A2.31 Polychaete/ bivalve-dominated mid-estuarine Atlantic littoral mud

Summary

Mudflats are sedimentary intertidal habitats created by deposition in low energy coastal environments, particularly estuaries and other sheltered areas. They are intimately linked by physical processes to, and may be dependent on, other coastal habitats such as saltmarshes. In large estuaries, mudflats may be several kilometres wide and commonly form the largest part of the intertidal area. Mudflats are characterised by high biological productivity and abundance of organisms, particularly infaunal polychaetes, bivalves and oligochaetes. They can also support large numbers of predatory birds and act as nursery areas for flatfish.

Historically land claim has been the most significant pressure on this habitat leading to direct loss of estuarine mudflats. The discharge of toxic substances from industrial facilities and increases in nutrient levels associated with run-off from the land has also been significant with pressures leading to degradation. These pressures continue today although, land claim activities have diminished. Other pressures on this habitat at a variety of scales result from coastal development, bait digging, pollution incidents and oil spills from tanker accidents. Sea-level rise due to climate change is another threat, the likely impact of which is dependent on whether there is scope for intertidal habitats to migrate inland in response to sea level rise.

Conservation and management schemes to benefit this habitat 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, reconnecting sediment supplies and managed retreat to reclaim areas of mudflat drained for agricultural land or allow inland movement of intertidal habitats. Water quality improvement programmes to reduce the risk of toxic contamination or nutrient inputs leading to eutrophication also benefit this habitat.

Synthesis

The majority of this habtiat in the North East Atlantic regional sea is hosted by the EU 28 countries. Historically, estuarine mudflats have suffered considerable declines in extent as a result of human activity. Whilst this no longer takes place on the scale practiced several centuries ago, piecemeal loss of areas of estuarine mudflat continues to occur. Declines in abiotic and biotic quality have also taken place, for example as a result of the discharge of industrial effluents and nutrient enrichment due to run-off from surrounding land, and this remains an issue in some estuaries.

 Because of the very substantial historical loss in quantity of this habitat, expert opinion is that this habitat should be assessed as Endangered 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
Endangered	A3	Endangered	A3

Sub-habitat types that may require further examination

None.

Habitat Type

Code and name

A2.31 Polychaete/ bivalve-dominated mid-estuarine Atlantic littoral mud

Mudflats exposed at low tide in the Severn Estuary, UK (© A.R.Davis).

Habitat description

Mid-estuarine shores of fine sediment, mostly in the silt and clay fraction though sandy mud (mostly very fine and fine sand) can also be a component of the substrate. Littoral mud typically forms extensive mudflats, though dry compacted mud can form steep and even vertical structures, particularly at the top of the shore adjacent to saltmarshes. Little oxygen penetrates these cohesive sediments, and an anoxic layer is often present within millimetres of the sediment surface. Most mid-estuarine muddy shores are subject to some freshwater influence, though at some locations more or less fully marine conditions may prevail. This habitat is mainly found along mid-estuarine shores and supports rich communities characterised by polychaetes, bivalves and oligochaetes. The mid-estuarine communities may also be present in sheltered inlets, straits and embayments which are not part of major estuarine systems, though there is usually some freshwater influence.

Indicators of quality:

Many indicators of quality have been used for this habitat with particular parameters 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. 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 mudflat itself 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:

The infauna is characterised by the polychaetes *Eteone longa, Hediste diversicolor* (ragworm) and *Pygospio elegans*, oligochaetes (mostly *Tubificoides benedii* and *T. pseudogaster*), the crustaceans *Corophium volutator* and *Crangon crangon*, the spire shell *Hydrobia ulvae* and the baltic tellin *Macoma balthica*. The cockle *Cerastoderma edule* may be abundant, and the sand gaper *Mya arenaria* may be superabundant, though these species are not always present, or may be absent in core samples due to their large size. The polychaetes *Arenicola marina, Polydora cornuta* and *Capitella capitata*, the shrimp *Crangon crangon*, and the Mussel *Mytilus edulis* are sometimes present. *Enteromorpha* spp. and *Ulva lactuca* may form mats on the surface of the mud during the summer months, particularly in areas of

nutrient enrichment or where there is significant freshwater influence.

