Infaunal communities of Baltic upper circalittoral muddy sediment dominated by bivalves

Summary

This habitat occurs across the Baltic although some of the associated biotopes are only present in some of the sub-basins. For example areas dominated by ocean quahog (*Arctica islandica)* are only present in the Belt Sea and those dominated by *Astarte* spp. are only found in the southern and western Baltic.

Eutrophication is one of the major threats to this habitat because it can result in long lasting and frequent periods of oxygen depletion at the seabed. Even though resistant to anoxic conditions, longer and repetitive periods can kill or diminish species that characterise this habitat such as *Arctica islandica.* Actions to reduce the level of eutrophication in order to increase the oxygen level on the deep muddy bottoms are urgently needed. Climate change is considered to be a future threat because of likely resulting changes in salinity.

Synthesis

The presence of this habitat type in the Baltic is well established and it is known to occur in all the sub-basins. There have been declines in extent over the last 50 years particularly where *Astarte* spp. and *Arctica islandica* dominate (by more than 50% and an estimated 20%, respectively). Further reduction in quantity is predicted (more than 80% in the next decades in the case of areas dominated by *A. islandica*). Habitat quality is also considered to have declined over the last 50 years.

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 biotope AB.H3L1, Baltic aphotic muddy sediment dominated by Baltic tellin as Least Concern (A1), AB.H3L3, Baltic aphotic muddy sediment dominated by ocean quahog as Critically Endangered (A2) and the biotope AB.H3L5, Baltic aphotic muddy sediment dominated by *Astarte* spp as Endangered (A1). Given the past and predicted future decline in extent of this habitat, differences in vulnerability to anoxic conditions between the associated biotopes and some envisaged decline in quality of all the associated biotopes current expert opinion is that this habitat should be assessed as Vulnerable (A1) for 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
Vulnerable	A1	Vulnerable	A1

Sub-habitat types that may require further examination

AB.H3L3 Baltic aphotic muddy sediment dominated by ocean quahog (*Arctica islandica*).

AB.H3L5 Baltic aphotic muddy sediment dominated by *Astarte* spp.

Habitat Type

Code and name

Infaunal communities of Baltic upper circalittoral muddy sediment dominated by bivalves

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

Habitat description

This habitat occurs on Baltic Sea aphotic bottoms with at least 90% coverage of muddy sediment according to the HELCOM HUB classification. Sessile/semi-sessile epibenthic macrofauna is not present and the biomass of infaunal bivalves dominates. The habitat generally occurs below a depth of approximately 20 m in locations of energy exposure. Three associated biotopes have been identified with different species of bivalves dominating (more than 50% of the biomass). These are: '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). These biotopes have slightly different distributions in the Baltic because of different temperature and salinity preferences of the associated dominating species. For example as an arctic-boreal species, *Astarte borealis* appears in these Baltic biotopes at its southern limit. It is resistant to anoxic conditions, however recurring and long lasting anoxia is fatal.The biotope dominated by the ocean quahog (*Arctica islandica*) can only be found in the southwestern parts in the Belt Sea where the salinity is high. Compared to shallow bottoms, the deep muddy bottoms are structurally relatively monotonous therefore the large shells of *Arctica islandica* increase the complexity of the habitat. It plays an important role as a biomass producer, enhancer of benthopelagic coupling, reducer of water turbidity, and ecosystem engineer as well as being among the longest-lived and slowest growing marine bivalves.

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 and, in the case biotopes dominated by *M. baltica,* the presence of a full size range of individuals in the population.

Characteristic species: *Macoma balthica*, *Arctica islandica*, *Astarte* spp.

Classification

EUNIS:

The closest correspondence in EUNIS (2004) level 4 is A5.41 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.

Level 6 of the HELCOM HUB classification;

'Baltic aphotic muddy sediment dominated by Baltic tellin (*Macoma balthica*)' (AB.H3L1)

'Baltic aphotic muddy sediment dominated by ocean quahog (*Arctica islandica*)' (AB.H3L3)

'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
A common, widespread, typical habitat of Baltic soft bottoms.

