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| **Document title** | Comments to the Danish proposal for chapter 4.7 in HOLAS II |
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| **Submitted by** | Executive Secretary |
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## Background

GEAR 16-2017 noted the request by Denmark to delete the quantitative estimates of loss and disturbance in chapter 4.7 and that other Contracting Parties could not accept this proposal. The Meeting stressed the importance of finding a compromise solution for chapter 4.7 and invited Denmark to re-consider its position. Instead of deleting quantitative parts, a redrafting of chapter 4.7 was proposed to highlight issues related to uncertainty of results.

The Meeting noted that a revision of chapter 4.7 according to these recommendations will be submitted to HOD 52-2017 (document 2-6). The Meeting invited Denmark to evaluate the proposal on chapter 4.7 as contribution to resolving the Danish study reservation and share the evaluation with GEAR contacts by Friday **2 June 2017**.

The Danish proposals for chapter 4.7 were shared among the GEAR contacts and are contained in document 2-12 (in track changes).

In this intersessional GEAR activity, GEAR contacts from Sweden, EU and Finland shared their response to the Danish proposals in document 2-12. The Swedish, EU and Finnish edits to the text have been compiled by the Secretariat in this document. However, they are not to be seen as the final position of these countries on the chapter. The amendments are in track changes (except for editorial improvements, including by the Secretariat, incorporated without track changes).

## Action requested

The Meeting is invited to consider the response of the Contracting Parties to the Danish proposals for chapter 4.7.

## 4.7 Seabed loss and disturbance

Comments by Swedish GEAR contact

Comments by Finnish GEAR contact

Comments by EU GEAR contact

*Loss and disturbance to the seabed is caused by human activities that inflict permanent changes or temporary disruptions ~~disturbance~~ to the physical habitat. Examples of such activities are extraction of seabed minerals and sand, modification of the seabed for installations, maintenance of open waterways by dredging, and bottom trawling. Based on ~~currently~~ the data available for thes assessment ~~information~~ and current knowledge, ~~it is estimated that~~ less than 1 % of the Baltic Sea seabed is potentially lost due to human activities while over 50% of the seabed area is potentially disturbed during the assessment period (2011-2015). ~~There is currently no established method for evaluating estimating how much of the potential loss and disturbance that is causing adverse effects on the marine environment.~~*

Several human activities may cause damage to benthic habitats and species, some by direct contact with the seafloor and others through indirect effects caused by, for example, the increased turbidity or sedimentation. Whether an activity leads to a permanent loss or a temporary disturbance of benthic habitats depends on many factors such as the duration and intensity of the activity, the technique used, and the sensitivity of the area affected. The loss of ~~one~~a habitat ~~type~~ may also give rise to a new habitat, for example when a construction overbuilds a natural habitat and creates a new artificial substrate. This may lead to ecological~~ly undesirable effects~~changes some of which may be undesirable from the human perspective. Many activities may contribute to both permanent loss and disturbance of the seabed (Figure 4.7.1). Estimating seabed loss and physical disturbance at a regional and sub-basin scale requires a generalised approach which links together different types of activities with potential loss and disturbance of the seabed and thereby simplifies the complex reality (Box 4.7.1).

