these continental waters flow in the East-Siberian Sea. In summer time waters of rivers Lena and Yana are noted north of Kotelnyi Island. In winter period continental flow in the Laptev Sea reduces considerably and has no essential impact on water flow in the sea. The near bottom water layer in the Laptev Sea is characterized by temperature that is negative or close to negative almost throughout the year.

Results

As a result of processing material 130 species of Foraminifera were identified of which 62 species are forms with agglutinated shell, and more than a half of species have been recorded in the given area for the first time.

The author has examined 42 quantitative box corer samples from collections of expeditions of r/v "Prof. Multanovskiy", 1994, r/v "Kap. Dranitsyn", 1995, r/v "Polarstern", 1998 and r/v "Jakov

Table 1. Distribution of bentic foraminifera in the Laptev Sea.

Expedition-year	Capitan Dranitsin, 1995														Prof. Multanovski, 1994						
Sample no.	2	9	17	23	29	33	41	48	55	60	64	65	68	71	10/13	14/24	15/41	18/62	19/51	20/63	92
Salinity	33	22	26	30	26	25	30	33	33	29.6	32	32	31.9		32.9	27	24	31	32	32	32
Temperature bottom	-1.5	1.9	2.1	-1.4	-0.8	0.5	-0.5	-1.5	-1.4	-0.6	-0.9	-0.9	-1		-1.7	-0.2	1.6	-1.3	-1.4	-1.5	-1.2
Species / Depth (m)	47	15	18	32	16	15	24	40	33	15	37	21	35	47	37	20	14	25	25	32	34
Allogromia sp.							5					8				4		3			8
Ammodiscus gullmarensis																		x			x
Ammotium cassis	34	14	21	10	3		8	30	5	6						11		2		52	6
Angulogerina fluens															7						
Archimerismus subnodosa															x						2
Astrononion gallowayi														3							
Bolivina pseudopunctata								1													
Buccella frigida	4			2	2			7	3									5		2	3
Buccella inusitata														5	5						
Cassidella complanata														1							
Cassidulina teretis													1								
Cornuspira involvens						3						2									2
Cribroelphidium bartletti	5	27	10	4				7	8	6	10		1		7			4	23	3	8
Cribroelphidium clavatum	14	14	10	4			11	21	27	10	14	3	9	6		1	1	22		35	4
Cribroelphidium subarcticum			1												17						13
Cribroelphidium subincertum	6	5	5	6				4				3									
Cuneata arctica	1			3				2	4				2		2						
Deuterammina rotaliformis																		x			
Elphidiella frigida													1								2
Elphidiella groenlandica	5	5	1	3		6	2	4										4			
Elphidium incertum		x																			
Esosyrinx curta		6	2				3		3						3						
Favulina melo																					1
Fissurina cucurbitas			1																		
Fursenkoina fusiformis														1							
Glabratella chasteri																					3
Haynesina orbicularis	5	9	4	6	6	1	5	3	13	10	18	5	3	5	20	2	28	12	31	3	3
Hippocrepina indivisa												2									
Hyperammina elongata														5							
Islandiella islandica	8	1		4				x	16						2						6
Islandiella norcrossi														6							
Labrospira crassimargo		2		1										2	3			1			
Lagena apiopleura			1																		
Lagena gracillima																					1
Lagenammina difflugiformis				8	42		8				29	8		40	6	32	4	31			

Smirnitskiy", 1995 from depths of 8 – 267 m. Results of processing of this material are presented in tables 1-2. Distribution of Foraminifera identified from 34 qualitative samples from Agassiz trawl from collections of r/v "Polarstern", 1993, 1995 from depths of 40-3171 m, is given in Tables 3-4. Data on depths, salinity and bottom temperature for each station are given. Relative percentages of each foraminiferal species to the total number of shells per sample is given. "x" indicates percentage less than 1.

Different depths and related diverse hydrological conditions of the southern and northern parts of the sea and also peculiar character of sea bottom relief have considerable impact on species composition and distribution of Foraminifera fauna in that region. Thus, in the southern shallow part of the Laptev Sea the majority are species of the sublittoral.

An assemblage of predominant species enduring considerable freshening has been defined in coastal regions influenced by freshwater flow of the Yana and Lena Rivers. Thus, east of the delta of the Lena River in the zone of influence of waters of the Yana River at depths 8-16 m at S=11-17 $^{o}/_{oo}$ and T. bott. =0 — - 6-7°C 18 species of Foraminifera have been found: *Ammotium cassis, Buccella frigida, Cornuspira involvens, Deuterammina rotaliformis, Elphidiella groenlandica, Haynesina orbicularis,, Lagenammina difflugiformis, Laryngosigma hyalascidia, Nodulina dentaliniformis, Pelosina variabilis, Portatrochammina bipolaris, Psammosphaera bowmanii, Psammosphaera fusca, Textularia torguata, Trochamminula lobata, Jadammina macrescens, Reophax bilocularis, Reophax subfusiformis*. The most common among them are *Deuterammina rotaliformis, Psammosphaera fusca, Lagenammina difflugiformis, Ammotium cassis* and *Nodulina dentaliniformis*.

