

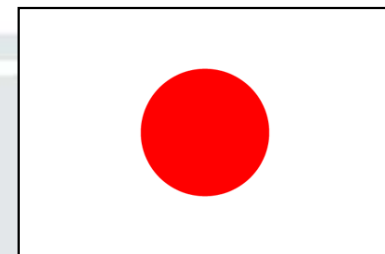
Outline for the Project of Harmonization of Microplastics Monitoring Methodologies in the Ocean conducted by Ministry of the Environment Japan

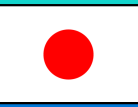
August 6th, 2018

Office of Marine Environment, Water Environment Division,
Environmental Management Bureau, Ministry of the Environment



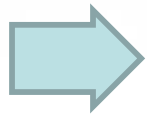
Ministry of the Environment





Background

- Marine litter including microplastic is very urgent matter. Measures against marine litter and microplastics need to be considered and taken, based upon scientific knowledge.
- Understanding their actual condition is important.
- Comparing and synthesizing measured data of microplastic abundance obtained by various researchers are currently difficult due to the diversified monitoring methods taken.



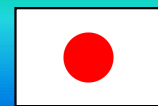
- Harmonization of monitoring methods
- Exploring how to compare existing data

- 'G7 Action Plan to Combat Marine Litter' was agreed in G7 Elmau Summit in 2015.
- Communique adopted at **G7 Toyama Environment Ministers' meeting in 2016** committed to implementing five priority measures in accordance with national circumstances, including **actions towards standardizing and harmonizing monitoring methodologies for microplastics.**
- Expert workshop held in Germany in 2015 following-up G7 Elmau Summit agreed that **Japan would lead the field of standardization and harmonization.**

The project of harmonization of microplastics monitoring methods in the Ocean has been conducted by MoEJ since FY2016.



The Project of Harmonization of Marine Microplastics Monitoring Methodologies, conducted by MoEJ



Goals

- Focus on net sampling and sample analysis methods
 - For developing distribution map of microplastics on sea surface
- Identify technical parameters to be harmonized
 - Considering minimum requirements and specific needs
ex. Sampling-net towing condition (duration, area etc.), type of sampling net (mesh size, shape), identification of polymer-type (PE, PP, PS, PET), etc.



Recommendation and Guidelines on Marine Microplastic Monitoring.

Steps

FY2016

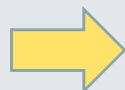
- Initial draft of recommendation of microplastic monitoring by international expert group

FY2017

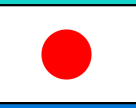
- Revising the draft focusing analyzing method in cooperation with laboratories in 10 economies using standardized samples.

FY2018

- Revising the draft focusing of field sampling on sea surfaces based on the comparison experiment of different sampling methods
- Finalize draft guidelines for marine microplastic monitoring



Inputs to GESAMP, UNEP, and WESTPAC (IOC-UNESCO)



Progress

➤ To hold the expert meetings

- Setting goals
- Sharing the way to monitor microplastic among participating experts
- Discussing which technical parameters are needed
- Discussing the results of field pilot studies
- Discussing the contents of recommendation
- Discussing future work

➤ To implement pilot projects

The following two pilot studies have been implemented since FY2017.

- To estimate “experimental variance”
- To estimate “sampling error” in the sea



Reflecting and updating recommendation and guideline

To be finalized by the end of FY2019



The Project of Harmonization of Marine Microplastics Monitoring Methodologies, conducted by MoEJ



Current Status

1. The following two pilot studies have been implemented since FY2017.

➤ **To estimate “experimental variance” (It was implemented in FY2017.)**

Cross-check of a common standard sample for quality control was implemented to estimate “experimental variance” among different laboratories.



The 12 institutes belonging to 10 countries (Canada, Norway, P.R.China, Russia, R. Korea, Spain, Switzerland, Thailand, USA, and Japan) attended this project.

➤ **To estimate “sampling error” (It is being implemented in FY2018.)**

It is now being implemented to estimate a “sampling error” by conducted simultaneous/parallel net-sampling of microplastics at sea in FY2018.





