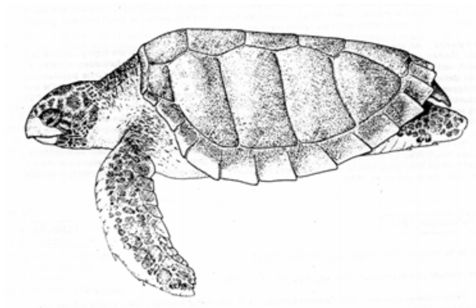
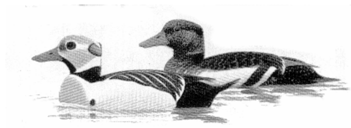
OSPAR COMMISSION

Case Reports for the OSPAR List of threatened and/or declining species and habitats

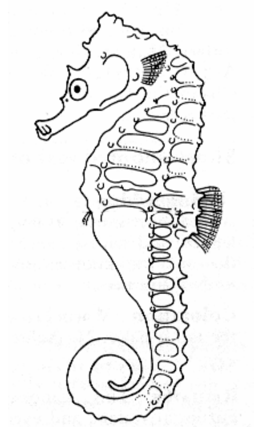
Biodiversity Series

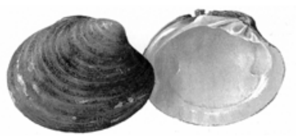
2008

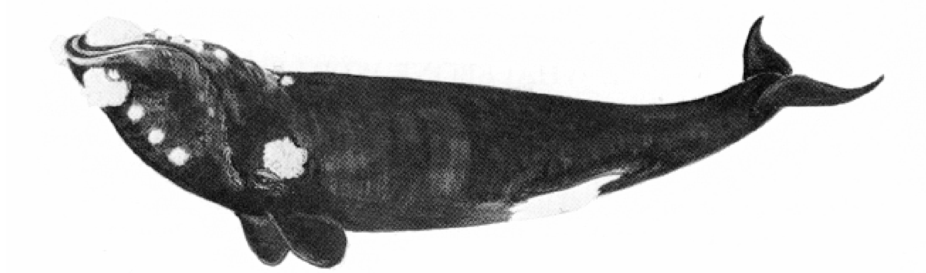


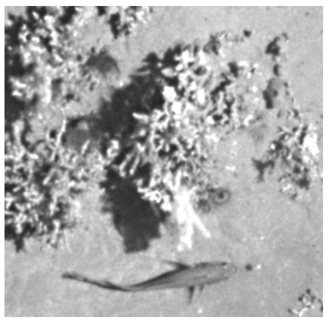


CASE REPORTS
for the OSPAR LIST of THREATENED and/or DECLINING SPECIES and HABITATS









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Executive summary

The OSPAR List of Threatened and/or Declining Species and Habitats (OSPAR List) has been developed to fulfil the commitment set up in the OSPAR Biological Diversity and Ecosystems Strategy that the OSPAR Commission will assess which species and habitats in the OSPAR maritime area need to be protected. This work is intended to guide the setting of priorities by the OSPAR Commission for its activities in implementing Annex V to the OSPAR Convention ("On the Protection and Conservation of the Ecosystems and Biological Diversity of the Maritime Area").

The OSPAR List has been developed on the basis of nominations by Contracting Parties and observers to the OSPAR Commission of those species and habitats that they consider to be priorities for protection. The evidence in support of these nominations has been collectively examined by the OSPAR Commission and its subordinate bodies on the basis of the relevant Texel/Faial criteria for the identification of species in need of protection (*Reference number 2003-13*). The information provided in support of nominations has been reviewed by the International Council for the Exploration of the Sea (ICES), in order to give assurance that its quality is suitable for the purpose for which it has been used[1]. This information is compiled in this justification report.

The purpose of the OSPAR List is to guide the OSPAR Commission in setting priorities for its further work on the conservation and protection of marine biodiversity. The inclusion of a species or of a type of habitat on the List has no other significance.

Fish species affected by fishing in the OSPAR List are marked with an asterisk (*). These species are subject to management by an international or national fisheries authority or body. The OSPAR Commission has no competence to adopt programmes or measures on questions relating to the management of fisheries. Where the OSPAR Commission considers that action is desirable in relation to such a question, it is to draw that question to the attention of the authority or international body competent for that question. The inclusion of species affected by fishing in this list must be read in this context.

In order to avoid duplication of work, other international agreements (in particular, EC Directives (including the Council Directive 92/43/EEC on the conservation of natural habitats and wild flora and fauna and the Council Directive 79/409/EEC on the conservation of birds) and measures under the Berne Convention, the Bonn Convention (including its regional agreements) and the Ramsar Convention, amongst other relevant instruments) should also be taken into account by Contracting Parties to the extent that they are bound by them or committed to them.

The OSPAR Biodiversity and Ecosystems Strategy makes clear that it may be necessary to consider separate populations of species for the purposes of the strategy on the same basis as whole species. The OSPAR List therefore specifies certain populations of species where separate treatment is justified, because the different populations are subject to differing pressures. Where this is done, there is no implication that other populations of the same species may be threatened and/or declining.

The OSPAR Commission wishes to consider any information that could improve the basis for the judgements that have been made in drawing up the OSPAR List. Any relevant information should be supplied to the OSPAR Secretariat to enable its consideration.

This OSPAR List of Threatened and/or Declining Species and Habitats will be subject to further development. Species and habitats will be added to or removed from the List, in the light of changes to their conservation status and to the threats they face and in the light of the latest scientific assessments, according to the Texel/Faial criteria.

The footnotes form an integral part of the List.

[1] The assessments of that data by the OSPAR Commission and by ICES differ in respect of *Polysticta stelleri, Puffinus assimilis baroli, Thunnus thynnus* and Oceanic ridges with hydrothermal vents/fields. The justification for the OSPAR assessment of these species and habitats is set out in the justification report.

Récapitulatif

La Liste OSPAR des espèces et des habitats menacés et/ou en déclin a été élaborée pour satisfaire à l'engagement prévu dans la stratégie OSPAR de protection et de conservation des écosystèmes et de la diversité biologique, à savoir que la Commission OSPAR jugera des espèces et des habitats nécessitant une protection. Ces travaux ont pour but d'orienter la définition des priorités, par la Commission OSPAR, dans ses activités de mise en œuvre de l'Annexe V à la Convention (« sur la protection et la conservation des écosystèmes et de la diversité biologique de la zone maritime »).

La Liste OSPAR est basée sur les nominations par les Parties contractantes et les observateurs à la Commission OSPAR des espèces et des habitats qu'ils considèrent comme nécessitant une protection prioritaire. Les preuves à l'appui de ces désignations ont été collectivement examinées par la Commission OSPAR et par ses organes subsidiaires par rapport aux critères pertinents de détermination des espèces et des habitats devant être protégés (critères Texel-Faial, numéro de référence 2003-13). Les informations fournies à l'appui des nominations ont été revues par le Conseil International pour l'Exploration de la Mer (CIEM), de manière à avoir l'assurance que leur qualité convient aux fins pour lesquelles elles ont été exploitées[2]. Les renseignements utilisés ont été rassemblés dans le présent rapport justificatif

L'objectif de la Liste OSPAR est de guider la Commission OSPAR dans la définition des priorités dans la poursuite de ses travaux sur la conservation et la protection de la biodiversité du milieu marin. L'inscription d'une espèce ou d'un type d'habitat sur la Liste n'a pas d'autre signification.

Les espèces halieutiques affectées par la pêche, dans la Liste OSPAR, sont indiquées par un astérisque (*). Ces espèces sont gérées par une autorité ou un organisme national ou international de la pêche. La Commission OSPAR ne dispose pas des compétences qui lui permettraient d'adopter des programmes ou des mesures visant les questions de gestion des pêcheries. Lorsque la Commission OSPAR considère qu'une action est souhaitable en ce qui concerne une telle question, elle doit attirer l'attention de l'autorité ou de l'organisme international compétent dans ce domaine sur cette question. L'inscription doit être vue dans ce contexte.

Afin d'éviter une répétition des travaux, il conviendrait que les Parties contractantes tiennent compte également d'autres accords internationaux (en particulier les Directives communautaires (dont la Directive 92/43/CEE du Conseil sur la conservation des habitats naturels ainsi que de la flore et de la faune sauvages et la Directive 79/409/CEE du Conseil sur la conservation des oiseaux) ainsi que des mesures dans le cadre de la Convention de Berne, de la Convention de Bonn (dont ses accords régionaux) et de la Convention de Ramsar, parmi d'autres instruments pertinents) dans la mesure où elles sont liées par ces accords ou mesures ou qu'elles y sont engagées.

Dans la stratégie OSPAR visant la biodiversité et les écosystèmes, il est clairement indiqué qu'il se peut qu'il soit nécessaire, aux fins de la stratégie, de considérer des colonies distinctes d'une même espèce comme s'il s'agissait de l'ensemble de l'espèce. La Liste OSPAR spécifie en conséquence certaines colonies d'espèces pour lesquelles un traitement séparé est justifié, ceci car les diverses populations ne sont pas soumises aux mêmes pressions. Dans de tels cas, ceci n'implique pas que d'autres populations de la même espèce sont susceptibles d'être menacées et/ou en déclin.

La Commission OSPAR souhaite considérer tout élément d'information qui pourrait améliorer la base des jugements qui ont été portés pour dresser la Liste OSPAR. Tout renseignement pertinent devrait être soumis au Secrétariat OSPAR pour examen.

L'élaboration de la Liste OSPAR des espèces et des habitats menacés et/ou en déclin se poursuivra. Des espèces et des habitats seront ajoutés ou retirés de la Liste, à la lumière des modifications apportées à leur statut de conservation et aux menaces auxquelles ils sont confrontés ainsi qu'à la lumière des toutes dernières évaluations scientifiques, selon les critères de Texel/Faial.

Les notes de bas de page font partie intégrante de la Liste.

[2] Les évaluations de ces données par la Commission OSPAR et par le CIEM diffèrent en ce qui concerne *Polysticta stelleri, Puffinus assimillis baroli, Thunnus thynnus* et les dorsales océaniques comportant des sources/champs de sources hydrothermales. La justification de l'évaluation OSPAR de ces espèces et habitats figure dans le rapport justificatif.

Introduction

A first version of this report was published in 2003 following the adoption of the Initial OSPAR List of Threatened and/or declining species andf habitats by OSPAR in 2003. The report was updated in 2005, to include the case reports of the two fish species and four habitats which were added to the list by OSPAR 2004, and in 2008 to include the case reports for four bird species, nine fish species and two habitats that were added to the list by OSPAR 2008.

A major element of OSPAR work on species and habitat conservation has been the development of the Texel-Faial criteria for the identication of those species and habitats in need of protection, conservation, and where practical, restoration and/or surveillance or monitoring (*Reference number 2003-13*).

In 2000 the OSPAR Biodiversity Committee, invited Contracting Parties and Observers to use these criteria to propose species and habitats for an OSPAR inventory of those species and habitats in the OSPAR maritime area that are threatened and/or declining. The various stages of review for the species and habitats that were nominated are shown in Table 1. This process led to the adoption of an Initial OSPAR List of Threatened and/or Declining Species and Habitats at the OSPAR Ministerial Meeting in 2003 and its amendment at OSPAR 2004. A further round of nominations was opened in 2006 leading to the inclusion of further species and habitats in the list at OSPAR 2008 and the removal of the word “initial” from its title. The qualification of a species or habitat for inclusion in the Llist leads to the preparation of the case reports that are compiled in this report.

The format used to prepare case reports for the species and habitats on the List has the following sections:

1. Geographical extent – including occurrence in OSPAR Regions, biogeographic zones (as specified in the original questionnaire) and region and biogeographic zone specified for decline and/or threat.
2. Application of the Texel-Faial criteria – information about each criterion under which the species/habitat has been proposed.
3. Relevant additional considerations – comments on the sufficiency of the data, how changes related to natural variability, the extent to which expert judgement has been used to make the nomination and a report of the ICES evaluation.
4. Threat and link to human activities – a cross reference to the checklist of human activities in the OSPAR Guidelines for the Management of Marine Protected Areas (*reference number: 2003-18*).
5. Management considerations – initial ideas on possible management mechanisms, note of whether the species/habitat is already listed for protection under other Conventions, and the potential role of OSPAR or other bodies in the management of the species/habitat.
6. Further Information – Source of nomination, contact persons and useful references.

Case reports for the first tranche of species and habitats included in the List in 2003 and 2004 were prepared initially by S. Gubbay under contract from the Directorate-General of Public Works and Water Management, National Institute for Coastal and Marine Management, the Netherlands. These were further revised following comments received from OSPAR Contracting Parties, Observers and the International Council for the Exploration of the Sea. The case reports for the species and habiatats added to the List in 2008 were prepared by the Contracting Party or Observer making the nomination.Two significant issues were raised during the work. These were the role of OSPAR in relation to the listed species and habitats, and the need for further species and habitats to be considered for the List.

Role of OSPAR

Each case report includes a section on “management considerations”. In these sections it is made clear that OSPAR is not able to introduce measures that fall under the remit of fisheries organisations. Rather, it is suggested that OSPAR might communicate an opinion to such (management) bodies about species and habitats on the OSPAR List. This type of role for OSPAR has been a matter of concern to Iceland and it highlights the need for OSPAR to consider in more detail what actions it might take and under what management framework, to fulfil its desired objective to support the protection, conservation, and where practical, restoration and/or surveillance or monitoring of species and habitats on the OSPAR List.

Further species and habitats

The ICES evaluation of the nominations included some of the nominated habitats that were not on the initial draft list and they concluded that some of these should be a high priority for the whole OSPAR area. The review of bird species by the ICES Working Group on Seabird Ecology ICES also made some additional suggestions. These were that the scientific case for including the Bulwer's petrel and Madeiran storm-petrel in the priority list of declining and threatened species within the OSPAR area would be strong, and that these cases might merit further evaluation. The group also suggested that a list of species that are endemic to the OSPAR area, or for which most of the world population occurs within the OSPAR area, would be a useful document, since that would focus some attention on endemic biodiversity, regardless of whether such species (or subspecies) have declining or threatened populations. Such a list would include the great skua (*Catharacta skua*), the only seabird endemic to the OSPAR area, and the northern gannet and European storm-petrel, which have very high proportions of their global population within the OSPAR area.

Acknowledgements

Many organisations and individuals provided information and feedback on the draft species and habitat case reports. Thanks to Heads of Delegations of Contracting Parties and Observers for this assistance and in particular to the following:

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TABLE 1: Timetable of actions undertaken to develop the OSPAR List of Threatened and/or Declining Species and Habitats

Event	**Work undertaken**
IMPACT 1995	Netherlands start programme of work on criteria for selection of habitats and species for conservation measures under OSPAR.
Texel Workshop, Feb. 1997	Initial drafting of criteria together with preliminary lists of habitats & species for illustrative purposes.
Faial Workshop, July, 1999	Further development of criteria and of preliminary lists of habitats and species.
BDC, Nov 2000	Agreement to continue the work with a strong focus on lists of threatened and declining species and habitats.
Intersessional work 2000/2001	Contracting Parties and Observers nominate species and habitats using questionnaires.
Intersessional work 2001	Compilation of report evaluating questionnaire returns on species and habitats.
Leiden workshop, Sept. 2001	Review and further assessment of nominations. Agreement on initial draft lists of species and habitats to be presented to BDC.
BDC, Nov. 2001	Further review and evaluation of initial draft lists. Request for case reports and further review by ICES.
Intersessional work 2002	Further review and evaluation of initial draft list carried out by ICES.
Intersessional work 2002	Case reports prepared for each species and habitat on the initial draft list, including evaluation by ICES, for submission to BDC 2003.
OSPAR 2003	Adoption of the OSPAR Initial List of Threatened and/or Declining Species and Habitats.
OSPAR 2004	Update of the OSPAR Initial List with the addition of two fish species and four habitats. Descriptions of habitats on the OSPAR Initial List were also agreed in 2004 and included in the case studies.
BDC 2006/OSPAR 2006	BDC 2006 agreed on revisions to the working definitions of habitat types. OSPAR agreed that seamounts should be retained in the habitats section of the Initial OSPAR List of threatened and/or declining species and habitats, and the footnote qualifying their inclusion should be removed
BDC 2006	BDC invited Contracting Parties to submit further nominations for threatened and/or declining species and habitats
MASH 2006/BDC 2007	First review of additional nominations and peer review of nomnations by ICES
MASH 2007/BDC 2008	Selection of further speceis and habitats for inclusion in the list and finalisation of case report
OSPAR 2008	Inclusion of a further four bird species, nine fish species (sharks and rays) and two habitats in the list. Removal of the word “initial” from the title of the List

Table 2: OSPAR List of Threatened and/or Declining Species and Habitats
Part I - Species

SCIENTIFIC NAME	COMMON NAME	OSPAR Regions[3] where the species occurs	OSPAR Regions[3] where the species is under threat and/or in decline	Date of inclusion in the List
INVERTEBRATES				
Arctica islandica	Ocean quahog	I, II, III, IV	II	2003
Megabalanus azoricus	Azorean barnacle	V	All where it occurs	2003
Nucella lapillus	Dog whelk	All	II, III, IV	2003
Ostrea edulis	Flat oyster	I, II, III, IV	II	2003
Patella ulyssiponensis aspera	Azorean limpet	V	All where it occurs	2003
BIRDS				
Larus fuscus fuscus	Lesser black-backed gull	I	All where it occurs	2003
Pagophila eburnea	Ivory gull	I	All where it occurs	2008
Polysticta stelleri	Steller's eider	I	All where it occurs	2003
Puffinus assimilis baroli (auct.incert.)	Little shearwater	V	All where it occurs	2003
Puffinus mauretanicus	Balearic shearwater	II, III, IV, V	All where it occurs	2008
Rissa tridactyla	Black-legged kittiwake	I, II, III, IV, V	I, II	2008
Sterna dougallii	Roseate tern	II, III, IV, V	All where it occurs	2003
Uria aalge – Iberian population (synonyms: *Uria aalge albionis, Uria aalge ibericus*)	Iberian guillemot	IV	All where it occurs	2003
Uria lomvia	Thick billed murre	I	All where it occurs	2008

[3] The OSPAR Regions are:

I - **the Arctic**: the OSPAR maritime area north of latitude 62°N, but also including Iceland and the Færoes;

II - **the Greater North Sea**: the North Sea, the English Channel, the Skagerrak and the Kattegat to the limits of the OSPAR maritime area, bounded on the north by latitude 62°N, on the west by longitude 5°W and the east coast of Great Britain, and on the south by latitude 48°N;

III - **the Celtic Seas**: the area bounded by, on the east, longitude 5°W and the west coast of Great Britain and on the west by the 200 metre isobath (depth contour) to the west of 6°W along the west coasts of Scotland and Ireland;

IV - **the Bay of Biscay/Golfe de Gascogne and Iberian coasts**: the area south of latitude 48°N, east of 11°W and north of latitude 36°N (the southern boundary of the OSPAR maritime area);

V - **the Wider Atlantic**: the remainder of the OSPAR maritime area.

SCIENTIFIC NAME	COMMON NAME	OSPAR Regions where the species occurs	OSPAR Regions where the species is under threat and/or in decline	Date of inclusion in the List
FISH				
**Acipenser sturio*	Sturgeon	II, IV	All where it occurs	2003
**Alosa alosa*	Allis shad	II, III, IV	All where it occurs	2003
**Anguilla anguilla*	European eel	I, II, III, IV	All where it occurs	2008
**Centroscymnus coelolepis*	Portuguese dogfish	All	All where it occurs	2008
**Centrophorus granulosus*	Gulper shark	IV, V	All where it occurs	2008
**Centrophorus squamosus*	Leafscale gulper shark	All	All where it occurs	2008
**Cetorhinus maximus*	Basking shark	All	All where it occurs	2003
Coregonus lavaretus oxyrinchus	Houting	II	All where it occurs	2003
**Dipturus batis* (synonym: *Raja batis*)	*Common skate*	*All*	All where it occurs	2003
**Raja montagui* (synonym: Dipturus montagui)	*Spotted ray*	*II, III, IV, V*	All where it occurs	2003
**Gadus morhua*– populations in the OSPAR regions II and III[4]	Cod	All	II, III	2003
Hippocampus guttulatus (synonym: *Hippocampus ramulosus*)	Long-snouted seahorse	II, III, IV, V	All where it occurs	2004
Hippocampus hippocampus	Short-snouted seahorse	II, III, IV, V	All where it occurs	2004
**Hoplostethus atlanticus*	Orange roughy	I, V	All where it occurs	2003
**Lamna nasus*		All	All where it occurs	2008
Petromyzon marinus	Sea lamprey	I, II, III, IV	*All where it occurs*	2003
**Raja clavata*	Thornback skate/ ray	I, II, III, IV, V	II	2008
**Rostroraja alba*	White skate	II, III, IV	All where it occurs	2008
**Salmo salar*	Salmon	I, II, III, IV	All where it occurs[5]	2003
**Squalus acanthias*	(Northeast Atlantic) spurdog	All	All where it occurs	2008
**Squatina squatina*	Angel shark	II, III, IV	All where it occurs	2008
**Thunnus thynnus*	Bluefin tuna	V	All where it occurs[6]	2003
REPTILES				
Caretta caretta	Loggerhead turtle	IV, V	All where it occurs	2003

4 That is, the populations/stocks referred to in ICES advice as the North Sea and Skagerrak cod stock, Kattegat cod stock, Cod west of Scotland, Cod in the Irish Sea, Cod in the Irish Channel and Celtic Sea.

5 In accordance with the comments of ICES in its review, the varying states of the numerous different stocks have to be taken into account.

6 The main threat is the high rate of catch of juvenile fish of the species (SCRS Report, page 59).

SCIENTIFIC NAME	COMMON NAME	OSPAR Regions where the species occurs	OSPAR Regions where the species is under threat and/or in decline	Date of inclusion in the List
Dermochelys coriacea	Leatherback turtle	All	All where it occurs	2003
MAMMALS				
Balaena mysticetus	Bowhead whale	I	All where it occurs	2003
Balaenoptera musculus	Blue whale	All	All where it occurs	2003
Eubalaena glacialis	Northern right whale	All	All where it occurs	2003
Phocoena phocoena	Harbour porpoise	All	*II, III*	2003

Table 3: OSPAR List of Threatened and/or Declining Species and Habitats Part II - Habitats

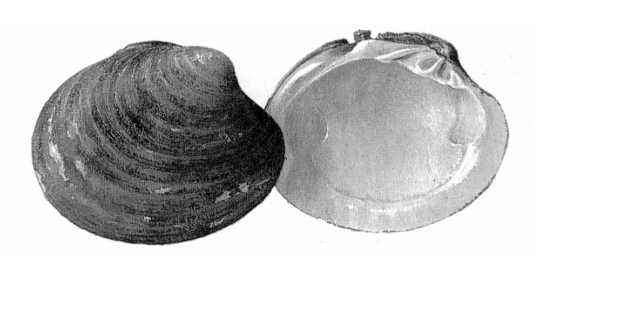
DESCRIPTION	OSPAR Regions where the habitat occurs	OSPAR Regions where such habitats are under threat and/or in decline	Date of inclusion in the list
HABITATS			
Carbonate mounds	I, V	V[7]	2003
Coral Gardens	I, II, III, IV, V	All where they occur	2008
Cymodocea meadows	IV	All where they occur	2008
Deep-sea sponge aggregations	I, III, IV, V	All where they occur	2003
Intertidal *Mytilus edulis* beds on mixed and sandy sediments	II, III	All where they occur	2004
Intertidal mudflats	I, II, III, IV	All where they occur	2003
Littoral chalk communities	II	All where they occur	2003
Lophelia pertusa reefs	All	All where they occur	2003
Maerl beds	All	III	2004
Modiolus modiolus beds	All	All where they occur	2004
Oceanic ridges with hydrothermal vents/fields	I, V	V	2003
Ostrea edulis beds	II, III, IV	All where they occur	2003
Sabellaria spinulosa reefs	All	II, III	2004
Seamounts	I, IV, V	All where they occur	2003
Sea-pen and burrowing megafauna communities	I, II, III, IV	II, III	2003
Zostera beds	I, II, III, IV	All where they occur	2003

7 To be confirmed in the light of further survey work being undertaken by Ireland

Biogeographic regions	1. (Holo)Pelagic - E. Atlantic Temperate - Warm-temperate waters 2. (Holo)Pelagic - E. Atlantic Temperate - Cold-temperate waters 3. (Holo)Pelagic - Arctic - Cold-Arctic waters 4. Shelf/UC Shelf - E. Atlantic Temperate - Warm-temperate pelagic waters 5. Shelf/UC Shelf - E. Atlantic Temperate - Azores shelf 6. Shelf/UC Shelf - E. Atlantic Temperate - Lusitanean (Cold/Warm) 7. Shelf/UC Shelf - E. Atlantic Temperate - Lusitanean-boreal 8. Shelf/UC Shelf - E. Atlantic Temperate - Cold-temperate pelagic waters 9. Shelf/UC Shelf - E. Atlantic Temperate - Boreal-lusitanean 10. Shelf/UC Shelf - E. Atlantic Temperate - seamounts and plateaus 11. Shelf/UC Shelf - E. Atlantic Temperate - Boreal 12. Shelf/UC Shelf - E. Atlantic Temperate - Norwegian Coast (Finnmark) 13. Shelf/UC Shelf - E. Atlantic Temperate - Norwegian Coast (Westnorwegian) 14. Shelf/UC Shelf - E. Atlantic Temperate - Norwegian Coast (Skagerrak) 15. Shelf/UC Shelf - E. Atlantic Temperate - South Iceland - Faroe Shelf 16. Shelf/UC Shelf - Arctic - Southeast Greenland 17. Shelf/UC Shelf - Arctic - North Iceland Shelf 18. Shelf/UC Shelf - Arctic - Northeast Greenland Shelf (incl. NEWP) 19. Shelf/UC Shelf - Arctic - High Arctic Maritime 20. Shelf/UC Shelf - Arctic - Barents Sea 21. Deep Sea - Atlantic 22. Deep Sea - Arctic subregion 23. Deep Sea - Atlantic subregion - North Atlantic Abyssal Province 24. Deep Sea - Hydrothermal Vents/Fields 25. Deep Sea - Lophelia pertusa-Reefs 26. Other

Nomination

Arctica islandica, Ocean quahog



Geographical extent

OSPAR Region; I,II,III,IV
Biogeographic zones: 6,7,8,9,11,13,14,15,
Region & Biogeographic zones specified for decline and/or threat: II/11

A.islandica is found buried in sediment on sandy and muddy sand from the low intertidal down to 400m. The species occurs on both sides of the North Atlantic and the Baltic. Within the OSPAR Maritime Area it has a distribution that extends from Iceland and the Faroes to the Bay of Biscay and includes the Irish Sea and North Sea, but not the wider Atlantic area (OSPAR Region V) (Merill & Ropes, 1969). This is thought to cover about 60% of its distribution area (AquaSense, 2001).

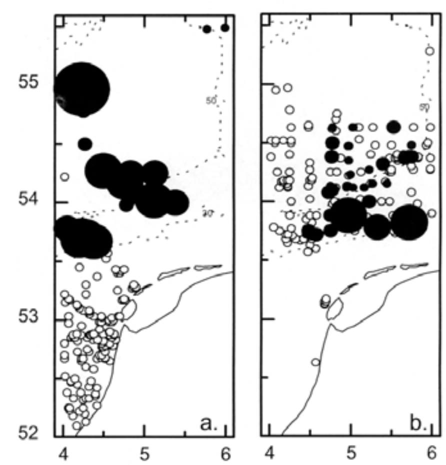
Application of the Texel-Faial criteria

A.islandica was nominated for inclusion on the OSPAR list with particular reference to decline, sensitivity with information also provided on threat, and as priority for OSPAR Region II.

Decline

Information on the distribution and density of *A.islandica* in the North Sea reveals significant changes during the last century. A comparison of historic epifauna data from 1902-1912 collected during ICES routine cruises in the North Sea, with epifauna data from the ICES-Benthos Survey of 1986, shows that *A.islandica* was present at 45% of the stations sampled in the early part of the century compared to between 20-30% of all stations in 1986 (Rumohr *et al*., 1998). Most of the difference was due to its absence at the shallower sampling stations between 30-50m. There is also information on the density of *A.islandica* in different parts of the North Sea including a detailed study of the south-eastern North Sea suggesting a significant decrease in relative abundance between 1972-80 and 1990-94 (Figure A).

FIGURE A. A comparison of relative densities of *A.islandica* in the south-eastern North Sea (fig.2.2. from Whitbaard, 1997).



