Sources of microplastic pollution in the Peter the Great Gulf

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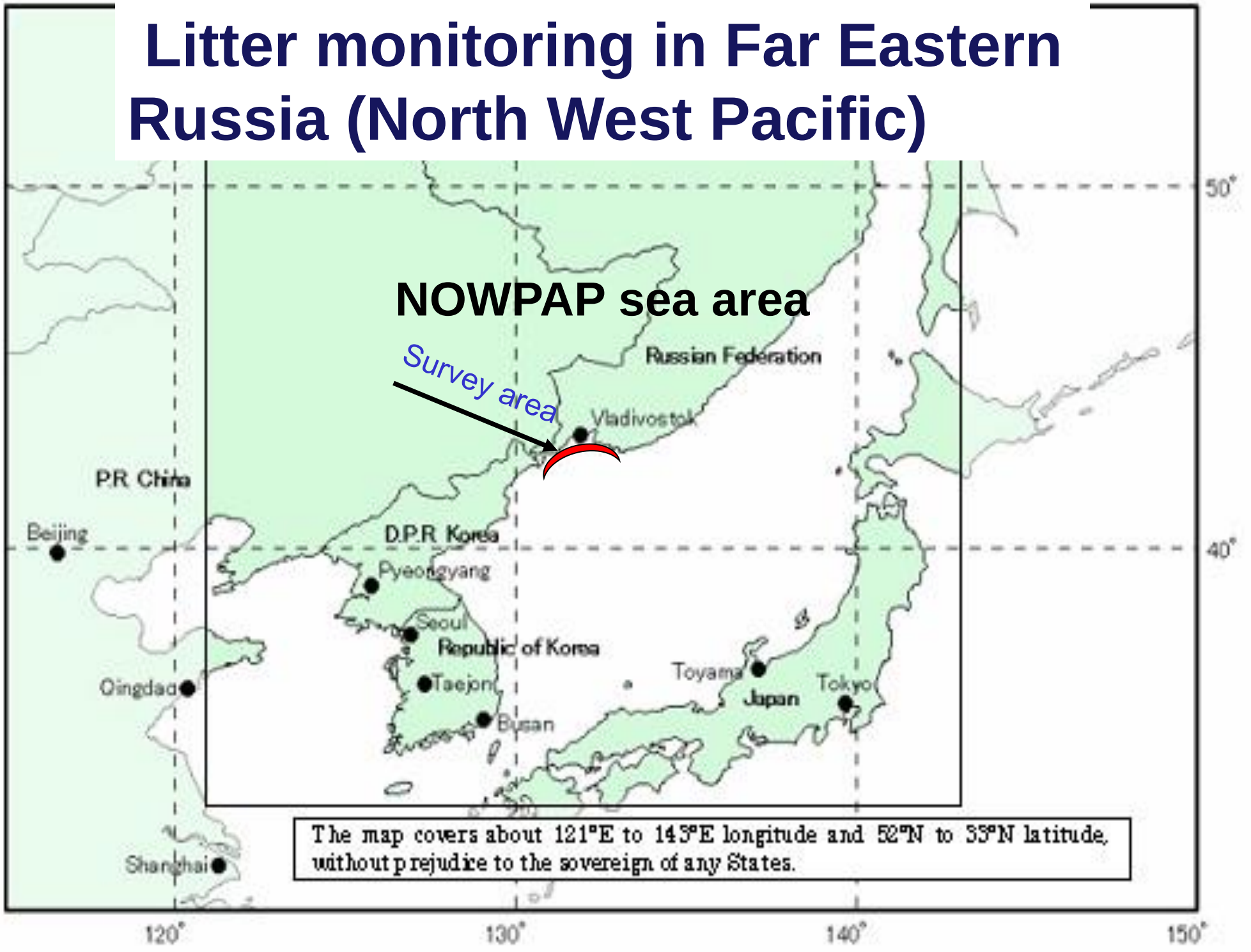
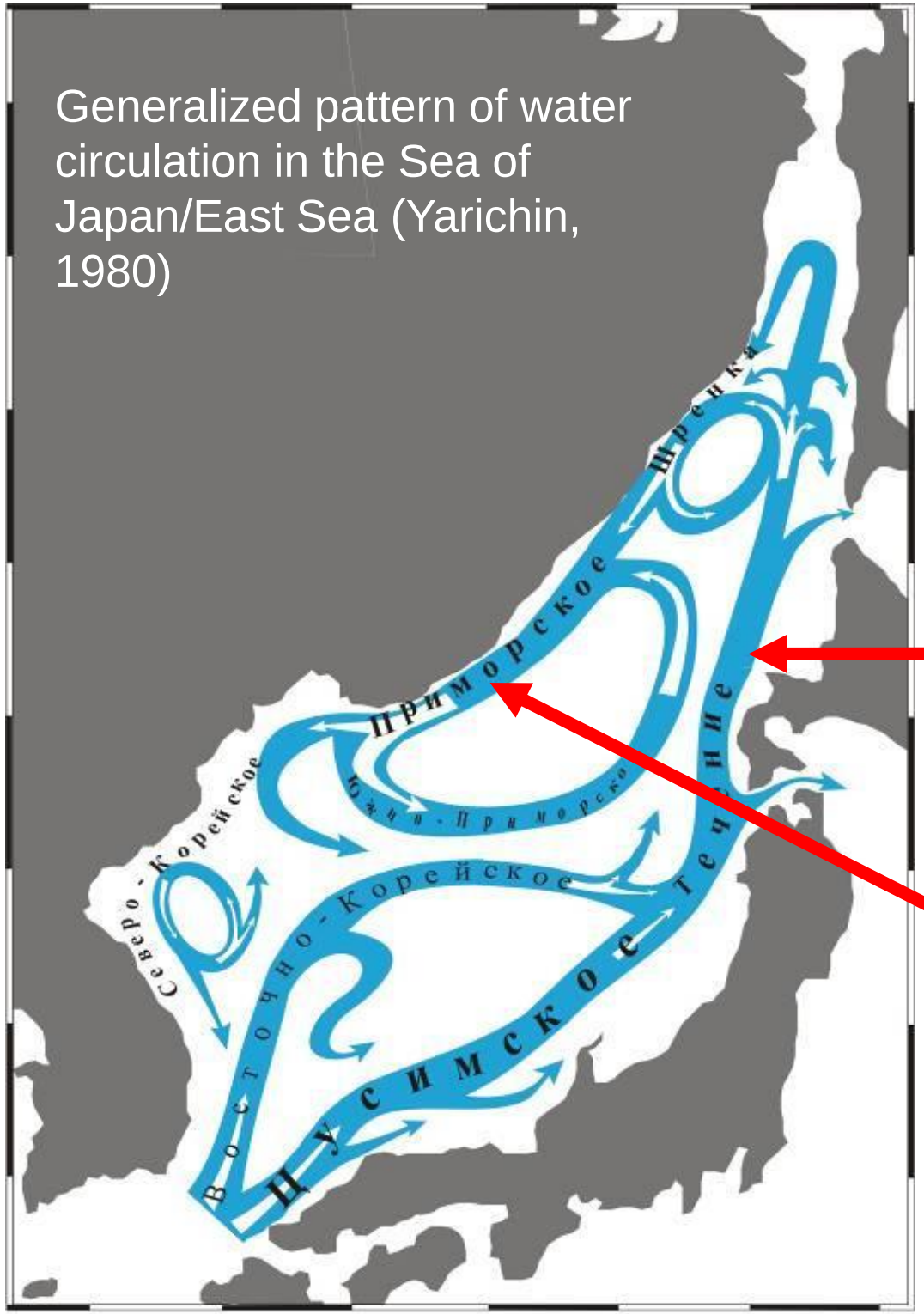
Litter monitoring in Far Eastern Russia (North West Pacific)





Generalized pattern of water circulation in the Sea of Japan/East Sea (Yarichin, 1980)

The pattern of currents is formed under general circulation of the Sea of Japan/East Sea, monsoon winds and tides.

The most prominent currents transporting the litter are:

northward Tsushima Current (a branch of warm Kuroshio Current); and

cold Primorskoye Current streaming southward along the coast of Primorsky Krai.

