Submerged rooted plant communities on Baltic infralittoral coarse sediment

Summary

This habitat occurs in all Baltic sub-basins in the shallow waters of the photic zone. Distribution of the associated biotopes depends on the dominant species and is influenced mainly by salinity and exposure. *Zostera noltei*, for example, is not found east of the Darss Sill in the Arkona basin, while *Potamogeton perfoliatus* occurs mostly in the northern part of the Bothnian Bay, and *Chara horrida* in the central Baltic and Archipelago Sea.The submerged rooted plant communities (higher plants and Charophytes) provide structure for the benthic environment and associated communities on the underlying sediment.

Eutrophication (increasing N, P and organic matter) has both direct and indirect negative impacts, for example by reducing light penetration through the water column and therefore the depth penetration of submerged species, increased sedimentation which can prevent settlement and excess of nutrients which often favours opportunistic species with short life cycles and rapid development over perennial species with lower productivity, causing a shift in the community composition. Climate change may also result in a shift in the dominant species due to predicted associated changes in salinity. All actions to reduce eutrophication of the Baltic Sea are important for the conservation of this habitat. Area protection and restrictions on coastal construction and dredging would also be beneficial.

Synthesis

The presence of this habitat type in the Baltic is well established with different submerged rooted plant communities dominating depending on the salinity and exposure. The best studied associated biotopes are those dominated by seagrass, brackish water angiosperms and charophytes and for most of them there have been declines in extent.

There have been significant declines (>25%) in the extent of the seagrass and charophyte dominated communities in the last 50 years and in the quality of some of the associated biotopes. *Zostera marina* and several species of charophyts are also on the HELCOM Red List of threatened species in the Baltic. The overall assessment for this EUNIS level 4 habitat has been based on the HELCOM (2013) assessments for the associated HELCOM HUB biotopes. Draft assessments were derived using a weighted approach whereby the HELCOM assessment outcomes were assigned a score. This was averaged across the relevant biotopes. The outcomes were reviewed by Baltic experts to reach a final conclusion. HELCOM (2013) assessed AA.I1B1, AA.I1B2 and AA.I1B6 as Least Concern (A1) and AA.I1B4 and AA.I1B7 as Near Threatened (A1). With no additional information on changes in extent or quality of this habitat the overall assessment for this habitat type based on expert opinion is Near Threatened fro both the EU 28 and EU 28+.

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
NT	A1	NT	A1

Sub-habitat types that may require further examination

AA.I1B4 Baltic photic coarse sediment dominated by Charales

AA.I1B7 Baltic photic coarse sediment dominated by common eelgrass (*Zostera marina*).

Habitat Type

Code and name

Submerged rooted plant communities on Baltic infralittoral coarse sediment

Chara species, Archipelago Sea, Finland (© Metsähallitus, Finland).

Habitat description

This benthic habitat occurs in the photic zone with at least 90% coverage of coarse sediment according to the HELCOM HUB classification. Coarse sediments covered by rooted plants (which also includes plants with rhizoids,i.e. Charales) are mainly distributed in areas of moderate exposure to wave actioin. The habitat covers the full salinity range of the Baltic Sea and is distributed from the Belt Sea up to the northern part of Bothnian Bay. Depending on the salinity the dominant species (>50% of the biovolume), defining the associated biotope type, varies. They also occupy different depth zones. Five associated biotopes have been identified: 'Baltic photic coarse sediment dominated by pondweed (*Potamogeton perfoliatus* and/or *Stuckenia pectinata*)' (AA.I1B1); 'Baltic photic coarse sediment dominated by *Ranunculus* spp.' (AA.I1B6); 'Baltic photic coarse sediment dominated by Charales' (AA.I1B4); 'Baltic photic coarse sediment dominated by *Zannichellia* spp. and/or *Ruppia* spp. and/or *Zostera noltei*' (AA.I1B2) and 'Baltic photic coarse sediment dominated by common eelgrass (*Zostera marina)*' (AA.I1B7).

