



Document title	Endorsement of HELCOM candidate indicator on 'Litter on the seafloor' and proposed shift in status to pre-core indicator
Code	4J-3
Category	DEC
Agenda Item	4J – HELCOM indicators and assessments
Submission date	12.10.2016
Submitted by	HELCOM EN-Marine Litter
Reference	Outcome of HOD 48-2015, para 3.63

Background

Development work on the candidate indicator 'Litter on the seafloor' has in 2015 and 2016 been taken forward by Lead and co-Lead Countries and communicated to and reviewed by the Contracting Parties through the HELCOM Expert Network on Marine Litter (HELCOM EN-Marine Litter).

Work on the litter on the seafloor candidate indicator has been co-led by Denmark and Sweden, in the absence of a leading country.

The HELCOM EN-Marine Litter has held six online working meetings (18.03.2016, 20.05.2016, 22.06.2016, 22.09.2016, 03.10.2016 and 07.10.2016) addressing, among other issues, the improvement of the litter on the seafloor indicator report¹. Memos of those working meetings are available in the litter on the seafloor candidate indicator folder of the [marine litter workspace](#).

For indicators to be included in the second holistic assessment (HOLAS II), GES boundaries and indicator concepts should be endorsed by relevant Working Groups in autumn 2016 and adopted at HOD 51-2016 (14-15 December 2016). Since GES has not been defined for indicators on litter, HOLAS II 5-2016 agreed that "to use a descriptive approach in the presentation of marine litter and underwater noise in the HOLAS II report due to the fragmented availability of data while also including a forward looking view on monitoring and ongoing knowledge building on these topics" ([Outcome of HOLAS II 5-2016](#), para 5.10).

This document contains the HELCOM candidate indicator 'Litter on the seafloor' as proposed by the HELCOM EN-Marine Litter. The draft indicator report has been prepared by Denmark and Sweden. Contributions and feedback has been received from Estonia, Finland and Germany.

Action requested

The Meeting is invited to:

- take note of the progress of work;
- endorse proposed indicator concept;
- endorse proposed interim definition of GES;
- endorse the proposed shift of status of 'Litter on the seafloor' indicator from candidate indicator to pre-core indicator.

¹ [Current version](#) as agreed by HOD 48-2015 to be kept as candidate indicator, para. 3.63 of the [Outcome of HOD 48-2015](#).

Litter on the seafloor

Key message

Note: There is no operational indicator for litter on the seafloor in the HELCOM area, but an indicator based on data of marine litter collected in trawls during fish stock surveys is proposed. The indicator concept is the amounts of litter (unit: items per km² seafloor) in different categories of litter items (plastic, glass/ceramics, metals, natural products, rubber and miscellaneous; for further details see also Annex 1), distributed in different sub-basins. It is important to note that the number of litter items recovered in trawls is only an indication of the true amount of litter on the seafloor. An interim definition of Good Environmental Status is proposed in the section on GES. The section on results includes a brief summary of data and information available in the Baltic Sea area, but the status is not assessed due to lack of agreement on GES.

Some data is available on the amount of litter collected in trawls during fish stock surveys ('number of items per haul' and 'number of items per km square), but this data only cover some Baltic Sea regions. The data set covers only a few years (from 2012 and forward in areas from the Northern Baltic proper and south, see map below in the section on current monitoring), and currently it is not possible to determine how the amounts have changed over time. Other methods for monitoring litter on the seafloor, e.g. in areas not covered by fish stock surveys, are still in the form of pilot studies.

Relevance of the core indicator

Once litter is introduced in the marine environment it can be transported long distances by water currents, and sink and accumulate on the seafloor far away from its original source. Recent reviews indicate that the density of macro-scale (>2 cm) litter items is higher on the seafloor than floating on the sea surface (Galgani et al., 2015), suggesting that a large part of the total amount of litter in the marine environment is deposited on the seafloor. The negative impacts of litter that is deposited on the seafloor are wide ranging including death of marine organisms (by entanglement and lack of oxygen), smothering and other damage to habitats, and can also have socioeconomic impacts, and may pose navigational hazards.