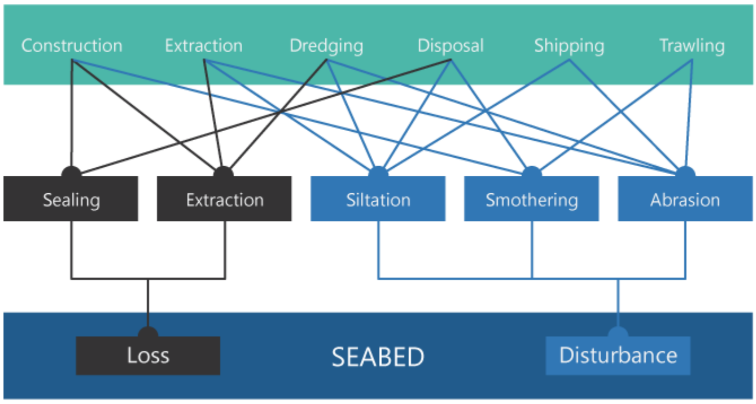


***Figure 4.7.1. Generalised overview of human activity types and the physical pressures they may exert on the seabed. The pressures are further grouped into those causing loss and disturbance of the seabed. Dark grey lines link to potential physical loss of ~~benthic~~ seabed habitats, and blue lines link to potential physical disturbance. Smothering is linked to disturbance in the graph, but may in some cases also lead to loss, depending on tolerance of the impacted organisms and intensity of the pressure.***

## Human activities potentially attributed to seabed loss and disturbance

### Dredging

Dredging activities are usually divided into capital dredging, which is carried out when building new constructions, and maintenance dredging, which is done in order to maintain existing waterways. Dredging causes different types of pressure affecting the sea-bed; removal of substrate~~,~~ ~~may also cause~~ altered physical conditions through changes in the seabed topography, increased turbidity caused by re-suspended fine sediments, and smothering and siltation of nearby areas due to settling suspension load. Loss of habitat occurs during capital dredging which usually is a pressure occurring once at a specific location. But loss of habitat also occurs during maintenance dredging which is performed repeatedly, often at regular intervals. The loss is ~~mostly~~ limited to the dredging site, while disturbance through sedimentation may have a wider spatial extent. Some studies have estimated that disturbance through sedimentation ~~, and~~ may affect animals and vegetation a couple of kilometres from the core activity (Lassalle et al. 1990, Boyd et al. 2003, Orviku et al 2008). In addition, remobilisation of sediments with deposited substances may contribute to ~~minor~~ contamination and eutrophication effects.

### Disposal of dredged matter

Disposal of dredged matter at sea ~~implies~~ ~~may cause~~s covering of the seafloor and smothering of benthic organisms;~~,~~ ~~changes in the characteristics of the sediment, and~~ it may potentially cause loss of habitat if the sediment characteristics are changed. In addition, increased turbidity during the disposal cause increased siltation on the site itself and in the areas around it. Disposed material may contain higher concentrations of hazardous substances and nutrients than the disposal site and may cause accumulation of these pollutants at the disposal site and adjacent areas. The impacts on the species depend mainly on the ~~benthic~~ seabed habitat type, the type and amount of disposed material, and distance to the disposal site. Smothering of benthic organisms may cause their mortality, but some species have the ability to re-surface (Olenin 1992, Powilleit et al. 2009). The probability of survival is higher on soft sediments, whereas vegetation and fauna on hard substrates die already from a few centimetres of sediment cover (Powilleit et al. 2009, Essink 1999). The spatial extent of the impacts is similarly as for dredging, i.e. up to a couple of kilometres from the core zone of the activity (Syväranta and Leinikki 2015, Vatanen et al. 2015).

**Commented [A1]:** FI: Questionable sentence. Loss of habitat may be caused also by covering of the seafloor and smothering of bentic organisms

### Sand and gravel extraction

During sand and gravel extraction sediment is removed from the seabed, for use in for example construction, coastal protection, beach nourishment and for land fills. Sand and gravel extraction can be performed either using static dredging or trailer dredging. When using static dredging ~~T~~the pressures exerted are comparable to those during dredging; potential physical loss of a habitat, which may be partial or complete depending on how much sand and gravel are removed from the site and which extraction technique is used, altered physical conditions through changes in the seabed topography, increased turbidity caused by fine sediments that are mobilised into the water, and smothering or siltation on nearby areas. When performing trailer dredging the pressures exerted are more limited. In ~~dynamic~~ areas where the movement and dynamics of sediment are naturally high ~~with high natural flow of sediment~~ the effect of extraction ~~will~~may be less significant ~~because of the high energy in the area~~.