In the freshened zone of the Lena River delta at depths of 14 – 24 m, S = 24 – 30 $^{o}/_{oo}$, T bott. = -1.1 – 1.6 °C 20 species of Foraminifera have been noted*: Allogromia* sp., *Ammotium cassis*, *Buccella frigida, Cornuspira involvens, Cribroelphidium clavatum, Cr. bartletti, Elphidiella groenlandica, Elphidium incertum, Esosyrinx cur-*

Table 1. (Continuation)

Expedition-year	Capitan Dranitsin, 1995														Prof. Multanovski, 1994						
Sample no.	2	9	17	23	29	33	41	48	55	60	64	65	68	71	10/13	14/24	15/41	18/62	19/51	20/63	92
Salinity	33	22	26	30	26	25	30	33	33	29.6	32	32	31.9		32.9	27	24	31	32	32	32
Temperature bottom	-1.5	1.9	2.1	-1.4	-0.8	0.5	-0.5	-1.5	-1.4	-0.6	-0.9	-0.9	-1		-1.7	-0.2	1.6	-1.3	-1.4	-1.5	-1.2
Species / Depth (m)	47	15	18	32	16	15	24	40	33	15	37	21	35	47	37	20	14	25	25	32	34
Laryngosigma williamsoni																					x
Laryngosigma hyalascidia	2				1	3		x							2						3
Miliolinella hauerinoides													23								8
Nodulina dentaliniformis	5	2	21			4	25				11				3	6	5				
Pelosina variabilis					3		3									6	4		8		2
Portatrochammina bipolaris			8		10													x			
Psammosphaera fusca		9	3		23	83	19				14	42		11	3	7	35		23		
Pyrgo elongata				2									2								x
Pyrgo williamsoni	1																				
Pyrulina cylindroides		x								3											
Quinqueloculina agglutinata																1					
Quinqueloculina seminulum			1	2									1								9
Recuvoides contortus	3							4					x	3							
Recurvoides laevigatum	5							7					1	3							
Reophax curtus				9								12	16	8	12			11			2
Reophax subfusiformis			4	15			8					5	3		5		7	1	15	2	
Rosalina wrightii		5	2																		3
Saccorhiza ramosa																					x
Silicosigmoilina groenlandica													2							2	
Spiroplectammina biformis	1										4		8								
Stainforthia concava														1							
Textularia torguata	1			18	2			13	22						2			5			
Triloculina oblonga																					x
Trochamminula lobata			2		6		3			14							5				
Verneuilinulla advena			3	3						51		8	27			26	11	2		1	7
No. counted	187	111	119	171	83	36	63	118	93	49	28	60	129	63	135	100	175	139	15	93	194
No. species	16	13	18	17	10	6	12	14	9	7	7	12	16	14	17	10	9	16	5	8	27
% agglutinated	44	31	39	47	70	33	67	36	33	43	57	50	38	50	53	80	78	69	60	50	30

ta, Haynesina orbiculare, Lagenammina difflugiformis, Laryngosigma hyalascidia, Nodulina dentaliniformis, Pelosina variabilis, Psammosphaera fusca, Pyrulina cylindroides, Reophax subfusiformis, Trochamminula lobata and *Verneuilinulla advena*.

Predominant in population density are *Verneuilinulla advena, Psammosphaera fusca, Haynesina orbiculare* and *Nodulina dentaliniformis*.

West of the Lena River delta where slight influence of river water is noted at depths of 21-37 m, S=32 $^{o}/_{oo,}$ T. bott.= 0.9°C 33 species have been found. Maximum population density in this regions is formed by *Psammosphaera fusca, Lagenammina difflugiformis, Haynesina orbiculare, Cribroelphidium clavatum, Cr. bartletti, Cr. subarcticum* and *Reophax curtus*..

Moreover, in the south-western part of the sea at St. 92 "Prof. Multanovskiy» at a depth of 34 m, S = 32.3 $^{o}/_{oo}$, T bott = -1.2^{o} C Foraminifera species composition unusual for this depth has been noted: *Archimerismus subnodosa, Pelosina variabilis, Saccorhiza ramosa, Lagena gracillima, Favulina melo, Triloculina oblonga, Glabratella chasteri* characteristic rather for bathyal.

In the western part of the sea along the eastern coast of the Taimyr Peninsula and in Vilkitsky Strait at depths 18-50 m, S=26-32 $^{o}/_{oo,}$ T. bott = -1 – 12.8^{o} C slight influence of waters of the Kara Sea is noted. Thirty five species of Foraminifera have been found in that region. Increase of species diversity of shells per sample up to 15-18 forms and lack of obvious predominance of separate species have been noted. Moreover, within the fauna composition there are very few foraminifera with calcareous shell (only *Cribroelphidium clavatum, Cr. bartletti, Elphidiella frigida, E. groenlandica, Miliolinella hauerinoides* and *Quinqueloculina seminulum*). Along with the sublittoral complex also forms of shallow water assemblage *Ammotium cassis*, *Psammosphaera fusca, Lagenammina difflugiformis*, *Nodulina dentaliniformis*, *Verneuilinulla advena* have been noted off Taimyr Peninsula coast. As a result of impact of waters of the Kara Sea species of the deep water complex *Archimerismus subnodosa*, *Atlantiella atlantica*, *Hyperammina elongata, Jaculella acuta, Pelosina variabilis* have been noted. Species *Verneuilinulla advena, Portatrochammina bipolaris, Miliolinella hauerinoides* are most abundant in that region.

In the eastern part of the sea north of the Lena River delta up to 76°N parellel at normal marine salinity 32 -33 $^{o}/_{oo}$ 28 species of Foraminifera were found. In some samples more than a half of shells belong to species *Ammotium cassis*. Along with this species, which is predominant up to the northern coast of the Kotelnyi Island an assemblage of species of the upper part of the shelf is represented in this region, comprising *Lagenammina difflugiformis, Psammo-*

Table 2. Disribution on bentic foraminifera in the Laptev Sea.