Microplastic survey in the Far Eastern Russia

‘Report on the microplastic content and migration in the Peter the Great Gulf’ to be published in late 2017

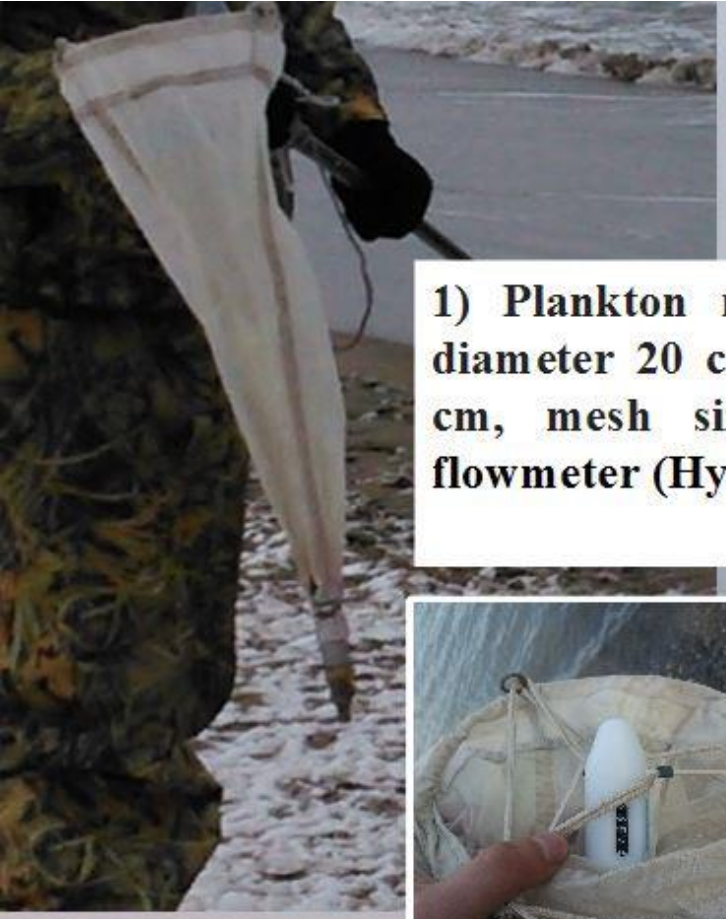
Survey methods

- **Sampling of seawater along the coastline using plankton/neuston net (mesh size 0.1 mm)**
- **Treatment of the collected samples.**
- **Defining size and morphological structure of obtained specimens using a microscope;**
- **Determining polymeric structure of plastics based on their FTIR-spectra;**
- **Calculating concentrations of plastic particles in the seawater and mapping.**

Selection of microplastic sampling sites in the coastal area of the Peter the Great Gulf

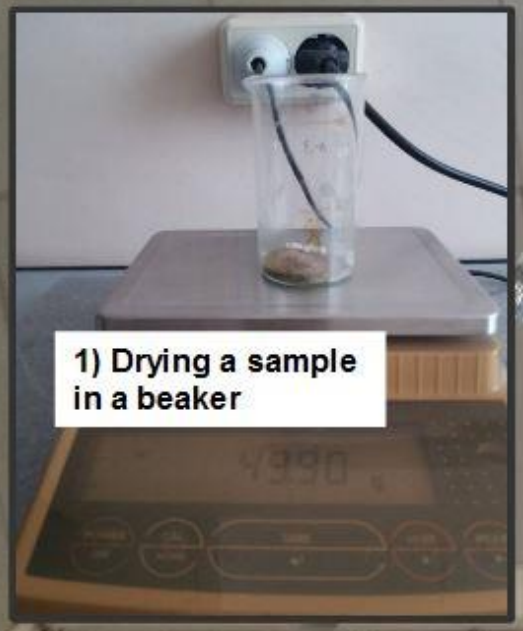
❖ Sampling

1) Plankton net (mouth diameter 20 cm, length 40 cm, mesh size 0.1 cm., flowmeter (Hydro-bios)



2) Neuston net (mouth width 50 cm/height 20 cm, length 100 cm, mesh size 0.1 cm., flowmeter

❖ Sample preparation



1) Drying a sample in a beaker

2) Adding 20 ml (or more) H_2O_2 + 20 ml of 0.05 M Fe(II) water solution

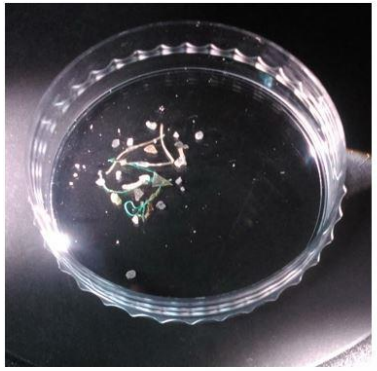
3) Adding 6 g NaCl (per 20ml) after the reaction

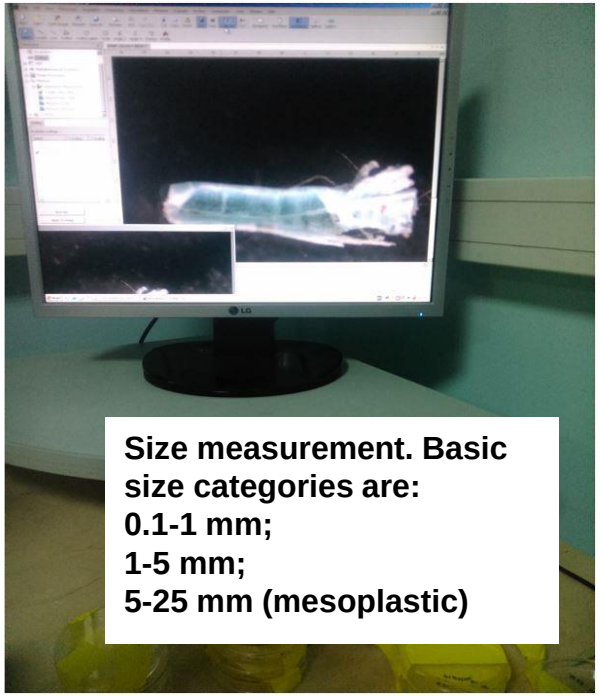
4) Density separation

5) Filtering (filter diameter 47mm, pore size 5 µm)

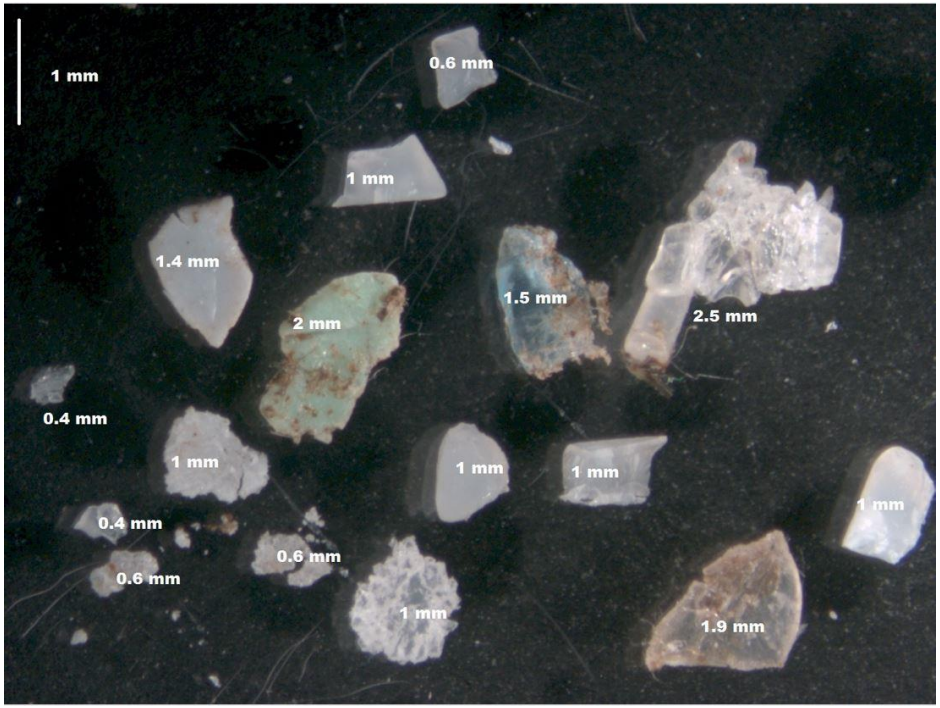
6) Transfer to Petri dish

❖ Type/size identification

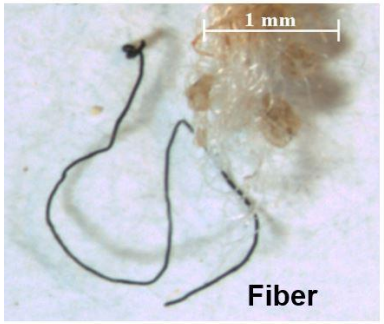


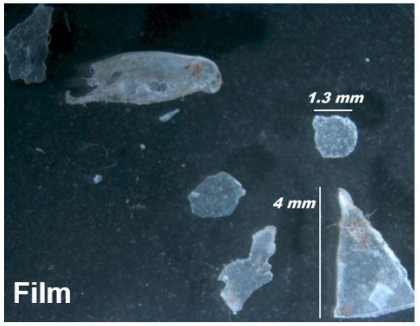


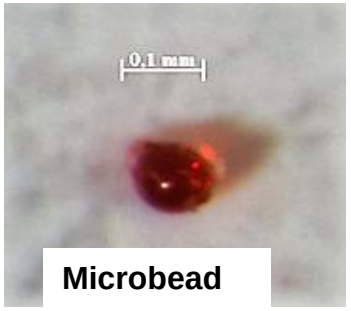
Size measurement. Basic size categories are:
0.1-1 mm;
1-5 mm;
5-25 mm (mesoplastic)