The latter differs most strongly from the other biotopes in distribution, occurring mainly at moderate to high exposure and in salinities of 5 psu or higher. It is typically found in deeper waters than the other biotopes (1-6 m) and often marks the lower depth limit distribution of soft bottom vegetation. This biotope is absent from areas with low salinity in the inner part of the Gulf of Bothnia.

Indicators of quality:

Both biotic and abiotic indicators have been used to describe marine habitat quality. These include the presence of characteristic species as well as those which are sensitive to the pressures the habitat may face; water quality parameters; levels of exposure to particular pressure, and more integrated indices which describe habitat structure and function, such as trophic index, or successional stages of development in habitats that have a natural cycle of change over time. There are no commonly agreed indicators of quality for this habitat, although particular parameters may have been set in certain situations e.g. protected features within Natura 2000 sites, where reference values have been determined and applied on a location-specific basis.

The vertical depth limit of submerged rooted plants is used in several countries as a Water Framework Directive parameter for assessing ecological status. The overall quality and continued occurrence of this habitat is, however, largely dependent on the presence of the rooted plant species, which create the biogenic structural complexity on which the characteristic associated communities depend. The density and the maintenance of a viable population of these species is a key indicator of habitat quality, together with the visual evidence of presence or absence of physical damage.

Characteristic species:

Chara baltica, *Potamogeton perfoliatus, Ruppia cirrhosa, R. maritima, Stuckenia pectinata, Zannichellia palustris, Zostera marina,* and *Zostera noltei* (formerly known as *Z. noltii* or *Z. nana*),

Classification

EUNIS:

The closest correspondence in EUNIS (2004) level 4 is to A5.53 Sublittoral seagrass beds and A5.54 Angiosperm communities in reduced salinity

Annex 1:

The relationship between HUB biotopes and Annex 1 habitats has not yet been mapped by HELCOM, however this habitat may occur in the following habitats:

1110 Sandbanks slightly covered all the time

1130 Estuaries

1160 Large shallow inlets and bays

1650 Boreal Baltic narrow inlets

MAES:

Marine - Marine inlets and transitional waters

Marine - Coastal

MSFD:

Shallow sublittoral coarse sediment

Shallow sublittoral mixed sediment

EUSeaMap:

Shallow coarse or mixed sediments

IUCN:

9.9 Seagrass

9.10 Estuaries

Other relationships:

Level 5 of the HELCOM HUB classification (2013):

This habitat has five sub-habitats on HUB level 6;

AA.I1B1 'Baltic photic coarse sediment dominated by pondweed (*Potamogeton perfoliatus* and/or *Stuckenia pectinata*)'

AA.I1B2 'Baltic photic coarse sediment dominated by *Zannichellia* spp. and/or *Ruppia* spp. and/or *Zostera noltei*'

AA.I1B4 'Baltic photic coarse sediment dominated by Charales'

AA.I1B6 'Baltic photic coarse sediment dominated by *Ranunculus* spp.'

AA.I1B7 'Baltic photic coarse sediment dominated by common eelgrass (*Zostera marina*)'

Does the habitat type present an outstanding example of typical characteristics of one or more biogeographic regions?

Yes

Regions
Baltic

Justification
This habitat is common on photic mixed substrate in the entire Baltic Sea. Most of the associated biotopes have a very typical and characteristic species composition for the Baltic Sea with a dominance of species with freshwater origin.

