HELCOM BalticBOOST Workshop on the development of joint principles to define environmental targets for pressures affecting the seabed habitats

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Background

This document presents interim results of the WP 3.1 and specifically the development of joint principles to define environmental targets for pressures affecting the seabed habitats. The 'joint principles' are given in the form of guidelines which aim to give a common framework for setting environmental targets and propose practical definitions for pressures and other elements of the environmental targets. The guidelines are based on the literature synthesis of non-fishery impacts of human activities on benthic habitats and conclusions of case studies of fishery and non-fishery impacts on benthic habitats.

The Meeting is invited to provide feed-back to the guidelines.

Guidelines for setting environmental targets in benthic habitats

1. Why environmental targets are necessary for benthic habitat?

Good environmental status of benthic habitats is a prerequisite for marine life as most of the marine species are either directly or indirectly linked to it and many spend at least part of their life history on seabed. Benthic habitats are also under increasing utilization due to their rich abiotic and biotic resources. As the impacts of those activities below the surface are not visible to our eyes, it is necessary that monitoring and assessment methods are quickly developed and regulatory mechanisms developed to avoid any unwished ecological and economic crises.

The newly accepted revision of the Commission Decision 477/2010/EU on criteria and methodological standards on good environmental status (GES) of marine waters (hereafter 'revised COM DEC') has a specific focus on impacts of anthropogenic pressures on benthic habitats. The well-being of benthic habitats – in that assessment framework – is measured from the human activity point of view and environmental data is only used to validate the results. Hence, the environmental targets, as defined in the Art. 10 of the Marine Strategy Framework Directive (MSFD), are closely linked with the GES assessment.

This document is a product of the WP 3.1 of the BalticBOOST project where a literature review and a number of case studies were made to iterate the significance of various human activities in affecting the benthic habitats. The case studies and a synthesis of the literature review are presented as separate meeting documents to this workshop. The findings of those work streams are the basis for guidelines in setting environmental targets for pressures affecting benthic habitats.

While the synthesis focused mostly on two pressures – physical loss and physical disturbance – and the activities causing them, there are other pressures (eutrophication, contamination, heat, noise, impulsive sound waves, seismic waves, electromagnetism, changes in hydrography, marine litter, indirect effects due to food web changes) which affect the benthic habitats and which should be considered when identifying environmental targets. In this document the main focus is in physical pressures, but some observations of the other pressures are also given.

2. Starting points for the guidelines

The WP 3.1 approach to compare pressures and impacts from human activities allows a concrete basis for setting environmental targets. Our starting points for an environmental target (ET) are based on case study results and a synthesis of >120 studies and are the following:

- ET is defined for a measurable pressure, often identifiable to a specific activity or sector. This means that ETs are sufficiently specific to enable measuring their progress and supporting also necessary management actions.
- ET is necessary if GES has not been reached (or there is a risk for sub-GES) and reduction of a pressure can improve the GES status. In our interpretation ETs are not necessary if a pressure does not inhibit any marine element being in GES. It may however be necessary to make an ET for a pressure if no other pressure can be managed and a marine element has not achieved GES (or is in risk).
- The need to set an ET should be separately evaluated on the basis of impacts caused by (1) physical loss due to permanent change of seabed substrate or morphology and to extraction of seabed substrate (permanent defined as 12 years) and (2) physical disturbance to the seabed.
- ET may be necessary for a habitat type if an activity is causing high amounts of non-reversible physical loss (e.g. removal of a specific substrate, land filling of marine area, covering a habitat with disposed sediment, etc.). Some substrate types may be preferred by the aggregate industry but a loss of such a substrate is an irreversible loss and hence requires specific regulation.

- ET is necessary if a significant proportion of benthic habitat is affected or lost due to the pressure (preferably at more detailed levels of biotope classification).
- ET's necessity should be considered if the spatial extent of pressure impact is wide.
- ET's necessity should be considered if the pressure lasts for a long time or is continuous.
- ET's necessity should be considered if sensitive or threatened features are at risk.
- ET's necessity should be considered if recovery from the pressure takes a long time.

The WP 3.1 synthesis particularly showed that the concepts of physical loss and physical disturbance are not simple. Our observations and proposed conclusions are given in Table 1.

