A5.32 Estuarine Atlantic sublittoral mud

Summary

This habitat consists of shallow sublittoral muds, extending from the extreme lower shore into the subtidal in variable salinity (estuarine) conditions, typically in the range of 18-35ppt and depths to 10 m. Turbidity and the mobility of the sediment are important influences on the associated marine communities which may be impoverished where this is high.

The most significant pressures and threats that the habitat faces include substratum loss, mainly deriving from activities such as coastal protection, barrages, impoundment and dredging. These activities could also change the abiotic conditions of the habitat such as wave exposure and water flow. Additionally, synthetic compound contamination would cause a decline in some characteristic species of the habitat, which are very intolerant to such toxic substances. Nutrient enrichment/eutrophication has been a major pressures on estuarine habitats, including sublittoral muds. Whilst this may increase the food supply to the benthos it can also lead to changes in species composition and numbers, increased biomass, changes in community structure and an impoverishment of benthic communities due to anoxia.

Conservation and management schemes to benefit estuarine habitats have been applied at a number of scales ranging from whole estuary systems to small areas within an estuary. They include the removal of dykes, and water quality improvement programmes to reduce the risk of toxic contamination or nutrient inputs leading to eutrophication. Furthermore, spatial management, including zoning of activities as part of Integrated Coastal Zone Management Schemes and Marine Protected Areas, that cover the entire estuary complex, as well as water quality throughout the watershed.

Synthesis

Survey information confirms that this habitat has a widespread distribution in the North East Atlantic. The precise extent is unknown however as EOO >50,000km^2 and AOO >50, this exceeds the thresholds for a threatened category on the basis of restricted geographic distribution.

There is a lack of data on trends, however this habitat has been assessed as Near Threatened for the EU 28 and EU 28+ because of historical reductions in quality which are believed to have been fairly substantial. The main threats continue, although probably to a lesser extent, and there have been improvements in water quality which may have facilitated some recovery but there is insufficient information to predict future trends.

Overall Category & Criteria			
EU 28		EU 28+	
Red List Category	Red List Criteria	Red List Category	Red List Criteria
Near Threatened	C/D1, C/D3	Near Threatened	C/D1, C/D3

Sub-habitat types that may require further examination

None.

Habitat Type

Code and name

A5.32 Estuarine Atlantic sublittoral mud

No characteristic photograph of this habitat currently available.

Habitat description

This habitat comprises shallow sublittoral muds, extending from the extreme lower shore into the subtidal in variable salinity (estuarine) conditions, typically in the range of 18-35ppt and extending to a depth of 10 m. The habitat is found within estuaries which are naturally highly dynamic and rapidly changing systems, forming a complex mixture of many different habitat types. These habitats do not exist in isolation, but rather have physical, chemical and biological links between them, for example in their hydrology, in sediment transport, in the transfer of nutrients and in the way mobile species move between them both seasonally and during single tidal cycles.

Turbidity and the mobility of the sediment are important influences on the associated marine communities which may be impoverished where this is high. There are typically fewer macrobenthic speices than in fully marine areas but potentially with a high abundance and biomass. Such habitats typically support communities characterised by oligochaetes, and polychaetes and have a dominance of deposit feeders. In lowered salinity conditions the sediments may include a proportion of coarser material, where the silt content is sufficient to yield a similar community to that found in more heterogeneous muds. Migratory flatfish such as plaice, dab and sole move in to estuaries to feed in these habtiats.

Indicators of Quality:

Long term studies of many estuaries typically focusing on the physical, biological and chemical characteristics. Indicators of quality of this habitat are frequently linked to those for the whole estuarine environment and therefore include morphological and physical characteristics, carrying capacity and water quality parameters. For the specific habitat, benthic indices, contaminant levels and productivity are some of the frequently used measures of quality.

Indices developed to assess the ecological status of coastal waters, including estuaries, according to the Water Framework Directive, include physical indicators, water quality indicators and measures of benthic diversity, species richness and abundance. The latter group, which is particularly relevant to benthic habitats, includes a Benthic Quality Index, an Infaunal Trophic Index, a Marine Biotic index based on ecological groups, and the Benthic Opportunistic Polychaetes/Amphipods Index.