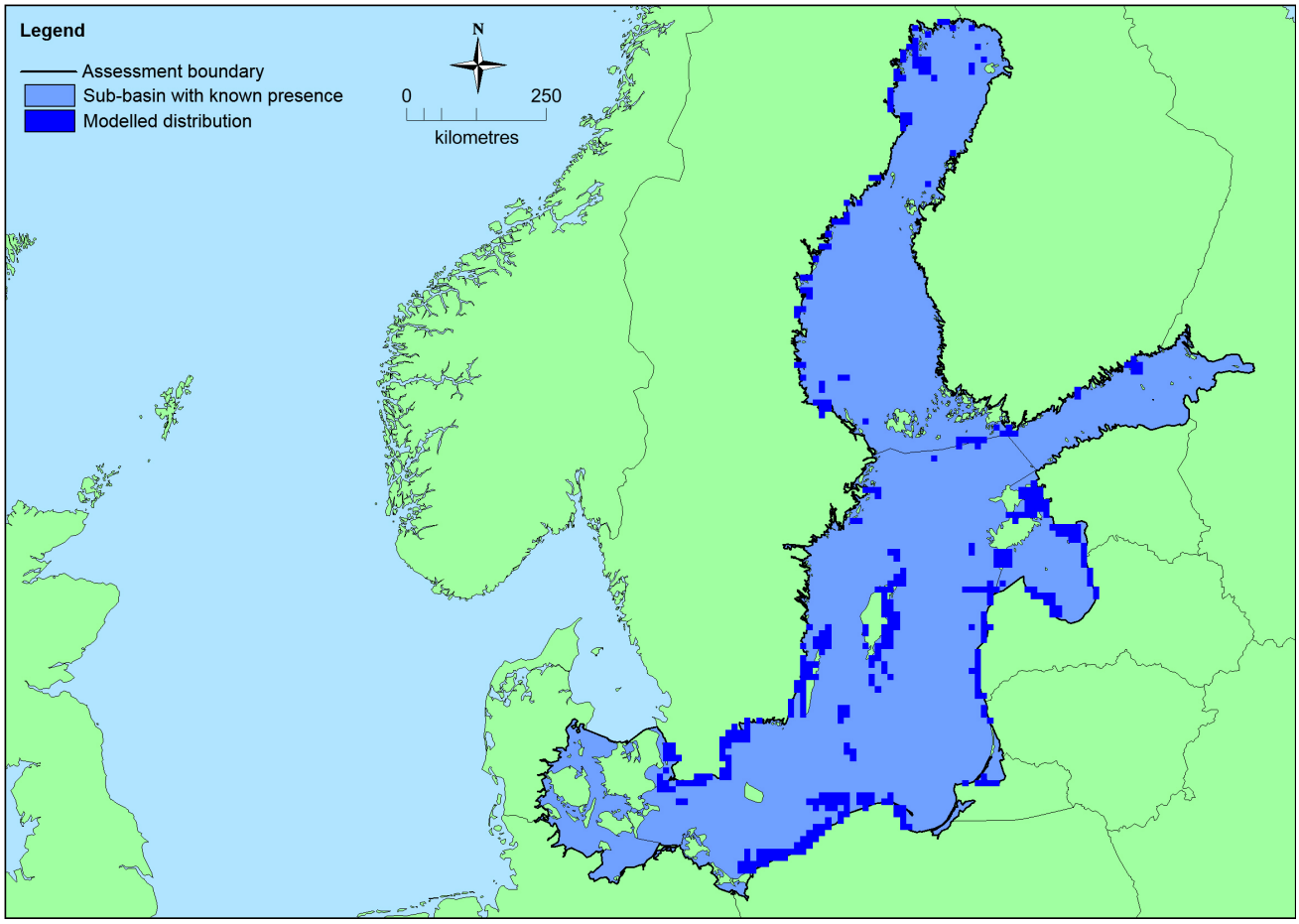
Geographic occurrence and trends

Region	Present or Presence Uncertain	Current area of habitat	Recent trend in quantity (last 50 yrs)	Recent trend in quality (last 50 yrs)
Baltic Sea	Baltic Proper: Present Belt Sea: Present Gulf of Bothnia: Present Gulf of Finland: Present Gulf of Riga: Present The Sound: Present	Unknown Km^2	Decreasing	Unknown