Expedition-year	Polarstern, 1998											Jacov Smirnitski, 1995									
Sample no.	80	92	104	114	117	125	134	138	154	158	159	21	23	24	26	28	59	66	73	75	76
Salinity	24,	32.4	32,	33.8		34.4	32.1	33.2	34.7	33.5	33.7	32	16	17	11	14	29.5	28	32.3	32	26
Temperature bottom	-1.1	-1.6	-1.6	-1.4	-1	-0.5	-1.6	-1.7	0.4	-1.5	-1.6	-1.1	0	0	6.7	6	-1	0.6	1.9	-1.2	-2.8
Species / Depth (m)	24	34	34	50	79	110	49	44	267	67	57	50	8	8	9	10	22	20	35	43	18
Adercotrima glomerata						1			1	x	x										
Allogromia sp.								2										2			
Ammodiscus gullmarensis				2	1							x									
Ammodiscus catinus				x	1	x		1	x	x	2										
Ammotium cassis	9	60	18				78	16			6	7	20	43	14		6	2		2	3
Angulogerina fluens						x				x											
Archimerismus subnodosa			4									7									
Astrononion galloway						2				2											
Astrorhiza limicola									x												
Astroriza arenaria					2	2			6	x											
Atlantiella atlantica					5	2			2			4									
Bolivina pseudopunctata																					
Buccella frigida	4				x			4			1										
Buccella inusitata						3															
Cassidulina teretis					1					1											
Cornuspira involvens	14																				
Cornuspira foliacea									x												
Cribroelphidium bartletti	5				x					1											
Cribroelphidium clavatum			4			2	2	41			2										
Cribroelphidium subarcticum						1				3											
Cribroelphidium subincertum										1	1										
Cuneata arctica							1			x	x										
Dentalina baggi									x												
Deuterammina grisea						x				3											
Deuterammina rotaliformis													60	32	45						4
Elphidiella frigida										x											
Elphidiella groenlandica		5	2				x	12													x
Elphidiella arctica						1															
Elphidium incertum	1				1					x											
Epistominel.exigua										x											

sphaera fusca, Haynesina orbiculare, Cribroelphidium clavatum, Cr. bartletti.

In the eastern part of the sea north and west of the Kotelnyi Island coast at depths of 15-49 m S=21.7-34.7°/$_{oo,}$ T, bott = -1.5-2.1°C, *Ammotium cassis* species retains predominant position in population density, constituting 44 to 78% of the total number of shells at st. 2, 17 "Kap. Dranitsyn" and st. 134 "Polarsten", 1998. Moreover, species *Lagenammina difflugiformis, Cribroelphidium clavatum, Cr. bartletti, Textularia torguata* and *Pelosina variabili* may be placed in the group of the most numerous species of that region. Thus, in the eastern part of the Laptev Sea along with relative species diversity of foraminifera fauna (16-18 species per sample) predominance of separate forms and relatively small percentage of species with agglutinated shell (from 31 to 47%) are observed.

The largest number of species was noted in the central part of the Laptev Sea. Particularly significant species diversity is noted not far from the boundary and on the boundary of the shelf at depths 57-267 m within the limits of section of stations 125, 154, 158 and 159 "Polarstern", 1998 (Table 2). In this region 27 to 44 species per sample were found. Most abundant among these forms were *Lagenammina difflugiformis* and *Portatrochammina bipolaris.*

In the northern deepwater part of the Laptev Sea (Tables 3-4) at depths 40–3171 m diverse Foraminifera fauna comprising 86 species was found. It includes sublittoral species and forms of bathyal and abyssal of the ocean. Even at small depths of elevations of 40 to 70 m we have not noted species of the shallow water coastal assemblage such as *Ammotium cassis* and *Verneuilinulla advena*. At depths of not deeper than 101 m 16 species of foraminifera were found – *Allogromia sp., Cribroelphidium subincertum, Elphidium incertum, Esosyrinx curta, Favulina hexagona, F, lineata, F. melo, Islandiella norcrossi, Nodulina dentaliniformis* etc.

24 species were found within the limits of 243 to 3171 m - *Astrorhiza limicola, Cornuspiroides striolatus, Crithionina pisum hispida, Fissurina annectens, Hormosina carpentery, Hyperammina cylindrica, Lagena mollis, L. striata, Nodosaria flintii, Parafissurina tectulostoma* etc. The most abundant forms of the open part of the sea are *Archimerismus subnodosa, Astrorhiza arenaria, Hormosina globulifera, Saccorhiza ramosa, Cornuspira involvens, C. foliacea, Elphidiella arctica,* etc.

Table 2. (Continuation)

Expedition-year	Polarstern, 1998											Jacov Smirnitski, 1995									
Sample no.	80	92	104	114	117	125	134	138	154	158	159	21	23	24	26	28	59	66	73	75	76
Salinity	24,	32.4	32,	33.8		34.4	32.1	33.2	34.7	33.5	33.7	32	16	17	11	14	29.5	28	32.3	32	26
Temperature bottom	-1.1	-1.6	-1.6	-1.4	-1	-0.5	-1.6	-1.7	0.4	-1.5	-1.6	-1.1	0	0	6.7	6	-1	0.6	1.9	-1.2	-2.8
Species / Depth (m)	24	34	34	50	79	110	49	44	267	67	57	50	8	8	9	10	22	20	35	43	18
Fissurina marginata						x				x											
Glomospira gordialis									x	x											
Gordiospira arctica	12																				
Haplophragmoides jeffreysi					1	3			x	1		3									
Haynesina orbicularis	15	4	40				3	20		x	1										
Hippocrepina indivisa											x									3	2
Hormosina normani					2				2												
Hyperammina elongata				4	1				x	x		12								21	3
Islandiella norcrossi										x											
Islandiella islandica						x				4	1										
Jacuella acuta				6	1	x			1	1										7	3
Jadammina macrescens																5					
Labrospira crassimargo				7		x	1			1	5	2									6
Lagena apiopleura																					
Lagena gracillima.										x	x										
Lagenammina difflugiformis	18	14		19	32	27			41	43	15	8			5	36	21	16		18	10
Laryngosigma hyalascidia	1					x		2		x											
Lobatula lobatula						5				3											
Melonis barleanum						x		2		x											
Nodulina dentaliniformis	2	6	4	3		3	1						20	25			3		+		2
Nonionella labradorica			2			x					x										
Pelosina variabilis		4															21			4	
Portatrochammina bipolaris				21	33	29			28	17	25	8			x					2	26
Psammosphaera fusca	3	4	4		4		x		1	1					14	48	8	50		10	2
Psammosphaera bowmanni															9			7			
Pyrgo williamsoni	1								1												
Pyrulina cylindroides																					
Quinqueloculina agglutinata			1																		
Quinqueloculina seminulum																					
Recurvoides contortus			3	4					x		7	10							+		

