Second Interim Report of the Technical Subgroup on Marine Litter

To the Working Group on GES in relation to the Marine Strategy Framework Directive 2008/56/EC (WG GES)

Background

In accordance with the terms of reference of the Technical Subgroup on Marine Litter (TSG ML), the group is expected to 1) identify and review existing data and on-going data collection on marine litter, 2) describe data needs and methods for future assessment of marine litter, 3) consider standards for recording of marine litter, 4) develop proposals for the development of impact indicators for each of the regions, 5) address how to develop objectives (characteristics of GES), environmental targets and associated indicators in relation to marine litter, 6) discuss effectiveness of measures leading to reductions in marine litter, and 7) recommend proposals for further research priorities.

The group is chaired by Francois Galgani (Ifremer, France) and co-chaired by Georg Hanke (JRC) and Stefanie Werner (UBA, Germany) supported by Henna Piha (JRC). Currently 37 people nominated by MS and stakeholders are participating in the group. The work is facilitated by a web-based communication tool (Basecamp) provided through JRC, which is used for collaboration, drafting documents and compiling all information.

The group has convened twice; the first meeting being held in Copenhagen, 4 November 2010, and the second in Calvi, 18-20 April 2011. The activity of the group focuses on developing **a toolbox** with applicable monitoring/quantification methods (**tools**) and **a roadmap** for the further MSFD Descriptor 10 implementation. The format for the tools has been developed and agreed upon and draft tools have been developed within the relevant tasks. The work has been divided into ten tasks for which progress updates are given in the following.

Task updates

Task 1 Available data and methodologies

A questionnaire on available data and methodologies related to marine litter in European seas has been circulated and data has been received from approximately 40 organisations covering altogether 56 different monitoring projects. This data is used in the development of tools in Tasks 2-6. It will also be used to provide an overview of monitoring and assessment methodologies and of the regional coverage of litter monitoring programmes (past and present) to the final report.

Task 2 Beach

An overview of available methods has been prepared. In general, the approach used by OSPAR is well developed. A method is recommended by HELCOM for the Baltic; however, it has not been tested yet and has some shortcomings in comparison to the OSPAR methods. In the Mediterranean and Black Sea regions, there is limited information on experiences with methods used there. For each methodology an overview is provided, which includes pros, cons, problems and experiences.

First conclusions/recommendations arising from the overview are:

- Proposals for "common best practices" should be made, based on the conclusions of an assessment of the overview. They should include a list of products that possibly will require further (regional) development.
- A common basic method that deals with all requirements should be proposed to MS.
- 100 m seems to be a practical length of coast for surveys.

- Counting items appears at present to be the most practical method, providing the best information for the identification of sources.
- Numbers of items should be converted into weight using a conversion factor. The use of agreed average weights for litter items would allow for the combination of different litter items among years and reliable statistical analysis.
- Minimum size range for sampling unit 0 - 2.5 cm (used e.g. in OSPAR).
- Surveys should be as extensive as possible: counting all litter in the 100 m stretches, minimum of four surveys per beach per year (seasons). Several beaches per country/region.
- The option of cleaning/not cleaning beaches should be left open.
- Member States will need to finance beach monitoring in order to ensure continuity and the necessary standard quality of surveys over the monitoring period required by the MSFD.

There is a major monitoring gap between the size ranges 5 mm and smaller, as used for surveying microparticles, and 2,5 cm and larger, as used for surveying macrolitter, which needs to be addressed. With regard to quality assurance, training of volunteers and communication are important (photo guides, survey forms, beach questionnaires). For statistical trend analyses no standard method has yet been defined. Both NOAA and a German R & D-project are developing and testing methods – the results from these tests should be assessed and an appropriate method of analysis should be incorporated into the toolbox.

Task 3 Water column & surface

Task 3 identified the recommended matrix for observation with regards to indicator 10.1.2 of the Commission Decision (2010/477/EU) and concluded that for monitoring, the surface itself and the uppermost water layer are priorities. The occurrence and distribution of marine litter in the deeper water column must be subject to further research.

The methodology of quantification varies with the size and the statistical occurrence of the litter items. Basically it can be discriminated between large litter items above 25 cm size, medium size litter from below a centimetre to a few decimetres and microparticles ranging from 5 mm down to nanoscale. While methodologies do not necessarily need to cover all fractions without gaps, it is important that the survey methods are harmonised, in particular for the target size range and are representative in order to allow the calculation of temporal trends.