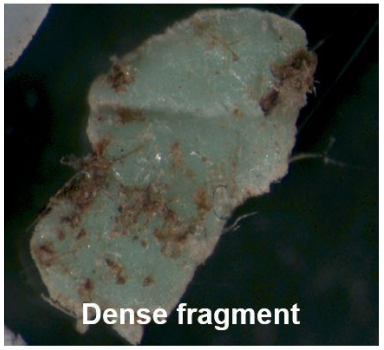


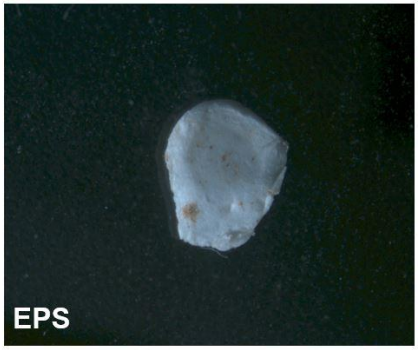
Basic types



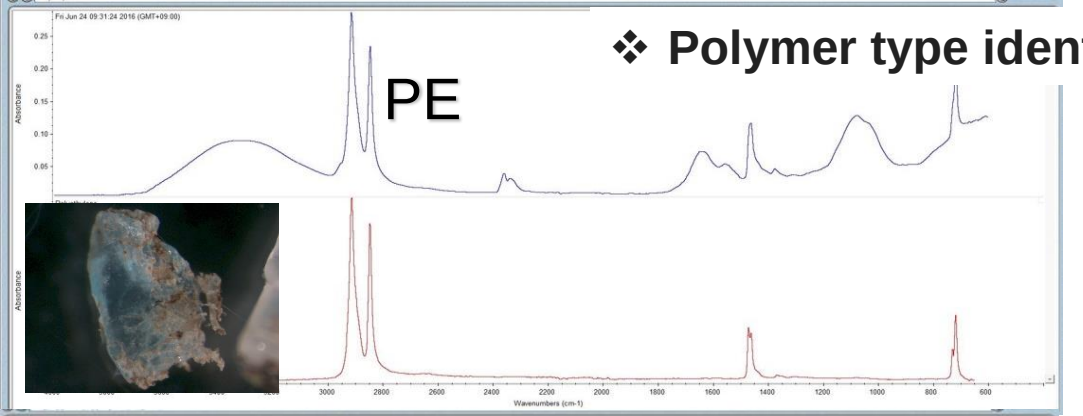


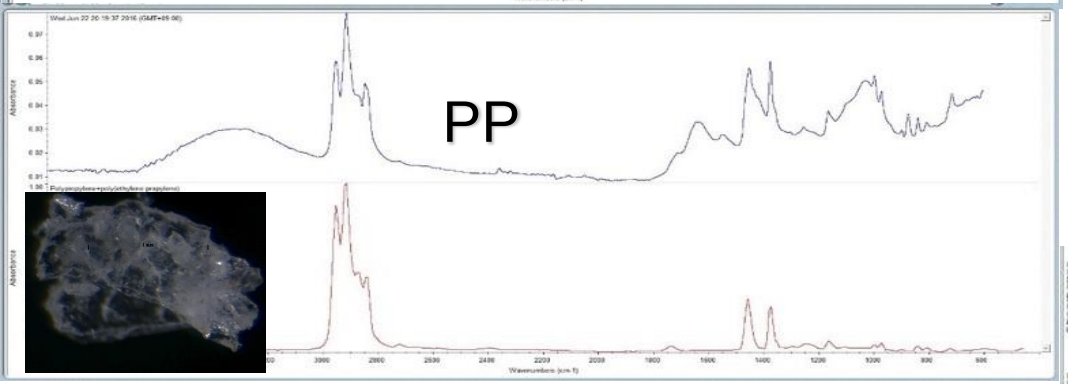


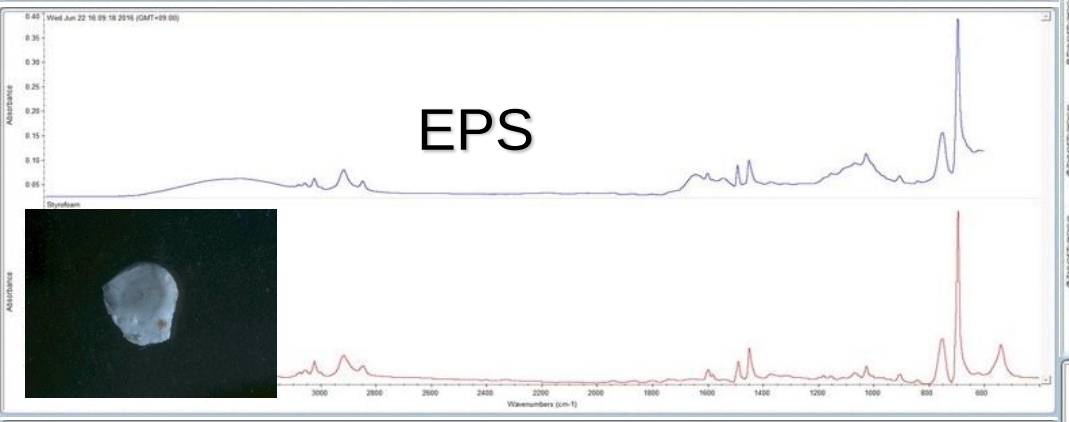


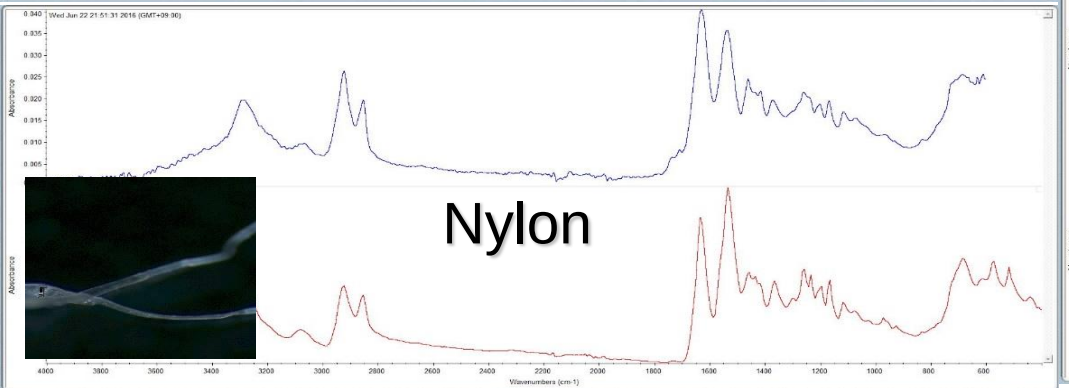


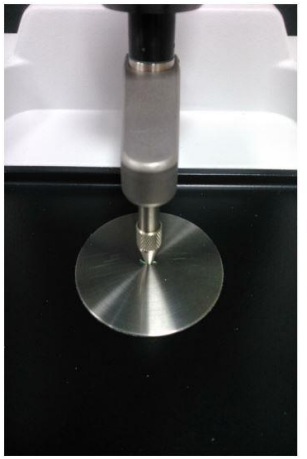
❖ Polymer type identification



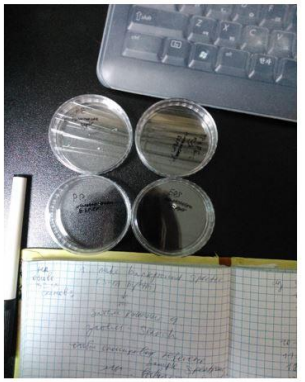


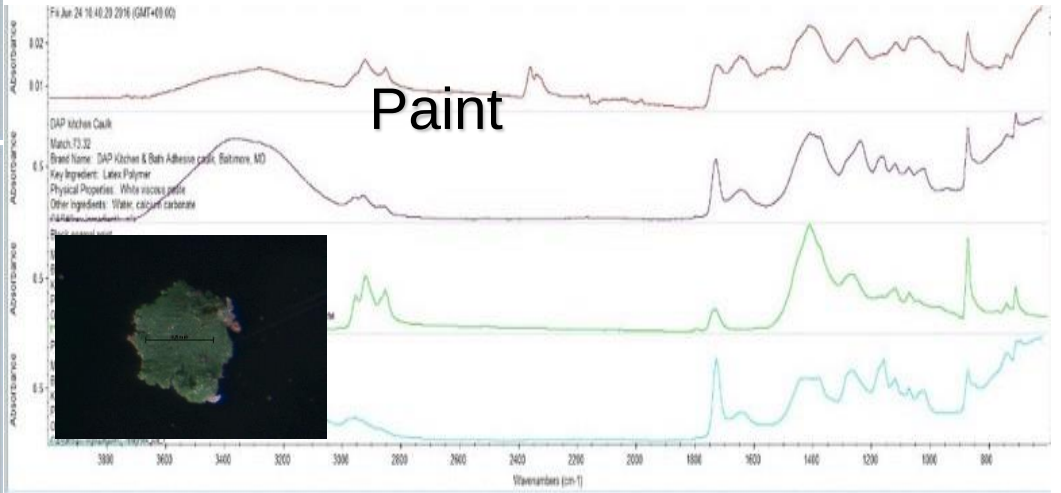


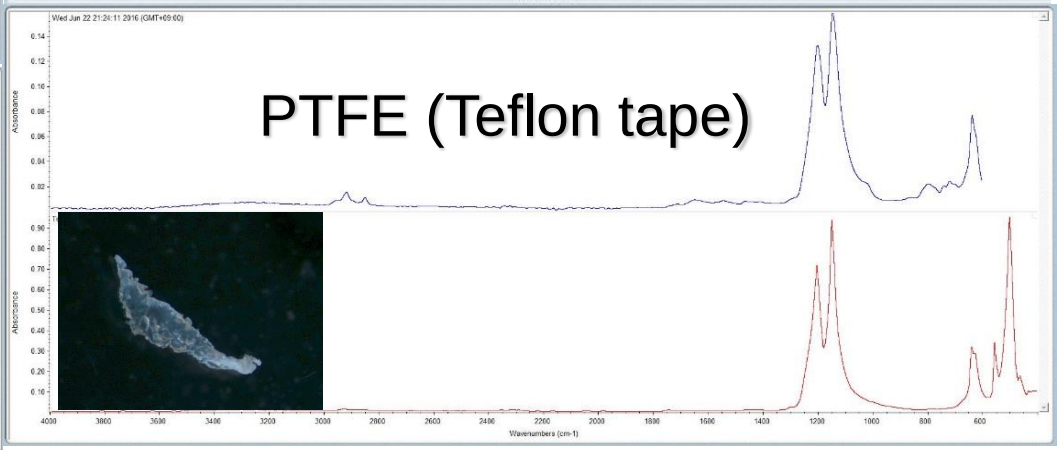


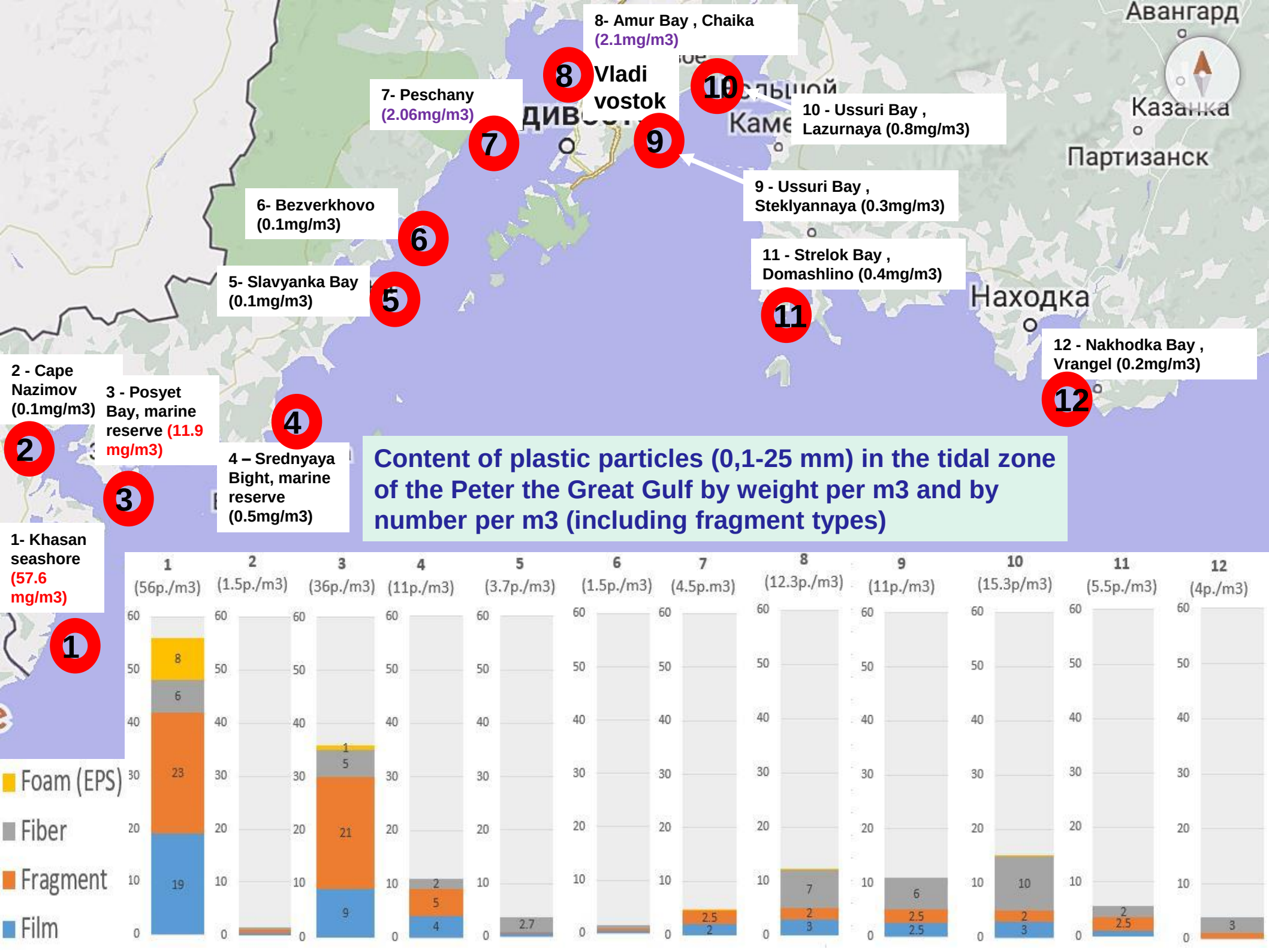


ATR FTIR spectroscopy

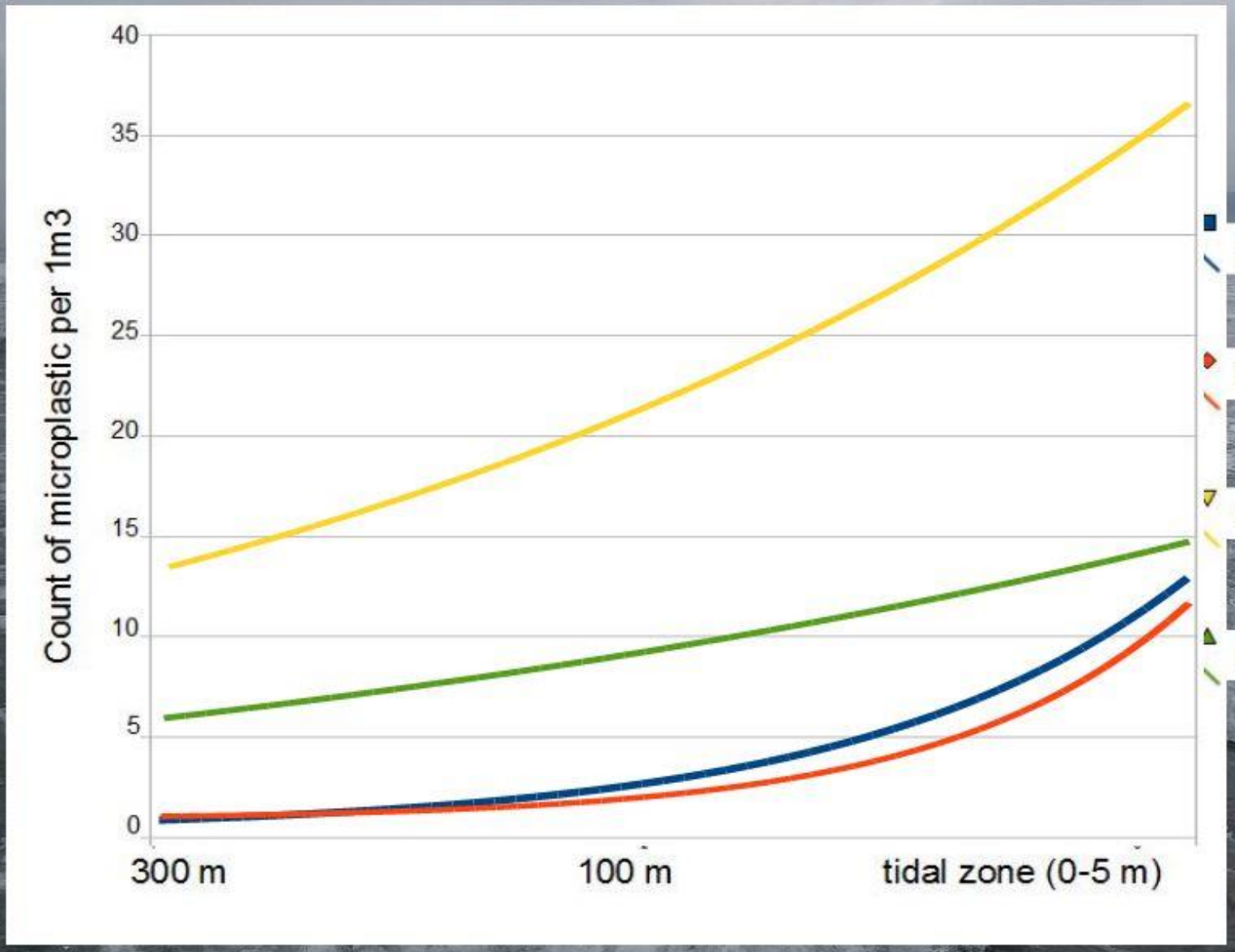




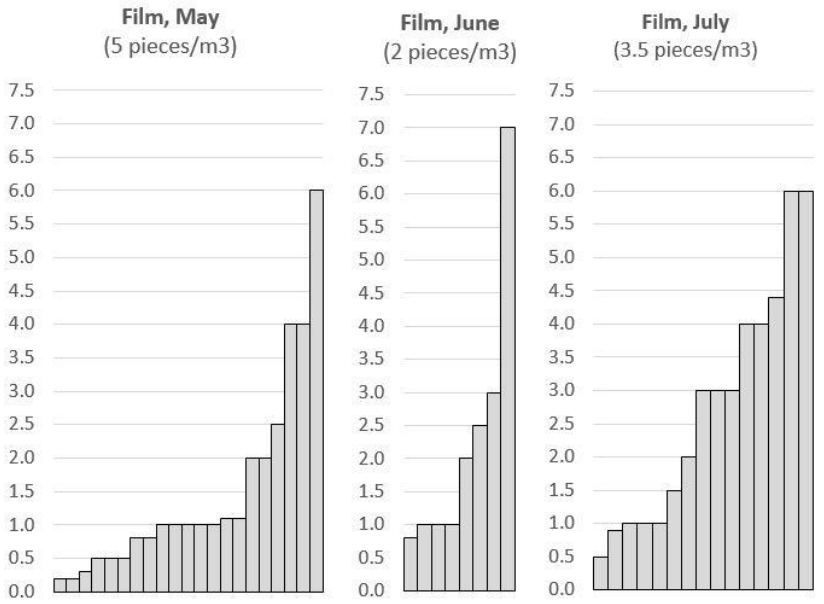