The size of the circles corresponds to the relative abundance. Hollow circles indicate the absence despite sampling (a) abundance as estimated by Noort *et al* (1979-1986) between 1972 and 1980 (b) densities determined from cruises with *RV Aurelia* and *RV Pelagia* between 1990 and 1994.

A study that examined the ecological requirements of *A.islandica* and used these to plot its potential distribution in the Dutch sector of the North Sea, suggested that it could potentially be more widespread. In particular, it was mainly absent from areas of apparently suitable habitat but where fishing intensity was high (AquaSense, 2001).

Sensitivity

The Ocean Quahog is a long-lived species with a very slow growth rate. Populations of 40-80 years old specimens with a substantial proportion over 100 years old have been observed. The population structure is often skewed with some locations dominated by juveniles and other by adults (AquaSense, 2001). These factors plus evidence of irregular recruitment or low juvenile survival mean that recovery may be very slow in areas where the population numbers become depleted.

Mechanical damage and incidental catch of *A.islandica* from bottom fishing gear is known to damage shells and lead to direct mortality (Piet *et* *al.,* 1998; Fonds, 1991, Klein & Whitbaard, 1995). This may have a particularly significant effect on sub-adult individuals as shell strength is correlated with size. *Arctica* can live with some shell damage but repeated disturbance may lead to death. After its planktonic larval stage *Arctica* settles on the seabed and is relatively stationary. It is therefore unlikely move away or burrow rapidly to avoid damage from rapidly approaching beam trawls.

Winter storms can wash *Arctica* ashore (Rees *et al.,* 1977) but as most populations in the North Sea live deep enough , this should not be an issue.

Threat

The main threat to *A.islandica* in OSPAR Region II is from disturbance to the seabed. This is particularly linked to beam trawling which is known to cause shell damage and direct mortality (e.g., Witbaard & Klein, 1994; Piet *et al*., 1998). Mortality of *Arctica* caught in a beam trawl has been estimated to be in the range of 74-90% (Fonds, 1991). Klein & Whitbaard (1995) have reported corresponding trends in the scar frequencies of *Arctica* shells and temporal fluctuations in the total engine capacity of the Dutch beam trawl fleet.

Other threats include sand and gravel extraction, where these coincide with the occurrence of *Arctica,* and direct as well as indirect effects of oil and gas extraction including suggested decrease in growth rates around exploration facilities (Witbaard, 1997).

A.islandic is recorded at significantly different densities across its range with the highest report in the northern parts of its distribution (up to 100/ m^2 compared to 16/m^2 in the northern North Sea and 0.18/m^2 in the south-eastern North Sea (Zatsepin & Filatova, 1961; Thórarinsdóttir & Einarsson, 1994: Witbaard, 1997). It is not clear whether there is any relationship between these figures and the intensity of human activities that pose a threat to this species.

It has been suggested that it is unlikely for *Arctica* to become extinct in the North Sea because of its relatively long pelagic larval stage (which is not affected by fishing activity), together with low catch-efficiency of the beam trawl for this species, and its wide-spread distribution in the North Sea (Witbaard, 1995).

Relevant additional considerations

Sufficiency of data

A comparison of present distribution with historical data is difficult as early records did not produce distributional maps or used a variety of sampling techniques that are not directly comparable. Some comparisons can be made using historic ICES data from the early 1900's (see section on decline). There are more easily comparable data fro the last few decades and ongoing studies on this species that should contribute to future assessments of its status.

Changes in relation to natural variability

A.islandica is subject to irregular recruitment and irregular survival of recruits, which will lead to natural fluctuations in population numbers and potentially, a long time scale for recovery of depleted populations. The likely contribution of natural variability to the observed declines in density and extent has not been determined.

Expert judgement

Changes in the abundance and the distribution of *A.islandica* in Region II have been documented in recent years as well as by using survey data from the early part of the 20th century. This is supplemented by detailed information for particular sectors of the North Sea. The damage caused to this species by bottom fishing activity has also been demonstrated, both in the field and in the laboratory. Nevertheless, without a systematic, repeat sampling programme that covers the whole of the North Sea, an element of expert judgement needs to be applied to assess the severity of the decline of this species throughout Region II.

ICES evaluation

The ICES review of this nomination (ICES, 2002) agreed that the species is impacted by bottom trawling fisheries and acknowledged the decline reported by Witbaard & Klein (1994). The group considered that there is no indication that the entire population is threatened (e.g. there is no decline in the Baltic and the species is common along the Norwegian coast). It should be noted however that some declines have been reported from outside the OSPAR Maritime Area (e.g. east coast of Denmark and the Keel Bight off the Baltic coast of Germany (Pearson *et al.,* 1985: Weigelt, 1991). This species is now only nominated for OSPAR Region II (the North Sea), which should address this concern.

ICES also noted that the failure of recruitment for many years in the North Sea is a possible point of concern and may be a signal, but there are no clues to the cause at the present time. The group suggests that further work is needed on the recruitment biology of this species to find possible explanations (ICES, 2002).

Threat and link to human activities

Cross-reference to checklist of human activities in OSPAR MPA Guidelines
Relevant human activity: Fishing, hunting, harvesting. Category of effect of human activity: Biological – removal of non-target species

Incidental shell damage and direct mortality of *Arctic*a has been linked to fishing (specifically beam trawling).

Field observations and laboratory experiments have shown that *A.islandica* is sensitive to damage from beam trawling e.g. a direct mortality of 20% in the tracks of a 12m trawl (Bergman & Van Santbrink, 2000). There is also some time series data on the incidence of shell damage that has been attributed to damage by fishing gear (Witbaard & Klein, 1994). Another potential link is that the decline in *Arctica* between the 1970's and 1990's in the Dutch sector the North Sea (Figure A) coincides with the intensification of beam trawl fisheries in this area (AquaSense, 2001).

Management considerations

The main cause of damage and direct mortality linked to human activity is the use of bottom fishing gear. Possible management options to reduce the threat to this species therefore include limiting or prohibiting disturbance of the benthos by such activity.

Management of fisheries in the OSPAR Region II falls under the remit of the European Common Fisheries Policy and the fisheries management bodies in Norway. OSPAR will therefore need to advocate management measures through these bodies as well as considering any additional actions that it can take to support appropriate measures introduced by such bodies.

Further information

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Sabine Christiansen, WWF International, Northeast Atlantic Programme, Am Guethpol 11, 28757 Bremen, Germany.

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Nomination

Megabalanus azoricus,
Azorean barnacle

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Geographical extent

OSPAR Regions; V
Biogeographic zones: 5
Region & Biogeographic zones specified for decline and/or threat: V

Megabalanus azoricus is considered to be endemic to the Azores Archipelago, although the phylogentic relationship to the *Megabalanus* occurring on Madeira and St. Helena is still not clear (Southward, 1998).

Application of the Texel-Faial criteria

There was a joint nomination by three Contracting Parties for the Azorean barnacle to be placed on the OSPAR list. The criteria were the global/regional importance, rarity, sensitivity, keystone status and decline. Information was also provided on threat.

Global/regional importance

The OSPAR Maritime Area is of global and regional importance for this species as it is considered to be endemic to the Azores.

Rarity

M.azoricus has a very restricted distribution in coastal habitat around the Azores where it is generally confined to a narrow subtidal area, from the infralittoral fringe down to 5 m depth, exceptionally to 15-40 m, on bedrock in areas that are moderately to highly exposed to wave action.

Sensitivity

The Azorean barnacle is considered to be very sensitive due to the restricted habitat in which it occurs and the ease with which it can be collected. This is the case as most of the population is concentrated a few meters below the surface. The zone that it colonises also makes it very vulnerable to contamination by oil pollution that washes ashore.

Keystone species

The empty shells of the barnacles are a vital habitat for the blennies *Parablennius rubber P. incognitus* and *Coryphoblennius galerita* as they provide shelter and substrata for egg deposition during reproduction. A large number of invertebrate species, including hydroids, sponges, polychaetes, crustaceans, molluscs, echinoderms (*Ophiotrix fragilis, Arbacia lixula* and *Paracentrotus lividus*), and bryozoans also use the empty shells.

Decline

The available quantitative and anecdotal information points to at least a significant decline around the Azores following the increase in exploitation over the last two decades.

Threat

The main threat to the Azorean barnacle is overexploitation as it is considered to be a delicacy on the islands of the Azores. Degradation of suitable habitat and poor water quality are other threats to this species.

Relevant additional considerations

Sufficiency of data

There is limited information on the status, harvesting and ecology of *M.azoricus* at the present time. Knowledge of its reproductive and recruitment success is also sparse. It seems that this is a fast growing, hermaphroditic species with seasonal spawning. The roles of complementary males and self-fertilisation needs to be assessed. It has been suggested that the length of first sexual maturity is 12 mm (rostral diameter – major length of the top of shell) (Regala, 1999).

Changes in relation to natural variability

Little is known about natural variability of the population of *M.azoricus* and knowledge of its reproductive and recruitment success is sparse. Predation by gastropods (*Stramonita haemastoma*) and blennies (*P. incognitus*) may control the populations of this barnacle and storms may influence the population size, especially in overcrowded areas.

Expert judgement

Expert judgement has played a part in putting this species forward for the OSPAR list. This is because there is limited information on its status but available quantitative and anecdotal information point to a decline. The threat to the Azorean barnacle is clear as it is harvested from shallow sublittoral areas around the islands of the Azores. An important additional consideration is that it appears to be endemic to the Azores and therefore to the OSPAR Maritime Area.

Threat and link to human activities

Cross-reference to checklist of human activities in OSPAR MPA Guidelines
Relevant human activity: Fishing, hunting, harvesting; *Category of effect of human activity:* Biological – removal of target species; Chemical – hydrocarbon contamination.

The main threat to this species is clearly linked to a human activity, as it is due to the collection of barnacles for consumption.

Management considerations

Management actions to safeguard this species should concentrate on regulating the fishery. This could include no-take zones, permits, minimum sizes, quotas and the need to provide landings records. A ban on fishing and trade was introduced for a year in 1984 but the fishery is not subject to any regulation at the present time.

Further information

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Joint submission by Iceland, Portugal and UK

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Useful References:

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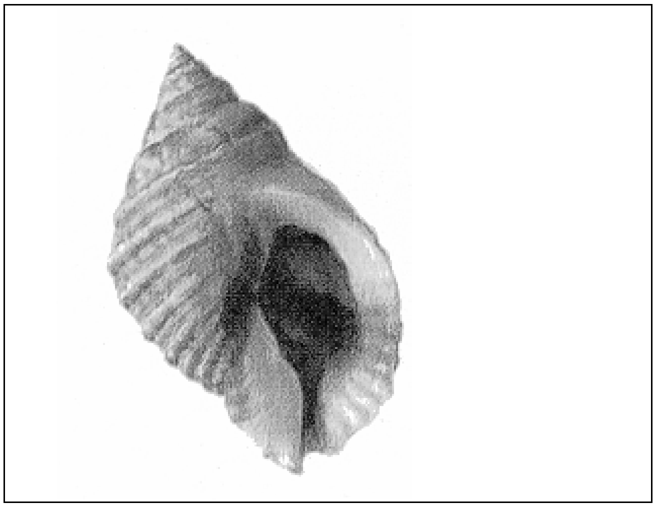
Nomination
Nucella lapillus,
Dog Whelk



Geographical extent
OSPAR Region; All
OSPAR Biogeographic zones: 4,6,7,9,11,14
Region & Biogeographic zones specified for decline and/or threat: II,III,IV

N.lapillus is a gastropod mollusc that is found on wave exposed to sheltered rocky shores. It is widely distributed on both sides of the North Atlantic where there is suitable habitat. In the OSPAR Maritime Area, its distribution extends from Iceland in the north, to Portugal in the south and includes Irish Sea and North Sea coasts.

Application of the Texel-Faial criteria
N.lapillus had two nominations for inclusion on the OSPAR list. The criteria in common were decline and sensitivity, with information also provided on threat.

Decline

Dog whelk populations are known to have declined in certain locations throughout their range in the OSPAR Maritime Areas. They used to be very common on the Belgium coast but disappeared during the end of the 1970s and early 1980s (Kerckhof, 1988). In the UK, local declines have been reported by Bryan *et al*., (1986) in south-west England.

The decline has been linked to contamination effects of tributyltin (TBT) compounds used in antifouling paints (see section on threats). Evans *et al.*, (1996) have suggested, for example, that the extinction of populations in Tarbert Harbour, western Scotland, the Clyde Sea, Lerwick in Shetland, the Solent, Channel Islands, Isle of Wight and east coast of the North Sea were probably due to TBT contamination. Since the introduction of a ban on use of TBT on small craft, some populations have recovered (e.g. Evans *et al.,* 1994;1995; Moore *et al.*, 2000). Nevertheless ten years after the introduction of restrictions on the use of TBT, biological effects are still evident many areas in OSPAR Region III, although often at a lower levels than some years previously (Harding *et al.,* 1998 in OSPAR 2000). Areas frequented by large vessels (which are not covered by the ban) such as such as Cork Harbour in Ireland, Sullom Voe in Scotland, and Milford Haven in south Wales, are still ‘hot spots’ of TBT contamination (e.g. Minchin *et al*., 1996; Moore *et al.*, 1995; Morgan *et al*., 2000).

Sensitivity

An assessment of the sensitivity of *N.lapillus,* based on a literature review by the Marine Life Information Network for Britain & Ireland (MarLIN), lists this species as being highly sensitive to synthetic compound contamination, changes in nutrient levels, and substratum loss (Tyler-Walters, 2002).

The most extensively studied sensitivity is in relation to TBT, which is known to cause an irreversible condition known as ‘imposex’ where female whelks develop male characteristics. The effects can be seen from very low concentrations. Imposex in *N. lapillus* is fully developed at ambient TBT concentrations of 1-2 ng/l and at 3ng/l or more females are fully sterilised (Gibbs & Bryan, 1996). The percentage of females in a locality falls with increasing degree of imposex which puts additional pressure on the population (Bryan *et al* 1986).

Sensitivity to changes in nutrient levels have been described by Gibbs *et al.* (1999) who reported a massive kill of *N. lapillus* in Bude Bay, north Cornwall, and suggested that the mass mortalities may have been caused by eutrophication and summer algal blooms linked to a new sewage outfall in the area.

N.lapillus has also been shown to be severely affected by toxic algal blooms. These have been reported from South West Ireland following a bloom of *Gyrodinium aureolum* in 1979 (Cross & Southgate, 1980), a bloom of *Chrysochromulina polylepis* in the Kattegat, Skagerrak and Norwegian coast of the North Sea in 1988 (Underdal *et al.,* 1989), and up to 98-99% mortality of dog whelks exposed to a toxic bloom of *Chrysochromulina polylepis* in Gullmar Fjord, west Sweden in June 1988 (Robertson, 1991).

Dogwhelks do not have planktonic larvae. Instead the juvenile emerge from egg capsules laid on the shore. This limits possibilities for recruitment once populations have become locally extinct. In these situations recovery is dependant on recolonisation, and may take many years due to their poor dispersal capability.

Threat

In the OSPAR Maritime Area, the main threat to *N.lapillus* is from pollution. Imposex in dog whelks, which has been linked to exposure to TBT from antifouling paints, is one of the most widely reported threats. It was first recognised in *N.lapillus* by Blaber (1970) in dog whelks collected from the south coast of England. Significant changes were also noted between its incidence in the late 1960's and 1985, with the incidence of imposex rising from 5% and less than 0.1% at two sites studied, to 67% and 48% respectively. The effects of TBT have since been observed in dog whelks from the coastal areas of all countries bordering the North Sea, the Atlantic coast of Spain and Portugal, as well as in the more remote northern shores around Iceland (OSPAR 2000; Svavarsson & Skarphéoinsdóttir, 1995; Skarphédinsdóttir *et al.,* 1996). In Portugal the contamination is still increasing.

It has been suggested that the high levels of imposex in dogwhelks around marine European shipping and fishing ports are unlikely to decline until TBT is banned on all vessels (Minchin *et al.,* 1995). Even then, there is the possibility of a continued contamination as TBT is persistent in sediments (Bryan & Gibbs, 1991; Hawkins *et al.* 1994).

Relevant additional considerations

Sufficiency of data

There is a considerable body of information on dog whelk populations as well as changes in population numbers following the discovery of a link between TBT contamination and imposex. These studies continue, and have shown recovery of the populations in some areas as well as no improvement in other areas.

Changes in relation to natural variability

The significant decline in dog whelk populations reported in the last two decades have been linked to TBT contamination rather than the result of natural fluctuations in population numbers. A reduction in recruitment caused by a lowered reproductive capacity, therefore appears to be responsible for the decline in *N.lapillus* numbers.

Expert judgement

A link between decline in dog whelk populations, imposex, and TBT has been demonstrated clearly, both in the field and in the laboratory. There have also been documented declines in populations following oil spills and toxic blooms. Consideration of the case on the basis of expert judgement, has therefore not been necessary.

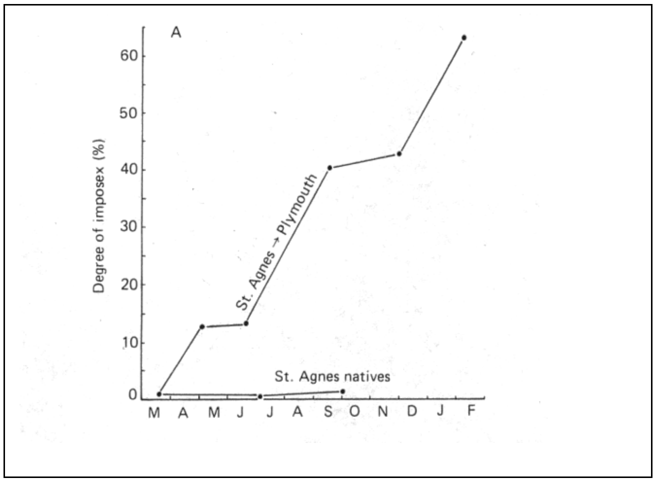
Threat and link to human activities

Cross-reference to checklist of human activities in OSPAR MPA Guidelines
Relevant human activities: Shipping and navigation; tourism & recreational activities; *Category of effect of human activity:* Chemical – synthetic compound contamination.

A direct link has been made between the decline in dog whelk populations and the concentration of TBT in surrounding waters. There is evidence from field observations and laboratory studies that organotins originating from the TBT compounds used in antifouling points cause imposex in dogwhelks, even at very low concentrations (e.g. Bryan *et al.,* 1986; Harding *et al.,* 1988; Gibbs *et al.,* 1991; Ruis *et al.,* 1998).

Further evidence for the relationship between imposex and TBT comes from transplantation experiments where dogwhelks were moved to areas where there was a high seawater concentration of tin. This resulted in a gradual increase in the degree of imposex (Figure A).
Oil pollution on rocky shores, and subsequent clean up operations are another potential threat to dog whelk populations (e.g. IPIECA, 1995). Declines have been observed following contamination of rocky shore with varying times for recovery depending on factors such as the severity of the spill, type of contamination, exposure of the shore, weather conditions and status before the incident (e.g. Bryan, 1968; Baker, 1976).

FIGURE A. Effect of transplantation on degree of imposex for dogwhelks moved from a relatively uncontaminated area (St. Agnes) to a contaminated area (Plymouth)
(from Bryan *et al.,* 1986)



Management considerations

TBT contamination has been determined as a major factor in the decline of dog whelk populations. The use of TBT based paints on vessels under 25m was first banned by France in 1982 and there is now a similar ban throughout the North Sea. In Portugal it was banned in 1993.

A more extensive ban is being promoted by the International Maritime Organisation (IMO) who adopted 'The International Convention on the Control of Harmful Anti-fouling Systems on Ships' on 5 October 2001. The Convention has still to come into force however, the IMO Assembly, also agreed to an effective implementation date of 1 January 2003 for a ban on the application of organotin-based systems.

Further information

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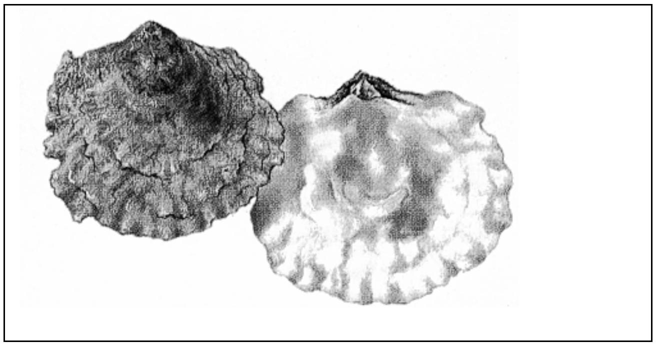
Nomination

Ostrea edulis, Flat Oyster



Geographical extent

OSPAR Region; I,II,III,IV
Biogeographic zones: 6,7,9,11,12,13
Region & Biogeographic zones specified for decline and/or threat: II/11

Ostrea edulis is a sessile, filter-feeding bivalve mollusc, associated with highly productive estuarine and shallow coastal water habitats. It is found naturally from the Norwegian Sea south through the North Sea down to the Iberian Peninsula and the Atlantic coast of Morocco, as well as in Mediterranean and Black Sea (Anon, 1999). It has also been cultivated in these areas as well as in North America, Australasia and Japan.

Application of the Texel-Faial criteria

O.edulis was nominated for inclusion on the OSPAR list with particular reference to global/regional/importance, rarity, decline, role as a keystone species, sensitivity and threat, and as a priority for OSPAR Region II and *O.edulis* beds have been nominated as a habitat.

Global/regional/local importance

O.edulis only occurs locally outside the OSPAR area in the Mediterranean and the northern shore of the Black Sea. The population in the OSPAR Maritime Area is therefore considered to be of global importance.

Decline

Natural stocks of *O.edulis* are known to have been more abundant and widespread in OSPAR Region II in the 18th and 19th centuries when there were large offshore oyster grounds in the southern North Sea and the English Channel. During the 20th century its abundance declined significantly in European waters (e.g. Korringa, 1952; Yonge, 1960; Svelle *et al*., 1997). Around 700 million oysters were consumed in London alone in 1864, for example, and the UK landings fell from 40 million in 1920 to 3 million in the 1960s, and have never returned to these levels (Edwards, 1997).

The northern 'coldwater' population, which used to thrive in areas such as the Firth of Forth, Schleswig Holstein and the Dutch Wadden Sea is extirpated and the southern warmer water population has declined (Korringa, 1976). *O.edulis* has also virtually disappeared from Belgian waters (Svelle *et al.,* 1997). It was believed to be extinct in the Dutch Wadden Sea from 1940 although a small number were found in 1992 (Dankers *et al.,* 1999). In recent years natural beds have become re-established in the Danish Limfjord and now support a fishery.

Keystone species

The role of the flat oyster and oyster beds in the ecology of marine communities has led to it being considered a keystone species (e.g. Coen *et al.,* 1998). These functions include providing a solid surface for settlement by other species, cryptic habitat that provides protection and nursery grounds for small fish and other species, stabilising sediment, which may in turn provide some protection from shoreline erosion, and filtration of large quantities of water.

Rarity

Natural beds of *O.edulis* have become increasingly rare in the North Sea and the species is extremely rare in parts of its former range such as the Wadden Sea where its status is considered to be 'critical' (under immediate threat of extinction) and therefore on the Red List of macrofaunal benthic invertebrates of the Wadden Sea (Petersen *et al.,* 1996). The populations in deeper waters in the southern North Sea, such as on the Oyster Grounds, disappeared during the 19th and 20th centuries (e.g. Benthem Jutting, 1943).

Sensitivity

An assessment of the sensitivity of *O.edulis* based on a literature review by the Marine Life Information Network for Britain & Ireland (MarLIN) (Jackson, 2001), lists this species as being highly sensitive to substrate loss, smothering (e.g. Yonge, 1960), synthetic compound contamination (e.g. Rees *et al.,* 2001), introduction of microbial pathogens/parasites (Edwards 1997), introduction of non-native species and direct extraction. The best evidence relates to it sensitivity to synthetic compounds and in particular tributyl tin.

Recovery is dependant on larval recruitment since the adults are permanently attached and incapable of migration. Recruitment is sporadic and dependent on the local environmental conditions, hydrographic regime and the presence of suitable substratum, especially adult shells or shell debris (Kennedy & Roberts, 1999). Recoverability is considered to be very low from substratum loss, smothering, extraction and introduction of microbial pathogens/parasites, in one case taking around 20 years (Spärck 1951, in Jackson 2001).

Threat

The main threats to *O.edulis* in OSPAR Region II have been over-exploitation for fisheries, poor water quality, and the introduction of other (warm water) races as well as other oyster species. The parasitic protozoan *Bonamia ostreae* is also known to have caused massive mortalities of *O.edulis* in France, the Netherlands, Spain, Iceland and England (Edwards, 1997).

Poor water quality and the resulting pollution specifically in the case of tributyl tin antifouling paints is known to have stunted growth of *O.edulis* and may also have affected reproductive capacity (Rees *et al.*, 2001)

Oyster grounds have been degraded in some areas by the introduced alien species *Crepidula fornicata*. This species is a filter feeder creating 'mussel mud' which degrades the grounds and hinders recruitment to oyster beds although the dead shells provide a surface on which the oyster spat do settle. The American oyster drill *Urosalpinx cinerea* is another alien species and is a predator of the flat oyster.

The cultivation and spread into the wild of the Pacific oyster *Crassostrea gigas* is another threat as there is a possibility that it may take over the niche of the native oyster and therefore limit the opportunities for recolonisation by *O.edulis*. At the present time it is unclear whether this is likely to happen (e.g. Drinkwaard, 1999; Reise, 1998; Nehring, 1998).

Relevant additional considerations

Sufficiency of data

Data on the status of naturally occurring stocks of *O.edulis* is available from a number of sources including landings records, benthic sampling and detail studies at particular locations. This information is considered to be a sufficient basis on which to determine that the species has declined in OSPAR Region II and is under threat from a variety of human activities.

Changes in relation to natural variability

Natural causes such as disease and severe winters may have contributed to the decline of *O.edulis* in the North Sea. There were high mortalities following severe winters such as those experienced in 1947 and 1963 for example, and in the UK the east coast stock has not recovered to the pre-1963 levels (Anon, 1999). Many other factors also affect oyster stock abundance as the species has a very variable recruitment from year to year. These include temperature, food supply, and hydrodynamic containment in a favourable environment. It may also be the case that spawning stock density or biomass may be too low in many areas to ensure synchronous spawning or sufficient larval production for successful settlement (Jackson, 2001).

Expert judgement

Changes in the distribution and abundance of *O.edulis* and *O.edulis* beds, have been recorded in many parts of its former range in the North Sea. This includes information from studies of specific areas such as the Wadden Sea (Reise & Schubert, 1987: Reise *et al.,*1989) and national records, as in the case of Belgium (e.g. Svelle *et al.,* 1997). The data provide a sound basis on which to report the threat to this species and its decline in OSPAR Area II.

ICES evaluation

The ICES review of this nomination by the states that there is good evidence of widespread decline of natural stocks of *O.edulis* and that overexploitation, the introduction of other (warm water) races and other oyster species, disease, and severe winters have all contributed to the decline of this species (ICES, 2002). ICES also report that there are some signs of recovery, e.g. in the outer Skagerrak area, and along the Normandy coast, where specimens are occasionally found.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; landbased activities; aquaculture/mariculture. *Category of effect of human activity:* Biological – removal of target species, introduction of microbial pathogens or parasites, introduction of non-indigenous species; Chemical – synthetic compound contamination

There is a long history of collection and cultivation of *O.edulis* in northern Europe. The dramatic declines seen in stock abundance in the middle of the 19th century are attributed mainly to over-exploitation. By the late 19th century stocks were beginning to be depleted so that by the 1950s the native oyster beds were regarded as scarce (Korringa, 1952; Yonge, 1960; Edwards, 1997). Overfishing in areas such as the Wadden Sea have been cited as a major contributing factor to the decline (e.g. Reise, 1982; Jackson, 2001). More recent effects, such as those caused by TBT pollution, are also directly linked to human activities.

Management considerations

The flat oyster has been subject to exploitation and cultivation in countries surrounding the North Sea for many centuries. Management measures need to take account of the fact that it was and continues to be subject to husbandry and cultivation practices as well as fishing (Anon, 1999). Useful management measures include continued regulation of the fishery, control of the spread of introduced species, reduction of the risk of transmission of disease, and maintenance of suitable habitat to support successful spatfall.