Characteristic species:

Species that are typically found in this habitat vary depending on sediment characteristics. For example in locations where there is firm mud or clay *Polydora ciliata* and *Corophium volutator*, in muddy sediment *Aphelochaeta marioni, Nephtys hombergii, Capitella capitata* and *Tubificoides* spp.. Salinity is also a factor with *Limnodrilus hoffmeisteri, Tubifex tubifex* and *Gammarus* spp. present in low salinity infralittoral muddy sediment and oligochaetes in variable or reduced salinity.

Classification

EUNIS (v1405):

Level 4. A sub-habitat of 'Atlantic shallow/infralittoral mud' (A5.3).

Annex 1:

1130 Estuaries

MAES:

Marine - Marine inlets and transitional waters

Marine - Coastal

MSFD:

Shallow sublittoral mud

EUSeaMap:

Shallow mud

IUCN:

9.6 Subtidal muddy

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

<u>Regions</u>
Atlantic

<u>Justification</u>
Estuaries are a characteristic coastal habitat of the North East Atlantic. They are present in all the sub-basins of this regional sea, except for Macaronesia, and are common because of the numerous rivers which discharge to the sea in a region where there is a significant tidal range (over 12 m). The sublittoral areas are predominantly muddy sediments although there may be areas with sands and gravel and occasional rocky outcrops.

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)
North-East Atlantic	Bay of Biscay and the Iberian Coast: Present Celtic Seas: Present Greater North Sea: Present Kattegat: 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	1,999,917 Km^2	187	Unknown Km^2	EOO and AOO have been calculated on the available data. Although this data set is known to be incomplete the figures exceed the thresholds for threatened status.
EU 28+	>1,999,917 Km^2	>187	Unknown Km^2	EOO and AOO have been calculated on the available data. Although this data set is known to be incomplete the figures exceed the thresholds for threatened status.

Distribution map
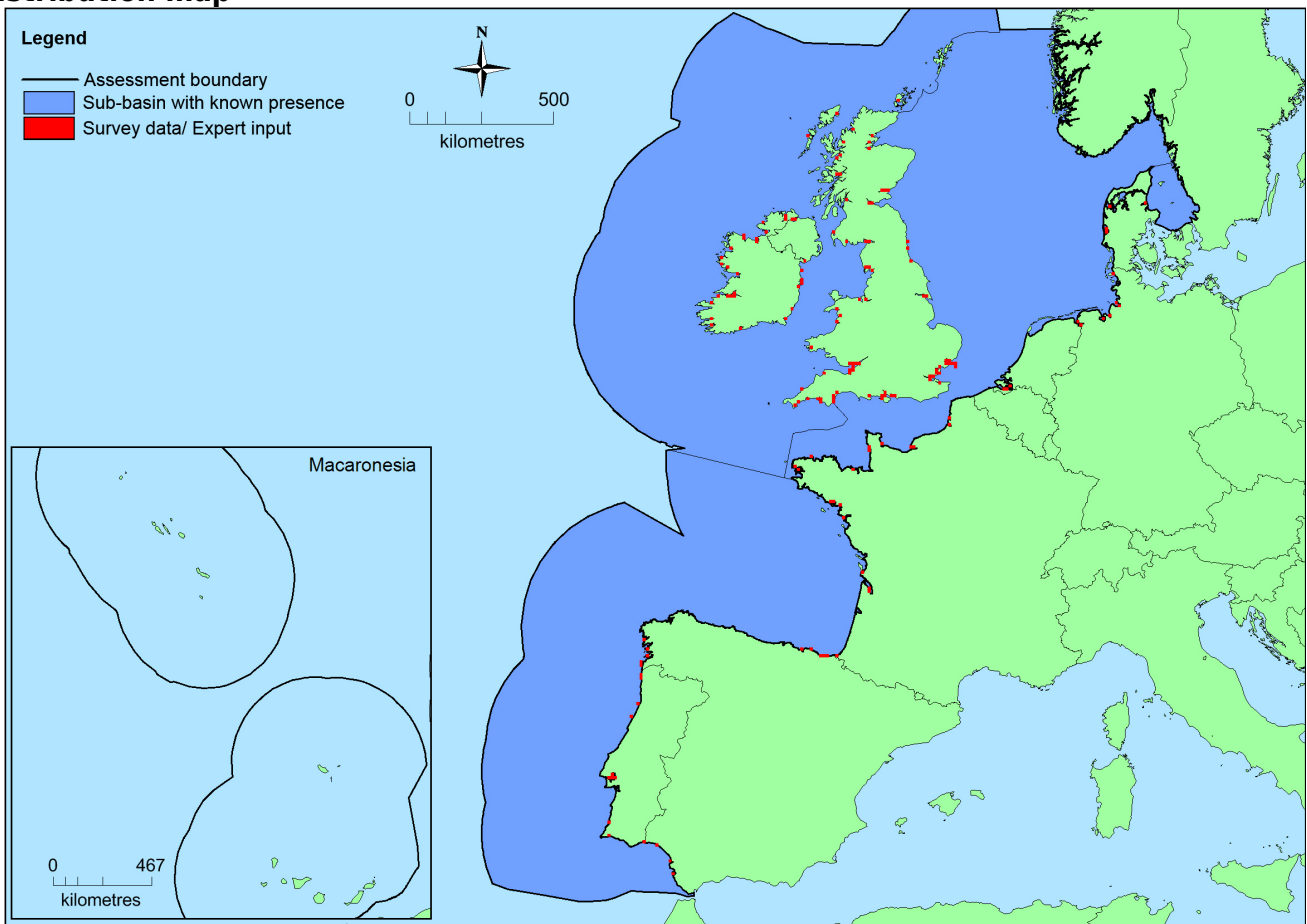
There are insufficient data to provide a comprehensive and accurate map of the distribution of this habitat. This map has been generated using EMODnet data from modelled/surveyed records for the North East Atlantic (and supplemented with expert opinion where applicable) (EMODnet 2010). EOO and AOO have been calculated on the available data presented in this map however these should be treated with caution as expert opinion is that this is not the full distribution of the habitat .

