Benthic infaunal community structure in the Chukchi Sea

Boris Sirenko and Sergey Gagaev (Zoological Institute, Russian Academy of Sciences. St. Petersburg)
Jackie Grebmeier , Lee Cooper, and Arianne Balsom (University of Tennessee)


Boris Sirenko and Arianne Balsam by B. Bluhm

The main goal of our scientific sampling team was to study the composition and distribution of benthic infaunal communities in the Chukchi Sea. In connection with this goal both Russian and US scientists undertook collaborative studies as follows:The main objectives of the Zoological Institution objectives were:

1. To examine the composition, distribution and quantitative data (abundance and wet weight abundance per square meter) of both the macro-and meiobenthos.
2. To map Chukchi Sea benthic community distributions in both Russian and U.S. waters.
3. To explore benthic community variations.
4. To determine the influence of climate change on distributions of warm water fauna in the Chukchi Sea.
5. To analyze dominant species' trophic structure interactions.

The main objectives of the University of Tennessee, Knoxville were:

1. To determine species composition, abundance and biomass (both wet weight and carbon biomass), of infaunal marine benthic communities.
2. Measurement of sediment chemistry parameters important to these benthic communities (sediment chlorophyll *a* content, total organic carbon content, sediment grain size, pigment content, and sedimentation rates using ^{7}Be and ^{137}Cs as indicators of particle setting rate).
3. Determination of ^{18}O stable oxygen isotope composition in the overlying water column, indicative of water mass variation and fresh water input.
4. Comparison of RUSALCA 2004 marine community analyses with data collections undertaken on previous Russian-U.S. cruises in this same region, particularly the BERPAC sponsored cruises that involved Russian and U.S. scientists in 1988 (*Academik Korolev*), 1993 (*Okean*), and 1995 (*R/VAlpha Helix*).

Sampling equipment used:

1. Van Veen benthic grab (0.1 m^2)
2. Ocean benthic grab (0.25 m^2)
3. Small rectangle dredge (entrance 22x70 cm, 1 cm mesh size)
4. Set of 10.5 and 1 mm mesh washing sieves.
5. Net of 100 µm mesh to collect qualitative meiobenthic samples.
6. Device to collect quantitative meiobenthic samples (18.8 cm^2).

The majority of samples (both infauna and surface sediment samples) were obtained using the van Veen grab. In total, 122 grab samples were taken at 17 stations. At 4 of these 17 stations, 3 van Veen replicates were collected for the Zoological Institute (deployments #1-#3), 5 van Veen replicates were collected for the University of Tennessee (deployments #4-#8), and additional grabs (#9-#10) were obtained, when requested, for other members of the expedition studying surface sediment parameters. Sediments from 8th and 9th grabs were used for studies of sediment parameters by the University of Tennessee, in addition to other RUSALCA sampling teams' studies of quantitative meiobenthic distribution, microbiology, geology, epifaunal distribution, trophic structure, and ichthyology. Finally, three additional stations (st. 22, 24 and 58B) were occupied for 3 grabs/station faunal collections for the Zoological Institute.

In order to examine the relationship between infaunal and epifaunal components in the composition and distribution of benthic Chukchi Sea communities, collaborations between RUSALCA participants are necessary. Infaunal community analysis will be examined in comparison with epifaunal samples collected using an otter trawl (in collaboration with Drs. D. Stein, C. Mecklenburg and B. Sheiko), and a beam trawl (in collaboration with Dr. B. Holladay). Data obtained from Remotely Operated Video Operations (in cooperation with Drs. K. Crane, V. Gladysh, B. Smirnov, V. Kaulio), and infaunal and epifaunal samples taxonomically sorted for trophic structure analysis (in collaboration with Drs. K. Iken and B. Bluhm) will also be used.

In addition to the investigation of the macrobenthos during the expedition, meiobenthic materials were also collected for analysis at the Zoological Institute: 15 quantitative samples at the all main stations and 16 qualitative samples at 8 stations.