Further information

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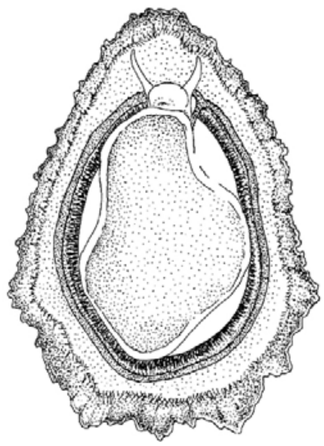
Nomination

Patella aspera
(Patella ulyssiponensis aspera)
Azorean limpet



Patella ulyssiponensis aspera was nominated for the OSPAR list as a Macronesian subspecies of *P.ulyssiponensis*. There has been some uncertainty about the systematics of Azorean limpets and the most recent work suggests that there are two distinct species - *P.aspera* which is endemic to Macaronesia, and *P.ulyssiponensis* which occurs on continental Europe (e.g. Hawkins *et al.,* 2000). The species nomination has therefore been amended to *P.aspera*. The local name for this species is "lapa brava".

Geographical extent

OSPAR Region; V
Biogeographic zone: 5
Region & Biogeographic zones specified for decline and/or threat: II/11

P.aspera (formally described as *P.ulyssiponensis aspera*) is believed to be endemic to the Macronesian islands. Its distribution in the OSPAR Maritime Area is limited to the islands of the Azores where it occurs on rocky substrates in the intertidal, and in the shallow sublittoral. (e.g. Christiaens, 1973; Titselaar, 1998).

Application of the Texel-Faial criteria

P.aspera was nominated for inclusion on the OSPAR list with particular reference to its decline, keystone status and sensitivity with information also present on threat.

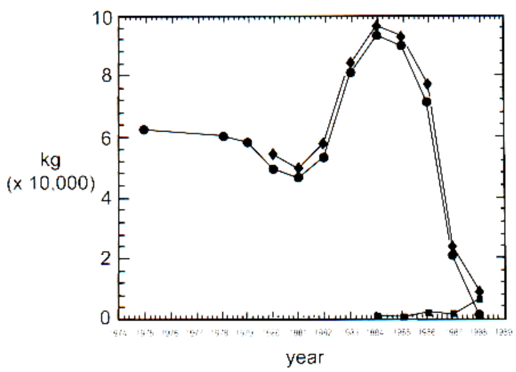
Decline

P.aspera is one of two species of limpet collected for human consumption in the Azores. Moderate harvests, mainly for self consumption, are believed to have taken place since the islands were colonised in the 15th century. A combination of easier access to sublittoral populations, improved refrigeration, increased commercial value and a hypothetical "limpet disease" led to a decline of stocks mainly in the Central group of islands (Faial, Pico, Terceira, São Jorge and Graciosa) in the mid to late 1980's and a collapse of the fishery by 1988 (e.g. Martins *et al.,* 1987; Santos *et al.* 1995; Ferraz *et al.,* 2001; Hawkins *et al.,* 2000) (Figure A). Effects have also been observed in the size distribution with more large individuals in professionally harvested landings than in unexploited stocks (Martins *et al*., 1987). Various fisheries management measures were introduced and since then populations appear to have recovered and are stable with regard to their biomass in the Central and Western Groups while those in the Eastern group of island (Santa. Maria and São Miguel) have not recovered from over-exploitation and seem to be dangerously low (Ferraz & Menezes, 1998 & 1999; Ferraz & Santos, 2000; Ferraz *et al*., 2001).

Keystone species

Limpets are known to have an important influence on the structure and function of rocky shore communities. They are dominant grazers that have a major influence on the community composition of rocky shores and can be considered keystone species (e.g. Raffaelli & Hawkins, 1996). Once removed, conditions may also change to a state that makes recolonisation less likely. In areas where uncontrolled human exploitation has taken place, for example, algal turfs tend to dominate the rock surfaces, which deprives the limpets of a lithothamnia covered nursery ground which can be easily grazed. There are only two species of patellid limpets found on the Azores therefore changes in the population status of *P.aspera* could have far reaching implications for rocky shore ecology of the islands.

FIGURE A. Collapse of the Sao Miguel limpet fishery (diamonds all islands; circles São Miguel, Squares other islands. Decline in landings (from Santos *et al*., 1990)



Sensitivity

P.aspera is thought to be a protandrous hermaphrodite. In heavily exploited populations the average size decreases and therefore the number of the large sized females is affected. This may lead to increased likelihood of recruitment failure due to lowered reproductive output. Genetically, it would also reduce the effective populations size considerably (Santos *et al.* 1995; Hawkins *et al.,* 2000). *P.aspera* is susceptible to "recruitment overfishing" due to distortion of the sex ratios by removal of the larger females, and to heavy exploitation which destroys the well-grazed lithothamnia dominated habitat needed for continual recruitment.

Threat

The main threat to *P.aspera* is overexploitation for the fishery. When harvesting was banned in the central group of islands in 1985 this increased exploitation in other islands, mainly in São Miguel and Santa Maria, and stocks in these islands have still to recover. The total ban on limpet collection in 1989 probably allowed the stocks to avoid catastrophic over-exploitation. Since then progressively tighter fisheries regulations have been introduced but limpet populations are still very much reduced in many of the islands (Hawkins *et al.,* 2000). Recent studies have shown that illegal harvesting in the Formigas islets, which had healthy stocks some years ago, has reduce the population to nearly zero (Cardigos *et al*. 2002). It can be concluded that there has been and continues to be a threat to this species across most of its range within the OSPAR Area.

Relevant additional considerations

Sufficiency of data

There are nearly 20 years of data on landings from limpet fisheries in the Azores but no records and statistical data prior to the 1980s. Since then, landings have been recorded from all the islands. The data show a substantial increase in landings in 1997 and 1998 which appears to be connected with the policy of the Regional Directorate of Fisheries to only issued licences to harvesters who declared catches in the previous year. Catch per unit effort data have been calculated using the information from individual "limpet capture diaries". Fisheries independent data on the status of the limpet population have also been collected (e.g. Martins *et al.,* 1987; Ferraz *et al.,* 1999) which enables a more direct assessment of the stock to be made. Taken together, there appears to be a sound information base on which to determine the status of *P.aspera* in the Azores.

Changes in relation to natural variability

Natural fluctuations occur in the limpet population. One of the causes is known to be prolonged storms and heavy seas that can lead to boulder damage on rocky shores.

During the severe decline of limpet populations in the early 1980's there was a suggestion that a "limpet disease" was partly responsible. The nature, extent and cause of this remains a mystery as it was virtually over before an investigation could be started although possible culprits include red tides or unusual warm temperature or disease (Martins *et al.,* 1987). However it seemed to occur primarily on the southern coasts, which are the more populated areas, with calmer seas, and thus also more accessible for harvesters. The only clear facts are that there was a huge increase on limpet's landings at the fish auction posts between 1982 to 1986, followed by a dramatic decline. Fisheries independent data and data comparing the size structure of natural populations with catches by professional harvesters give an indication of "natural" changes in *P.aspera* but are only available for recent years.

Expert judgement

Local knowledge and unquantified observations pointed to a dramatic decline in the population of *P.aspera* on most of the islands of the Azores in the 1980s. This is supported by a good data set showing changes in the landings of *P.aspera* from

1978 and verified by surveys (e.g. on the southern coasts of Pico and São Jorge in 1983) which provided fisheries independent data. Consideration of the case on the basis of expert judgement was therefore unnecessary.

ICES evaluation

The ICES review of this nomination raised the question of whether the decline of the subspecies is rather local given that *P. ulyssiponensis* is abundant in the Cantabrian Sea (northern Spain). Recent research has however proposed that there are two distinct species (*P. aspera* an endemic species which occurs in Macronesia and *P. ulyssiponensis*, which occurs on the continent of northern Europe) (Hawkins *et al.,* 2000). The status of the mainland population therefore becomes less relevant to the overall status of the species found in the Azores.

Threat and link to human activities

Cross-reference to checklist of human activities in OSPAR MPA Guidelines
Relevant human activity: Fishing, hunting, harvesting. *Category of effect of human activity:* Biological – removal of target species

The increase in landings, subsequent crash of the fishery, and recovery (in some areas) following temporary closure and licensing arrangements for the harvest of limpets, suggests that there is a strong link between the threat to *P.aspera* populations and the collection of limpets in the Azores. Records showing that the sex rations of the population were seriously distorted after the dramatic decline in landings are another indication that over-exploitation was a major factor in their decline as females are the larger individuals and therefore more valuable to the harvesters (Martins *et al.,* 1987). Independent research to evaluate the effects of new regulations based on reserve areas versus fisheries areas, have shown that after the open season the mean individual size and the proportion of females is higher on the populations of the reserve areas in spite of poor enforcement of regulations.

Management considerations

A number of management measures have been introduced to the limpet fishery since its dramatic collapse in the late 1980’s. These include closed seasons, closed areas, size limits, licensing of fishermen and endeavours to get better management information. This combination of measures is planned to continue for the foreseeable future although the details may change depending on the status of the population. Complete closure of the fishery has been instituted in the past and remains an option if required to stabilise, aid recovery and/or prevent decline in the stocks.

Further information

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Joint submission from Iceland, Portugal, UK

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Nomination

Larus fuscus fuscus Lesser Black Backed Gull

©Chris Gomersall, RSPB

Geographical extent

OSPAR Regions; I
Biogeographic zones: 12, 13
Region & Biogeographic zones specified for decline and/or threat: as above

Five subspecies of the Lesser Black-Backed gull have been described and the classification is widely accepted (ICES, 2002). Three subspecies, *L. f. fuscus*, *L. f. intermedius*, and *L. f graellsii*, breed entirely or partly within the OSPAR area. The subspecies *Larus fuscus fuscus* breeds in Sweden and northern Norway to the western part of the Kola Peninsula and the western White Sea (Strann, Semashko & Cherenkov, in Anker-Nilssen *et al*., 2000). The breeding colonies are found along the coast, as well as inland on bogs or other flat areas with rich vegetation. It is a migratory species leaving the breeding areas from August to fly south to the Black Sea and the eastern part of the Mediterranean and Africa.

Application of the Texel-Faial criteria

The Lesser Black-Backed Gull was nominated by one Contracting Party. The criteria cited were decline, rarity and sensitivity, with information also provided on threat.

Decline

The total population of this subspecies is believed to be under 15,000 pairs, of which about 2,500 pairs breed within the Barents Sea on Norwegian and Russian coasts (Anker-Nilssen *et al*., 2000). The evidence for a marked decline in breeding numbers of *L. f. fuscus* in northern Norway is very strong. It has been estimated that the population of *L.f.fuscus* has declined by 90% since 1970. The species has also disappeared from the Murman coast and the north-western White Sea (Anker-Nilssen *et al*., 2000).

Rarity

The relatively small population and limited number of breeding sites make this a rare sub-species in OSPAR Region I.

Sensitivity

Due to the small numbers breeding at a very limited number of locations, this species is considered to be sensitive to disturbance, predation, and oil pollution.

Threat

The nomination form submitted for this species cites the likely principle threats as man-made pollution such as PCBs, decline in prey species, and competition and predation by the Herring Gull. Threats to *L. f. fuscus* are summarised by Anker-Nilssen *et al*. (2000).

Relevant additional considerations

Sufficiency of data

There is evidence of a decline in the number of breeding *L.f.fucus* but only hypotheses about the reasons for this decline at the present time.

Changes in relation to natural variability

The extent to which the decline in numbers of *L.f.fucus* can be attributed to natural variability as opposed to other factors is unknown.

Expert judgement

There is good evidence to support the view that this species has declined. Less is known about the reasons for the decline.

ICES evaluation

The ICES evaluation of this nomination is that the evidence that numbers of *L. f. fuscus* have declined is compelling, and that this subspecies is a strong candidate for inclusion as a priority of concern for OSPAR (ICES, 2002).

Threat and link to human activities

Cross-reference to checklist of human activities in OSPAR MPA Guidelines
Relevant human activity: Fishing, hunting, harvesting; landbased activities; aquaculture/mariculture. *Category of effect of*

human activity: Biological – removal of target species, introduction of microbial pathogens or parasites, introduction of non-indigenous species; Chemical – synthetic compound contamination

Causes of the decline of *L. f. fuscus* are not known (Anker-Nilssen *et al*., 2000). Strann and Vader (1992) suggested that a change in food resources in breeding areas (particularly the long-term lack of young herring) was the main reason. Whether this is linked to human activity i.e. fishing is unclear.

Management considerations

Management measures should ensure that breeding area remain suitable for use by these birds and seek to minimise predation on the chicks. Until more is known about the reasons for their decline and the possible link with food supply it is difficult to suggest any specific management measures.

The lesser black backed gull is listed on Annex II of the EU Birds Directive but not the subspecies *Larus fucus fucus.*

Further information

Nominated by:
Norway

Contact persons:
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Useful References:

Anker-Nilsen, T. *et al*. 2000. The status of marine birds breeding in the Barents Sea region. Norwegian Polar Institute Report. No. 113. 213 pp.

Lorentsen, S.-H. 2000. The national monitoring programme for seabirds. Results including the breeding season 2000. NINA Oppdragsmelding 670: 1–30.

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Nomination

Pagophila eburnea, Ivory Gull

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Geographical extent

OSPAR Regions: I
Biogeographic zones: 2,3,8,18-20
Region & Biogeographic zones specified for decline and/or threat: As above

Pagophila eburnea has a near-circumpolar distribution in the Arctic seas and pack ice, breeding north of the July isotherm of 5˚C from north Canada through North and East Greenland, Svalbard and islands off northern Russia, with Europe accounting for less than a quarter of its global breeding range. Its OSPAR breeding population is small. The species breeds mainly on inaccessible cliffs, broken ice fields and low rocks or flat shorelines. Outside the breeding season, it normally avoids ice-free waters, being closely associated with pack ice, favouring areas with 70-90% ice cover near the ice edge. It feeds mainly on fish, shrimps, shellfish, algae, carrion, offal and animal faeces.

Application of the Texel-Faial criteria

P. eburnea was nominated for inclusion on the OSPAR List with particular reference to the regional importance, rarity, decline, and sensitivity criteria, with information also provided on threat.

Global/regional importance

The total OSPAR breeding population for this species is restricted to a small number of locations in Greenland, Svalbard and the westernmost areas of Franz Josef Land. Therefore, *P. eburnea* qualifies under this criterion as a high proportion of the total population of the species in the OSPAR area is restricted to a relatively small number of breeding locations (all within OSPAR Region I).

Data showing the distribution of this species within the IBAs[1] found in the OSPAR Maritime Area[2] support this conclusion. The occurrence of this species within IBAs is restricted to only three sites: Henrik Krøyer Holme and Kilen (NE Greenland) and North-east Svalbard Nature Reserve (Heath & Evans, 2000).

Rarity

The OSPAR breeding population of *Pagophila eburnea* is small. There are an estimated 550 – 1200 pairs for Greenland and Svalbard (BirdLife International, 2004), but the total for the OSPAR Area will be lower than this estimate as the figures for Greenland include western Greenland, outside of the OSPAR Area. An estimated c.250 pairs can be found in NE Greenland, within the OSPAR Area (del Hoyo *et al.*, 1996). Some birds also breed on the western islands of Franz Josef Land that fall just within the OSPAR area (Bakken & Tertitski, 2000). The latest data from Victoria Island, Franz Josef Land, suggest that around 750 breeding pairs can be found in one colony there (Bakken & Tertitski, 2000). No other recent data are available for colonies in the parts of Franz Josef Land that fall within the OSPAR area. Therefore, estimates using best available knowledge suggest that there are no more than a couple of thousand breeding pairs in the Arctic regions of the OSPAR area.

Decline

The European breeding population of this species underwent a large decline over the period 1970-1990, mostly due to decreases in European Arctic Russia (Tucker & Heath, 1994).

The species possibly declined in Svalbard at this time (many colonies there were reported to hold a hundred or more pairs at the end of the 19th century, but thorough investigations failed to reveal any colonies of this size in more recent years – Tucker & Heath, 1994). However, the species definitely declined in Svalbard over 1990-2000 [by up to 19%] (BirdLife International, 2004). The largest known colony in Svalbard was discovered on Kvitǿya in 1931, where it was estimated that 400 pairs were breeding. This area has been visited subsequently without any observations of breeding *P. eburnea* (Bakken & Tertitski, 2000).

Trend data were not available for key populations in Greenland (for the period 1990-2000) so the overall trend for the OSPAR population as a whole remains unknown. However, since 2005 the species has

[1] Important Birds Areas - areas identified by BirdLife International as being of importance for birds.
[2] Excluding purely terrestrial or inland IBAs.

been listed as Globally 'Near Threatened' on the IUCN Red List, (IUCN, 2007) and is likely to suffer further declines in the future as it will be particularly sensitive to climate change effects (being dependent upon the vanishing Arctic pack ice).

Sensitivity

The species is very sensitive. It has a low *resilience* to adverse effects due to its life history characteristics: the species will not breed if food availability is low in any one year, and it has a relatively slow reproductive rate, laying only 1-2 eggs per clutch (del Hoyo *et al.,* 1996).
P. eburnea is also very easily adversely affected by human activity, being restricted to the pack-ice zone for much of the year, avoiding ice-free waters, and therefore particularly vulnerable to climate change. In addition, their extensive use of seal and whale blubber makes them particularly sensitive to heavy-metal contamination. The species also appears to be sensitive to overflights by aircraft.

Threat

Pagophila eburnea is principally threatened by future climate change – in particular by the prospect of climate warming in the Arctic. This species is confined mostly to the pack-ice zone outside the breeding season. Satellite data indicate a continuation of the 2.7 ± 0.6% per decade decline in annual mean Arctic sea ice extent since 1978. The decline for summer extent is larger than for winter, with the summer minimum declining at a rate of 7.4 ± 2.4% per decade since 1979 (Lemke *et al.,* 2007). This constitutes a major threat of potential habitat loss for *P. eburnea*.

This species is also threatened by pollution – for example, it is vulnerable to heavy metal contamination due to its extensive use of seal and whale blubber. A recent paper postulated that the effects of chemical pollutants such as Endocrine Disrupting Chemicals (EDCs) could combine synergistically with those of climate change to threaten Arctic seabirds, such as *P. eburnea* (Jenssen, 2006).

Relevant additional considerations

Sufficiency of data

Evidence of decline in the OSPAR area is available but poorly documented. There is enough evidence about the effects of pollutants and human-induced climate change on Arctic wildlife in general, as well as specifically on the *P. eburnea*, for serious cause for concern about the prospects for this species.

Changes in relation to natural variability
The likely contribution of natural variability to the observed declines has not been determined.

Expert judgement

Expert judgement is required to assess the likely full extent of decline across the OSPAR population for this species, in the face of scant evidence.

ICES Evaluation

The ICES Evaluation of this nomination (ICES 2007) agreed that the species is 'very sensitive'.

Threat and link to human activities

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

Category of effect of human impact: Physical – Temperature changes, Noise disturbance, Visual disturbance. Chemical – Synthetic compound contamination, Heavy metal contamination. Biological – Displacement (moving) of species.

The main threats to this species can be clearly linked to human activities as they are due in part to heavy metal and other chemical contamination throughout the Arctic, and in part to habitat loss due to retreating Arctic sea ice in the face of continued, human-induced climate change. Birds at the breeding colonies may also be threatened by disturbance in the nesting areas by aircraft, tourists or by predators such as domestic dogs from nearby human settlements.

Management considerations

The species is listed under Appendix II of the Bern Convention. CAFF (Conservation of Arctic Flora and Fauna) have also produced a CBIRD 'Draft Conservation Strategy of the Ivory Gull' (unpublished report).

Given the significant impact that continued climate change will have on this species, OSPAR should continue to do everything in its power to combat, mitigate the effects of, and prepare for adaptation to future climate change.
The species only breeds in a relatively limited number of locations within the OSPAR area, including only three IBAs (Henrik Krøyer Holme and Kilen, both located in North East Greenland, and North-east Svalbard Nature Reserve). These IBAs should be a priority for international protection. Efforts should be made to locate and protect the most important breeding colonies for this species throughout the OSPAR area. It will be essential to

establish a monitoring system for this species – including if possible not only monitoring numbers of breeding pairs in colonies but also colour ringing birds to document any movements of breeding individuals between different breeding colonies.

Further information

Nominated by:
BirdLife International

Contact persons:
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Useful references:
Bakken, V. and Tertitski, G.M. (2000) Ivory Gull *Pagophila eburnea* pp 104-107 *in* Anker-Nilssen, T., Bakken, V., Strøm, H., Golovkin, A.N., Bianki, V.V., and Tatarinkova, I.P. (eds.) *The Status of Marine Birds Breeding in the Barents Sea Region* Norsk Polarinstitutt Rapport No. 113.

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Heath, M.F., and Evans, M.I. (eds.) (2000) *Important Bird Areas in Europe: priority sites for conservation.* Cambridge, UK: BirdLife International. (BirdLife Conservation Series No. 8).

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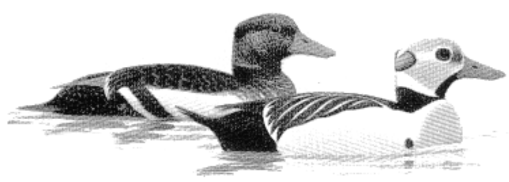
Nomination

Polystica stelleri Steller's eider



Geographical extent

OSPAR Regions; I
Biogeographic zones: 2,12,13
Region & Biogeographic zones specified for decline and/or threat: as above

Steller's Eider breeds along the Arctic coast of Alaska and the eastern half of Siberia. Most birds winter in the northern Pacific, but the main European areas used by non-breeders in summer and wintering birds are the coastal areas of northern Norway, Estonia and Lithuania (Anon, 1999). Studies of Steller's eider in 2000/01 along the Lithuanian coast in the Baltic (outside the OSPAR Maritime Area) indicated that the ducks congregated in a narrow stretch of coast, feeding on crustaceans, bivalves and gastropods. In spring they gather at herring spawning grounds and fed mainly on fish eggs (Žydelis, 2002).

In the OSPAR Maritime Area there are both wintering and summering birds in the Varangerfjord in northern Norway. These are found in flocks of varying size, in sheltered and shallow bays on the outer coast. While most flocks are of 10-100 birds, dense flocks of up to 3,000 individuals have been reported from Vadsø in the Varangerfjord (Frantzen, 1985). Moulting birds have been recorded from late May in the Varangerfjord (Frantzen & Henriksen, 1992)

In 1995 the size of the population wintering in northern Europe was believed to be between 30-50,000, compared to an estimated 400-500,000 in the 1960s, (Nygard *et al.,* 1995; Tucker & Heath, 1994). With the world population decreasing the species was considered to be globally threatened. In Europe there is particular concern about recent decreases of seaduck (Steller's eider and Common eider) in the Baltic (S.Pihl, Seaduck Specialist Group).

Application of the Texel-Faial criteria

There was one nomination for Steller's Eider citing the regional importance of the OSPAR Area for this species and sensitivity, with information also provided on threat.

Regional importance

Nygard *et al*. (1995) estimated that there were between 25,000 and 40,000 Steller's Eiders wintering in the Barents Sea representing between 15–20 % of the world population at that time. The wintering population in the OSPAR Maritime Area is found predominantly within the Varangerfjord, northern Norway which has typically supported between 5,000 – 8,500 birds from the early 1980's to early 1990's.

Sensitivity

Steller's Eider are particularly sensitive to oil pollution and are known to have suffered mortality following contact with oil from spills. This species also appears to be especially sensitive to disturbance as the ducks spend a large part of the day feeding. Loss of foraging time through disturbance might therefore adversely affect the ability of the birds to satisfy their daily energetic requirements (Žydelis, 2002)

Threat

Within the OSPAR Maritime Area, Steller's Eider are most threatened when the non-breeding birds congregate in large numbers in restricted areas.

Incidental capture in fishing gear is a major threat to this species. In Norway, birds have been known to get caught and drown in the set nets placed in shallow water where Steller's Eiders feed (Frantzen & Henriksen, 1992). In the Baltic gill nets are a serious threat to the small numbers of ducks that winter on the Lithuanian coast and one study has estimated that up to 10% of birds wintering along this coast might drown in fishing nets annually (Žydelis, 2002).

Oils spills have been a cause of mortality in the past with 2,500 duck (many of which were Stellar's eider) being killed by a minor spill in Vadsø harbour in 1973 (Grastveit, 1975) and a spill in Varangerfjord in 1979 killed 20,000 seabirds, including Steller's Eider (Barrett, 1979). This is because the birds are often close to harbours in the Varangerfjord. A relatively new threat is offshore development of windfarms. The likely effects on the seaduck are unknown at the present time.

Relevant additional considerations

Sufficiency of data

There are available on the population at the main non-breeding sites in the OSPAR Maritime Area at Varangerfjord in Norway, where numbers have been recorded since 1980. Very few studies have been carried out on breeding Steller's eider.

Changes in relation to natural variability

It is not possible to gauge the effect of natural variability on population trends of this species at the present time.

Expert judgement

The global population of Steller's Eider is believed to have decreased by about 50% throughout its range over the last 30 years (Anon, 1999). In Europe it was believed to be stable/ fluctuating or increasing in the early 1990's (Tucker & Heath, 1995). More recent views are that, within Europe, the Baltic populations may also be declining but as this does not appear to be the case in the OSPAR Maritime Area it has been nominated for the OSPAR list on the basis of threat to the population.

ICES evaluation

ICES make no recommendation with respect to Steller's Eider as they consider this species has a stable, or possibly increasing, population within the OSPAR area, and because it was not clear how much the status and trends outside the OSPAR area should affect a decision to list this species. They note that Steller's eider is severely threatened elsewhere in the world. ICES supports the view that the main threats to this species in the OSPAR area are oil pollution and incidental capture.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; shipping & navigation, oil and gas exploration & exploitation. *Category of effect of human activity:* Biological – removal of non-target species; Chemical – hydrocarbon contamination

The main threats identified for this species in the OSPAR Maritime Area (incidental catch, oil pollution, disturbance and offshore development) all have clear links to human activities.

Management considerations

A European Species Action Plan for Steller's Eider was published in 1999 with a recommendation that it should be reviewed every five years unless there is a need for an emergency review. Objectives have been suggested in relation to policy and legislation, species and habitat conservation, monitoring and research and education and training (Anon, 1999).

Management measures relevant to this species in the OSPAR Maritime Area will need to be focused on the few locations where they are concentrated. This could include protected areas, safeguards to reduce the risk of pollution incidents and contingency planning measures. The global decline in this species does however mean that measures will need to be taken to throughout its range to safeguard this species.

Steller's eider is listed on Annex II of the Bern Convention and Annex II of the Bonn Convention. It is also listed as 'Vulnerable' by IUCN.

Further information

Nominated by:
BirdLife International

Contact persons:

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Useful References:

Anker-Nilssen, T., Bakken, V., Strøm, H., Golovkin, A.N., Bianki, V.V., and Tatarinkova, I.P. (2000). The status of marine birds breeding in the Barents Sea region. Report No. 113. Norsk Polarinstitutt, Tromsø. 213 pp.

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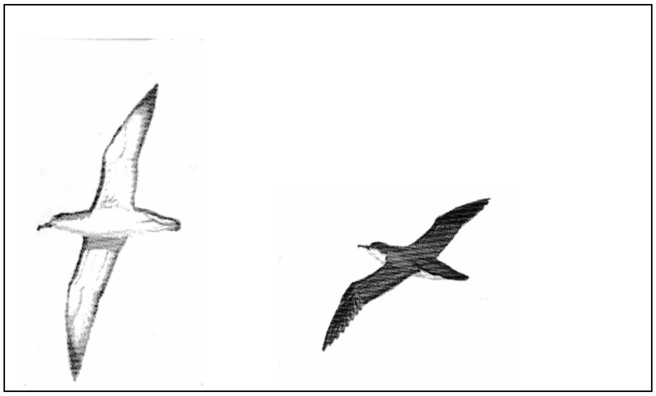
Nomination

Puffinus assimilis baroli Little shearwater



Geographical extent

OSPAR Regions: V
Biogeographic zones: 1,4,5,21,23
Region & Biogeographic zones specified for decline and/or threat: as above

The Little Shearwater has a fragmented distribution in all three major oceans with most of its range in the southern hemisphere. *Puffinus assimilis baroli* is an endemic European race that breeds in the archipelagos of Madeira, the Azores and the Canaries (Cramp & Simmonds, 1997).

Little Shearwaters feed from surface of sea possibly on small fish, cephalopod and crustaceans and spend more time on water than other shearwaters. They breed in rocky ground, caves, cliffs, and stone walls. The rough nest is generally a tunnel in soft soil or a hole between rocks or under fallen boulders (Monteiro *et al*., 1996a). They also use old tunnels of other species. Little is known about breeding habits, as they are winter breeders, laying eggs in January or February with chicks fledging in May and June. The birds frequently visit breeding sites outside breeding season.

Application of the Texel-Faial criteria

The Little Shearwater was nominated in a joint submission by three Contracting Parties and also by one Observer. The criteria common to both nominations were decline, regional/local importance, and sensitivity, with information also provided on threat.

