INTERNATIONAL COUNCIL OF CHEMICAL ASSOCIATIONS

Request for Proposals (RfP)

Microplastic biomonitoring in fish: Assessing the feasibility and conducting a pilot field study

Background

Observations of microplastic particles (MPs) (<5mm) in the environment and their detection in the stomachs and intestines of aquatic organisms have been observed routinely over the last several decades. The ingestion of plastic debris of varying sizes has recently been summarized in a critical review interpreting data for >800 species representing approximately 87,000 individual organisms, for which MPs are observed in about 17,500 or 20% of individuals (Gouin, 2020). The average number of reported MP/individual across all studies is estimated at 4, with studies typically reporting averages ranging between 0 and 10 MP/individual, observations that are consistent with Hermsen et al. (2017). Overall, there is substantial heterogeneity in how samples are collected, processed, analyzed, and reported, causing significant challenges in attempting to assess temporal and spatial trends or in helping to inform mechanistic understanding. Nevertheless, several studies suggest that the characteristics of MPs ingested by organisms is generally representative of plastic debris (>5mm) in the vicinity of where individuals are collected. Monitoring spatial and temporal trends of ingested MPs could thus potentially be useful in assessing mitigation efforts aimed at reducing the emission of plastic to the aquatic environment and potential exposures to MPs.

In Europe, the Marine Strategy Framework Directive (MSFD) has established an aim of assessing progress towards the achievement of Good Environmental Status (GES) for European waters. Demonstrating GES requires all member states to ensure that 'the amount of litter and micro-litter ingested by marine animals is at a level that does not adversely affect the health of the species concerned' (EC, 2013). The proposed threshold used under the MSFD to quantify the level of litter being ingested are largely based on recommendations from the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR). Under OSPAR an example of a threshold value for assessing GES is based on monitoring the quantity and incidence of litter ingested by *Fulmarus glacialis*, North Sea northern fulmars, where a quantitative level target of <10% of North Sea fulmars should have no more than 0.1 g of plastic in their stomach over a continuous period of at least 5 years in all North Sea regions (OSPAR, 2008; EC, 2013). Generally, the stomach contents of northern fulmars have proven to be a cost-effective biomonitor and can provide timely information related to the effectiveness of efforts at reducing the leakage of plastic into the environment by assessing both increasing and decreasing trends (van Franeker et al., 2011; Avery-Gomm et al., 2012; Trevail et al., 2015; Beer et al., 2018).

Building on the application of northern fulmars as a biomonitor for the North-East Atlantic and North Sea, there have been additional efforts to identify other species that may lend themselves well as biomonitors. A key challenge is to identify species with traits and spatial distribution that may make them suitable. For instance, in assessing the suitability of nearly 50 different fish species to act as biomonitors for the Mediterranean basin, Bray et al. (2019) suggest *Engraulis encrasicolus*, *Boops boops*, and three species of *Myctophida* (*Hygophum benoiti*, *Myctophum punctatum* and *Electrona risso*) as well

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as *Mullus barbatus barbatus* and *Chelidonichthys lucerna* as suitable pelagic, benthopelagic, mesopelagic, demersal, and benthic biomonitoring species, respectively.

Based on the observations that MPs are largely observed in the GIT of fish and building on the use of *F. glacialis* as a biomonitor for GES, a feasibility study will be conducted to assess the use of a fish species for which physiological and behavioural traits are relatively well understood with respect to feeding and where a sample size >50 can be obtained. Ideal species may include, but are not limited to, commercial fish, such as lancetfish, mullet, scad, plaice, mackerel, seabream, and/or flounder. Applying best practices in relation to quality assurance and quality control (QA/QC) for sample collection, storage, transport and analysis, the ideal study would work collaboratively with a commercial fishery, gaining access to the GIT of individual and/or pooled fish for subsequent analysis of MPs. The feasibility study would support efforts aimed at developing methods for acquiring fish samples in a robust manner aimed at maintaining good QA/QC throughout the analytical process, identifying associated challenges and assessing overall potential for expanding the practice to monitor one or more species at a global scale.

Objectives

The project's objectives are to assess the feasibility of using a fish species for use as a biomonitor for MPs in the aquatic environment, which includes:

- Assessment of the key properties of a species required with respect to its suitability as a biomonitor and which considers the potential challenges for use at a global scale versus regional.
- Conduct a field study applying best practices with respect to QA/QC, including for sample handling, and state-of-the art analytical method
- Identify strategies for the implementation of a biomonitoring programme that might work in collaboration with a commercial fishery, where large sample numbers can be obtained in helping to strengthen the statistical power of the data.
- Report on the challenges and potential for applying and establishing a global biomonitoring programme.

Scope

1. Determine the feasibility of characterizing, and measuring the quantity of, microplastic particles collected from the gastrointestinal tract of an appropriately defined fish species, including its relevance for use as a global biomonitor and understanding of key physiological traits in relation to feeding behaviour. To aide in the design of the study, a power analysis will be conducted to describe sample sizes and effect sizes needed to obtain statistically meaningful results at local and global levels,
2. Conduct a pilot field study at a regional scale to assess the feasibility of implementing a scientifically robust sampling and analysis protocol.

Research proposals should provide specific details in relation to how they intend to collect, store, transport, prepare and analyse samples, including measures to control for background contamination and insight regarding the lower size limit possible for both microplastic particles and fibres. Additionally,

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the research proposal should also include a statement regarding the number of fish to be included in the pilot study needed to support the assessment and feasibility of expanding fish biomonitoring to the global scale.

Deliverables

1. Preliminary report updating on project status including details of number of fish sampled, QA/QC, and discussion of challenges encountered in implementing the protocol during the pilot study. To also include issues to be considered in follow up discussions by the ICCA MP Task Force related to designing MP biomonitoring studies in fish at regional and global scales. Due no later than September 15, 2020.
2. Final report by November 30, 2020, with the potential to develop the study results into a peer-reviewed publication.

Cost and Timing

Start Spring 2020, duration 1 year.
Budget in the order of €80 000.

Partnering/Co-funding

Applicants should provide an indication of additional partners and funding opportunities that can be appropriately leveraged as part of their proposal. Partners can include, but are not limited to industry, government/regulatory organizations, research institutes, etc.

Proposal Deadline

20th April 2020

Submit proposals and enquires to:
Todd Gouin
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Notification of results anticipated week beginning 4th May, 2020.

References

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