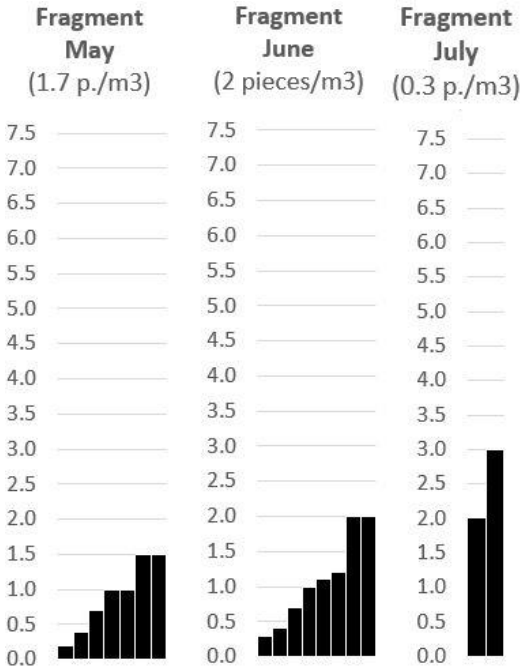

8- Amur Bay , Chaika (2.1mg/m3)
8
Vladi vostok
10
10 - Ussuri Bay , Lazurnaya (0.8mg/m3)
7- Peschany (2.06mg/m3)
7
9
9 - Ussuri Bay , Steklyannaya (0.3mg/m3)
6- Bezverkhovo (0.1mg/m3)
6
11 - Strelok Bay , Domashlino (0.4mg/m3)
5- Slavyanka Bay (0.1mg/m3)
5
11
12 - Nakhodka Bay , Vrangel (0.2mg/m3)
12
2 - Cape Nazimov (0.1mg/m3)
3 - Posyet Bay, marine reserve (11.9 mg/m3)
4
2
3
4 – Srednyaya Bight, marine reserve (0.5mg/m3)
1- Khasan seashore (57.6 mg/m3)
1
Авангард
Казанка
Партизанск
Находка