Regional/Local importance

The Azores holds the entire known breeding population of *P.a.baroli* in the OSPAR Maritime area. Breeding sites were known from the islands of Flores, Corvo, Graciosa and Santa Maria and Monteiro *et al*. (1999) located several previously unknown colonies in the Azores during seabird surveys in the late 1990s. They estimated that there were 840–1,530 pairs of little shearwaters in the Azores at that time. The Wider Atlantic OSPAR Region (Region V) is therefore of regional importance for this subspecies.

Decline

The first known breeding record for Little Shearwater from the Azores was in 1953 on São Miguel (Bannerman & Bannerman, 1966). With rats now present on that site it is no longer used by the breeding birds (Le Grand *et al.,* 1984). ICES (2002) consider that evidence for a decline in breeding numbers within the OSPAR area is based on relatively poorly documented population trends in the Azores (Monteiro *et al*., 1996b). However, they note that there is very strong circumstantial evidence indicating that most areas of the Azores have become unsuitable as breeding habitat due to rats and cats introduced by human colonisation and established settlement on the main islands. Almost all of the remaining colonies of little shearwaters are on highly inaccessible cliffs or rat- and cat-free islets.

Sensitivity

The little shearwater is considered sensitive due to the small numbers breeding on the Azores. *P.a.baroli* breeds in winter therefore disturbance is less of an issue but predation (e.g. by rats) appears to have a significant impact on breeding distribution (ICES, 2002). Like all seabirds they are also sensitive to oil pollution.

<u>Threat</u>

The major threat to shearwaters is predation at their breeding sites. They are taken by mammalian predators, such as rats and cats, as well as by yellow-legged gulls whose numbers appear to be increasing in the Azores. The adult birds are also susceptible to oil pollution whilst feeding at sea, but are less sensitive to human disturbance at their breeding sites that some other seabirds, as they breed during the winter months.

Relevant additional considerations

Sufficiency of data

The little shearwater is difficult to study, partly because it is a winter breeder. As a consequence relatively little is known about its biology including aspects such as the age of breeding or breeding success rate in particular locations. The birds are also difficult to study at sea as they do not flock and are therefore difficult to observe. These difficulties mean that there is limited information about *P.a.baroli* in the OSPAR Maritime Area.

Changes in relation to natural variability

It is not possible to gauge the effect of natural variability on population trends of this species at the present time.

Expert judgement

There is limited information about population size and trends of Little Shearwater in the OSPAR Maritime Area however the threat to this species is clear.

ICES evaluation

The ICES evaluation of the subspecies *P.a. baroli* notes that the number that occur outside the OSPAR area are rather larger than numbers within the OSPAR area. The population in Cape Verde appears to be declining and threatened while the population in Madeira is currently stable but has probably declined in the past (ICES, 2002). Within the OSPAR Maritime Area ICES report that there is very strong circumstantial evidence indicating that most areas of the Azores have become unsuitable as breeding habitat for *P.a.baroli*, mostly because of the numbers of predators (rats, cats and yellow-legged gulls).

Threat and link to human activities

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

Relevant human activity: shipping and navigation; *Category of effect:* Biological –introduction of non-indigenous species;

Little shearwaters are threatened by predators at their breeding sites. Some of these predators (rats and cats) will have been introduced by man. At sea, the species is susceptible to oil pollution.

Management considerations

Useful management measures to consider include protection at breeding sites, including predator control, and minimising disturbance from human activity. Measures to reduce the risk of pollution and to safeguard food supplies would benefit this species at sea.

The Little Shearwater is listed on Annex 1 of the EU Birds Directive and the subspecies *Puffinus assimilis baroli* is listed on Annex II of the Bern Convention.

Further information

Nominated by:
Joint Submission by Iceland, Portugal & UK; BirdLife International

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Duncan Huggett, BirdLife International, Royal Society for the Protection of Birds, the Lodge, Sandy, Bedfordshire, SG19 2DL. UK.

Useful References:

Bannerman DA & Bannerman WM (1966) Birds of the Atlantic islands, 3: a history of the birds of the Azores. Edinburgh. Oliver & Boyd

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Nomination

Puffinus mauretanicus **-** Balearic Shearwater[3]

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Geographical extent

OSPAR Regions: II, III, IV, (V)
Biogeographic zones: 1,2,4,6-9,11,13
Region & Biogeographic zones specified for decline and/or threat: As above

This species breeds only in the Balearic Islands, where it nests on the small islands and coastal areas of Formentera, Ibiza, Mallorca, Cabrera and Menorca (Arcos and Oro, 2003). During the breeding season, the species forages mainly along the eastern Iberian coast, with the largest concentrations occurring off the Ebro Delta (Louzao *et al*., 2006a). After the breeding season, the species moves into the Atlantic, dispersing northwards along the coasts of Portugal and north-western Spain to the traditional post-breeding grounds in the Bay of Biscay, off the coast of western France (Le Mao and Yésou, 1993). Although the species has long been a regular visitor to the western English Channel and – to a lesser extent – the North and Celtic Seas (Mayol-Serra *et al*., 2000), there is increasing evidence for a northwards shift in its core post-breeding range (Wynn and Yésou, 2007; Wynn *et al*., 2007). Some birds over-winter in the Atlantic (off south-west UK, in the Bay of Biscay and off the coast of Morocco), but most individuals return to the Mediterranean in the autumn (Mayol-Serra *et al*., 2000), where large gatherings of birds winter off the coast of eastern Spain.

[3] *Puffinus mauretanicus* was formerly treated as a subspecies of *P. yelkouan* (and before that *P. puffinus*), but is now considered to deserve specific status (e.g. Austin, 1996; Heidrich *et al*., 1998; Brooke, 2004).

Application of the Texel-Faial criteria

P. mauretanicus was nominated for inclusion on the OSPAR List with particular reference to the global importance, rarity, decline, and sensitivity criteria, with information also provided on threat.

Global regional/importance

Although the species' breeding colonies and main wintering grounds are in the Mediterranean, the majority of the global population disperses into the OSPAR Area during the post-breeding period (Le Mao and Yésou, 1993). Individuals start leaving the Mediterranean in late May with passage through the Strait of Gibraltar peaking in June, so by the end of July the bulk of the population is in the Atlantic (Mayol-Serra *et al*., 2000). The return passage to the Mediterranean begins in September and peaks in October–November, although late individuals are still recorded passing through the Strait of Gibraltar between December and April (Mayol-Serra *et al*., 2000).

The OSPAR area is hence of global importance for the species during the summer months (particularly June to October), when a high proportion of the total population occurs along the coasts of Portugal, north-western Spain, western France and southern/western Britain and Ireland.

Rarity

The global breeding population of this species is small. The most comprehensive census to date, based on surveys carried out between 2000–2005, gave an estimate of 2,000–2,400 breeding pairs at 24 colonies (Rodríguez Molina and McMinn Grivé, 2005; Viada, 2006). The total global population – including a significant number of 'floating' non-breeding birds – is currently believed to number in the region of 10,000 individuals (Wynn and Yésou, 2007).

Decline

Several breeding colonies on Cabrera and Formentera have disappeared completely in the last few decades, and numbers at long-term monitoring sites have also declined (Mayol-Serra *et al*., 2000; Oro *et al*., 2004; Rodríguez Molina and McMinn Grivé, 2005; Viada, 2006).

Estimates of adult survival based on capture–recapture data for 374 individuals ringed during 1997–2002 at two focal colonies in Mallorca (0.78 ± 0.03) are unusually low for a Procellariiform (Oro *et al*., 2004). Since both colonies were free of mammalian predators, the low adult survival between years is likely to be a consequence of at-sea mortality away from the colonies (Oro *et al*., 2004). A model based on the demographic parameters derived from the study suggested that the population was declining by an average of 7.4% per year, and mean extinction time for the global breeding population (calculated using population viability analysis) was estimated at just over 40 years (Oro *et al*., 2004).

At-sea censuses have shown declines, with numbers wintering off the coast of north-eastern Spain declining from 10,000–11,000 birds in the early 1990s to just over 5,000 individuals during the winter of 2002–2003 (Gutiérrez, 2003). Similar reductions have been observed within the OSPAR area in the traditional post-breeding quarters off western France, where 8,000–10,000 individuals were regularly recorded in the 1980s, compared to no more than half this number during surveys in 1999–2000 (Yésou, 2003). Although this decline may in part be explained by changes in the species' post-breeding distribution, the increasing number of individuals recorded further north in recent years does not compensate for the birds 'missing' from the Bay of Biscay (Yésou, 2003; Wynn and Yésou, 2007). While the recorded rates of decline in these at-sea concentrations do not reach the dramatic levels suggested by Oro *et al.* (2004), they represent significant reductions in numbers, and are cause for concern.

As a consequence of its rapidly declining population, the species faces a very high risk of extinction and is currently classified as Critically Endangered (Arcos and Oro, 2004; IUCN 2007).

Sensitivity

This species has very low *resistance*, with several aspects of its behaviour and ecology making it very sensitive to the adverse effects of human activities. Its very small breeding range (<10 km^2) and nesting behaviour make it very vulnerable to predation by introduced mammals, habitat loss and degradation, and other forms of human disturbance or persecution (Aguilar, 1999; Arcos and Oro, 2004). Away from the breeding colonies, the species' tendency to congregate in large numbers in coastal waters, often near important harbours, makes it vulnerable to oil spills, particularly in the moulting quarters (Aguilar, 1999; Mayol-Serra *et al*., 2000). Its diet of small shoaling pelagic fish, particularly clupeids and engraulids (Le Mao and Yésou, 1993; Louzao *et al*., 2006b), and tendency to aggregate in the most productive waters (Louzao *et al*., 2006a), also make the species susceptible to interactions with commercial fisheries (Arcos *et al.,* in press). These interactions include by-catch on long-lines causing direct mortality, and reduction of natural prey due to overfishing. In addition, the species makes extensive use of trawling discards, which represent over 40% of its energy requirements during the breeding season (Arcos and Oro, 2002). Planned reductions in discarding rates could lead to food shortage; moreover, discards represent an extra source of mercury and other pollutants (Arcos *et al.*, 2002), resulting in the unusually high levels shown by the Balearic Shearwater (Ruiz and Martí, 2004; Arcos *et al.*, 2004).

The species also has very low *resilience*. Individuals do not breed until at least their third year, they are long-lived (the longevity record is 23 years) and reproduce slowly, and hence are very sensitive to human activities increasing adult mortality, such as long-line fishing (Aguilar, 1999; Arcos and Oro, 2004; Oro *et al*., 2004). The Procellariiformes are one of the avian orders that show a particularly high risk of extinction (Genovart *et al*., 2007).

Threat

The species currently faces threats at its breeding grounds and in its non-breeding quarters, both of which have an impact on the population summering in the OSPAR Area.

Predation of eggs and chicks by rats, and of adults by introduced mammals such as domestic cats and mustelids, is a significant threat at some breeding colonies (Mayol-Serra *et al*., 2000; Ruiz and Martí, 2004; Arcos and Oro, 2004). Harvesting of the species for human consumption was historically a major threat, but is now of lesser concern (Aguilar, 1999). Development of its coastal habitat means that the number of suitable nesting areas is limited, with the species probably now occupying sub-optimal sites (Aguilar, 1999). The potential impact of competition with Cory's Shearwaters *Calonectris diomedea* for nest cavities is unclear (Aguilar, 1999). The use of lights for certain fishing practices, leisure craft and urban lighting near colonies may disturb breeding birds and fledglings (Aguilar, 1999; Gutiérrez, 2003; Ruiz and Martí, 2004). The occurrence of Yelkouan Shearwaters *Puffinus yelkouan* at one colony in Menorca raised concerns that hybridisation with this closely-related species may occur (Genovart *et al*., 2005), although any genetic impact from this is not currently believed to be a threat (Genovart *et al*., 2007).

Away from the breeding colonies, the species also faces a number of at-sea threats in the Mediterranean and the Atlantic. Overexploitation and changes in the distribution of its fish prey is a potentially increasing threat (Aguilar, 1999; Arcos and Oro, 2004). In the OSPAR area, the dramatic decline and local disappearance of pilchard *Sardina pilchardus* and anchovy *Engraulis encrasicolus* populations in the Bay of Biscay – probably as a consequence of recent increases in sea temperature – are strongly implicated in the coincident decline in *Puffinus mauretanicus* numbers in the area (Mayol-Serra *et al*., 2000; Yésou, 2003; Wynn *et al*., 2007). The resulting increase in dispersal range and/or decrease in foraging success in the summering quarters may be having an impact on the species' survival (Mayol-Serra *et al*., 2000; Wynn *et al*., 2007). The increasing importance for the species of fishery discards (see 'Sensitivity') – potentially in response to the decline in traditional prey species – means that it may also be adversely affected by incoming fishing policies directed at reducing discard rates (Arcos and Oro, 2002; Arcos and Oro, 2004; Louzao *et al*., 2006b). Although the species appears to be less prone to accidental by-catch on long-lines and in fishing nets than *Calonectris diomedea* (Aguilar, 1999; Belda and Sánchez, 2001), its congregatory behaviour and close association with fishing vessels can result in occasional instances of 'mass mortality' (Arcos and Oro, 2004; Ruiz and Martí, 2004). These events could be difficult to detect in a standard monitoring program, given their occasional nature, but could have a high impact on the Balearic Shearwater population (Arcos *et al*., in press). The species' tendency to congregate in coastal waters near important harbours – most notably during its post-breeding moult in OSPAR waters – makes the potential threat from oil pollution very significant (Aguilar, 1999; Mayol-Serra *et al*., 2000). The sinking of the tanker *Erika* off Brittany in 1999, the wreck of the *Prestige* off Galicia in 2002 and the beaching of the *MSC Napoli* off south-west England in 2007 all occurred in important areas for the species (Mayol-Serra *et al*., 2000; Gutiérrez, 2003; Ruiz and Martí, 2004; Wynn and Yésou, 2007). The impact on the species of other forms of chemical pollution, such as its accumulation of unusually high levels of mercury, remains unquantified (Arcos and Oro, 2004; Ruiz and Martí, 2004, Arcos *et al.,* 2004). Poisoning by toxic phytoplankton may be a threat in some feeding areas, particularly the Mor-Braz area, north of the Loire estuary (Mayol-Serra *et al*., 2000).

Relevant additional considerations

Sufficiency of data

Trends based on comparisons of breeding population estimates over time may be confounded by differing survey methodologies and effort. Nevertheless, the recent extinction of entire breeding colonies, and the results of the recent multi-year demographic study at two colonies (Oro *et al*., 2004) provide clear evidence of an ongoing population decline. Models of this decline were particularly sensitive to changes in adult survival, but this parameter was estimated with a narrow confidence interval, based on capture data from six breeding seasons, so it is likely to be robust (Oro *et al.*, 2004).

Further studies are required to clarify the extent to which the reductions in numbers in the Bay of Biscay and off north-east Spain are the consequence of an overall population decline and/or changes in the species' wintering and post-breeding distributions.

Threats, past and present, at the breeding colonies are relatively well documented (e.g. Aguilar, 1999; Arcos and Oro, 2004), but do not fully explain the rapid population decline or the high levels of adult mortality (Oro *et al*., 2004). At-sea threats are currently less well understood, however, and further studies are needed to determine their relative importance in the Mediterranean and the OSPAR area.

Changes in relation to natural variability

Inter-annual variability in the availability of small pelagic fish was found to have an influence on the species' overall breeding performance, but current values of breeding success fail to explain the sharp decline of the species (Louzao *et al*., 2006). Recent changes in the Balearic Shearwater distribution range within the OSPAR area seem to parallel changes in its prey distribution (Wynn *et al.*, 2007).

Expert judgement

There is good evidence of the threats facing this species, including those that would be relevant to the OSPAR Area. Expert judgement is required to assess the likely extent of decline across the OSPAR region for this species, given the severe declines documented at the breeding colonies.

ICES Evaluation
[Not yet evaluated]

Threat and link to human activities

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

Relevant human activity: Constructions (e.g. Offshore wind-farm); Land-based activities;

Shipping and navigation; Fishing, hunting, harvesting; Tourism and recreational activities[4].

Category of effect of human activity: Physical – Temperature changes. Chemical – Hydrocarbon contamination. Biological – Removal of target species; Removal of non-target species.

At the breeding colonies, *Puffinus mauretanicus* are threatened by several human activities. Introduced ground predators threaten eggs and chicks, and development of the coast (with associated light pollution) cuts down the availability of suitable nesting habitat for the species.

Away from the breeding colonies and into the OSPAR Area, marine pollution and incidental capture in fishing nets are the main threats that are directly linked to human activities. The species' congregatory behaviour exacerbates the potential effect of both of these threats.

Human activities are also likely to have an indirect impact on the species via climate change effects. Human-induced climate change is leading to increasing sea temperatures, in turn affecting the abundance and distribution of prey fish species. In response the species has to disperse further in the post-breeding season to find adequate food supply, and there is some evidence that there is also a resulting increase in this species' dependence on fishery discards as a food source – bringing the birds into dangerous proximity with fishing vessels and further increasing the likelihood of a 'mass mortality' event.

Management considerations

The species is listed (as *Puffinus puffinus mauretanicus*) in Annex I of the EU Birds Directive, 79/409/EEC. A LIFE Nature project "Recovery Plan for *Puffinus mauretanicus* in the SPA network of the Balearic Islands", carried out between 1998–2001, resulted in a number of conservation actions for the species, including the development of the first Recovery Plan (Ruiz and Martí, 2004). In 1999, a Species Action Plan was prepared for the European Commission by BirdLife International (Aguilar, 1999). In 2000, the species was listed as "in Danger of Extinction" in the Spanish National Catalogue of Threatened Species (Ruiz and Martí, 2004), and the Balearic Government designated three new Special Protection Areas, such that all the Important Bird Areas (IBAs) identified for the species when nesting are now protected. A second Recovery Plan for the species in the Balearic Islands, covering the period 2004–2010, was formally approved in July 2004 (by Decreto 65/2004), and the species is also the subject of a National Strategy for Conservation in Spain (Anon., 2005). In November 2005, the species was added to Appendix I of the Convention on Migratory Species by the Eighth Conference of the Parties. Ongoing LIFE projects by the BirdLife Partners in Spain (SEO/BirdLife) and Portugal (SPEA) to create inventories of marine IBAs will be the first step towards the effective protection of the species' foraging grounds around the Iberian Peninsula (and the Balearic Islands). However, there has been little other action taken to date for the species in the OSPAR area.

This species requires a wide and well-coordinated conservation and recovery strategy, to study population trends, size and distribution, threats and competition with other bird species. Activities in the OSPAR area should complement those activities both planned and already executed in the Mediterranean (such as protecting breeding and feeding areas, and raising the awareness of local fishermen).

Within the OSPAR area, it is vital to diagnose and ameliorate the threats the species may face as its post-breeding range expands northwards. This species suffers from high adult mortality, and so the threats that are faced in the OSPAR area are likely to be having a significant impact on the overall population of this threatened species. Monitoring and assessment under OSPAR (if this species was listed) could play an important part in coordinating the collection of information about the time spent by Balearic Shearwaters in OSPAR waters. This should include more information about the threats faced by this species in OSPAR waters, and more work to understand these if necessary, for example collation of information on the status of its prey fish species, whether the resource is overexploited by human fishing activity, and how this might impact on the Balearic Shearwater. At present there is limited understanding of exactly where the birds now congregate in Atlantic waters during post-breeding dispersal. Forward modelling of SST data could be used to identify potential future sites of importance in Atlantic waters e.g. SW Scotland.

Gibraltar data from this year show there could possibly be many missing pairs not currently being monitored. More long-term monitoring of key strategic 'flyways' is required, e.g. Gibraltar (increase coverage), Iberian capes, and Moroccan capes. The UK is covered at present by SeaWatch SW – but funding will be required to support this in future years.

[4] N.B. This activity may mainly be a threat outside the OSPAR Area.

Where possible, consistently-used sites and key flyways within the OSPAR area should be identified and designated as SPAs and/or OSPAR MPAs.

Further information

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Nomination

Rissa tridactyla tridactyla, Black-legged Kittiwake

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Geographical extent

OSPAR Regions: all
Biogeographic zones: 1 – 4, 6 – 9, 11 – 20
Region & Biogeographic zones specified for decline and/or threat: Particularly Regions I and II.

The species breeds on coasts as far north as open water occurs, preferring high steep cliffs with narrow ledges (species will nest on glacier or snow bank face when it covers traditional cliff sites). *Rissa tridactyla* eat mainly marine invertebrates and small fish, with breeding birds feeding mainly within 50km of the colony. However they will also feed on discarded offal and/or fish behind fishing boats and in harbours. The species winters south to the Sargasso Sea and West Africa, being highly pelagic in the non-breeding season.

There are two recognised subspecies. Most of the global population is of the nominate subspecies, *R. t. tridactyla,* which can be found in the North Atlantic from Canada and North East USA, east through Greenland to West and North Europe and on to Russia. Another subspecies, *R. t. pollicaris* has been described in the North Pacific (Cramp & Simmons, 1983).

Application of the Texel-Faial criteria

Rissa tridactyla tridactyla was nominated for inclusion on the OSPAR List with particular reference to the global importance, decline and sensitivity criteria, with information also provided on threat.

Global regional/importance

The subspecies *tridactyla* is found throughout the north Atlantic, however, 85% of the breeding numbers of this subspecies are found within the OSPAR area, thus the OSPAR area is of global importance for this subspecies (Heubeck, 2004).

Decline

This species is evaluated as significantly declined. There was a moderate increase in the breeding population of this species in the OSPAR area over the period 1970-1990. From 1990-2000, the species declined in Greenland, Norway and the UK, and suffered a moderate decline [>10%] overall in Europe. Overall, population decreases of 20-29% were seen in Norway and the UK (with very high rates of proportional decline in Shetland [69%] and North East England [40%]), and declines [up to 19%] were seen in the Greenland population.

Rissa tridactyla population size monitored in the UK as part of JNCC's Seabird Monitoring Programme (SMP) has shown continued decline since 2000. In 2004 numbers declined in all regions of the UK to reach or approach their lowest levels since the SMP started in 1986, with the Northern Isles (Shetland and Orkney) being particularly hard hit (Mavor *et al.,* 2005). Results from 2006 surveys show that this downward trend is continuing, with the UK population index of *Rissa tridactyla* reaching its lowest in 21 years of monitoring, 50% lower than its peak in 1992 (JNCC, 2007). Recent declines have also been documented for populations in Iceland: a stronghold for this species. Monitoring of cliff-breeding seabirds at various colonies in Iceland revealed a significant overall decrease in numbers from the mid-eighties to 2005, although there were some localised increases (Garđarsson, 2006a). 2005 in particular was a bad year for breeding *R. tridactyla* in Iceland, with widespread breeding failure, particularly in the north and east of Iceland (Garđarsson, 2006b).

Sensitivity

The species is sensitive. It has a low *resilience* to adverse effects from human activity, with recovery likely to be slow due to its life history characteristics (long-lived and relatively slow to reproduce). First breeding does not usually occur until 4-5 years, usually 2 eggs are laid (can be 1-3) (del Hoyo *et al.,* 1996; Cramp & Simmons, 1983).
The species is sensitive to over-fishing. *R. tridactyla* are small-bodied surface feeders, with a relatively restricted foraging range from the breeding colony (staying mainly within 50km of the colony), and so

are more likely to be affected by local changes in prey abundance or availability (Furness & Tasker, 2000).

Threat

During the breeding season, *Rissa tridactyla* feed mainly on small pelagic shoaling fish, for example capelin *Mallotus villosus*, Ammodytidae (sandeels), herring *Clupea harengus*, and sprat *Sprattus sprattus* (Barrett & Tertitski, 2000; Cramp & Simmons, 1983). Planktonic invertebrates probably form much of the diet for the rest of the year, though there is little information available on this (Cramp & Simmons, 1983). *R. tridactyla* have a relatively restricted foraging range from the breeding colony, and therefore are more severely affected than wider-ranging seabirds by downturns in the supply of sandeels and other small pelagic shoaling fish. There is substantial published indirect evidence for a link between the observed decline in this species in the UK and lack of sandeels. Frederiksen *et al.* (2004) showed that both breeding productivity and adult survival of *R. tridactyla* were negatively affected by high sea surface temperatures and by the localised presence of an industrial sandeel fishery, with both factors presumed to affect sandeel abundance. Frederiksen *et al.* (2005) showed that *R. tridactyla* colonies in the UK could be grouped into regional clusters with similar patterns of temporal variability in breeding productivity, and that these clusters were consistent with sandeel population structure. Frederiksen *et al* (2006) also showed that the abundance of sandeel larvae was strongly related to plankton abundance, and that seabird (including *R. tridactyla*) breeding productivity was positively related to the abundance of sandeel larvae in the previous year. The close correlation in some areas between sandeel abundance and breeding success of this species is expected to continue to cause problems into the future, due to climate change effects, and likely resulting regime changes, for example in the North Sea.

R. tridactyla are also threatened by predation. Great Skuas *Stercorarius skua* are important predators of adults and their chicks in Shetland (Oro & Furness, 2002), and White-tailed Eagles *Haliaeetus albicilla* are known predators of chicks and major causes of disturbance in colonies in Norway (Barrett & Krasnov, 1996).

Relevant additional considerations

Sufficiency of data

There is sufficient data detailing the population trends of this subspecies within the OSPAR area, and the relevant threats. There is a substantial amount of information available on the link between sandeel populations and *Rissa tridactyla* breeding success.

Changes in relation to natural variability

Frederiksen *et al.* (2004) used a population model to predict *R. tridactyla* population growth in the North Sea and showed that if sea temperatures increase further the observed decline is expected to continue even if the sandeel fishery remains closed.

Expert judgement

There is good evidence of both threats to and decline of this species in the OSPAR area.

ICES Evaluation

The ICES evaluation of this nomination (ICES, 2007) agreed that the species is highly sensitive, and facing certain threats. Additional references were provided in support of the description of sensitivity and threat.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting.

Category of effect of human activity: Physical – Temperature changes; Biological – Removal of target species.

Rissa tridactyla is threatened by reductions in the supply of small pelagic shoaling prey fish. Human activity can directly or indirectly alter the availability of these prey species, therefore affecting *R. tridactyla* survival. The industrial sandeel fishery can contribute to the lack of sandeels locally, but also human-induced climate change leading to increased sea surface temperatures will in turn affect sandeel (and other fish species) abundance.

Management considerations

R. tridactyla is a relatively well-studied and monitored species throughout the OSPAR area, due to the relative ease with which this can be achieved.

As threats to food supply are such an important consideration for *R. tridactyla*, it would be beneficial to investigate further the causes of poor sandeel recruitment and quality (in terms of nutritional content) in recent years, and how these factors affect population dynamics. The ongoing "real-time" management of the North Sea sandeel fishery should be supported, and fisheries exclusion zones around important *R. tridactyla* colonies should be considered where they are not already in place. Protection from oil pollution would also be beneficial where this is feasible.

Further information

Nominated by:
BirdLife International

Contact persons:
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Nomination

Sterna dougallii Roseate Tern

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Geographical extent

OSPAR Regions: II,II,IV, V
Biogeographic zones: 1,2,5-9,11
Region & Biogeographic zones specified for decline and/or threat: as above

The Roseate Term is a pantropical species with an estimated world population of between 25,000-50,000 birds. Within Europe, the Atlantic race *S.d.dougallii* nests in Ireland, UK , France, the Azores and possibly the Canaries (Cramp, 1985). Between 3-6% breed in the OSPAR region on the Azores and on islets off the east and west coasts of Britain and Ireland, and the north coast of Brittany in France (Tucker & Heath, 1994). They spend only a few months of the year in their European breeding grounds and the winter months in West Africa. The nest sites tend to be concealed amongst rocks, vegetation or artificial cover on isolated marine islands. The birds forage in small groups generally further offshore than other terns, but over shallow water, hydrographic features, or in association with large predatory fish such as tuna.

Application of the Texel-Faial criteria

There were three nominations for the Roseate Tern including a joint submission by three Contracting Parties. The criteria common to all nominations were regional importance, rarity, sensitivity and decline, with information also provided on threat.

Regional importance

In the OSPAR Maritime Area, the Roseate Tern breeds in the Azores, France, Ireland, and the UK. There are currently estimated to be about 70 pairs in France, 618 pairs in Ireland, and 50 pairs in the United Kingdom (Mavor *et al.,* 2001). In 1989 a complete survey of the Azores coastline estimated a population of 992 pairs representing about 65% of the Western Palearctic population (del Nevo *et al.,* 1990; Monteiro *et al.,* 1996). About 379–1,051 pairs of have nested in the Azores between 1985 and 2000, and these represent the largest part of the population of this species. The Azores population has consistently been by far the largest in the OSPAR area in recent years, but may have been overtaken by the colony at Rockabill, Ireland, in the past two or three years (Upton *et al*., 2000; ICES, 2002).

