WORKING GROUP ON MARINE LITTER (WGML; outputs from 2024 meeting)

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i Executive summary

The Working Group on Marine Litter (WGML) aims to provide scientific guidance for the international harmonisation of monitoring data on seafloor litter and microlitter, acting as a knowledge hub for other international organisations and supporting the ICES Secretariat.

WGML activities focus on reviewing and assessing the quality and potential uses of current data in the ICES DATRAS (Trawl Surveys) and DOME (Marine Environment) databases, while also reporting on new developments in quality assurance for marine litter and microplastic monitoring in Europe and providing information on relevant proficiency testing schemes. To validate the ICES manual for seafloor categorisation and accompanying photo guide, a seafloor macrolitter proficiency test was created to assess classification accuracy and the usability of ICES manual, helping improve seafloor litter categorization and data collection methodologies. In addition, WGML reviewed and approved a new microplastic and litter data submission format, splitting it into four compartments: water, sediment, biota, and seafloor litter. The format was stress-tested and aligned with EMODnet standards, with recommendations for improved data reporting and integration with EMODnet microlitter data flows. WGML, in collaboration with ICES Marine Chemistry Working Group (MCWG) and Working Group on Biological Effects of Contaminants (WGBEC), contributed to an A1-publication evaluating knowledge gaps on plastic additives. Based on an online stakeholder survey, the publication highlighted key issues in assessing the risks of plastic additives, particularly data gaps in production volumes, use, persistence, bioaccumulation, and toxicity. A new focus area for WGML is evaluating innovative monitoring methods for both macro- and microlitter. A review of emerging underwater technologies for seafloor litter, including sonar systems and optical sensors, revealed their potential to enhance monitoring capabilities. However, many of these tools are still in early development stages.

Looking ahead, WGML term 2025–2027 will focus on integrating these advanced technologies, working toward a shift from traditional methods to more sustainable, effective monitoring solutions for marine litter. Other priorities are the quality assurance processes for data acquisition and the optimisation of the usability of the ICES litter category list.

ii Expert group information

Expert group name	Working Group on Marine Litter (WGML)
Expert group cycle	Multiannual
Year cycle started	2022
Reporting year in cycle	3/3
Chairs	Lisa Devriese, Belgium
	Christopher Pham, Portugal
	Bavo De Witte, Belgium
Meeting venues and dates	22-29 April 2022, Trondheim, Norway, 36 participants (physical attendees and remote combined)
	5-9 June 2023, Horta, Azores, Portugal, 40 participants (physical attendees and remote combined)
	3-7 June 2024, Gdynia, Poland, 39 participants (physical attendees and remote combined)

1 Release of plastic additives and their effects on the marine environment

Within this activity, the aim was to evaluate current knowledge and gaps on the release of plastic additives and their effects on the marine environment. A publication was written in collaboration with the Marine Chemistry Working Group (MCWG) and the Working Group on Biological Effects of Contaminants (WGBEC); (Maes *et al.*, 2023). The activity started with an online survey to evaluate expert opinions and knowledge on plastic additive chemicals. Based on a literature review, 9 relevant additives groups were selected to address within the survey: phthalates, aromatic amines, organophosphates, metal acetates, PFAS/PFOS, metals, organotins, polybrominated diphenyl ethers and phenelynediamines. Next to questions on demographic information, the survey included following questions (Maes *et al.*, 2023):

Q8 - To the best of your knowledge what are the approximate volumes of these compound groups/chemicals produced globally, relative to each other?
Q9 - To the best of your knowledge are there sources and pathways, other than plastics, of these compound groups/chemicals into the marine environment?
Q10 - To the best of your knowledge are there standardized and well-developed methods available to analyse these compound groups/chemicals?
Q10b - Please can you name the methods that you are aware of to analyse the above compound groups/chemicals?
Q11 - To the best of your knowledge are these compound groups/chemicals persistent, bioaccumulative and/or toxic?
Q12 - To the best of your knowledge do these compound groups/chemicals cause a risk to the lower marine trophic levels (plankton, algae,…)?
Q13 - To the best of your knowledge do these compound groups/chemicals cause a risk to the higher marine trophic levels (fish, mammals, birds,...)?
Q14 - From your expert perspective, what would be an important question to ask stakeholders (e.g. a policy maker, or the plastic industry) related to the use of plastic additives?
Q15 - From your expert perspective, which knowledge gap needs to be addressed urgently in order to support policies on standards and legislation for the use of plastic additives?

The survey was completed by 50 respondents and revealed following issues (Maes *et al.*, 2023):

- Lack of knowledge on production volumes and use of plastic-related additives.
- Gaps in knowledge regarding comparative ecotoxicity studies of diverse polymer types and the effects of related weathering phenomena.
- Lack of comparative studies investigating the effects of plastic leachates degradation and the co-occurring release of additives.
- Lack of comprehensive life cycle assessment studies regarding plastics.
- Need to improve and standardise analytical methods for plastic additives.
- Need to improve current methods to characterise leaching of plastic additives.
- Low knowledge of PBT characteristics of plastic additives.
- Risk assessments hampered due to gaps in crucial data.
- Phenylenediamines, particularly 6-PPD, came up repeatedly as a compound group for which knowledge gaps exist on pathways into the environment, analytical methods, PBT characteristics and risks.

Based on this publication, a suggestion for a follow-up publication was made, which could start from the toxicity data compiled within Maes *et al.* (2023). Further contacts were made with MCWG and WGBEC.

2 Interaction with other expert groups

The Working Group on Introduction and Transfers of Marine Organisms (WGITMO) requested feedback from the WGML on a protocol for monitoring Non-Indigenous Species (NIS) on marine litter. The protocol was designed as an opportunistic sampling method to assess NIS on marine litter across various compartments, including the coastline, seafloor, and floating debris at the surface. It provided a detailed description of the NIS as well as the types of marine litter associated. While we offered several suggestions on what to report, our primary recommendation was to utilize existing classification lists (e.g., ICES and J-List, tailored to specific compartments) for categorizing marine litter. This approach would facilitate the integration of collected data with other marine litter monitoring initiatives.

3 WGML alignment with international partners

During the WGML brainstorm session in June 2023, an online meeting with PICES members (Amy Uhrin, Matthew Savoca, and Jennifer Provencher) was held in which several potential collaboration initiatives were discussed, with the main topics being the ICES ASC 2024, UN Ocean Decade and the use of bioindicator species for monitoring plastic pollution. This led to the proposal for a specific ICES-PICES session on the ICES ASC 2024, entitled "Improving our understanding of marine litter dynamics: from overarching assessments to innovative detection technologies" which was unfortunately not approved.

Within the topic of the UN Ocean Decade (OD) and the SmartNet programme- Join expert groups (OD actions), some PICES/ICES Joint Expert Groups have already been established (mainly themes 1-4), dealing with: small pelagic fishery ecology & sustainable management, ocean negative carbon emission, integrated ecosystem assessment for the Arctic Ocean, impacts of warming on growth rates & fisheries yield, climate change effects on marine ecosystems or climate extremes. A joint 'marine litter and bioindicator species' discussion between AMAP – ICES – PICES would be interesting, covering the Northern Hemisphere oceans. The bioindicator project under the OD's SmartNet program (via PICES WG 42) was approved and may also provide an opportunity for collaboration in future. Moreover, collaboration between PICES and ICES members was established through a review publication on bio-indicators for marine litter (Savoca *et al.*, 2025). Currently, the WGML has no ToR on bioindicators for plastics, but this may be included in the next cycle.

ICES WGML was in close contact with the OSPAR Seafloor Litter Expert Group (SLEG) and OSPAR MicroPlastic Expert Group (MPEG). A clear alignment of tasks took place on seafloor litter in which ICES WGML focused on data entry in the DATRAS and DOME databases, QA/QC of data collection and reporting and innovative approaches. Focus of OSPAR SLEG was on ensuring the monitoring data can feed into the policy and decision making and on making assessment for the OSPAR Quality Status Report. Both groups shared information and progress on new methods to monitor seafloor litter. Current collaboration with OSPAR MPEG is including a technical input into the development and refinement of the ICES DOME database with the testing of the new litter format as part of the DOME litter data testing subgroup. MPEG is currently focusing on the reporting of microplastics from seafloor sediment to support the new common indicator on microlitter (including microplastics) in seafloor sediment for the OSPAR Maritime Area (OSPAR MPEG, 2024). ICES WGML has been suggested to act as a quality control body to initially assist with the quality control and quality assessment of data submitted to ICES DOME with additional support for data submission.

Close collaboration with AMAP, OSPAR and HELCOM was also established through the development of the new ICES DOME litter format (section 7) to ensure that the new format allows optimal assessments of litter and microplastic occurrence within the different sea regions.

4 Innovative methods for macro-and microlitter monitoring

Evaluation of current monitoring efforts and prospectives for future monitoring for macro- and microlitter

In 2023, a brainstorming workshop was organised with WGML members in the context of the microlitter/microplastic and seafloor litter approach of the future to discuss, as well as the role our working group can and wants to take in this. The purpose of this exercise was mainly to position our group well within the landscape, where our goals will be translated into the programme of ToRs 2025–2027. Some focal points from workshop were:

Microlitter/Microplastic.

- ICES WGML can and will play a role in the QA/QC on microplastic monitoring.
- ICES WGML will be guided by current research projects on microplastic methods of monitoring (detection, quantification).
- ICES WGML can play an important role when it comes to assessing microplastics related to fisheries and fisheries products, such as plastic ingestion and entanglement.
- ICES WGML will mainly focus on current gaps (e.g. positive controls) for microplastic monitoring.

Seafloor litter/Macroplastic.

- ICES WGML will remain committed to seafloor litter data.
- ICES WGML wants more visibility on alternative methods to observe seafloor litter.
- ICES WGML is launching a desktop study to evaluate the potential of underwater technologies for seafloor litter.

Review paper on underwater technologies for marine litter observations

Accepted publication: A systematic review of state-of-the-art technologies for monitoring plastic seafloor litter - ScienceDirect

Extended summary: In recent decades, the increasing levels of plastic in the World's oceans has drawn significant public attention and raised concerns about the impacts this might be having on the marine environment, marine organisms and human health. This has resulted in marine litter, and especially plastic litter, being high on the political agenda. A large proportion of this plastic accumulates at the bottom of the ocean, resulting in a need to monitor and quantify seafloor litter. The monitoring of litter in marine environments is a fundamental part of the wider state of environmental reporting, and a key component of ecological risk assessments, which are ideally based on realistic exposure conditions. Marine litter is a transboundary problem, and international cooperation and coordination are crucial to monitor and reduce marine pollution. On a global level, marine litter is included under the UN Sustainable Development Goal 14 'Life Below Water' and Challenge 1 of the UN Decade of Ocean Science for Sustainable Development 'Understand and beat marine pollution'. Since the 2010s, frameworks such as the International Council for the Exploration of the Sea (ICES), the Regional Seas Conventions (e.g. Oslo Paris Convention; OSPAR) and the European Union Marine Strategy Framework Directive (MSFD) have been quantifying and monitoring seafloor litter using beam trawl hauls, revealing the first insights into the prevalence distribution patterns, transport routes and accumulation zones of plastic litter.

Benthic trawl surveys are a practical way to monitor seafloor litter because they are already coordinated by ICES for fish stock assessments, but are a destructive sampling technique that has been subject to discussion and criticism for many years. In line with the Biodiversity Strategy 2030, the European Commission has the intention of implementing restrictions to limit bottom trawling in EU waters, supporting the transition to more selective and less damaging fishing techniques. It has subsequently put forward a legislative proposal to phase out bottom trawling by 2030. In addition, a catch-based assessment of seafloor litter comes with a number of other drawbacks, e.g. limited to locations for fishing, focus on shallow waters, no monitoring in marine protected areas (MPAs), uncertainty when comparing different trawls with different mesh sizes, and inability to quantify the litter on the seafloor etc..

