

## Nomination

*Modiolus modiolus* horse mussel beds  
EUNIS Code: A5.621, A5.622, A5.623 and  
A5.624

National Marine Habitat Classification for UK &  
Ireland code: SS.SBR.SMus.ModT,  
SS.SBR.SMus.ModMx,  
SS.SBR.SMus.ModHAs and  
SS.SBR.SMus.ModCvar



## Definition for habitat mapping

The horse mussel *Modiolus modiolus* forms dense beds, at depths up to 70m (but may extend onto the lower shore), mostly in fully saline conditions and often in tide-swept areas. Although *M. modiolus* is a widespread and common species, horse mussel beds (with typically 30% cover or more) are more limited in their distribution. *Modiolus* beds are found on a range of substrata, from cobbles through to muddy gravels and sands, where they tend to have a stabilising effect, due to the production of byssal threads. Communities associated with *Modiolus* beds are diverse, with a wide range of epibiota and infauna being recorded, including hydroids, red seaweeds, solitary ascidians and bivalves such as *Aequipecten opercularis* and *Chlamys varia*. As *M. modiolus* is an Arctic-Boreal species, its distribution ranges from the seas around Scandinavia (including Skagerrak & Kattegat) and Iceland south to the Bay of Biscay.

## Geographical extent

OSPAR Regions; Entire OSPAR Area  
Biogeographic zones: 4,6-9,12-15  
Region & Biogeographic zones specified for decline  
and/or threat: Entire OSPAR Area

*M. modiolus* is an Arctic-Boreal species whose distribution in the OSPAR area extends from the

seas around Scandinavia and Iceland down to the Bay of Biscay. Within the Maritime Area it is particularly abundant in the Barents Sea, Iceland, Norway and the northern coasts of Britain. It is also present in the Skagerrak and Kattegat, the Wadden Sea and along the coast of France (Brown, 1984; Hayward & Ryland, 1990; Roberts, 1975; Schweinitz & Lutz, 1976; Tebble, 1966; Jones *et al.*, 2000).

## Application of the Texel-Faial criteria

Nomination of *M.modiolus* beds to be placed on the OSPAR list cited sensitivity, ecological significance and decline with information also provided on threat. The nomination was for all OSPAR regions.

### Decline

Decline in the extent of *M.modiolus* beds has been recorded within the OSPAR Maritime Area, for example in studies along the coast of the UK which have shown a clear decrease of this habitat over the period from 1950s to 1990s (Magorrian *et al.*, 1995; Hill *et al.*, 1997; Jones *et al.*, 2000).

Scallop dredging, which is undertaken using heavy metal dredges, usually with large prominent metal teeth along the leading edge, is known to have caused widespread and long-lasting damage to beds in Strangford Lough, Northern Ireland (Magorrian, 1995). Surveys in 2003 reveal the virtual elimination of horse mussel beds within the lough (J. Breen, pers. comm.). The beds of *Modiolus* off the Isle of Man are reported to have become progressively much more scattered and less dense over the years (Jones 1951), although not surveyed in detail. The effect on associated communities has also not been studied, although it is known that the very large barnacle *Balanus hameri*, which used to be abundant in this particular community, has not been found there recently.

### Sensitivity

*M.modiolus* is a long-lived species and individuals within beds studied around the UK are frequently 25 years old or more. The species is considered to be highly intolerant to substratum loss, abrasion and physical damage. As recruitment is sporadic, varying with season, annually, with location, and hydrographic regime, and is generally low, it may take many years for a population to recover from damage, if at all (Tyler-Walters, 2001).

The fragility of individual *Modiolus* is not particularly high nor are reefs thought to be particularly fragile however very physical activities such as impacts by towed fishing gear are known to be damaging, not

only by disruption and flattening of clumps and larger aggregations, with reduction in the value of the habitat, but also by damage, and presumably mortality, to individual *Modiolus*. It should be noted also that the shells of old individuals can be very brittle due to the activities of the boring sponge *Clione celata* (Comely, 1978).

#### *Ecological significance*

The species composition of *Modiolus* beds is variable and is influenced by the depth, degree of water movement, substratum and densities. Three main components are:

- Very dense aggregations of living and dead *Modiolus* shells which form the frame work in a single or multiple layers
- A rich community of free living and sessile epifauna and predators.
- A very rich and diverse community which seeks shelter in the crevices between the *Modiolus* shells and byssus threads and flourishes on its rich sediment.

Brown & Seed (1977) recorded 90 invertebrate taxa associated with *Modiolus* clumps in Strangford Lough, with most of the major groups well represented. Holt & Shalla (unpublished) found 270 invertebrate taxa associated with *Modiolus* reef areas to the north east of the Isle of Man, and suggested that this was likely to be an underestimate, particularly in terms of sponges and infauna. Because of the abundant epifauna and infauna *Modiolus* beds have been considered to support one of the most diverse sublittoral communities in north-west Europe (Holt *et al.*, 1998).

The possible role of *Modiolus* reef communities in providing a nursery refuge for other species is occasionally mentioned in the literature but does not appear to have been investigated. Dense growths of bushy hydroids and bryozoans could conceivably provide an important settling area for spat of bivalves such as the scallops *Pecten maximus* and *Aequipecten opercularis*, adults of which are often abundant in nearby areas.

The byssus threads of the *M.modiolus* have an important stabilising effect on the seabed, binding together living *M.modiolus*, dead shell and sediments. As *M.modiolus* is a filter feeder the accumulation of faeces and pseudofaeces probably represents an important flux of organic material from the plankton to the benthos.