Decline

Roseate terns have declined in number in North America and Europe since the 1960's. Within the OSPAR area, long-term declines of Roseate Tern have been well documented in Britain, Ireland, and France (Lloyd *et al*., 1991) The numbers in Britain and Ireland fell by 70–75 % between 1969 and 1985, for example, and between 1990-1994 the annual counts of 1,051, 853, 750, 379 and 547 breeding pairs, revealed a downward trend in the Azores (Monteiro *et al.*, 1996). Conservation efforts at Rockabill in Ireland have led to an increase in numbers in the last few years. Counts of breeding pairs of roseate terns in the Azores in the period 1995–2001 have been only about 50% of those in 1985–1995 (ICES, 2002).

Counts vary considerably from year to year and it is not clear how much of the variation is due to counting difficulties, and how much to birds choosing not to breed in some years, perhaps in response to changes in food availability. Certainly, the distribution of pairs around the Azores can change considerably from year to year, suggesting that birds are responding by moving site according to conditions. This may also be influenced by predation impacts at particular colonies.

Rarity

The total breeding population of Roseate Tern in the OSPAR Maritime Area is probably no more than 1,600 pairs.

Sensitivity

Roseate terns are considered sensitive due to the small numbers that breed predominantly at a small number of sites, mostly concentrated within one biogeographic region. Threats on land include introduced predators such as cats, dogs, rats and mustelids. At sea, the species is sensitive during breeding season due to its highly concentrated distribution around breeding colonies. Like all seabirds they are sensitive to oil pollution.

Threat

A major threat to the Roseate Tern is the trapping of the birds which takes place at their wintering grounds in West Africa. This activity takes place outside the OSPAR Maritime but there is strong evidence to implicate it as the primary cause of population decline (Lloyd *et al*., 1991). Other threats include predators at colonies, including foxes, rats, gulls, egg collectors, and peregrine falcons in Britain, Ireland, and France (Lloyd *et al*., 1991). Birds in the Azores are killed at colonies by common buzzards and yellow-legged gulls. European starlings also take eggs. All European colonies have been subject to variable levels of disturbance and/or predation from human activities and avian and ground predators (Tucker & Heath, 1994).

Relevant additional considerations

Sufficiency of data

There are good data on the numbers of breeding birds and their breeding success at some of their nesting sites in Europe. Less is known about the factors that influence their breeding success, the survival of chicks and the mortality rate. There is also a lack of knowledge about where the terns are to be found during the second half of the winter. A better understanding of issues such as these are needed to identify further actions that could be taken to improve the status of this species.

Changes in relation to natural variability

Little is known about the effects of natural variability of the population status of the Roseate Tern.

Expert judgement

There is good evidence of both threat and decline to Roseate Tern in the OSPAR Maritime Area.

ICES evaluation

The ICES evaluation notes that the roseate tern is a very clear case for listing as a priority species due to a well-documented and severe population decline within the OSPAR Maritime Area (ICES, 2002). There is some evidence that birds can move between the OSPAR Area and North American colonies, but since both have adverse conservation status, such movements will do little to mitigate population declines, which are serious in other parts of the world as well.

Threat and link to human activities

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

Relevant human activity: shipping and navigation.; *Category of effect:* Biological –introduction of non-indigenous species;

Human disturbance can be a problem at colonies, although most sites have legal protection. This is not very effective in the Azores, where fishermen and tourists may visit nesting islets and cause serious disturbance (ICES, 2002).

Management considerations

Within the OSPAR Maritime Area, protection of breeding sites is important for the conservation of this species and many of these locations have been protected for many years. Complementary actions to improve breeding success have included the provision of nest boxes to give some protection to adults and chicks from predators, predator control and wardening to prevent disturbance by visitors (Avery & del Nevo, 1991). Measures such as these are relevant to the birds at their breeding grounds but there is also a need for conservation measures at their wintering grounds outside the OSPAR Maritime Area.

The Roseate Tern is listed under Annex I of the EU Birds Directive, Annex II of the Bern Convention and Annex II of the Bonn Convention.

Further information

Nominated by:
Joint submission from Iceland, Portugal, UK; and individual submissions from UK, & BirdLife International

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Mark Tasker, Joint Nature Conservation Committee, Monkstone House, Peterborough, PE1 1UA, UK.

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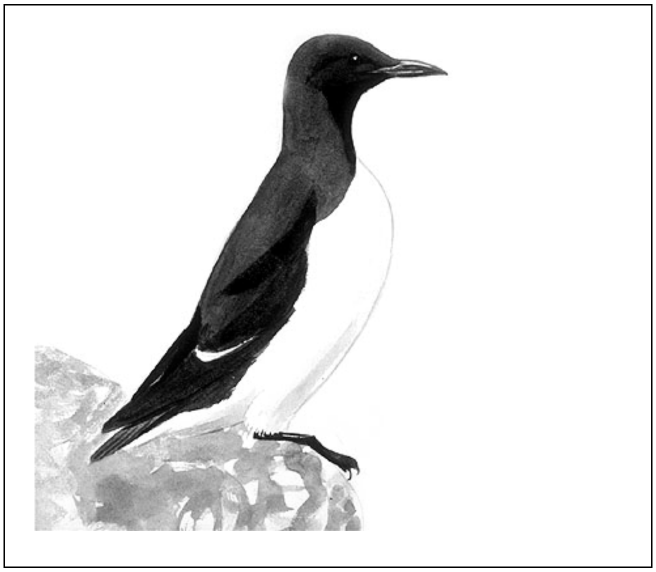
Nomination

Uria aalge (U.a.ibericus. U.a.albionis) Iberian guillemot



The status of the Iberian guillemot as a distinct sub-species of the common guillemot *Uria aalge* is unclear. *Uria aalge ibericus* was first proposed as a subspecies by Solomomsen in the 1930s, but was retracted by him in his later works as not being a sufficiently distinct form to merit subspecific recognition (ICES, 2002). The subspecies "*ibericus*" was supported by Bernis (1949) and subsequently accepted by the standard text on these birds of the 1960s and early 1970s (Tuck, 1960). This was current when the EU Directive on the Conservation of Wild Birds (79/409/EEC) (the Birds Directive) was initially drawn up in the 1970s, and when the Annexes to the Directive were amended when Spain and Portugal joined the European Union. This taxonomic treatment has not been followed in more recent definitive texts such as del Hoyo *et al*. (1996) or Cramp (1985), or in a recent major monograph on the auks (Gaston & Jones, 1998), which all recognise only three subspecies of the common guillemot, *Uria aalge*, *albionis*, and *hyperborea*.

Geographical extent

OSPAR Regions; IV
Biogeographic zones: 6
Region & Biogeographic zones specified for decline and/or threat: IV

The common guillemot (*Uria aalge*) is an abundant and widespread breeding seabird throughout much of the OSPAR area. The breeding population is thought to number around 3.5 million pairs at the present time, with about half of these in OSPAR Region I, and most of the rest in OSPAR Regions II and III. Numbers breeding in OSPAR Region IV are extremely small (these are all of the putative *ibericus*) and they may now be extinct. None breed in OSPAR Region V (ICES, 2002).

Application of the Texel-Faial criteria

U.a.ibericus was nominated by one Contracting Party citing regional importance, rarity, sensitivity and decline, with information also provided on threat.

Rarity

The number of breeding pairs of the (Iberian) guillemot in Region IV have been various quoted as about 100 pairs and maximum of 40 pairs (websites of the European Environment Agency and of the World Conservation Monitoring Centre) but it is not clear how recent these figures are, and no indication is given of the source of the figures.

Regional importance

In the OSPAR Maritime Area the (Iberian) guillemot is only found in Region IV. Breeding birds are found on the coast of NW Spain, the Portuguese coast and Berlenga islets off the southern Portuguese coast.

Decline

Common (Iberian) guillemot numbers have declined drastically in OSPAR Region IV and they may now be extinct in Iberia. The common guillemot may also be extinct in one part of OSPAR Region I (Barents Sea and Norwegian Sea). In the remaining OSPAR areas, numbers have increased over the past 20–30 years (ICES, 2002).

Sensitivity

This species is considered to be sensitive to disturbance, predation and oil pollution. The scale of the impact of the oil spill from the tanker *MV Prestige* has still to be determined but has killed seabirds in the region.

Threat

Oil pollution and incidental take in fisheries are the clearest threats to guillemots in Region IV. There have been major problems with drowning in set nets, particularly salmon nets and gillnets for cod (ICES, 2002). As a specialist piscivore feeding on small, shoaling, lipid-rich fish in winter as well as in summer, common guillemots can show mass mortality of fully-grown birds, especially during winter, if stocks of these food fish are low. For example, well over half of the common guillemots in the Barents Sea died in winter 1986/1987 when the capelin stock collapsed (Vader *et al*., 1990; Lorentsen, 2001). Colonies in the extreme south of the species' breeding range (France–Iberia) have declined and may now be extinct, apparently as a result of combined impacts of egg collecting (in the past), capture of unfledged young to keep as pets (Berlengas), taking of adult birds for food, shooting (off northern coasts of Spain), by-catch in fishing nets, oil spills, and predation at colonies by introduced mammals, large gulls, and other birds (Bárcena *et al*., 1984).

Relevant additional considerations

Sufficiency of data

Data on the status and trends in the numbers of breeding birds exists for the common guillemot, but the situation is unclear for the Iberian guillemot given the uncertainties about its status as a sub-species.

Changes in relation to natural variability

The extent to which natural fluctuations in the population of this sub-species may have affected its status is not known.

Expert judgement

An important issue to be resolved is whether the form of guillemot in Iberia is taxonomically separable from other forms. ICES (2002) report that most experts consider that it is not separate sub-species. This will affect the assessment as the common guillemot is not considered to be threatened or declining in the OSPAR Maritime Area.

ICES evaluation

ICES raise the issue of the status of *U.a.ibericus* as a subspecies as there does not appear to be any recent scientific justification for separating guillemots from Iberia as a distinct subspecies (ICES 2002). They report that the current treatment is to group Iberian guillemots with those from France, Ireland, England, and southern Scotland as subspecies *Uria aalge albionis* (Gaston & Jones, 1998).

The ICES evaluation is that there is a clear case for identifying the common guillemot in Iberia as requiring urgent conservation action, first to assess its status and, if not already extinct, to draw up and implement a recovery plan.

In the case of the common guillemot, there are highly divergent population trends for common guillemots in different sections of OSPAR Region I. In the eastern sector (Barents Sea and Norwegian Sea), common guillemot numbers have decreased drastically, whereas in the western part of Region I (e.g., Iceland) numbers appear to be fairly stable. A strong case could be made for identifying the common guillemot in the Barents Sea region (including the Norwegian coast south to the Lofoten Islands) as a priority for listing as a seriously declined population (ICES, 2002).

Threat and link to human activities

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

Relevant human activity: Shipping & navigation; Fishing, hunting, harvesting; *Category of effect of human activity:* Chemical – hydrocarbon contamination; Biological - removal of non-target species, changes in population or community structure or dynamics.

Marine pollution and incidental capture are the two threats to guillemots in Region IV that can be directly linked to human activities. Depletion of food sources may be an indirect effect of fishing pressure on species that form part of the diet of the guillemot.

Management considerations

Management measures will need to be focused on the land-based breeding sites in the first instance. ICES recommend that a recovery plan be drafted for this species as well as a better assessment of its taxonomic status.

The Iberian Guillemot is listed in Annex 1 of the EU Birds Directive.

Further information

Nominated by:
Portugal

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Useful References:

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Nomination

Uria lomvia, Thick-billed Murre

© Helge Sørensen, BirdLife Denmark

Geographical extent

OSPAR Regions: I
Biogeographic zones: 2,3,8,12,13,15-20
Region & Biogeographic zones specified for decline and/or threat: As above

Uria lomvia is almost completely restricted to the high and low Arctic zones with open water and an adequate summer food supply, feeding mainly on fish, squid and crustaceans. It is an exclusively marine species, occurring offshore and along seacoasts. It winters mostly offshore, to the edge of the continental shelf, and along seacoasts and in bays where suitable concentrations of fish and invertebrates occur. During the winter, this species is found in flocks at sea, most likely related to non-random distribution of winter prey.

Application of the Texel-Faial criteria

U. lomvia was nominated for inclusion on the OSPAR List with particular reference to the regional importance, decline, and sensitivity criteria, with additional information provided on threat.

Global/ regional importance

The OSPAR breeding population for this species, though numerous, is concentrated in a relatively small number of colonies in Greenland, Iceland, Norway, Svalbard and the westernmost areas of Franz Josef Land. Therefore, *U. lomvia* qualifies under this criterion as a high proportion of the total population of the species in the OSPAR area is restricted to a relatively small number of breeding locations (all within OSPAR Region I).

Data showing the distribution of this species within the IBAs[5] found in the OSPAR Maritime Area[6] support this conclusion. The occurrence of this species within IBAs is largely restricted to fewer than 10 sites. In particular, three IBAs for this species within the OSPAR Maritime Area (Hælavíkurbjarg – Iceland; Bear Island and Høpen Island – Svalbard) hold very large concentrations of this species.

Decline

The OSPAR breeding population was broadly stable between 1970-1990, but suffered declines over 1990-2000. The large population in Svalbard remained broadly stable overall, but the species suffered declines in Greenland [0-19%] and Iceland [30-49%], declining at an overall rate that, if sustained, would equate to a large decline [>30%] over 3 generations (BirdLife International, 2004). Recently published results of seabird monitoring in SW and NE Iceland showed that *Uria lomvia* decreased in both regions from the mid-eighties to 2005, at a rate of nearly 7% per annum (Garðarsson, 2006). Large colonies of *Uria lomvia* can be found in E Greenland, near Scoresby Sound. Surveys conducted in 2004 (by the Greenland Institute of Natural Resources (GINR); results analysed but not yet published – C. Egevang *pers comm.*) showed declines in these colonies, verifying the decline identified by an earlier 1995 survey (Falk et al. 1997). A 2004 French photographic survey of E Greenland colonies also found evidence of declines (results of this survey included in the Greenland Seabird Colony database, http://www.dmu.dk/International/Arctic/Oil/Seabird+colonies/).

Sensitivity

This species is classed as sensitive. Its life history characteristics (relatively long lived, and slow to reproduce) suggest a low *resilience*, meaning that it would take a long time for a population to recover from any adverse effects from human activity. Age at first breeding is estimated at 5 years (infrequently 3 or 4 years during periods of colony expansion), and birds lay only one egg per clutch. However, where measured, breeding success is usually high with 70-80% of eggs laid producing fledglings (del Hoyo *et al.,*1996).

The species also has a low *resistance* to threats including oil pollution, by-catch in and competition

[5] Important Bird Areas – areas identified by BirdLife International as being of importance for birds.
[6] Excluding purely terrestrial or inland IBAs.

with commercial fisheries operations, and being targeted for hunting –particularly in Greenland. This species is also sensitive to climate change and warming in the Arctic.

Threat

A serious threat to this species is the hunting in Greenland, particularly that which occurs during the winter season. Boertmann *et al.* (2006) report that a significant proportion of OSPAR's breeding population of *U. lomvia* winters in and around SW Greenland – the area being particularly important for birds from Svalbard and Iceland. Here they are threatened by (amongst other things) the unsustainable hunting that occurs in this region. Declines in Icelandic *U. lomvia* have been related to the winter hunting in SW Greenland (Boertmann *et al.,* 2006).

Other threats to this species include disturbance from hunting activity (separate from hunting mortality), egg-harvesting in some colonies, incidental kills in fishing nets, competition with commercial fisheries (particularly relevant to Iceland), and chronic oil pollution and oil spills. Climate change could also be a relevant threat for *Uria lomvia: a* recent paper speculated that the long-term declines seen for this species in colonies throughout Iceland could have been caused by large scale changes in their food supply associated with global climatic change (Garđarsson, 2006). The combination of increased daily temperatures and increased parasitism from mosquitoes resulting from warming in the Arctic has also been suggested as having a direct effect on increasing mortality of Arctic seabirds such as *Uria lomvia* (Gaston *et al.*, 2002).

Relevant additional considerations

Sufficiency of data

There is reliable data describing declines of this species within the OSPAR area. More data would be useful to fully assess trends in Eastern Greenland and Iceland.

Changes in relation to natural variability

The effect of natural variability on population trends of this species has not been estimated – however the rates of decline seen in some areas e.g. Iceland, Greenland, seem to lie outside the realm of natural variability in population size.

Expert judgement

There is good evidence of both threats to and decline of this species in the OSPAR area.

ICES Evaluation

The ICES evaluation of this nomination (ICES, 2007) agreed that populations of this species are sensitive and under threat, and suggested some additional evidence for this, along with some extra references. These were taken into account in the production of this case report.

Threat and link to human activities

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

Relevant human activity: Shipping and navigation; Fishing, hunting, harvesting.
Category of effect of human activity: Physical – Temperature changes. Chemical – Hydrocarbon contamination. Biological – Displacement (moving) of species; Removal of target species; Removal of non-target species.

Hunting (including disturbance effects), marine pollution and incidental capture in fishing nets are the main threats that are directly linked to human activities. Human activities are likely to have an indirect impact on the species via climate change effects as well.

Management considerations

There is very little current management targeted specifically for this species. However, the Conservation of Arctic Flora and Fauna program of the Arctic Council drafted an International Murre Conservation Strategy that is being implemented by CAFF Member Countries, including Arctic countries in the OSPAR region (CAFF, 1996).

Areas holding recurrent concentrations in winter are difficult to designate for this species as they tend to vary in time and space according to the distribution of their pelagic prey, however there are a few particular areas where *Uria lomvia* concentrate regularly – often at upwelling sites or fjord mouths with strong tidal movements. It is particularly important to create some safe havens for wintering and breeding populations of this species in Greenland, where they can be protected from hunting.

The top three IBAs for this species within the OSPAR Maritime Area (excluding purely terrestrial and inland sites) are Hælavíkurbjarg – Iceland; Bear Island, and Høpen Island – Svalbard. These sites should be priority candidates for protection as OSPAR MPAs, as they hold the largest concentrations of this species found within IBAs in the OSPAR Maritime Area. Hælavíkurbjarg IBA

(Iceland) is already designated at the national level, as a national nature reserve (for landscape). However, none of the three sites above yet have international protection.
It will be important to gather more information about the status and distribution of this species along the East Greenland coast. None of the East Greenland IBAs are presently monitored – monitoring should be set up for these sites, and research should be done to pinpoint other important sites along the rest of the coast (these sites could then be monitored and/or protected as appropriate).

Further information

Nominated by:
BirdLife International

Contact persons:
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Useful references:

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Nomination

Acipenser sturio, Common Sturgeon

Geographical extent

OSPAR Region; II, IV
Biogeographic zone: 6
Region & Biogeographic zones specified for decline and/or threat: as above

The common sturgeon. *A.sturio*, is a migratory species reproducing in fresh water and then moving into the sea until ready to spawn again.

At one time *A.sturio* was the widest distributed sturgeon species in Europe. Early in the last century it was found off all European coasts and migrated up most of the large rivers to spawn. This included the Rhine and the Elbe which were the most important west European rivers for the species. Today the Atlantic population in the OSPAR Maritime Area is centred on the River Gironde in France and, during the marine parts of its life history, in the Bay of Biscay the Bristol Channel and the North Sea (Castelnaud *et al.,* 1990).

Application of the Texel-Faial criteria

A.sturio was nominated for inclusion on the OSPAR list with particular reference to its global/regional importance, decline, sensitivity with information also provided on threat.

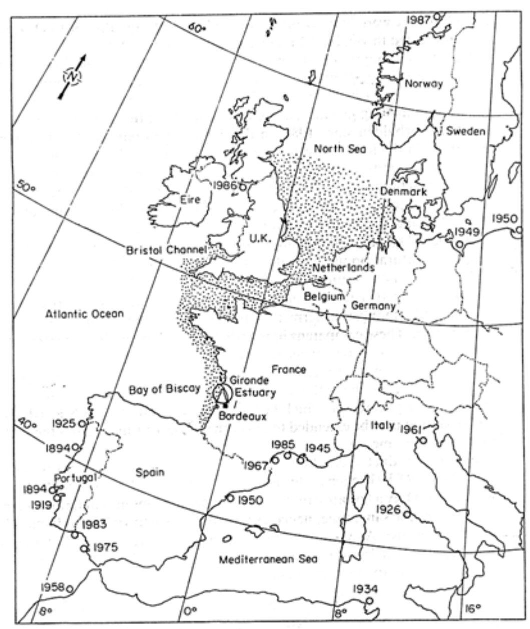
Global/regional importance

The common sturgeon is limited in its distribution to a population centred around the River Gironde in France and the River Rioni in Georgia, which drains into the Black Sea. As the remnants of a much more widespread and abundant population (see section on decline) this makes the OSPAR Maritime Area of global importance for this species.

Decline

The sturgeon was once widely distributed in European waters, from the Barents Sea to the Black Sea, and was abundant in rivers suitable for spawning. There is no total estimate of the population size but it is known to have been greatly reduced. Historically, this species inhabited nearly all the large tributaries of the European Atlantic, the Black, Adriatic, Mediterranean and North Seas. In the middle of the 20th century *A.sturio* occurred in south-west France, Portugal and Spain, in the Adriatic, and in Georgia. Since then the populations have declined in all parts of its range including within the OSPAR Maritime Area (e.g. Almaca, 1988: Elvira *et al*., 1991; Elvira & Almodovar, 1993). The common sturgeon is now extinct in a number of its former spawning rivers including the Elbe and the Rhine. Only two clusters remain centred on the Gironde-Garonne-Dordogne basin in France, and in the Rioni basin in Georgia (Rochard et al., 1990) (Figure A.).

FIGURE A: Distribution of the west European (Atlantic population. Shaded area shows known range in Atlantic & N.Sea. Small circles with dates indicate last observations for other localities (from Rochard *et al.,* 1990)



The sturgeon was originally exploited for its flesh and, more recently for caviar. In the early 1900's annual fish catches were of the order of 10,000 in western Europe (van Winden *et al*., 1999). In the Gironde, there was a fishery for caviar from the 1920s but the population decreased dramatically from 1970 and the fishery has now closed.

Sensitivity

Sturgeon require a relatively long time to reach sexual maturity. This varies between populations but is about 8 years for males and 14 years for females. After spawning for the first time, males reproduce every 1-2 years and females every 3 or more years (Rochard *et al*., 1990). The species is vulnerable to physiological stresses each time they migrate between fresh and saline water and it is at this time that they are also vulnerable to fishing.

Threat

The main threats to sturgeon in the OSPAR Maritime Area are obstruction of migration routes, pollution of lower river reaches, targeted commercial fisheries, and damage to spawning grounds (e.g. Fernandez 1967). There is also occasionally a by-catch in other sea fisheries at the entrance to estuaries.

The majority of these threats take place on the inland waters used by the migrating fish. The construction of dams and artificial embankments prevent the fish migrating freely, while extraction of water for irrigation can also make spawning grounds inaccessible and create difficulties for the alevins and adult spawners returning downstream.

The spawning grounds themselves have been degraded by extraction of gravel and stones from the river bed, and modifications in water flow caused by channelling and fluctuating water levels below dams. Poor water quality is another concern affecting the fish directly and indirectly through effects on their food.

Relevant additional considerations

Sufficiency of data

Data on the threat and decline of the common sturgeon came through anecdotal reports in the first instance but this has subsequently been supported by the collapse of the fishery through most of its range and the fact that the species has become locally extinct in parts of its former range.

Changes in relation to natural variability

The dramatic decline in abundance of common sturgeon and reduction in its range following extensive exploitation by fisheries, points to changes beyond that which would be expected through natural variability.

Expert judgement

The collapse of the sturgeon catches and local extinctions have provided the data on which this species has been given international protection through the EC Habitats and Species Directive and a number of international conventions.

ICES Evaluation

The ICES review of this nomination by the Working Group on Fish Ecology (WGFE) reached the following conclusions (ICES, 2003).

The geographical distribution of the last known population of common sturgeon (spawning in the Gironde basin) is within the OSPAR area; the species is of particular importance in the Gironde system but can be encountered in most of the coastal zones. The decline in the OSPAR area, as well as in a number of other populations is clear. The last remaining population has been monitored and still exhibits evidence of a decrease and it may be that a viable population no longer exists

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; extraction of sand, stone and gravel; constructions, land-based activities. *Category of effect of human activity:* Physical – substratum removal and change, water flow rate changes, Biological – removal of target species

The main threats to this species can be clearly linked to human activities as they are due to targeted fisheries and damage to critical habitat requirements of the sturgeon.

Only three single natural reproductions have been observed in the Gironde population since 1980 (Arne, 2002). The species therefore remains under serious threat in the OSPAR Maritime Area.

Management considerations

The main management measures that would assist the recovery of sturgeon populations in the OSPAR Maritime Area are improvement of water quality, habitat conditions, and access to suitable spawning grounds in the estuaries and rivers of Europe. Artificial breeding programmes with reintroduction of juveniles to the wild are currently underway in France, but these will only be successful in the long term if conditions that led to the decline in the first place have been tackled.

The sturgeon is listed on Annexes II & IV of the EC Habitats & Species Directive, the Bern Convention and the Bonn Convention. It was classified as

Critically Endangered by IUCN in 1996. It is also protected under Appendix I of CITES.

Further information

Nominated by:
Belgium, Germany, Portugal

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Ronald Fricke, Staatliches Museum fuer Naturkunde, Rosenstein 1, D-70191 Stuttgart, Germany

Jan Haelters & Francis Kerckhof, Management Unit of the North Sea Mathematical Models, 3e en 23e Linieregimentsplein, 8400 Oostende, Belgium.

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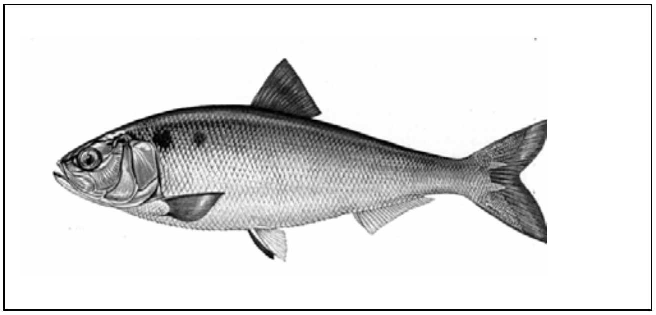
Nomination

Alosa alosa, Allis Shad



Geographical extent

OSPAR Region; II, III, IV
Biogeographic zone: 4,6,7,9,11,13,14
Region & Biogeographic zones specified for decline and/or threat: as above

The Allis Shad *Alosa alosa* is a migratory species reproducing in fresh water and then moving into the sea until ready to spawn again. It has a distribution that extends along the coasts of Western Europe from northern Norway to Spain and Portugal, as well as and in the western Mediterranean (Wheeler, 1978). It occurs mainly in shallow coastal waters and estuaries and the lower reaches of rivers where it spawns. It is also found offshore e.g. in the Bay of Biscay but aggregated near the mouths of rivers such as the Gironde and the Loire, where it migrates to spawn (Taverny & Elie, 2001). The most successful breeding rivers are thought to be in western France and Portugal.

Application of the Texel-Faial criteria

A.alosa was nominated for inclusion on the OSPAR list with particular reference its rarity and decline, with information also provided on threat.

Decline

Records show a sporadic distribution around the coasts of the British Isles, where it is considered to have declined in abundance since the mid-nineteenth century (e.g. Aprahamian & Aprahamian, 1990). Former spawning grounds that are no longer believed to support allis shad include the River Severn (England/Wales) and the rivers that feed the Solway on the west coast of Scotland. It is possible that viable populations remain on the Solway Firth and the rivers that drain into it and the Bristol Channel (Potts & Swaby, 1993). Declines in Portugal have been reported by Costa *et al.,* (2001) and in the Wadden Sea by Berg *et al.,* (1996) It may now only breed in a few French and Portuguese rivers.

Rarity

A.alosa has been reported as becoming increasing rare in European rivers and estuaries. They were common migrating up rivers in Belgium until the late 1940's, for example, but no specimens have been reported from the coast and rivers of the country since 1947 (Van Beneden, 1871; Poll, 1947). The species is also considered to be extinct in the Netherlands. Adult fish occur in small numbers around the coast of the UK but even here they are considered to be uncommon (Swaby & Potts, 1990).

Threat

The main threats to Allis Shad in the OSPAR Maritime Area are obstruction of migration routes, pollution of lower river reaches and damage to spawning grounds.