In light of all these drawbacks, scientists have been seeking new and innovative ways to detect and quantify plastic litter present on the seafloor and in the lower layer of the water column. These approaches include elements of autonomous detection (in situ detection without human interference), which can enable swift observations of marine litter, allowing the quick analysis of evolutionary patterns of litter distribution, as well as better policy alignment. The need for innovation in monitoring and observation activities for seafloor litter was also raised by the ICES Working Group on Marine Litter (ICES WGML) and explicitly mentioned in the OSPAR Quality Status Report, which is endorsed by 15 Governments and the European Union. Furthermore, the following focal points can be identified when screening the literature:

- There is a clear gap in the available scientific literature and knowledge for sustainably and accurately monitoring plastic seafloor litter at an international level.
- There is currently no off-the-shelf in situ detection technique that is operational for systematic seafloor monitoring of plastic litter in diverse marine environments that provides sufficient details to meet the required objectives for exposure, effects, and risks assessment of seafloor plastic litter.
- With the increased interest and desire to efficiently and effectively sample and monitor seafloor litter, it is necessary to compare the different available approaches to allow researchers and regulators to identify the most suitable techniques for use in research or monitoring.

To address these gaps, this study evaluates which existing technologies are eligible for future in situ meso- and macroplastic litter (>5 mm) detection on the seafloor and the hyperbenthic area (<1 m above seafloor). The current state of the different technologies was benchmarked against the envisaged final product to determine the main steps toward innovation. A set of objectives to describe the final product were introduced and a Technological Readiness Level (TRL) was defined for each technique in the context of plastic litter detection based on the suggested scale by Aliani *et al.* (2023). Four objectives, underpinned by the expert judgment of the ICES WGML, were set up that matched the expectations of the desired technology for seafloor plastic litter detection: (i) identification and differentiation of plastic litter, (ii) spatial coverage of detection techniques, (iii) detection size range of detection techniques and (iv) artificial intelligence for plastic detection. Furthermore, the compatibility of each technique with operating platforms (e.g. USV, AUV, ROV, ships and towed systems) was determined. This study provides the following results:

- Fourteen technologies that are potentially suitable for in situ plastic detection in marine environments were identified in this systematic review based on 101 scientific publications (see figure below);
- Most of these technologies are currently at low-middle TRLs, requiring several more development, testing and commercialisation steps before they can be applied effectively in marine field conditions and achieve a level of identification and quantification that is comparable to the existing seafloor litter monitoring programs;
- Sonar systems (e.g. 2D imaging sonars) and optical sensing systems (e.g. camera) have the highest TRL for in situ meso- and macroplastic detection. Synthetic Aperture Sonars (SAS) have been shown to be the most promising for seafloor plastic detection given its differentiation possibilities, along with the broad detection size range and spatial coverage;
- Spectral imaging and capacitance systems look promising at the proof-of-concept level, but currently lack validation in an operational environment;
- For technologies targeting micro- and mesoplastics, further research is urgently needed;
- Detection methods are region-specific in terms of applicability. Therefore, a decision tool to define the most suitable method for different scenarios was developed;
- This study enables determination and comparison of the different state-of-the-art detection techniques.

It is anticipated that the compilation of information in this study, in combination with the proposed decision framework would be helpful in identifying the optimal monitoring system design worldwide for seafloor litter. While a TRL scale has many advantages, there is an additional need for a comparability assessment between the different technologies to ensure that the resulting monitoring data is fit for purpose and sufficiently comparable across studies utilising different analysis approaches. To enable the comparison of data generated by these different technologies as they develop further, there is a need for harmonisation of the categories of seafloor litter items and units. These technologies, alone or in combination, have the potential to contribute to the establishment of more robust global environmental indicators and monitoring programs for plastic pollution. The monitoring, research and regulatory communities need to view such technologies as the future for marine litter monitoring and already start to develop a road map for their harmonisation, validation, approval and inclusion in official monitoring programs.

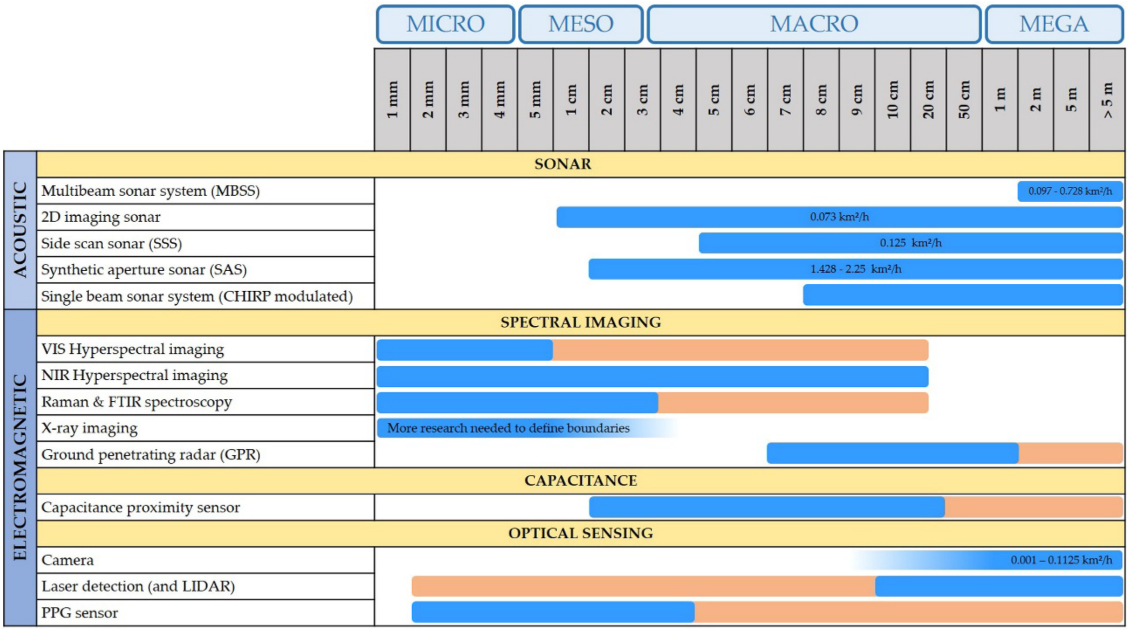

Figure 1. Detection size range and spatial coverage (in km²/h) by seafloor detection technique. Blue bars show the detection range reported in literature to date. Orange bars show the possible extension of size range based on expert judgement of the co-authors (Sandra *et al.*, 2023 - https://doi.org/10.1016/j.joes.2023.07.004).

Integration of innovative approaches into the ToR 2025-2027 programme

A session was organised in 2024 to determine the draft programme of ToRs for 2025–2027. Based on the work done and new insights, it was decided to formulate a new ToR on innovative technologies and future monitoring activities for seafloor litter and microplastic. Listed below are the potential actions under this ToR divided into must haves and nice to haves. The definitive programme was finalised by the end of 2024.

Core activities (must have):

- Strengthen expertise within the group on digital technology, including by co-inviting new members.
- Establishment of a roadmap to shift away from trawling to digital/visual technology.
- Establishment of a blueprint for deep sea surveys and technology.

Nice to have:

- Formulation of recommendations on the integrated approach for video surveys (e.g. combining benthic and litter surveys).
- Drafting guidelines for monitoring (macro, mega litter) in underwater imagery, and alignment with the ICES seafloor litter guide (trawling).
- Knowledge hub related to the use of underwater technologies (e.g. sonar) for litter applications.
- Citizen science: evaluation of the added value in an ICES perspective.

5 Seafloor litter guidance document

Background and progression of the manual

The seafloor guidance document has had a long start-up phase. The first in-person meeting of ICES working group on marine litter, WGML, was in Copenhagen in Denmark in 2018. At this meeting, the lack of instructions on how to sample litter during ICES fish surveys was considered one of the topics of highest importance for the WGML. As a result, an Annex with some first guidelines on how sampling should be conducted was produced, as well as an additional Annex with a photoguide with seafloor litter categories. As the first meeting of WGML showed the great need for detailed instructions on how to sample and record litter, the group continued to elaborate on the instructions for sampling and reporting to DATRAS during and after the WGML-meetings in 2019 and 2020 (only digital due to Covid). In 2021 there was no formal full week in-person WGML-meeting, only online meetings on ToRs for 2022–2024, and a meeting on how to disseminate the guidelines in the best way. In 2022 the work on publishing the manual gained momentum and after several online meetings throughout the year, an actual in-person meeting (the first since 2019) and individual efforts the manual and the photoguide were published in November 2022 as "ICES techniques in marine environmental science" documents: https://doi.org/10.17895/ices.pub.21435771.

In 2023, the group started to explore solutions to make ICES 42 litter categories correspond to the Joint List 183 categories prepared by the MSFD Technical Group on Marine Litter (MSFD TG ML) https://publications.jrc.ec.europa.eu/repository/handle/JRC121708. It was considered important to improve the seafloor litter monitoring because it would allow tackling two monitoring hindrances: the reduced comparability of the ICES system with the systems used in other environmental compartments (beach, floating, etc.), and the limited information on litter sources that the actual ICES system provides.

These two lists are constructed following different principles (Figure 2). For the ICES list there are two levels, the material and then the type of object. For the Joint List, litter categories are assigned after passing through 5 levels of classification. For instance, two examples of codes at level five are shown to the right in the figure 2 below (plastic drink bottles of two sizes). However, in the ICES list there is only one plastic bottle category (i.e. A1) regardless of the intended use of the bottle and the size (i.e. these characteristics are not included in the category).

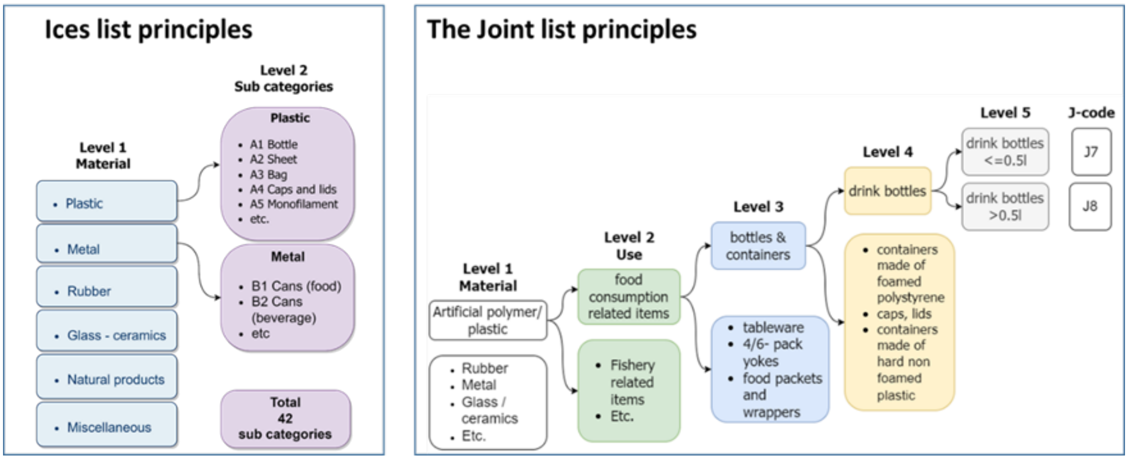

Figure 2. Principles for the ICES list to the left and principles for the Joint List to the right. There are 90 categories on level 3 in the Joint List, 55 on level 4 and 37 seven on level 5. In the figure to the left there are two examples of categories on level 5.

As the two lists have different principles and different numbers of categories a conversion is not straightforward. There are Joint List categories that only fit one single ICES category, but some Joint List categories can be placed in several ICES categories, see figure 3 below.

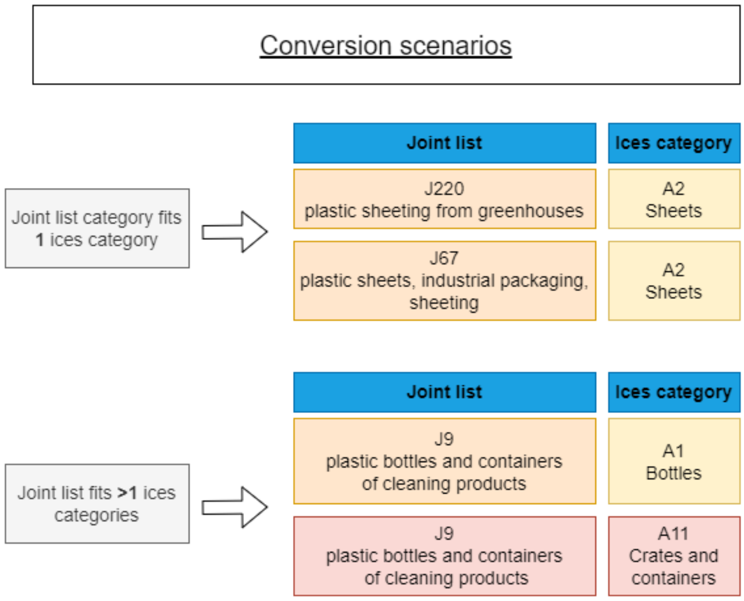

Figure 3. Conversion scenarios between Joint List and ICES categories.