Table 1. Practical definitions of the physical pressures affecting benthic habitats.
The physical loss pressure is defined in the revised MSFD Annex III as 'Physical loss (due to permanent change of seabed substrate or morphology and to extraction of seabed substrate)' and the revised COM DEC defines the 'permanent' as lasting at least 12 years. For sand extraction, dredging and disposal of dredged matter this is not a simple definition and these activities do not only cause one of the two pressures and therefore the BalticBOOST project defined this in practical terms: – the core zone of the activity (extraction/ dredging site, disposal site) is considered 'lost' because the seabed morphology has been changed for at least 12 years; – the core zone may be lost forever, if the site is emptied of the particular substrate (e.g. extracting specific grain size) or covered by a new substrate (depositing dredged matter over a different substrate type); – these activities also cause physical disturbance in the form of gradually decreasing sedimentation to nearby areas and turbidity of the adjacent water areas.
In case of physical loss, it is necessary to consider also the potential to reverse the loss in the longer perspective, i.e. remove an obstacle (e.g. wind turbine or sea wall), compensate for the loss by building a new habitat (e.g. an artificial reef), or restore a habitat (e.g. restore a sill to an semi enclosed bay). The GES assessment does not currently cover these aspects but environmental targets can be defined more accurately and also support more realistic GES assessments in future.
There are several different techniques on how specific human activities are carried out in practice. For instance, a construction project can be planned to cause minimal impacts to the environment, or a dredging or a sand extraction technique can be less impacting than another one. As a result of this, assessments of human impacts can overestimate impacts from environmentally friendly projects. No method exists to include such information into the region-wide guidelines. In addition, the GES assessment does not currently cover these aspects but environmental targets can be defined more accurately and also support more realistic GES assessments in future.
Pressures and impacts from an activity depend strongly on the hydrography of the site. Exposed areas will have weaker effects than sheltered areas, but generalizations are difficult.
Seasonality of a feature (habitat or species) affects the impact: impacts can be high on a sensitive season, whereas pressures acting on other seasons may cause negligible impacts. The data is, however, often annual, and therefore the seasonality can be difficult to observe. This is, however, a critical aspect in planning of construction projects and should be also included in environmental targets and GES assessments.
Temporal extents of the activities vary greatly. A long lasting or a frequent pressure can cause higher impacts than single occurrences of that pressure. In this respect also the significance of the impact depends on the recovery of the benthic feature; frequent pressures restrict recovery.
Permanent hydrographical alterations due to construction of wind turbines, platforms or other obstacles take place in the vicinity of the object. If these cause changes in water flows, they may exert physical disturbance (i.e. abrasion, resuspension and sedimentation) to the seabed, but these are difficult to assess and approximations are needed.

The geographical scale of an environmental target (ET) is not defined in the EU MSFD except that they are set for marine regions by Member States. The geographical scale in this context means the following: (1) it is the geographical area where the ET is applicable and (2) it is the geographical area where the ET is assessed. The case studies of the WP 3.1 suggest that some environmental targets might be best on the level of the HELCOM sub-basins for the following reasons:

- The proposed GES decision has identified 'subdivision of region or subregion, reflecting biogeographic differences in species composition of the broad habitat type' as the relevant scale for the assessment of descriptor six criteria.
- The Benthic Quality Index, which has been proposed as a core indicator for benthic faunal communities, is assessed for sub-basins.
- The cumulative benthic impact indicator, which has been proposed as a core indicator for impacts on sea bed, is assessed for sub-basins.