Classification

EUNIS (v1405):

Level 4 of the EUNIS classification. A sub-habitat of 'Atlantic littoral mud' (A2.3).

Annex 1:

1130 Estuaries

MAES:

Marine - Marine inlets and transitional waters.

MSFD:

Littoral Sediment

EUSeaMap:

Not mapped

IUCN:

9.10 Estuaries

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

Regions
Atlantic

Justification
Estuarine mudflats 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). This also enables the development of some very large expanses of estuarine mudflat.

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	Stable	Stable

Extent of Occurrence, Area of Occupancy and habitat area

	Extent of Occurrence (EOO)	Area of Occupancy (AOO)	Current estimated Total Area	Comment
EU 28	630,325 Km^2	201	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+	>630,325 Km^2	>201	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
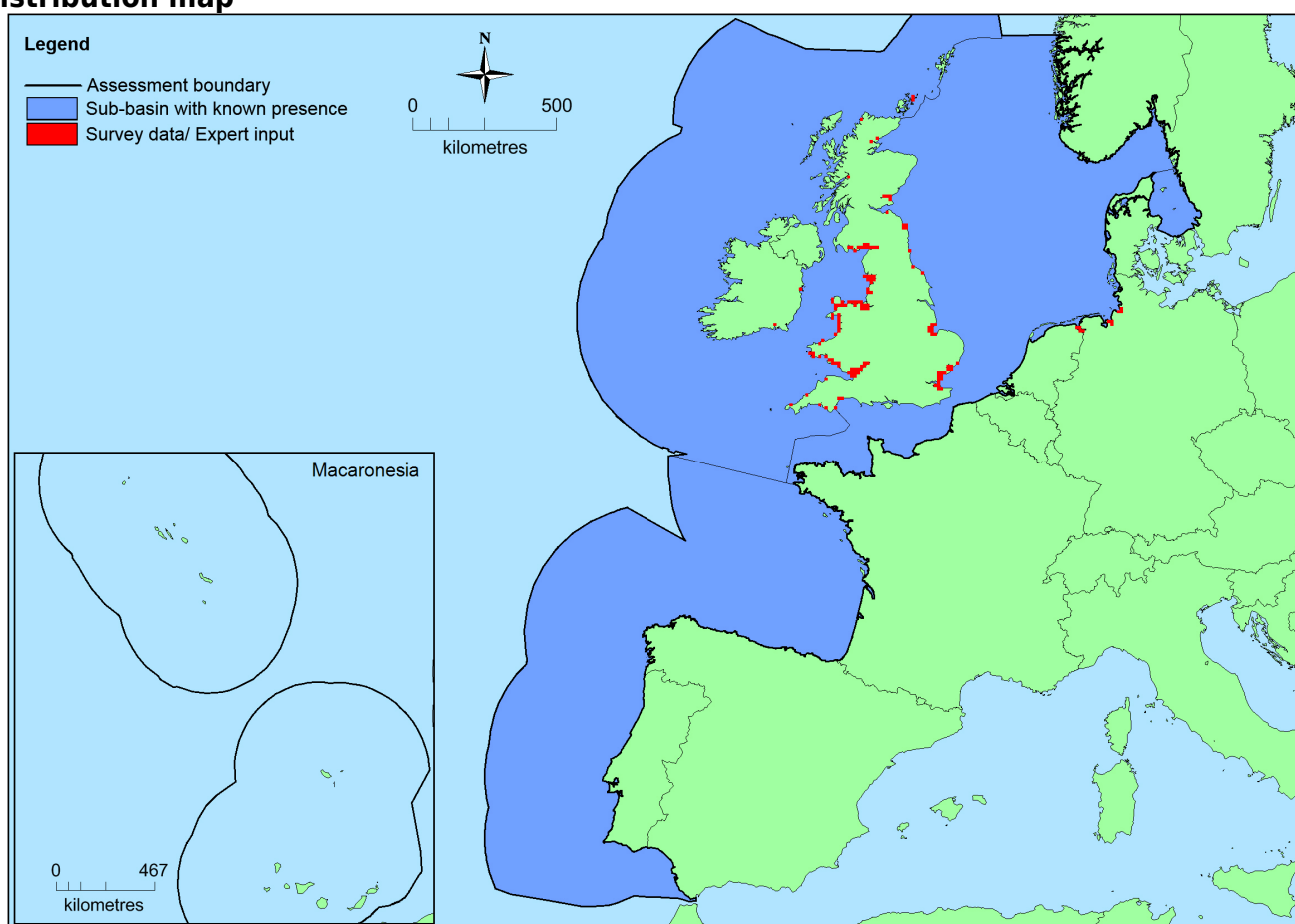
There are insufficient data to provide a comprehensive and accurate map of the distribution of this habitat. This map has been generated using EMODnet data from modelled/surveyed records for the North East Atlantic (and supplemented with expert opinion where applicable) (EMODnet 2010). EOO and AOO have 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?

