Baltic Marine Environment Protection Commission

Working Group on the State of the Environment and Nature Conservation

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Background

The first HELCOM TAPAS benthic habitat indicator workshop (HELCOM TAPAS benthic indicator WS 1-2016) considered suitable approaches for assessing impacts on benthic habitats for HOLAS II purposes. At the workshop it was noted that the proposed indicator for assessing cumulative impacts on benthic habitats does not have a proposal for a GES boundary and since the indicator is unlikely to be operational in time for HOLAS II, an interim solution should be looked for.

The HELCOM TAPAS project has developed the Baltic Sea Impact Index (BSII) and collated Baltic Sea-wide datasets on human activities, pressures and ecosystem component layers. The BSII approach is an operational concept with available input data that could be used to develop an evaluation of impacts on benthic habitats for HOLAS II purposes, albeit without a quantitative GES assessment since thresholds are not defined for the BSII. The TAPAS project presented the approach at HELCOM TAPAS benthic indicator WS 1-2016. The HELCOM TAPAS benthic indicator WS 1-2016 proposes to use the BSII approach and selected pressure layers to evaluate impact on benthic habitats for HOLAS II purposes (point 47 of the outcome).

This document prepared by the TAPAS project presents the method to calculate the area physically lost and disturbed due to human activities and the proportion of benthic habitats under cumulative impacts from physical disturbances.

Action requested

The Meeting is invited to:

- agree on the proposed method,
- endorse delivering the results on cumulative impacts on benthic habitats as input to HOLAS II.

Proposal for evaluating cumulative impacts on benthic habitats using BSII for HOLAS II purposes

Aim of the approach

This proposal is developed to provide an established and operational method to calculate spatial cumulative impacts on benthic habitats as well as the area of seabed lost or physically disturbed due to human activities. The spatial data layers that are proposed to be used in the approach have been compiled in the TAPAS project and the separation of the relevant components into a benthic-impact analysis will not require any new data collation or significant additional work in doing the analysis.

At the moment, the method to calculate cumulative impacts on benthic habitats using the Baltic Sea Impact Index (BSII) approach does not include any threshold values. Developing a spatial evaluation of the cumulative impacts can still be useful in identifying areas of particular concern, or habitats of particular concern. The approach is also considered to be the best available approach for doing a regionally coherent and comparable analysis of the impacts on benthic habitats within the timeframe of HOLAS II.

The HELCOM TAPAS benthic indicator WS 1-2016 discussed the need for those Contracting Parties of HELCOM that are also EU Member States to assess seafloor integrity in accordance with EU MSFD requirements. The workshop considered the assessment requirements in the draft EU Commission Decision on GES (version 14.9.2016) and noted that for the proposed criteria D6C1 and D6C2 there is no requirement to assess against a threshold value, and that an assessment to meet these requirements could be made using the spatial pressure datasets for 'loss' and 'disturbance' as developed for the Baltic Sea Impact Index, BSII. The proposed criterion D6C3 could be assessed using the pre-core indicator 'Cumulative impacts on benthic biotopes' when operational and including a GES boundary. However, that indicator is not operational for the HOLAS II and, hence, cumulative impacts could be analyzed using the method used for the BSII (see e.g. Korpinen et al. 2013[1]).

Based on the discussions at the workshop and identified assessment needs for HOLAS II the TAPAS project proposes an approach to assess impacts on benthic habitats using the BSII approach (Table 1.) Test results were delivered to the HELCOM TAPAS benthic indicator WS 1-2016 but the input data needed for the calculation are developed in the TAPAS project and will be available by the end of 2016.

Table 1. Overview of the outputs from the method to calculate the area of seabed physically lost or physically disturbed and proportion of benthic habitats under different levels of cumulative impacts.

Assessment outputs	Criteria in the draft Commission Decision on GES (version 14.9.2016)	BSII approach
Area of seabed physically lost due to human activities	D6C1: Spatial extent and distribution of physical loss (permanent change) of the natural seabed	Use spatial dataset 'physical loss'. Since no assessment against a threshold value is needed, the approach fully meets the assessment requirement.
Area of seabed under different levels of physical disturbance due to human activities	D6C2: Spatial extent and distribution of physical disturbance pressures on the seabed	Use spatial dataset on 'physical disturbance'. Since no assessment against a threshold value is needed, the approach fully meets the assessment requirements.