The work to make a correspondence of the lists continued in 2024 and the solution to the dilemma was to make the classification of litter a two-step procedure, setting the first step compulsory and the second advisable. Firstly, the litter item is classified using the ICES list and thereafter, when feasible, the item is further assigned to the corresponding Joint List category. This way the ICES dataset will be compatible with the new classification system. Since the second step is not compulsory although advisable, ICES member states can decide whether to classify litter following the Joint List system or not, considering their availability of resources. As background material for the conversion, the document "Conversion tables for seafloor marine litter categories used in different lists V2.xlsx" written by F. Ronchi, T. Fortibuoni, M. Angiolillo, F. Galgani and revised by K. Staunton was used.

Revisions of the document "Conversion tables..." were prepared ahead of the 2024 Gdynia meeting and these revisions were then addressed during the 2024 meeting in Gdynia. As all revisions could not be taken care of during the Gdynia meeting, the final ones were addressed during a web-meeting in November 2024.As the Joint List is undergoing some revisions too, WGML will need to address these revisions when these are made public.

The correspondence list for a two-step categorisation will be published in the next revision of the ICES Manual for seafloor litter data collection and reporting from demersal trawl samples.

5.1 Overview of the manual and its supplementary photoguide

The manual consists of 22 pages with a summary, a foreword, two chapters, and an example sheet for recording seafloor litter.

The foreword defines marine litter, explains the importance of monitoring litter and gives some background information on fish trawl surveys coordinated by ICES. The foreword also introduces WGML and how the collection of seafloor litter was added to some ICES surveys and first recorded in DATRAS in 2011.

Chapter one on data collection and processing has three parts. The first lists surveys for which the procedures in the manual are mandatory. The second part provides instructions on collecting litter from trawl hauls. Part three describes details for processing litter on board which includes:

- Counting items
- Categorizing items (detailed table with 42 litter categories)
- Weighting items
- Sizing items
- Describing items and recording attached organisms
- Picture number

Chapter two describes data submissions and extraction and consists of three sections. Section one is on how to register litter for submission to DATRAS (ICES database) with a table that describes the format for each field in the dataset to be submitted. Section two describes how data can be downloaded from DATRAS. Section three is on how to submit data to ICES DOME database and how to download data from it. Section three also has a table that describes the format for each field in the dataset to be submitted.

The supplementary photoguide consists of pictures of litter belonging to each of the 42 litter categories. The number of pictures is one to several for each category and the number of pages for the photoguide is 54.

5.2 Strengths and weaknesses of the manual

The strength of the manual is its short and concise format. The whole manual only consists of 22 pages and generally readers are interested in either data collection/processing or data submission/extraction. Another strength of the photoguide is that photos are very helpful and exemplify many of the possibilities explained on the descriptions.

The weakness of the manual is that the categorization table could be more detailed regarding the descriptions as today some fail to classify certain litter objects like for example wrappings from snacks. More pictures should be added to overcome this weakness. In the future there will be a table with the correspondence between the ICES litter categories and the Joint List categories as mentioned before.

6 Macrolitter identification exercise

A seafloor macrolitter proficiency test was created December 2022 with two aims: to assess classification accuracy among people involved in marine litter surveys and assess the usability of the ICES seafloor litter guidelines. The test was set up using mentimeter.com with 39 images depicting seafloor litter items retrieved from trawl surveys. Each image was accompanied by five predefined categorical options derived from the ICES manual. There was a total of 70 responses with an 82% categorisation accuracy. For the items scoring below the average accuracy, a more detailed analysis was done to identify why an item was not classified correctly: due to insufficient knowledge on the object, an unclear picture, the inability to handle the item physically or due to unclear category descriptions in the provided guidelines. This test proved a useful tool to strengthen monitoring guidelines, data collection and understand human errors in datasets such as the ICES DATRAS seafloor litter dataset. The results of the test were used to write a scientific publication which is submitted to the journal Marine Pollution Bulletin (Husabo *et al.*, submitted). The quality control mechanisms that this test provides have not been employed previously in analysis of seafloor litter reporting or in other type of litter monitoring, therefore this is a unique tool in improving seafloor litter categorisation methodologies.

7 New format for microplastic and litter data submission

Based on the reviews by the WGML members and ICES Data Centre in 2022, it was agreed that the present DOME litter format (as part of the Environmental Reporting Format (ERF) 3.2.5) is sufficient only for reporting of the microlitter data in water. In addition, there is a strong wish in the community to make sure the format is EMODnet-compatible, as many countries are submitting data to EMODnet. Therefore, a Workshop on the Revision of the DOME Litter Data Format (WKLIDA) was proposed for the beginning of the 2023. Workshop participants shared their insights into variety of approaches in different litter data collections and reviewed the litter format proposal from ICES Data Centre. Together with representatives of EMODnet Chemistry, it was also possible to review possible mappings between the ICES litter format and the EMODnet water and sediment microlitter formats. The workshop came up with the recommendations:

- Split the existing format into 4 separate formats / data types by compartments as follows: Litter in water, Litter in sediment, Litter in biota, Seafloor litter.
- WGML to review the proposal, test it against the real data, and approve the new formats for implementation.
- ICES Data Centre to strengthen the link between ICES and EMODnet microlitter data flows. First focus on mapping data and references submitted to ICES for EMODnet to decrease the national reporting burden. Then, estimate the possibility to harvest EMODnet microlitter data into DOME.
- A user-friendly data submission template would be beneficial.

More information can be found at the WKLIDA report https://doi.org/10.17895/ices.pub.23541141

WGML reviewed the format proposal in 2023 and approved it for the implementation with note that it would need to be stress-tested against real data afterwards.

ICES Data Centre, acting as an EMODnet Data Centre, received Swedish microlitter data submission for DOME, and mapped it to respective sediment and water microlitter formats, providing the respective data for an EMODnet microlitter data call 2024. Countries can now submit EMODnet litter data via ICES. Some reference mappings related to this process were reviewed by WGML in 2024, and some of the requests are to be taken up with the TGML.

To follow-up work started at WKLIDA and WGML in 2023, a WGML session was organised in 2024 to review the new DOME litter formats for biota, sediment, seafloor litter, and water, and to check the formats against data examples.

Based on the review, some format fine-tuning was suggested for implementation by ICES Data Centre, and a subgroup was formed to test the data formats intersessionally. See the format draft in the Annex 4. Methods list for data reporting collated based on the EUROqCHARM was reviewed by the group. However, the list could not be approved as the group suggested adding percentages of KOH for tissue digestion. The list is to be reviewed and approved by the WGML intersessionally.

Data reporting for procedural blanks and positive controls was discussed as well. Based on the recommendations from the regional commissions and EU TGML, WGML agreed to change the recommendations from 2023. Previous recommendation was to report microlitter data corrected for procedure blanks and positive controls. Now the recommendation is changed that the raw litter data should be reported, together with the positive and negative controls.

8 Towards an assessment of the distribution of Abandoned, Lost or otherwise Discarded Fishing Gear (ALDFG)

The importance of focusing our efforts on ALDFG (Abandoned, Lost, or Otherwise Discarded Fishing Gear) was recognized, leading to the agreement on two primary objectives. First, we aimed to leverage monitoring data to gain deeper insights into the spatial distribution of ALDFG on the seafloor within the ICES area, identifying trends and potential accumulation zones. However, exploratory analyses and subsequent brainstorming revealed that the current categorization of ALDFG items is insufficient, hindering reliable source attribution and limiting our ability to draw definitive conclusions. While some categories are truly ALDFG items (C3, B3, A8, A6 and A5), other important ADLFG items are not discernible (e.g. dolly rope). Additionally, there are a number of biases and issues, which have been discussed previously in detail that needs to be resolved before attempting to integrate all trawling data to highlight spatio-temporal trends in the abundance of ALDFG, which are the following. The choice of the appropriate unit, between number and weight or the use of presence/absence needs to be decided, taking into account that excluding some years, surveys or programs might permit using different units and that careful cost-benefit analysis of losing a long time series over using reliable units is needed. Other biases, includes the use of different trawl types across the region.

Identification of relevant categories for ALDFG items have been discussed, acknowledging the issues associated with the introduction of new categories of litter items. Presentations were made on some frequent ALDFG items that appear in different case study areas. Attempts will be made to link the occurrence of ALDFG in the ICES area with key anthropogenic and ecological drivers.

The latest OSPAR QSR assessments for both seafloor litter and beach litter mention 'fisheries related litter' and 'maritime related litter' but do not discuss ALDFG although items are included in the categories. Routine monitoring needs to harmonise between indicators and assessments the terminology and categorisation of these specific items so the data can help to fill the evidence gaps and advance our understanding of ALDFG (Barry *et al.* 2022; Lacroix *et al.*, 2022). The EU Joint List, prepared but he MSFD coordination group provides a comprehensive list of litter types which aims to bridge the gap between different compartments and indicators but there is work to be done to merge this with the ICES seafloor list (Fleet *et al.*, 2021). The EU list has more detailed categories for fisheries related items, although still doesn't specifically define ALDFG items. And as we look at new methods for monitoring which include use of videos and images, it is important to develop methods for quantifying and categorising ALDFG consistently. With use of videos and images there is also opportunity to include more information on the biota-litter interactions and build on our understanding of harm that it is causing to the marine environment.

The Centre of Environment, Fisheries and Aquaculture Science (Cefas) have been working on a case study to specifically provide a comprehensive description of fisheries related litter (including ALDFG) around the UK through reanalysis of existing photographs and descriptions of litter taken as part of the routing monitoring programme for the North- East Atlantic (OSPAR) (manuscript submitted for publication, 2025). As part of this study a photo guide for identification of ALDFG categorisation is included and can be used to build on future discussions and work towards agreed terminology and harmonisation of categorisation. Ideally between indicators and different methods for collecting data.

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Annex 2: WGML resolution

The **Working Group on Marine Litter** (WGML), chaired by Lisa Devriese, Belgium; Christopher Pham, Portugal; and Bavo De Witte, Belgium; will work on ToRs and generate deliverables as listed in the Table below.

	Meeting dates	Venue	Reporting details	Comments (change in Chair, etc.)
Year 2022	25–29 April	to be decided		
Year 2023	5-9 June	Azores, Portugal		
Year 2024	3-7 June	Gdynia, Poland	Final report by 15 August to SCICOM	

ToR descriptors

ToR	Description	Background	Science Plan Codes	Duration	Expected Deliverables
a	Internal and external cooperation and response to any advice requests as passed from ACOM (e.g. EU, Regional Seas Conventions, ICES Data Centre/Secretariat, ICES expert groups).	Science or Advisory Requirements. Follow-up on future needs is key to constructively guiding and supporting the development process for monitoring, threshold development and impact assessment. Additionally, improve governance of marine litter and microplastic across ICES and its working groups and stakeholders. Assess the relevance and current status of plastic additive chemicals as a pollutant and how this is considered across all related ICES WGs.	2.1; 3.1; 6.3	3 year	Review publication focused on the release of additives from plastics and their effects in the marine environment. In collaboration with MCWG and WGBEC. Follow-up on requests from other groups.
b	Review and propose guidance for ongoing and future monitoring of marine litter and microplastic to support ICES data collection and assessment	Provide guidance in solving problems related to sampling, data comparability and ICES data submissions. Prospecting innovation in new monitoring technologies and approaches. Check possibility to organise a ringtest for seafloor litter monitoring based on the work	3.1; 3.2; 3.5	3 year	ICES ASC session on innovative methods for macro- and microlitter monitoring Macrolitter idenfication exercise between labs, reported in the EG report. Other reporting platforms will be discussed. SWOT analysis of current monitoring approaches and prospectives for future

		previously initiated by WGML. Evaluate the relevance of different matrices (water, sediment, biota) for use in microplastic monitoring and determine the best available techniques for sampling, processing, analysis, reporting and assessment.			monitoring for macro- and microlitter, reported in the EG report.
c	Report new developments in quality assurance in marine litter and microplastic monitoring in Europe, and provide information on other proficiency testing schemes with relevance to WGML.	Availability of high quality proficiency testing is vital to produce reliable results. Improve QA/QC of seafloor litter and microplastic data.	4.1; 6.3	3 year	Finalisation of seafloor litter monitoring guide as ICES TIMES publication. Yearly updates on outputs from other groups working on marine litter and from ongoing research projects, reported within the EG report
d	Align WGML with key international expert groups by collaborating with EMODNET regarding marine litter and microplastic data assessment and quality assurance.	Improve data streams to/from DOME and DATRAS. Evaluate the current simplified format for microplastics data and its future needs. Facilitate the interoperable flow of microplastic data between databases and organisations.	3.1; 3.5	3 year	WGML alignment with international partners Evaluation of data formats for microplastic and litter data submission, reported within the EG report.
e	Establish a national or regional reporting system on abandoned, lost or otherwise discarded fishing gear (ALDFG)	ICES is ideally positioned to address this issue based on its historical expertise with stock assessments and surveys using a range of equipment. ICES WGML could assess the sources, distribution, trends and impacts of specific ALDFG (Abandoned, lost or otherwise discarded fishing gear).	2.1; 2.6	3 year	Assessment on ALDFG loss in the marine environment.