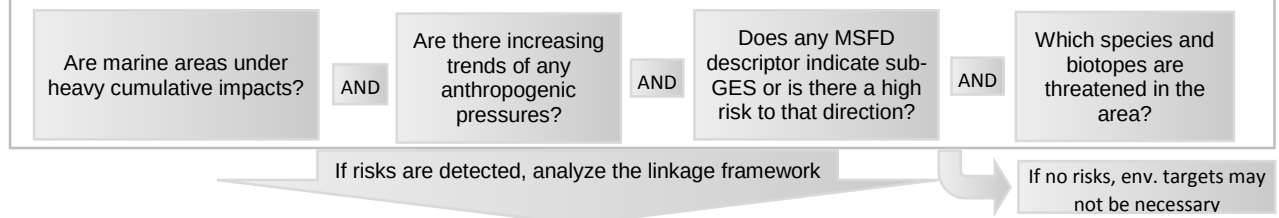
On the other hand, some benthic biotopes of more detailed HUB level, may be restricted to coastal areas and their response to a pressure may be uniform over a wider geographical area. In such a case the ET may be more relevant to define for a larger geographical area, even the entire Baltic Sea or national parts of it. That might be particularly adequate for those biotopes which have been listed as threatened in the HELCOM Red List of biotopes (http://www.helcom.fi/baltic-sea-trends/biodiversity/red-list-of-biotopes-habitats-and-biotope-complexes).

As environmental targets aim to guide progress towards GES in the area by reducing pressures, they should not be conceptually too limited. It is beneficial for their purpose that they can encompass a pressure type in general, a pressure affecting a certain habitat type or even a pressure type in a certain time period, depending on the need. Hence, the environmental targets could be used as a tailor-made tool.

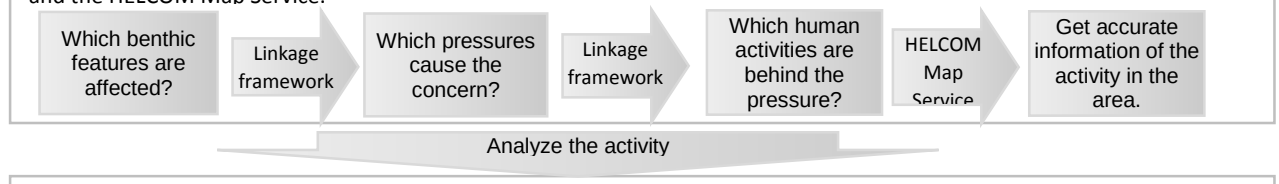
3. Guidelines to set environmental targets

The guidelines are in the form of steps which give a general framework for setting of environmental targets for benthic habitats (Figure 1). The guidelines take into account the starting points listed in the previous section but do not, as such, include proposals for any pressure thresholds or any activity-specific details. More specific information of potential thresholds or details and examples for the guideline steps are given in the synthesis report (Document 2 of the Meeting) on the basis of the literature review and the case studies, but some examples are also given in the next section.

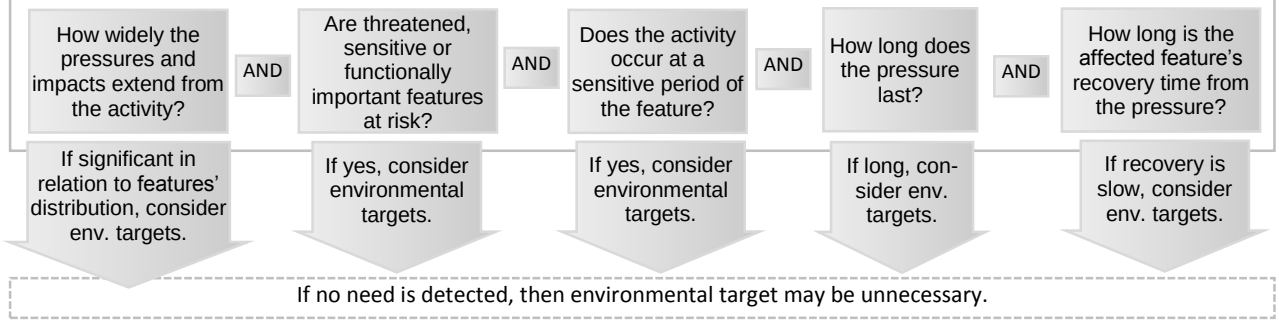
Step 1. Scoping phase. The HOLAS II pressure assessment (incl. the Baltic Sea Impact Index and trend analyses) indicates areas of potential problems and pressures of increasing trends. The HOLAS II state assessment indicates which benthic features have not reached GES or indicate a worrying trend. The HELCOM and national red lists present threatened species and biotopes. Four components should be considered.