Policy relevance of the core indicator

	BSAP Segment and Objectives	MSFD Descriptors and Criteria
Primary link	<ul style="list-style-type: none"> Concentration of hazardous substances close to natural levels 	D 10 Marine litter 10.1. Characteristics of litter in the marine and coastal environment
Secondary link	<ul style="list-style-type: none"> Safe maritime traffic without accidental pollution Thriving and balanced communities of plants and animals 	D 10 Marine litter Influence on achieving GES of the criteria 10.2 - Impacts of litter on marine life
Other relevant legislation:		

Cite this indicator

HELCOM 2016. Litter on the seafloor. HELCOM core indicator report. Online. [Date Viewed], [Web link].

Results and confidence

Some data is available on the amount of litter collected in trawls during fish stock surveys ('number of items per haul' and 'number of items per km square'), but this data only cover some Baltic Sea regions. The data set covers only a few years (from 2012 and forward in areas from the Northern Baltic proper and south, see map below in the section on current monitoring), and currently it is not possible to determine how the amounts have changed over time, since no Baltic -wide assessment of the data collected in trawl tows has been done yet.

Lundqvist found ca 3000 items /km² in Swedish coastal waters (in the Skagerrak) and cited figures from other parts of the world of between 140 and 14900 items/km² (the latter counted by Scuba diving in Greece). Preliminary data from IBTS monitoring in the OSPAR region for the period 2012-2014 give an average number of items of 13-230 items/km², depending on subregion (Lundqvist 2013). How this compares to the amounts found in the Baltic will be shown when an assessment of the Baltic BITS data has been made.

Confidence of the indicator status evaluation

As no evaluation of the results from marine litter data from the BITS programme for the HELCOM region has yet been made, no current confidence evaluation is given.

Good environmental status

No quantitative definition of Good environmental status has been set for the indicator due to a low availability in long-term monitoring data on seafloor litter.

Metrics are currently not available for setting quantitative thresholds for when litter on the seafloor is causing harm to the environment. In their absence, the thresholds may be replaced by downward trends in the indicators (Galgani et al., 2013), such as the amount, distribution and, where possible, composition of the litter on the seafloor to provide proxies for evaluating progress towards GES.

The Baltic International Trawl Surveys (BITS) that could provide relevant and comparable data to the indicators have only been carried out since 2012, with the most comprehensive sampling from 2015. A longer monitoring period is necessary to provide a reliable baseline. Data from such a baseline period could then be used to calculate the sampling intensity needed to achieve the desired statistical power for detecting temporal trends.

Given the variability of litter data, which is influenced greatly by season, weather conditions and water currents, a 6-year running mean in line with the requirements of the MSFD could be a suitable period to evaluate for trends in terms of an average level of pollution. However, similar to any monitoring programme, the ability of such an assessment to detect significant trends will depend on the rate of change of the occurrence of litter, and on the number of sites monitored.

Assessment protocol

An assessment protocol has not yet been developed for the HELCOM area. Assessment protocols are currently under development in OSPAR and the Barcelona Convention.

A future assessment protocol could include analyses of trends of total amount of litter (unit: items per km² seafloor), distribution in different sub-basins, and trends and amounts in different categories of litter items (plastic, glass/ceramics, metals, natural products, rubber and miscellaneous; for further details see also Annex 1). Some information on sources of litter may also be given by the current protocols, although the details of item categories are not as precise as for beach litter monitoring.

It is important to note that the number of litter items recovered in trawls is only an indication of the true amount of litter on the seafloor. The rate of recovery of litter items by bottom trawls is not known, so the recorded numbers probably represent an underestimation of the true amounts. If the purpose of the monitoring programme is to give an estimation of true amounts, additional investigations e.g. combining trawl investigations with underwater video will be necessary.

An assessment of litter in the BITS programme has not yet been made. The possibility to make good assessments is dependent on accessibility to data, and there are still some problems with the current data structure. Litter data collected in the BITS programme is currently stored in the [ICES DATRAS database](#). While the structure of this database is designed to accommodate trawl survey data, it is currently not ideal for litter data management.

There are several aspects of the database that makes it difficult to analyse litter data:

1. the data on hauls (position, tow length, depth etc.) is not directly tied to the content of the trawl (litter items), but these must be matched via haul ID matching;
2. the different categories of litter items are listed in different rows;
3. only litter item categories found are listed. Item categories not found in a haul are not listed.