Current Status

2. The expert meetings were held to discuss harmonization of monitoring method on microplastic monitoring.

➤ The 1st meeting held in December 2016

- Sharing recognition that harmonization on monitoring methods is important and necessary.
- Setting goals.
- Making a draft of recommendation of microplastic monitoring
- Suggesting two pilot projects in order to harmonization on microplastic monitoring (shown in the previous slide).

➤ The 2nd meeting held in February 2018.

- Reporting the result of inter-laboratory calibration exercise
- Revising and discussing the recommendation draft according to the result of inter-laboratory calibration exercise.
- Discussing the contents of the pilot study to estimate “sampling error”.
- Discussing the future work



If you have any questions, please send email to
KAIYOU02@env.go.jp

Recommendations by Experts on the Required Parameters for Microplastics Monitoring in the Ocean

As of 12 June 2018

The following table shows recommendations on procedures for monitoring microplastics in the ocean as a result of discussions among the international experts who attended the meetings organized by the Ministry of Environment, Japan (MOEJ).

The Japanese Government has been working towards standardization and harmonization of monitoring procedures for microplastics in the ocean in accordance with discussions about the importance of marine litter at the G7 Elmau Summit and other international meetings.

The recommendations are made for the purpose of compiling a 2-dimensional worldwide distribution map (2-D map) of microplastics, and to be updated as necessary.

The first draft of the recommendations was made based the discussion in the first experts meeting in 2016. This version was revised based on the discussion of inter-laboratory calibration exercise results at the second experts meeting in February 2018.

| Item | Recommendations for microplastics monitoring in the ocean | Background/reason for recommendation |
|--------------------|--|--|
| Sampling | | |
| Sampling equipment | Neuston/ manta net (single net) [for specific purposes] Sampling by bottle or vessel's underway pump* ¹ | * ¹ :A bottle or the vessel's underway pump can be selected instead of the net or for specific purposes to focus on particles smaller than the net aperture. (Note: While a grab sampler is used to collect sediment samples for studying the accumulation or fate of microplastics, the procedure is not covered here.) |
| | [for specific purposes] Neuston/manta net (multiple connection) | |
| (Mesh size) | Less than 0.4 mm* ² [for specific purposes] No lower limit (decide in accordance with research needs) | * ² :The smaller the better, but it should be considered that mainstream mesh sizes are 0.330 or 0.355 mm. |

| Item | Recommendations for microplastics monitoring in the ocean | Background/reason for recommendation |
|------------------|--|--|
| Towing procedure | <p>The towing procedure should be decided by each researcher according to the purpose, necessary number of particles, conditions in the target area, and so on. The important considerations are as follows.*¹</p> <ol style="list-style-type: none"> 1) Tow time, speed and area: about 20 minutes (based on literature) at 2-3 knots, which converts to about 1000 m² sampling area/tow, but this would depend on plankton abundance. 2) Tow length: consider the rough particle volume of the target sea area (to estimate minimum particle abundance), and existence of biota 3) Tow number: needs further consideration, but depends on tow time, length, and area considerations. | <p>*¹:It is suggested that a tow direction against the wind is important for reducing the sampling variability. If every tow is perpendicular to the wind direction, data variability (standard deviation) is minimized and the necessary number of tows is decreased.</p> <p><i>(Reference: Based on Dr. Cozar's study in the North Pacific, an optimal tow number and sampling area to obtain an average value would be 120 tows and 174,000 m², respectively. Goldstein et al.(2012) also shows 50 tows and 33,000m² and also suggests 250 tows as an optimal sampling effort, corresponding to 165,000m². Area figures from two analyses show the sampling area to be better than tow number as a sampling effort unit.)</i></p> |
| Metadata | <p>(Major items)*¹</p> <ul style="list-style-type: none"> - Sampling level (depths) - Wind speed - Beaufort scale - Current speed and direction - Filtered volume - Log - | <p>*¹:Metadata are critical to introducing inter-comparability and helping harmonize. <i>(Reference: EU has a table on metadata.)</i></p> |

