

Method for monitoring microplastics
in water using citizen science:
case study from the Russian Arctic (White Sea basin)

Authors: Alexandra Ershova, Irina Makeeva
(Russian State Hydrometeorological University)

Artem Smolokurov, Anna Begeba
(NGO "Chisty Sever – Chistaya strana")

Nikita Sobolev
(Northern (Arctic) Federal University
Named After M. V. Lomonosov)



Background

Microplastics – are synthetic polymer particles (fibers, beads, pellets, fragments) less than 5 mm in size.

Microplastics are ubiquitous in all Arctic ecosystems, but our understanding of their abundance, distribution and sources is limited due to the lack of regular monitoring data in this region. Large plastic litter and microplastics including microfibers come in the Arctic from various sources, both with Atlantic currents and local environments. The monitoring of microplastic pollution in the Arctic must be held on a regular basis and citizen-science might be of valuable help for this purpose.

The method was developed in frames of the study held in summer-autumn 2020 in Arkhangelsk Region in the Russian Arctic by the members of Arkhangelsk Regional Youth Ecology Public Organization “Clean North-Clean Country”, with the assistance of scientists of Russian universities (RSHU and NARFU) and involving over 200 volunteers trained in microplastic sampling and litter separation, and learning about microplastic pollution. The main criteria of selection of sampling sites and monitoring strategy were driven by the accessibility of the shores and by the availability of volunteers from local communities. Sampling points were located at the lake shores and on the White Sea coast with intensive tidal activity. However, one should consider high marshiness of the Arctic shores when they are not accessible and some lakes were eliminated due to their high bioproductivity and phytoplankton abundance.

A simple, low-cost and easy-to-use microplastics sampling protocol was tested to be further applied by volunteers in remote Arctic communities.



Materials:



EQUIPMENT:

Sampling of water:

- GPS-device
- Camera
- Roulette / folding ruler
- 1 metal bucket (10 L)
- Bright-colored gown
- 2 Sieves (400 μm , 80 μm)
- Metal foil
- Sealed airtight container

Field pre-treatment of sample:

- Tent, metal table and a chair
- Ethanol (≈ 15 ml per sample) and a syringe
- Distilled water (or MQ) (≈ 500 ml per sample)
- 3 Chemical beakers (glass, 500 ml)
- 2 Wash Bottles (250 ml, 500 ml)
- 1 Can (glass) per sample
- Waterproof pen

Preparation for research

Before the expedition it is necessary to complete the preparatory stage on the basis of a specialized laboratory:

- Before the start the laboratory premises are cleaned in order to exclude any source of microplastic contamination of laboratory equipment, furniture and air.
- During the lab work, no other person except the researcher is allowed in the laboratory and all procedures must be done in pressurized by HEPA-filtered air laboratory and laminar flow cabinet in order to eliminate any source of background microplastic particles in the laboratory.
- The researcher works exclusively in a white cotton lab coat and nitrile gloves of a bright and easily identifiable color.
- For the preparation of materials and reagents only glass laboratory glassware is used, which is washed at least three times with deionized water filtered using a membrane filter with a pore diameter of $<0.45 \mu\text{m}$.
- Before use all reagent solutions are filtered into clean laboratory glassware through a glass filter with a pore diameter of $<0.7 \mu\text{m}$.
- To control background contamination 3 blank glass fiber filters are placed near the sample preparation (on three sides of the working area) and analysis spots and are controlled every day for any contamination. The filters are then analyzed in the same way as the samples themselves (under a microscope and, if particles are present, with an IR spectrometer).
- All laboratory utensils and equipment for field research must be made of metal and glass materials.
- Jars for samples storage, reagents, as well as field work instruments must be entirely prepared in the specialized laboratory before the field work.

Sampling Scheme

Sampling in the field

The sampling spot must be GPS-registered and pictured by a camera. Also, any potential litter or plastics sources must be registered (landfills, sewage outlets etc.)

To carry out the field work you need at least 2 people dressed in a work uniform (preferably bright-colored gown to be easily distinguished when sample processing). One volunteer holds a calibrated metal bucket, and another - 2 metal sieves. Sampling is carried out in the coastal zone of the water area. The sample is taken at a distance of at least 10 meters from the water line from a depth of at least 0.5 meters (Figure 1). Before the start the metal bucket is washed with water from the sampled water body with a volume of at least 50 liters. The system of 2 metal sieves should be prepared for work in the field laboratory (washed with distilled (MQ) water). One volunteer takes water upstream, then the water is filtered through a sieving system (400 μm sieve above the 80 μm sieve) and is drained downstream. For one sample 500 liters of water are filtered.