[1] Korpinen S, Meidinger M & Laamane M (2013) Cumulative impacts on seabed habitats: An indicator for assessments of good environmental status. Marine Pollution Bulletin 74: 311-319. Available at: http://www.sciencedirect.com/science/article/pii/S0025326X13003421

Area and proportion of benthic habitats under different levels of cumulative impacts due to human activities	D6C3: Spatial extent of each habitat type which is adversely affected, through change in its biotic and abiotic structure and its function (e.g. through changes in species composition and their relative abundance, absence of particularly sensitive or fragile species or species providing a key function, size structure of species), by physical disturbance. Member States shall establish threshold values for the adverse effects of physical disturbance through regional or subregional cooperation	Use - the spatial pressure dataset 'physical disturbance'; - the ecosystem components for 'broad habitat types' and other benthic habitats; - the TAPAS sensitivity values for the habitats to the relevant pressures. Calculate the BSII index for the relevant spatial area. The evaluation can only be considered to partly meet the assessment needs since threshold values have not been defined.

Use of BSII to calculate the cumulative impact of pressures acting on benthic habitats

As the detailed description of the BSII calculation is given in document 4J-18, this document focuses on describing how the method can be used to assess the state of the seafloor integrity.

Assessment area and assessment unit

The assessment area is the HELCOM Convention Area and the BSII will be calculated for the 1 km x 1km squares. As the input data will be prepared for this grid, it is not feasible to select another unit size.

Input data

The pressure data used in the BSII is presented in document 4J-18 but for this indicator only two pressure data layers will be used: physical loss and physical disturbance (Annex 2).

Both the data layers have been produced from several more specific data layers (Annex 2). These more detailed layers are human activity data which has served as proxies for the physical loss or disturbance. The document 4J-18 and also its Annex 2 describe how the data layers have been modified to more realistically represent the two pressures. However, an overview of the modifications is given below:

- *Defining spatial extent*: values for spatial extents for physical loss (i.e. how much seabed area is lost due to the specific pressure) and physical disturbance (i.e. how much seabed area is disturbed due to the specific pressure and how this attenuates away from the pressure source) have been defined. The extent values will be confirmed on the basis of a literature review (BalticBOOST WP3) and an expert survey (HELCOM TAPAS Theme 1) by the end of November 2016.
- *Applying the spatial extent*: As many physical disturbance or loss pressures act on a smaller area than the grid cell, the actual disturbed or lost area will be used to weight down the impacts. This is especially important in case of really small disturbance areas such as cables, which may disturb the seabed (during their placement) only a couple meters in width. Also the attenuation gradient from the pressure source will be used to weight down the impacts.
- *Temporal aggregation of physical loss*: physical loss is defined by the proposed revision of the COM DEC 2010/477/EU as a permanent change to the seabed which has lasted or is expected to last for a period of two reporting cycles (12 years) or more. Hence, all pressures causing physical loss will be summed up spatially (not counting overlays) over the 2011-2016 period.
- *Temporal aggregation of physical disturbance*: physical disturbance is defined by the proposed revision of the COM DEC 2010/477/EU as a change to the seabed which can be restored if the activity causing the disturbance pressure ceases. The pressures are averaged over the assessment period.

- *Aggregation of specific data layers to pressure data layers*. The BSII method aims to avoid situations where data rich sectors could bias assessment results. Hence, the BSII pressure data layers have been aggregated according to the indicative pressure list of the MSFD Annex III (proposed revision). Therefore, only two pressure data layers will be used to assess impacts on benthic habitats. The aggregation rules are given in the document 4J-18 describing the BSII method. The simplest aggregation rule is when the data sets use the same metric; this is the case in physical loss where the metric is area (km^2). If the specific data layers use different metrics, like in the case of physical disturbance to seabed, then more extensive aggregation methods are needed. The method is described in the document 4J-18, describing the BSII method, where the literature review is used to rank the magnitudes of pressures and impacts from different human activities (i.e. the specific data layers). The result of this aggregation is a physical disturbance layer where some specific data layers are down-weighted if the underlying activities do not cause high pressures and impacts.

The benthic habitats to be considered in the impact assessment are described in Annex 1 of this document. The benthic habitat data layers are taken from two sources: (1) the EMODnet Seabed habitats portal providing broad-scale habitats covering the European seabed and (2) the HELCOM data on habitat-building species. The reason to have the more detailed habitats included in the assessment of cumulative impacts is that they include also biological features and are therefore considered more sensitive than the abiotic broad-scale habitats.

The habitat input data can result in more than 1 habitat per grid cell. As the assessment on benthic habitats will only estimate a single value of cumulative impact per grid cell, the assessment method will select the most sensitive habitat type per grid cell and use that for the assessment. This will of course rely on the assumption that all the habitat types will occupy the entire grid cell which is not correct. However, most of the human activities causing physical disturbance have spatial extents more than 1 km and therefore such an assumption may be justified.