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

There is insufficient information to calculate an exact proportion but as the majority of this habitat is within the EU 28, it is estimated to be of the order of 90%.

Trends in quantity

The habitat is very dynamic and some smaller yearly changes in area may be expected. Historically there have been dramatic changes in the extent of estuaries and their associated habitats with significant permanent loss, for example, as a result of the conversion of flood plains into polders in Germany and the Netherlands. Land claim has also been widespread, cumulative and piecemeal in the UK where it has affected at least 85% of British estuaries. Whilst the main areas affected have been intertidal, the loss of sublittoral estuarine mud habitat has also taken place. Impoundements in the Netherlands as part of the Delta works are well known examples and include the loss of the Grevelingen estuary which has been converted into an artificial brackish lagoon. Channel maintenance works, such as dykes, dredging and dredge spoil disposal continue to result in more piecemeal and localised reductions in the extent of this habitat. Because of these smaller scale continuing changes the current trend is considered to be decreasing.

- 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 has a large natural range in the North East Atlantic region with examples as far south as the Atlantic coast of southern Spain, along the western coasts of Ireland, around the British Isles, and on the mainland of northern Europe in France, Belgium, The Netherlands, Germany and Denmark. Within this range the habitat the habitat is limited naturally to the transition area between river mouths and the sea.
- Does the habitat have a small natural range by reason of its intrinsically restricted area?
  No
  Justification
  This habitat has a large natural range in the North East Atlantic region with examples as far south as the Atlantic coast of southern Spain, along the western coasts of Ireland, around the British Isles, and on the mainland of northern Europe in France, Belgium, The Netherlands, Germany and Denmark. Within this range the habitat the habitat is limited naturally to the transition area between river mouths and the sea.

Trends in quality

Long term studies of many estuaries typical focus on the physical, biological and chemical characteristics. In Germany the physcial changes are on such a scale that they are estimated to have affected over 90% of the habitat to the extent where a "natural" hydrographic regime no longer exists for German North Sea estuaries. Many estuaries have also had a long history of receiving pollutants and conseqeuntly have suffered a significant historical decline in quality.