Extent of Occurrence, Area of Occupancy and habitat area

	Extent of Occurrence (EOO)	Area of Occupancy (AOO)	Current estimated Total Area	Comment
EU 28	732,697 Km^2	434	Unknown Km^2	This habitat is present in all the Baltic sub-basins.
EU 28+	>50000 Km^2	>50	Unknown Km^2	This habitat is present in all the Baltic sub-basins

Distribution map



There are insufficient data to provide a comprehensive and accurate map of the distribution of this habitat. This map has therefore been generated using the modelled data available on EMODnet for EUNIS level 3 habitats in the Baltic Sea (EMODnet, 2010) supplemented with expert input. This means it indicates potential areas in which this habitat may occur, not the actual distribution of this EUNIS level 4 habitat.

How much of the current distribution of the habitat type lies within the EU 28?

This habitat occurs in the EU 28+ (Russia). The percentage hosted by EU 28 is therefore less than 100% but there is insufficient information to establish the proportion.

Trends in quantity

This habitat is relatively common in most suitable areas of the Baltic Sea although there are some differences in the distribution of different associated biotopes. For example, AA.I1B7 'Baltic photic coarse sediment dominated by common eelgrass (Zostera marina)' is absent from areas with low salinity in the inner part of the Gulf of Finland and Gulf of Bothnia. There are area estimates for some of the associated biotopes (100 x 100km grid squares from HELCOM data) however as these only indicate presence the area could range from 1 - 350,000 km2. Reduction in depth distribution for *Zostera marina* from 10 m to currently 4-6 m resulted in area reduction (since 1930s) to about 25-50 % along the German and Danish coastline but to varying extents in the different Baltic Sea regions. The associated biotope AA.I1B4 'Baltic photic coarse sediment dominated by Charales' has declined by >25% during the last 50 years but to varying extent in different Baltic Sea regions. The strongest decline occurred again in the Western and Southern Baltic Sea. In some bays and lagoons conditions have changed so intensively that the biotope has disappeared completely. The remaining associated biotopes are believed to have declined by less than 25% during the last 50 years. Detailed historical area daa are only available for some areas/countries. Some of the associated biotopes are considered likely to decline in the future (e.g. by more than 20% for those dominated by Charales)

- Average current trend in quantity (extent)

EU 28: Decreasing
EU 28+: Decreasing

- Does the habitat type have a small natural range following regression?
  No
  Justification
  This habitat occurs in all the Baltic Sea sub-basins therefore does not have a small natural range.
- Does the habitat have a small natural range by reason of its intrinsically restricted area?
  No
  Justification
  This habitat occurs in all the Baltic Sea sub-basins therefore does not have a small natural range.

Trends in quality

The quality of the habitat has declined during the past 50 years and historic times, at least in some areas and for some associated biotopes, such as those dominated by charophytes around the Hanko peninsula (Finland) and the German Bodden and Haffe. There are very precise data about Secchi depth reductions along the German and Danish coastline but insufficient data on a large scale to assess any overall trend in quality.

- Average current trend in quality
  EU 28: Unknown
  EU 28+: Unknown

Pressures and threats

Wasting disease in the 1930s' has been the most significant threat leading to substantial loss of the biotope AA.I1B7 'Baltic photic coarse sediment dominated by common eelgrass (*Zostera marina*)'. Eutrophication, bottom trawling, water traffic, construction, sand extraction, dredging, dumping, aquaculture, coastal works and locaslied damage from mooring have all been identified as past and current threats. These are also likely to be threats in the future along with climate change. One predicted effect is a lowering of salinity in the northern parts of the Baltic Sea due to an increase of precipitation, where *Zostera marina* is already at the northernmost limits of its salinity tolerance.