Since the extracted material is sieved at sea to the wanted grain size, the unwanted matter is discharged and may result in a changed grain size of the local sediment on the seabed. Sedimentation levels are more restricted during sand and gravel extraction than during dredging, and may occur a few hundred metres from the core activity (Newell et al. 1998). There is more or less full mortality of benthic organisms at the site of sand and gravel extraction as they are removed together with their habitat (Boyd et al. 2002, 2003, Barrio Frojan et al. 2008), whereas the extent of the impact on adjacent areas is smaller (Vatanen et al 2010). Importantly, there are modern techniques and concepts which, if applied, can help to minimize the negative impact. Recolonization by sand- and gravel dwelling organisms is for example facilitated if the substrate is not completely removed. Such precautionary measures are also recommended in HELCOM Recommendation 19/1 on ‘Marine Sediment Extraction in the Baltic Sea Area’.

### Shipping

Ship traffic can cause disturbance to the seabed in several ways; propeller induced currents may cause abrasion, resuspension and siltation of sediments, ship bow waves may cause stress to littoral habitats, and dragging of anchors may cause direct physical disturbance to the seabed. Disturbances to the seabed from shipping mainly occur in shallow areas. The effects are often local, concentrated to shipping lanes and to the vicinity of harbours. For larger vessels, increased turbidity has been observed down to 30 m depth (Vatanen et al. 2010), and mid-sized ferry traffic has been estimated to increase turbidity by 55% in small inlets (Eriksson et al. 2004). Erosion of the seabed can be substantial along intensely-used shipping lanes, and has been observed to cause up to 1 m of sediment loss due to abrasion (Rytkönen et al. 2001).

### Constructions

Off shore wind farms, harbours, as well as underwater cables and pipelines are examples of constructions that cause a local but permanent loss of the habitat ~~where they are being placed~~. In addition to this permanent effect, disturbance to the seabed occurs during the ~~time~~ period of construction or installation. The pressures exerted during the construction phase are in some instances similar to those during dredging into the seabed and sea-bed extraction. In other cases, installations of off shore structures may also encompass drilling, or the relocation of substrate for use as scour protection. The area lost by scour protection around the foundation of a wind farm turbine have been estimated to extend in the order of 20 m from the wind turbine (OSPAR 2008). The area of seabed lost by scour protection can however give rise to a new hard substrate habitat. Cables and pipelines may be placed in a trench and then covered with sediment extracted elsewhere. Most often the sediment composition then differs from surrounding habitats (Schwarzer 2014). On hard substrates, cables are often covered with a protective layer of steel or concrete casings. The loss of habitats by smothering and sealing from cables has been generalised to a 2 m distance for assessment purposes (OSPAR 2008).

### Bottom trawling

Bottom contacting fishing gear causes surface abrasion. During bottom trawling it may also reach deeper down in the sediment, causing subsurface abrasion to the seabed. The substrate that is swept by bottom trawling is affected by temporary disturbance, and bottom dwelling species are removed from the habitat or relocated (Dayton et al., 1995). The impact is particularly strong on slow growing sessile species which may be eradicated. Since the same areas are typically swept repeatedly, and due to high density of trawling in some areas, the possibility to recover may be low also for more resilient organisms, and a change in species composition may be seen (Kaiser et al. 2006, Olsgaard et al. 2008). In addition, the activity may mobilise sediments into the water, which may be transported to other areas and cause smothering on hard substrates, or may release hazardous substances that have been previously buried in the seabed (Jones (1992, Wikström et al. 2016). The estimate of disturbance from fishing used in this evaluation is based on fishing intensity calculated by ICES, based on data from the vessel monitoring system on the location of fishing vessels complemented with logbook information.

Box 4.7.1 Method to estimate ~~potential~~ loss and disturbance of the seabed

Physical loss is defined as a permanent change of seabed substrate or morphology, meaning that there has been change to the seabed which has lasted or is expected to last for a long period (>12years) (EC 2017, Annex III). Activities ~~potentially~~ causing loss of the seabed were identified as dredging, disposal of dredged matter, sand and gravel extraction, constructions at sea and on the shoreline, also including cables and pipelines, marinas and harbours, land claim, and aquaculture. For example, open systems of aquaculture affect the seabed through sedimentation of excrements under the fish and shellfish farms as the accumulated material changes the seabed substrate, and currently no information exists on the recovery rate from this disturbance; aquaculture may not always lead to loss of seabed habitat ~~and it is unknown if mariculture can be characterized as lost;~~ .