Nutrient loads have affected the quality of sublittoral communities in estuaries and although nutrient inputs have may have declined, the recovery of the habitat is not clear cut. For example in the 1980s Danish coastal waters suffered severe nutrient enrichment. Following reductions in nutrient inputs there remained substantial inter-annual variations in benthic macrofaunal biomass but over a period of 25 years, a decrease in filter feeders and increase in deposit feeders the latter appearing to have benefitted from the increasing stratification, despite an overall decrease of food availability. Hypoxia and anoxic events may still occur especially during warm and calm summer months.

Channel management practicies such as dredging to deepen access to ports within estuaries, and stabilisation with dykes are also known to affected the quality of this habitat but changing the sediment characteristics as well as the associated species. This is one of the consequence of changing the regime from conditions of low physical sress to highly dynamic areas with increased current flow. Regular dredging also alters the infauna communities.

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

Pressures and threats

This habitat is sensitive to substratum loss, mainly deriving from activities such as coastal protection, barrages, impoundment dredging and spoil disposal. Apart from direct habitat removal there can be indirect effects, through changes in sediment and hydrological regimes. In addition, dredging may increase water flow rate and wave exposure, which in turn will alter the sediment granulometric characteristics, washing away fine silts and muds, resulting in a possible change in community structure. Coastal construction and coast protection works can also cause an increase in water flow rate leading shifts in infaunal community structure.

Many estuaries in the North East Atlantic have had a long history of receiving pollution for example as effluents from heavy industry.The combination of fine sediments and estuarine salinity gradients produce favourable conditions for the binding, deposition and accumulation of toxic contaminants within the muddy substrate. An accumulation of discharged toxic compounds, together with hydrocarbon contamination incidents, such as oil spills, can therefore have significant impacts on this habitat type, either immediately or by remobilisation after storms, dredging or changes in currents. Some oligochaete and polychaete species may be particularly susceptible to synthetic chemicals that bind to sediments, thus synthetic compound contamination would cause a decline in species richness.

Nutrient enrichment/eutrophication has been a major pressures on estuarine habitats, including sublittoral muds. Whilst this may increase the food supply to the benthos it can also lead to changes in species composition and numbers, increased biomass, a shift from k-selected to r-selected species, shifts in functional groups, changes in community structure and an impoverishment of benthic communities due to anoxia.

List of pressures and threats

Urbanisation, residential and commercial development

Discharges
  Disposal of household / Recreational facility waste
  Disposal of industrial waste
  Water discharges (with/without contaminants)

Pollution

Pollution to surface waters (limnic, terrestrial, marine & brackish)
  Pollution to surface waters by industrial plants
  Pollution to surface waters by storm overflows
  Diffuse pollution to surface waters via storm overflows or urban run-off
  Diffuse pollution to surface waters due to household sewage and waste waters
  Input of contaminants (synthetic substances, non-synthetic substances, radionuclides) - diffuse sources, point sources, acute events
Marine water pollution
  Toxic chemical discharge from material dumped at sea
  Non-synthetic compound contamination
  Synthetic compound contamination

Natural System modifications

Human induced changes in hydraulic conditions
  Removal of sediments (mud...)
  Estuarine and coastal dredging
  Change of sea-floor substrate
  Modification of hydrographic functioning, general
  Wave exposure changes
  Alteration of sea-floor/ Water body morphology
  Siltation rate changes, dumping, depositing of dredged deposits
  Dumping, depositing of dredged deposits
  Other siltation rate changes
  Dykes, embankments, artificial beaches, general
  Sea defense or coast protection works, tidal barrages
  Dykes and flooding defense in inland water systems

Climate change

Changes in abiotic conditions
Water flow changes (limnic, tidal and oceanic)
Wave exposure changes
Sea-level changes

Conservation and management

Conservation and management schemes to benefit estuarine habitats have been applied at a number of scales ranging from whole estuary systems to small areas within an estuary. They include the removal of dykes, and water quality improvement programmes to reduce the risk of toxic contamination and to reduce nutrient inputs leading to eutrophication.

Spatial management including zoning of activities as part of Integrated Coastal Zone Management Schemes and Marine Protected Areas that cover the entire estuary complex, as well as management of water quality throughout the watershed, are beneficial.