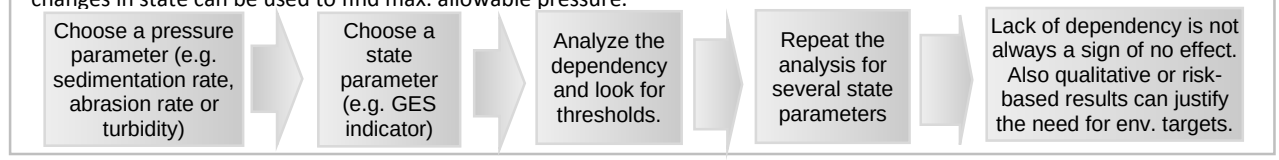
Step 2. Linkage framework. Activities causing potential impacts in an area can be identified through the linkage framework and the HELCOM Map Service.



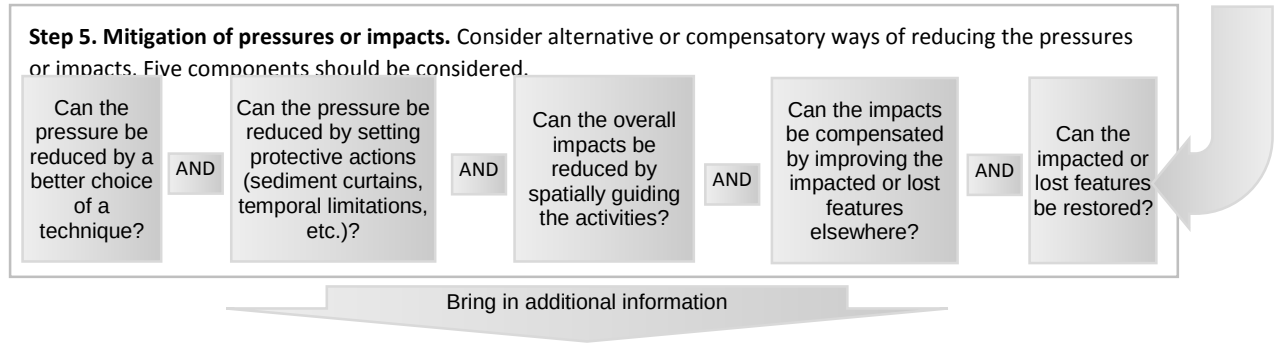
Step 3. Analysis of the human activities and their impacts. The analysis focuses on the facts whether the activities pose real risk to the features of the benthic habitats or species? Five components should be considered.



Step 4. Estimate the maximal allowable pressure. Allowable magnitude of a measurable pressure (e.g. sedimentation rate, abrasion rate, depth of sediment abrasion, turbidity) can be defined through its impact on a state parameter. If the state parameters have GES boundaries, the analysis becomes simpler to interpret. If no GES indicator is available, also other changes in state can be used to find max. allowable pressure.



Step 5. Mitigation of pressures or impacts. Consider alternative or compensatory ways of reducing the pressures or impacts. Five components should be considered.



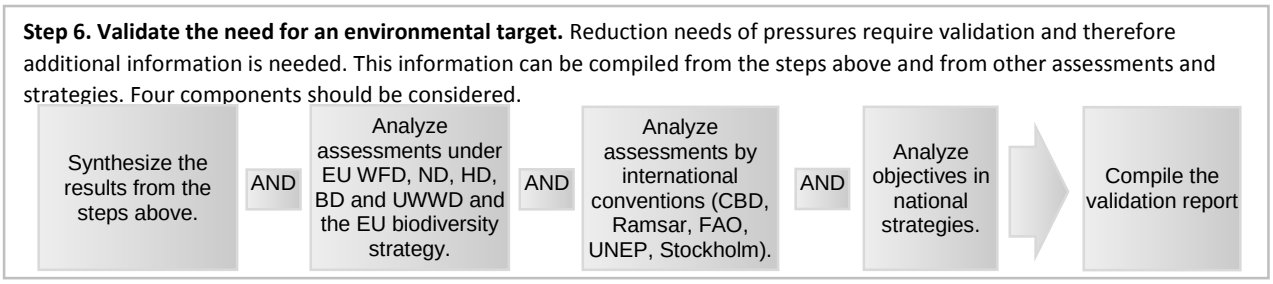


Figure 1. Guidelines for the setting of environmental targets for pressures affecting benthic habitats.