This habitat occurs in the EU 28+ (e.g. in sheltered locations at the head of inlets, estuaries and fjords in Norway, Isle of Man, Channel Islands). The percentage hosted by the EU 28 is likely to be between more than 90% but there is insufficient information to establish the exact figure.

Trends in quantity

Historically there have been dramatic changes in quantity of this habitat 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. It has affected at least 85% of British estuaries and has removed over 25% of intertidal land from many estuaries and over 80% in some such as the Tees and the Tyne. Whilst it is not possible to determine how much of this constituted mudflat habitat, the scale and extent of the land claim schemes suggests this has been significant.

In recent decades, the direct losses of intertidal habitat in estuaries appears to have stabilised (in the German Wadden Sea an estimated loss of less than 10% within the last 50 years compared to over 70% loss over the last 250 years) although piecemeal losses continue to occur.

Climate change, with predicted sea level rise and changes in storm surge levels and frequency is considered likely to lead to future habitat loss unless there is scope for inland migration of intertidal habitats within estuaries.

- Average current trend in quantity (extent)
  EU 28: Stable
  EU 28+: Stable
- 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.
- 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.

Trends in quality

There has been a significant historical decline in quality of this habitat. For example, in Germany this is 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. An estimated 70% has declined in quality over the last 50 years. Land claim has affected at least 85% of British estuaries, including areas of mudflat, leading to a decline in quality. Substanial nutrient inputs to Danish coastal waters, including estuaries, in the 1980s provide other well-documented examples of changes quality of this habitat.

More recently activities such as dredging, discharge of effluents, development of anoxic conditions and eutrophication have affected the quality of mudflats in some estuaries but overall they are considered to be mostly stable.

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

Pressures and threats

Land claim for agricultural purpose, industrial use or port expansion, degraded water quality, bait digging and the spread of the cord grass *Spartina anglia* have all been factors contributing to declining quantity and quality of intertidal mudflat areas. Other potential threats include pollution incidents such as oil spills from tanker accidents and the consequences of sea-level rise due to climate change.

These pressures operate in a variety of ways. Diffuse and point-source discharges from agriculture, industry and urban areas including polluted storm-water run-off can create abiotic areas or produce algal mats. Barrage schemes pose a threat to the integrity and ecological value of mudflats in estuaries and enclosed bays. Fishing and bait digging can have an adverse impact on community structure and substratum. For example, suction dredging for shellfish or juvenile flatfish bycatch from shrimp fisheries may have a significant effect on important predator populations. Higher sea level and increased storm frequency resulting from climate change may affect the sedimentation patterns of mudflats and estuaries.