Summary of the Work Plan

Year 1	Development of the outlines of a review document on plastic additives, task division between working groups Follow up on requests from other groups Start session preparation for ICES ASC on innovative methods Development of macrolitter identification exercise List of current monitoring approaches and knowledge gaps Dissemination of seafloor monitoring guide Yearly updates on outputs from other groups working on marine litter and from ongoing research projects

	Intersessional meetings with relevant actors on marine litter monitoring Evaluation of currently used litter data formats Check data availibility on ALDFG
Year 2	Finalisation of review document on chemical additives Follow up on requests from other groups Stock take on innovative methods Executing macrolitter identification exercise SWOT analysis on current monitoring approaches for macro- and microlitter Yearly updates on outputs from other groups working on marine litter and from ongoing research projects Suggestions for changes in current litter data formats
Year 3	ICES ASC session on innovative methods Follow up on requests from other groups Data assessment of macrolitter identification exercise Yearly updates on outputs from other groups working on marine litter and from ongoing research projects Assessment on the rate of gear loss in the marine environment Final report

Supporting information

Priority	The current activities of multiple WGs and external representatives will lead ICES into issues related to monitoring and fundamental research of marine litter. Consequently, such monitoring and research activities are considered to have a very high priority with respect to the issue of seafloor litter and MPs.
Resource requirements	The research programmes which provide the main input to this group are already underway, and resources are already committed. The additional resource required to undertake additional activities in the framework of this group is negligible.
Participants	The Group is normally attended by some 20–25 members and guests.
Secretariat facilities	ICES Data Centre – data extractions. Standard EG support.
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	There are currently no linkages with ACOM, but the EG will be ready to address advisory requests if these are forthcoming.
Linkages to other committees or groups	There will be close working relationships with HAPISG EG. The planned work is especially relevant to MCWG, WGBEC and IBTSWG.
Linkages to other organizations	PICES, CIESM, EU, JPI Oceans, GESAMP, UN, RSC, G7, G20

Annex 3: Country specific monitoring programmes and activities overview for WGML members

Belgium: seafloor litter and microplastic monitoring and research activities (2022–2024)

Seafloor litter monitoring and research in Flanders & Belgium

Routine macrolitter monitoring on the seafloor by Belgium is done within two different sampling surveys by ILVO. Litter is recorded within the bottom trawl survey, making use of a 4m beam trawl with 40 mm mesh size at the cod end. This monitoring campaign includes 5 stations within the Belgian part of the North Sea but also 57 stations at other parts of the Southern North Sea. Litter is also collected within environmental monitoring campaigns at the Belgian part of the North Sea, which are held twice a year. Within environmental monitoring, 8m bottom trawl is used with 20 mm mesh size at the cod end. Data from 2012 onwards is made publicly available within the ICES databases (DATRAS and DOME). Data reporting within MSFD is coordinated by the Royal Belgian Institute of Natural Sciences (RBINS). Other macrolitter monitoring in Belgium includes beach litter (OD Nature/RBINS), plastics in Fulmar stomachs (INBO) and plastics in marine mammals (OD Nature/RBINS).

Research project PLUXIN

The PLUXIN project aimed at mapping and tackling the plastic flow from rivers and harbours into the North Sea, and to understand the behaviour of plastic in our watercourses. The plastic flux calculation will provide the T0-value for the monitoring of the inflow of plastic into the marine environment in Flanders (OVAM). Besides the traditional sampling techniques, different sensor systems (RGB, multi-spectral, hyperspectral) and sensing set-ups/platforms (UAV, fixed poles & near-surface set-ups) are evaluated in the PLUXIN project to define to which extent plastics near the water surface can be detected and quantified based on remotely sensed data. The project showed, among other things, that not all plastic flows into the sea through rivers, but estuaries (e.g., of lowland tidal rivers) can function as accumulation zones for plastic litter.

Research project Marine plastics

The Marine Plastics project aims at assessing this monitoring data, taking into account the different anthropogenic pressures at the Belgian Part of the North Sea. Seafloor litter on the Belgian Part of the North Sea (BPNS) as well as the broader North Sea was studied in this project. Two datasets were used: litter recorded during environmental monitoring campaigns by ILVO (2013–2019) and litter recorded during the international beam trawl surveys (BTS; 2011–2019). The environmental monitoring campaigns use a fine-mesh net (20 mm in the cod end), with fishing trawls at close intervals and trawling both inside and outside the 12 nautical mile zone. This results in a relatively high number of litter items in the net, averaging 12.7 ± 17 items per ha in the 12 nautical mile zone. Within the BTS campaigns, the average number of debris items in the net is lower, averaging 2.2 ± 2.8 items per ha, due to the larger mesh size of the net used (40 mm in the cod end) and due to trawling further from shore. However, the BTS covers a large geographical area as data is available from different countries. This makes it possible to compare seabed litter for the North Sea, English Channel, Celtic Sea and Irish Sea.

Seafloor litter consists mainly of plastics. 88% of all litter found in the fishing trawls of the environmental monitoring campaigns consisted of plastic. For the BTS this was 77%. However, there were large differences in the distribution of the specific waste items. Heavier plastics with a land-based source, such as plastic bottles and containers, are mainly found within the 12 nautical mile zone. In contrast, low-density monofilament ropes show a more even distribution across the BPNS.

Various factors influence the distribution of macro debris on the seabed. Not only is the location of the waste source important, but hydrodynamic and geomorphological factors will also play a role. Consequently, it is not always easy to establish links between human activities and the spread of waste on the seabed. Within the Marine plastics project, no link was found with sand extraction or wind farms. Nor was there a clear link between fishing activities and the spread of fishing-related waste.

On the BPNS, there was an increased concentration of waste on the dredging shore BR&WZO, located near the port of Zeebrugge. In this zone, an average of 61 ± 79 waste items per ha was found, compared to 15 ± 15 waste items per ha in zones close to the discharge quay and 12 ± 14 waste items in more distant reference zones. Again, however, the effect of dredging sludge disposal cannot be clearly distinguished from the effect of hydrodynamic processes such as sedimentation.

<u>Research project Andromeda – BE contribution</u>

Based on decision tree models, a method is developed in which microplastics can be identified using Nile Red as colouring agent. The model allows to identify with a high accuracy plastics from non-plastics as well as the plastic polymer. The classification models represent a semi-automated, high through-put and reproducible method to characterize microplastics in a straightforward, cost- and time-effective yet reliable way. Details of this work can be found in following publication (more publications upcoming):

References:

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<u>Research project TREASURE - Targeting the reduction of plastic outflow into the North Sea</u>

A large share of marine litter is expected to reach the sea via inland waterways, posing a serious threat to the environment and human health. Recognising the urgency of this challenge, the North Sea Commission (NSC) Marine Resources Group initiated this transnational InterReg project to reduce plastic pollution in waterways. The TREASURE consortium involves regional authorities, water management bodies, knowledge institutes, companies, and NGOs from 5 countries. TREASURE aims to reduce marine pollution by preventing the outflow of plastic waste from inland waters into the North Sea by improving governance, policy, data collection, removal and prevention approaches, resulting in a cleaner riverine and marine environment through science-supported cooperation. TREASURE started on the 1st of June 2023.

To establish a common approach and effective solutions on a North Sea basin and European level, transnational cooperation is urgently needed. A regular, well-structured and documented transnational knowledge transfer offers the foundation for meaningful cooperation in implementing appropriate and innovative methods and tools and will facilitate the transnational exchange of best practices and lessons learned. Solutions to plastic pollution are developed and implemented in the following 5 Living Labs: East Frisian-Frisian-Wilhelmshaven "PlasticFREE-sia" (DE); joint Dutch Delta (NL); Nieuwpoort Yser (BE); Northern French ports and harbours (FR); and Westcoast watersheds (DK).

Research project INSPIRE - Innovative Solutions for Plastic free European Rivers

To date, preventive and technological interventions to reduce the amount of litter in rivers, development of clean-up technologies and innovation towards improved technologies to remove litter, plastics (as general term for meso- and macro- size items) and microplastics from rivers by research driven institutes and private sector organizations, frequently with strong engagement of the society, often remain isolated attempts. In order to stimulate innovation and to vitalize the uptake of the innovative solutions to stop the plastic problem and being able to objectively assess the impact of the interventions, an overarching holistic approach is needed. The Horizon Europe project INSPIRE focusses on a holistic consideration over the full chain from disposal up to collection. This includes actions to prevent litter, macro- (>2.5cm), meso- (0.5–2.5 cm) and microplastics (<0.5 cm) entering the river. Holistic also means that care must be taken to draw the advantages of positive environmental impacts that can be realized through the combinations of technologies (= solutions). This INSPIRE project started in May 2023.

Norway: microplastic monitoring and other research activities (2022–2024)

National microplastics monitoring programme (Mikornor)

Norway's national monitoring programme for microplastics was established in 2021, with the first phase running from 2021–2023, it is now in its second phase. The programme covers coastal waters, rivers and lakes, as well as some selected terrestrial systems (urban samples: WWTPs and stormwaters; Atmosphere). The programme is coordinated by NIVA, on assignment from the Norwegian Environment Agency (Miljødirectrate). Its purpose is to investigate the extent of microplastics (5 mm–50 µm) in the environment, provide information on levels and types of microplastics in the aquatic environment and the atmosphere, compare different geographical areas and sample types. The programme is adapted from recommendations under the Arctic Council (AMAP) and GESAMP and other international activities to ensure harmonised approach to monitoring. Samples are collected through other national monitoring programmes as well as vessels of opportunities (commercial ferry routes). Data is reported following AMAP recommendations and stored in Vannmiljø (https://vannmiljo.miljodirektoratet.no/) and ICES Dome.

Available reports:

van Bavel, B.V., Lusher, A.L., Consolaro, C., Hjelset, S., Singdahl-Larsen, C., Buenaventura, N.T., Röhler, L., Pakhomova, S., Lund, E., Eidsvoll, D. and Herzke, D., 2022. Microplastics in Norwegian coastal areas, rivers, lakes and air (MIKRONOR1). NIVA-Report 7811-2023. 82 p.

Alling, V., Lund, E., Lusher, A., van Bavel, B., Snekkevik, V. K., Hjelset, S., Singdahl-Larsen, C., Consolaro, C., Jefroy, M., Martinez-Frances, E., Rødland, E., Pakhomova, S., Knight, J., Schmidt, N., Herzke, D. (2023). Monitoring of microplastics in the Norwegian environment (MIKRONOR). Report for the Norwegian Environment Agency, M2624-2023. 103 p.

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MAREANO mapping of microplastic in the sediment

Norwegian national program of detailed biological, geological and chemical mapping of the seabed, started in 2005. Includes data on microplastics in marine sediments (surface and sediment cores), reported since 2018.