4. Experience from the WP 3.1 work

In this section more concrete proposals for the setting of environmental targets are presented. They are given in the order of the six steps of the guidelines (Figure 1) and also more practical explanations of the steps are given.

Step 1: Scoping phase. In this step, one becomes familiar with the most recent assessment results and identifies potential problem areas where environmental targets may be required. In addition to the HOLAS II results, also other information sources can be used. The starting points presented in Section 2 may support the scoping phase by pointing out the features which should be included in the evaluation.

Step 2: Linkage framework. Linkage frameworks are presented in the synthesis (Document 2 of the Meeting). At present the interim linkage framework indicates only on/off linkages, but the project aims to include also the strength of the linkage into the final product. This would be based on the ranking of the activities (see the synthesis document). Confidence of the linkages can be retrieved from the number of information sources where the link has been identified.

Step 3: Analysis of the human activities. Spatial extents of human activities are given in the synthesis document and will be also complemented by the TAPAS project's expert survey. This information can be included in any spatial assessment of physical disturbance and physical loss. GIS data layers including this information will be available on the HELCOM Map Service. Spatial overlay analysis of species and habitats and the pressures could be made available as a HOLAS II product and, at minimum, GIS data layers of benthic habitats and some species as well as threatened biotopes are available on the HELCOM Map Service. Additional spatial data, such as national maps of distribution of threatened biotopes should be analysed as well. Recoverability information of benthic features is given in the synthesis document and will be complemented by the TAPAS expert survey. The step 3 also proposes that duration of the pressure and sensitive seasons should be considered as long-lasting pressure or a pressure taking place in a sensitive time period for a species or habitat will likely affect the benthic features more significantly. Unfortunately the WP 3.1 synthesis did not include sufficient temporal information to allow any conclusion on these matters. However, Table 2 gives some preliminary considerations on sensitive periods in benthic habitats.

Table 2. Potential overlaps of pressures and sensitive time periods of species. The table is interim and more thorough analysis of this is needed.

	Physical disturbance		
	Sedimentation	Turbidity	Abrasion, changes in water flow
Infralittoral hard bottom	Late spring -early summer is sensitive time for Fucus recruitment, and spring for herring spawning.	Summer time vegetation growth affected.	
Infralittoral mud bottom	Summer is sensitive for vegetated enclosed bays.	Summer is sensitive for vegetated enclosed bays.	

Infralittoral sand bottom	Eelgrass is sensitive year round	Eelgrass is sensitive year round	Eelgrass is sensitive year round
Circalittoral hard bottom	Red algae are sensitive year round.	Red algae are sensitive year round.	Mussel beds are sensitive to abrasion year round.
Circalittoral mud bottom			
Circalittoral sand bottom			

Step 4: Estimate the maximal allowable pressure. The WP 3.1 case studies aimed to find simple answers to the question 'How much pressure a benthic feature can tolerate and still be in GES?'. In the synthesis document this matter was discussed and only partial answers can be provided. The ICES case study (Document 1-3 of the Meeting) provides information which benthic communities are most impacted as a result of bottom-trawling fishery. The Femern belt case study (Document 1-2 of the Meeting) confirmed that generally the bottom-trawling fishery had statistically strong negative impact on species diversity and abundance of benthic fauna. The SLU case study (Document 1-1 of the Meeting) showed that in some areas the bottom-trawling fishery impacts are visible in the abundance of benthic fauna and the Benthic Quality Index (i.e. a HELCOM core indicator for assessing GES of benthic fauna). The IOW case study on non-fishery impacts in German marine area (Document 1-4 of the Meeting) showed that when assessing more detailed biotope maps, aggregate extraction seems to have significantly wide spatial impacts on some biotope types. The SYKE case study on non-fishery impacts in Finnish marine area (Document 1-5 of the Meeting) shows that dredging, shipping and disposal of dredged matter cause significantly high turbidity and sedimentation which have adverse impacts on the surrounding environment of the activity.

Table 3 and 4 give an interim summary of the findings and the project's final report will give more examples of the maximal allowable pressures.

