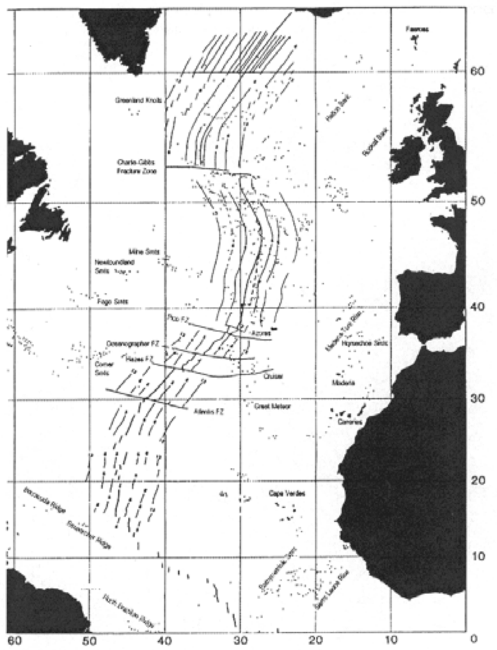
Nomination

Seamounts
EUNIS Code: A6.72
National Marine Habitat Classification for UK & Ireland code: Not defined



Location of seamounts in the North Atlantic (from Epp & Smoot, 1989)

Definition for habitat mapping

Seamounts are defined as undersea mountains, with a crest that rises more than 1,000 metres above the surrounding sea floor (Menard, 1964 in Rogers, 1994). Seamounts can be a variety of shapes, but are generally conical with a circular, elliptical or more elongate base. Seamounts are volcanic in origin, and are often associated with seafloor ‘hot-spots’ (thinner areas of the earth’s crust where magma can escape). Seamounts, often with a slope inclination of up to 60°, provide a striking contrast to the surrounding ‘flat’ abyssal plain. Their relief has profound effects on the surrounding oceanic circulation, with the formation of trapped waves, jets, eddies and closed circulations known as Taylor columns (Taylor, 1917 in Rogers, 1994). Seamounts occur frequently within the OSPAR Maritime Area. Analysis of narrow beam bathymetric data by the US Naval Oceanographic office from 1967-1989 identified more than 810 seamounts within the North Atlantic. The majority occur along the Mid-Atlantic ridge between Iceland and the Hayes fracture zone (Gubbay, 2002).

The enhanced currents that occur around seamounts provide ideal conditions for suspension feeders. Gorgonian, scleratinian and antipatharian corals may be particularly abundant, and other suspension feeders such as sponges, hydroids and ascidians are also present. Concentrations of commercially important fish species, such as orange roughy, aggregate around seamounts and live in close association with the benthic communities (Gubbay, 2002).

Geographical extent

OSPAR Regions; I, IV,V
Biogeographic zones: 1,2,3,21,22,25
Region & Biogeographic zones specified for decline and/or threat: I, IV,V

Seamounts are undersea mountains which are typically cone shaped, rising steeply from the seabed, but which do not emerge above sea level. They can be very large features, and more than 100km across the base. They often occur in chains or clusters, which are probably linked to seafloor hotspots and associated volcanic activity. Geological studies indicate that they have been generated along the Mid-Atlantic Ridge for the past 35 million years, although some, such as the seamounts around Rockall Bank and between the south-west corner of Rockall and the Charlie-Gibbs fracture zone may have formed before then (Epp & Smoot, 1989).

The majority of the seamounts in the OSPAR Maritime Area lie along the Mid-Atlantic Ridge (MAR) between Iceland and the Hayes fracture zone. There are also groups of seamounts some distance from the MAR to the south west of the Rockall Bank, west of Portugal on the Madeira-Tore Rise , and the Milne seamounts to the east of the MAR (Gubbay, 1999).

Application of the Texel-Faial criteria

Seamounts were nominated in a joint submission by three Contracting Parties citing decline, sensitivity, and ecological significance with information also provided on threat. The nomination was for Region V.

Decline

Consideration of decline is most relevant to the biological communities associated with seamounts rather than the physical structure of the feature itself. There are documented cases of extensive damage to seamount communities in some parts of the world (eg. Butler *et al.,* 2001; WWF/IUCN/WCPA 2001) but limited information specific to seamounts in the OSPAR Maritime Area

Sensitivity

Seamount habitats are very sensitive to the physical impact of trawling and to the removal of benthic and pelagic key species by commercial fisheries. Being isolated and confined to small areas, seamount habitats and faunas will be able to recover only over long time periods by the sporadic re-colonisation from nearby seamounts and shelf areas. Where this is not possible, as in the case of endemic species, disturbance might lead to extinction.