List of conservation and management needs

Measures related to wetland, freshwater and coastal habitats

Restoring/Improving water quality
Restoring/Improving the hydrological regime

Measures related to spatial planning

Establish protected areas/sites

Measures related to urban areas, industry, energy and transport

Urban and industrial waste management

Conservation status

Annex 1:

1130: MATL U2

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

The capacity for this habitat to recover once severely damaged is unknown.

Effort required

Red List Assessment

Criterion A: Reduction in quantity

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

There has been historical loss of the quantity of this habitat associated with land claim works, dredging and dyke construction on estuaries however the extent to which this has occurred cannot be quantified. This habitat is therefore assessed as Data Deficient under criteria 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	No	>50	Unknown	Unknown	No	No
EU 28+	>50,000 Km^2	Unknown	Unknown	No	>50	Unknown	Unknown	No	No

TThis habitat has a large natural range in the North East Atlantic region. The precise extent is unknown however as EOO >50,000km^2 and AOO >50, this exceeds the thresholds for a threatened category on the basis of restricted geographic distribution. Trends are unknown. The distribution of the habitat is such that the identified threats are unlikely to affect all localities at once. This habitat has therefore been assessed as Least Concern under criteria B1(c) B2 (c) and B3 and Data Deficient for all other criteria.

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 %	fairly substantial %	unknown %	unknown %	unknown %	fairly substantial %
EU 28+	unknown %	fairly substantial %	unknown %	unknown %	unknown %	fairly substantial %

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 historical decline in quality of this habitat associated with nutrient enrichment, and chemical contamination of sediments in estuaries. The scale of this is difficult to quantify however expert opinion is this is likely to have been fairly substantial. This habitat has therefore been assessed as Near Threatened under criteria C/D1, C/D3 for both the EU 28 and EU 28+.

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	DD	DD	DD	DD	LC	LC	LC	NT	DD	NT	DD	DD	DD	DD	DD	DD	DD
EU28+	DD	DD	DD	DD	LC	LC	LC	NT	DD	NT	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
Near Threatened	C/D1, C/D3	Near Threatened	C/D1, C/D3

Confidence in the assessment

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

Assessors

C. Karamita & G.Saunders.

Contributors

C. Karamita and the North East Atlantic Working Group: S. Gubbay, G. Saunders, H. Tyler-Walters, N. Dankers, F. Otero, J. Forde, K. Fürhaupter, R. Haroun, N. Sanders.

Reviewers

J. Janssen.

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Date of review

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References

Borja, A., Franco, J. & Perez, V 2000. A Marine biotic index to establish the ecological quality of soft-bottom benthos within European estuarine and coastal environments. *Marine Pollution Bulletin.* 40(12):1100-1114.

Conley, D.J., Kass, H., Møhlenberg, F. et al. 2000. Characteristics of Danish Estuaries. *Estuaries*. 23(6):820-837.

Connor, D.W., Allen, J.H., Golding, N. *et al.* 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05 JNCC. [online] Peterborough: ISBN 1 861 07561 8. Availiable at: http://jncc.defra.gov.uk/pdf/04_05_introduction.pdf. (Accessed: 30/08/2014).

European Environment Agency. 2014. EUNIS habitat type hierarchical view. Available at: http://eunis.eea.europa.eu/habitats-code-browser.jsp. (Accessed: 05/01/2016).

MarLIN (Marine Life Information Network). 2015. MarLIN - The Marine Life Information Network. Available at: http://www.marlin.ac.uk/speciesfullreview.php. (Accessed: 18/11/2015).

Meire, P., Ysebaert,, T., van Damme, S. *et al.,* 2005. The Scheldt estuary: a description of a changing ecosystem. Hydrobiologia. 540:1-11.

Muxika, I., Borga, A. & Bald, J. 2007. Using historical data, expert judgement and multivariate analysis in assessing reference conditions and benthic ecological status according to the European Water Framework Directive. *Marine Pollution Bulletin* 55:16-29.

Riemann, B., Carstensen, J., Dahl, K., *et al.,* 2016. Recovery of Danish Coastal Ecosystems after reductions

in nutrient loading: A Holistic Ecosystem Approach. *Estuaries and Coasts*. 39:82–97.