List of pressures and threats

Biological resource use other than agriculture & forestry

Marine and Freshwater Aquaculture
Intensive fish farming, intensification
Professional active fishing
Benthic or demersal trawling

Pollution

Pollution to surface waters (limnic, terrestrial, marine & brackish)
Nutrient enrichment (N, P, organic matter)
Input of contaminants (synthetic substances, non-synthetic substances, radionuclides) - diffuse sources, point sources, acute events

Natural System modifications

Removal of sediments (mud...)
Estuarine and coastal dredging
Dykes, embankments, artificial beaches, general
Sea defense or coast protection works, tidal barrages

Climate change

Changes in abiotic conditions

Temperature changes (e.g. rise of temperature & extremes)

Changes in biotic conditions

Habitat shifting and alteration

Conservation and management

All actions to reduce eutrophication of the Baltic Sea are important for the conservation of this habitat. Conservation measures such as area protection and restrictions on coastal construction and dredging would also benefit this habitat.

List of conservation and management needs

Measures related to wetland, freshwater and coastal habitats

Restoring/Improving water quality

Measures related to marine habitats

Restoring marine habitats

Measures related to spatial planning

Establish protected areas/sites

Measures related to urban areas, industry, energy and transport

Other measures

Managing marine traffic

Conservation status

Annex 1:

1110: MBAL U1

1130: MBAL U2

1160: MBAL U2

1650: MBAL U2

HELCOM (2013) assessments:

1110 VU C1

1130 CR, C1

1160 VU C1

1650 VU C1

HELCOM (2013) have assessed the associated biotopes AA.I1B1, AA.I1B2 and AA.I1B6 as LC(A1), biotopes AA.I1B4 and AA.I1B7 were assessed as NT(A1)

When severely damaged, does the habitat retain the capacity to recover its typical character and functionality?

The associated biotope AA.I1B7 ’Baltic photic coarse sediment dominated by common eelgrass (*Zostera*

marina)' can be slow to recover after strong decline (>20 yrs) although intervention (planting) may speed up the recovery. Tansplantation experiments have had limited success to date. Regeneration from root systems is slow and recovery of entire beds, with characteristic structure and associated species will take long. For the other associated biotopes natural recovery can probably occur within 10 years.

Effort required

10 years	20 years
Naturally and through intervention	Naturally and through intervention

Red List Assessment

Criterion A: Reduction in quantity

Criterion A	A1	A2a	A2b	A3
EU 28	>25 %	unknown %	unknown %	unknown %
EU 28+	>25 %	unknown %	unknown %	unknown %

Two of the five associated biotopes have reported declines of more than 25% with good quantity data for *Zostera marina* and Charophytes. As these are the most common biotopes, an overall decline of more than 25% over the last 50 years is considered likely. This habitat has therefore been assessed as Near Threatened under Criteria A for the EU 28 and EU 28+.

Criterion B: Restricted geographic distribution

Criterion B	B1				B2				B3
	EOO	a	b	c	AOO	a	b	c	
EU 28	>50,000 Km^2	Yes	Unknown	No	>50	Yes	Unknown	No	No
EU 28+	>50,000 Km^2	Yes	Unknown	No	>50	Yes	Unknown	No	No

This habitat has a large natural range in the Baltic Sea extending from the Danish coast in the west to the Bothnian Bay in the north-east. EOO >50,000 km^2 and AOO >50, and it is not limited to a few locations, however the precise extent of this habitat over the last 50 years is unknown. It has been assessed as Least Concern under Criteria B.

Criterion C and D: Reduction in abiotic and/or biotic quality

Criteria C/D	C/D1		C/D2		C/D3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	unknown %	unknown %	unknown %	unknown %	unknown %	unknown %
EU 28+	unknown %	unknown %	unknown %	unknown %	unknown %	unknown %

Criterion C	C1		C2		C3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	unknown %	unknown %	unknown %	unknown %	unknown %	unknown %
EU 28+	unknown %	unknown %	unknown %	unknown %	unknown %	unknown %

Criterion D	D1		D2		D3	
	Extent affected	Relative severity	Extent affected	Relative severity	Extent affected	Relative severity
EU 28	unknown %	unknown%	unknown %	unknown%	unknown %	unknown%
EU 28+	unknown %	unknown%	unknown %	unknown%	unknown %	unknown%

There have been declines in the quality of some of the associated biotopes in some areas e.g. Charophytes and *Zostera marina* however experts consider there to be insufficient data on which to make an overall assessment of criteria C/D.