More information can be found here: https://mareano.no/en

"Suggestion for national monitoring of seabed litter in Norway was published", including a discussion of different non-trawling monitoring techniques for litter; (Forslag til nasjonal overvåking av søppelenheter på havbunnen | Havforskningsinstituttet link: https://www.hi.no/hi/nettrapporter/rapport-fra-havforskningen-2025-7)

IBTS (North Sea)

IMR participates in ICES International bottom trawl survey (IBTS). Recording bycatch of litter (WGML protocol), reporting to ICES.

BESS (Barents Sea)

Norwegian Russian Barents Sea Ecosystem survey. Recording bycatch of litter in trawls (Norwegian data: WGML protocol, report to OSPAR) and microplastics in Manta trawls. (Survey report (Part 2) from the joint Norwegian/Russian Ecosystem Survey in the Barents Sea and the adjacent waters August-October 2023. Havforskningsinstituttet link: https://www.hi.no/hi/nettrapporter/imr-pinro-en-2024-9#sec-4-4)

Reseach Project: EUROqCHARM

The goal of the EUROqCHARM project (EUROpean quality Controlled Harmonization Assuring Reproducible Monitoring and assessment of plastic pollution) was to establish harmonized methods for monitoring and assessing macro-, micro-, and nanoplastics in the environment, as well as outlines for standards and recommendations for policy and legislation. EUROqCHARM engaged ICES WGML through bilateral discussions across topic areas. The outputs connected with the ICES WGML through introduction of technological readiness levels (Aliani *et al.*, 2023) in the exploration of methods for seafloor monitoring (see above) and through the harmonisation approach (WP1, WP3), including assistance in the development of the new ICES DOME database format.

Aliani, S., Lusher, A., Galgani, F., Herzke, D., Nikiforov, V., Primpke, S., ... & Van Bavel, B. (2023). Reproducible pipelines and readiness levels in plastic monitoring. *Nature Reviews Earth & Environment*, *4*(5), 290-291. https://doi.org/10.1038/s43017-023-00405-0

Research project FACTS
Microplastic analyses within the JPI Oceans project FACTS investigated a transect from the North Sea along the Norwegian Coastal Current towards Arctic waters, also including samples of muscle and liver of cod and tusk (to be published).

Internal research project Institute of Marine Research
Analysis of microplastic in muscle and liver of haddock and plaice (to be published).

OSPAR Beaches and Northern Fulmar.

One Ocean Expedition (OOE)
IMR and NORCE collaborate on analyses of MPs from filtered sea water (pore size 10 um) from the OOE expedition. (The One Ocean Expedition: Science and Sailing for the Ocean We Want | Havforskningsinstituttet link: https://www.hi.no/hi/nettrapporter/rapport-fra-havforskningen-en-2023-34)

Canada: seafloor litter, ALDFG, and microplastic research activities

Seafloor litter research (2023–2024)

The Fisheries and Oceans Canada (DFO) ecosystem surveys are conducted annually and are a source of integrated ecosystem monitoring data. The surveys follow a stratified random sampling design, and include sampling using a bottom otter trawl (Western IIA fishing trawl, wing spread 12.5 m) to monitor the distribution and abundance of fish and invertebrates across several major NAFO zones (4VWX, 5Z) in spring, summer, or fall. Starting in 2023, seafloor litter has been consistently recorded in all sets when present, photographed, and categorized using the ICES seafloor litter guide. Seafloor litter data is currently being analysed to determine quantities, spatial distribution, and relationships to environmental and human-use factors, across the Scotian Shelf, NW Atlantic.

ALDFG reporting (2020–2024)

DFO's Ghost Gear Program (https://www.dfo-mpo.gc.ca/fisheries-peches/management-gestion/ghostgear-equipementfantome/index-eng.html) is a federally funded program intended to support Canada's commitment to preventing and mitigating the risk of ghost fishing and encouraging the development of sustainable fishing practices, particularly as it applies to abandoned, lost or otherwise discarded fishing gear (ALDFG) domestically and abroad. As part of this program, mandatory lost gear reporting was established for all commercial fisheries as a condition of licence starting in 2020. A total of 2470 tonnes of fishing gear and aquaculture debris (excluding ropes and buoys) have been recovered from Canadian waters (Arctic, Atlantic, Pacific) as of October 2024. Of the number of lost gear reports from 2020–2024, approximately 98% are connected to trap fisheries (lobster, crab).

Microplastic research projects (2019–2024)

There is currently no routine monitoring for microplastics conducted by DFO. Individual research projects have occurred on an opportunistic basis depending on available ship time and funding. Collectively, results of these studies demonstrate that microplastic pollution is highly variable across Atlantic Canadian waters, that the characteristics of microplastic pollution change depending on location (i.e. estuaries, nearshore, offshore), and some areas of high pollution risk overlap with important habitat for endangered cetaceans.

Some recent publications:

Kelly, N.E. 2024. Spatial distribution and risk assessment of microplastics in surface waters of the St. Lawrence Estuary. Science of The Total Environment, 946, p.174324. https://doi.org/10.1016/j.scitotenv.2024.174324

Kelly, N.E., Trela, O., Gavel, H., Vander Kuylen, A. 2024. Plastic and anthropogenic microfiber pollution on exposed sandy beaches in Nova Scotia, Canada. Water Emerging Contaminants & Nanoplastics 2024;3:6. https://dx.doi.org/10.20517/wecn.2023.66

Kelly, N.E., Feyrer, L., Gavel, H., Trela, O., Ledwell, W., Breeze, H., Marotte, E.C., McConney, L. and Whitehead, H. 2023. Long term trends in floating plastic pollution within a marine protected area identifies threats for endangered northern bottlenose whales. Environmental Research. p.115686. https://doi.org/10.1016/j.envres.2023.115686

Finland

Seafloor litter monitoring

In Finland, monitoring of seafloor macrolitter has not been routinely carried out due to the lack of benthic trawling in the Finnish sea areas. Since 2021, trials have been made to monitor seafloor macrolitter, first using a seafloor litter collector modified from an old pelagic trawl, and later, with the help of professional fishermen using otter trawls that are towed at the seafloor in deep sea areas, and visual methods (ROV equipped with an UW video camera) in more sensitive, nearshore marine areas. The future national monitoring program of seafloor macrolitter in Finland will combine otter trawling in the deep open sea, and visual methods in shallower and more sensitive areas. The operationalisation of the monitoring, i.e. the selection of suitable monitoring areas and the establishment of the methodology, is currently being carried out.

Beach litter monitoring

Beach macrolitter has been monitored on the Finnish seashores since 2012. Currently, the data are collected three times per year from altogether 15 urban, natural and peri-urban beaches and coastal areas from around the Finnish coastline. The monitoring is originally based on the UNEP method, where all >2.5 cm litter items found on a survey beach with a minimum area of 1000 m2 (100 m x 10 m) are counted and classified according to their material and intended use (HELCOM 2021, Galgani *et al.* 2023). The TG ML Joint List of Litter Categories has been used for the classification of litter items since 2023.

Microlitter monitoring

Finland has set up a national microlitter monitoring program for the years 2020-2026. Monitoring covers 12 offshore stations, and samples from the seafloor sediment and from surface waters are collected every other year from these stations. The sampling is conducted in May, in conjunction with the national COMBINE II monitoring cruise of R/V Aranda. Surface waters are sampled with a Manta trawl equipped with a flow meter, whereas sediment samples are taken with GEMAX corer (top 5 cm of the core). Samples are kept frozen until further processing. Following the HELCOM guidance (HELCOM 2022a,b), monitoring will also in future cover coastal sites and has already been carried out in the years 2023 and 2024, but not at fixed stations.

In the laboratory, samples are fractionated to two size classes: 1-5 mm and <1 mm. From the 1-5 mm size fraction, all microlitter is quantified, whereas from the <1 mm size fraction only microplastics are analysed. Density separation with NaI and the enzymatic purification method by Löder *et al.* (2017) is applied for sample processing with some modifications. Extracted particles are stained with Nile red and analyzed with epifluorescence microscope and automated image analysis. A subset of particles is identified for their polymer composition with FTIR.

Currently, microlitter in biota is not routinely monitored, but in several research projects samples have been taken from e.g., fish (Budimir *et al.* 2018, Sainio *et al.* 2021, Uurasjärvi *et al.* 2021), bivalves (Railo *et al.* 2018), seabirds (Lehtiniemi *et al.*, unpublished) and crustaceans (Lehtiniemi *et al.*, unpublished). First tests for developing a monitoring program for microlitter in biota will be carried out during the years 2025-2026, aiming at either collecting bivalves (blue mussels) from different sites or setting up mussel exposure cages.

Plastic pellets belong by size in the category of microlitter/microplastics. Testing of the EU guidelines (Galgani *et al.* 2023) for pellet monitoring was carried out in 2023 as a part of a research project. Based on the results the methodologies will further be tested in 2025-2026 and pilot monitoring carried out at 5 different beaches. In addition, citizen science tools for reporting of pellets have been developed in the Finnish Environment Institute and will be widely advertised in spring 2025 (https://rosgis.syke.fi).

References:

Galgani, F. *et al.* 2023. Guidance on the monitoring of marine litter in European seas. Publications Office of the European Union, Luxembourg. https://publications.jrc.ec.europa.eu/repository/handle/JRC133594

HELCOM 2021. HELCOM Guidelines for monitoring beach litter. https://helcom.fi/wp-content/uploads/2021/03/HELCOM-guidelines-for-monitoring-beach-litter.pdf

HELCOM 2022a. https://helcom.fi/wp-content/uploads/2022/11/HELCOM-Guidelines-on-monitoring-of-microlitter-in-the-water-column-in-the-Baltic-Sea.pdf.

HELCOM 2022b. https://helcom.fi/wp-content/uploads/2022/11/HELCOM-Guidelines-on-monitoring-of-microlitter-in-seabed-sediments-in-the-Baltic-Sea.pdf

Budimir, S., Setälä, O., Lehtiniemi, M. 2018. Effective and easy to use extraction method shows low numbers of microplastics in offshore planktivorous fish from the northern Baltic Sea. Marine Pollution Bulletin 127, 586–592. https://doi.org/10.1016/j.marpolbul.2017.12.054

Railo, S., Talvitie, J., Setälä, O., Koistinen, A., Lehtiniemi, M. 2018. Application of an enzyme digestion method reveals microlitter in Mytilus trossulus at a wastewater discharge area. Marine Pollution Bulletin 130, 206–214. https://doi.org/10.1016/j.marpolbul.2018.03.022

Sainio, E., Lehtiniemi, M., Setälä, O. 2021. Microplastic ingestion by small coastal fish in the northern Baltic Sea, Finland. Marine Pollution Bulletin: 112814. https://doi.org/10.1016/j.marpolbul.2021.112814

Uurasjärvi, E., Sainio, E., Setälä, O., Lehtiniemi, M., Koistinen, A. 2021. Validation of an imaging FTIR spectroscopic method for analyzing microplastics ingestion by Finnish lake fish (Perca fluviatilis and Coregonus albula). Environmental Pollution 288: 117780. https://doi.org/10.1016/j.envpol.2021.117780

Germany: Micro/nanoplastic related research activities

In the following, examples of research activities in Germany are presented, which focus on the assessment of micro/nanoplastic in marine waters (including the interface riverine/estuarine/marine).

Within the joint project PLAWES (funded by the Federal Ministry of Education and Research, Germany), e.g., the Weser River was investigated holistically from its tributaries to North Sea waters, in order to assess its role as a pathway for microplastics (1). Beside the environmental contamination with microplastics down to 10 µm within the river system (water and sediment samples), also various potential sources were studied (e.g., waste water treatment plants, drainage and atmospheric input). Moreover, the interaction with pathogens and biota was analyzed. The obtained data were applied in modelling studies, and gained knowledge was implemented into teaching materials to raise the awareness of the plastic waste problem.

Outcomes on microplastic pollution in surface water samples collected within PLAWES were published in Roscher *et al.* 2021, using a microplastic net and a filtration system for sampling, and ATR-FTIR and µFTIR as analysis tools. Maximum concentrations of microplastics reached 9.7×10^3 MP m^{-3}, with polyethylene being dominant polymer type in the larger particle fraction, whereas most smaller particles were assigned to the cluster acrylates/PUR/varnish.

Microplastic analyses within the JPI Oceans project FACTS (2) tied up with the above assessment on pollution in the North Sea, as it investigated a transect from the North Sea along the Norwegian Coastal Current towards Arctic waters. More information on recorded microplastic pollution levels in surface water and sediments can be found in recent studies by Wu *et al.* 2024a and Wu *et al.* 2024b.