Content of plastic particles (0,1-25 mm) in the tidal zone of the Peter the Great Gulf by weight per m3 and by number per m3 (including fragment types)
1 (56p./m3)
2 (1.5p./m3)
3 (36p./m3)
4 (11p./m3)
5 (3.7p./m3)
6 (1.5p./m3)
7 (4.5p.m3)
8 (12.3p./m3)
9 (11p./m3)
10 (15.3p/m3)
11 (5.5p./m3)
12 (4p./m3)
Foam (EPS)
Fiber
Fragment
Film

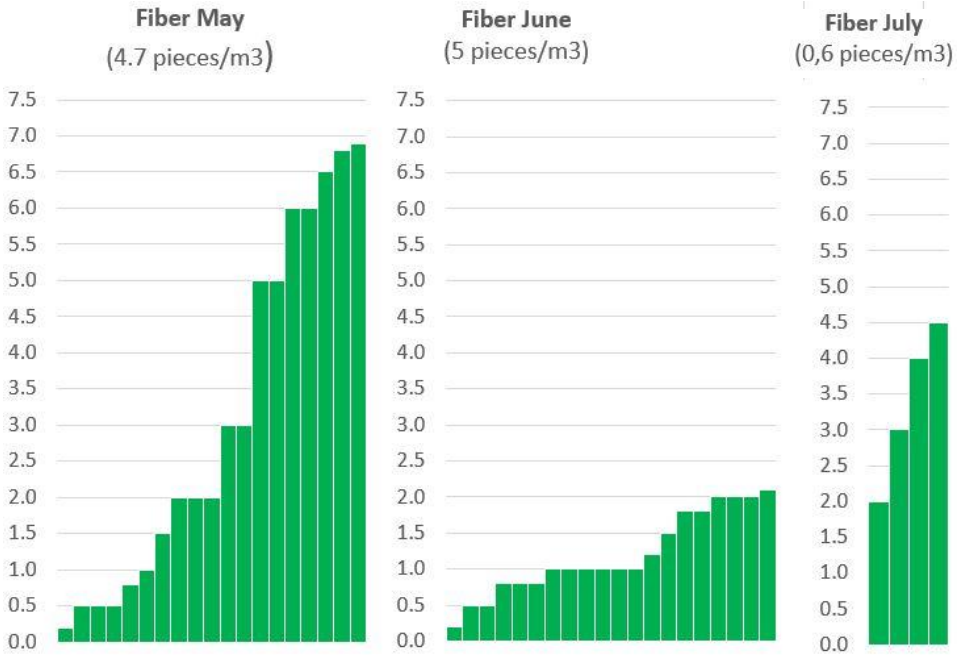
Comparison of microplastic concentrations (by number) in the tidal zone (right) and seawards (left) in the Peter the Great Gulf



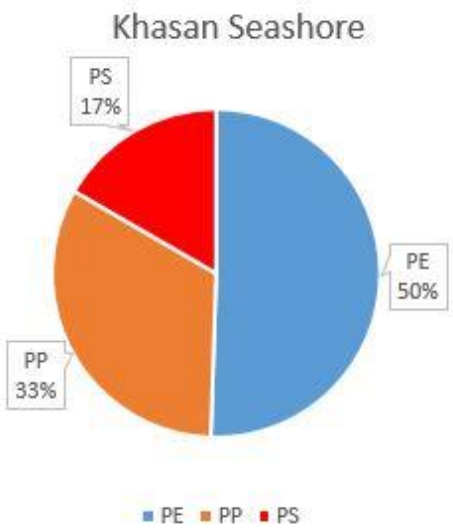
Arranging seasonal dynamics of basic types of microplastics (by the example of Chaika Beach of the Amur Bay) with size range (length, mm)