Table 3. Estimates of maximal allowable pressures on some state parameters. The results are preliminary and will be corrected in the project. The pressure amounts are measured at 0.2-0.9 km distance but the amounts still depend on local environmental factors. The numbers are from semi-exposed coast.

	Physical disturbance
Fucus coverage	20-30 g/m^2/d sediment
Fucus depth limit	
Fucus colonization	0.2 cm burial
Fucus growth	7 g/m^2 sediment
Red algae growth	
Seagrasses in bays	1 marina, 10 ferries/day
Herring fry mortality (detachment)	40-60 g/m^2/d
Pike juvenile mortality	1 marina
Benthic fauna mortality	10-40 cm burial in mud, 1-2 cm burial in hard bottom
Mortality of juvenile Macoma balthica	40-60 g/m^2/d
Benthic fauna community (Benthic Quality Index)	

Table 4. Amounts of human activities causing the maximal allowable physical disturbance pressures. The pressure amounts are measured at 0.2-0.9 km distance but the amounts still depend on local environmental factors. The numbers are from semi-exposed coast.

		Physical disturbance	
	Sedimentation	Turbidity	Abrasion, changes in water flow
Capital dredging	~8000 m^3	~8000 m^3	
Maintenance dredging		8000-12000 m^3	
Disposal of dredged matter	500-3000 m^3		
Sand extraction			
Wind turbine construction	1 turbine	1 turbine	1 turbine
Pipeline construction			
Cable placement			
Shipping and ferry traffic		1 ship	
Boating		1 ferry	
Marinas			

Step 5: Mitigation of pressures or impacts. Environmental targets do not only need to reduce the activities but can also influence the way of carrying out the activity. Requiring environmentally friendly techniques (e.g. a change of fishing gear), protective actions (e.g. sediment curtains) and precautionary planning (e.g. avoiding sensitive time periods and areas) can sufficiently reduce the impacts. Marine spatial planning could reduce impacts by guiding activities away from sensitive areas (e.g. disposal of dredged matter) or concentrating them to some areas (e.g. fishery). The fishery case studies showed that large areas are trawled much less (i.e. trawling concentrates on some areas) and overall fishery impacts would be significantly reduced by preventing fishery from these areas and directing it to the core fishery areas.

Environmental targets could also be 'positive', i.e. improving the state of environment, by a number of potential ways. Enhanced protection of features (e.g. MPAs, other protection measures) can compensate for the degradation or loss of a feature elsewhere. Other compensation measures could be artificially improving the state of a feature (e.g. restocking a species, restoring a lost habitat such as a coastal wetland or vegetated bay, introducing an artificial reef). Restoration actions can also take place at the site after cessation of the pressure. Mitigation of dredging impacts is discussed in PIANC (2009).

Step 6: Validate the need for an environmental target. As environmental targets mean usually increased costs, sufficient validation is needed to back up the target. This includes a comprehensive synthesis of the analyses (steps 1-5) but also results from other assessments, studies and strategies. For instance, results and recommendations arising from the assessments under the EU Water Framework Directive, Habitats Directive, Birds Directive, Urban Waste Water Directive and Nitrate Directive may provide good argumentation. Moreover, assessment results and recommendations from international conventions such as CBD, Ramsar, Stockholm Convention or UN bodies may give additional information. The EU biodiversity Strategy, Baltic Sea Action Plan and national strategies give important support for setting the environmental targets and may also guide towards the quantitative target (e.g. how many restored salmon or trout rivers are aimed at, etc.).

5. Conclusions of the need to set environmental targets for the Baltic benthic environment

This guideline should be read together with the other project deliverables. The case study reports present the findings and limitations of the methods and the synthesis report presents what products were made on the basis of the case studies and a literature review. Many of the products will directly feed into the HELCOM map products and also the Baltic Sea Impact Index. Therefore, the steps presented in Figure 1 can be implemented with the data products which will be soon available on the HELCOM Data and Map Service and in the HELCOM Second Holistic Assessment. The environmental targets are, however, a task where specific guidance is difficult to give as they can be of several types. However, as the well-being of the Baltic

marine environment is a shared responsibility, it is a well-justified objective to have some coordinated environmental targets under the HELCOM umbrella.