Recently, the citizen project “Mikroplastikdetektive” (3) published their findings, containing the investigation of beach samples from 71 locations along the German coast with respect to micro, meso and macroplastics (Walther *et al.* 2024). A total of 1,139 samples had been collected and analysed, The majority (~90%) of all plastic particles were polyethylene, polypropylene, polystyrene and polyester (identification method: ATR-FTIR).

In a currently running Danish-German project (“PlastTrack” (4), project lead: SDU, Denmark), the focus lies on microplastics, but also nanoplastics, including the analysis of transport mechanisms and degradation processes. Development of methods in the laboratory goes hand in hand with sampling campaigns in the Baltic Sea, where feasability and potential challenges can be examined and evaluated.

(1) PLAWES Plastik in der Umwelt. 2024. Federal Ministry of Education and Research. https://bmbf-plastik.de/en/joint-project/plawes
(2) Facts project. 2024. JPI Ocenas. https://jpi-oceans-facts.eu
(3) Citizen scientists help discover microplastics along the entire German coastline. 2024. Alfred Wegener Institute. https://www.awi.de/en/about-us/service/press/single-view/buergerforschende-entdecken-mikroplastik-entlang-der-gesamten-deutschen-kueste.html
(4) PlastTrack. 2024. https://www.plasttrack.eu/. PlastTrack Project.

References:

Roscher, L., Fehres, A., Reisel, L., Halbach, M., Scholz-Böttcher, B., Gerriets, M., ... & Gerdts, G. (2021). Microplastic pollution in the Weser estuary and the German North Sea. *Environmental Pollution*, *288*, 117681. https://doi.org/10.1016/j.envpol.2021.117681

Wu, F., Zonneveld, K. A., Wolschke, H., von Elm, R., Primpke, S., Versteegh, G. J., & Gerdts, G. (2024a). Diving into the Depths: Uncovering Microplastics in Norwegian Coastal Sediment Cores. *Environmental Science & Technology*, *58*(38), 17036-17047. https://doi.org/10.1021/acs.est.4c04360

Wu, F., Reding, L., Starkenburg, M., Leistenschneider, C., Primpke, S., Vianello, A., ... & Gerdts, G. (2024). Spatial distribution of small microplastics in the Norwegian Coastal Current. *Science of the Total Environment*, *942*, 173808. https://doi.org/10.1016/j.scitotenv.2024.173808

Walther, B. A., Pasolini, F., Korez Lupše, Š., & Bergmann, M. (2024). Microplastic detectives: a citizen-science project reveals large variation in meso-and microplastic pollution along German coastlines. *Frontiers in Environmental Science*, *12*, 1458565. https://doi.org/10.3389/fenvs.2024.1458565

Poland

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Seafloor litter monitoring in Poland conducted by National Marine Fisheries Research Institute (NMFRI)

The monitoring of the southern part of the Baltic Sea has been done since 2015 in quarters 1 (Q1) and 4 (Q4). Marine litter from the bottom of the sea were collected in the framework of the Baltic International Trawl Surveys programme (BITS) realized by the National Marine Fisheries Research Institute (NMFRI, Poland) within the Polish Multiannual Fisheries Data Collection Programme on R/V Baltica.

The standard fish control-catch procedure is described in detail in the Manual for the Baltic International Trawl Surveys. The fish control-catch sites are randomly selected by the WGBIFS from the fixed list of sites sampled within the BITS programme. The rigging cod ground trawl type TV-3#930 (without bobbins and additional chains fastened to the footrope) is in use during the operations. Mesh bar length of 10 mm in the codend allowed sampling macro-litter and larger fractions of meso-litter. Fish control-hauls are conducted at 3 knots vessel speed. The standard trawling-time is 30 minutes; however, the time is modified in case of unexpected logistical reasons.

The sampling and reporting of marine litter were additional tasks of BITS surveys, recommended and partly coordinated by the Baltic International Fish Survey Working Group. The litter BITS Q1 and Q4 survey data were entered into DATRAS database.

Microplastic research conducted by National Marine Fisheries Research Institute (NMFRI).

Sampling microplastic in Polish Economic Zones of southern Baltic has been done since 2021 r. during august oceanographic cruises, realized by the National Marine Fisheries Research Institute (NMFRI, Poland) within the Polish Multiannual Fisheries Data Collection Programme on R/V Baltica.

Collecting samples is performed using neuston nets. Water surface and water column samples are taken using respectively, Manta and Bongo nets.

Multilevel preparation of collected samples is performed in NMFRI, such includes initial filtration of the samples, liofilization, (two steps) mineralization, decantation, final filtration and visual inspection using stereo-microscope.

Since 2025, NMFRI is equipped into high-class FT-IR Imaging System, which will enable proceed complex analyses of microplastic.

Other microplastic monitoring programmes carried on in Poland

Another institution that monitors litter and microplastics in Poland is Polish Institute of Meteorology and Water Management - National Research Institute (IMGW-PIB). The monitoring deals with the microplastics in the sea water and sediments, collected once a year from 4 locations on the Baltic Sea and in the Vistula Lagoon and Szczecin Lagoon. Both monitorings have been carried out in frame of the State Environmental Monitoring since 2014. (Information obtained thanks to the kindness of Dr. Er. Tamara Zalewska, Professor of IMGW-PIB Tamara.Zalewska@imgw.pl).

Spain (last updated 2025)

Routine macrolitter monitoring on the seafloor is conducted by IEO (Instituto Español de Oceanografía, IEO, CSIC) in the Spanish waters (Cantabrian Sea and Gulf of Cadiz) under the umbrella of the IBTS. Sampling is carried out using the BAKA otter trawl and following the ICES Manual for Seafloor Litter Data Collection and Reporting from Demersal Trawl Samples (latest version published in 2022). This monitoring is ongoing since 2013 and the results are reported to ICES DATRAS on annual basis. Other monitoring methods, such as submarine videos and records from scientific scuba divers, are being evaluated under the contract signed between the IEO and the Spanish Ministry for the Ecological Transition and Demographic Challenge for the monitoring and assessment of marine litter. All the data gathered are used for the assessment and reporting of the MSFD, and to support the Spanish Government in monitoring the efficiency of marine litter reduction measures. Furthermore, IEO is partner in the Free LitterAT project (https://freelitterat.eu/) in which different innovative technologies are being tested for seafloor monitoring (e.g. ROV).

IEO is also in charge of the programme for monitoring floating macrolitter in Spain. IEO has been collecting these data (coupled to the recording of top predators' presence) in multidisciplinary oceanographic surveys since 2007.

In terms of beach macrolitter, the monitoring in Spain is running since 2013, following the recommendations set by OSPAR and the TGML. This monitoring programme is coordinated by the Ministry for the Ecological Transition and Demographic Challenge and nowadays it includes 29 beaches along the Spanish continental and island shores.

Microplastic monitoring and research in Spain

IEO is responsible for the MSFD monitoring programme of microplastics in surface water and bottom sediments in Spain. The surface water is sampled with an AVANI trawl following the recommendations from the MSFD guidance protocols and the improvements made in the framework of projects like BASEMAN and ANDROMEDA. For bottom sediments, only the top 5 cm of the corer is considered. Samples are kept frozen on board and processed on land. Both types of samples are analysed up to the level of polymer identification using infrared spectroscopy, either ATR-FTIR (Attenuated Total Reflectance-Fourier Transform Infrared) or LDIR (Laser Direct Infrared) depending on the size of the particle.

Considering microplastics in biota, IEO has already explored the use of fishes and mussels in projects such as CleanAtlantic (Filgueiras *et al*., 2020, Soliño *et al*., 2022, Gerigny *et al.*, 2023). Since 2021, IEO is taking samples of wild mussels along the Atlantic coast of Spain to check the feasibility and adequacy of this organism to monitor the ingestion of microplastics by marine biota. Regarding microplastics on beaches, this monitoring programme is active since 2016 and led by CEDEX (Centro de Estudios de Puertos y Costas).

Some recent publications of IEO on the topic:

Filgueiras, A.V., Preciado, I., Cartón, A., Gago, J. Microplastic ingestion by pelagic and benthic fish and diet composition: A case study in the NW Iberian shelf. Marine Pollution Bulletin, Volume 160, 2020, 111623, ISSN 0025-326X, https://doi.org/10.1016/j.marpolbul.2020.111623.

Gerigny, O., Bakir, A., Barry, J., Cardin, Z., Chouteau, L., El Rakwe, M., Gago, J., Incera, M., Le Moigne, M., Otero, P., Pérez, P., Prado. E., Russell, J., Thomas, L., McGoran. A. 2023. CleanAtlantic- Tackling Marine Litter in the Atlantic Area. Characterization of microplastics ingested by mussels. Toward the determination of a bio-sentinel species of the marine environment contamination by microplastics? WP 5.3:

Monitoring the interaction of marine litter with fauna. CleanAtlantic project deliverable. https://www.cleanatlantic.eu/wp-content/uploads/2024/01/20231106_CleanAtlantic_Mussels.pdf

Soliño, L., Vidal-Liñán, L., Pérez, P., García-Barcelona, S., Baldó, F., Gago, J. Microplastic occurrence in deep-sea fish species *Alepocephalus bairdii* and *Coryphaenoides rupestris* from the Porcupine Bank (North Atlantic). Science of The Total Environment, Volume 834, 2022, 155150, https://doi.org/10.1016/j.scitotenv.2022.155150

Sweden

Sea floor litter

The Swedish University of Agricultural Science, Institute of Marine Research is performing sea floor litter monitoring. The sampling of sea floor litter in Skagerrak and Kattegat is done during the, by the ICES coordinated, NS-IBTS (North Sea international bottom trawl survey) in quarter one and quarter three. The survey in the Baltic (Baltic international trawl survey, BITS, also coordinated by ICES) is performed in quarter one and quarter four. In a national trawling programme (the coastal trawl survey) sampling of sea floor litter is performed closer to the coast and within the fjords in Skagerrak and Kattegat during the third quarter annually. Litter sampled within ICES coordinated surveys is registered on board and litter sampled within the national coastal trawl survey is generally registered in the lab.

Currently the reporting of seafloor litter data presents results: per year, per km2 and for specific areas within Skagerrak/Kattegat and the Baltic. The results include:

- The number of stations that was sampled
- The number of stations that did not have any litter
- Graphs of mean weight of litter per km2 per litter category A-plastic, B-metal etc.
- Graphs of mean number of litter items per km2 per litter category, A-plastic, B-metal etc.

Data on sea floor litter from IBTS and BITS is uploaded to the DATRAS database every year. Sea floor litter data from IBTS, BITS and from the coastal trawl survey is also sent to the Swedish Agency for Marine and Water Management. Results from analysis of IBTS, BITS and national trawling survey data is reported to the Swedish Agency for Marine and Water Management. The quality control is in later years mainly based on the manual produced by ICES working group on marine litter (ICES, 2022) but also reports from the ICES working group on marine litter as well as DATRAS format descriptions and information presented in BITS and IBTS manuals. Data from sea floor litter sampling within IBTS and BITS has been reported to DATRAS since 2012. The national coastal trawl survey started in 2015.

Beach litter

Sweden monitors macro-litter on beaches in the North Sea and in the Baltic Sea. Monitoring began along the Skagerrak coast in 2001 and along the Kattegat and Baltic Sea in 2014. Sixteen beaches are monitored, 8 in the North Sea (Skagerrak, Kattegat, and Öresund), and 8 in the Baltic Sea. The beaches along the Skagerrak are designated reference beaches within OS and are selected to reflect the amount of litter washed ashore from the sea. These beaches are chosen because they are not significantly affected by beach visitors. The beaches by the Kattegat and the Baltic Sea have a slightly different character and are selected to show both peri-urban beaches with visitors as well as rural beaches with primarily sea-borne litter. The selection of beaches depends on the requirements of the respective monitoring methods from the regional sea conventions Helcom and OSPAR. The beaches are monitored in the spring (April), summer (mid-June to mid-July), and autumn (mid-September to mid-October).

All items along a 100-meter beach stretch are collected and counted. The litter is categorized into different types, such as plastic, rubber, metal, food waste etc. As of 2023, the litter is categorized in the same way within both methods based on the list developed within the EU. Sweden also applies the EU threshold value for good environmental status regarding beach litter, which is 20 litter items per 100 meters of beach.