Estimation of the habitat sensitivity

The cumulative benthic impacts will require an estimate of habitat sensitivity. This will be received from two sources: the BalticBOOST literature review and the HELCOM TAPAS expert survey (see document 4J-18. The sensitivity will be given in four categories: not sensitive, low, moderate and high.

The sensitivity scores will be interpreted as number in linear scale, and therefore they can be averaged. Physical loss was included in the TAPAS expert survey but in the indicator it will be shown separately as a lost habitat as none of the impact categories describe a lost habitat.

Calculation of the impact results

The cumulative impact is calculated by the EcoImpactMapper (Stock 2016), a freely available software calculating the BSII (see document 4J.18).

As the analysis is made to calculate the cumulative impact on benthic biotopes from anthropogenic physical disturbance, it will not be calculated for areas of permanent hypoxia. Physical loss will be calculated also for those areas, but their interpretation may require more thinking. In the long-term, this can be solved by studying the synergistic effects of hypoxia and physical disturbance.

Confidence of the cumulative impact analysis

The input data as well as the sensitivity scores will be given a confidence score and an overall confidence will be assessed for the cumulative impacts (see document 4J-18).

Annex 1. Benthic habitats to be included in the Baltic Sea Impact Index

(extract from the document 4J-19).

Ecosystem component	**Data**	**Status** (x = ready)	**Planned schedule**
Broad-scale seabed habitats			
Infralittoral hard bottom	EMODnet seabed habitats (EUSeaMap II project)		New release in October 2016
Infralittoral sand	EMODnet seabed habitats		October 2016
Infralittoral mud	EMODnet seabed habitats		October 2016
Circalittoral hard bottom	EMODnet seabed habitats		October 2016
Circalittoral sand	EMODnet seabed habitats		October 2016
Circalittoral mud	EMODnet seabed habitats		October 2016
Habitat forming species			
Furcellaria sp.	HELCOM data call	x	
Zostera marina	HELCOM data call	x	
Charophytes	HELCOM data call	x	
Mytilus edulis	HELCOM data call	x	
Fucus sp.	HELCOM data call	x	

Annex 2. The specific datasets included in the data layers 'loss' and 'disturbance'

(extract from document 4J-18).

A. Aggregated pressure	B. Temporal nature	C. Spatial datasets to be combined	D. Spatial extent[2]	E. Data used for analysis / data processing	F. Depth / exposure	G. Aggregation method
Physical loss (permanent effects on the seabed)	Cumulative (summed over the period)	Land claim	Area of polygon or 50 m buffer for points, 30m buffer for lines	Calculate area lost (polygon)	Not relevant	Activities are combined and potentially overlapping areas are removed. Combined layer is intersected with 1 km grid to calculate % of area lost within a cell.
		Water course modification	50 m buffer	Calculate buffer to indicate lost area	Not relevant	
		Coastal defence and flood protection	50 m buffer for lines, 100 m buffer for points	Calculate buffer to indicate lost area	Not relevant	
		Extraction of sand and gravel	area of polygon	Calculate area lost (polygon)	Not relevant	
		Oil platforms	25 m buffer	Calculate buffer to indicate lost area	Not relevant	
		Pipelines	15 m buffer	Calculate buffer to indicate lost area	Not relevant	
		Wind farms	30 m buffer around each turbine	Calculate area lost (polygon)	Not relevant	
		Cables	1.5 m buffer	Calculate buffer to indicate lost area	Not relevant	
		Harbours	polygon with 200 m buffer	Calculate area lost (polygon)	Not relevant	
		Marinas and leisure harbours	point with 200 m buffer	Calculate buffer to indicate lost area	Not relevant	
		Bridges	2 m buffer	Calculate buffer to indicate lost area	Not relevant	
		Bathing sites, beaches	300 m buffer	Calculate buffer to indicate lost area	Not relevant	
		Oil terminals, refineries	point with 200 m buffer	Calculate buffer to indicate lost area	Not relevant	
		Finfish mariculture	150 m buffer	Calculate buffer to indicate lost area	Not relevant	
		Shellfish mariculture	area of polygon	Calculate buffer to indicate lost area	Not relevant	
Physical disturbance or damage to seabed (temporary or reversible effects)	Temporary (averaged between the years)	Shipping density	AIS data calculated directly to 1 km grid cells.	Average of total shipping density in a 1km x 1 km cell 2011-2014, log-transformed, normalized	rescaled with depth: 0-10 m= 100% 10-15 m= 50% 15-20 m= 25% 20-25 m= 10% 25m < =0%	Spatial extents, including spatial attenuation of the pressures, are calculated per specific data sets. Mean pressure intensity per grid cell is assigned to the grid cell. The final grid cell intensity is downweighted (by areal %) if the pressure area is smaller than the grid cell. Activities are weighted according to the method

[2] Note that the spatial extent values in the column D are interim and will be revised according to results from the literature review(BalticBOOST WP3) and expert survey (TAPAS Theme 1).