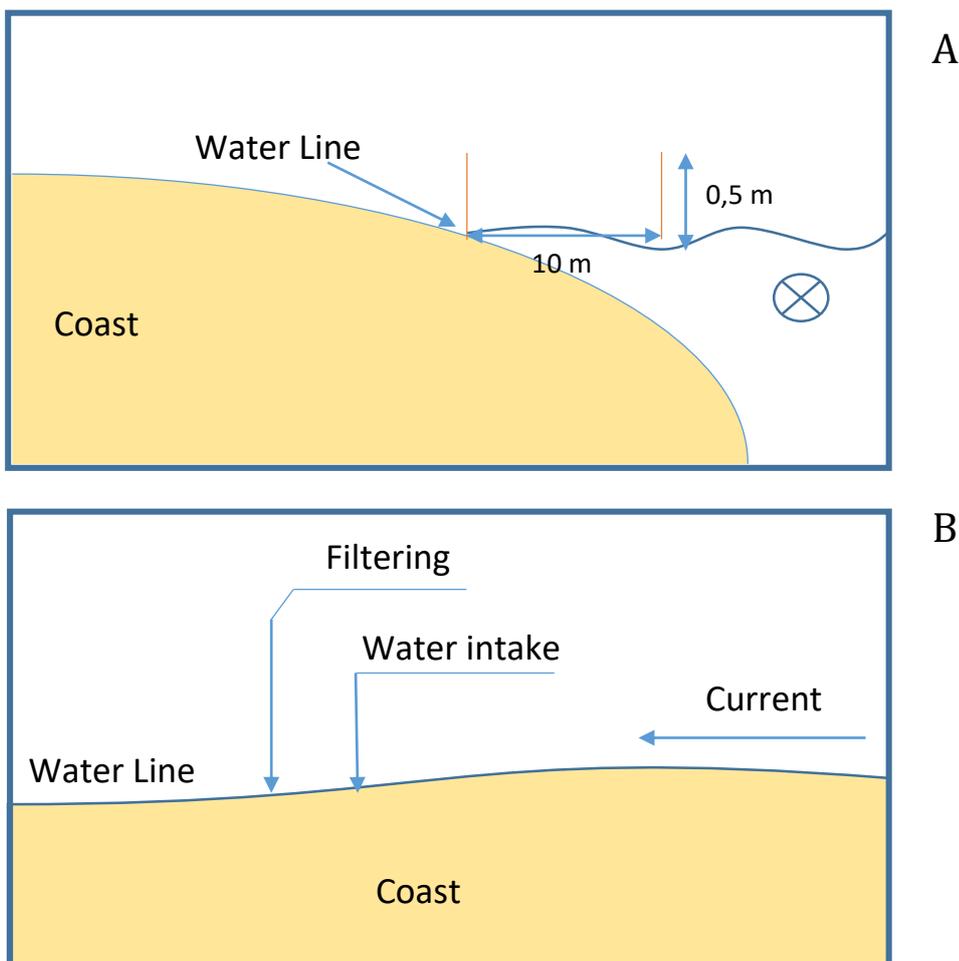


Figure 1. A) Side view; B) View from the shore

Pre-treatment in the field laboratory

On the basis of the field laboratory the sample is transferred from the sieves to a glass jar. From each sieve rinse all of the sampled material into a glass beaker using a wash bottle with distilled (MQ) water. After the sieve is visually absolutely clean it must be rinsed 5 more times. Then the entire volume of the sample is transferred from a glass beaker to a glass jar. The glass beaker is washed thoroughly several times (5 times at least). Then the obtained sample is fixed with ethanol and hermetically sealed in a glass jar (Figure 2). The jar is carefully marked.



A

B

C

Figure 2. A) Sieve washing with MQ; B) Water sample transfer to the jar; C) Sample with ethanol-fixed suspended organic matter

Avoiding contamination

One must consider all materials that are present during the collection and processing of samples. For this, pieces of materials (fibers from clothing, etc.) that are directly in the vicinity of the study area are taken to eliminate errors with artificial polymers: fibers from a work gown, from a tent where samples are processed, and plastic instruments involved. Pieces of materials are then sent to the laboratory together with the samples.

Next step

The samples are then transferred to the specialized laboratory for further treatment: organic matter digestion and qualitative and quantitative assessment according to the existing protocols based on the method applied in the specific laboratory in charge (microscopy, spectrometry, etc.).

General field security rules

- Wear weather-appropriate clothing (wind- and rain-proof, etc.).
- Always have enough drinking water with you.
- Volunteer team must consist of at least two people.
- Study beforehand the area where you are conducting your research.
- If you find potentially dangerous items (e.g. cans of petroleum products, chemicals, gas, etc.), contact local authorities (e.g. the Committee for Nature Management, Environmental Protection Agency etc.) to report dangerous items. If you are in doubt or unsure about their source, do not touch!
- Make sure that you have an emergency connection (mobile phone, radio).
- Always have a first-aid kit with you. The first-aid kit must also include a mosquito repellent, a sunburn remedy, and drinking water.