Microlitter

Monitoring of microlitter in sediment was conducted as a pilot study in 2020, as part of the monitoring program for hazardous substances in open sea areas. Surface sediment samples (0-2 cm depth) from 16 monitoring stations in the open sea were analyzed for microlitter particles sized 100–300 µm and identified using FTIR and Raman microspectroscopy. So far, we have only had preliminary results from the project, and we are awaiting the final report before decisions are made to include microlitter in the next sediment sampling scheduled for 2026.

The Swedish Environmental Protection Agency funded five research projects about microplastic between 2019 and 2022.

1. Environmental impact of nanoplastics from fragmenti[1]zed consumer plastics
2. MIXiT: Towards quantifying impacts of microplastics on environmental and human health
3. Urban Plastics: Sources, sinks and flows of microplastics in the urban environment
4. Evaluating the properties, fate and individual-to-ecosystem level impacts of contrasting microplastics in freshwaters
5. Development of analytical methods for microplastics in environmental samples for research and environmental monitoring

UK: marine litter and microplastics monitoring

As part of the UK national marine litter monitoring programme, there are currently three adopted indicators: beach litter, seafloor litter, and plastic ingested by Fulmar.

Seafloor litter

A number of UK government agencies, including Cefas, monitor seafloor litter as part of the ICES International Bottom Trawl Surveys (IBTS), which aim to primarily conduct long term monitoring of demersal fish and provide information on stock assessments. In the North Sea, there is a fixed grid station design, while in the Celtic Seas the method is to use randomly stratified site selection, from within fixed defined stratum polygons. All seafloor litter data generated by these surveys is collected following the WGML user manual and uploaded to the ICES DATRAS data portal on an annual basis.

Beach Litter

Marine Conservation Society and Keep Northern Ireland Tidy both collect data for the UK's beach monitoring, in line with the OSPAR Coordinated Environmental Monitoring Programme and submit data to OSPAR.

Plastic ingested by Fulmar

Volunteers collect Fulmars, mostly from the North Sea region, and send then to Wageningen University for analysis and reporting.

Research and development

There is also currently development underway for microplastic indicator in marine sediments, as well as work on microplastics in biota and floating water.

<u>Microlitter monitoring</u>

There is currently no routine monitoring for microlitter (including microplastics) nationally, however the UK is currently in the process of considering the implementation the microlitter (including microplastics) indicator.

The UK is co-leading the OSPAR Microplastic Expert Group (MPEG) alongside Denmark and Germany. MPEG produced some guidelines for the monitoring of microlitter (including microplastics) in seafloor sediment for the OSPAR Maritime Area (https://www.ospar.org/documents?v=57834) to support the recently approved OSPAR common indicator for microlitter. Current efforts are focusing on producing baseline and monitoring data for the UK for seafloor sediment while ensuring regional cooperation for data harmonisation and data comparison. Cefas collaborated with the Netherlands and the Icelandic government to deliver pilot studies as well method optimisation technical reports (Bakir and van Loon, 2024; van Loon *et al.*, 2024). Cefas is also involved in the testing of the ICES DOME new litter format for the reporting of microlitter (including microplastics) in biota, surface water and water column and seafloor sediment with the idea of developing a national database for microlitter.

Cefas is also collaborating with Marine Scotland to ensure harmonisation in sampling strategies for seafloor sediment, surface water and water column and biota samples to ensure comparable outputs.

Cefas is involved in the Natural Capital Ecosystem Assessment Programme (mNCEA) aiming to collect data on the extent, condition and change over time of England's ecosystems and natural capital, and the benefits to society (https://www.gov.uk/government/publications/natural-capital-and-ecosystem-assessment-programme/natural-capital-and-ecosystem-assessment-programme). Current work on microlitter is focusing on the increase on spatial scale of data on seafloor microplastics in relating to other contaminants (e.g. metals, hydrophobic organic compounds including PFAS etc…).

Other activities around microplastics are focusing on gathering baseline and monitoring data for microplastics in biota (Gerigny *et al.*, 2023), surface waters and the water column (Hoehn *et al.*, 2024).

Recent publications include:

Hoehn, D.P., McGoran, A.R., Barry, J., Russell, J., Nicolaus, E.M. and Bakir, A., 2024. Microplastics in sea surface waters in the Southern Bight of the North Sea. Frontiers in Marine Science, 11, p.1430307.

Barry, P.J., Silburn, B., Bakir, A., Russell, J. and Tidbury, H.J., 2024. Seafloor macrolitter as a settling platform for non-native species: A case study from UK waters. Marine Pollution Bulletin, 204, p.116499.

Bakir, A., McGoran, A.R., Silburn, B., Russell, J., Nel, H., Lusher, A.L., Amos, R., Shadrack, R.S., Arnold, S.J., Castillo, C. and Urbina, J.F., 2024. Creation of an international laboratory network towards global microplastics monitoring harmonisation. Scientific Reports, 14(1), p.12714.

Barry, J., Rindorf, A., Gago, J., Silburn, B., McGoran, A. and Russell, J., 2023. Top 10 marine litter items on the seafloor in European seas from 2012 to 2020. Science of the Total Environment, 902, p.165997.

Bakir, A., van Loon, W.M.G.M., 2024. Analysis of microplastics in Dutch marine sediments : method development and data 2023.

Gerigny, O., Bakir, A., Barry, J., Cardin, Z., Chouteau, L., El Rakwe, M., Gago, J., Incera, M., Le Moigne, M., Otero, P., Perez, P., Prado, E., Russell, J., Thomas, L., McGoran, A., 2023. CleanAtlantic Tackling Marine

Litter in the Atlantic Area. Characterization of microplastics ingested by mussels. Toward the determination of a bio-sentinel species of the marine environment contamination by microplastics? WP 5.3: Monitoring the interacti.

OSPAR MPEG, 2024. CEMP Guidelines for the monitoring of microlitter (including microplastics) in seafloor sediments for the OSPAR maritime area OSPAR Agreement 2024-06.

van Loon, W., Lusher, A., Pakhomova, S., Bakir, A., 2024. Selective Identification and Quality Control of Microplastics: an Optimization Study.

Annex 4: New Litter Format for use in DOME

Draft from 05-06-2024, WGML

RecID 00	**File Information**			M
No	**Field Code**	**Field Name**	**Valid Value**	**Mandatory / Recommended**
1	RECID	Record identifier	'00'	M
2	RLABO	Reporting institute code	cf. RLABO	M
3	CNTRY	Country code	cf. CNTRY	M
4	MYEAR	Monitoring year	YYYY	M
5	RFVER	Reporting format version number	'3.2.5'	M
6	DCFLG	Data centre flag - Reserved	multiple options possible	

RecID 90	**Sampling Platform Record**			M
No	**Field Code**	**Field Name**	**Valid Value**	**Mandatory / Recommended**
1	RECID	Record identifier	'90'	M
2	SHIPC	Platform / Ship code	cf. SHIPC	M
3	*CRUIS*	Cruise identifier (series of sampling occasions)(must be unique for file)	Any character 0–9, A–Z etc.	M
4	Owner	Data owner	Any character 0–9, A–Z etc.	R
5	PRDAT	Public release date	Date YYYYMMDD	
6	DCFLG	Data centre flag - Reserved	multiple options possible	

RecID 91	**Sampling Event Record**			M	
No	**Field Code**	**Field Name**	**Valid Value**	**Mandatory / Recommended**	**Multiples allowed**
1	RECID	Record identifier	'91'	M	
2	**CRUIS**	Cruise identifier (series of sampling occasions)(must be unique for file)	Any character 0–9, A–Z etc.	M	
3	*STNNO*	Station identification /Sampling event ID (must be unique for CRUIS)	Any character 0–9, A–Z etc.	M	
4	LATIT	Latitude (degrees/minutes/decimal minutes or as decimal degrees). Start position if sampling by line	-90 00.000 to +90 00.000 or -90.0000 to +90.0000	M	
5	LONGI	Longitude (degrees/minutes/decimal minutes or as decimal degrees). Start position if sampling by line	-180 00.000 to +180 00.000 or -180.0000 to +180.0000	M	
6	POSYS	Positioning system	cf. POSYS	R	multiples
7	SDATE	Sampling date	YYYYMMDD	M	
8	STIME	Sampling time/start (UTC)	0000–2359 (hhmm)		
9	ETIME	Sampling end time (UTC)	0000–2359 (hhmm)		
10	WADEP	Water depth (sounding in meters)	float, 0-99999		
11	STATN	Station name	cf. STATN Any character 0–9, A–Z etc. (max. 50)	R	
12	MPROG	Monitoring programme	cf. MPROG	M	multiples
13	WLTYP	Water/land types (river basin/eurotypes)	cf. WLTYP	R	
14	MSTAT	Type of monitoring station cf. Eurowaternet Technical report number 97	cf. MSTAT	R	
15	PURPM	Purpose of monitoring	cf. PURPM	R	multiples
16	EDATE	Sampling end date	YYYYMMDD		
17	DCFLG	Data centre flag - Reserved	multiple options possible		

RecID 92	Site Description			O		
No	Field Code	Field Name	Valid Value	Mandatory / Recommended	Multiples allowed	Comment
1	RECID	Record identifier	'92'	M		
2	**CRUIS**	Cruise identifier (series of sampling occasions)(must be unique for file)	Any character 0–9, A–Z etc.	M		
3	**STNNO**	Station identification /Sampling event ID (must be unique for CRUIS)	Any character 0–9, A–Z etc.	M		
4	RSRVD	Reserved				
5	MATRX	Matrix analysed	"SI"	M		
6	PARAM	Parameter code	cf. PARGROUP S-DES parameters	M		water: DISTRW, salinity, TEMP
7	MUNIT	Measurement unit	cf. MUNIT	M		
8	VALUE	Value	Any format	M		
9	DCFLG	Data centre flag - Reserved	multiple options possible			

RecID 40	Transect record		Remove for Sediment	O	
No	Field Code	Field Name	Valid Value	Mandatory / Recommended	Multiples allowed
1	RECID	Record identifier	'40'	M	
2	**CRUIS**	Cruise identifier (series of sampling occasions)(must be unique for file)	Any character 0–9, A–Z etc.	M	
3	**STNNO**	Station identification /Sampling event ID (must be unique for CRUIS)	Any character 0–9, A–Z etc.	M	
4	*TRANS*	Transect ID (must be unique for STNNO)	Any character 0–9, A–Z etc.	M	
5	TRDGR	Transect direction degrees (compass heading)	int, 0–360	R	
6	POSYS	Positioning system	cf. POSYS		multiples
7	LATRS	Transect start Latitude (degrees/minutes/decimal minutes or as decimal degrees)	-90 00.000 to +90 00.000 or -90.0000 to +90.0000		
8	LNTRS	Transect start Longitude (degrees/minutes/decimal minutes or as decimal minutes)	-180 00.000 to +180 00.000 or -180.0000 to +180.0000		
9	TRSLN	Length of whole transect (m)	decimal2, 0–99999		
10	TREDT	Transect end determination	cf. TREDT		
11	LATRE	Transect end Latitude (degrees/minutes/decimal minutes or as decimal degrees)	-90 00.000 to +90 00.000 or -90.0000 to +90.0000		
12	LNTRE	Transect end Longitude (degrees/minutes/decimal minutes or as decimal minutes)	-180 00.000 to +180 00.000 or -180.0000 to +180.0000		
13	DEPAD	Depth adjustment	cf. DEPAD	n/a	
14	TREDP	Transect end depth (distance to surface or water depth) (m)	decimal2, 0–9999		
15	MXVEG	Maximum depth where vegetation is found (m)	float, 0–999	n/a	
16	SPVEG	Species found at Depth limit	cf. WoRMS	n/a	
17	RLIST	Reference code list used for species ID	cf. RLIST	n/a	
18	DCFLG	Data centre flag - Reserved	multiple options possible		