| Item | Recommendations for microplastics monitoring in the ocean | Background/reason for recommendation |
|-------------------------|--|---|
| | <p>[for specific purposes]</p> <ul style="list-style-type: none"> - Significant wave height - T/S record (locations of oceanic fronts) - Photos or videos of net towing^{*2} | <p>^{*2}:It is useful to assess sea states, use automatic detection for larger plastics and understand wind row issues.</p> |
| Primary analysis | | |
| Sample processing | <p>Record how each sample was stored and processed, including description of chemical treatment. ^{*1}</p> <p>Special care should be taken to distinguish plastics from natural particles. ^{*2}</p> <p>To enhance reliability, it is required to provide or report QA/QC data. ^{*3}</p> <p>Any use of procedural blanks and blank corrections should be noted.</p> | <p>^{*1}:Number of microplastics in organisms could be counted when chemical treatment is implemented.</p> <p>^{*2}:Even in other laboratories that did not use equipment such as FTIR or Raman spectrometers for ILC, by carefully confirming plastic particles, the accuracy reported was similar to those that used equipment such as FTIR or Raman spectrometers.</p> <p>^{*3}:Examples of QA/QC data can be procedural blanks, recovery rate, repeatability, etc. Subset of sample analysis should be confirmed with further analytical methods such as FTIR or Raman spectrometers. FTIR or Raman spectrometer should be used when visual identification can be/should be supported by FTIR or Raman, if the particles are less than 1mm.</p> |

| Item | Recommendations for microplastics monitoring in the ocean | Background/reason for recommendation |
|--|---|---|
| Sample processing | <p>When taking out particles from samples, care should be taken not to overlook smaller particles less than 1 mm.*²</p> <p>It is recommended to use stereo microscope to take out particles.</p> <p>Particles should be dried thoroughly before weighing them.</p> | <p>*²:When filtering particles from the samples, particles with minor diameters smaller than the sieve openings passed through the sieve, even though the major diameter was larger than the sieve openings.</p> <p>Also, when picking up particles from sieves and filters, it became difficult to visually spot transparent particles mixed among contaminants, so small particles were overlooked.</p> <p>Regarding the method of filtering particles from samples, using sieves and then filtering the particles that passed through the first sieves again with sieves or filters with smaller openings, improves the accuracy of filtration and is effective in operation.</p> |
| Size of particle | <p>[for specific purposes]</p> <p>Density separation or chemical processing (e.g., H₂O₂ treatment)</p> <p>Length (longest length (maximum Feret's diameter) *¹)</p> <p>It is recommended to use image processing software to acquire additional size dimensions, for example minimum aperture length.*²</p> | <p>The type of processing is important with regard to harmonization.</p> <p>*¹:Aperture length is the size of the smallest opening through which the particle can pass. This means that even if the mesh size is 0.3 mm, it doesn't mean that any particle less than 0.3 mm is not captured. It depends on the shape.</p> <p>*²:Provide comment on the reason for the additional experiment.</p> <p>If particles are classified according to type, it will be possible to convert area to weight with equations of volume and weight.</p> |
| Concentration (particle counts/weight) by size | <p>5 mm*¹>d</p> | <p>*¹:While 'micro' means from 1 micron to 1,000 microns in SI, the definition of microplastics in policy (NOAA, EC Directive) is particles of less than 5 mm.</p> |