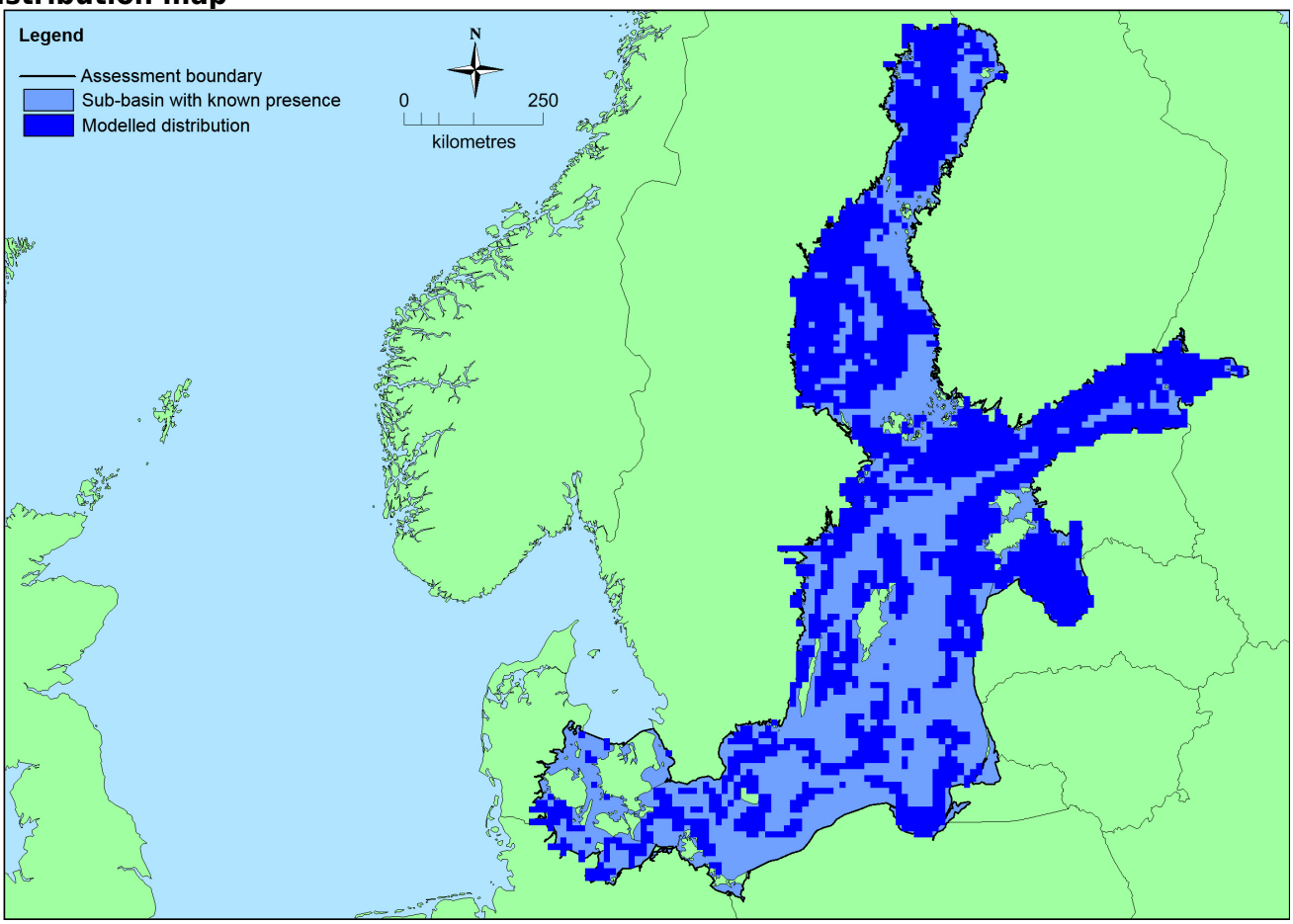
Geographic occurrence and trends

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	>50,000 Km^2	Unknown	Unknown Km^2	This habitat is present in all the Baltic sub-basins therefore EOO is likely to exceed 50,000km2
EU 28+	>50,000 Km^2	Unknown	Unknown Km^2	This habitat is present in all the Baltic sub-basins therefore EOO is likely to exceed 50,000km2