RecID 3L	**Litter Sample record**			M	
No	**Field Code**	**Field Name**	**Valid Value**	**Mandatory / Recommende**	**Multiples allowed**
1	RECID	Record identifier	'3L'	M	
2	**CRUIS**	Cruise identifier (series of sampling occasions)(must be unique for file)	Any character 0–9, A–Z etc.	M	
3	**STNNO**	Station identification /Sampling event ID (must be unique for CRUIS)	Any character 0–9, A–Z etc.	M	
4	DTYPE	Data type	LW, LS, LF, LB	M	
5	**TRANS**	Transect ID	Any character 0–9, A–Z etc.	M if transect	
6	*SMPNO*	Sample identification (for each sediment core, each sediment grab, each water bottle, each transect section	Any character 0–9, A–Z etc. For transects, sequential numbering from transect	M	
7	**SMLNK**	Sampling method link	1–999	M if transect	
8	ATIME	Actual time of sampling (UTC)	0000–2359 (hhmm)		
9	NOAGG	Number of subsamples combined if sample is an aggregation	2–99		
10	SPECI	Species of specimen	cf. WoRMS	M for LT in Biota, na for others so far	
11	RLIST	Reference code list used for species ID	cf. RLIST		
12	FINFL	Factors potentially influencing guideline compliance and interpretation of data	cf. FINFL	R	multiples
13	SMVOL	Total sampled volume (litre for LT in Water, litre sediment for LT in Sediment*)	*Sample weight option to be included in the new format. Right now, weight-based data can be reported instead (items/g, items/kg)	R for LT data per sample (water, sediment), na for LF and LB	
14	SUBST	Bottom substrate type	cf. SUBST		
15	PRSUB	Percent of bottom covered with the particular bottom substrate type	1–100		
16	TRSCS	Start of tansect section (meters from transect start to section start. (TRSCS=TRSCE if transect point is sampled)	0–999		
17	TRSCE	End of transect section (meters from transect start to section end TRSCS=TRSCE if transect point is sampled)	0–999		
18	NPORT	Number of portions in split sample (SMPNO)	1–9999	n/a, deleted	
19	TRCSD	Distance to surface (m) (water depth) at start of transect section (if transect point is sampled, TRCSD=TRCED)	0–999		
20	TRCED	Distance to surface (m) (water depth) at end of transect section (if transect point is sampled, TRCSD=TRCED)	0–999		
21	DCFLG	Data centre flag - Reserved	multiple options possible		

				M for litter in biota, na for others so far	
RecID 04	**Biota Specimen Data Record**				
No	Field Code	Field Name	Valid Value	Mandatory/Recommended	Multiples allowed
1	RECID	Record identifier	'04'	M	
2	**CRUIS**	Cruise identifier (series of sampling occasions)(must be unique for file)	Any character 0–9, A–Z etc.	M	
3	**STNNO**	Station identification /Sampling event ID (must be unique for CRUIS)	Any character 0–9, A–Z etc.	M	
4	**SMPNO**	Sample identification (for each species in haul, each sediment core, each sediment grab, each water bottle)	Any character 0–9, A–Z etc.	M	
5	*SUBNO*	Sub-sample identification (each fish, egg, bird or aggregate pool of same species. New species – new sample record and SMPNO)	Any character 0–9, A–Z etc.	M	
6	NOINP	Number of individuals in sub-sample (i.e. 1 individual or number in pool)	01–99999	M	
7	ORGSP	Origin of specimen	cf. ORGSP		
8	SEXCO	Sex code	cf. SEXCO	R	
9	STAGE	Stage of development	cf. STAGE	R	
10	CONES	Condition of specimen	cf. CONES	R	
11	ASTSA	Animal state at time of sampling	cf. ASTSA	O	
12	NODIS	Number of diseases looked for during a fish disease survey	0–99	n/a	
13	BULKID	Bulk identification (for individuals only)	If an individual (or parts thereof) has been analysed in one or more bulks, insert the SUBNO identification(s) of the bulk(s). Note that BULKID can only refer to a SUBNO within the same sample.		multiples
14	DCFLG	Data centre flag - Reserved	multiple options possible		

RecID 36 Litter Record				M				
N	Field Code	Field Name	Valid Value	Example 1	Example	Mandatory / Recommended	Multiples allowed	Column
1	RECID	Record identifier	'36'			M		
2	**CRUIS**	Cruise identifier (series of sampling occasions)(must be unique for file)	Any character 0–9, A–Z etc.			M		
3	**STNNO**	Station identification /Sampling event ID (must be unique for CRUIS)	Any character 0–9, A–Z etc.			M		
4	**TRANS**	Transect ID	Any character 0–9, A–Z etc.			M if transect data		
5	**SMPNO**	Sample identification (for each sediment core, each sediment grab, each water bottle, each transect section or point)	Any character 0–9, A–Z etc. For transects, sequential numbering from transect starting			M		
6	*SUBNO*	Sub-sample identification (each fish, egg, bird or aggregate pool of same species, grab portion or core slice)	Any character 0–9, A–Z etc.			M for LT in Biota, R for other types		
7	MNDEP	Minimum depth of sample (metre). For litter on seafloor, upper depth of gear.	0–999					
8	MXDEP	Maximum depth of sample (metre). For litter on seafloor, lower depth of gear - will often be sounding depth.	0–999					
9	MATRX	Matrix analysed	cf. MATRX			M		
10	LITIDtype	type of the ID:group, subgroup, or indiv.particle	GRP, SUBGRP, INDIV	group	indiv/subgroup	m		
11	LITID	Litter identification for each litter category or each piece of litter (unique for subno). Note: with reporting categories and separate particles in same sizcl would need LITID only for the indiv.particles	Any character 0–9, A–Z etc.	CatID1	id1/sgid	m		
12	ParentLITID			*null*	CatID1			
13	LTSZC	Litter size category (first priority)	cf. LTSZC	300-999	300-999			
14	LTREF	Litter reference list:recommend H01 for micro	cf. LTREF	H01	H01	M		
15	LTPAR	Litter category code: recommend H01 codes	cf. parameters listed in pargroup "LT" or parameters in LTREF	film /fulmars: items	film	M		
16	TYPPL/NEW	Material type, rename field?	new ref.list	Category:plastic, metal, glass, natural	Category:plastic, metal, glass, natural	is the suggested H05 sufficient? Double reporting?		delete
17	LTSRC	Litter source, if possible to identify, mainly for macrolitter or industrial pellets	cf. LTSRC			m for fulmars		

18	PARAM	Measurement parameter code	new PARAMs: COUNTTOT LENGTHMAX MASSTOT MASSMEAN DIAM (remove) also H04 and H05 (or TYPPL?) codes	Totalcount: 200; LDPE: 10%; PP:40%; countnr for polymer ID: 140; blue: 5%;	LDPE: 1; diam: 350; blue: 1; maxlngt: 700	M	Need checking: count, meanweight , totalmass , maxlength, diam	add min diam and Feret diam. And Perpend diam to max length
19	MUNIT	Measurement unit	cf. MUNIT			M		
20	BASIS	Basis of determination	cf. BASIS			mandatory for some PARAMs/MATRIX		
21	VFLAG	Validity flag	cf. VFLAG				multiples	
22	QFLAG	Qualifier flag	cf. QFLAG					
23	VALUE	Value measured	Any format			M		
24	PERCR	Percentage recovery - to be applied (if thought necessary by data submitter) to the reported value (in VALUE field) at an assessment to give a better approximation of the real value	1-100					
25	UNCRT	Uncertainty value	0-9					
26	METCU	Method of calculating uncertainty	cf. METCU					
27	DETLI	Limit of detection value	0-9					
28	LMQNT	Limit of quantification	0-9					
29	**AMLNK**	Analytical method link (unique for file)	1-999	1	2; 3; 4; 5; 2			
30	DCFLG	Data centre flag - Reserved	multiple options					

RecID 20 Sampling		**Method Record**		M	
N	**Field Code**	**Field Name**	**Valid Value**	**Mandatory / Recommended**	**Multiples allowed**
1	RECID	Record identifier	'20'	M	
2	SLABO	Sampling laboratory code	cf. RLABO	M	
3	*SMLNK*	Sampling method link (unique for entire file)	1–999	M	
4	SMTYP	Sampler type	cf. SMTYP	M	
5	NETOP	Net opening width (m)	0–999		
6	MESHS	Mesh size of net or sieve (µm)	0–999		
7	SAREA	Sampler area (cm^2) (includes field of view and swept area for some data types. See definitions)	0–999	M if relevant	
8	LNSMB	Length of sampler (core) barrel (cm)	0–999		
9	SPEED	Speed (ex. trawls) (knots)	0–40		
10	PDMET	Plankton (or eutrophication) sampling depth method	cf. PDMET	n/a	
11	SPLIT	Sample splitting technique	cf. SPLIT	n/a	
12	OBSHT	Observation height (from surface) (metre)			
13	DURAT	Duration of haul or sampling (minutes)			
14	DUREX	Duration of exposure in days		n/a	
15	ESTFR	Estimated water sampling rate (flow) in litres per day		n/a	
16	DCFLG	Data centre flag - Reserved	multiple options		

RecID 21 Analytical Method Record				R	
N	**Field Code**	**Field Name**	**Valid Value**	**Mandatory / Recommended**	**Multiples allowed**
1	RECID	Record identifier	'21'	M	
2	*AMLNK*	Analytical methods link (unique for entire file)	01–999 sequential numbering	M	
3	ALABO	Analytical laboratory code	cf. RLABO	M	
4	METDC	Method documentation	User defined code to match method document submitted		
5	REFSK	Reference source or key	cf. REFSK	R	
6	METST	Method of storage	cf. METST	R for sediment	
7	METFP	Method of chemical fixation/preservation	cf. METFP		
8	METPT	Method of pretreatment	cf. METPT		multiples
9	METCX	Method of chemical extraction	cf. METCX		multiples
10	METPS	Method of purification/separation	cf. METPS		
11	METOA	Method of analysis	cf. METOA	R	
12	AGDET	Age determination	cf. AGDET	n/a	
		Bioassays			
13	SREFW	Source of reference seawater	cf. SRCWT	n/a	
		Live test organism used in bioassay			
14	SPECI	In vivo/In vitro test organism or cell line	cf. VIVIT	n/a	
15	RLIST	Reference code list used for species ID	cf. RLIST	n/a	
16	ORGSP	Origin of test specimen	cf. ORGSP	n/a	
		Information for conversions			
17	SIZRF	Size class reference list	cf. SIZRF	n/a	
18	FORML	Formula used in calculation	cf. FORML	n/a	
		Information on accreditation			
19	ACCRD	Accredited laboratory for the linked parameter	'Y' for Yes or 'N' for No		
20	ACORG	Accrediting organisation	cf. ACORG		
21	(LSIZLIM)	Lower size limit defined by method for litter	unit um	R	
22	(USIZLIM)	Upper size limit defined by method for litter	unit um	o	
23	DCFLG	Data centre flag - Reserved	multiple options		

RecID 93 Reference Material Record				O	
N	**Field Code**	**Field Name**	**Valid Value**	**Mandatory/Recommended**	**Multiples allowed**
1	RECID	Record identifier	'93'	M	
2	**AMLNK**	Analytical methods link (unique for entire file)	01–999 sequential numbering	M	
3	*QALNK*	QA information link	1–99	M	
4	CONCH	Type of reference material	cf. CONCH	M	
5	CRMCO	Reference material code	cf. CRMCO	M	
6	CRMMB	Reference material – basis of determination used in control chart analysis. Note:The same basis should be used as that of the reference material to allow comparison.	cf. BASIS		
7	CRMMV	Reference material mean value found – value	0–999 Any format		
8	MUNIT	Measurement unit	cf. MUNIT		
9	CRMSD	Reference material's standard deviation - standard deviation	0–999 Any format		
10	CRMNM	Control chart – number of measurements	0–999		
11	CRMPE	Control chart – period in weeks	0–999		
12	DCFLG	Data centre flag - Reserved	multiple options		

RecID 94 Intercomparison Record				O	
N	**Field Code**	**Field Name**	**Valid Value**	**Mandatory/Recommended**	**Multiples allowed**
1	RECID	Record identifier	'94'	M	
2	**AMLNK**	Analytical methods link (unique for entire file)	01–999 sequential numbering	M	
3	*ICLNK*	QA information link	1–99	M	
4	ICCOD	Intercomparison exercise code	cf. ICCOD	M	
5	ICLAB	Intercomparison: lab participation code – can be ALABO	cf. RLABO or any character 0–9, A–Z etc.		
6	DCFLG	Data centre flag - Reserved	multiple options		