Criterion E: Quantitative analysis to evaluate risk of habitat collapse

Criterion E	Probability of collapse
EU 28	unknown
EU 28+	unknown

There is no quantitative analysis available to estimate the probability of collapse of this habitat type.

Overall assessment "Balance sheet" for EU 28 and EU 28+

	A1	A2a	A2b	A3	B1	B2	B3	C/D1	C/D2	C/D3	C1	C2	C3	D1	D2	D3	E
EU28	NT	DD	DD	DD	LC	LC	LC	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD
EU28+	NT	DD	DD	DD	LC	LC	LC	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
NT	A1	NT	A1

Confidence in the assessment
Low (mainly based on uncertain or indirect information, inferred and suspected data values, and/or limited expert knowledge)

Assessors
S. Gubbay and N. Sanders.

Contributors
HELCOM RED LIST Biotope Expert Team 2013 and Baltic Sea Working Group for the European Red List of Habitats 2014 and 2015.

Reviewers
K. Fürhaupter.

Date of assessment
08/07/2015

Date of review
29/12/2015

References

Baden, S.P. and Boström, C. 2001. The leaf canopy of seagrass beds: faunal community structure and function in a salinity gradient along the Swedish coast. In: Reise, K. (ed.). *Ecological comparisons of*

sedimentary shores, Ecological Studies 151, Springer-Verlag, Berlin, pp. 213-236.

Baden, S.P., Loo, L.-O., Pihl, L. and Rosenberg, L. 1990. Effects of eutrophication on benthic communities including fish: Swedish west coast. *Ambio* 19: 113-122.

Berg Ch., Dengler J., Abdank A. and Isermann, M. 2004. Die Pflanzengesellschaften Mecklenburg-Vorpommerns und ihre Gefährdung – Textband. *Weissdorn-Verlag, Jena*: 94–98.

Berglund, J., Mattila, J., Rönnberg, O., Heikkilä, J. and Bonsdorff, E. 2003. Seasonal and inter-annual variation in occurrence and biomass of rooted macrophytes and drift algae in shallow bays. *Estuarine, Coastal and Shelf Science* 56(5–6): 1667–1175.

Blindow, I. 2000. Distribution of charophytes along the swedish coast in relation to salinity and eutrophication. *International Reiew.of Hydrobiology* 85 (5–6): 707–717.

Borum, J., Duarte, C.M., Krause-Jensen, D. and Greve T.M. (eds), 2004. *European seagrasses: an introduction to monitoring and management*. *The M&MS project*. 95 pp. Available at: http://www.seagrasses.org/handbook/european_seagrasses_low.pdf (Accessed: 18/07/2015).

Boström, C. 2001. Ecology of Seagrass Meadows in the Baltic Sea. *Environmental and Marine Biology*, Department of Biology, Åbo Akademi University, Åbo, Finland. 47 pp.

Boström, C. and Bonsdorff, E. 1997. Community structure and spatial variation of benthic invertebrates associated with Zostera marina (L) beds in the northern Baltic Sea. *Journal Of Sea Research* 37(1-2): 153–166.

Boström, C., Baden, S.P. and Krause-Jensen, D. 2003. The seagrasses of Scandinavia and the Baltic Sea. In: Green, E. P. & Short, F.T. (eds). *World Atlas of Seagrasses*. University of California Press. pp. 27-37.