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). This means that 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 has declined in extent. Areas of aphotic muddy sediment dominated by ocean quahog (*Arctica islandica*) are believed to have declined by 20% over the last 50 years and those dominated by *Astarte* spp. to have declined by at least 50%. There are no signs of decline in areas dominated by the Baltic tellin (*Macoma baltica*).

The biotope dominated by ocean quahog (*Arctica islandica*) is expected to be reduced by more than 80% in the next decades. No estimation of future trends for the other associated biotopes have been made.

- 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
  Not overall although the biotope dominated by *Astarte* spp. has a small range following regression.
- Does the habitat have a small natural range by reason of its intrinsically restricted area?
  No
  Justification
  Not overall although the biotope dominated by *Astarte* spp. has a small range following regression.

Trends in quality

The biotope dominated by ocean quahog *(Arctica islandica*) has shown an intermediate decline in quality in 50% of the area. There has been an increase in biomass of some of the sub-habitats, associated with eutrophication during the 1980s. For example a high biomass of molluscs was recorded in The Sound between late 1980s and early 1990s but since then biomass has reduced. In contrast biomass of polychaetes has steadily increased.

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

Pressures and threats

Eutrophication is considered to be the major anthropogenic threat to this habitat. Long lasting and frequent periods of oxygen depletion have caused mortality of *Arctica islandica* populations. Due to the slow population growth rate, the recovery of declined populations is slow, and therefore communities characterized by *Arctica islandica* have been replaced by communities consisting of short lived polychaetes. No successful spawning of *Arctica islandica* has occurred in the in the muddy areas of Mecklenburg and the Kiel Bight during the last decades. In sampling carried out during the early summer of 2013 in German areas, a lot of tiny 1-2 mm small *Arctica islandica* were observed in the shallow sandy areas, but none in the mud. Even if the larvae were able to settle, they are apparently killed by the recurring oxygen depletion in the summer. Demersal fisheries may also impact this habitat by damaging

and removing bivalves from the sediment.

Climate change is considered to be a future threat because of predicted changes in salinity and therefore the survivability of species characteristic of some of the associated biotopes.

List of pressures and threats

Biological resource use other than agriculture & forestry

Fishing and harvesting aquatic resources
Professional active fishing

Pollution

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

Climate change

Changes in abiotic conditions
Temperature changes (e.g. rise of temperature & extremes)

Conservation and management

The main anthropogenic threat of the habitat is eutrophication and the anoxia of the bottoms that follows. Even for species such as *Astarte borealis* which are resistant to anoxic conditions, longer and repetitive periods can cause mortality.

Action to reduce the level of eutrophication, which will benefit oxygen levels on the deep muddy bottoms, is urgently needed because successful recruitment of the characteristic bivalves requires a few consecutive years of good oxygen levels. Restricting bottom trawling in the areas where this habitat occurs may also improve the potential of the *Arctica islandica* to recolonize the seabed.

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

Measures related to hunting, taking and fishing and species management

Regulation/Management of fishery in marine and brackish systems

Conservation status

Annex 1:

1130: MBAL U2

1160: MBAL U2

1650: MBAL U2

HELCOM (2013) assessments:

1130 CR C1

1160 VU C1

1650 VU C1

HELCOM (2013) have assessed AB.H3L1 as LC(A1), AB.H3L3 as CR A2 and AB.H3L5 as EN (A1).