The majority of these threats take place on the inland waters used by the migrating fish. The construction of dams and artificial embankments prevent the fish migrating freely, while extraction of water for irrigation can also make spawning grounds inaccessible and create difficulties for the fish returning downstream.

The spawning grounds themselves have been degraded by extraction of gravel and stones from the river bed, and modifications in water flow caused by channelling and fluctuating water levels below dams. Poor water quality is another concern affecting the fish directly and indirectly through effects on their food (e.g. Berg *et al.,* 1996).

Relevant additional considerations

Sufficiency of data

The number of Allis shad recorded in rivers and estuaries known to have been used by the migrating fish reveal a decline in the population and local extinctions in parts of its former range.

Changes in relation to natural variability

Little is known about the natural variability in the population of Allis shad and therefore whether the decline and local extinctions are greater than might be expected through natural change. The fact that human activity is known to have affected the ability of adults to reach spawning sites does however suggest that the decline is at least in part due to human activity rather than natural variability.

Expert judgement

The decline in records and local extinctions have provided the data on which this species has been given international protection through the EC Habitats and Species Directive and a number of international conventions.

ICES Evaluation

The ICES review of this nomination by the Working Group on Fish Ecology (WGFE) reached the following conclusions (ICES, 2003).

There is extensive evidence that the OSPAR area is of global importance to *Alosa alosa.*All the remaining self-sustaining populations are confined mainly to France and Portugal and complete their life cycle within the OSPAR area. there is good evidence for a reduction in their range and in certain rivers the population has declined to such a level that it is extremely unlikely that a self-sustaining population exists and the population may well be extinct.

The main threats to the Allis Shad in Europe are obstruction of migration routes, pollution of lower river reaches, impingement at river intakes, and damage to spawning grounds. The majority of these threats take place in estuarine and freshwater environments used by migrating fish and there is no evidence that anthropogenic activities in fully marine environments are major threats to their populations, although they are occasionally taken in marine fisheries. t is suggested that in the future both shad species should be protected as protection measures for *A. alosa* will also afford protection to the twaite shad *A. fallax*.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; extraction of sand, stone and gravel; constructions, land-based activities. *Category of effect of human activity:* Physical – substratum removal and change, water flow rate changes, Biological – removal of target species.

The main threats to this species come from the degradation of spawning habitat and poor water quality, both of which are linked to human activities. Specific examples include the reports of Allis shad being severely affected by pollution in the River Clyde (Maitland, 1974; Cazemier, 1988) and the building of navigation weirs on the River Meuse in France, Belgium and the Netherlands (Phillipart, 2000).

Management considerations

The main management measures that would assist the recovery of the Allis shad in the OSPAR Maritime Area are improvement of water quality, habitat conditions, and access to suitable spawning grounds in the estuaries and rivers of Europe. Guidance to fishermen on the status and threats to the shad will be valuable in providing records of the species.

The Allis shad is listed on Annexes II & V of the EC Habitats & Species Directive, and Appendix III of the Bern Convention.

Further information

Nominated by:
Belgium

Contact persons:

Jan Haelters & Francis Kerckhof, Management Unit of the North Sea Mathematical Models, 3^{e} en 23^{e} Linieregimentsplein, 8400 Oostende, Belgium.

Useful References:

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Nomination

Anguilla anguilla (Linnaeus 1758), European eel

Geographical extent

OSPAR Regions: I, II, III, IV, V
Biogeographic zones: 5,6,8,9,10,11,12,13,14,15,16,17,19,23
Region & Biogeographic zones specified for decline and/or threat: as above

Eel can occur in all ICES fishing areas in the north-east Atlantic except for the areas directly east of Greenland and the Spitsbergen area north of continental Norway (Figure 2). Within its distribution area it cannot be confused with any other species of fish (except possibly with *Conger conger*) with its elongated snake-liked body and smooth slimy skin.[1] Before reaching sexual maturity the eel can reach a length of well over 1 m and a weight of several kilos. It can also attain a very high age, well over 50 years (CITES 2007a).

The European eel has an unusual distribution pattern with its spawning grounds somewhere in the warm offshore waters of the Sargasso Sea, an extended larval phase migration using the Gulf Stream to reach European coasts, and an adult distribution in freshwater habitats and adjacent brackish and coastal marine waters of Iceland and Europe from Norway southward, Northwest Africa, and the Mediterranean and Black Sea watersheds of Turkey and the Middle East (Figure 3 a, b). Adults migrate back to the West Atlantic, probably spawn only in one season and die afterwards (Dekker 2003; Froese & Pauly 2006; Fricke 2007).

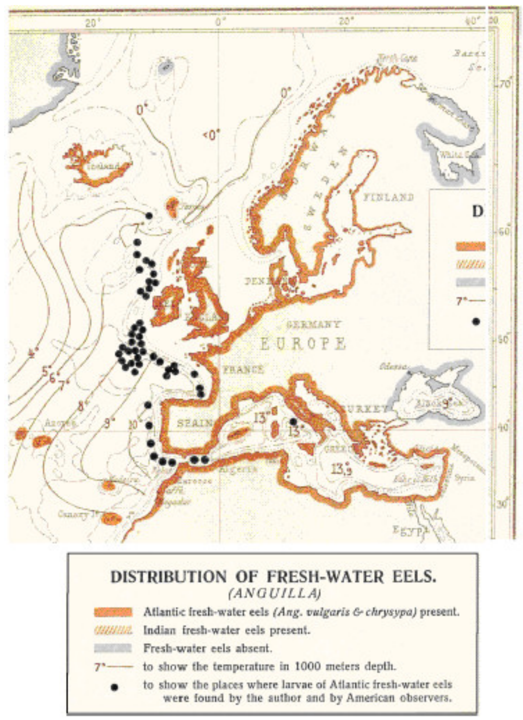

Figure 2: Distribution of *Anguilla anguilla* in European coastal waters. Map reproduced and adapted from Schmidt (1909); source: Dekker 2003. The Black Sea as part of the natural distribution area of the European eel is currently debated.

[1] However, it should be noted that Iceland is unique in that it can harbour European eel (*Anguilla anguilla*) *and* American eel (*Anguilla rostrata*) hybrids. Historically, the numbers of either species in Iceland have been low.

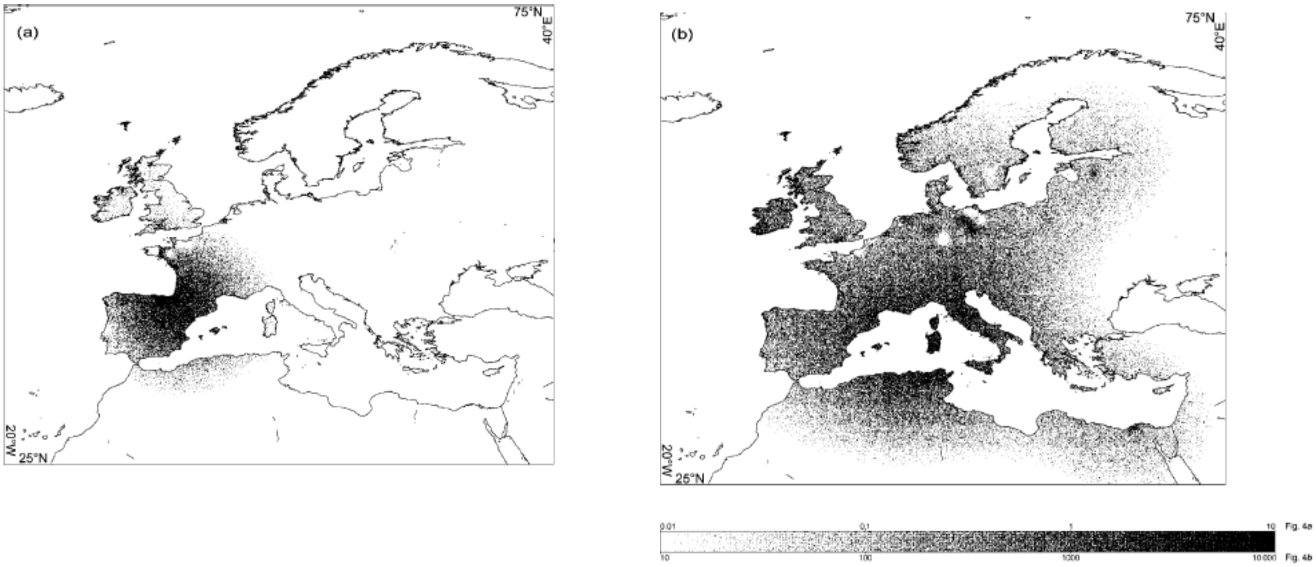

Figure 3 (from Dekker 2003): Model prediction (Kriging technique) of geographic spread of eel fishing yield per surface area. Spatially predicted values are scaled between minimum and maximum observed values, represented by dithered gray scales: the higher the density of pixels, the higher the yield. Note the logarithmic transformation of the yield. (*a*) Yield of glass eel per river drainage area. (*b*) Yield of yellow/silver eel per water surface area. Legend for Figs. 3*a* and 3*b*: units in kg·km–2; the scale is logarithmic.

Application of the Texel-Faial criteria

Global/regional importance

Global importance. As a conservative estimate, at least 80% (possibly 100%) of the larvae of European eel pass through the OSPAR Maritime area, and at least 50% of the adult eels live in river systems flowing into the area. Therefore, OSPAR Maritime Area is of global importance for *Anguilla Anguilla.*

Decline

Severely declined. The population of the European eel (*Anguilla anguilla*) is in decline and current fisheries are considered outside sustainable limits (WGEEL 1999, 2000, 2001, 2002, 2005, 2006). For European eel, a massive decline of *glass eel* arriving at European coasts was observed during the last 25 years (Figure 4, 5). It has been estimated that 1-5% of the former numbers of recruit arrive in Europe today (Dekker 2004; WGEEL 2006; CITES 2007a). There are no signs of improved recruitment since the worst year of 2001; thus it is likely that the stock will continue to decrease (Figure 4). Due to the long time lag between recruitment (glass eel) and maturity (silver eels), the severity of the situation of European eel is often not realized by fishermen, fishery managers and even scientists (H. Wickström, Swedish Board of Fisheries, Institute of Freshwater Research, Drottningholm, personal communication, 11 Feb. 2005).

Sensitivity

The European eel *Anguilla anguilla* has an unusual life history, making its sensitivity difficult to assess. Eels are long-lived and spawn only once in their lifetime (Figure 6). An analysis of the stock dynamics under different management regimes indicates that the recovery time for eel could be at least 20 years, depending on the implemented fisheries restrictions and the model assumptions (Åström & Dekker 2006).

Anguilla anguilla shows a complex and not yet fully understood migration pattern with a large proportion of the stock showing catadromous spawning migrations after a freshwater life history stage. After semelparous spawning of adult eel in the western Atlantic Sargasso Sea. European eel leptocephalus larvae follow the Gulf Stream and arrive in Europe as “glass” eels. The migration towards Europe takes seven months to three years. Arriving in western European continental waters, glass eels are regularly harvested for direct human consumption or collected for aquaculture and restocking purposes. European eel is relatively long-lived; the generation time is 12 years in the North Sea drainages and continental Europe, but 17-20 years in Scandinavia and around most of the Baltic Sea (Dekker 2003, 2004; H. Wickström, Swedish Board of Fisheries, Institute of Freshwater Research, Drottningholm, Sweden, personal communication, 11 Feb. 2005). Maximum total length 50 cm (male), 133 cm (female); maximum total weight 2.85 kg; maximum individual age 85 years, usually up to 15-20 years (Fricke 2007, Vollestad 1992).

As stated above, it is generally believed that most eels are catadromous. However, yellow eels can also be found in estuarine and coastal habitats throughout the area where glass eels and elvers occur naturally, and some may actually remain in marine habitat their entire life-cycle (Tsukamoto et al 1998, Daverat et al 2006). For the Baltic Sea is emerging that around 80% of the eel could remain in this marine habitat for all their life (Wickström & Westerberg 2006).

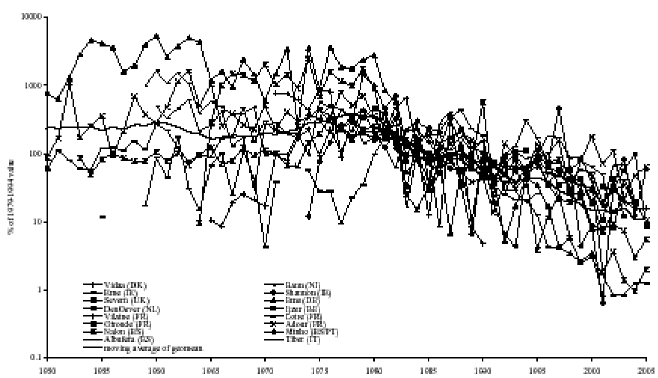

Figure 9.4.9.1 Time-series of **glass eel** monitoring in Europe. Each series has been scaled to the 1979-1994 average. The heavy line indicates the geometric mean of the series from Loire (F), Ems (D), Göta Älv (S), and DenOever (NL), which are the longest and most consistent time-series.

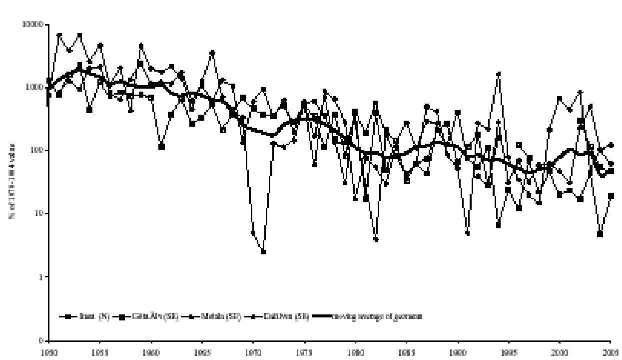

Figure 9.4.9.2 Time-series of **yellow eel** recruitment. Each series has been scaled to the 1979-1994 average. The heavy line indicates the geometric mean of all time-series.

Figure 4: Trends in recruitment and landings of the European eel. Glasseel (above), yellow eel (below). Source: ICES 2006a.

Threat

Although European eels still seem to be common in many areas (mainly due to introduction), they are subject to several threats. Main threats include: fisheries, stream migration blockages, loss of habitat, pollution, parasites and diseases, predatory birds as well as climatic changes of their environment especially during their larval marine migration.

Different life stages of eel are targeted in several countries. The youngest eel stages (glass eel and elvers) are heavily exploited as they are the basis of a worldwide established eel aquaculture industry; yellow and silver eels are also major targets for freshwater and coastal fisheries and their migration into and from rivers is impeded by dams and hydropower stations. Current eel fisheries and eel aquaculture in Europe is based on young eel mainly exported from France, Great Britain and Spain and traded within the EU. A substantial part of European glass-eel catches are traded on the Asian market, mainly to China and Japan. Some 90% of eel consumed in the world is based on eel aquaculture, but like direct fishing, this is based on young eel caught in the wild. The glass eel stage is by far the most commercially important life stage and a substantial proportion (~50%) of European glass-eel catches are for aquaculture, most of which (~85%) are bound for Asian markets (CITES 2007a).

Fisheries: European eel has been commercially heavily exploited in fisheries, though catches in many areas have considerably decreased. The fishing yield of European eel amounts to more than half of the world eel fisheries on all eel species. Annual averages in the 1990s, according to FAO data bases, were of the order of approx. 15,000 tons out of a world fisheries catch of some 29,000 tons (CITES 2007a).

Dekker (2003) and Moriarty & Dekker (1997) reviewed the locations of fisheries with regard to stocking and life history. The fisheries threat is not confined to glass eel, but applies to all life stages including migrating, maturing silver eel. European eels on their spawning migration may also be caught as bycatch in trawl and other demersal fisheries, though the numbers are not believed to be high. The threat situation has been discussed in detail by WGEEL (2006).

It is hoped that the recent June 2007 EC eel regulation should help address the fisheries threat (EC 2007). Assuming the implementation of immediate action, analysis of stock dynamics under different fisheries management regimes indicates that recovery times may vary from 20 up to 200 years, depending on the intensity of implemented fisheries restrictions. However, restrictions on fisheries alone will be insufficient, and management measures aimed at other anthropogenic impacts on habitat quality, quantity and accessibility will also be required (WGEEL 2006).

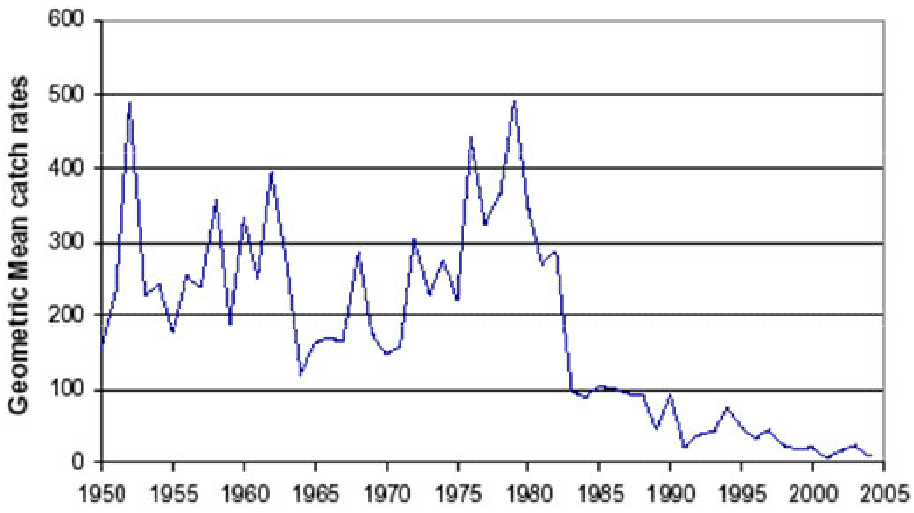

Figure 5: Time series of glass eel monitoring in Europe. The line indicates the geometric mean of the series from the Loire (FR), Ems (DE), and DenOevre (NL), which are the longest and most consistent time series. Source: ICES 2005.

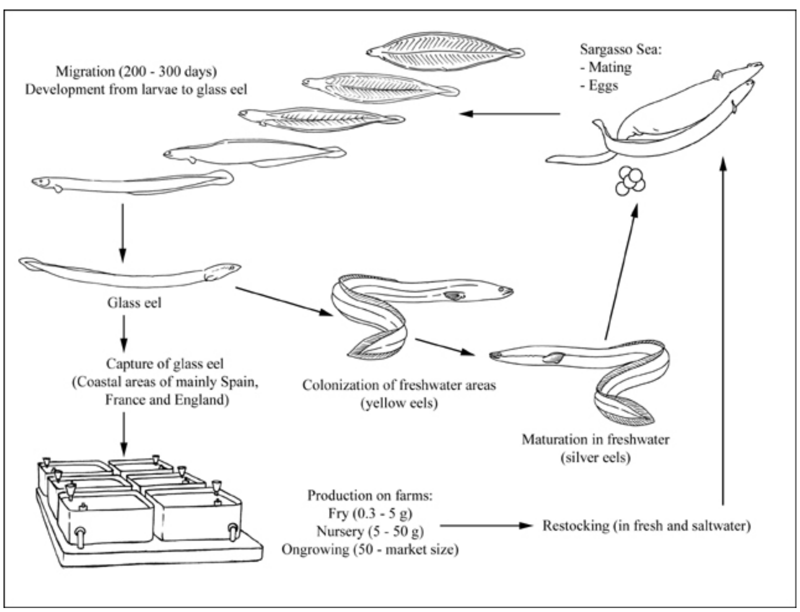

Figure 6: life cycle of European eel. Source: FAO 2007.

Migration blockage: Accessibility between inland waters and the sea is crucial for the natural occurrence and dispersal of European eels. Eels introduced in upstream rivers and streams often never reach the ocean on their spawning migration, due to a multiplicity of possible hazards, mostly electrical turbines, dams, weirs, and drained watercourses.

Pollution: There is evidence that chemical contamination can affect spawning success (WGEEL 2006; EELREP 2005) but there is not sufficient data to evaluate this at the stock-wide level. Most contaminants are not absorbed through the skin, but via the food-chain. There is considerable evidence that eel fat, muscle and internal organs accumulate chemical contaminants such as PCBs, Dioxins, pesticides and heavy metals (WGEEL 2006).

Climate change: There are indications that climate change, as reflected by the North Atlantic

Oscillation Index, is affecting eel recruitment. The drastic decline in recruitment of European eels in the 1970s coincided with an almost identical decline in recruitment of the American eel (*Anguilla rostrata*). A high NAO, indicating warmer oceanic climate with warmer sea surface temperatures and stronger westerly winds seem to have a clearly negative impact on eel larvae.

Diseases: In recent years, eels have been affected by parasites (e.g. the swim-bladder nematode *Anguillicola crassus*), viruses (*EVEX, EVE, HVA*) and other diseases. Effects were reviewed by WGEEL (2006). Parasite infections are not only a reflection of general health problems, but in extreme cases, such as with *Anguillicola crassus,* may cause debilitation and even mortality. *Anguillicola* infections have been shown to damage swim bladders and impair the swimming ability of infected eels (EELREP 2005). The impact of *Anguillicola* has not been evaluated at the stock level.

Relevant additional considerations

Sufficiency of data

Data are considered as sufficient to indicate a severe depletion of stocks that is most probably caused or exacerbated by human activities. However, there is as of yet still no agreed assessment method for European eel. This is due to both methodological issues and lack of data. An assessment method for eel was proposed by Dekker (2000). The current advice on the status of the eel stock is largely based on the recruitment time series and secondly on the landing statistics for adult eel.

National monitoring of the various eel stages is fragmentary. Some traps on rivers provide fairly reliable data on upstream migration of young yellow eels, but there are virtually no regular routine surveys of yellow and silver eel in fresh water or along the coasts. Some of the long-term series may also be terminated in the near future as a consequence of decreased turnover of local fisheries and the impossibility of addressing this large-scale stock decline at the local level (CITES 2007a).

There are also inconsistencies between official statistics on eel landings and ICES estimates. The WGEEL recently (2006) reviewed the available data, and the Workshop on National Data Collection – European Eel, Sanga Saby, Sweden, September 2005, also reviewed and made recommendations for improvements on monitoring and data collection.

Routes of the adult spawning migration, location of spawning sites, spawning habitats and reproductive biology are still largely unknown. The lack of specific knowledge about eel biology, particularly about spawning areas and aspects of larval biology, makes it difficult to identify changes in the environment that might be critical to eel survival. Possible factors include changes in access to food as well as changes in the direction of sea currents that transport the *Leptocephalus* larvae to the European coasts.

Changes in relation to natural variability

Natural variation: While the relative contribution of the various possible influences causing stock decline remain unknown, specific focus is necessarily placed on those processes and influences which are potentially manageable. As indicated above, the coincidence of decline for both the European and Atlantic and Pacific American eel stocks point to a possible common cause, such as climate change, probably augmented by human induced impacts on the eel stock in European waters. Some authors (e.g. Knights 2003) even propose oceanic climate to be the major cause of decline, whereas others do not (see Dekker (2004) for a comprehensive discussion).

Genetic variation: Little is known about the genetic variability and a putative population structure within *Anguilla anguilla*. Earlier molecular genetic studies indicated that European eel exhibits isolation by distance, implying non-random mating and restricted gene flow among eels from different locations (Wirth & Bemachez 2001). However, more recent research has suggested that the European eel is genetically panmictic and the genetic variation found is of mainly temporal and not spatial origin (Albert *et al.*2006, Dannewitz *et al.* 2005, Maes *et al.* 2006 a,b., Pujolar *et al.* 2006). In spite of the apparent genetic similarity with distance, the stock is not biologically homogeneous over its range and there are considerable geographical differences in recruitment patterns, population dynamics (i.e. growth rates, sex ratios, rates of survival, and productivity of the habitat). Taking this into account the ICES Working Group on Application of Genetics in Fisheries and Mariculture (WGAGFM) recommended in their 2007 report that "in the light of emerging information suggesting putative stock structure of European eel it is recommended from the genetic viewpoint that glass eels, elvers and other life history stages should not be trans-located between river basins for restocking purposes".

Expert judgement

It is most probable that human factors (including fisheries, habitat destruction, chemical contamination and the spread of *Anguillicola* *crassus*) contributed to the depletion of eel stocks, although oceanic and climate change factors cannot yet be discounted (ICES 2006).

The ICES Working Group on the Application of Genetics in Fisheries and Mariculture (WGAGFM 2004) reported on the possible genetic risks of transferring eels over long distances. There is some general agreement that the European eel stock is one panmictic homogeneous stock (Dannewitz *et al.* 2005), but there are dissenters from this view. The ICES WGAGFM concluded that application of the precautionary principle obliges management actions to minimize necessary transfer distances and to manage the natural spawning stock over as wide a geographical area as possible.

ICES WGEEL Evaluation

The ICES/EIFAC Working Group on Eels (e.g. WGEEL 2005, 2006) has evaluated trends in recruitment, stock and yield, modelling of local stock dynamics, monitoring of eel fisheries, and management measures. WGEEL concludes that the population as a whole has declined in most of the distribution area, that the stock is outside safe biological limits and that current fisheries are not sustainable. Recruitment is at a historical minimum and most recent observations indicate the decline continues in many areas. There is some evidence that depensation[2] in the reproductive phase might be involved, triggering a new and heightened level of precautionary advice. Under this situation, the advice is to restore spawning stock biomass above levels at which depensation is expected to occur. Evidence has been given in earlier WGEEL reports that anthropogenic factors (e.g. exploitation, habitat loss, contamination and transfer of parasites and diseases) as well as natural processes (e.g. climate change, predation) have likely contributed to the decline. Measures aimed at recovery of the stock are well known and should be a composite of exploitation, restocking of recruits (though critical due to small number of glass eels and uncertainty whether those eels would find back to the spawning grounds in the Sargasso Sea) and restoration of habitats (including access to and from).

The 2005 WGEEL report proposed to strengthen the knowledge base. The information in this report constitutes a further step in an ongoing process of documenting eel stock status and fisheries and developing a methodology for giving scientific advice on management, specifically for eel. To this end, a line of thought has been generated in previous reports (WGEEL 2000; 2002), and an inventory of ultimately required knowledge assembled (Moriarty and Dekker 1997; WGEEL 2000, 2001).

The 2006 session of the Joint EIFAC/ICES Working Group on Eels at FAO headquarters in Rome (Italy) recommended that:

a. the rapid development and implementation of **management plans** is facilitated in a work programme of workshops and guidelines, *inter alia* for:
   - o re-stocking practices,
   - o recruiting eel immigration passages,
   - o silver eel deflection schemes,
   - o monitoring and post-evaluation procedures, potentially in pilot projects,
   - o pollution and disease monitoring,
   - o development of models and tools for management of the stock;

b. **areas producing high quality spawners** (large sized females, low contaminant and parasite burdens, unimpacted by hydropower stations) be identified in order to **maximise protection** for these areas;

c. **management targets are set for spawner escapement** with reference to the 1950s–1970s, either identifying the actual spawner escapement levels of that period in full, or 30–50% of the calculated spawner escapement that would have existed if no anthropogenic mortalities would have impacted the stock – and where adequate data are absent, with reference to similar river systems (ecology, hydrography);

d. under the implementation of the **WFD eel specific extensions** should be implemented as an indicator of river connectivity and ecological and chemical status.

(WGEEL 2006, p vii)

Threat and link to human activities

Relevant human activity: Fishing, hunting, harvesting; constructions; land-based activities.

Category of effect of human activity: Physical - damage in turbines; chemical – toxin accumulation; biological – removal as target and non-target species by fisheries, diseases, parasites, predatory birds.

[2] Depensation: The effect where a decrease in spawning stock leads to reduced survival or production of eggs, a) through increased predation per egg given constant predator pressure, or b) the 'Allee' effect which is the reduced likelihood of finding a mate.(http://filaman.ifm-geomar.de/Glossary/Glossary.cfm?TermEnglish=depensation)

Due to its unusual and complicated life history, reasons for the decline of the European eel are not fully understood. However, there are indications of linkages between the decline of eels and human activities, especially by fisheries, construction of dams, weirs or embankments in rivers, chemical pollution and loss / damage of eel habitats.

Management considerations

Current management

UNCLOS: Catadromous species (spawning in the sea but often growing and maturing in inland waters) like the European eel are recognised under the United Nations Convention on the Law of the Sea (UNCLOS), under Article 67. In short, the following rules apply:

1. Coastal states/countries are responsible for management, but also states through the territory of which the species migrate are responsible for binding agreements concerning management measures.