Preliminary results

Several specimens of the Northern Pacific crab *(Telmessus cheiragonus*) were collected in the south-eastern Chukchi Sea at station 17. These specimens are the third northernmost documentation of this species in the Chukchi Sea; the most northern discovery of *T. cheiragonus* was made in 1988 (*Academic Korolev*, st. 66), near the entrance of Kotzebue Sound. The second northernmost find occurred during 1990 in Kotzebue Sound by Feder et al. (in print). At RUSALCA station 17, the Pacific crab *Oregonia gracilis* and the bivalve *Pododesmus macrochisma* were also found, and to our knowledge, for the first time in the Chukchi Sea. These three findings of Pacific taxa in Arctic waters may testify to a continued warming trend in the Chukchi Sea; mentioned previously by P.V. Ushakov (1952).

The taxa at the two most southerly transect lines (st 11-15, 22-25) demonstrated an infaunal community composition dominated by the bivalve *Macoma calcarea* in the south-central and south-eastern Chukchi Sea (66º50'N to 68º20'N and 168º20'W to 173º00'W), which was also documented in the beginning of the last century. Macrobenthic community wet weight biomass in the south-central Chukchi Sea stations averaged 1000-2000g/m^2, exceeding 4000 g/m^2 at st. 13. Soft bottom benthic communities do not show these values of high biomass in temperate regions of the World Ocean, but they have been reported in the Arctic Ocean. These large supplies of bivalves may be attracting walruses, which feed on primarily on benthic animals.

Such protracted existence of high productive benthic communities of bivalves in the south-central and south-eastern Chukchi Sea most likely results from currents moving northwesterly from the Bering Strait, before veering to the northeast in the Chukchi Sea. The settlement of infaunal larvae in other regions of the Chukchi Sea is impeded by this water circulation pattern. These currents also entrain concentrated amounts of food utilized by benthic communities, namely phytoplankton, zooplankton and fecal pellet material. Organic materials synthesized by phytoplankton in the southwestern Chukchi Sea are consumed by benthic animals inside the boundary of the aforementioned *Macoma calcarea* community. The northwesterly currents are likely phosphate-, silicate-, nitrate- and phytoplankton-poor; benthic biomass in those regions falls to a wet weight biomass range of 200-300 g/m^2. However, sufficient data is needed in the central and western Chukchi Sea in order to support this hypothesis. In our opinion, one of the main tasks of future RUSALCA Chukchi Sea expeditions must be a much more detailed hydrological and hydrobiological investigation in both the central and western regions.

Taxa using filtration feeding strategies dominated in eastern Chukchi Sea benthic communities, communities exhibited low wet weight biomass (80-250 g/m^2,st. 17 and 18); these results were similar to previous expeditions to the same region.

The northernmost transect line (st. 58B, 62B, 73B, 85B, 106 and 107) in Herald Trough and its vicinity was dominated by polychaetes (*Maldane sarsi*, *Nicomache lumbricalis*, *Nephtys ciliata*), brittle stars (*Ophiura sarsi*) and sipunculids (*Golfingia margaritacea*) with a wet weight biomass ranging form from 102 to 343 g/m^2. An unexpectedly rich settlement of sedentary epifaunal organisms (soft corals, sponges and bryozoans) encrusting both pebbles and manganese nodules was encountered on st.62B. On this same transect line, the Remotely Operated Video filmed a Cerianthid (Tube Anemone), which was the first known observation of this taxonomic order in the Chukchi Sea .

Appendix

Bottom communities of the Chukchi Sea and their quantitative characters

Station	Nm^2	Bm^2	Community
11	306	1291.2	*Yoldia hyperborea+Macoma calcarea+Leionucula tenuis +(Ampelisca sp.)*
13	819	4231.7	*M. calcarea*
15	167	1081.7	*M. calcarea*
17	310	248.8	*Cheliosoma orientalis+Nephtys ciliata*
18	60	86.3	*Polychaeta varia*
20	320	156.1	*Ophiura sarsi+Nephtys spp.*
22	640	260	*M. calcarea+L. tenuis*
23	1350	612.8	*L. tenuis*
24	350	491.4	*M. calcarea*
25	1150	934.6	*M. calcarea+Y. hyperborea*
27	680	12.2	*Gammaridea+Polychaeta*
106	110	116.9	*Maldane sarsi+O.sarsi*
85B	340	231.4	*M. sarsi+Astarta borealis+Ct.crispatus*

73B	550	380	*M. sarsi*
62B	510	343.1	*Golfingia margaritacea+Nicomache lumbricalis*
58B	170	134.6	*N. ciliata+M. sarsi+Actiniaria*
107	300	102.5	*N. ciliata+M. Sarsi+G. margaritacea*