Many of these species have life-history strategies that make them particularly sensitive to exploitation. The orange roughy *Hoplostethus atlanticus* is probably the best known as it is slow growing and, with an estimated life span of more than 100 years, one of the longest lived fish species (Allain & Lorance, 2000). Orange roughy tend to form discrete and dense aggregations around seamounts from which high catch rates can be obtained, fisheries can rapidly deplete the stocks. Deep water corals and sponges are also found on seamounts and are very sensitive to physical damage caused by fishing gear.

Ecological significance

Seamounts are a distinct and different environment from much of the deep sea. They act as ‘islands’ for epibenthic and pelagic faunas, have a high rate of endemic species, are used as ‘stepping stones’ for the transoceanic dispersion of shell species and as reproduction/feeding grounds for migratory species (eg. Richer de Forges, 2000) Their steep slopes, which are often current-swept, and the predominance of hard exposed rock surfaces provides a marked contrast to the characteristically flat and sediment-covered abyssal plain. Their profile and elevation from the surrounding seafloor also affects the circulation of water in the area, for example by deflecting currents as well as leading to the formation of trapped waves, jets and eddies (Rogers, 1994).

Studies of the pelagic communities above seamounts reveal both qualitative and quantitative differences when compared to the surrounding water. The biomass of planktonic organisms over seamounts is often higher than surrounding areas, which, in turn, become an important component of the diet of fish and top predators such as sharks, rays, tuna and swordfish. The ecological importance of seamounts for top predators is emphasised by the fact that some far-ranging pelagic species concentrate their mating and spawning in such places. Two examples are the pelagic armorhead (*Pentaceros wheeleri*) and the scalloped hammerhead (*Sphyrna lewini*) (Boehlert & Sasaki, 1988). An example in the OSPAR Area is the Formigas Bank in the south eastern part of the Azores which appears to act as a feeding ground and possibly a fish spawning and nursery area for many species as suggested by the groups of small cetaceans such as bottlenose dolphin, common dolphin, spotted dolphin and pilot whales as well as captures of loggerhead turtles recorded in the area.

The benthic fauna are dominated by suspension feeders some of which are typically restricted to the seamount environment. They are characterised by high levels of endemism, which suggests limited reproductive dispersal. Sampling of the benthic seamount fauna in the SW Pacific, for example, suggests that some of these species are notably localised. Somewhere between 29-34% of the species collected during 23 cruises to the region are believed to be new to science and potentially endemic to these seamounts (Richer de Forges *et al.,* 2000). Less is known about the level of endemism on seamounts in the North East Atlantic.

The concentration of commercially valuable fish species around seamounts is well documented. Fishes such as the orange roughy and some deepwater oreos appear to be adapted to life in this environment, their substantial aggregations supported in the otherwise food-poor deep sea by the enhanced flow of prey organisms past the seamounts (Koslow & Gowlett-Holmes, 1998).

Apart from these general characteristics of seamounts that make them ecological significant there are also unique situations which make some even more significant. One example is the João de Castro bank which is the only known example of a shallow water hydrothermal vent seamount in the NE Atlantic. Its uniqueness and rare fauna assemblages mean it might have an important role as a ‘stepping stone’ for species colonising the Azorean islands.

Threat

The biological resources of seamounts have been the targets of intensive exploitation, as they support commercially valuable fish, shellfish and corals. This has created serious problems as resources have been fished before there is a reasonable understanding of the biology of the species being targeted, no formal stock assessment and no quotas. The result has been over-exploitation and major crashes in various stocks (eg. Koslow & Gowlett-Holmes, 1998; Koslow *et al*., 2001; Lutjeharms & Heydorn, 1981). There is no published information on whether crashes have also occurred on NE Atlantic seamounts but there are certainly anecdotal reports of sites being fished out and vessels moving to new areas to sustain their fishing activity as seamounts beyond the EEZ of the Azores become depleted.