| Item | Recommendations for microplastics monitoring in the ocean | Background/reason for recommendation |
|--------------------|--|--|
| categories | <p data-bbox="436 284 719 316">[for specific purposes]</p> <p data-bbox="465 320 573 352">$d \geq 5$ mm</p> <p data-bbox="465 357 1211 421">$d < 1$ mm (The result of $d < 1$ mm should be reported separately from the result of $d \geq 1$ mm. ^{*2)}</p> <p data-bbox="436 628 1211 724">Measuring weight is optional, especially for particles less than 1mm. Sufficient drying is required and chemical processing is recommended before weighing ^{*3).}</p> | <p data-bbox="1238 284 1980 421">^{*2:}In the result of the ILC, while the accuracy for the measured number of particles ≥ 1mm was high, for particles less than 1mm the result tended to be smaller than the actual number.</p> <p data-bbox="1267 426 1980 521">Data should be accumulated to determine the factor to convert the measured number of particles less than 1mm to a more authentic number.</p> <p data-bbox="1267 526 1980 622">Analysis of microplastics in marine organisms (plankton, fish, etc.) is necessary when investigating biological effects, etc.</p> <p data-bbox="1238 627 1980 754">^{*3:}Converting numbers to weight is possible assuming particle size, shape and density. Data from actual sea areas need to be accumulated to compare the results of numbers and weight.</p> <p data-bbox="1296 759 1912 791">Moisture and electro-static changes the results.</p> |
| Units (metrics) | <ul style="list-style-type: none"> <li data-bbox="465 831 1211 927">- Particle count per unit area or weight per unit area^{*1} Area is calculated by the width of the net and towed length <li data-bbox="465 1034 1211 1198">- Particle count per unit volume or weight per unit volume^{*2} For calculating the volume, it is important to record flowmeter data, speed thorough the water, tow distance and tow time. | <p data-bbox="1238 831 1980 927">^{*1:}If the dimensions of net aperture are recorded, the per unit area could be converted to per unit volume with certain assumptions.</p> <p data-bbox="1238 932 1980 1027">^{*1:}Use of unit area is better for talking about floating plastics, while concentration per volume depends on the sea state and sampling depth.</p> <p data-bbox="1238 1032 1980 1128">^{*2:}Unit volume would be used in talking about contaminants or environmental modelling for calculations.</p> <p data-bbox="1238 1133 1980 1265">^{*1,*2:} A convincing explanation on why two-dimensional units should be used is that the nature of the sample is mostly at the surface, where it affects organisms, such as surface feeding fish and birds</p> |

| Item | Recommendations for microplastics monitoring in the ocean | Background/reason for recommendation |
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| Colour | <p>Record the colour of each particle</p> <p>[for specific purposes]</p> <p>Photos of microplastics samples to categorize the color.</p> | |
| Particle type categories | <p>(Five broad categories)</p> <ol style="list-style-type: none"> 1) Fragments (irregular shapes particles, crystals, powder, granules, shavings, fluff, films) 2) Beads (grains, spherical microbeads, microspheres) 3) Foams (expanded polystyrene) 4) Pellets (nibs, nurdles, reproduction resin pellets) 5) Fibers (filaments, lines, microfibers, strands, threads, strings, etc.) | <p>(A specific discussion)</p> <p><i>In the "fibers" category, separation between lints and fishing lines should be considered; lints can originate from ropes, fishing lines or other products but they are likely mainly of textile origin. Moreover, lints can be transported by air currents, becoming very abundant, and are the main candidates for contaminating samples. "Potential textile fibers" can be identified according to shape and rigidity, although they can be difficult to classify in some cases. Lints typically ranged from hundreds of microns to centimeters in length and from one to a few tens of microns in width, being easily folded; whilst pieces of fishing lines are wider and generally straight in shape.</i></p> |
| <p>Polymer types (for specific purposes)</p> <p>Sample preservation</p> | <p>[for specific purposes]</p> <p>If you need additional information on polymer composition, spectroscopy or similar methods should be used.</p> <p>Maintain visual representation (pictures, etc.) of all individual particles</p> <p>Store and record samples</p> | <p>PE, PP, PS, others</p> |
| Contamination | <p>Record possible risks (quantify) and take steps to prevent contamination</p> | |

| Item | Recommendations for microplastics monitoring in the ocean | Background/reason for recommendation |
|------------|--|--|
| Automation | [for specific purposes] FTIR can be semi-automated Automation of measurement parameters* ¹ (e.g., size, colour, polymer type) | ^{*1} : Depending on progress of automating technologies, monitoring method categories may change from 'recommended' to 'minimum' in the future. |