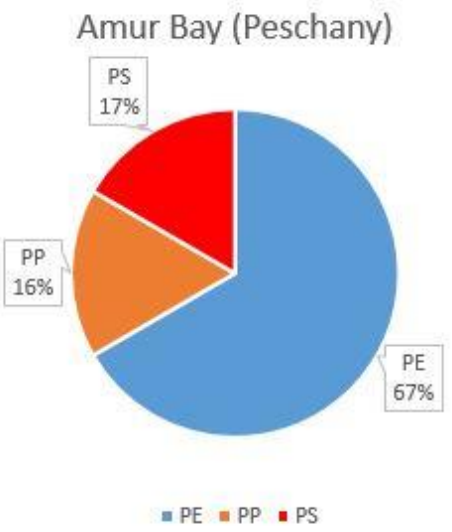


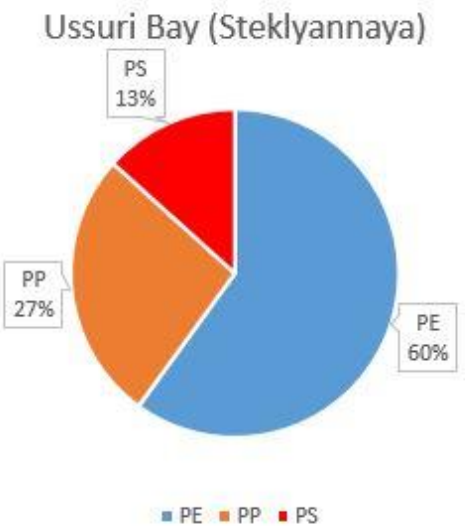


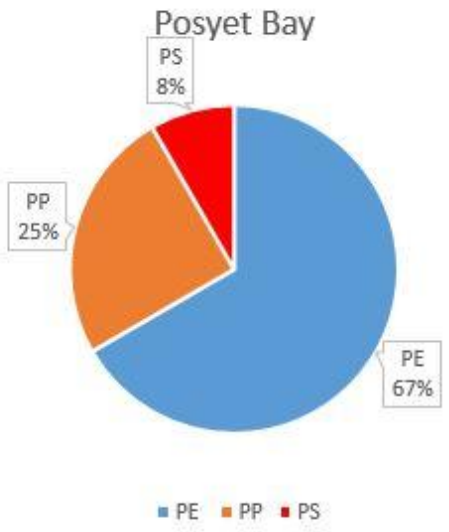


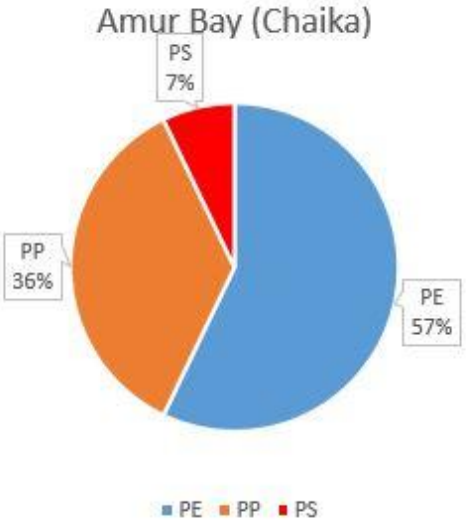
Ratio of basic polymer types of floating MP

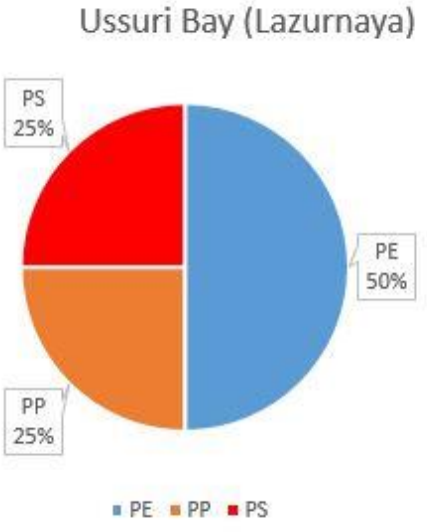












All fibers were ≥0.02 mm in diameter

We registered nylon, polyester, PP, PS, and PE.

Suggested sources of microplastic contamination in the coastal area of the Peter the Great Gulf

According to the results of this survey, we suggest that the basic sources of microplastic pollution in the study area are as follows:

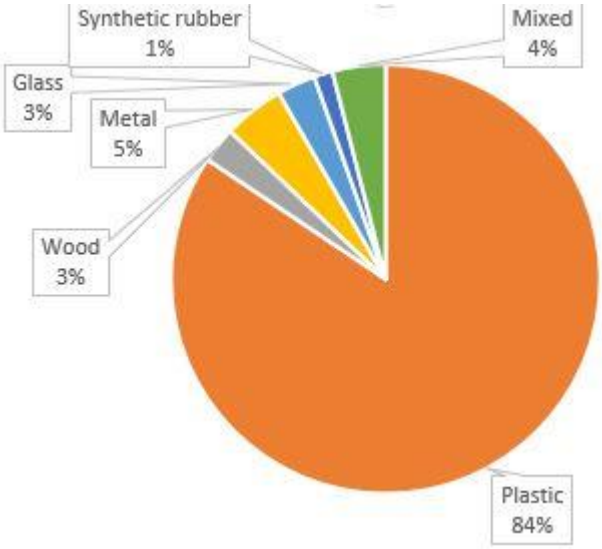
1) Untreated discharge of domestic water from coastal inhabited localities;

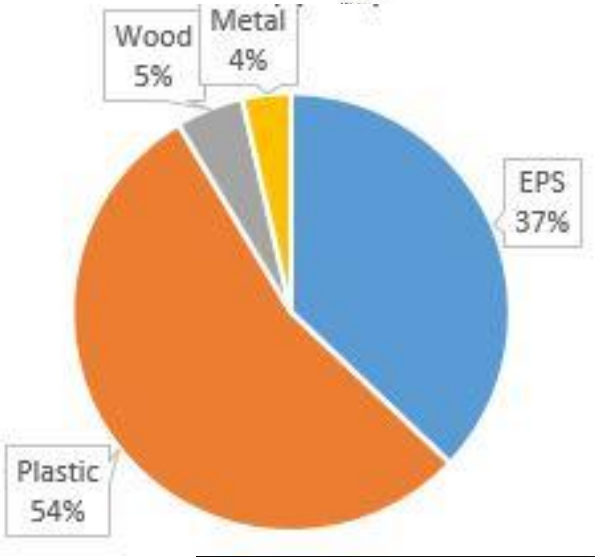
2) Degradation of larger litter, which comes from land, fisheries and aquaculture on beaches (mostly remote);

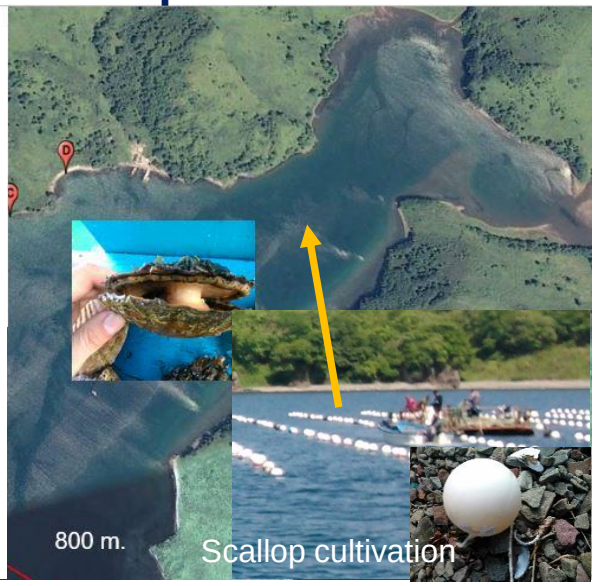
3) Summer recreation; and

3) Riverine discharge in major rivers

Beached litter as a source of microplastic in the Far Eastern Marine Biospheric Reserve

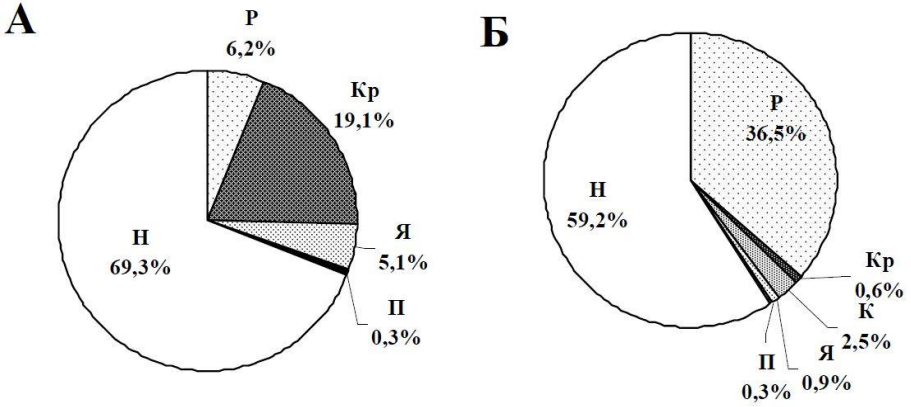




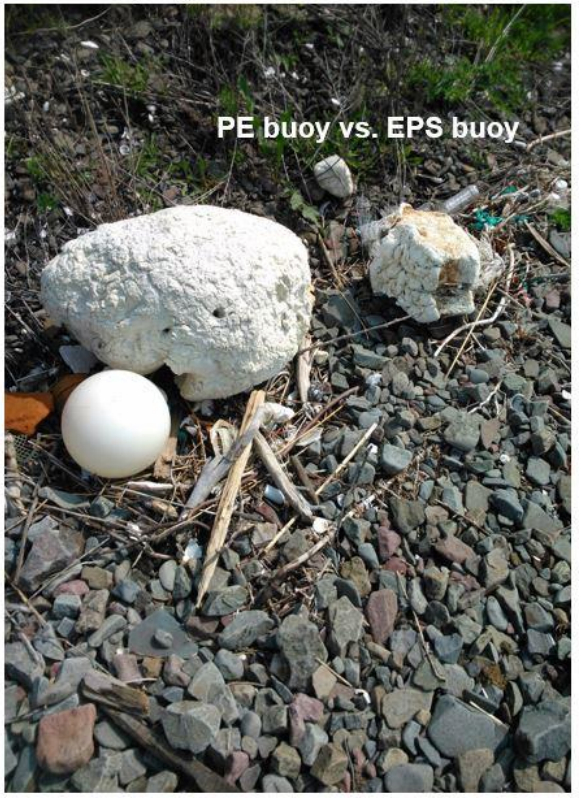


Beached litter in southern part of FEMBR in 2007 (by A.A. Kepel, 2008)

