Nomination

Seapen and burrowing megafauna
EUNIS Code: A5.361 and A5.362
National Marine Habitat Classification for UK & Ireland code: SS.SMu.CFiMu.SpnMeg and SS.SMu.CFiMu.MegMax

Definition for habitat mapping

Plains of fine mud, at water depths ranging from 15-200m or more, which are heavily bioturbated by burrowing megafauna with burrows and mounds typically forming a prominent feature of the sediment surface. The habitat may include conspicuous populations of seapens, typically *Virgularia mirabilis* and *Pennatula phosphorea*. The burrowing crustaceans present may include *Nephrops norvegicus*, *Calocaris macandreae* or *Callianassa subterranea*. In the deeper fiordic lochs which are protected by an entrance sill, the tall seapen *Funiculina quadrangularis* may also be present. The burrowing activity of megafauna creates a complex habitat, providing deep oxygen penetration. This habitat occurs extensively in sheltered basins of fjords, sea lochs, voes and in deeper offshore waters such as the North Sea and Irish Sea basins.

Geographical extent

OSPAR Regions; I, II, III, IV
Biogeographic zones: 6,7,9
Region & Biogeographic zones specified for decline and/or threat: II, III/6,7,9

This biotope occurs in areas of fine mud that is heavily bioturbated by burrowing megafauna. Burrows and mounds may form a prominent feature on the sediment surface with conspicuous populations of seapens, typically *Virgularia mirabilis* and *Pennatula phosphorea*. In the deeper fiordic lochs which are protected by an entrance sill, the tall seapen *Funiculia quadrangularis* may also be present. These soft mud habitats occur extensively throughout the more sheltered basins of sealochs and voes and are present in quite shallow depths probably because they are very sheltered from wave action. This biotope also occurs in deep offshore waters in the North Sea with high densities of *Nephrops norvegicus* present.

Application of the Texel-Faial criteria

Seapen and burrowing megafauna communities were nominated by one Contracting Party with reference to decline and sensitivity, with information also provided on threat. It has been nominated for OSPAR Regions II & III.

Decline

There has been no detailed mapping of this biotope in the OSPAR Maritime Area and therefore no quantifiable information on changes in extent. Nevertheless, it is likely to have been affected by the extensive fisheries that take place inshore and on the shallow waters of the continental shelf. One possible indication of decline is that the seapen *F.quadrangularis* appears to be absent from the *Nephrops* fishing grounds of the Irish and North Sea, even though these areas are suitable for this species (Anon, 1999). Evidence from shallower waters (including Jennings & Kaiser, 1998) shows the damage that communities of burrowing megafauna in muddy sediments endure as a result of trawling activities, that the diversity of species is reduced, and that such communities can take several years to recover.

In spite of additional material researched by ICES (Linnane *et al.*, 2000), evidence that this habitat is undergoing decline remains unclear, certainly for deeper water, simply because of gaps in our knowledge (although Roberts *et al.* (2000) reports evidence of deep-sea trawling physically impacting the seabed at depths of over 1000 m).

Sensitivity

The findings from various studies on the sensitivity of this habitat have been brought together in a review by Hughes (1998).

F.quadrangularis is a characterising species of this biotope and its particular habitat requirements i.e. undisturbed soft mud, appear to be important in limiting its distribution to sheltered localities, often behind shallow sills (Anon, 2000). While trawling activities are likely to damage or destroy populations (Bergmann *et al*., 2001), research on the effects of creeling (potting) for *Nephrops norvegicus*, indicates that this is less damaging as the seapen has the ability to right itself if hit by a creel pot (Eno *et al*., 1996).

There have been few studies on sensitivity of sea pens to organic pollution, but it is reasonable to suppose that they will be susceptible to the same adverse effects as the other components of the benthic fauna. Hoare & Wilson (1977) noted that *Virgularia mirabilis* was absent from part of Holyhead Harbour heavily affected by sewage pollution, while both *Virgularia mirabilis* and *Pennatula phosphorea* were found to be abundant near the head of Loch Harport, Skye, close to a distillery outfall discharging water enriched in malt

and yeast residues and other soluble organic compounds (Nickell & Anderson, 1997). Smith (1988) examined the distribution and abundance of megafaunal burrowers along a gradient of organic enrichment in the Firth of Clyde. At the centre, the sediment contained about 10% organic carbon. Burrowing megafauna were abundant in areas of < 4% organic carbon, and absent where this exceeded 6%. Other potentially harmful contaminants could include oil or oil-based drilling muds, pesticides, polychlorinated biphenyls (PCBs) and heavy metals.

The reproductive biology of the sea pens found in this habitat has not been studied, but work on other species suggest that some may live up to 15 years, and take five or six years to reach sexual maturity (Birkeland, 1974). Larval settlement can be patchy in space and highly episodic in time, with no recruitment taking place in some years (Davis & Van Blaricom, 1978). If the same were true of the seapen species found in this habitat it would mean patchy recruitment, slow growth and long life-span.