A first draft of tool sheets has been developed in order to cover different size fractions:
- The observation of the **sea surface from air** can cover large areas, using opportunities such as e.g. cetacean research surveys, coast guard oil spill surveys. Even using existing platforms, these might need dedicated personnel. Aerial surveys can only identify larger items for example derelict fishing gear, packaging and items which could compromise shipping safety.
- The quantification of **floating marine litter from ship-based platforms** using visual observation is a method of choice. The performance depends on the observing conditions and also on the employed protocols, which need to be harmonised. Dedicated observers are needed for this. Camera systems which perform these observations automatically are under development.
- Tow net surveys are in use for the quantification of **floating and near-surface small litter particles**. There is further need to harmonise these surveys with regards to their representativeness and their results under differing environmental conditions. A practical lower limit of 330 µm for harmonised monitoring appears reasonable.

The units and categories for reporting of the results are still under discussion. The group aims at a coordinated approach between the different target matrices. As a next step the group will develop a second draft of the proposed tool sheets and a roadmap which will highlight the expected and necessary developments over the next years.

Task 4 Seafloor

The work of Task 4 focuses on the trends in the amounts of litter deposited on the seafloor, with analysis of its composition, spatial distribution and, where possible, source (Indicator 10.1.2). The task considered the shallow waters, shelves and deep sea floor:

- The group reviewed the most commonly used methods to estimate marine debris density in shallow coastal areas. Based on this, protocols were divided into those based on plot sampling and those based on distance sampling to be provided to Member States. There is however a need for further work to develop an appropriate plan for monitoring (sites, depths, priority areas, link to existing biological monitoring projects and cleanup initiatives).

- Monitoring programs for demersal fish stocks undertaken as part of the International bottom trawl surveys (IBTS and MEDITS) can provide information on the amount and composition of litter on the seafloor. They are recommended for the evaluation of litter on continental shelves (or alternative "shelf seas"). Protocols are already available and the existing fish stocks assessment network will enable, after rationalization and implementation, coverage of most European seafloor areas between 40 and 800 m. This must be co-organized and coordinated within the two groups ICES/IBTS covering the NE Atlantic and the Baltic Sea and MEDITS covering the Mediterranean and Black Seas. This will need to be organized within STEFC (sc. Tech. Econ. fishery council) and its Subgroup Research Needs (SGRN) with the support of the Data Center Framework (DCF) from DG mare.

- Monitoring of deep-sea areas is presently only carried out on an irregular basis because it is very expensive. The monitoring of specific deep-sea areas, which are heavily impacted by litter and where trawling does not take place should take priority. Assessment will have to be performed on a long-term scale (every 5 – 10 years).

Task 5 Biota

The work of Task 5 focuses on indicator 10.2.1 *Trends in the amount and composition of litter ingested by marine animals*. As the indicator is based on assessing trends in ingested litter, the primary task is to develop tools for trends in ingested litter that cover all the MSFD marine regions. However, in the COM Dec it is stated that the improvement of knowledge concerning impacts on marine life (affected species, species used as indicators, the normalisation of methods and the determination of thresholds) is also needed. Hence, the second issue is to develop strategies for assessing harm/impacts (roadmap). In the North Sea, an indicator which expresses the impact of marine litter is available (OSPAR EcoQO). This indicator/tool measures ingested litter in Northern Fulmar and it is used to assess temporal trends, regional differences and compliance with a set target for acceptable ecological quality in the North Sea area (Van Franeker et al. 2011). The tool is applicable to most NE Atlantic countries. Alternative tools are needed for the Baltic Sea, the Mediterranean Sea, the Black Sea, and southern parts of the NE Atlantic.

On the basis of available information and expertise, Task 5 is currently focusing on the further development of the following tools in order to implement indicator 10.2.1:

- Fulmars: extension to areas currently not covered in regular monitoring.

- Shearwaters: should be applicable to the southern parts of NE Atlantic and to parts of the Mediterranean.
- Sea turtles: if monitoring programmes can be established, these could be applicable to the Mediterranean and potentially the Black Sea and some parts of the southern Atlantic.
- Seals: further investigation of the applicability of by-caught seals for ingested litter monitoring. These could cover the Baltic and the NE Atlantic.
- Fish: further investigation of the applicability of fish for ingested litter assessment. Trials for plastic in fish have been carried out in the North Sea, which currently indicate that incidences of plastic in fish in this area are too low to be useful for monitoring purposes. However, more information is needed on other areas and the suitability of other species, such as sand eel, sprat, herring or sardines, or species of bottom-feeding fish.
- Investigation of other possibilities.

As no single species can provide full coverage over all Europe's marine sectors, a range of species is needed to monitor ingested litter. Some spatial overlap between regionally restricted monitoring species is desirable to link pollution measurements in the different areas.