Beached litter in Minonosok Bay, western part of the reserve, in 2016 (by PGI)



Structure of marine litter in western part of the Marine Biospheric Reserve by country of origin in 1990-s (left) and in 2000-s (right) (by A.A. Kepel, 2008)

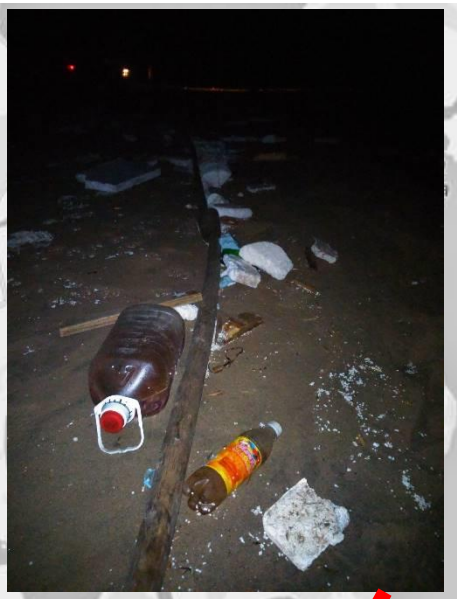


Tumen River pollution impact

China, Jilin Province (27 mln. residents)

DPRK, North Hamgyong Province (2 mln. residents)

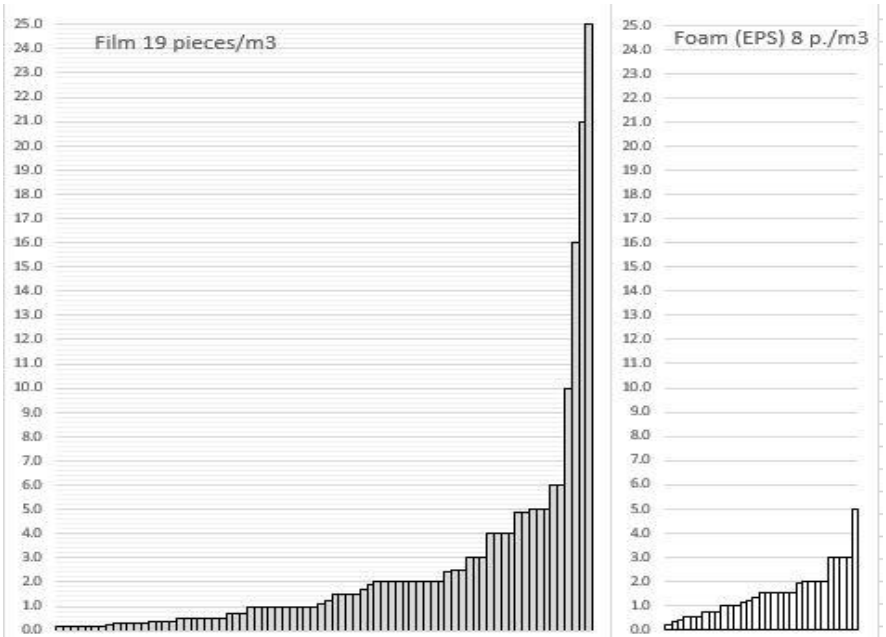
Russia, Khasansky District (~32,000 residents)

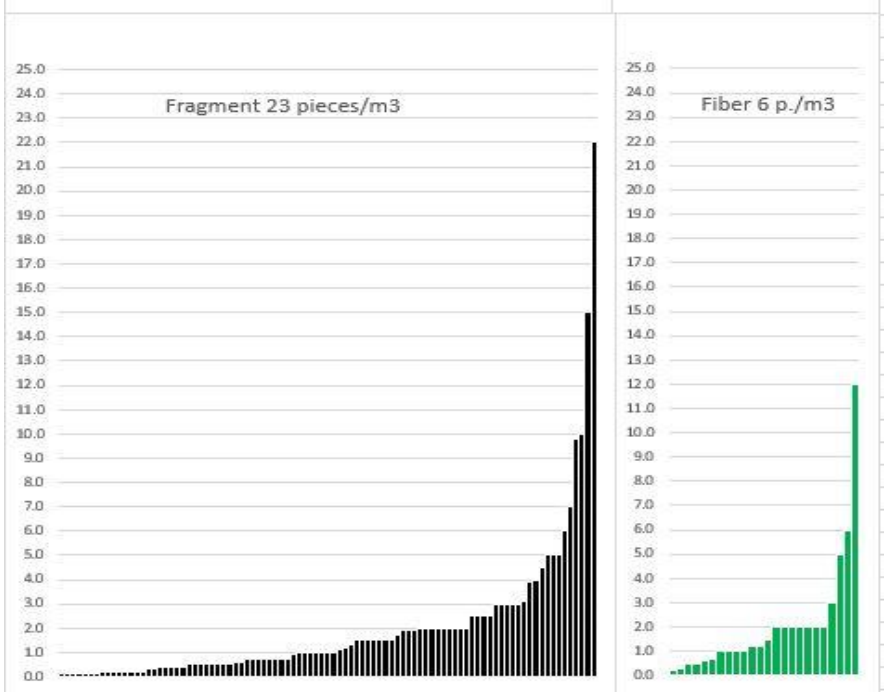


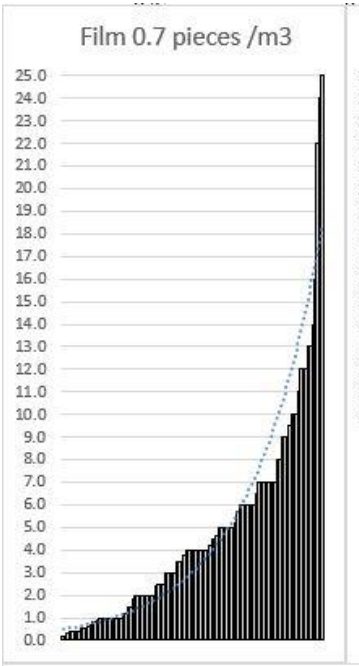
Assessment of river water contamination with microplastic

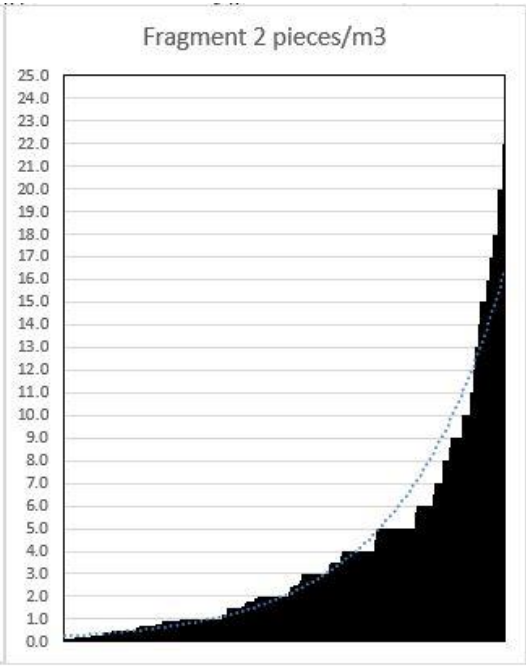
To figure out the impact of larger rivers on microplastic contamination of sea area, we collected samples from the Tumen River and the Razdolnaya River. We used gasoline pump with capacity of 15m3 per hour to filter the water through 0.1 mm mesh for sampling from depth below 20 cm, and a neuston net for surface sampling.

