Infaunal communities of Baltic infralittoral muddy sediment - bivalves

Summary

This habitat occurs in all Baltic sub-basins in the shallow waters of the photic zone and is mostly characterised by dominance of the infauna by the Baltic tellin *Macoma balthica*. Areas dominated by ocean Quahog (*Arctica islandica*) and *Abra* spp. are only present in the Belt Sea. and photic muddy sediment dominated by *Unionidae* are restricted to oligohaline lagoons, bays and estuaries and the northern most part of the Bothnian Sea. Eutrophication is considered to have been the main pressure on this habitat and pressures associated with climate change are considered to be a likely future threat. Every action to reduce the level of eutrophication in order to increase the oxygen level on the deep muddy bottoms are urgently needed. Some consecutive years when the oxygen level remains at a good level is needed for the recruitment to be successful.

Synthesis

The presence of this habitat type in the Baltic is well established and the occurrence of some of the biotopes has been mapped, but there is a lack of comprehensive quantitative data on the area covered. There have been declines in the extent of two of the four associated biotopes with overall decline is considered to be more than 25%. There have also been some declines in quality of this habitat in the Belt Sea (more than 10% in for *A.islandica* dominated areas).

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 the two biotopes AA.H3L1 and AA.H3L8 as LC(A1). AA.H3L3 and AA.H3L8 were assessed as NT(A1). Given the severity of decline of some of the associated biotopes over the last 50 years, the current expert opinion is that this habitat should be assessed as Near Threatened (A1).

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Near Threatened	A1	Near Threatened	A1

Sub-habitat types that may require further examination

AA.H3L3 Baltic photic muddy sediment dominated by ocean quahog (*Arctica islandica*)

AA.H3L6 Baltic photic muddy sediment dominated by Unionidae

Habitat Type

Code and name

Infaunal communities of Baltic infralittoral muddy sediment - bivalves

Astarte spp. on muddy sediments (© Karin Fürhaupter, MariLim GmbH.).

Habitat description

This is a Baltic Sea benthic habitat in the photic zone where at least 90% of the substrate is muddy sediment according to the HELCOM HUB classification. Sessile/semi-sessile epibenthic macrofauna are absent and infaunal bivalves dominate the biomass at depths of below approximately 20 m. It is a habitat that is present in conditions of low to moderate exposure to wave action and currents.

Three associated biotopes with different dominant species of bivalves (at least 50% of the infaunal bivalves) and slightly different distributions have been identified. 'Baltic aphotic muddy sediment dominated by Baltic tellin (*Macoma balthica*)' (AB.H3L1) is commonly found all parts of the Baltic Sea. 'Baltic aphotic muddy sediment dominated by ocean quahog (*Arctica islandica*)' (AB.H3L3) can only be found in the southwestern parts in the Belt Sea where the salinity is > 15 psu and has an optimum depth range of between 25 and 80 m. 'Baltic aphotic muddy sediment dominated by *Astarte* spp.' (AB.H3L5) is only found in areas where the near bottom water exhibits a salinity range between 10 and 15 psu, a temperature between 3 and 8°C and relatively good oxygen conditions. It is encountered in the southern and western Baltic Sea, in the southern Baltic Proper, in the Belt Sea and the Sound. As an arctic-boreal species, *Astarte borealis* appears in these Baltic biotopes at its southern limit.

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. Diversity, abundance and biomass of fauna are potential indicators of quality.

Characteristic species:

Macoma balthica, Arctica islandica, Astarte spp.

Classification

EUNIS:

The closest correspondence in EUNIS (2004) level 4 is A5.31 Sublittoral mud in low or 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 Annex 1 habitats:

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 mud

EUSeaMap:

Shallow muds

IUCN:

9.6 Subtidal muddy

Other relationships:

Level 5 of the HELCOM HUB classification (2013):

AB.H3L Baltic aphotic muddy sediment characterized by infaunal bivalves This habitat has three associated biotopes on HUB level 6; 'Baltic aphotic muddy sediment dominated by Baltic tellin (*Macoma balthica*)' (AB.H3L1) 'Baltic aphotic muddy sediment dominated by ocean quahog (*Arctica islandica*)' (AB.H3L3), and 'Baltic aphotic muddy sediment dominated by *Astarte* spp.' (AB.H3L5).

