MICROPLASTIC POLLUTION IN THE ARCTIC SEAS

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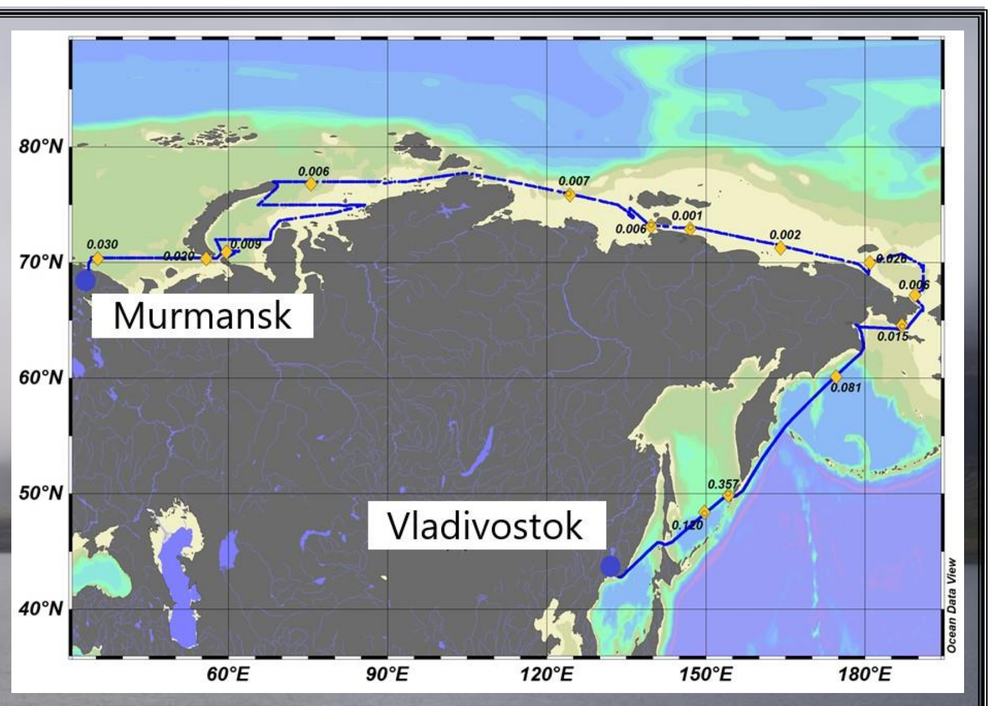
INTRODUCTION

Today, pollution of the marine environment with microplastics (plastic particles less than 5 mm) is a global environmental problem. In the aquatic environment, microplastic particles travel with currents throughout the World Ocean until they reach the accumulation zone. There are several such zones (“garbage patches”) in the world, and one of them is already being formed in the Arctic region [1]. The Russian Arctic, which is one of the most important highly productive marine ecosystems of the Arctic Ocean (AO), with a constantly increasing anthropogenic load, is still poorly studied. There is still no single standardized method (protocol) for determining the concentration of microplastic particles in water. In this regard, the aim of the study was to obtain new field data to understand the distribution of microplastic particles in the Arctic. In the summer of 2019, the RSHU conducted field research in frames of TRANSARCTIC-2019 programme aiming at quantitative and qualitative assessment of the accumulation of microplastic particles in the water area of the Russian part of the Arctic basin.



METHODOLOGY

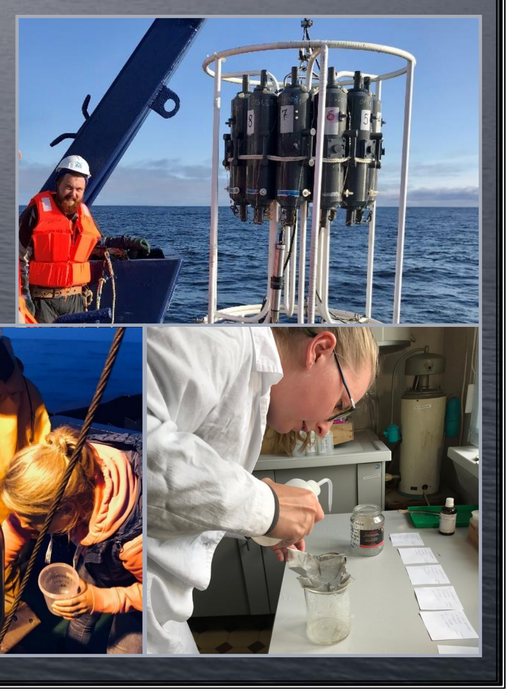
Sampling was carried out using a shipboard pump built into the flow-through system in the keel part of the vessel and sampling seawater along the vessel's course from the subsurface layer (up to 4 m). Water flowing through a special sampler was filtered through a metal mesh (mesh size - 100 μm). Then the sample was fixed and sent for laboratory analysis.