Figures of Foraminifera species found in the Laptev Sea, executed by the author, are given at figs 1-103.

Discussion

Thus as a result of examination of vast material from the entire Laptev Sea collected within a wide range of depths from 8 to 3171 m three assemblages of foraminifera species were revealed. The first one is shallow water coastal complex comprising *Psammosphaera fusca, Lagenammina difflugiformis, Ammotium cassis* and *Nodulina dentaliniformis.* The second is sublittoral complex comprising the largest number of species occurring in coastal and deep water parts of the Laptev Sea - *Reophax curtus, R. bradyi, R. subfusiformis, Textularia torguata, Miliolinella hauerinoides, Cribroelphidium clavatum, Cr. bartletti, Cr. subarcticum, Haynesina orbiculare*. The third is deepwater complex noted in the open part of the sea - *Archimerismus subnodosa, Astrorhiza arenaria, Hormosina globulifera, Saccorhiza ramosa, Cornuspira involvens, C. foliacea, Elphidiella arctica* etc.

The study of characteristic features of fauna distribution permitted an assumption that occurrence of the shallow water complex *Ammotium cassis* and *Lagenammina difflugiformis* off the Kotelnyi Island coast and north of it can be possibly accounted for by penetration of these forms along the eastern branch of Lena River paleovalley with a powerful river water current up to 76° latitude to a depth of 47 – 49 m. Occurrence of deepwater species not far from the coast and west of the Lena River delta at small depths can be attributed to transfer by deep water current going from the Kara Sea along the coast of Taimyr Peninsula along the Anabar Khatansky trench. Apart from that 3 areas of cold bottom water, which are remains of winter shelf waters were described in the south-western part of the sea in the summer period (Timohov and Churun, 1994), which also supports the possibility of transfer with current.

The nearly total absence of *Lobatula lobatula* species (one of the most abundant forms in the western sector of the Arctic) within the fauna of the southern part of the Laptev Sea is remarkable. In the northern deepwater part of the sea this species is found in small amount.

Table 2. (Continuation)

Expedition-year	Polarstern, 1998											Jacov Smirnitski, 1995									
Sample no.	80	92	104	114	117	125	134	138	154	158	159	21	23	24	26	28	59	66	73	75	76
Salinity	24,	32.4	32,	33.8		34.4	32.1	33.2	34.7	33.5	33.7	32	16	17	11	14	29.5	28	32.3	32	26
Temperature bottom	-1.1	-1.6	-1.6	-1.4	-1	-0.5	-1.6	-1.7	0.4	-1.5	-1.6	-1.1	0	0	6.7	6	-1	0.6	1.9	-1.2	-2.8
Species / Depth (m)	24	34	34	50	79	110	49	44	267	67	57	50	8	8	9	10	22	20	35	43	18
Recurvoides laevigatum				16	2	x	8		1	x	6	4									8
Reophanus ovicula					x																
Reophax bilocularis															4	11		3		3	
Reophax bradyi					2					2	x										
Reophax curtus	11											4					17	20		5	6
Reophax subfusiformis				5	1		2		1	3	7	7			9		12		99	9	11
Repmania charoides						x															
Rhabdammina abyssorum						3				1											
Robertinoides charlottensis										x											
Rosalina wrightii																					
Rupertina stabilis										x											
Saccorhiza ramosa									1	x	x										
Silicosigmoilina groenlandica			4	6	x	x			x	x	1	3								5	
Spiroplectammina biformis				4	3	3			2	2	10	8								3	1
Stainforthia concava						x				1	1										
Textularia torguata		1		1		1			x	2	3										
Textularia earlandi				2	1	2			x	1	2										
Tholosina vesicularis			6		5				4												
Tholosina bulla		1				1				1	1									4	
Triloculina oblonga																					
Triloculinella cf. tegminis										x											
Tritaxis bullata									2												
Trochamminula lobata										x		5									x
Trochammina globigeriniformis												3									
Trochammina inflata						2			2	1											
Trochamminopsis pusillus						x			x												
Verneuilinulla advena	4	1	8			x	2		x	x	x	5					12			4	12
No. counted	138	58	116	335	224	742	278	123	909	822	472	151	75	141	22	42	58	61	25	115	155
No. species	14	10	13	14	20	33	11	9	27	44	27	18	3	3	6	4	8	7	3	15	17

Therefore in the Laptev Sea within a wide range of depths rich Foraminifera fauna was identified. Change of species composition may be traced with increasing depth, although not as distinct as could be expected considering the abrupt overfall of depths. This can be accounted for by strong currents and characteristic features of sea bottom relief.

Given below is a list of all species of Foraminifera found in the Laptev Sea. Species names are arranged in the alphabetical order.