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

Yes

Regions
Baltic

Justification
Common and widespread especially in inner coastal waters (bays, lagoons, estuaries) of the Baltic Sea.

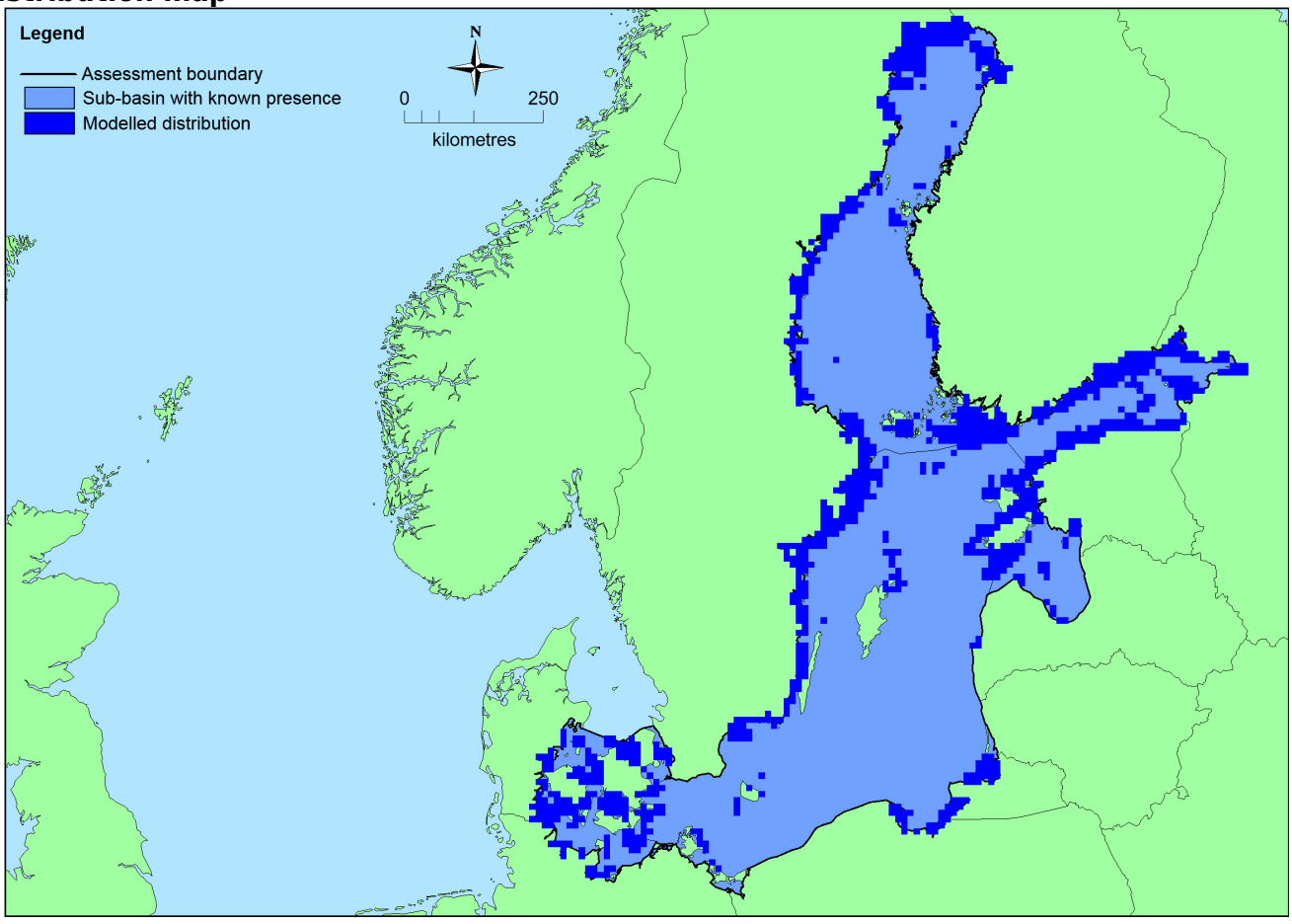
Geographic occurrence and trends

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	Decreasing

Extent of Occurrence, Area of Occupancy and habitat area

	Extent of Occurrence (EOO)	Area of Occupancy (AOO)	Current estimated Total Area	Comment
EU 28	Unknown Km^2	Unknown	Unknown Km^2	This habitat is present in all the Baltic sub-basins however there is insufficient information for accurate calculation of EOO and AOO.
EU 28+	Unknown Km^2	Unknown	Unknown Km^2	This habitat is present in all the Baltic sub-basins however there is insufficient information for accurate calculation of EOO and AOO.