Physical disturbance is defined as a change to the seabed which can be reverted if the activity causing the disturbance ceases (EC 2017). All activities mentioned above were identified as potentially causing physical disturbance to the seabed, acting via the following pressures: siltation, sedimentation, turbidity, and abrasion.

The potential extent of loss and disturbance to the seabed was estimated by identifying the spatial distribution of human activities exerting these pressures. The extent of pressures was estimated based on literature information, and the data sets were aggregated into two layers representing physical loss and physical disturbance, respectively. Whether an activity in reality leads to loss or disturbance of habitats depends on many factors such as the duration and intensity of the activity, the technique used and the sensitivity of the area affected. The ~~definitions~~identification of which activities lead to loss and/ or physical disturbance respectively ~~might require further work in the future~~is still under development. The aggregated layers were also compared with information on the spatial distribution of broad benthic habitat types, in order to estimate the potentially lost and disturbed area of benthic habitats [*ref to supplementary material for full description of method estimates of extent of pressures*].

The results are presented descriptively as an indication of the potential extent of the pressure. However, no threshold values are defined for physical loss and disturbance and thus no value judgement on status is placed on the results.

Confidence in the assessment has not been calculated because the data layers include only ´presence information’. Therefore the potential loss and disturbance can be underestimated in some sub-basins due to lack of data of specific pressures. It is however possible to qualitatively estimate gaps in the pressure layers based on knowledge of the national data sets that are underlying the Baltic wide layers.

## Estimated ~~potential~~ physical loss and disturbance

The level of long term physical loss of seabed in the Baltic Sea was estimated to be less than 1% on the regional scale until the year 2015. Highest estimates of potential loss at the level of sub-basins were found in the more densely populated southern Baltic Sea and ranged ~~around 4~~between 1-5 % in the Sound, ~~3% in~~ the Bay of Mecklenburg and ~~the 2% in~~ the Great Belts. In the majority of the other sub-basins, less than 1% of the seabed area was estimated to be potentially lost (Figure 4.7.2). The human activities mainly connected with seabed loss were sand extraction, dredging and disposal of dredged matter and to a lesser extent offshore and coastal installations and aquaculture. In terms of broad benthic habitat types, the highest proportion of area potentially lost was 'infralittoral sand', but the highest total area potentially lost was estimated for 'infralittoral mixed substrate' (Figure 4.7.3).

Around half of the Baltic seabed was estimated to have been potentially disturbed (236 000 km$^2$) during 2011-2015. The spatial extent of potential physical disturbance to the seabed varied between ~~circa 22~~20 and almost ~~96~~100 % per sub-basin (1 200 to 39 000 km$^2$; Figure 4.7.4). However, the estimation does not reflect whether the potential disturbance is causing adverse effects to the benthic habitats as the intensity of the disturbance is unknown. The intensity or severity of the disturbance is an important aspect which is intended to be covered in future indicator-based assessments.

The activities connected to the widest potential physical disturbance are the bottom-trawling fishery, which is common in the southern parts of the Baltic Sea, and shipping. At a more local scale, however, more severe physical disturbance may be caused by dredging and the disposal of dredged material. The largest area of potentially disturbed seabed were estimated in the Eastern Gotland Basin and the Bornholm Basin, which are also both comparatively large sub-basins in the Baltic (Figures 4.7.4 and 4.7.5). The sub-basins with highest proportion of potential disturbed seabed were found in the southern Baltic Sea, between the Kattegat and the Arkona Basin.

Importantly, these estimates are based on best available data on the extent of the activities concerned. In some cases, areas licensed for an activity such as dredging and extraction of sand and gravel, do not necessarily reflect the extent of the exerted pressure, as the activity may be undertaken only in parts of the licensed area. These limitations in data add to the uncertainties of the estimate.