2. Fishing at sea is allowed within the Exclusive Economic Zone but prohibited in the high seas.

3. Management must include provisions for secured immigration and emigration of the species.

(noted in CITES 2007a, p14)

CITES Appendix II: In June 2007, the listing of European eel on Appendix II of CITES was adopted. In general, such a listing includes those species that, although not necessarily threatened with extinction, may become so unless trade is strictly regulated in order to avoid utilization incompatible with their survival. International commercial trade in Appendix II species is allowed, but is controlled. Parties may only grant a permit to export such species after it has determined that the export will not be detrimental to the survival of the species. Management can be summarised as follows:

1. An export permit or re-export certificate issued by the Management Authority of the State of export or re-export is required. An export permit may be issued only if the specimen was legally obtained and if the export will not be detrimental to the survival of the species. A re-export certificate may be issued only if the specimen was imported in accordance with the Convention.

2. In the case of a live animal or plant, it must be prepared and shipped to minimize any risk of injury, damage to health or cruel treatment.

3. No import permit is needed unless required by national law. In the case of specimens introduced from the sea, however, a certificate has to be issued by the Management Authority of the State into which the specimens are being brought, for species listed in Appendix I or II.

(CITES 2007b)

EC eel regulation: The Council Regulation (EC) No 1100/2007 establishing measures for the recovery of the stock of European eel was adopted on 18 September 2007 (EC 2007a).

- o It is based on the 2003 Action Plan for management of European Eel (COM 2003-573); 2005 Proposal for a Council Regulation establishing measures for the recovery of the stock of European Eel (COM 2005-472); 2006 European Parliament proposed amendments; and ensuing in-depth discussions.
- o It applies to Community maritime waters and inland waters of EU Member States that discharge into ICES areas III, IV, VI, VII, VIII, IX and the Mediterranean.
- o MS must designate “eel river basins” – natural eel habitat.
- o Because the characteristics and pressures on river basins vary considerably, each MS is asked to submit a separate Eel Management Plan for each eel river basin (or one covering each entire eel river basin territory), by 31 December 2008. In the case of shared river basins, Eel management plans are to be prepared jointly by riparian states. Failure to submit an adequate management plan on time will result in a mandatory 50% reduction in fishing effort.[3]
- o The goal of the management plans should be to allow at least 40% of the silver eels to escape to the sea (measured with respect to undisturbed conditions).[4,5]

[3] It should be noted that ICES recommended the implementation of a **recovery plan for the whole stock** (ICES WG EEL 2005). An important element of such a recovery plan should be a ban on all exploitation (including eel harvesting for aquaculture) until clear signs of recovery can be established. Other anthropogenic impacts should be reduced to a level as close to zero as possible.

[4] It should be noted that ICES advice was 50%, due to the large uncertainties in eel management and biology, and because there is one single stock, spawning only once in their lifetime (ICES 2006b).

[5] ICES also has some concerns using one objective for all fish, since male and females grow to different sizes: “...as females grow bigger than males (>50 cm against <45 cm)

- o 60% of eel <12cm long are to be used in restocking, aiming to increase escapement of silver eel to the sea. (Starting at 35%, ramping up to 60% silver eel to the sea by 2013).[6]

- o Maritime catches are to be reduced to 50% of average 2004-2006 catches, and will be phased in over a five year period from when the regulation enters into force.

(Theophilou 2007; EC 2007b)

Other EU legislation:

- o The Water Framework Directive: The 2003 Action Plan for management of European Eel (COM 2003-573) considered the possibility to include eel as an indicator species for "good ecological status" in relation to "river continuity", *i.e.* as a biological quality element; This could build upon the currently existing quality element "composition, abundance and age-structure of ichthyofauna" (Annex V, items 1.1.1, 1.2.2 of the Directive) the interpretation of which is at the discretion of Member States..

- o The Common Fisheries Policy only applies to eel fisheries in fully marine areas.

  Until the national eel management plans (cf Council Regulation (EC) No 1100/2007) have been approved by the Commission and are put in place, the eel fishery is closed from the 1st to the 15th of each month (COM(2005) 472 final). Fishing could, however, continue during the closed period where a Member State can reliably demonstrate that measures of similar effectiveness guaranteeing the 40% escape rate requirement are already in place. Fishing for glass eel could also continue if these eels are used for restocking rivers but not used for aquaculture. Seasonal closures have been applied locally in several areas. The effects of such closures to restrict fishing have not been evaluated. In some countries there are license systems that control the glass eel fisheries.

- o The EU Habitats Directive: Eel have a very wide ranging area, covering most European inland waters. For this kind of species, the Directive states that "sites will be proposed only where there is a clearly identifiable area representing the physical and biological factors essential to their life and reproduction". However, because eels are very widely distributed, it is difficult within this legal framework to argue that particular sites should receive enhanced protection over others.

HELCOM: HELCOM has listed *Anguilla anguilla* on its List of threatened and/or declining species and biotope/habitats in the Baltic Sea area.

Sweden: Sweden has listed the eel on its national Red List as Criticially Endangered.

Restocking: Restocking has been practised by some countries for decades, generally to maintain fisheries. Since artificial reproduction is currently not possible for eel, all aquaculture and restocking has to be based on capture of glass eels. There is currently no evidence indicating the effectiveness of restocking in improving the spawning stock biomass or recruitment.

Further management

The national management plans for the recovery of eel as required by Council Regulation (EC) No 1100/2007 should target the recovery of the spawning stock rather than the sustainability of the eel fisheries. Restocking measures from the natural glasseel stocks should be minimised and should therefore primarily take place in those waters/river-basins through which the fish can migrate back to the sea, and where environmental conditions (e.g. low contamination) are most favourable to producing healthy eel populations. Here, fishing should be restricted or closed so that a minimum of 40 % of the population can migrate back to the sea. Longterm monitoring is required.

As recommended by ICES (WG Eel 2006) areas producing high quality spawning eels should be closed to fishery. Building on the river-basin management plans for the recovery of eel as required by Council Regulation (EC) No 1100/2007, a recovery plan for the whole stock of European Eel needs to be implemented (ICES WG Eel 2005). This may include a ban on all exploitation (including eel harvesting for aquaculture) until clear signs of recovery can be established. Other anthropogenic impacts should be reduced to a level as close to zero as possible. Management targets should be set for both eel sexes separately.

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and sexual differentiation is density dependent, there is a risk that for some river basins the objective is reached with only male escapement due to directed harvesting of large fish. ICES recommends that the objective should be defined in terms of both sexes separately." (ICES 2006b, p118)

[6] In case of significant differences between the price of glass eel destined for restocking and the price of those marketed for other uses, the percentage required to be set aside for restocking will be temporarily reduced in order to counter the price discrepancies.

In rivers and streams adjacent to OSPAR area, fish passes ("ladders") could be constructed that prevent the passage of eels through turbines and favour downstream migration. The content of heavy metals and chemical pollution of freshwater habitats needs to be considered in light of declining eel populations. Licensing of dealers and fishers, where this is not already occurring, should be considered.

Further information

Nominated by:

Separately submitted by Germany and WWF to OSPAR MASH 2006 and BDC 2007. This case report was compiled from those two separate nominations, incorporating comments received from ICES WGEEL review in 2007, and also drawing upon the successful CITES (2007a) nomination document.

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Nomination

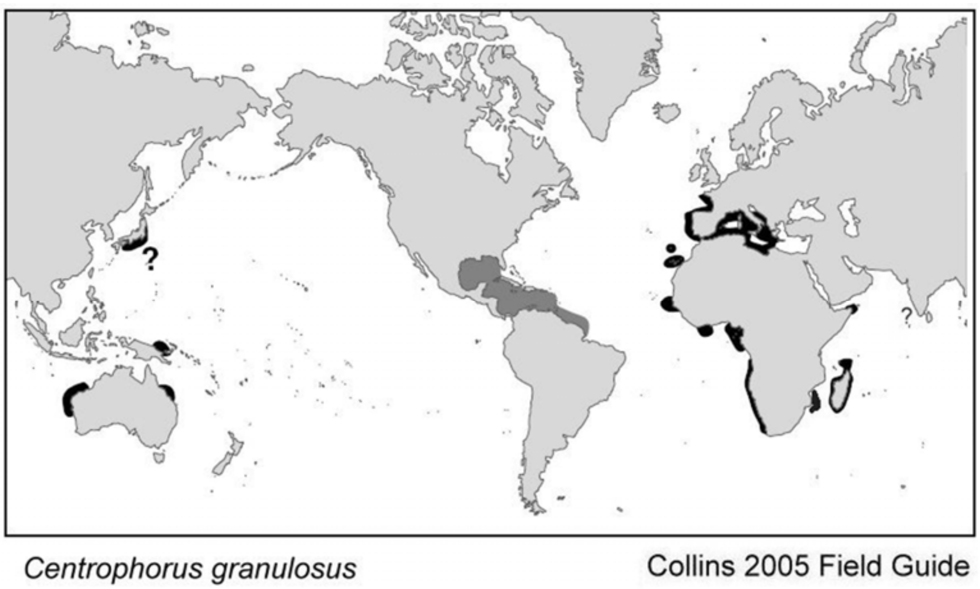
Centrophorus granulosus, Gulper shark

Gulper shark *Centrophorus granulosus* (Bloch & Schneider, 1801)

Geographical extent

- OSPAR Regions: IV, V
- Biogeographic zones: 14,15,16,17
- Region & Biogeographic zones specified for decline and/or threat: as above

Figure 1: Global distribution of *Centrophorus granulosus* (from Compagno *et al*. 2005)



Centrophorus granulosus is widely distributed on the upper continental slopes and outer continental shelf of temperate and tropical seas. In the Northeast Atlantic it occurs off France, Spain and Portugal, and in the Mediterranean. It is recorded along the Atlantic coast of Africa, in the Gulf of Mexico and Caribbean, in the Western Indian Ocean, and in the West Pacific. Distribution outside the OSPAR area, where the species is often misidentified as *C. uyato*, is uncertain. (Compagno 1984; Compagno *et al*. 2005; Froese *et al*. 2006; Guallart *et al*. 2006).

Application of the Texel-Faial criteria

Global importance

This species is widely distributed in tropical and temperate seas. The OSPAR population is not of global importance.

Regional importance

There is no information about genetic differentiation of regional populations; the OSPAR Area is not thought to be of regional importance.

Rarity

C. granulosus occurs only in the southern part of the OSPAR Regions V and VI. It is considered by ICES WGEF (in prep.) to be rare in waters from ICES Sub-area VIIIc northwards (north of Portugal).

Sensitivity

Deepwater elasmobranchs are adapted for life in a very stable, cold, low-productivity environment, and have an even lower productivity than coastal and pelagic sharks. Indeed, this large deepwater dogfish is believed to have the lowest reproductive potential of all elasmobranch species. The reproductive biology of deepwater sharks is characterized by a particularly late onset of maturity and great longevity. This species gives birth to only one pup per litter (Tortonese 1956, Capapé 1985, Fischer *et al*. 1987, Guallart 1998) after a two-year gestation period and occasional resting periods between litters (Guallart 1998). It is extremely vulnerable to overexploitation and stock depletion. Where data are available on catch per unit effort (CPUE), these are initially high, then decline quickly.

Despite a lack of data for certain regions within its geographic range, this species has been assessed as Vulnerable globally on the IUCN Red List of Threatened Species on the basis of its limiting life history traits, recorded declines in fisheries, and the global increase in unmanaged fishing effort in deeper waters. It is assessed as Critically Endangered in the Northeast Atlantic (Guallart *et al*., 2006).

C. granulosus is highly sensitive to deepwater fishing, mainly longline fishing and gillnet fisheries. Its extremely low intrinsic rate of population increase mean that recovery of depleted populations will be very slow, taking longer than 25 years even if deepwater fisheries close and all bycatch ceases.

Keystone species

No information.

Decline

A decline of 80-95% from baseline has been estimated for the Northeast Atlantic population (Guallart *et al*. 2006), based on data from the Portuguese target longline fishery within the main distribution range of this species. This fishery started in 1983, exhibited a strong decline in annual catch from about 1,000 t in 1990 to less than 100 t in 2004, and has since closed. Most of the landings compiled by the ICES WGEF (2006) and represented in Figure 2 were from this fishery. These fisheries data have been analysed with a Delury depletion model, using different assumptions of effort to provide a rough index of abundance. The depletion model (Figure 3), suggests that the stock has declined since fishing began by between 80% (if effort fell by 50%) and 95% (if effort remained constant).

Figure 2: Estimated Portuguese *Centrophorus granulosus* landings 1990–2005 (ICES WGEF 2006)

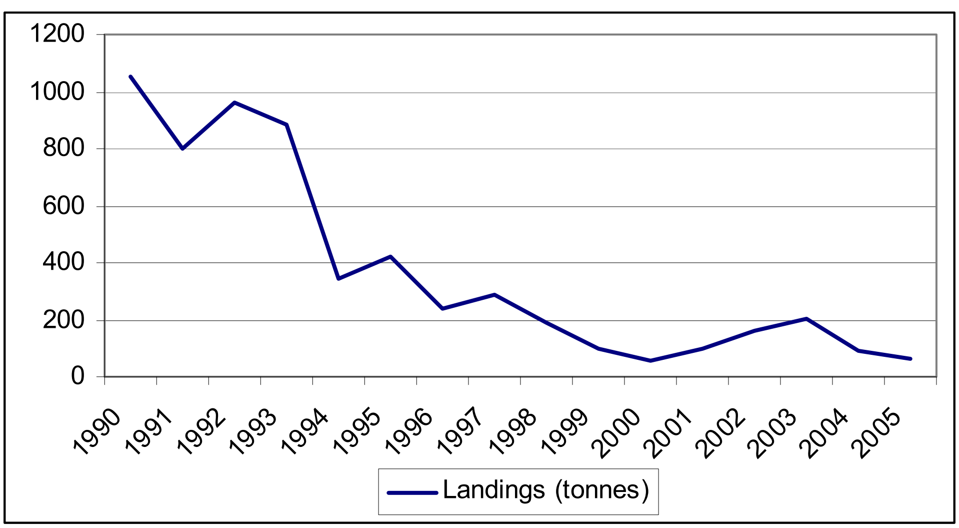
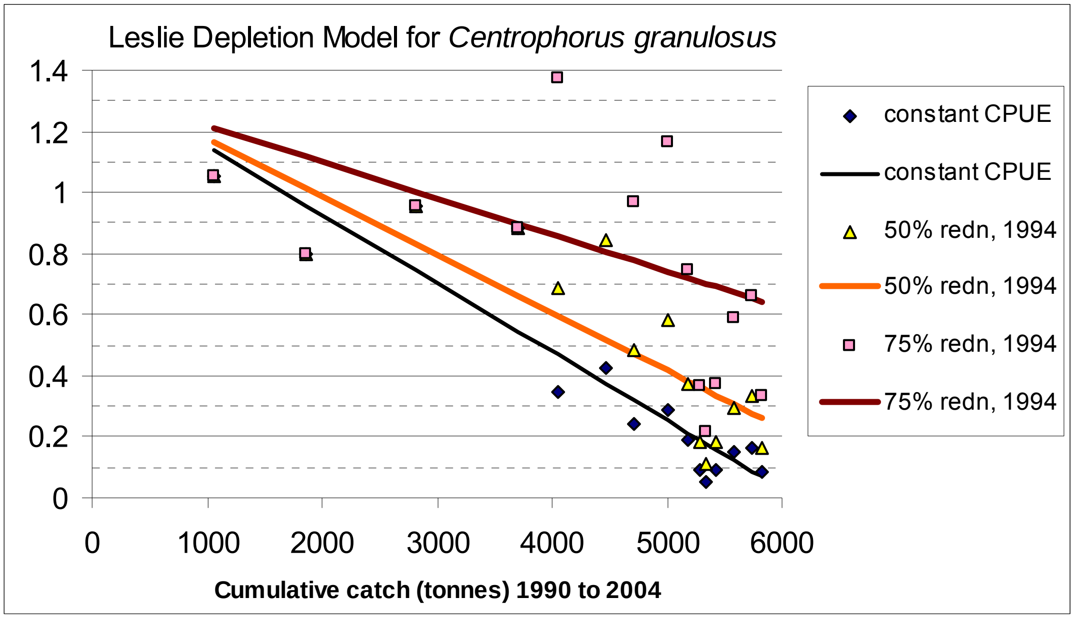


Figure 3: Estimates of depletion of *Centrophorus granulosus* off the Portuguese coast, 1990–2004. (Model developed at IUCN SSC Shark Specialist Group Northeast Atlantic Red List Workshop, 2006)



Steep declines in stocks of this and other species of *Centrophorus* are also reported from other locations where deepwater shark fisheries have taken place.

Threat

The main threat to *Centrophorus granulosus* is deepwater fisheries. These are among the most valuable of deepwater sharks, primarily for their liver oil and flesh (Guallart *et al*. 2006), but target fisheries for *Centrophorus* species rapidly become economically unviable when stocks decline.

STECF (2003) describes a directed longline fishery for deep-water sharks, based at Viana do Castelo in northern Portugal, initiated in 1983. Its landings were predominantly of gulper shark, with relatively small quantities of leafscale gulper shark and Portuguese dogfish. In the early years of the fishery, only the livers of the sharks were of commercial value and the carcasses were discarded at sea. Fishermen then started to process part of the catches on board to increase the value of the fish landed. The fishery declined rapidly (the trend in Figure 2 reflects the activity of this fishery). STECF (2003) reported that in recent years only one Portuguese longliner fished full time. This fishery has now closed (partly influenced by falling oil prices), but the species is still occasionally taken as bycatch in the Portuguese black scabbardfish longline fishery in ICES Subarea IX (ICES WGEF 2006).

Although some other European countries have also reported landings of this species (UK (England, Wales and Scotland), France and Spain), these landings are low and those by UK vessels are considered to be misidentified leafscale gulper sharks (ICES WGEF 2006).

Relevant additional considerations

Sufficiency of data

Data available on *Centrophorus granulosus* in the OSPAR area are very limited; the species can be confused with other deepwater shark species, and species-specific statistics are generally lacking. The ICES WGEF has, for this reason, not been able to assess the stock. The Delury model cited by Guallard *et al*. 2006 provides only a crude indication of stock status. However, all deepwater shark populations in the area are declining and it is generally agreed that conservation measures for these species are needed.

Changes in relation to natural variability

Nothing has been published on the natural variability of *C. granulosus*, but its extremely low intrinsic rate of population increase and data for other members of this genus demonstrate that population size and distribution are unlikely to fluctuate naturally. The *Centrophorus granulosus* group needs revision and the species, as currently recognized, has occasionally been misidentified as *C. uyato*. Nothing is known about its population genetics. Studies of the population genetics of this species are urgently needed to determine whether populations in different areas are genetically distinct.

Expert judgement
The lack of data on population size and trends for this species in the OSPAR Maritime Area means that expert judgement has played a part in this nomination. It rests on recognition that the threats to the gulper shark are known, that such threats occur in the OSPAR Maritime Area, and that they have led to significant declines in stocks of *Centrophorus* species and other deepwater sharks in this area and elsewhere.

ICES Evaluation

ICES WGEF (in prep.) reviewed an earlier draft of this nomination and considered that the data available were insufficient to assess the status of the stock/species and that there was no robust justification presented to list this species as a Threatened and Declining species. The WGEF (in prep.) expressed concern, however, at the declining landings of this species in ICES Sub-area IXa (part of OSPAR Area IV), especially as the biological characteristics of this species make it sensitive to over-exploitation. They noted that the available data show a decline in landings of about 90% since the early 1990s, though this is at least partly due to fluctuations in the price of liver oil or changing fishing patterns. The OSPAR nomination has since been rewritten, with incorrect data deleted, and new information is presented above to strengthen the case for this nomination.

Since 2005, the ICES Advisory Committee on Fisheries Management (ACFM) has advised that the total allowable catch (TAC) for all deep water sharks in mixed fisheries be set at zero for the entire distribution area of the stocks, with no target fisheries permitted unless there are reliable estimates of current exploitation rates and stock productivity. Catches of sharks are generally not recorded to the species level; they should be.

Preventing bycatch mortality will be very difficult to achieve, requiring the identification and implementation of measures to avoid any by-catches of deep water sharks in these fisheries. If this is not possible, reduction of catches in the mixed fisheries that take deep water sharks as a by-catch will require a reduction in overall fishing effort to the lowest possible level. Current deepwater shark catch quotas (which are not species-specific) are higher than total catches and only restrict the catches of deepwater sharks in a few areas.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; *Category of effect of human activity:* Biological – removal as target and non-target species by fisheries.

The decline in catches of many of the deepwater shark fisheries, including the NE Atlantic fishery for *Centrophorus granulosus*, is believed to be an indication of a decline in the population and therefore a threat that is linked to human activity.

Although no catch per unit effort data are available for this species in the OSPAR Area, the declining catches for the Portuguese fishery are believed to represent falling yields from a declining stock. This pattern of steeply declining catches is recorded in other fisheries for species of *Centrophorus* for which stock and catch per unit effort data are also available. It is recognised that, for this species, falling liver oil prices and changing patterns of fisheries may also have influenced the closure of the fishery, although market demand for deepwater shark flesh remains high in Europe.

Management considerations

There is no agreed management plan for this species. Deepwater sharks are managed by a combination of TACs, effort regulations and technical measures (fishing gear restrictions) in different OSPAR/ICES areas.

In 2007, the TAC for deepwater sharks in international waters of ICES Sub-areas V, VI, VII, VIII and IX (parts of OSPAR regions IV and V) is 2,472 t. In 2008, the TAC for these species in these areas will be reduced to 1,646 t. In 2007 and 2008, the TAC for deepwater sharks is set at 20 t annually in ICES Sub-area X, and 99 t in Sub-area XII (part of OSPAR region V). These TACs apply to a list of 13 deepwater shark species, including gulper shark. They are not restrictive in all sub-areas, but quota restrictions have contributed towards the decline in landings for all these species combined from around 10,000 t in 2004, to about 2000 t in 2006. Gillnet bans have also resulted in a decline in the proportion of international landings from gillnet fishing countries (UK and Germany – their fisheries do not take gulper shark). Overall, recent deepwater shark landings are the lowest since the fishery reached full development in the early 1990s, and much lower than the total 7,100 t of TACs available. (ICES WGEF in prep.) ICES ACFM has, since

2005, recommended a zero quota for deepwater sharks.

European Council Regulations have regulated effort in deepwater fisheries. Regulation (EC) No 2347/2002 set maximum capacity and power (kW) ceilings on individual Member States' fleets fishing for deepwater species, and Regulation (EC) No 27/2005 set a limit of effort (kilowatt days) at 90% of the 2003 level for 2005, and 80% for 2006.

Regulation (EC) 1568/2005 banned the use of trawls and gillnets in waters deeper than 200 m in the Azores, Madeira and Canary Island areas. In 2006, a ban on gillnetting was applied to waters deeper than 200 m in ICES Divisions VIa, b, VII b, c, j, k and Sub-area XII following concern over excessive deepwater shark mortality. Following a review by STECF in 2006, Regulation (EC) No 41/2007 revised this measure, banning the use of gill nets by Community vessels at depths greater than 600 m (thus permitting hake and monk netting, but protecting many deepwater shark stocks previously targeted). A maximum by-catch of deepwater shark of 5% is allowed in hake and monkfish gillnet catches above 600 m. This ban does not cover Sub-areas VIII or IX (gulper shark occurs in the latter) and redirection of deepwater shark fishing effort to these areas has been noted.

A gillnet ban in waters deeper than 200 m is also in operation in the NEAFC regulatory Area (international waters of the ICES/OSPAR Areas).

Bycatch mortality, whether discarded or utilised, poses a particular challenge for the management of deepwater sharks; these species cannot be returned alive following capture in commercial fisheries. Deepwater trawls, in particular, are not species-selective and take a bycatch of non-commercial species, including deepwater sharks (Allain *et al*. 2003). There are no obvious measures that could mitigate the by-catch of this shark in these commercial fisheries

This species is classified as Vulnerable worldwide, but as Critically Endangered in the Northeast Atlantic in the IUCN Red List (Guallart *et al*., 2006). The species is listed as Vulnerable in Turkey (Fricke *et al*., in press).

Further information

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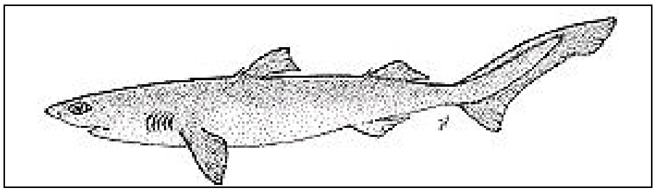
Nomination

Centrophorus squamosus, Leafscale gulper shark

Leafscale gulper shark *Centrophorus squamosus* (Bonnaterre, 1788)



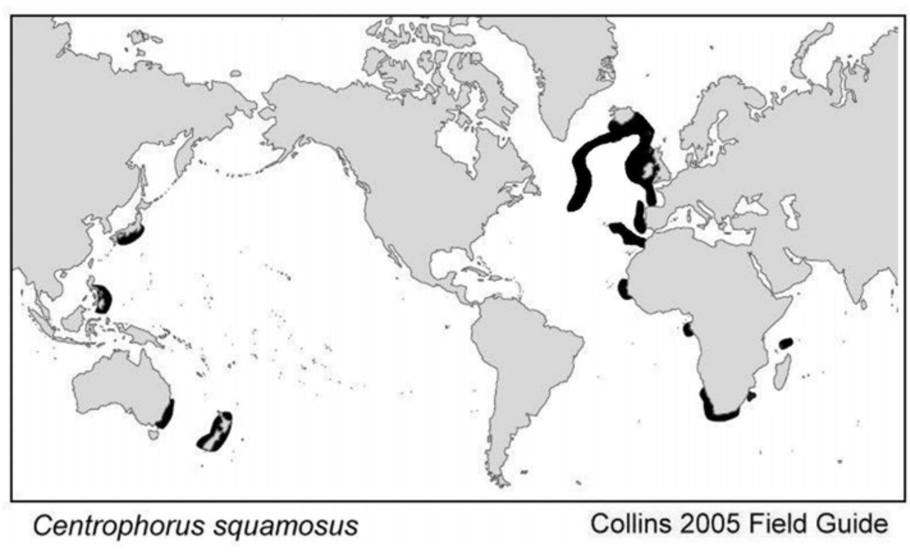
Geographical extent

- OSPAR Regions: I, II, III, IV, V
- Biogeographic zones: 8,12,13,14,16,17,18,19
- Region & Biogeographic zones specified for decline and/or threat: as above

Centrophorus squamosus is widely distributed in the OSPAR Area from Iceland and the Faroes on the Atlantic slope to Africa, including Madeira and Azozes, on the Mid-Atlantic Ridge from Iceland to the Azores (Hareide and Garnes 2001), and on the Hatton Bank (Heessen 2003) (Figure 1). It also occurs in a few regions in the Western Indian Ocean and the Western Pacific (Compagno 1984 and in prep; Froese & Pauly 2006; White 2003).

The species can live on or near the seabed at depths of 230–2400 m on continental slopes, occur in the upper 1250 m of oceanic water, well above the seabed in depths of around 4000 m (Compagno and Niem, 1998). The species appears to be highly migratory (Clarke *et al*. 2001, 2002). Pregnant females and pups are found in mainland Portugal and Madeira, with only pre-pregnant and spent females in the north (Moura *et al.* 2006; Garnes pers. comm. to ICES WGEF (ICES WGEF in prep.)).

Figure 1: Global distribution of *Centrophorus squamosus* (from Compagno *et al*. 2005)



Application of the Texel-Faial criteria

Global importance

This species is widely distributed, occurring in the Atlantic, Indian and Pacific Oceans. The OSPAR population is not of global importance.

Regional importance

The IUCN WGEF (2006, in prep) has adopted a single stock assessment unit in the Northeast Atlantic, possibly linked with the western Africa stock. At a stock level, the OSPAR Area is of regional importance, but not at species level.

Rarity

C. squamosus is not rare in the OSPAR Area.

Sensitivity

Deepwater elasmobranchs are adapted for life in a very stable, cold, low-productivity environment, and have an even lower productivity than coastal and pelagic sharks. *Centrophorus* species are considered to be among the deepwater sharks that are most sensitive to depletion by fisheries because of their severely limiting life history characteristics, particularly longevity, late maturity and low reproductive output (e.g. ICES WGEF in prep.). Where data are available on *Centrophorus* fisheries catch per unit effort (CPUE), these are initially high, then almost invariably decline quickly.

This species usually gives birth to some five to eight pups per litter (Compagno *et al*. 2005) and has ovarian fecundity estimates of up to ten mature oocytes (Girard and DuBuit, 1999; Clarke *et al*. 2001). Though the gestation period is not yet known, it is likely to be at least as long as for related species, i.e. approximately 22-24 months (Last and Stevens 1994, Cox and Francis 1997). Preliminary age estimates (Clarke *et al*. 2002) suggest that this is the longest-lived shark species yet examined. These factors combine to make it extremely vulnerable to overexploitation and population depletion.

