

Methodology used by Oceaneye for the quantification of micro- and mesoplastic concentration of surface waters

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Introduction

Since 2011, the association Oceaneye is performing a program to monitor the micro- and mesoplastic pollution of surface waters. To collect the samples, Oceaneye has first led their own expeditions and, since 2015, has equipped and trained volunteer sailboats. The organizations participating in this program were: Association Oceaneye (www.oceaneye.ch), Fondation Pacifique (www.fondationpacifique.org), Swiss Cetacean Society (www.swisscetaceansociety.org), Association Rêves-sur-mer (www.reves-sur-mer.ch), Bonavalette, Marémotrice (www.maremotrice.ch), Saileat (www.saileat.fr), Precious Plastic Léman (www.preciousplasticleman.ch), Swiss Sailing Club (www.swiss-sailing-club.ch), Bekwaïpa, Oceasciences (<https://oceasciences.wixsite.com/oceasciences>), Seatheplastic (www.seatheplastic.com) as well as individual sailors willing to remain anonymous. The set of samples formed between 2011 and 2020 is composed of 764 net tow coming from the Mediterranean Sea, the Atlantic, the Pacific, the Indian and the Arctic Oceans, Southeast Asia as well as Lake Geneva and the Rhône River.

Sampling

Samples were collected with manta nets from different sailboats with a length ranging from 10 to 33 m. The Manta Trawl were placed on the windward side of the ship at a distance of 2.0 m off the hull to avoid any wake effect of the ship. The net had a mesh size of 0.33 mm, and the size of the inlet flow rectangular opening was 0.6 m × 0.15 m. The samples have been collected at a target speed of 1.5 m/s (3.0 kn) in wind conditions between 0 and 10.3 m/s (20.0 kn). The duration of the trawl ranged from 30 to 90 min. Until 2014, the distance covered during such trawl was evaluated by the GPS distance traveled between the net launch and the net exit. From 2015, the nets were equipped with a mechanical flow meter (Hydrobios 438 110). The wind speed was measured for each sample with an anemometer placed at the top of the mast, and the sea conditions were classified in three categories

according to Douglas' scale: slight (wave height <0.5 m), smooth (0.5 m < wave height < 1.25 m) and moderate (1.25 < wave height < 2.5 m).

Storage

Between 2011 and 2014, the particles in the collector were transferred and stored in tube bottles in water saturated by salt at room temperature and protected from exposure to light (only for Oceaneye expeditions). As of 2015, in order to avoid any handling errors by the volunteers, the participating sailboats were equipped with one cod-end per sample. After a sample collection, every cod-end and its contents were wrung out, loaded with salt, sealed in a hermetic food bag and stored at room temperature and protected from exposure to light.

Distance measurement method	Particles were transferred and stored in tube bottles	1 cod-end per sample stored in food bags
GPS distance	Distance measurement method: GPS, sample storage method: tube bottles	Distance measurement method: GPS, sample storage method: food bags
Mechanical flowmeter	Distance measurement method: flowmeter, sample storage method: tube bottles	Distance measurement method: flowmeter, sample storage method: food bags

Identifier P01: SAMPROT

Analysis

Samples were first sieved through 5 mm, 1 mm and 300 µm sieves, to separate mesoparticles from bigger and smaller microparticles, and rinsed with water. The resulting filtrate was placed in plastic Petri dishes, and observed through a stereo microscope. All particles were visually identified, separated from the plankton and sorted into six form categories based on that of Shaw and Day (1994)—fragments from larger pieces, pellets (including preproduction pellets as well as smaller cosmetics microbeads), lines (fishing lines), thin films, foams and other particles (fibers, tar, glass, etc.). Not being able to visually differentiate between synthetic and natural fibers, they were all placed in the category others. Once dried for one week at ambient temperature, the particles of each category were counted and weighted (accuracy 0.1 mg).

Size of the particles (by sieving)	Code
0.33 à 5.00 mm	H0300010
1.00 à 5.00 mm	H0300008
> 5.00 mm	H0300009

Identifier P01: MLITSIZW

Quality control with FTIR analysis

Sixty-one particles were analyzed using FTIR (Fourier Transform Infrared Spectroscopy) in order to confirm their polymeric identity. Particle characterization was performed using a Agilent Cary 630 ATR-FTIR spectrometer, based at the Chimiscope of University of Geneva (<https://scienscope.unige.ch/chimiscope/>). The infrared spectra were processed and analyzed using Agilent MicroLab software. Polymer identification was performed by comparison with a commercial library. Sample spectra were compared to this database and only matches > 72% with reference spectra were accepted as verified polymers. The results show a polymer identification rate of 89%.

Related publications

Faure F., Saini C., Potter G., Galgani F., de Alencastro L.F., Hagemann P. *An evaluation of surface micro- and mesoplastic pollution in pelagic ecosystems of the Western Mediterranean Sea*. Environ Sci Pollut Res Int. 2015 Aug; 22(16):12190-7. doi: 10.1007/s11356-015-4453-3. Epub 2015 Apr 19. PMID: 25893619.

Michida Y. et al., 2019. *Guidelines for Harmonizing Ocean Surface Microplastic Monitoring Methods*. Ministry of the Environment Japan, 71 pp.

Isobe, A., Buenaventura, N. T., Chastain, S., Chavanich, S., Cózar, A., DeLorenzo, M., Hagemann, P., Hinata, H., Kozlovskii, N., Lusher, A. L., Martí, E., Michida, Y., Mu, J., Ohno, M., Potter, G., Ross, P. S., Sagawa, N., Shim, W. J., Song, Y. K., ... Zhang, W. (2019). *An interlaboratory comparison exercise for the determination of microplastics in standard sample bottles*. Marine Pollution Bulletin, 146, 831-837. <https://doi.org/10.1016/j.marpolbul.2019.07.033>