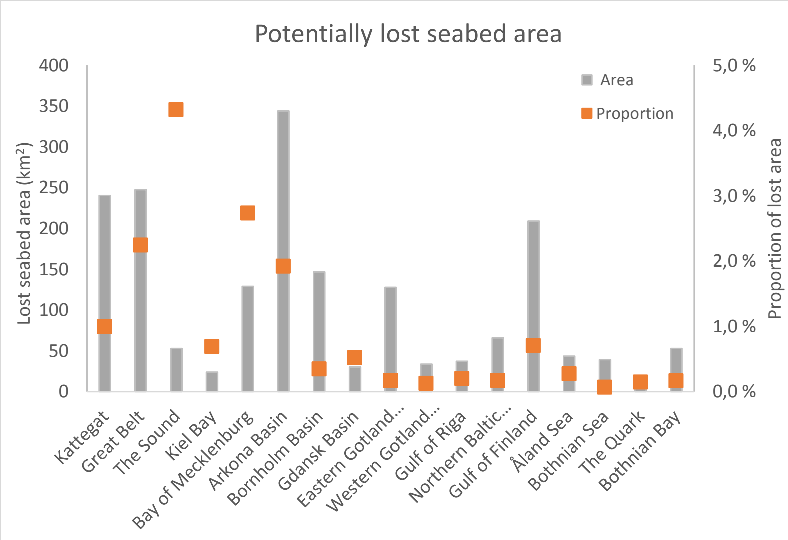


***Figure 4.7.2. Estimate of seabed area (km²) potentially lost due to human activities per Baltic Sea sub-basin. The right hand y-axis shows the proportion (%) of area lost per sub-basin. The estimation is calculated from spatial data of human activities causing physical loss, as listed in the text.***

**Commented [A2]:** DK: Don't use the second y-axis. Instead use two different colours on the bars of estimated seabed eg. one for < 1 % and another for 1-5 %.

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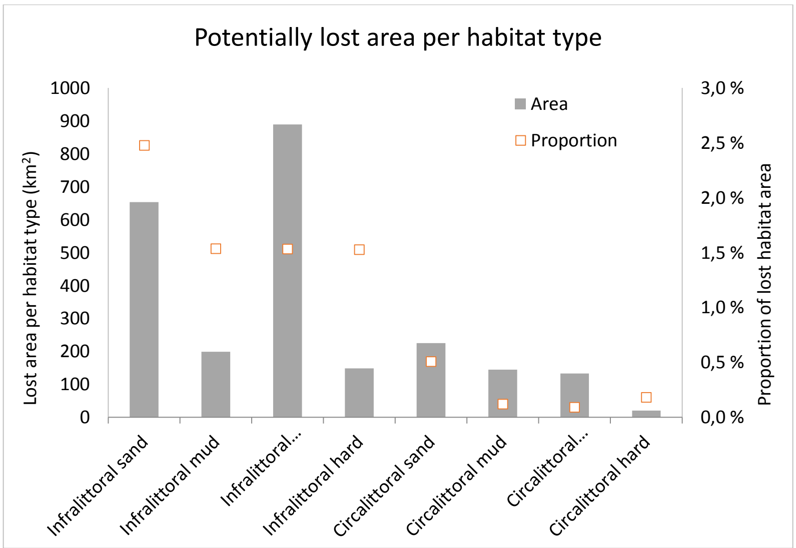


***Figure 4.7.3. Estimate of area of broad benthic habitat types potentially lost due to human activities. The right hand y-axis shows the proportion of potentially lost habitat area, calculated as the area lost in relation to the habitat extent. 'Infralittoral' is the permanently submerged part of the seabed that is closest to the surface, typically with benthic habitats dominated by algae. 'Circalittoral' is the zone below the infralittoral, and is in the Baltic Sea typically dominated by benthic animals.***