List of pressures and threats

Urbanisation, residential and commercial development

Discharges
Disposal of industrial waste

Biological resource use other than agriculture & forestry

Fishing and harvesting aquatic resources
Professional active fishing
Leisure fishing
Bait digging / Collection

Natural System modifications

Human induced changes in hydraulic conditions
Modification of hydrographic functioning, general
Other ecosystem modifications
Reduction or loss of specific habitat features
Anthropogenic reduction of habitat connectivity

Climate change

Changes in abiotic conditions
Changes in biotic conditions

Conservation and management

Conservation and management schemes to benefit this habitat 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 managed retreat to reclaim areas of mudflat drained for agricultural land, and reconnecting sediment supplies to mudflats. Water quality improvement programmes have been introduced to reduce the risk of toxic contamination and of nutrient inputs leading to eutrophication

Spatial management including zoning of activities as part of Integrated Coastal Zone Management Schemes and Marine Protected Areas and controls of discharges throughout the watershed, are also beneficial as they facilitate management of the entire estuary complex.

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 hunting, taking and fishing and species management

Regulation/Management of fishery in marine and brackish systems

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 establishment and maintenance of mudflats is closely linked to physical processes. If the "natural" hydrographic regime no longer exists recovery is unlikely. Where the underlying conditions are suitable there can be rapid recovery as demonstrated where dykes have been removed and in managed retreat projects. The determination of effort required is therefore contingent on the retention of a residual state that will allow reinstatement of the habitat.

Effort required

10 years	20 years	50+ years
Naturally and through intervention	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 %	>70 %
EU 28+	<25 %	unknown %	unknown %	>70 %

Estuaries and their associated mudflats are naturally dynamic systems, therefore, trends in quantity need to be set within a wider understanding of accretion and deposition of this habitat type. There have been substantial historical losses of estuarine intertidal mudflat habitat. The full extent across the North East Atlantic has not been quantified but there are numerous studies detailing the losses in individual estuaries. Expert opinion is that, taken overall, the historical decline is likely to have been more than 70%. In the last 50 years the percentage decline is believed to be much reduced and probably less than 25%. This habitat has therefore been assessed as Endangered under criterion A3 for both the EU 28 an 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	No	>50	Yes	Yes	No	No
EU 28+	>50,000 Km^2	Yes	Yes	No	>50	Yes	Yes	No	No

This habitat has a large natural range in the North East Atlantc region. The precise extent is unknown however as EOO >50,000^2 and AOO >50, this exceeds the thresholds for a threatened category on the basis of restricted geographic distribution. The habit may suffer a continuing decline in spatial extent or abiotic/biotic quality in the future, but the distribution of the habitat is such that the identified threats are unlikely to affect all localities at one. This habitat has therefore been assessed as Least Concern under

Criteria B1, B2 & B3 for both the EU 28 and EU 28+.

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 %	fairly substantial %	>30 %	severe %
EU 28+	unknown %	unknown %	unknown %	fairly substantial %	>30 %	severe %

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 are numerous studies indicating declines in the abiotic quality of estuaries and their associated mudflats over the last 50 years as well as over longer time periods. This has been associated with diffuse and point-source discharges from agriculture, industry and urban areas, as well as pollution from oil, tar, and hazardous substances. Resultant degradation of the associated communities has also taken place and long term risks also exist, for example through resuspension of toxic materials within sediments. These trends are difficult to quantify but are considered to be substantial historically. This habitat has therefore been assessed as Vulnerable under criteria C/D3 for both the EU 28 and the 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	LC	DD	DD	EN	LC	LC	LC	DD	NT	VU	DD	DD	DD	DD	DD	DD	DD
EU28+	LC	DD	DD	EN	LC	LC	LC	DD	NT	VU	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
Endangered	A3	Endangered	A3

Confidence in the assessment
Medium (evenly split between quantitative data/literature and uncertain data sources and assured expert knowledge)

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Reviewers
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