These are all problems that may easily be solved by someone with database programming skills, but for a person not skilled in programming it is presently very time-consuming to transfer the data to a format suitable for e.g. statistical or graphical software.

Another current problem is the use of different item category lists by different countries. The suggested list of items has been changed a number of times since the start of litter monitoring in the IBTS and BITS programmes. As an example, in the data reported so far to DATRAS for 2016, three different lists (RECO-LT, C-TS and C-TS-REV) are reported. These lists are partly incompatible, making a current assessment difficult. If any assessment beyond total amount for individual tow is to be made, it is essential that all countries use the same list of item categories, i.e. the one recommended by ICES WGBIFS 2016 (see also the section on "Monitoring methodology" below, and Annex 1).

Relevance of the indicator

Policy Relevance

The 2013 HELCOM Ministerial Declaration (HELCOM, 2013) committed to achieve a significant quantitative reduction of marine litter by 2025, compared to 2015, and to prevent harm to the coastal and marine environment. Such aim is to be reached through the implementation of the land-based, sea-based and educational and outreach measures defined as part of the HELCOM Action Plan on Marine Litter adopted in 2015 (HELCOM Recommendation 36/1, 2015).

The action plan aims to the development of common indicators and associated targets related to quantities, composition, sources and pathway of marine litter, and that where possible, the harmonized monitoring protocols based on the recommendations of the EU Technical Group on Marine Litter will be used. In that sense, recommendations for sampling seafloor litter (specifying shallow or deeper waters) are provided by the MSFD GES Technical Group on Marine Litter (JRC, 2013) to contribute to the monitoring of litter in the marine environment according to the MSFD requirements. Seabed litter is also a common and candidate indicator of the OSPAR area, as detailed in the Regional Action Plan for Prevention and Management of Marine Litter in the North-East Atlantic (OSPAR, 2014).

Effects of litter on the seafloor on the ecosystem

Litter on the seafloor can cause anoxia to the underlying sediments, which alters biogeochemistry and benthic community structure (Goldber, 1994). Furthermore, litter may provide substrata for the attachment of sessile biota in sedimentary environments and increase local diversity (Mordecai et al. 2011; Moret-Ferguson et al., 2010; Pace et al., 2007) although this replaces existing species and leads to non-natural alterations of faunal community composition (Bergmann & Klages, 2012). Considering plastics, the main component of the marine litter, as they are heavy enough (part of fishing gear), colonized by bacteria or loaded with sediments they sink to the seafloor (Thompson, 2006; Ye & Andrady, 1991) where they can

persist for centuries (Derraik, 2002), be ingested by organisms or cause ghost fishing for long periods. Litter containing hazardous substances can act as source to these, and thereby contribute to pollution effects in the ecosystem. The monitoring of seafloor litter is required to close the loop of marine litter monitoring in the aquatic environment.

Human pressures linked to the indicator

As the deep seafloor is thought to constitute a sink/accumulation area also for marine litter, most sources for marine litter can probably contribute to litter on the seafloor. Recent reviews of the amount and composition of litter on the seafloor show that items associated with maritime activities (e.g. fishing, shipping) dominate in some areas, but that items from land-based sources also commonly occur (Galgani et al., 2010; Galgani et al., 2015; Pham et al., 2014). In addition to that seafloor litter originating from human activities can affect the ecosystem and its integrity, it should also be recognised that litter in the sea can have a socio-economic impact on human activities related to the sea, e.g. costs for damage or loss of fishing gear, obstruction of motors, beach cleanups then washed ashore and potential effects on tourism and recreation (Newman et al., 2015).

Several litter item categories included in appendix 12 of the IBTS manual (ICES 2015) target specific human pressures, although most of the categories may come from several types of human activities.

Fishing gear that has been lost, so called ghost nets, are a very special type of anthropogenic litter on the seafloor. Ghost nets are known to continue fishing and can be considered as posing an especially large risk to the environment compared to other types of litter. Static and bottom trawling fishing gear are known to be frequently lost and/or discarded. Studies have estimated the total catch of cod by ghost nets to 3-906 tonnes during a 28 month study period, amounting to 0.01-3.2% of the total weight of reported and landed cod catch from the same area and time period (Brown et al., 2005).