Distribution map



There is insufficient data to provide a comprehensive 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). This means it indicates potential areas in which this habitat

may occur, not the actual distribution of this EUNIS level 4 habitat. EOO and AOO cannot be calculated at the present time, although the habitat is known to occur in all the Baltic Sea sub-basins.

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

This habitat occurs in the EU28+ (Russia). The percentage hosted by EU28 is therefore less than 100% but there is insufficient information to establish the proportion. Similar habitats may occur in other European Regional Seas.

Trends in quantity

This habitat is common throughout the Baltic Sea mainly represented by areas dominated by Baltic tellin (*Macoma baltica*). The biotopes AA.H3L8 'Baltic photic muddy sediment dominated by *Abra* spp.' and AA.H3L3 'Baltic photic muddy sediment dominated by ocean quahog (*Arctica islandica*)' are only present in the Belt Sea. AA.H3L6 'Baltic photic muddy sediment dominated by *Unionidae*' is restricted to oligohaline lagoons, bays and estuaries and the northern most part of the Bothnian Sea. The location of some of the associated biotopes has been mapped by HELCOM but there is a lack of comprehensive quantitative data on which to determine the current extent of this habitat. Infralittoral muddy sediment dominated by ocean quahog (*Arctica islandica*)' or by *Unionidae*' are believed to have declined by 25-30% over the last 50 years.There is insufficient information on which to determine any historical trends. No future trends have been estimated.

- 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 so 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 so does not have a small natural range.

Trends in quality

In 2002 and 8-10 week period of low bottom water oxygen concentrations changed benthic faunal diversity and composition in an area of several thousand square kilometers in the southern Baltic including parts of this habitat in The Sound and Arkona Basin.

Areas of muddy sediment dominated by ocean quahog (*Arctica islandica*) are estimated to have shown a severe decline in quality in around 10% of the area in which it occurs.

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

Pressures and threats

Eutrophication is considered to have been the main pressure on this habitat while pressures associated with climate change are considered to be a likely future threat. In areas dominated by *Arctica islandica* long lasting and frequent periods of oxygen depletion have caused mortality. Due to the slow population growth rate, the recovery of declined populations is slow, and therefore communities characterised by *Arctica islandica* have been replaced by communities consisting of short living polychaetes., Another pressure resulting from eutrophication is increasing the particle concentration in impeding the filter-

feeding of the *Unionidae* mussels.The alien species zebra mussel (*Dreissena polymorpha)* is also thought to pose threat to this habitat. It is a non-native species which was already established in the Baltic Sea in the 19th century as a result of the construction of canals in Europe. It originates from the Ponto-Caspian region and was first reported from the south-eastern Baltic lagoons and estuaries in 1825. The spread of the species is restricted by salinity and temperature as it cannot survive freezing. In the Gulf of Finland the recruitment success of new larvae is only possible during more favourable warmer years with Unionidae shells providing hard substratum for the settlement of zebra mussel juveniles. The overgrowth of Unionidae mussels by *D. polymorpha* impairs their filter-feeding, burrowing and movement along the sediment surface. Evidence of local Unionidae extinction due to a *D. polymorhpa* invasion has been found in other parts of the world (e.g. Belarus lakes, North American Great Lakes and the Mississippi River).

List of pressures and threats

Biological resource use other than agriculture & forestry

Fishing and harvesting aquatic resources
Professional active fishing
Benthic or demersal trawling
Benthic dredging

Pollution

Pollution to surface waters (limnic, terrestrial, marine & brackish)
Nutrient enrichment (N, P, organic matter)

Natural System modifications

Siltation rate changes, dumping, depositing of dredged deposits

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 that reduce the level of eutrophication in the Baltic Sea will benefit this habitat.These actions include measures to reduce the diffuse run off of nutrients from agriculture and tackling point source pollution by installation of waste water treatment plants. Some consecutive years when the oxygen level remains at a good level is needed for the recruitment to be successful.