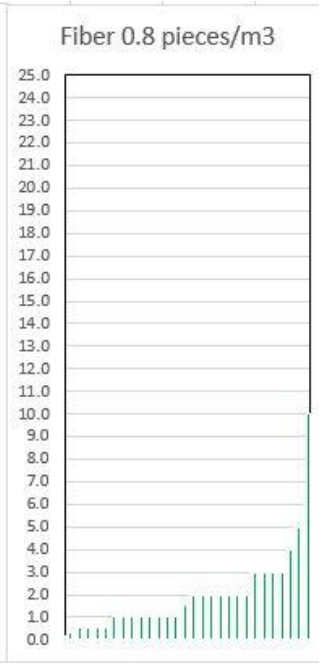
Comparison of microplastic composition in Khasan Seashore water (left) and Tumen River discharge (right)

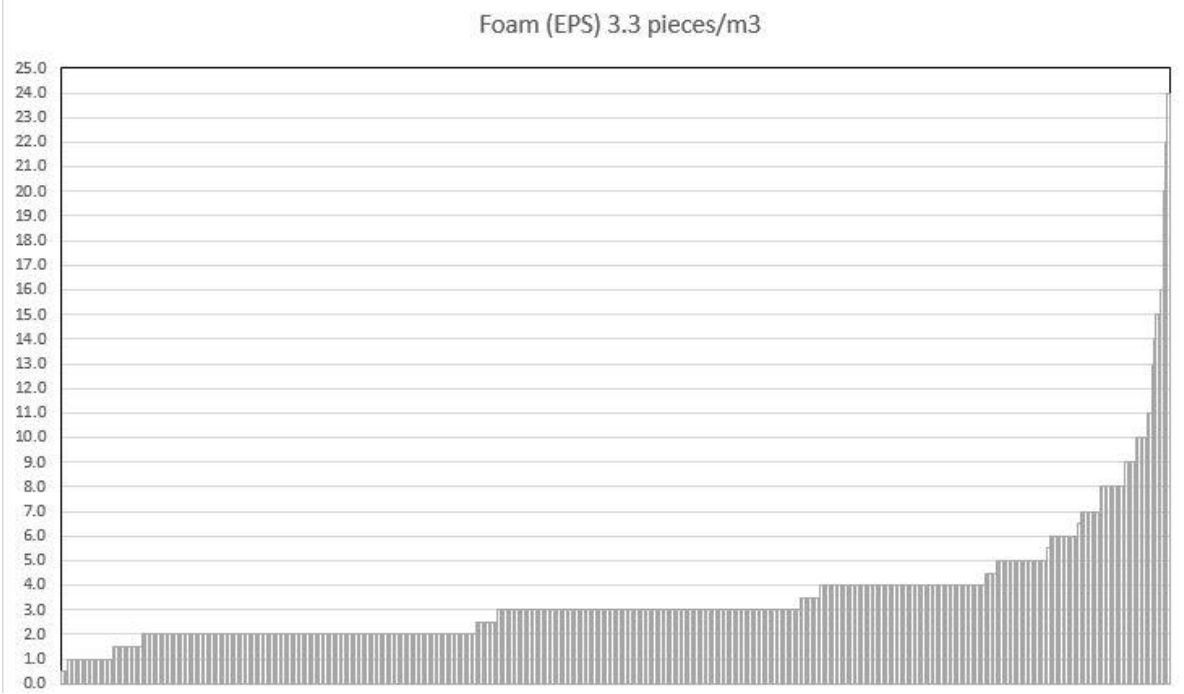






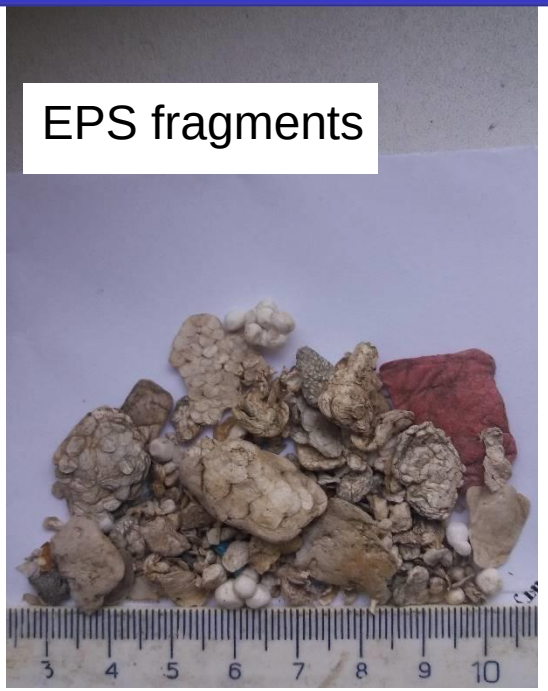






Tumen River pollution impact

Mesoplastic fragments in the river



EPS fragments

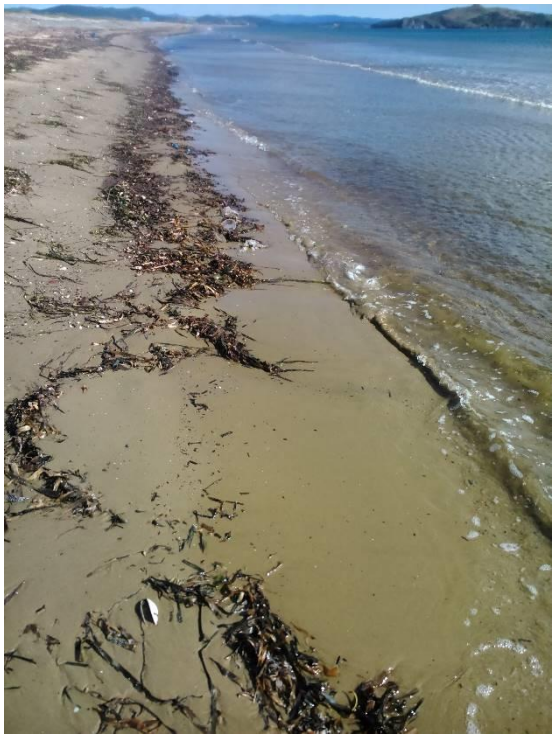
Pellets

Larger plastic

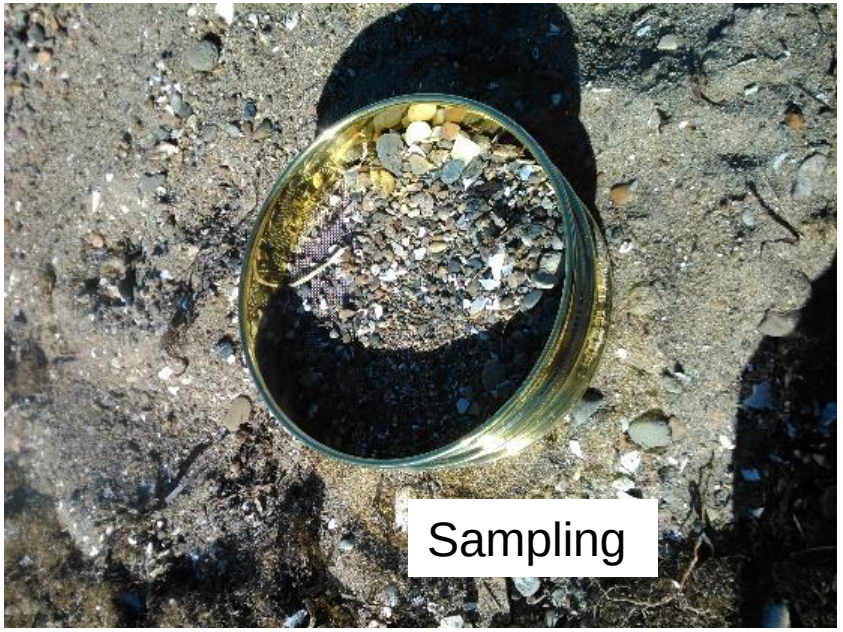
Untreated seawater sample (near the estuary)

Processed seawater sample (near the estuary)

Assessment of beach contamination with microplastic



To assess microplastic contamination of beach areas, we collected samples from several sand beaches along the coast of the Amur Bay. Using screen system (5-1-0.5-0.3 mm) we sieved beach sand and collected for consequent analysis. The assessment is still in progress



Sampling

Beach contamination of Khasan seashore (near the Tumen River mouth)

While evaluating preliminary results of the survey by NOWPAP POMRAC, the following peculiarities were revealed:

❖1) Plastic particles are registered in most of collected coastal water samples, though sporadic samplings in winter and late autumn show decrease in the concentrations;

❖2) Most commonly, size of plastic particles ranges from 1mm to 5 mm;

❖3) Larger amounts of primary microplastic particles were revealed near inhabited localities, and larger amounts of secondary microplastics along the remote coasts;

❖4) Five morphological types of microlitter were revealed in the seawater, including fibers, dense fragments, films, EPS fragments, and microbeads, while paint particles were also registered;

❖5) As of now, predominating polymer type in the coastal water is PE, followed by PP (including mixtures such as PP+PE). Though, in certain areas EPS concentrations overcome other polymer types.


Thank you very much
for your attention!!!