Ref: van Franeker, J.A., et al. (2011 in press), Monitoring plastic ingestion by the northern fulmar *Fulmarus glacialis* in the North Sea, Environmental Pollution (2011), doi:10.1016/j.envpol.2011.06.008

Task 6 Microplastics

A first step for Task 6 is to establish appropriate methods to monitor microplastics in the marine environment. It seems inappropriate to define microplastics on the basis of the size of mesh used since it is entirely probable that pieces smaller than the mesh size used will exist. Hence, the group proposes to consider all sizes less than 5 mm, but to recognise that there are logistical limits to how small it is feasible to sample. As yet there are no routine methods for monitoring of microplastics. A brief summary of different approaches is provided below. A critical next step for the group however remains on agreeing how best to monitor and which compartments to monitor (beaches, sea surface, seafloor).

Sampling from sandy beaches

One approach that has been used with some success since 2004 is to collect replicate samples of sand and then extract less dense material according to density for example using a concentrated sodium chloride solution. More buoyant material can be collected on to filter paper and pieces that appear unusual (potentially plastic) can be formally identified using FT-IR spectroscopy. However, at present, separation is not fully efficient and is likely to result in an underestimate of the total plastic burden.

Sampling from the sea surface / surface waters

This has been achieved using the continuous plankton recorder (CPR) which samples at around 10m depth and then removing from the sample collect any items, which appear unusual (potentially plastic). The identity of these items is then confirmed using FT-IR microscopy (see above). The limitation of the method is that the CPR does not sample the sea surface where greatest quantities are likely to be present.

Sampling has also been achieved using various surface towed nets and trawls (e.g. manta trawl). These approaches capture material at the surface. The minimum size of particle captured will depend on the mesh size which is typically similar to or greater than that of the CPR.

With either of these approach particles need to be identified for example by FT-IR.

Sampling from the seafloor

Only one study has examined this. Sediment samples were collected using an Eckman grab and then processed in the same manner as for intertidal sediment.

A chemical approach to oxidise organic material other than the plastic has also been developed by University of Washington/NOAA, and draft details have been posted on the Basecamp site. The approach can be used for material that has been collected either by net or from sediments. It uses more reagents than the methodology outlined above However, it does not include any formal identification, for example using FT-IR. Hence this approach does not require expensive analytical equipment such as FT-IR, but as a consequence polymer type is not confirmed.

Ref: Thompson, R. C., Olsen, Y., Mitchell, R. P., Davis, A., Rowland, S. J., John, A. W. G., McGonigle, D. & Russell, A. E. (2004). Lost at sea: where is all the plastic? Science 304, 838. (doi:10.1126/science.1094559)

Task 7 Objectives and targets

To implement the MSFD, Member States have to provide the first milestones to the European Commission by July 2012. Article 8, point 1 (Initial Assessment) requests an analysis taking account of existing data, where available, on the current status of (a) biological, physical, chemical and other ecological features and characteristics listed in Annex III Table 1 for the marine waters concerned. It furthermore asks for an analysis of the predominant pressures and impacts on the environmental status, based on an indicative list in Annex III Table 2. Additionally, according to Article 3, a set of characteristics defining GES (GES) shall be determined on the basis of the qualitative descriptors in Annex I, while the extent to which GES is being achieved will be assessed by criteria and related indicators laid down for each descriptor in the Commission Decision. Pursuant to Article 9(1), a set of environmental objectives based on characteristics, pressures and impacts listed in Annex I and Tables 1 and 2 of Annex III have to be determined.

Whereas for some pressure descriptors such as D8 (Contaminants and pollution effects) or D5 (Eutrophication) advanced assessment methods are available and internationally set targets exist, which will still have to be harmonized with the requirements of the MSFD, there are some underdeveloped descriptors such as D10 (Marine litter) or D11 (Energy), where quantitative assessment of the impacts is presently insufficient. This makes it hard to set adequate targets and determine GES.

A screening of internationally available background information/literature outside the MSFD implementation process concluded that there is no comparable approach of setting quantitative objectives to be found in the field of marine litter. Up till now measures to tackle the problem have been developed without setting quantitative targets or monitoring to assess whether or not targets are being reached. Therefore a general discussion took place within the group on the determination of GES with related targets for D10 dealing with overlaps with other directives/policies, the aggregation of indicators within the descriptor, the degree of ambition in goal setting, the possibility of identifying danger/harm-categories for different materials of marine litter, the setting of operational/intermediate targets focusing on reduction, prevention and removal based on source identification and the weight of socioeconomic analyses when defining GES. The role of operational targets was also discussed, which could be linked to specific sources and be established in addition to targets, which are linked to the indicators.

The TSG ML is currently working on transferring the results of these considerations into advice on target setting and determination of GES for Marine Litter as requested by the Member States. It will be available for the next meeting of the Working Group on GES in relation to the Marine Strategy Framework Directive 2008/56/EC (WG GES).

This work is closely linked to the work on sources under Task 8.