#### *Threat*

The main threat to *Modiolus* beds is from fishing, particularly using trawls and dredges, which damage both the *Modiolus* and associated epibenthic species. On the Isle of Man bed, for example, scallop and queen scallop dredging is known to have damaged to a variety of epibenthic species, including many found in association with *Modiolus*, such as *Alcyonium digitatum*, spider crabs such as *Hyas* and *Inachus*, *Cancer*, *Echinus esculentus*, *Psammechinus miliaris* and to a lesser extent *Buccinum undatum* (Hill *et al.*, 1997) and probably others including particularly sponges (Veale, pers. comm. in Holt *et al.*, 1998). Obvious effects, including severe damage to *Modiolus* (ie the majority broken), flattening of emergent *Modiolus* clumps, and loss of the majority of epifauna, especially emergent species (Magorrian *et al.*, 1995).

*Modiolus* beds are also likely to be badly damaged by other physical impacts such as aggregate extraction, trenching and pipe/cable-laying, dumping of spoil/cuttings or use of jack-up drilling rigs.

The Horse Mussel is known to accumulate contaminants such as heavy metals in spoil disposal areas but the effects on condition, reproduction and mortality rates are unknown (UKBAP, 2000).

Recruitment is slow and sporadic. Spat survival to adulthood occurs best where the spat shelter amongst the mass of adults. Thus, where impacts are so severe that extensive areas are cleared of horse mussels, recovery is unlikely even in the medium term. The time taken for small breaks in a bed to close up by the growth of surrounding clumps is not known, nor is the survival of clumps torn away from the main bed.

The biology of this species (long-lived and slow growing) places it in a vulnerable position, especially in light of the lack of information on its extent in the OSPAR area.

Global warming and any phenomena that increase the water temperature could also have an effect on the current distribution of this northern species.

### **Relevant additional considerations**

#### *Sufficiency of data*

There is a lack of information on the full extent and status of *Modiolus* beds in the wider OSPAR area, but reasonable information for areas around the Britain, Ireland, France and Norway.

The damage caused by scallop dredging has been well documented and is very clear.

Rates of development of reefs are not known. There would appear to be some potential for spread of existing bioherms where these take the form of very dense raised beds, as a result of clumps of mussels dropping off from the edges, which are often quite discrete. This would undoubtedly be a very slow process taking probably many years per metre of spread. Spread or recovery of more infaunal types of reefs would presumably be slower still, although this is purely speculative (Holt *et al.*, 1998).

#### *Changes in relation to natural variability*

Many aspects of the reproduction, development and growth of *Modiolus* seem to be highly variable. Natural fluctuations in spawning, settlement and recruitment into adult sizes occur in some beds, with predation of young mussels probably being very influential. These must affect the population structure over periods of a few years, but in the long term they seem to be stable features.

Dense reefs and beds are thought in general to be very stable in the long term, despite somewhat intermittent recruitment in some cases. This is based upon observations that reefs are consistently found in the same place over long time periods, but to what degree the *Modiolus* population structure, physical nature of the reefs, or the associated community structure might vary does not appear to have been studied. The variable nature of recruitment in at least some populations demonstrates that some variation in *Modiolus* population structure with time must occur, but this has not been described in any detail (Holt *et al.*, 1998).

Predation of young *Modiolus* by crabs and starfish, in particular, appears to be important. Factors affecting the proportion of young *Modiolus* surviving through to the size at which predation appears no longer to be a serious threat have not been studied, although in comparison with *Mytilus* reefs, which are composed of much younger animals, the effect of one or two 'bad years' of recruitment would be far less serious. It is suspected that juveniles living within the mass of adult byssus threads have greatly enhanced chances of survival, in which case infaunal *Modiolus* could be at a disadvantage since the byssus may be largely inaccessible.

#### *Expert judgement*

More information is needed on the extent and status of this habitat. However, under the concept of precaution, the inclusion of this habitat is

considered as sensible, until more research on its status is completed given the observed impacts and decline in well-studied locations, and the demonstrated threat to this habitat from fishing methods that are widespread in the OSPAR Maritime Area.

#### *ICES evaluation*

OSPAR (2001) considered this habitat to be threatened and/or declining across the whole OSPAR area. The Leiden Workshop concluded that evidence for the decline of and threat to *Modiolus modiolus* beds was "strong" across the whole OSPAR area. The view of ICES is that the literature only supports evidence of threat in some parts of the OSPAR Area. They concluded that the need for more information on this habitat is essential and under the concept of precaution, the inclusion of this habitat should be considered as sensible until more research on the status of this habitat is completed (ICES, 2003).

### **Threat and link to human activities**

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

*Relevant human activity:* Fishing, extraction of sand, stone and gravel, dumping of solid waste and dredged spoils, placement and operation of submarine cables and pipelines.

*Category of effect of human activity:* Physical – substratum removal, substratum change, water flow rate changes, temperature changes. Biological – physical damage to species, removal of target species, removal of non-target species.

The main threat to this habitat is from fishing, particularly using trawls and dredges for scallops and queen scallops. This is known to have caused widespread and long-lasting damage to some beds and has been implicated in the dramatic reduction in density and extent of the widespread and often dense areas of *Modiolus* bed. There is therefore a clear link between threat and certain human activities.

### **Management considerations**

The main management measures which would assist the conservation of this habitat are protection from physical damage. Closed areas to particular types of fishing are used to protect certain habitats and species in the NE Atlantic and could be applied to protect this habitat. This is a matter that falls within 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 Marine Protected Areas).

*M. modiolus* has been placed on the Red List of Macrofaunal Benthic Invertebrates of the Wadden Sea, and *Modiolus* beds are the subject of a specific UK Biodiversity Action Plan. In some locations the beds are also a key feature within some of the Annex I habitats listed in the EU Habitats & Species Directive and therefore given protection through the designation of Special Areas of Conservation.

## Further information

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