The list of species of Foraminifera of the Laptev Sea

1. *Adercotryma glomerata* (Brady) = *Lituola glomerata* Brady, 1878
2. *Allogromia* sp.
3. *Ammodiscus catinus* Hoglund, 1947
4. *Ammodiscus gullmarensis* Hoglund, 1947
5. *Ammotium cassis* (Parker) = *Lituola cassis* Parker, 1870
6. *Angulogerina fluens* Todd, 1947
7. *Archimerismus subnodosa* (Brady) = *Hyperammina subnodosa* Brady, 1884
8. *Astacolus hyalacrulus* Loeblich and Tappan, 1953
9. *Astrononion gallowayi* Loeblich and Tappan, 1953
10. *Astrorhiza arenaria* Norman, 1876
11. *Astrorhiza limicola* Sandahl, 1857
12. *Atlantiella atlantica* (Parker) = *Trochamminella atlantica* Parker, 1952
13. *Bolivina pseudopunctata* Hoglund, 1947
14. *Buccella frigida* (Cushman) = *Pulvinulina frigida* Cushman,1922
15. *Buccella inusitata* Andersen, 1952
16. *Cassidella complanata* (Egger) = *Virgulina schreibersiana* var. *complanata* Egger, 1893
17. *Cassidulina teretis* Tappan, 1951
18. *Cornuspira involvens* (Reuss) = *Operculina involvens* Reuss, 1850
19. *Cornuspira foliacea* (Philippi) = *Orbis foliacea* Philippi, 844

Table 3. Disribution on bentic foraminifera in the Laptev Sea.

Expedition-year	Polarstern, 1993												
Sample no.	32	38	39	40	41	43	47	48	49	50	54	67	68
Salinity	34.8	34.8	34.8	34.8	33.8	33	34.8	34.8	34.6	34.8	34.9	34.3	34.2
Temperature bottom	-0.8	0	0.7	1.4	-1.4	-1.6	0.1	0.9	0.5	-0.8	-0.8	-1.2	
Species / Depth (m)	3028	1038	526	233	72	55	1079	556	280	1993	3081	51	101
Archimerismus subnodosa		+	+		+	+						+	
Astrorhiza arenaria			+	+			+	+					+
Astrorhiza limicola			+	+									
Cornuspira involvens					+								
Cornuspira foliacea							+			+			
Cornuspiroides striolatus			+		+								
Cribroelphidium bartletti					+								
Cribrostomoides subglobosum	+	+				+							
Dentalina baggi		+	+										
Dentalina frobischerensis			+		+								
Elphidiella arctica												+	
Haplophragmoides jeffreysi			+						+				
Hormosina carpentery	+												
Hormosina globulifera		+	+	+	+		+	+					
Hormosina normani			+		+			+					
Hyperammina cylindrica		+											
Hyperammina elongata	+				+			+					+
Labrospira cassimargo					+							+	+
Lobatula lobatula	+				+		+	+	+	+	+	+	+
Miliolinella hauerinoides											+		
Nodosaria flintii			+				+						
Planispirinoides bucculentus		+	+										
Pseudonodosinella nodulosa		+	+				+	+					
Pyrgo williamsoni											+		
Quinqueloculina arctica	+	+											
Quinqueloculina seminulum											+		
Reophanus ovicula	+												
Reophax bradyi		+			+								
Reophax sabulosus			+										
Reophax subfusiformis		+			+								

20. *Cornuspiroides striolatus* (Brady) = *Cornuspira striolatus* Brady,1882
21. *Cribroelphidium bartletti* (Cushman) = *Elphidium bartletti* Cushman, 1933
22. *Cribroelphidium clavatum* (Cushman) = *Elphidium incertum* (Williamson), var. *clavatum* Cushman, 1930
23. *Cribroelphidium subarcticum* (Cushman) = *Elphidium subarcticum* Cushman, 1944
24. *Cribroelphidium subincertum* (Asano) = *Elphidium subincertum* Asano, 1950
25. *Cribrostomoides subglobosum* (G.O.Sars) = *Lituola subglobosum* G.O.Sars, 1872
26. *Crithionina pisum hispida* Flint, 1899
27. *Cuneata arctica* (Brady) = *Reophax arctica* Brady, 1881
28. *Dentalina baggi* Galloway and Wissler, 1927
29. *Dentalina frobischerensis* Loeblich and Tappan, 1953
30. *Deuterammina grisea* (Earland) = *Trochammina grisea* Earland, 1934
31. *Deuterammina rotaliformis* (Heron – Allen and Earland) = *Trochammina rotaliformis* Heron – Allen and Earland, 1911
32. *Elphidiella arctica* (Parker and Jones) = *Polystomella arctica* Parker and Jones in Brady, 1864
33. *Elphidiella frigida* (Cushman) = *Elphidium frigida* Cushman, 1933
34. *Elphidiella groenlandica* (Cushman) = *Elphidium groenlandica* Cushman, 1933
35. *Elphidium incertum* (Williamson) = *Polystomella umbilicatula* var. *incerta* Williamson, 1858
36. *Epistominella exigua* (Brady) = *Pulvinulina exigua* Brady,1884
37. *Esosyrinx curta* (Cushman and Ozawa) = *Pseudopolymorphina curta* Cushman and Ozawa, 1930
38. *Favulina hexagona* (Williamson) = *Entosolenia squamosa* var. *hexagona* Williamson, 1848
39. *Favulina lineata* (Williamson) = *Entosolenia squamosa* var. *lineata* Williamson, 1848
40. *Favulina melo* (D'Orbigny) = *Oolina melo* D'Orbigny, 1839
41. *Fissurina annectens* (Burrows and Holland) = *Lagena annectens* Burrows and Holland, 1885

Table 3. (Continuation)

