The "Mantamaran", a light, robust, portable and affordable sampler designed for altitudes lake microplastics sampling campaigns

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The "Mantamaran", a light, robust, portable and affordable sampler designed for altitudes and remote lake microplastics sampling campaigns

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The presence of microplastics in the oceans is deeply documented and is the subject of numerous investigations and publications. Research on microplastics in fresh water, especially in mountainous and remote locations, however, is very poorly documented.

In this context, a research programme called PLASTILAC (www.aqualti.org/plastilac) involving NGO AQUALTI and research teams (University SAVOIE MONT-BLANC, University GUSTAVE EIFFEL) was launched to measure microplastics in alpine altitude lakes in the French Alps and to confirm the possible presence of microplastics in areas far away from sources of pollution. Access is generally possible by helicopter or by foot only and requires a light weight.
Nine mountain lakes in altitudes above 1800 m were monitored in 2019 and 2020.

To monitor lake surfaces, the "Mantamaran", a contraction of manta net and catamaran, was developed for the purpose.
The main advantage of this boat is to be able to collect representative samples over the entire surface of the lake.

The Mantamaran (credits photo Marie Raison)

The "Mantamaran" is a light, robust and portable sampler specially designed for campaigns on altitude and remote places.

Equipment

The "Mantamaran", is composed of two inflatable kayaks, a metal structure, and some special equipment and is designed to be assembled on site. Four to five persons are required to carry the equipment (60 kg).

Since sampling cannot be achieved while paddling, the raft is propelled by a non-polluting electric motor. The electric motor and lithium-ion battery package were specifically designed for the project by SHEMATIC (www.shematic.ch), and a compromise weight versus power was achieved to allow at least three runs in the same campaign.

This device incorporates a 50 µm removable mesh net designed specifically for this special craft.
A compromise was made between mesh dimensions and propulsion power, to limit drag force and avoid mesh tear.

A logging device was developed by HEPIA (www.hesge.ch/hepia) including a GPS system and several sensors (flow sensor, sonic sensor, temperature) that allow for high accuracy of the measurements. Special attention has been paid to the measurement of flow velocities and water heights into the net in order to properly determine the filtered water surfaces and volumes.

Experience feedback

The boat, propelled at a speed of about 1 knot, allows filtering of volumes between 100 and 200 $m^{3,}$ depending on sampling times.

The raft has been tested and optimized in various and challenging conditions. It offers excellent stability, buoyancy and safety with a payload of up to four persons and scientific equipment.

Due to its small dimensions (360 cm x 250 cm), the boat is very manoeuvrable and can be used in complex conditions to avoid shoals and ice floes. The electric propulsion system is retractable and can be easily removed.

Our work has shown that estimating the filtered volumes from the speed of the boat, as it is often done, instead of the real flow velocities within the net induces an overestimation by a factor of up to 2 or 3, which has direct consequences on the estimated concentrations of microplastics. In addition, the calculation of the ratio between the speed of flow in the net and that of the boat's advance makes it possible to set an objective criterion for monitoring the net clogging which constitutes a major bias in the contamination estimation. Indeed, the clogging of the net induces the backflow of the surface water layer and the loss of floating microplastics.

AQUALTI NGO will be happy to give you more information or to carry out sampling campaigns in remote environments in any place in the world.