A. Aggregated pressure	B. Temporal nature	C. Spatial datasets to be combined	D. Spatial extent[2]	E. Data used for analysis / data processing	F. Depth / exposure	G. Aggregation method
		Recreational boating and sports	Total fuel consumption of recreational boats modelled directly to 1 km grid cells.	Total fuel consumption of leisure boats modelled in SHEBA project. Fuel usage range in a 1km x 1 km cell in 2014, log-transformed, normalized	rescaled with depth: 0-5m= 100% 5-7 m= 70% 7-10 m= 50% 10-15 m= 10% 15m < =0%	described in the document. All the pressure intensities of specific pressure layers are summed per grid cell.
		Extraction of sand and gravel	400 m buffer suggested	Average amount of extracted material over years, if value missing, 25% percentile of the existing information is given, normalized	Weighted by the exposure map	
		Dredging	1 km buffer considered, point and polygon data converted directly to 1 km grid cells	Average amount of dredged material over years, if value missing 25% percentile of the existing information is given, normalized	Weighted by the exposure map	
		Deposit of dredged material	1.5 km buffer considered, point and polygon data converted directly to 2 km grid cells	Average amount of deposited material 2011-2014, if value missing 25% percentile of the existing information is given, normalized	Weighted by the exposure map	
		Bathing sites, beaches	1 km buffer considered, point data on beaches converted directly to 1 km grid cells.	Amount of bathing sites in a cell, normalized	Not relevant	
		Wind farms (construction)	300 m buffer considered for windfarms under construction, polygon data converted directly to 1 km grid cells.	Location of wind farms under construction	Weighted by the exposure map	
		Cables (construction)	100 m buffer considered for cables under construction, line data converted directly to 1 km grid cells	Location of constructed cables, rescaled intensity to 0.6	Weighted by the exposure map	
		Pipelines (construction)	No pipelines under construction reported	No pipelines under construction reported	Weighted by the exposure map	
		Potting / creeling	Eventually 0.05 x 0.05 c-square degree grid (reporting unit for VMS data from ICES)	Average of potting/creeling intensity in 2011-2015 log-transformed and normalized (not included in initial tests)	Not relevant	

A. Aggregated pressure	B. Temporal nature	C. Spatial datasets to be combined	D. Spatial extent[2]	E. Data used for analysis / data processing	F. Depth / exposure	G. Aggregation method
		Demersal long lining	0.05 x 0.05 c-square degree grid (reporting unit for VMS data from ICES)	Average of seabed surface contacting gear fishing intensity (Surface area ratio) in 2011-2013, logtransformed, normalized	Not relevant	
		Bottom trawling	0.05 x 0.05 c-square degree grid (reporting unit for VMS data from ICES)	Average of seabed surface contacting gear fishing intensity (Surface area ratio) in 2011-2013, logtransformed, normalized	Not relevant	
		Demersal Danish seining	0.05 x 0.05 c-square degree grid (reporting unit for VMS data from ICES)	Average of seabed surface contacting gear fishing intensity (Surface area ratio) in 2011-2013, logtransformed, normalized	Not relevant	
		Demersal Scottish seining	0.05 x 0.05 c-square degree grid (reporting unit for VMS data from ICES)	Average of seabed surface contacting gear fishing intensity (Surface area ratio) in 2011-2013, logtransformed, normalized	Not relevant	
		Water course modification (construction)	No watercourse modification under construction reported	No watercourse modification under construction in 2011-2015	Not relevant	
		Coastal defence and flood protection (construction)	500 m buffer considered, point and line data converted directly to 1 km grid cells	Location of coastal defence and flood protection under construction	Weighted by the exposure map	
		Finfish mariculture	300 m buffer considered, point data converted directly to 1 km grid cells	Average P load 2011-2015, if values missing 25% percentile of the remaining was given, normalized	Weighted by the exposure map	
		Shellfish mariculture	300 m buffer considered, polygon data converted directly to 1 km grid cells	Average production in 2011-2015, if values missing, 25% percentile of the remaining was given, normalized	Weighted by the exposure map	
		Maerl and furcellaria harvesting	No buffer considered, polygon data converted directly to 1 km grid cells	Calculated amount/area of harvested material, normalized	Not relevant	
		Scallop and blue mussel dredging	No buffer considered, polygon data converted directly to 1 km grid cells	Sum of scallop and blue mussel dredged per year, averaged for 2011-2015, normalized	Not relevant	