Expedition-year	Polarstern, 1993												
Sample no.	32	38	39	40	41	43	47	48	49	50	54	67	68
Salinity	34.8	34.8	34.8	34.8	33.8	33	34.8	34.8	34.6	34.8	34.9	34.3	34.2
Temperature bottom	-0.8	0	0.7	1.4	-1.4	-1.6	0.1	0.9	0.5	-0.8	-0.8	-1.2	
Species / Depth (m)	3028	1038	526	233	72	55	1079	556	280	1993	3081	51	101
Rhabdammina abyssorum	+	+			+						+	+	+
Rhabdammina aff. discreta									+	+			
Saccammina sphaerica		+	+				+						+
Saccorhiza ramosa		+	+	+	+		+	+					
Sorosphaera confusa		+											
Tholosina bulla	+	+				+			+	+			+
Tholosina vesicularis						+						+	
Triloculina trichedra	+												
No. species	9	15	15	4	14	4	8	7	4	4	5	6	7

42. *Fissurina cucurbitasema* Loeblich and Tappan, 1953
43. *Fissurina marginata* (Montagu) = *Vermiculum marginata* Montagu, 1803
44. *Fursenkoina fusiformis* (Williamson) = *Bulimina pupoides* var. *fusiformis* Williamson, 1858
45. *Glabratella chasteri* (Heron – Allen and Earland) = *Discorbina chasteri* Heron – Allen and Earland, 1913
46. *Globigerina pachyderma* (Ehrenberg) = *Aristerospira pachyderma* Ehrenberg, 1872
47. *Glomospira gordialis* (Jones and Parker) = *Trochammina squamata* var. *gordialis* Jones and Parker, 1860
48. *Gordiospira arctica* Cushman, 1933
49. *Haplophragmoides jeffreysi* (Williamson) = *Nonionina jeffreysi* Williamson,1858
50. *Haynesina orbicularis* (Brady) = *Nonionina orbicularis* Brady, 1881
51. *Hippocrepina indivisa* Parker in G.M.Dawson,

Table 4. Distribution on bentic in the Laptev Sea.

Expedition-year	Polarstern, 1995																				
Sample no.	4	9	10	11	16	17	19	21	23	24	30	33	51	53	56	69	71	79	81	83	84
Salinity	33.1	33.4	33.1	33	33.7	34.2	34.4	34.9	34.9	34.9	34.9	34.8	34.9	34.9	35	34.9	34.9	34.9	34.8	34.6	34
Temperature bottom	-1.8	-1.8	-1.7	0.3	-1.4	-0.8	-0.8	-0.1	-0.8	-0.7	-0.7	-0.3	-0.7	-0.2	-0.4	-0.1	0.6	-0.6	0.1	-0.4	-1.4
Species / Depth (m)	54	77	48	40	53	68	276	1193	2330	3171	1935	255	1800	940	2027	984	534	1658	535	243	101
Allogromia sp.				+																	
Archimerismus subnodosa	+	+	+	+		+										+				+	
Astacolus hyalacrulus																			+	+	
Astrononion gallowayi																				+	
Astrorhiza arenaria	+	+	+	+			+	+				+				+	+		+	+	+
Buccella frigida												+				+			+		
Buccella inusitata							+					+							+		+
Bulimina exilis																			+		
Cassidulina teretis		+					+					+				+	+		+		
Cornuspira involvens	+	+	+	+	+	+						+				+			+	+	+
Cornuspira foliacea	+						+		+		+		+	+	+	+					
Cribroelphidium bartletti		+	+	+		+						+									+
Cribroelphidium clavatum		+			+							+					+		+		
Cribroelphidium subarcticum					+		+													+	+
Cribroelphidium subincertum		+	+			+															
Cribrostom.subglobosum								+	+	+		+			+						
Crithionina pisum hispida															+						
Dentalina baggi		+	+	+	+	+				+						+				+	
Dentalina frobischerensis	+	+	+	+	+					+										+	
Elphidiella arctica			+	+			+					+			+		+				+
Elphidiella frigida			+	+	+							+									
Elphidiella groenlandica			+	+	+	+													+	+	
Elphidium incertum		+																			
Esosyrinx curta		+			+																
Favulina hexagona					+																
Favulina lineata				+	+																+
Favulina melo			+	+																	
Fissurina annectens																		+			
Globigerina pachyderma		+	+									+			+			+	+		
Haplophragmoides jeffreysi												+					+			+	+

Table 4. (Continuation)

Expedition-year	Polarstern, 1995																				
Sample no.	4	9	10	11	16	17	19	21	23	24	30	33	51	53	56	69	71	79	81	83	84
Salinity	33.1	33.4	33.1	33	33.7	34.2	34.4	34.9	34.9	34.9	34.9	34.8	34.9	34.9	35	34.9	34.9	34.9	34.8	34.6	34
Temperature bottom	-1.8	-1.8	-1.7	0.3	-1.4	-0.8	-0.8	-0.1	-0.8	-0.7	-0.7	-0.3	-0.7	-0.2	-0.4	-0.1	0.6	-0.6	0.1	-0.4	-1.4
Species / Depth (m)	54	77	48	40	53	68	276	1193	2330	3171	1935	255	1800	940	2027	984	534	1658	535	243	101
Haynesina orbiculare		+		+	+					+											+
Hormosina globulifera						+	+	+				+				+	+		+		
Hyperammina elongata		+	+				+	+	+	+		+				+			+	+	+
Islandiella islandica																					+
Islandiella norcrossi		+			+																
Labrospira cassimargo	+	+	+		+	+	+					+			+		+			+	+
Lagena laevis					+																+
Lagena mollis																			+		
Lagena striata							+														
Lagenam.difflugiformis		+	+	+	+													+		+	+
Laryngosigma hyalascidia				+	+																+
Lobatula lobatula				+			+					+			+		+	+	+	+	+
Melonis barleanum																				+	+
Miliolinella hauerinoides	+	+	+	+	+					+							+	+			+
Nodosaria flintii												+									
Nodulina dentaliniformis		+	+		+																
Nonionellina labradorica		+			+	+															
Oolina globosa			+																+	+	
Parafissurina tectulostoma																			+		
Pelosina variabilis																			+		
Pseudonodosin. nodulosa		+					+			+		+				+	+		+		
Pullenia bulloides																			+		
Pyrgo elongata		+	+	+	+		+					+						+	+		+
Pyrgo williamsoni						+															
Pyrgoella sphaera																+	+		+		
Quinqueloculina arctica										+		+			+	+		+	+		
Quinqueloculina lamarckiana							+					+				+					
Quinqueloculina agglutinata	+		+																		
Quinqueloculina seminulum			+		+												+	+	+		+
Reophax bradyi	+						+	+				+			+	+	+	+	+	+	+
Reophax curtus		+	+		+																+