The types of gear lost and the reasons for the gear being lost are believed to differ regionally in the Baltic Sea, however comprehensive statistics are currently not available. In 2011, WWF Poland together with fishermen, scientists and divers conducted a pilot project financed by Baltic Sea 2020, with a view to work out the methodology for net removal and carry out activities to clean the Polish territorial waters from ghost nets. As a result 6 tonnes of ghost nets were retrieved from the Baltic during 24 days of actions at sea – from sea bottom and two ship wrecks. In 2014 a ghost net project was conducted by the Ozeaneum Stralsund, archeomare e.V., Drosos foundation and the WWF Germany on Rügen. Thereby divers removed around 4 tonnes of ghost nets from 2 wrecks.

New data on the occurrence of derelict fishing gear (DFG) in the Baltic will be collected through MARELITT Baltic, an EU-supported project involving partners from Estonia, Germany, Poland and Sweden. Among the aims of the project are to develop cost-efficient methods for mapping the occurrence of DFG, and to develop cost-efficient and environmentally sound methods for collecting DFG. The project will run for the period 2016-2019.

Monitoring requirements

Monitoring methodology

HELCOM members carry out monitoring activities that also allow for monitoring of litter on the seafloor through the quantification and identification of the type of litter items found. The methodology used is to record litter items caught in trawls during fish stock surveys in the Baltic International Trawl Surveys (BITS) programme. Harmonized monitoring methodology, as standard trawl gear and standard sampling procedures, were implemented in 2000 through the BITS programme. The monitoring protocol is derived from the IBTS /BITS protocols (see the protocol manual, ICES 2014). BITS is conducted as a depth-stratified survey. All countries have a standard haul duration to 30 minutes (defined as the moment when the vertical net opening and door spread are stable), using two different sizes of standardised TV trawls (TVL and TVS).

For fish stock assessment, the spread of the trawl doors is considered the appropriate measure when calculating area covered. For marine litter, the wing spread is considered a more appropriate measure, and should ideally be noted for each haul. If this is not possible, conversion factors between door spread and wing spread should be established for both trawl types.

The categorisation of litter items found in trawls in the BITS programme has varied during the years, but currently follows the recommendations laid out in annex 11 of the IBTS manual (ICES, 2015). From 2016 4th Quarter, BITS will be using LTREF "[C-TS-REV](#)" (Annex 1 to this document). There is currently no standard protocol laying out exactly how litter items should be treated/enumerated during BITS or IBTS surveys. Such a protocol (preferably common for IBTS, BITS and MEDITS) should be developed by HELCOM as part of the quality assessment for the monitoring programme.

As mentioned in the next section, some areas of the Baltic are not covered by the BITS programme. There are also areas where the use of bottom trawls is not practical, e.g. due to bottom topography. For such areas, other monitoring methods may need to be developed and tested, e.g. diving transects, video transect, or using remotely operated vehicles (ROVs) (JRC 2013).

Current monitoring

The use of data for litter on the seafloor collected during fish stock surveys is recommended by the EU technical subgroup on marine litter (JRC 2013). Similar protocols for assessing litter on the seafloor are used in the OSPAR (through the IBTS programme) and in the Mediterranean Sea regions (through the MEDITS programme), and are being tested in the Black Sea through the Black Sea Convention. An assessment of the results from the OSPAR IBTS programme is currently under development for the upcoming OSPAR Intermediate assessment.

Given the extensive spatial distribution of hauls in the BITS programme, the litter data provided in the BITS programme can be used to identify spatial patterns in litter densities. However, the spatial cover of the data needs to be enhanced, since there are some areas in the Baltic Sea where regular monitoring is not performed. This concerns especially areas north and east of The Baltic Proper.

The BITS programme covers stations with a depth ranging from 13 to 118 m. The programme therefore does not give information on the amounts of litter on the seafloor at shallow depths. Alternative methods for monitoring marine litter in shallow waters are available (JRC 2013), but need to further tested in the Baltic before proposals for their implementation can be developed.

The extent of data collected by different countries through the BITS programme so far is presented in the table below.