List of conservation and management needs

Measures related to wetland, freshwater and coastal habitats

Restoring/Improving water quality

Measures related to spatial planning

Establish protected areas/sites
Legal protection of habitats and species

Measures related to hunting, taking and fishing and species management

Regulation/Management of fishery in marine and brackish systems

Conservation status

Annex 1-type:

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.H3L3 and AA.H3L8 as LT(A1) and AA.H3L3 and AA.H3L6 as NT(A1).

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

The most threatened biotopes, those dominated by ocean quahog (*Arctica islandica*) and Unionidae are characterised by species with a slow growth rate and a life span >>50 years so natural recovery times to re-establish communities with mixed age populations of this species are likely to be substantial.

Adult individuals of *Arctica islandica* can tolerate periods of anoxia by burrowing deeper into the sediment and remaining inactive. The larvae settling on the surface and younger specimens have not got this potential. *Astarte borealis* is resistant to anoxic conditions, however recurring and long lasting anoxia is fatal

Effort required

50+ years
Naturally

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 %

This habitat occurs in all the Baltic sub-basins. There has been a decline in quantity of some the associated biotopes dominated by the infaunal bivalve *Arctica islandica* and *Unionidae* with an estimated overall decline of >25%. This habitat has therefore been assessed as Near Threatened under Criterion A.

Criterion B: Restricted geographic distribution

Criterion B	B1				B2				B3
	EOO	a	b	c	AOO	a	b	c	
EU 28	>50,000 Km^2	Unknown	Unknown	unknown	unknown	Unknown	Unknown	unknown	unknown
EU 28+	>50,000 Km^2	Unknown	Unknown	unknown	unknown	Unknown	Unknown	unknown	unknown

This habitat occurs in all the Baltic sub-basins therefore the EOO is likely to exceed 50,000km^2. HELCOM have mapped the presence of some of the associated biotopes but there is insufficient information on which to calculate area of this habitat across the Baltic or accurately calculate EOO and AOO.

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 however experts considered there to be insufficient data on which to assess 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 that estimates 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	VU	LC	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	LC	DD
EU28+	NT	DD	DD	DD	LC	DD	DD	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

Overall Category & Criteria			
Near Threatened	A1	Near Threatened	A1

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

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Reviewers
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References

Conley, D.J. Carstensen, J., Ertebjerg, G. et al. 2007 Long-term changes and impacts of hypoxia in Danish coastal waters. *Ecological Applications* 17(5): 165-184.

Gic-Grusza, C., Kryla-Straszewska, K., Urbański, J., Warzocha, J., & 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.

Gogina, M., Zettler, M.L. 2010. Diversity and distribution of benthic macrofauna in the Baltic Sea: Data inventory and its use for species distribution modelling and prediction. *Journal of Sea Research* 64(3): 313–321.

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

Krzymińska, J., 2000. Bivalves in surface deposits of the Southern Baltic. *Folia Malacologica* 8(1): 95-100.

Morton, B. 2011. The biology and functional morphology of Arctica islandica (Bivalvia: Arcticidae): A gerontophilic living fossil. *Marine Biology Research* 7: 540–553.

OSPAR. 2009. OSPAR Background for Ocean quahog Arctica islandica. Biodiversity Series. http://qsr2010.ospar.org/media/assessments/Species/P00407_Ocean_quahog.pdf

Trutschelt, K., Samtleben, C. 1988. Shell growth of Astarte elliptica (Bivalvia) from Kiel Bay (Western Baltic Sea). *Marine Ecology progress Series* 42: 155-162.

Zettler, M. L., Bönsch, R., Gosselck, F. 2001. Distribution, abundance and some population characteristics of the ocean quahog, Arctica islandica (Linnaeus, 1767), in the Mecklenburg Bight (Baltic Sea). *Journal of Shellfish Research* 20: 161– 169.

Zettler, M. 2002. Ecological and morphological features of the bivalve Astarte borealis (Schumacher 1817) in the Baltic Sea near its geographical range. *Journal of Shellfish Research* 21: 33-40.