1870

52. *Hormosina carpentery* Brady, 1881
53. *Hormosina globulifera* Brady, 1879
54. *Hormosina normani* Brady, 1881
55. *Hyperammina cylindrica* Parr, 1950
56. *Hyperammina elongata* Brady, 1878
57. *Islandiella islandica* (Norvang) = *Cassidulina islandica* Norvang, 1945
58. *Islandiella norcrossi* (Cushman) = *Cassidulina norcrossi* Cushman, 1933
59. *Jaculella acuta* Brady, 1879
60. *Jadammina macrescens* (Brady) = *Trochammina inflata* var. *macrescens* Brady, 1870
61. *Labrospira crassimargo* (Norman) = *Haplophragmoides crassimargo* Norman, 1892
62. *Lagena apiopleura* Loeblich and Tappan, 1953
63. *Lagena gracillima* (Seguenza) = *Amphorina gracillima* Seguenza, 1862
64. *Lagena laevis* (Montagu) = *Vermiculum laevis* Montagu, 1803
65. *Lagena mollis* Cushman, 1944
66. *Lagena striata* (D'Orbigny) = *Oolina striata* D'Orbigny,1839
67. *Lagenammina difflugiformis* (Brady) = *Reophax difflugiformis* Brady, 1879
68. *Laryngosigma hyalascidia* Loeblich and Tappan, 1953
69. *Laryngosigma williamsoni* (Terquem) = *Polymorphina williamsoni* Terquem,1878
70. *Lobatula lobatula* (Walker and Jacob) = *Nautilus lobatulus* Walker and Jacob, 1798
71. *Miliolinella hauerinoides* (Rhumbler) = *Quinqueloculina subrotunda* var. *hauerinoides* Rhumbler, 1936
72. *Melonis barleanum* (Williamson) = *Nonionina barleanum* Williamson, 1858
73. *Nodosaria flintii* Cushman, 1923
74. *Nodulina dentaliniformis* (Brady) = *Reophax dentaliniformis* Brady, 1881
75. *Nonionellina labradorica* (Dawson) = *Nonionina labradorica* Dawson, 1860
76. *Oolina globosa* (Walker) = *Serpula laevis globosa* Walker, 1784
77. *Parafissurina tectulostoma* Loeblich and Tappan, 1953
78. *Pelosina variabilis* Brady, 1879

Table 4. (Continuation)

Expedition-year	Polarstern, 1995																				
Sample no.	4	9	10	11	16	17	19	21	23	24	30	33	51	53	56	69	71	79	81	83	84
Salinity	33.1	33.4	33.1	33	33.7	34.2	34.4	34.9	34.9	34.9	34.9	34.8	34.9	34.9	35	34.9	34.9	34.9	34.8	34.6	34
Temperature bottom	-1.8	-1.8	-1.7	0.3	-1.4	-0.8	-0.8	-0.1	-0.8	-0.7	-0.7	-0.3	-0.7	-0.2	-0.4	-0.1	0.6	-0.6	0.1	-0.4	-1.4
Species / Depth (m)	54	77	48	40	53	68	276	1193	2330	3171	1935	255	1800	940	2027	984	534	1658	535	243	101
Reophax pilulifer		+																			
Reophax sabulosus																+					
Reophax subfusiformis	+						+	+				+			+	+	+	+	+	+	+
Rhabdammina abyssorum	+		+				+			+							+				+
Rhabdammina aff. discreta	+																				
Robertinoid.charlottensis												+									
Saccammina sphaerica		+						+										+			
Saccorhiza ramosa		+					+					+				+	+		+		
Silicosigmoil.groenlandica		+	+	+	+															+	
Tholosina bulla	+			+												+					
Tholosina vesicularis	+					+															
Thurammina favosa																			+		
Thurammina papillata																+			+		
Triloculina tricarinata										+											
Triloculina trichedra																			+		
No. species	13	28	24	21	23	11	20	7	3	10	1	26	1	1	11	20	18	11	31	20	24
% agglutinated	69	43	42	33	22	36	50	100	67	40	0	38	0	0	55	55	56	36	39	50	38