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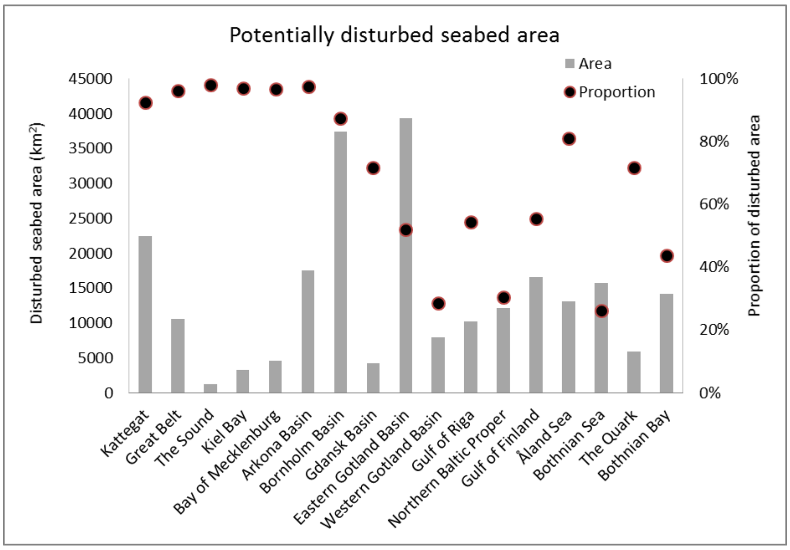


***Figure 4.7.4. Estimate of seabed area (km²) potentially disturbed in the Baltic Sea sub-basins. The right hand y-axis shows the proportion of potentially disturbed seabed area per sub-basin. The area is estimated based on spatial information on the distribution of human activities connected to the pressures, as explained further in the text. The estimate is based on any presence of a human activity connected to the pressure, and does not consider the level or severity of the disturbance.***

**Commented [A5]:** DK: Don't use the second y-axis. Instead give the bars diffent colours, eg. 0-20, 20-40, 40-6, 60-80 and 80-100 %. Same coulors as in figure 4.7.5

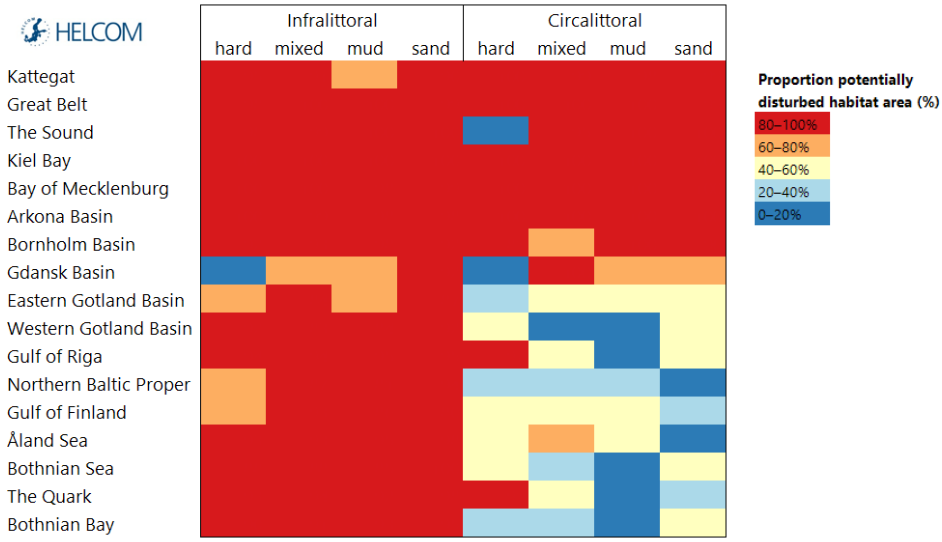


***Figure 4.7.5. Estimate of the proportion (%, given in ranges) of the different broad benthic habitat types potentially disturbed due to human activities per sub-basin. The estimate is based on the total of human activities linked to potentially causing this pressure, and does not reflect the actual level of impact.***

**Commented [A6]:** Places of infralittoral and circalittoral switched as suggested by EU

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