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

In areas dominated by the ocean quahog (*Arctica islandica*) recovery is likely to take many decades because of the long generation time of this species. No information exists on likely recovery rates for the other associated biotopes

Effort required

50+ years	200+ years
Naturally	Naturally

Red List Assessment

Criterion A: Reduction in quantity

Criterion A	A1	A2a	A2b	A3
EU 28	30-50 %	unknown %	unknown %	unknown %
EU 28+	30-50 %	unknown %	unknown %	unknown %

There have been declines in the extent of the habitat in the last 50 years particularly where *Astarte* spp. and *Arctica islandica* dominate (more than 50% and an estimated 20%, respectively). Further reduction in quantity of more than 80% in the next decades has been predicted in the case of areas dominated by *A. islandica*. The overall decline is considered to have been between 30-50% This habitat has therefore been assessed as Vulnerable under Criteria A for both 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	Yes	unknown	unknown	Yes	Yes	unknown	unknown
EU 28+	>50,000 Km^2	Yes	Yes	unknown	unknown	Yes	Yes	unknown	unknown

This habitat is found in all the Baltic sub-basins therefore EOO exceeds 50,000 km^2 however with no quantitative data on habitat extent or area, accurate calculation of EOO and AOO is not possible at the present time. Further reduction in quantity is predicted (more than 80% in the next decades in the case of areas dominated by *A. islandica*). This habitat has been assessed as Least Concern under criteria B1a and B1b and Data Deficient for all other criteria. OVerall it is considered to be Data Deficient.

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 has been a reduction in quality of this habitat over the last 50 years but there are 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	VU	DD	DD	DD	LC	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD
EU28+	VU	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
Vulnerable	A1	Vulnerable	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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Contributors
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Reviewers
G. Sanders.

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References

Bergstrom, L., Diekmann, R., Flinkman, J. *et al*. 2010. Integrated ecosystem assessments of seven Baltic sea areas covering the last three decades. ICES cooperative research report 302.

Brey, T., Arntz, W.E., Pauly, D. & Rumohr, H. 1990. *Arctica* (Cyprina) *islandica* in Kiel Bay (Western Baltic): growth, production and ecological significance. *J. Exp. Mar. Bio. Ecol.* 136: 217-235.

Carstensen, J., Andersen, J.H., Gustafsson, B.G. & Conley, D.J. 2013. Deoxygenation of the Baltic Sea during the last century. *PNAS* 111(5): 5628-5633.

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

Gogina, M., Glockzin, M. & Zettler, M.L. 2010. Distribution of benthic macrofaunal communties in the western Baltic sea with regard to near-bottom environmental parameters. *J. Marine Systems* 80: 57-70.

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. Biotope information sheet; Baltic aphotic muddy sediment dominated by ocean quahog (*Arctica islandica*) AB.H3L3.

Karlson, K, Rosenberg, R. & Bonsdorf, E. 2002. Temporal and spatial large-scale effects of eutrophication and oxygen deficiency on benthic fauna in Scandinavian and Baltic waters - a review. *Oceanography & Marine Biology: An Annual Review* 40: 427-489.

Kotta, J., Kotta, I., Martin, G. & Kukk, H. 1998. A survey of data published on the littoral zoobenthos of the Gulf of Riga. *Proc. Estonian Acad. Sci. Biol. Ecol* 47(2): 83-97.

Kotta, J. & Olafsson, E. 2003. Competition for food between the introduced polychaete *Marenzelleria viridis* (Verrill) and the native amphipod *Monoporeia affinis* Lindstrom in the Baltic Sea. *Journal of Sea Research* 50: 27-35.

Krause, J. Ch. 2000. Der Einfluss von Sand- und Kiesabbau auf bestandsgefährdete Makrofauna - Populationen in der südlichen Ostsee. PhD thesis, University of Rostock.

Moen, F. E. & Svensen, E. 2004. Marine fish & invertebrates of Northern Europe. KOM, Kristiansund. 608pp.

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.