The number of trawl hauls where litter on the seafloor is monitored twice a year, as reported in the [ICES DATRAS database](#) (accessed 161003, see Table 1). The BITS program does not cover Finland nor Russia. However, the content of the data in the DATRAS database as outlined in the table is not quite accurate. For instance, Denmark has been monitoring litter in the Baltic since 2011, but these data did not show up in the data downloaded in September-October 2016. If this is due to technical problems during download or if the data really is not listed is unknown to the authors.

Country	Year				
	2012	2013	2014	2015	2016
Denmark	*	*	*	16	
Estonia				9	
Germany	51	102	152	49	
Latvia				14	30
Lithuania				4	5
Poland				32	49
Sweden	81	75	74	78	47

* *Monitoring has been done, but data is missing.*

Table 1 – Number of trawl hauls where litter on the seafloor is monitored twice a year, as reported in the [ICES DATRAS database](#) (accessed 3 October 2016).

This programme currently contains stations in the following HELCOM sub-basins: The Kiel bay, The bay of Mecklenburg, The Arkona basin, The Bornholm basin, The Easter Gotland basin, The Western Gotland basin, The Gdansk basin, and the Northern Baltic Proper. See Figure 1.

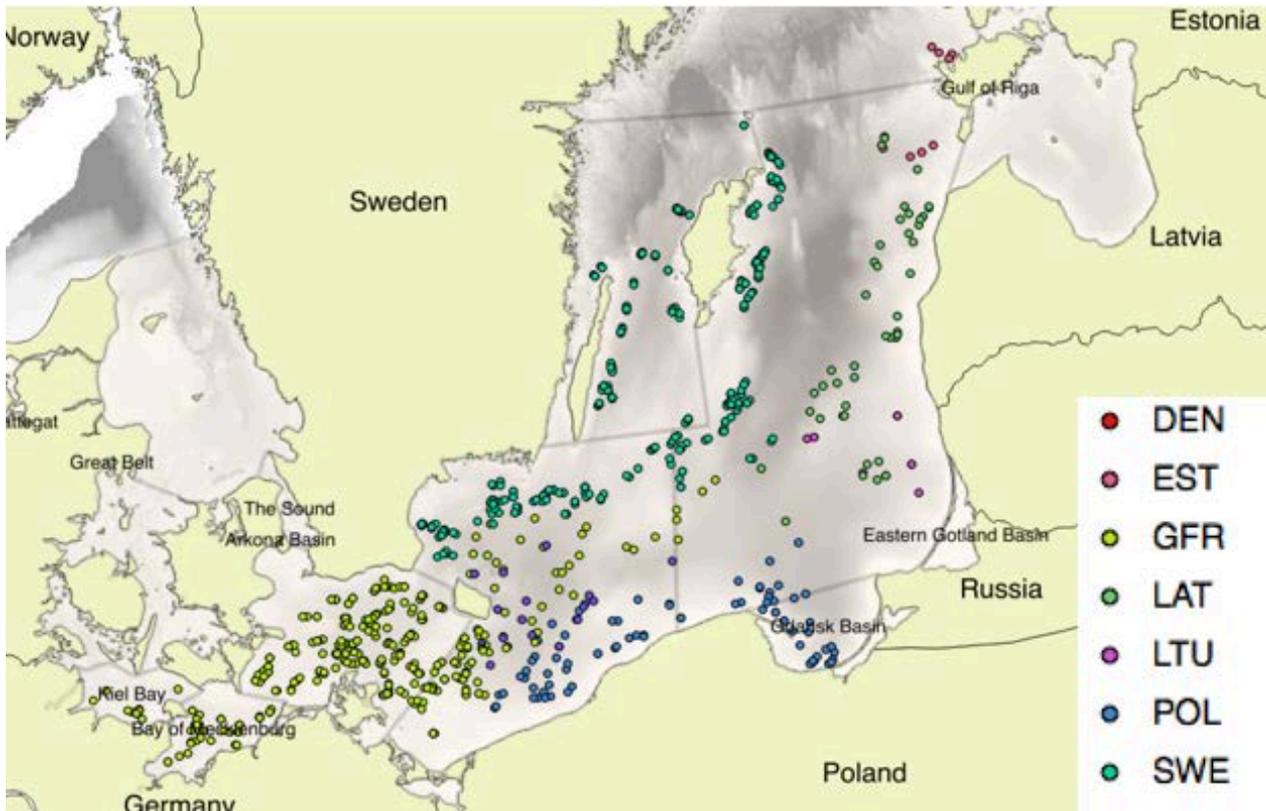


Figure 1 - Maps of trawls hauls from the BITS fish stock monitoring programme, as listed in the DATRAS database (accessed 3 October 2016). Data covers the years 2012-2016 (first quarter). Each data point represents one haul. (DEN: Denmark; EST: Estonia; GFR: Germany; LAT: Latvia; LTU: Lithuania; POL: Poland; and SWE: Sweden).

Additionally, underwater surveys have started in June 2016 (pilot monitoring) in Finland carried out by ROVs/video.

“Fishing for litter” activities as applied in several countries including Poland and Germany give some additional insight about the composition of seafloor litter, but cannot be regarded as a standardized monitoring method.

Description of optimal monitoring

Optimal monitoring should cover the seafloor of the Baltic Sea in a representative way. The current use of combined monitoring for fish stock assessment and marine litter assessment is very cost efficient. However, the location of trawling stations is set by requirements for fish stock surveys through the BITS protocol. This means that the data collection for marine litter is also decided by what is appropriate for fish stock assessment, which influences the representativity of the litter assessment. Any future changes in the fish stock assessment programme will thus also have an influence on the assessment of marine litter. It is therefore important that HELCOM countries communicate this to national experts involved in the design of the BITS programme.