Task 8 Sources

As marine litter originates from many diffuse sources it is important to identify which are the most significant, however given that many items can come from multiple sources this is not a straightforward task. A point that is recognised in the Commission Decision where consideration of sources are only in relation to 10.1.1 and 10.1.2 litter on the coastline, in the water column (including the surface) and deposited on the seabed, and then with the caveat of "where possible". However it is important to, as far as possible identify sources as this can allow the development of operational targets focused on the most significant problems aiding the development of measures.

The group identified that monitoring of litter on the coastline and seabed was most likely to provide valuable information on sources as they recorded the greatest number of litter items. This also gave rise to an initial discussion of how harmonised litter monitoring categories should be for different indicators and what level of detail should be recorded. The initial consensus was that litter items should be recorded in harmonized categories across the indicators and should be recorded in as much detail as possible to allow further analysis. The categorisation should, to the largest extent possible, be compatible with already established, international approaches, and allow budgeting and trend assessments across environmental matrices. The group is currently discussing the possibility of using a hierarchical litter categorisation, where the main categories would be based on material and the subcategories would be based on source and/or application. In order to be able to set operational targets, the important sources in the region or sub-region must first be identified. This information should be contained within the initial assessment developed by each Member State. However as litter monitoring implementation varies greatly throughout the EU this will be difficult for some regions. Therefore the TSG ML is currently reviewing source data for the Regional Seas drawing on work undertaken for the UNEP Regional Seas Assessments and recent publications to assist Member States in this area. The group will also develop diagrams highlighting the connections between sources of litter and individual items, and vice versa, to assist in the development of operational targets.

Task 9 Reporting and data treatment

Reporting for the MSFD will be done through the WISE MARINE system, presently under development. DG ENV and EEA, together with the MS (WG-DIKE) are currently developing reporting sheets for the MSFD (Art 8, 9 and 10). These reporting sheets will provide the proposed scope and detail of the information and data to be reported for the Initial Assessment. The EEA and ETC/ICM, together with ENV are also working with the INSPIRE Directive community in order to get an overview of the Inspire developments for marine data and see how these could apply to the MSFD reporting requirements. There is currently no harmonised set of data reporting parameters and metadata, and hence the use of common approaches for quantifying marine litter by the scientific community should be encouraged. With EMODNET currently being developed as a portal for accessing environmental data in the marine environment a module for Marine Litter data might be useful and linkages should be explored.

Task 10 Research needs

The objective of achieving or maintaining GES in the marine environment by 2020 and related monitoring requirements demand a thorough understanding of mechanisms and processes associated with the causes and impacts of litter at sea. This requires considerable research at the region/sub region scale to give a scientific and technical basis for monitoring and definition of measures, to link quantities of litter and associated harm in the context of GES, to define priority areas, to harmonise and coordinate

common and comparable monitoring approaches and finally support guidelines to assess GES on a regional/European scale.

The achievement of these goals requires significant upstream work on various aspects. In addition to immediate research needs mentioned in different tasks, the group listed important research which should be promoted and recommend the following short-term priorities to support the start of monitoring by 2014:

Sources, behaviour and fate of litter
- Develop comprehensive models to define source and destinations of litter regions (especially accumulation areas, permanent gyres and deep sea zones), residence and drift times, and transformer transportation from/to MSFD region/sub regions.
- Identify sources and pathways of entry into the marine environment for direct inputs of resin pellets and land-based litter.
- Investigate the sources of litter disposed of from shipping and identify possible management options.
- Evaluate the behaviour of litter in the marine environment (floatability, density, etc.) and factors affecting the transport and fate of litter (weather, temperature driven variations, slopes, bays, etc.).
- Evaluate rates of degradation of different types of litter and quantify degradation products.

Impacts of litter on biota
- Establish the environmental impacts of microparticles, especially microplastics.
- Evaluate environmental consequences of litter related chemicals (Phthalates, bisphenol A etc.) in marine organisms.
- Evaluate the suitability of various species for evaluating impacts.
- Evaluate the risk for transportation of invasive species.

Socio-economic impacts of litter
- Evaluate direct costs to industry, fishing industry, local authorities and governments, and ecosystem goods and services.

Monitoring of litter
- Develop automated monitoring systems (ship based cameras, microplastics quantification etc.).
- Rationalise monitoring (standards/baselines; data management/quality insurance; extend monitoring protocols to all MSFD subregions).

Time schedule and deliverables

The next TSG ML meeting will be held 12.-14.10.2011 in Varna, Bulgaria, where the **final report will be** reviewed and finalised to be **delivered to the Marine Directors meeting** taking place in **November 2011**. Until then a series of intermediate milestones has been identified. The structure of the report has been agreed upon.

Concluding remarks

The group reports that it had now concentrated on high priority issues and that further work after November 2011 is necessary in order to progress towards a harmonised implementation of MSFD Descriptor 10.