79. *Planispirinoides bucculentus* (Brady) = *Miliolina bucculentus* Brady, 1884
80. *Polymorphina* sp.
81. *Portatrochammina bipolaris* Bronnimann and Whittaker, 1980
82. *Psammosphaera bowmanni* Heron – Allen and Earland, 1912
83. *Psammosphaera fusca* Schulze, 1875
84. *Pseudonodosinella nodulosa* (Brady) = *Reophax nodulosa* Brady, 1879
85. *Pullenia bulloides* D'Orbigny, 1826
86. *Pyrgo elongata* (D'Orbigny) = *Biloculina elongata* D'Orbigny, 1826
87. *Pyrgo williamsoni* (Silvestri) = *Biloculina williamsoni* Silvestri, 1923
88. *Pyrgoella sphaera* (D'Orbigny) = *Biloculina sphaera* D'Orbigny, 1839
89. *Pyrulina cylindroides* (Roemer) = *Polymorphina cylindroides* Roemer, 1838
90. *Quinqueloculina agglutinata* Cushman, 1917
91. *Quinqueloculina arctica* Cushman, 1933
92. *Quinqueloculina lamarckiana* D'Orbigny, 1839
93. *Quinqueloculina seminulum* (Linne) = *Serpula seminulum* Linne, 1764
94. *Recurvoides contortus* Earland, 1934
95. *Recurvoides laevigatum* Hoglund, 1947
96. *Reophanus ovicula* (Brady) = *Hormosina ovicula* Brady, 1879
97. *Reophax bilocularis* Flint, 1899
98. *Reophax bradyi* Bronnimann and Whittaker, 1980
99. *Reophax curtus* Cushman, 1920
100. *Reophax pilulifer* Brady, 1884
101. *Reophax sabulosus* Brady, 1881
102. *Reophax subfusiformis* Earland, 1933
103. *Repmania charoides* (Jones and Parker) = *Trochammina squamata* var. *charoides* Jones and Parker, 1860
104. *Rhabdammina abyssorum* M.Sars, 1869
105. *Rhabdammina aff. discreta* Brady, 1881
106. *Robertinoides charlottensis* (Cushman) = *Cassidulina charlottensis* Cushman, 1925
107. *Rosalina wrightii* (Brady) = *Discorbina wrightii* Brady, 1881
108. *Rupertina stabilis* Wallich, 1877
109. *Saccammina sphaerica* Brady, 1871
110. *Saccorhiza ramosa* (Brady) = *Hyperammina ramosa* Brady, 1878
111. *Silicosigmoilina groenlandica* (Cushman) = *Quinqueloculina fusca* var. *groenlandica* Cushman, 1933
112. *Sorosphaera confusa* Brady, 1879
113. *Spiroplectammina biformis* (Parker and Jones) = *Textularia biformis* Parker and Jones, 1865
114. *Stainforthia concava* (Hoglund) = *Virgulina concava* Hoglund, 1947
115. *Textularia earlandi* Parker, 1952
116. *Textularia torguata* Parker, 1952
117. *Tholosina bulla* (Brady) = *Placopsilina bulla* Brady, 1881
118. *Tholosina vesicularis* (Brady) = *Placopsilina vesicularis* Brady, 1879
119. *Triloculina oblonga* (Montagu) = *Vermiculum oblonga* Montagu, 1803
120. *Triloculina tricarinata* D'Orbigny, 1826
121. *Triloculina trichedra* Loeblich and Tappan, 1953
122. *Triloculinella cf. tegminis* (Loeblich and Tappan) = *Scutuloris tegminis* Loeblich and Tappan, 1953
123. *Tritaxis bullata* (Hoglund) = *Trochamminella bullata* Hoglund, 1947
124. *Trochammina globigeriniformis* (Parker and Jones) = *Lituola nautiloidea* var. *globigeriniformis*

Parker and Jones, 1865
125. *Trochammina inflata* (Montagu) = *Nautilus i nflata* Montagu, 1803
126. *Trochamminula lobata* (Cushman) = *Trochammina lobata* Cushman, 1944
127. *Trochamminopsis pusillus* Hoglund, 1947
128. *Thurammina favosa* Flint, 1899
129. *Thurammina papillata* Brady, 1878
130. *Verneuilinulla advena* (Cushman) = *Vernuilina advena* Cushman, 1922

Acknowledgements

The author would like to thank the staff of Laboratory of Marine Research of the Zoological Institute, Russian Academy of Sciences for support and especially for the material which was collected and given for the identification.

References

Kochetov S.V., Kruglov V.E. and Timohov L.A. 1994. Ozenka presnovodnogo balansa morei Laptev i East – Siberian. In: Nauchnie resultaty expeditions LAPEXP – 93, St.Petersburg. pp. 107-119 (in Russian).

Loeblich A.R. and Tappan H. 1987. Foraminiferal genera and their classification, V.1-2, Van Nostrand Reinhold, New York.

Nikiforov E.G. and Shpaiher A.O. 1980. Laws of formation of large-scale fluctuations of hydrological mode of the Arctic Ocean. L. Hydrometioizdat (in Russian).

Tamanova S.V. 1982. Species Composition of Modern Foraminifera as an Indication of the Arctic Sea's Hydrological Regime. In: The Arctic Ocean and Its Coast in the Cenozoic Era. Amerind Publishing CO.PVT.LTD. pp.195–199 (in Russian).

Timohov L.A. and Churun V.N.1994. Cold bottom water in the southern Laptev Sea. In: Nauchnie resultati expeditions LAPEXP – 93, St. Petersburg. Pp. 83-91 (in Russian).

Todd R. and Low D.1966. Foraminifera from the Arctic ocean off the Eastern Siberian coast. U.S. Geol. Survey Prof. Paper 550-C, C79 – C85.

Stschedrina Z.G. 1936. Zur Kenntnis der Foraminiferenfauna der Arktischen Meere der USSR. Transactions of the Arctic Institute. 33, 51–64 (in Russian with Germany summary).

Address for correspondence: Tatiana G.Lukina. Laboratory of Marine Research, Zoological Institute of Russian Academy of Sciences, St. Petersburg, Universitetskaya nab. 1, 199034, Russia. E-mail: ltg@main.line.ru

The manuscript is presented by A.A.Dobrovolskij