Except for pilot studies, there is currently no monitoring conducted in shallow areas, nor in areas north of the northern Baltic Proper. Monitoring litter in trawls is probably not an option in such areas (although Sweden conducted trawl surveys for marine litter in coastal areas of the Kattegat and Skagerrak during the autumn of 2015). Instead, methods using diving, ROV or towed video could be used (JRC 2013). In the shallow coastal monitoring areas could be selected both in areas without local sources and close to sources, e.g. cities and waste water treatment plants, to provide monitoring data that could show differences in long-term

amounts and trends in amounts of litter on the seafloor with only limited time lag. In the deep areas of the central Baltic Sea, monitoring areas could be selected to represent sites where litter is accumulated over longer time-periods.

Data and up-dating

Access and use

The data and resulting data products (tables, figures and maps) available on the indicator web page can be used freely given that the source is cited. The indicator should be cited as following:

HELCOM (2016). Litter on the seafloor. HELCOM core indicator report. Online. [Date Viewed], [Web link].

Metadata

The data collected and used in the indicator are based on data reported by HELCOM members to the [ICES DATRAS database](#). Quality assurance routine is developed by ICES and/or at national level. The current data structure is not ideal (see section on "Marine litter assessment" above), and a solution to this is important for assessment efficiency.

Contributors and references

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Additional relevant publications

Annex 1 Litter reference list: Revised CEFAS Trawl litter survey parameters (2013)
(C-TS-REV)

Code	Description	Code	Description
A	Plastic	D	Glass/Ceramics
A1	Plastic bottle	D1	Jar
A10	Plastic strapping band	D2	Glass bottle
A11	Plastic crates and containers	D3	Glass/ceramic piece
A12	Plastic diapers	D4	Other glass or ceramic
A13	Sanitary towel/tampon		
A14	Other plastics		
A2	Plastic sheet		
A3	Plastic bag		
A4	Plastic caps/lids		
A5	Plastic fishing line		
A6	(monofilament)		
A7	Plastic fishing line (entangled)		
A8	Synthetic rope		
A9	Plastic fishing net Plastic cable ties		
B	Metals	E	Natural products
B1	Cans (food)	E1	Wood (processed)
B2	Cans (beverage)	E2	Rope
B3	Fishing related metal	E3	Paper/cardboard
B4	Metal drums	E4	Pallets
B5	Metal appliances	E5	Other natural products
B6	Metal car parts		
B7	Metal cables		
B8	Other metal		
C	Rubber	F	Miscellaneous
C1	Boots	F1	Clothing/rags
C2	Balloons	F2	Shoes
C3	Rubber bobbins (fishing)	F3	Other
C4	Tyre		
C5	Glove		
C6	Other rubber		