Nomination

Intertidal mudflats
EUNIS Code: A2.3
National Marine Habitat Classification for UK & Ireland code: LS.Lmu

Definition for habitat mapping

Two sub-types:
1 Marine intertidal mudflats
2 Estuarine intertidal mudflats

Intertidal mud typically forms extensive mudflats in calm coastal environments (particularly estuaries and other sheltered areas), although dry compacted mud can form steep and even vertical faces, particularly at the top of the shore adjacent to salt marshes. The upper limit of intertidal mudflats is often marked by saltmarsh, and the lower limit by Chart Datum. Sediments consist mainly of fine particles, mostly in the silt and clay fraction (particle size less than 0.063 mm in diameter), though sandy mud may contain up to 80% sand (mostly very fine and fine sand), often with a high organic content. Little oxygen penetrates these cohesive sediments, and an anoxic layer is often present within millimetres of the sediment surface. Intertidal mudflats support communities characterised by polychaetes, bivalves and oligochaetes. This priority habitat has been divided into two sub-types, based on the predominant salinity regime.

Geographical extent

OSPAR Regions; I,II,III,IV
Biogeographic zones: 4, 6-9, 11
Region & Biogeographic zones specified for decline and/or threat: as above

Intertidal mudflats are created by sediment deposition in low energy coastal environments, particularly estuaries and other sheltered areas. Their sediment consists mostly of silts and clays with a high organic content. They are characterised by high biological productivity and abundance or organisms, but low diversity with few rare species (Anon, 2000). The largest continuous area of intertidal mudflats in the OSPAR Area is in Region II bordering the North Sea coasts of Denmark, Germany and the Netherlands in the Wadden Sea and covering around 499,000ha.

Application of the Texel-Faial criteria

Intertidal mudflats were nominated by one Contracting Party with reference to decline, sensitivity, and ecological significance, with information also provided on threat.

Decline

Reductions in the area of intertidal mudflats have occurred in many parts of the OSPAR area with estuarine mudflats particularly favoured for land claim. A review carried out in the late 1980's noted that parts of at least 88% of British estuaries had lost intertidal habitat to agricultural land claim in the past (Davidson *et al,* 1991; Burd, 1992). One example is loss of over 80% of the intertidal flat claimed for agriculture, industry and ports since 1720 in the Tees estuary.

A reduction in the area and biological integrity of these biotope complexes will reduce their carrying capacity for supporting bird and fish predator populations. For example, removal of intertidal areas for industrial developments such as those in the late 1980s in the Port of Felixstowe resulted in the loss of feeding grounds and subsequent reduction in foraging time for waterfowl (Evans, 1996 in Jones *et al*, 2000).

Ecological Significance

Intertidal mudflats are usually low in species diversity but often support very dense populations of invertebrates making the overall biomass of the area extremely high. The particular species present vary with the sediment type. Mudflat invertebrates are comparatively small and thin-walled and, under these conditions they can stay in the upper layers of the mud during the low tide (Tubbs, 1977). As a result mudflats are particularly important sources of food for waders and wildfowl as the invertebrates are relatively easy to reach. They also supply the great quantity of food necessary to support these birds. A redshank, for example, has been estimated to eat around 40,000 *Corophium* a day (Barnes, 1974).

Sensitivity

The findings from many studies on the sensitivity of this habitat and associated species have been brought together in a review by Elliott *et al*., (1998)

Physical removal of the habitat will have both direct and indirect effects and can include significant effects of the ecology of these areas. Although the area of intertidal mudflats in estuaries can be smaller than the subtidal area, it may be very significant as a feeding area for the fish populations (Elliott & Taylor, 1989). For example, land-claim in the Forth Estuary has removed 24% of the natural fish habitats in the estuary but 40% of their food supply (McLusky *et al*, 1992). The greatest effect of land claim in this area is therefore on flatfish such as flounder and juvenile plaice.

At a larger scale, land claim may reduce the carrying capacity (Goss-Custard, 1985) of the entire migration and winter feeding grounds for particular waders and wildfowl and diminishing prey levels may intensify competition and increase winter mortality rates, with a consequent effect on equilibrium population size (Goss-Custard & Ditdurell, 1990).

Threat

A wide variety of threats have been documented on intertidal mudflats and their associated species. The main findings from a review carried out by Jones *et al.* (2000) are summarised here.

Land claim for agricultural use has been a threat to this habitat in the past. Today the threats are more likely to be linked to coastal developments such as urban and transport infrastructure and for industry. Apart from physical removal of the habitat there is a knock-on effect on other parts of the food chain (McLusky, *et al.,* 1992).