The analysis of samples was carried out according to the methodology developed by the Atlantic Branch of P.P. Shirshov Institute of Oceanology of Russian Academy of Sciences [2], and consisted of two stages:

- Digestion of organic material;
- Visual identification of microplastic particles using a microscope.

To obtain a preliminary assessment of microplastic pollution of the Arctic seas, 14 samples were treated, taken in all seas of the Arctic basin of the Russian Federation.

Third stage – FTIR analysis for identification of plastic type – was not completed due to COVID-19 restrictions.



CONCLUSION

A quantitative assessment of microplastic particles in the Arctic seas showed microplastic particles of various shapes, sizes and colors.

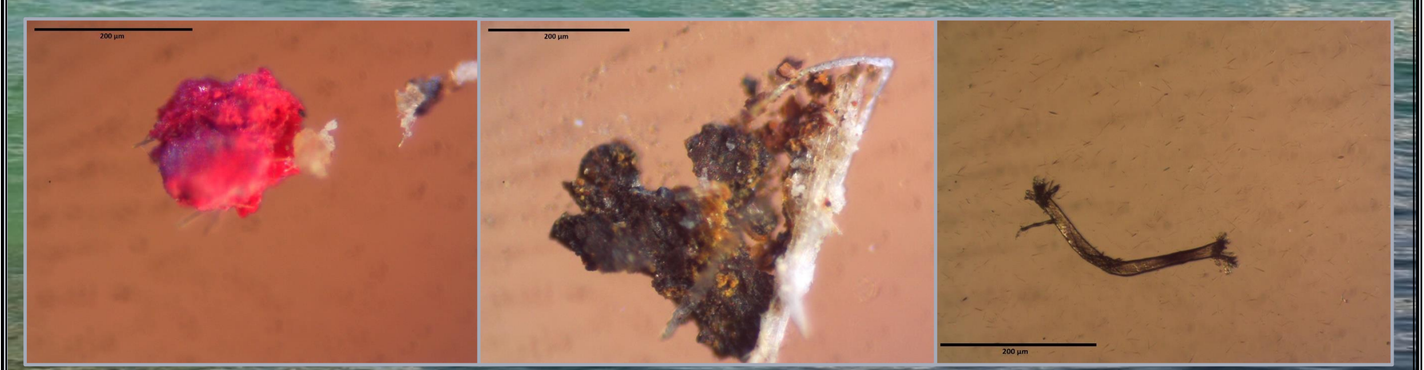
Among them, the most common were filamentous transparent fibers - they were present in each of the samples. Particles of indeterminate shapes were found in the seas with a strong traffic load, namely the Barents, Kara and Okhotsk seas. The particle size varied from 100 to 3500 μm.

The highest concentration of microplastics was observed in the Sea of Okhotsk, and the lowest - in the East Siberian Sea and amounted to 0.357 and 0.001 particles per 1 liter, respectively.

The method of subsurface shipboard pump has been successfully used by researchers Lusher et al., (2015) in the area of the Spitsbergen archipelago in the Barents Sea. However, the results of our expedition showed significantly higher concentrations (30 pcs / m^3 in this study and 2.46 pcs / m^3 in Lusher et al. [3].

Laboratory analysis of the samples according to the method of AB IO RAS [2] showed that this technique needs to be improved for the Arctic seas due to their high productivity and abundance of zooplankton and krill, thus the organic material is not completely digested, which is significant and complicates the analysis process and affects the accuracy of the result.

The work will be continued in order to get the qualitative assessment of types of plastic particles (after the FTIR analysis will become available), as well as to develop recommendations for the determination of microplastic particles in the marine waters of the Russian Arctic.



References

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2. M. B. Zobkov, E. E. Esyukova, Microplastics in the marine environment: review of methods for sampling, preparation and analysis of water, bottom sediments and coastal sediments// Research methods and devices, 2018, no. 1 (58), pp. 149-157. SDI: 007.001.0030-1574.2018.058.001
3. Lusher, A. L. et al. Microplastics in Arctic polar waters: the first reported values of particles in surface and sub-surface samples. Sci. Rep. 5, 14947; doi: 10.1038/srep14947 (2015).

RESULTS

Stations	Liters filtered, (m^3)	Number of particles found, (pcs)	Concentration, (pcs / l)
Okhotsk sea			
Station 1	0,075	9	0,120
Station 2	0,028	10	0,357
Bering Sea			
Station 1	0,173	14	0,081
Station 2	0,450	7	0,015
Chukchi sea			
Station 1	0,787	5	0,006
Station 2	1,087	28	0,026
East-Siberian Sea			
Station 1	2,700	4	0,002
Station 2	1,800	1	0,001
Laptev sea			
Station 1	1,500	9	0,006
Station 2	1,950	14	0,007
Kara Sea			
Station 1	1,688	10	0,006
Station 2	1,800	16	0,009
Barents Sea			
Station 1	1,875	38	0,020
Station 2	3,150	92	0,030