Boström, C., Bondsorff, E., Kangas, P. and Norkko, A. 2002. Long-term changes of a brackish water eelgrass (Zostera marina L.) community indicate effects of coastal eutrophication. *Estuarine Coastal Shlef Science* 55: 795-804.

Gic-Grusza, C., Kryla-Straszewska, K., Urbański, J., Warzocha, J. and Węstawski, J.M. 2009. *Atlas of Polish marine area bottom habitats. Environmental valorization of marine habitats.* Gic-Grusza, C., Kryla-Straszewska, K., Urbański, J., Warzocha, J., & Węstawski, J.M. (Eds), Gdynia, Poland.

den Hartog, C. 1970. *The seagrasses of the world*. Verh K Ned Ak Wet Adf. North-Holland, Amsterdam 59: 1-275.

Hauxwell, J., Cebrian, J., Furlong, C. and Valiela, I. 2000. Macroalgal canopies contribute to eelgrass (Zostera marina) decline in temperate estuarine ecosystems. *Ecology* 82: 1007-1022.

HELCOM. 2013. Biotope information sheet- Baltic photic muddy or coarse sediment, sand or mixed substrate dominated by Charales. Available at: http://helcom.fi/Red%20List%20of%20biotopes%20habitats%20and%20biotope%20complexe/HELCOM%20Red%20List%20AA.H1B4,%20AA.I1B4,%20AA.J1B4,%20AA.M1B4.pdf (Accessed: 29/07/2015).

HELCOM. 2013. Biotope information sheet- Baltic photic muddy sediment, coarse sediment, sand or mixed substrate dominated by common eelgrass (Zostera marina). Available at: http://helcom.fi/Red%20List%20of%20biotopes%20habitats%20and%20biotope%20complexe/HELCOM%20Red%20List%20AA.H1B7,%20AA.I1B7,%20AA.J1B7,%20AA.M1B7.pdf (Accessed: 29/07/2015).

HELCOM. 2013. Biotope information sheet- Baltic photic muddy sediment or sand dominated by spiny naiad (Najas marina). Available

at:
http://helcom.fi/Red%20List%20of%20biotopes%20habitats%20and%20biotope%20complexe/HELCOM%20Red%20List%20AA.H1B5,%20AA.J1B5.pdf (Accessed: 29/07/2015)

HELCOM, 2009. *Biodiversity in the Baltic Sea. An integrated thematic assessment on biodiversity and nature conservation in the Baltic Sea*. Zweifel, U.L. and Laamanen, M. (Eds). Helsinki, Finland.

HELCOM, 2013. *Red List of Baltic Sea underwater biotopes, habitats and biotope complexes*. Avellan, L. (Ed). Helsinki, Finland.

HELCOM, 2013. *Red List of Baltic Sea species in danger of becoming extinct.* Kontula, T and Haldin, J., (Eds). Helsinki, Finland.

HELCOM, 1998. Red List of marine and coastal biotopes and biotopes complexes of the Baltic Sea, Belt Sea and Kattegat. *Baltic Sea Environmental Proceedings* No. 75. Helsinki Commission, Helsinki. 115pp. Available at: http://www.helcom.fi/Lists/Publications/BSEP75.pdf (Accessed: 29/07/2015).

HELCOM Website http://www.helcom.fi/environment2/biodiv/endangered/Algae/en_GB/Chara_horrida/- LINK BROKEN

HELCOM, 2013. Species In

HELCOM. 2013. Climate change in the Baltic Sea: HELCOM thematic assessment in 2013. *Baltic Sea Environmental Proceedings* XXX

Holmen, M. 1987. The aquatic Adephaga (Coleptera) of Fennoscandia and Denmark. I. Gyrinidae, Haliplidae, Hygrobiidae and Noteridae. *Fauna Ent. Scand*. 20:1-168.

Kruk-Dowgiallo, L. 1996. The role of filamentous brown algae in the degradation of the underwater meadows the Gulf of Gdansk. *Oceanological Studies XXV* (1-2): 125-135.