Threat

The main threats to this habitat are activities that physically disturb the seabed, such as demersal fisheries, and marine pollution through organic enrichment.

The most direct threat is from demersal fisheries and there is good evidence that this biotope is threatened by trawling. Linnane *et al.* (2000) listed work giving estimates of penetration depth of up to 300 mm in mud for otter board trawl doors and beam trawls. Jennings & Kaiser (1998) also describe the detrimental effects of trawling on infauna in muddy habitats, as well as the effects of hydraulic dredges. They also point out that, in intensively fished zones (many of which occur in OSPAR Regions II and III), areas can be impacted several times a year. *Nephrops* fisheries are another threat as this species is part of the biological community of this biotope. The intensity of *Nephrops* fisheries and their wide geographic coverage, mean they have the potential to affect large areas of seapens and burrowing megafauna (Hughes, 1998).

Organic pollution is another threat and may come from sewage outfalls or other discharges. Fish farming operations are also a source of organic matter as the area beneath cages used to rear Atlantic salmon can become enriched by fish faeces and uneaten food. In severe cases this can lead to faunal exclusion and the development of bacterial mats on the sediment surface (Dixon, 1986; Brown *et al*., 1987; Gowen & Bradbury, 1987). Megafaunal burrowers are certainly absent from heavily-impacted sea beds below salmon cages, but threshold levels of enrichment causing changes in megafaunal communities around sea loch salmon farms have not been determined, and information is largely anecdotal at present (Hughes, 1998).

Relevant additional considerations

Sufficiency of data

There is little quantitative information on the extent of this habitat in the OSPAR Maritime Area or documented changes on community structure or extent in particular locations. In relation to threat, specific examples of known sensitivity to pollutants are rare, probably because burrowing megafauna are generally too difficult to sample to be included in standard pollution monitoring studies. Much more information is available on the impact of demersal fisheries, providing a firm foundation on which to consider this habitat threatened by such fisheries.

Changes in relation to natural variability

The lack of long-term observational studies of this biotope means little is known about changes that might be the result of natural variability. Repeated disturbance from demersal fishing gear is however likely to mask such changes, especially if such disturbance occurs several times a year, as calculated for parts of the North Sea (Jennings & Kaiser, 1998).

Expert judgement

Expert judgement has played a part in putting forward this nomination. This is because there is mostly qualitative data on the extent and decline to this habitat. There is however a good basis on which to consider it to be threatened. The main consideration is that seapen and megafauna communities are known to be impacted by, and therefore threatened by, certain fishing operations and should therefore be listed by OSPAR.

ICES evaluation

The ICES review of this nomination agrees that evidence that this habitat is undergoing decline is unclear, but that there is clear evidence of threats across the whole region (ICES, 2002). There was also a discussion of increased future threat with ICES noting strong evidence in the literature to support the case that, as fishing effort increases, so will the threat to burrowing megafauna in sublittoral muds. As human activity in the deep sea (such as deep-sea mining, hydrocarbon exploration)

increases, so will the threat to deep-sea macrofauna from disturbance.

ICES concludes that that while the evidence of decline is insufficient, the evidence for threat is sufficient across the whole OSPAR area, and recommends this biotope is listed for Regions II and III. As the activity of trawlers reaches further and further afield so will the threat to this biotope on a broader geographical scale than Regions II & III at which time ICES recommends that OSPAR to revisit the regional scope of the listing .

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting, dumping of solid waste and dredged spoils, aquaculture/mariculture, landbased activities. *Category of effect of human activity:* Physical – substratum change including smothering, Chemical – nutrient changes; Biological – removal of target and non-target species, physical damage to species.

The link between threat to this habitat and human activities is strongest in relation to demersal fisheries. Mobile fisheries, such as demersal trawls, in particular are known to impact both epifauna and infauna in areas of soft sediment and therefore there is a clear link between threat and human activity. Other threats, such as the impact of pollution, may not have not been studied in the same level of detail but on general biological principles, it can be assumed that the various forms of contaminant shown to damage other benthic communities could also have adverse effects on this biotope.

Management considerations

Closed area for particular types of fishing are used to protect certain habitats and species in the NE Atlantic and could be applied more widely to protect this habitat. This is a matter that falls with the remit of fisheries organisations rather than OSPAR, although OSPAR can communicate an opinion on its concern about this habitat to the relevant bodies and introduce any relevant supporting measures that fall within its own remit (such as MPAs) if such measures exist or are introduced in the future. In inshore areas, more strategic planning and management of the location of aquaculture facilities and control of other organic inputs and contaminants will assist the conservation of this habitat.

Further information

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