Effluent discharges on industrialised and urbanised estuaries and coastlines may contain contaminants with a long half-life or which are likely to bioaccumulate, and therefore have a toxic effect on intertidal mudflat species (Clark 1997). Effects of organic enrichment include increased coverage by opportunistic green macroalgae such as *Ulva* sp. and *Enteromorpha* sp. resulting in the formation of ‘green tide’ mats. Anoxic conditions below the mats, reduce the diversity and abundance of infauna (Simpson 1997).

Oil spills from tanker accidents can cause large-scale deterioration of intertidal sediment communities (Majeed 1987). Oil covering intertidal muds prevents oxygen transport to the substratum and produces anoxia resulting in the death of infauna. In sheltered low-energy areas such as intertidal mudflats pollutant dispersion will be low and the finer substrata in these areas will act as a sink (McLusky 1982; Somerfield, *et al.*, 1994; Ahn, *et al.,* 1995; Nedwell 1997). The pollutants will then enter the food chain and be accumulated by predators.

Fishing and bait digging are further threats as they can have an adverse impact on community structure and substratum e.g. suction dredging for shellfish or juvenile flatfish, or by-catch from shrimp fisheries affecting important predator populations. Bait digging can reduce community diversity and species richness, especially when carried out on a commercial scale (Brown & Wilson 1997).

Sea level rise is another issue to consider, especially in areas where the land is sinking such as southern and south-east England. Any associated increased storm frequency, resulting from climate change, may further affect the sedimentation patterns of mudflats and estuaries.

Relevant additional considerations

Sufficiency of data

There is a long history of study and a great deal of data on many aspects of intertidal mudflats. These provide a sound basis on which to assess the status of intertidal mudflats in the OSPAR Maritime Area.

Changes in relation to natural variability

Intertidal mudflats are dynamic environments and subject to natural change, as well as change associated with human activity. The habitat is sensitive to changes in the hydrophysical environment for example. Periodic increases in wave action can severely alter the appearance of the intertidal region as the top 20cm of sand can be removed by storm events (Dolphin *et al*, 1995). The strength of wave action affects the topography (as flatness/steepness and shore width) of the intertidal area therefore a significant change in wave action will affect the physical and biological integrity of that habitat and the exposure regime.

The extreme temperatures experienced in the intertidal habitat also influence their populations’ behavioural and reproductive activity and food and oxygen availability (Eltringham, 1971). For example, summer water temperatures may control the number of generations per year of *Corophium volutator.* Many intertidal species have wide tolerances for temperature and can also alter metabolic activity, or simply burrow deeper in the sediment or move seaward to combat temperature change (Brown, 1983). Severe changes in temperature in intertidal areas will result in a seasonal reduction in benthic species richness and abundance, although the species are well adapted to such changes. Temperature is also an important factor explaining dynamics of microbial activity and microphytobenthic primary production on intertidal mudflats (Blanchard & Guarini, 1996).

Expert judgement

There is a considerable amount of information on intertidal mudflats including detailed studies of their ecology, the threats and impacts of human activities. These provide good evidence on which to include intertidal mudflats on the OSPAR list.

ICES evaluation

The ICES review of this nomination finds that there is good evidence that intertidal mudflats occur throughout the OSPAR region and that the threats are similar in all areas (ICES, 2002). The review put more emphasis on estuarine as opposed to other intertidal mudflats and concluded that there was good evidence of declines and threat to estuarine intertidal mudflats throughout the OSPAR area.

Threat and link to human activities

Cross-reference to checklist of human activities in OSPAR MPA Guidelines

Relevant human activity: Construction, traffic infrastructure, landbased activities, fishing, tourism and recreational activities. *Category of effect of human activity:* Physical – substratum removal or change, visual disturbance. Biological – removal of target species and non-target species, changes in population or community structure or dynamics; Chemical – synthetic compound contamination , heavy metal contamination, hydrocarbon contamination, radionuclide contamination, nutrient changes.

There are clear links between human activities and threats to intertidal mudflats. These include physical intervention, for example through land claim or the construction of barrages, as well as inputs such as organic matter, industrial and domestic effluent. There are many studies showing the impact of such activities on the habitat and associated fauna and flora.

Management considerations

Management of both terrestrial and marine activities will be important to control factors leading to the decline and threats to this habitat type. Much of this is likely to fall under the remit of national planning authorities and would include decisions about the location of coastal developments and improvements to water quality. Areas could also be designated under the proposed OSPAR MPA programme although it should be noted that intertidal mudflats are covered by the EU Habitats Directive and could therefore be included in the *Natura 2000* network.

Further information

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