Lundberg, C. 2005. *Eutrophication in the Baltic Sea* – from area-specific biological effects to interdisciplinary consequences. Environmental and Marine Biology. Department of Biology. Åbo Akademi University, Åbo Finland 166 pp

McGlathery, K.J. 2001. Macroalgal blooms contribute to the decline of seagrass in nutrient-enriched coastal waters. *J. Phycol*. 37: 453-456.

Mäkinen, A., Tallberg, P., Anttila, S., Boström, C., Boström, M., Bäck, S., Ekebom, J., Flinkman, J., Henricson, C., Koistinen, M., Korpinen, P., Kotilainen, A., Laine, A., Lax, H.-G., Leskinen, E., Munsterhjelm, R., Norkko, A., Nyman, M., O'Brien, K., Oulasvirta, P., Ruuskanen, A., Vahteri, P. and Westerbom, M. 2008. *Itämeren vedenalaiset luontotyypit*. In: Raunio, A. Schulman, A. & Kontula, T. (eds). 2008. Suomen luontotyyppien uhanalaisuus − Osa II: Luontotyyppien kuvaukset. Finnish Environment Institute, Helsinki. Suomen ympäristö 8/2008. 572 p.

Möller, T. 2008. *Zostera marina* (LINNAEUS 1753), Eelgrass (Angiospermophyta). HELCOM Species Fact Sheet.

Moller and Martin 2007. Distribution of the eelgrass Zostera Marina L. in the coastal waters of Estonia, NE Baltic Sea. *Proceedings of the Estonian Academy of Science, Biology, Ecology* 56(4): 270-277.

OSPAR 2008. OSPAR List of Threatened and/or Declining Species and Habitats.

OCEANA 2011. Conservation proposals for ecologically important areas in the Baltic Sea. p. 31. Available at: http://oceana.org/sites/default/files/reports/OCEANA_Baltic_report_2011_ENG.pdf (Accessed: 19/10/2015).

Pihl, L., Isaksson, I., Wennhage, H. and Moksnes, P.-O. 1995. Recent increase of filamentous algae in

shallow Swedish bays: effects on the community structure of epibenthic fauna and flora. *Neth. J. Aquatic Ecol*. 29: 349-358.

Preston, C.D. and Croft, J.M. 1997. *Aquatic Plants in Britain and Ireland*. Harley Books: 236-237.

Schiewer, U. 2002. Recent changes in northern German lagoons with special reference to eutrophication. In: Schernewski, G. & U. Schiewer (eds.), *Baltic coastal ecosystems, structure, function and coastal zone management.* Central and Eastern European Development Studies, Springer Verlag, Berlin, pp. 19-30.

Schubert, H. and Blindow, I. (eds.) 2003. Charophytes of the Baltic Sea. *The Baltic Marine Biologists Publication*, No. 19: 326 S.

Schubert, H.; Blümel, C.; Eggert, A.; Rieling, T.; Schubert, M. and Selig, U. 2003. Entwicklung von leitbildorientierten Bewertungsgrundlagen für innere Küstengewässer der deutschen Ostseeküste nach der EU-WRRL. *Forschungsbericht zum BMBF Projekt* ELBO. FKZ 0330014: 1-109.

Selig, U., Eggert, A., Schories, M., Schubert, C., Blümel, C. and Schubert, H. 2007a. Ecological classification of macroalgae and angiosperm communities of inner coastal waters in the southern Baltic Sea. Ecological Indicators 7(3): 665–678.

Torn, K., Martin, G., Kukk, H. and Trei, T. 2004. Distribution of charophyte species in Estonian coastal water (NE Baltic Sea). *Scientia Marina* 68(1): 129-136.

Torn, K., Martin, G., Kotta, J. and Krupp, M. 2010. Effects of different types of mechanical disturbances on a charophyte dominated macrophyte community. *Estuarine, Coastal and Shelf Science* 87(1): 27-32.