There has also been a massive impact on the benthos of some of the seamounts that have been studied. The substrate of heavily fished seamounts in Tasmania, for example, now consists predominantly of either bare rock or coral rubble and sand, features not seen on any seamount that was lightly fished or unfished (Koslow *et al.,* 2001). The abundance and species richness of the benthic fauna on heavily fished seamounts was also markedly reduced.

While commercial is the overriding threat to seamount fauna at the present time there is also the propose that some areas may be targeted by deep sea mining companies that are already looking at the possibility of extracting ferromanganese crusts and polymetallic sulphides from seamounts, and where the potential physical damage could also be considerable (Sarma *et al*., 1998).

Relevant additional considerations

Sufficiency of data

Historic and recent hydrographic surveys are the main source of information on the location of seamounts. They give an overview of the main areas of distribution as well as more information on the bathymetry of locations that have been studied in some detail. A number of reports collate this information to give a first overview of the situation in the OSPAR Maritime Area (eg. Gubbay, 1999; WWF, 2001) .

Less is known about the biological resources of seamounts in the OSPAR Area as only a few have been studied in detail. The majority of these are seamounts around the Azores although there is also some basic information on others such as the Gorringe Ridge and Galacia Bank of the coast of Portugal, the Anton Dohrn Seamount in the Rockall Trough and the Josephine and Gettysburg seamounts south of the Tagus Abyssal Plain (WWF, 2001).

Landings records from the commercial fisheries that operate on seamounts are another source of information about seamount fauna however as this is pooled it is rarely possibly to distinguish information for individual seamounts. This also makes it difficult to show the level of fishing effort on particular seamounts.

Changes in relation to natural variability

Little is known about natural fluctuations in the populations of seamount fauna however the this is likely to be insignificant when compared to the changes caused by fishing some of the long-lived species to the point of commercial extinction in a few years. The extensive damage to benthos to the point where areas have been reduced to bare rock, rubble and sand is also unlikely without some catastrophic event such as landslips.

Expert judgement

There is a limited amount of detailed information about the level of threat and damage to individual seamounts in the OSPAR Maritime Area, but lessons learnt from other parts of the world show that seamounts and their associated fauna are seriously threatened. Documented examples include the crash in populations of the rock lobster, *Jasus tristani* on the Vema seamount due to a combination of overfishing and unpredictable larval recruitment; fishing of the pelagic armourhead *Pseudopentaceros wheeleri* over the southern Emperor seamounts and seamounts in the northern Hawaiian Ridge to commercial extinction within 10 years of their discovery; and the orange roughy *Hoplostethus atlanticus* fishery on seamounts off the coasts of New Zealand and Australia where new discoveries of stocks are typically fished down to 15-30% of their initial biomass within 5-10 years (Koslow *et al*., 2001). Given this pressure and the fact that seamounts in the OSPAR Maritime Area are targeted by commercial fisheries expert judgement suggests that seamounts should be on the OSPAR list of threatened and/or declining species and habitats.

ICES evaluation

The ICES evaluation of this nomination acknowledges the threat to seamount habitats in some parts of the world but points to the limited information presented on threat and decline to seamounts in the OSPAR Maritime Area with the original nominations (ICES, 2002). They conclude that there is insufficient evidence for the nomination but note that inclusion of this habitat should be considered on the grounds of “precaution” until further data are available. This report makes the case for such inclusion with particular reference to expert judgement as described above.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting;. Bioprospecting; extraction of mineral resources. *Category of effect of human activity:* Biological – physical damage to species, removal of target species, removal of non-target species, changes in population or community structure or dynamics. Physical – substratum removal or change, increased siltation.

The damage to biological resources on seamounts has been clearly linked to fishing and therefore to human activity. This is the most pressing threat to the environment of seamounts at the present time both within and outside the OSPAR Maritime Area.

Management considerations

The principle management measures that would help with the conservation of seamount fauna at the present time are those which will address the damaging effects of fisheries. These could include controls on the directed fishery and by-catch, and closed areas. These measures fall outside the remit of OSPAR although OSPAR can communicate an opinion on its concern about this species to the relevant bodies. OSPAR could also introduce any relevant supporting measures that fall within its own remit if such measures exist. Marine Protected Areas on seamounts are one possibility and would compliment the provisions in the EU Habitats & Species Directive to establish Special Areas of Conservation on “reefs” within the 200nm zones of Member States of the European Union.

Further information

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Iceland, Portugal, UK

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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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Useful References:

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