Pregnant females of *C. squamosus* have only very rarely been found in commercial landings in the Northeast Atlantic, indicating that these are fortunately segregated away from current commercial fisheries. This slightly decreases the sensitivity of this species compared with those deepwater sharks that have no refuge from fisheries. Should fisheries expand into areas where pregnant females are located, the sensitivity of this species will increase significantly.

The sensitivity of this species to deepwater fishing activity and its low intrinsic rate of population increase means that recovery of depleted populations will be slow and likely take longer than 25 years, even if deepwater fisheries close and all bycatch ceases.

Keystone species

No information.

Decline

Accurate assessments of the decline rate for this species are difficult to achieve because landings and CPUE data for *C. squamosus* are generally combined with *Centroscymnus coelolepis* as 'siki shark'. In 2005, ICES WGEF compiled available catch per unit effort (CPUE) data for *C. squamosus* (see Figure 2 and summary below). Some of these represent very short time series and are only preliminary estimates. The following are from ICES WGEF (2005) unless otherwise noted.

ICES Sub-area V (OSPAR Region I):

- CPUE from French trawlers was reduced in 2001 to around 20% of the level recorded in 1995.

ICES Sub-area VI (OSPAR Region III):

- CPUE from French trawlers was reduced in 2001 to around 34% of the level recorded in 1995.
- CPUE from Scottish trawl surveys was reduced in 2004 to around 20% of that in 2000.

ICES Sub-area VII (OSPAR Region III):

- CPUE from French trawlers was reduced in 1999 to around 23% of the level recorded in 1995.
- CPUE from Irish trawlers was reduced in 2004 to around 14% of the levels recorded in 2001.
- CPUE from Irish commercial longliners shows a reduction from 2001 to 2003 (but Irish longline surveys, which took place in 1997 and 1999, showed no changes in CPUE).

ICES Sub-area IX (OSPAR Region IV):

- CPUE from Portuguese longliners was reduced in 2004 to around 74% of that in 2001 (but a new analysis in 2006 showed no trend).

ICES Sub-area XII (OSPAR Region V):

- CPUE by French trawlers was reduced in 1999 to around 32% of that in 1995.
- CPUE by Norwegian commercial longliners was reduced in 2001 to around 1% of that in 1999; Norwegian longline surveys also decreased in 1999 to about 2% of that in 1998.

ICES WGEF (2006) considered new French commercial trawl data that were considered to provide a more accurate estimate of *C. squamosus* stock abundance. These data showed an overall decline in CPUE in all ICES subareas exploited by French commercial trawlers since 1995. In 2005 in subareas V and VI, the level of CPUE was about 10% of the level estimated in 1995. In subarea VII the level of CPUE in 2005 was less than 10% of the level estimated in 1995. The decline in CPUE between 2001 and 2005 was consistent across all areas and also supported by CPUE data from Irish trawlers. In contrast, the CPUE series in the south (ICES Division IXa), although short, appears stable.

Although CPUE has been falling sharply, the ICES WGEF (2006) estimates of species-specific landings of *C. squamosus* from the Northeast Atlantic rose significantly from 2000 to 2005 (Figure 3). Overall catches for the whole of the ICES/OSPAR areas do not reflect overall stock status, particularly because market demand remains high and new fisheries open and fishing effort can move rapidly from fished to unfished grounds as stocks decline, or as restrictive management measures are introduced (the latter in recent years). For example, ICES WGEF (in prep.) notes that new gillnet and longline fisheries developed in Sub-area VIII and Division IXb in 2006. This represents a displacement of effort from VI and VII, due to the ban on gillnet fishing in those areas. Reported landings from these fisheries are about 250 t from UK registered vessels, including 23 tonnes of deepwater shark from Subarea VIII and 135 tonnes, plus 31 tons of livers and oil, from Subarea IX.

Figure 2: Catch per unit effort series for leafscale gulper shark (*C. squamosus*) (ICES 2005).

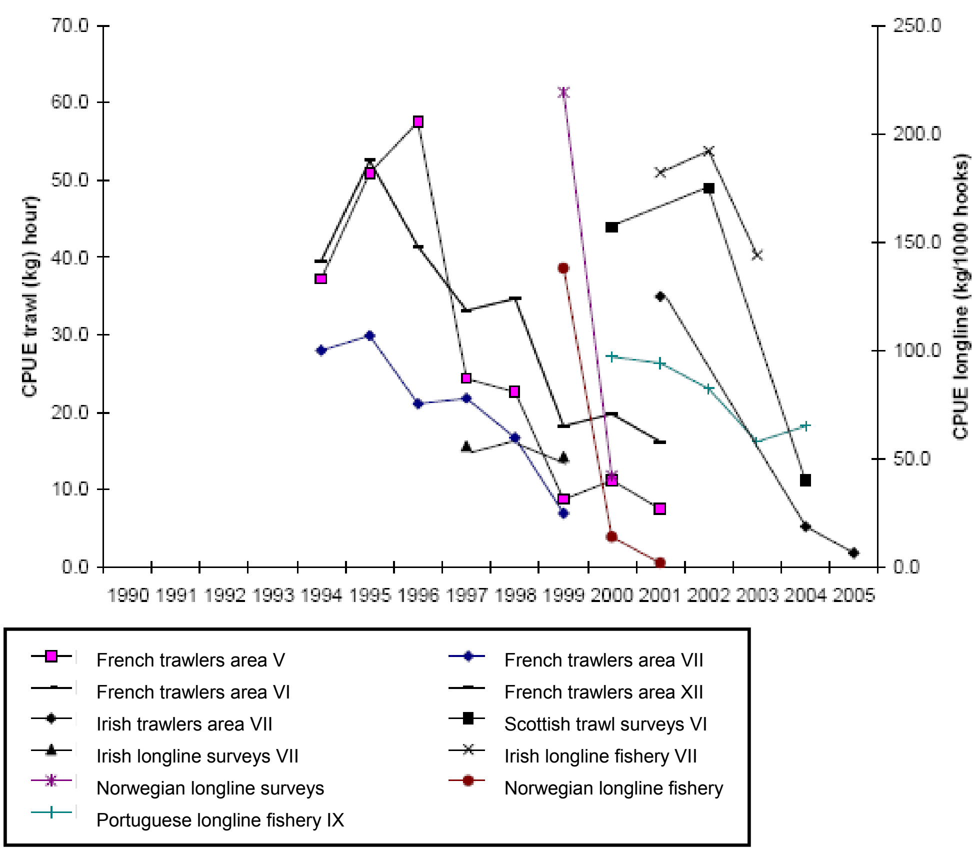
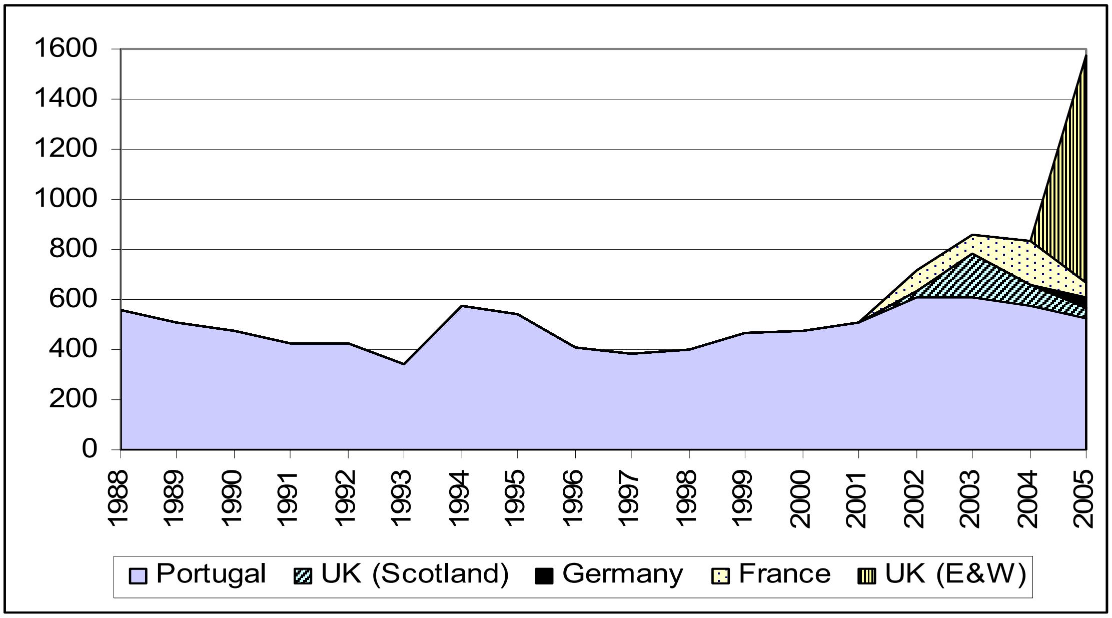


Figure 3: Estimated catch of leafscale gulper shark (*C. squamosus*), 1988 to 2005, (ICES WGEF 2005).



Recent landings of the two species of siki shark, combined, are much lower than the Total Allowable Catches (TACs) available (7,100 t), although TACs are restrictive in some areas. CPUE data sets for these two siki species combined have also declined significantly. ICES ACFM (2005) advised that, based on these data, stocks of Portuguese dogfish and leafscale gulper shark are considered to be depleted and likely to be below any candidate limit reference point. In 2006, ICES advised that no target fisheries should be permitted unless there are reliable estimates of current exploitation rates and stock productivity. ICES also advised that the TAC should be set at zero for the entire distribution area of the stocks and additional measures should be taken to prevent by catch of Portuguese dogfish and leafscale gulper shark in fisheries targeting other species.

Threat

Centrophorus squamosus is an important component of mixed trawl fisheries, and mixed and directed longline and gillnet shark fisheries on the continental slope to the west of Ireland, Spain, Portugal and France (ICES WGEF 2005). The flesh and liver are marketed from this species in many areas. The fresh meat is in high demand as 'siki' for human consumption in Europe and is also utilized elsewhere, dried and salted for human consumption. The liver oil is a source of squalene (Compagno 1984 & in prep.).

Deepwater shark fisheries in the OSPAR Area were described in detail by ICES WGEF (2005, updated in 2006 and in prep.) and Hareide *et al*. (2004). Most catches have been from the northern area (ICES subareas V-VII, OSPAR Regions I and the northern part of V). Some 12 countries report landings of deepwater sharks. IUU fishing also occurs in international waters (ICES WGEF in prep.).

Discarding was negligible after the early years of the fishery, once markets had developed for the flesh, but may be increasing now as a result of restrictive quotas for deepwater sharks in some southern areas, where deepwater mixed fisheries are still underway and these sharks are still fairly commonly taken as bycatch. Some discard of decaying carcasses occurs from deepwater net fisheries when soak times are excessive (STECF 2006). ICES WGEF (2006) reported on retrieval survey of lost nets west of Ireland. One fleet of deepwater nets (7.5 km) was retrieved that had been left at sea while the gillnet vessel was landing. A total catch of 6500 kg of deepwater sharks was recorded of which 96% was *Centrophorus squamosus*. About 70% of the catch was decayed and not fit for human consumption.

In 2005, ICES WGEF advised that the current level of these deepwater shark fisheries is unsustainable, and should cease. In 2006, this advice was repeated: no target fisheries should be permitted unless there are reliable estimates of current exploitation rates and stock productivity. The TAC should be set at zero for the entire distribution area of the stocks and additional measures should be taken to prevent by catch of Portuguese dogfish and leafscale gulper shark in fisheries targeting other species. In 2007, the WGEF noted that management measures had resulted in diversion of effort to previously unexploited fishing grounds inside and outside the OSPAR/ICES Area, and expressed concern that these new fisheries are developing without prior evaluation of sustainable catches having been carried out (ICES WGEF in preparation).

Relevant additional considerations

Sufficiency of data

As noted above, species-specific data on *Centrophorus squamosus* are limited; the species is often recorded with other deepwater shark species (particularly *Centroscymnus coelolepis*), often with no separate statistics are available. However, the ICES WGEF has provided sufficient species-specific data on rising landings and the declines in catch per unit effort caused by unsustainable fisheries exploitation to demonstrate the urgent need for conservation measures for this species.

Changes in relation to natural variability

Nothing has been published on natural variability, but the low intrinsic rate of population increase in this species demonstrate that population size and distribution are unlikely to fluctuate naturally. Nothing is known about the population genetics of *Centrophorus squamosus*. Studies of the population genetics of this species are urgently needed to determine whether populations in different areas are genetically distinct.

Expert judgement

The shortage of information on population size and trends for this species in the OSPAR Maritime Area means that expert judgement has also played a part in this nomination. It rests on recognition that the threats to this deepwater shark are known, that such threats occur in the OSPAR Maritime Area, that they have already led to significant declines in the number of this and other deepwater shark species in this Area and elsewhere, and that further declines are likely to take place as fishing effort moves to previously un-exploited grounds – unless new management measures are introduced and enforced.

ICES Evaluation

Early attempts at stock assessment (for *C. squamosus* and *C. coelolepis* combined) were undertaken by SGDEEP (ICES 2000) and the DELASS study (Heessen 2003). The ICES Working Group on Elasmobranch Fisheries reviewed information on this and other important species of deepwater shark in 2005, 2006 and 2007. Deepwater sharks are mostly caught in mixed trawl fisheries for deepwater species, particularly in northern areas of the Northeast Atlantic, as well as in directed shark fisheries using longlines and gillnets. Gillnet and longline fisheries targeting sharks and deepwater crab are now developing in previously unexploited fishing grounds due to displacement of effort from areas where gillnet fishing has been banned. These fisheries are expanding, landings are rising, and catch per unit effort is falling sharply.

Since 2005, the ICES Advisory Committee on Fisheries Management (ACFM) has advised that stocks of Portuguese dogfish and leafscale gulper shark are depleted and likely to be below any candidate limit reference point. They have recommended that the total allowable catch (TAC) for deep water sharks in mixed fisheries should be set at zero for the entire distribution area of the stocks, with no target fisheries permitted unless there are reliable estimates of current exploitation rates and stock productivity. Catches of sharks are generally not recorded to the species level; they should be. Additional measures should be taken to prevent by catch of Portuguese dogfish and leafscale gulper shark in fisheries targeting other species. ICES WGEF (in prep.) notes that there are no obvious measures that could mitigate by-catch of this shark in commercial fisheries.

Preventing bycatch mortality will be very difficult to achieve, requiring the identification and implementation of measures to avoid any by-catches of deep water sharks in these fisheries. If this is not possible, reduction of catches in the mixed fisheries that take deep water sharks as a by-catch will require a reduction in overall fishing effort to the lowest possible level. Current quotas are higher than total catches and only restrict the catches of deepwater sharks in a few areas.

ICES WGEF (in prep.) reviewed an earlier draft of this nomination, concluding that it is appropriate to list the leafscale gulper shark *C. squamosus* as Threatened and Declining in OSPAR Regions I–V.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; *Category of effect of human activity:* Biological – removal as target and non-target species by fisheries.

Catch per unit effort data for this species, demonstrate that steep population declines have taken place in most OSPAR Regions. These declines result directly from unsustainable target and bycatch fisheries. Total catches are significantly lower than total quotas available, fisheries management is not underway in all fishing areas, and fisheries are expanding into new grounds. The population decline is therefore a continuing threat that is directly linked to human activity.

Preliminary information from retrieval surveys of gillnets suggests that excessive soak time leads to high discard rates of sharks (ICES WGEF 2006). Lost or discarded gillnets (ghost fishing) may also add to deepwater shark mortality (ICES ACFM 2005).

Management considerations

There is no agreed management plan for these stocks. They are managed by a combination of TACs, effort regulations and technical measures (fishing gear restrictions) in different OSPAR/ICES areas.

In 2007, the TAC for deepwater sharks in international waters of ICES Sub-areas V, VI, VII, VIII and IX (parts of OSPAR regions IV and V) is 2,472 t. In 2008, the TAC for these species in these areas will be reduced to 1,646 t. In 2007 and 2008, the TAC for deepwater sharks is set at 20 t annually in ICES Sub-area X, and 99 t in Sub-area XII (part of OSPAR region V). These TACs apply to a list of 13 deepwater shark species, including leafscale gulper shark. They are not restrictive in all sub-areas, but quota restrictions have contributed towards the decline in landings from around 10,000 t in 2004, to about 2000 t in 2006. Gillnet bans have also resulted in a decline in the proportion of international landings from the gillnet fishing countries (UK and Germany). Overall, recent landings are the lowest since the fishery reached full development in the early 1990s, and much lower than the total 7,100 t of TACs available. (ICES WGEF in prep.) ICES ACFM has, since 2005, recommended a zero quota for deepwater sharks.

European Council Regulations have regulated effort in deepwater fisheries. Regulation (EC) No 2347/2002 set maximum capacity and power (kW) ceilings on individual Member States' fleets fishing for deepwater species, and Regulation (EC) No 27/2005 set a limit of effort (kilowatt days) at 90% of the 2003 level for 2005, and 80% for 2006.

Regulation (EC) 1568/2005 banned the use of trawls and gillnets in waters deeper than 200 m in the Azores, Madeira and Canary Island areas. In 2006, a ban on gillnetting was applied to waters deeper than 200 m in ICES Divisions VIa, b, VII b, c, j, k and Sub-area XII following concern over excessive deepwater shark mortality. Following a review by STECF in 2006, Regulation (EC) No 41/2007 revised this measure, banning the use of gill nets by Community vessels at depths greater than 600 m (thus permitting hake and monk netting, but protecting many deepwater shark stocks previously targeted). A maximum by-catch of deepwater shark of 5% is allowed in hake and monkfish gillnet catches above 600 m. This ban does not cover Sub-areas VIII or IX.

A gillnet ban in waters deeper than 200 m is also in operation in the NEAFC regulatory Area (international waters of the ICES/OSPAR Areas).

Bycatch mortality, whether discarded or utilised, poses a particular challenge for the management of deepwater sharks; these species cannot be returned alive following capture in commercial fisheries. Deepwater trawls, in particular, are not species-selective and take a bycatch of non-commercial species, including deepwater sharks (Allain *et al*. 2003). The long soak times and discards of nets from gillnet fisheries increase bycatch mortality (Hareide *et al*. 2005). There are no obvious measures that could mitigate the by-catch of this shark in these commercial fisheries

This species was classified as Vulnerable globally on the 2003 IUCN Red List (White 2003). A regional listing of Endangered in the Northeast Atlantic is currently in preparation by the IUCN SSC Shark Specialist Group (Hareide, Crozier, Ebert and Blasdale, in prep.).

Further information

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Germany

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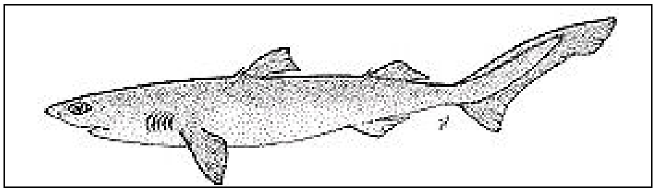
Nomination

*Centroscymnus coelolepi*s, Portuguese Dogfish

Portuguese Dogfish *Centroscymnus coelolepis* (Barbosa du Bocage & Brito Capello, 1864)



Geographical extent

- OSPAR Regions: I, (II, III), IV, V
- Biogeographic zones: 8,10,11,12,13,14,15,16,17,18,19
- Region & Biogeographic zones specified for decline and/or threat: as above

Widely distributed in the Atlantic, Indian Ocean and Western Pacific (see Figure 1). It inhabits continental and insular slopes and abyssal plains, on or near the bottom at depths of 270-3,675 m, at temperatures of 5-13°C (this is one of the deepest-living shark species). In the OSPAR Area it occurs from Greenland to Iceland and the Faeroe Banks south along the east Atlantic continental slope to Portugal, primarily in the deep waters of OSPAR regions I, IV and V. There appears to be some vertical migration and females move to shallower waters for parturition (Clarke *et al.* 2001).

Elsewhere, *C. coelolepis* occurs off northwest Africa; in the western Mediterranean; the Canary Islands, Azores and Madeira; the Northwest Atlantic; South Africa; on submarine seamounts between Australia and Africa; Australia and New Zealand; Japan and the South China Sea (Froese *et al*. 2006; Compagno 1984 & in preparation; Compagno *et al*. 2005).

Application of the Texel-Faial criteria

Global importance

This species is widely distributed, occurring in the Atlantic, Indian and Pacific Oceans. The OSPAR population is not of global importance.

Regional importance

The IUCN WGEF (2006, in prep) considers there to be a single stock of *C. coelolepis* in the ICES/OSPAR Area, probably linked to the Northwest Atlantic and western African populations. There may also be some distinct local populations within this stock. At a stock level, the OSPAR Area is likely of regional importance, but not at species level.

Rarity

C. coelolepis is not rare, is becoming increasingly scarce in the northern part of the OSPAR Area.

Sensitivity

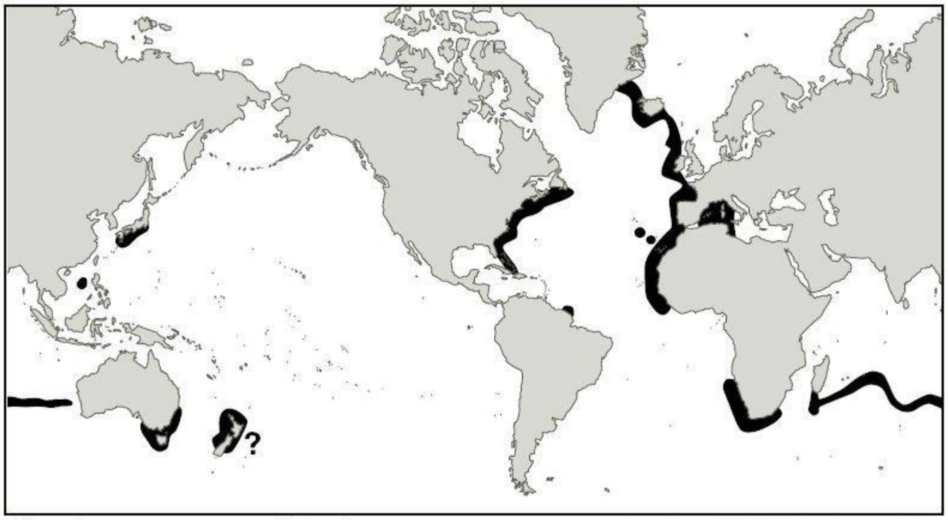
C. coelolepis is considered to be very sensitive to depletion by fisheries because of the severely limiting life history characteristics, particularly a low reproductive output, that are common to this and other deepwater elasmobranch species. These characteristics result in a very low resistance to depletion by fisheries. It is ovoviviparous, giving birth to litters of 13 to 29 young, born at 27-31 cm in length. Though age, growth and gestation period are not yet known, these are likely to be similar to that of related species, with very slow growth, late maturity, long intervals between litters, and extreme longevity. All reproductive stages, including mature and pregnant females, occur together in the OSPAR Area, but the largest mature females are found in slightly shallower water, where they are more likely to be targeted by longline and gillnet fisheries; exploitation of this reproductively-active sector of the population is particularly damaging to the stock. Where data are available on catch per unit effort (CPUE), these are initially high, then decline quickly. The very similar patterns of decline recorded in different areas in different years suggest that this species is sedentary (ICES WGEF 2006).

The sensitivity of this species to deepwater fishing activity and its low intrinsic rate of population increase mean that recovery of depleted populations will be slow and likely take longer than 25 years even if deepwater fisheries close and all bycatch ceases. If the species is sedentary, recolonisation of depleted stocks from neighbouring areas will also be extremely slow, and most unlikely to take place within 25 years.

Keystone species

No information.

Figure 1: Global distribution of *Centroscymnus coelolepis* (from Compagno *et al*. 2005)



Centroscymnus coelolepis From Compagno et al. 2005

Decline

There have been significant declines in this species within the OSPAR Area, estimated conservatively as greater than 50% and possibly greater than 80% across the whole population. These declines are stronger in the north than the south. For example, there has been a consistent overall decline in CPUE in all ICES subareas exploited by French commercial trawlers since 1995, to 10% or less of the 1995 level by 2005. This is supported by CPUE data from Irish trawlers (ICES WGEF 2006), and by some fishery-independent data. Basson *et al*. (2002) estimated that the proportion of non-zero hauls (the hauls where at least one specimen was caught) from surveys conducted by the Scottish Association for Marine Science between 1975 and 1999 had reduced from 72% to 12% in the northeast Atlantic. Declines in populations of this sensitive species are also reported from elsewhere in its global range where deepwater shark fisheries have taken place (Stevens and Correia 2003; IUCN SSC Shark Specialist Group in prep.).

This species is taken in multi-species deepwater fisheries in the OSPAR Area. Most landings of deepwater sharks are not recorded to species level, but as 'siki', combining records of *C. coelolepis* and *Centrophorus squamosus*. This means that catch and catch per unit effort (CPUE) data for both species are incomplete. The ICES Working Group on Elasmobranch Fishes has, however, compiled and reconstructed data for this species in order to develop estimates of recent and historic catches (Figure 2). It is unclear how the commercial time series information is affected by any changes in fishing patterns. Because fishing effort moves rapidly from fished to unfished grounds as stocks decline or restrictive management measures are introduced (the latter in recent years), overall catches and CPUE data for the whole of the ICES/OSPAR areas do not reflect overall stock status. The decline in landings from around 10,000 t during 2001 to 2004, to about 2000 t in 2006 (Figure 2) is partly due to quota restrictions and partly to gillnet bans in ICES Areas V, VII and ICES international waters. Recent landings are, however, now much lower than the Total Allowable Catches (TACs) available (7,100 t), although TACs are restrictive in some areas, and declining landings may also reflect an overall decline in stocks, particularly in the north.

It is necessary to consider CPUE trends by fishery and area in order to quantify declines. Figure 3 presents *Centroscymnus coelolepis* CPUE data collated by ICES WGEF (2005) from several different fisheries and fishery independent surveys. They concluded that there had been a strong decline in CPUE in northern areas, but that the fishery in the south appears more stable.

Figure 2: ICES WGEF estimate of species-specific landings (t) of Portuguese dogfish *Centroscymnus coelolepis*, 1998–2005 (from ICES WGEF 2006).

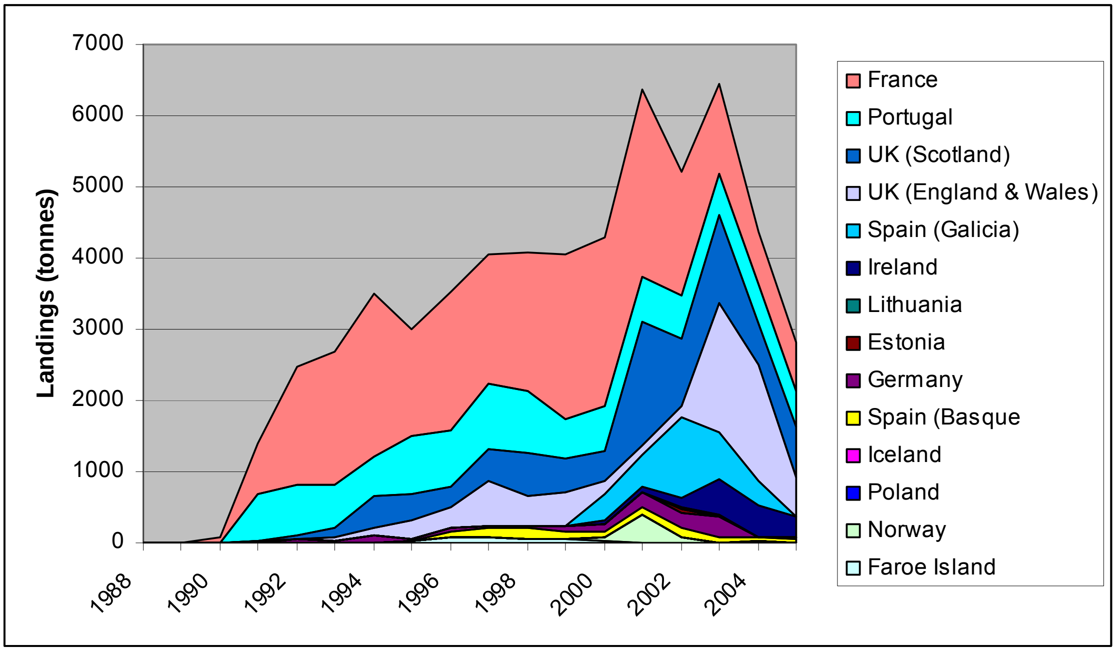
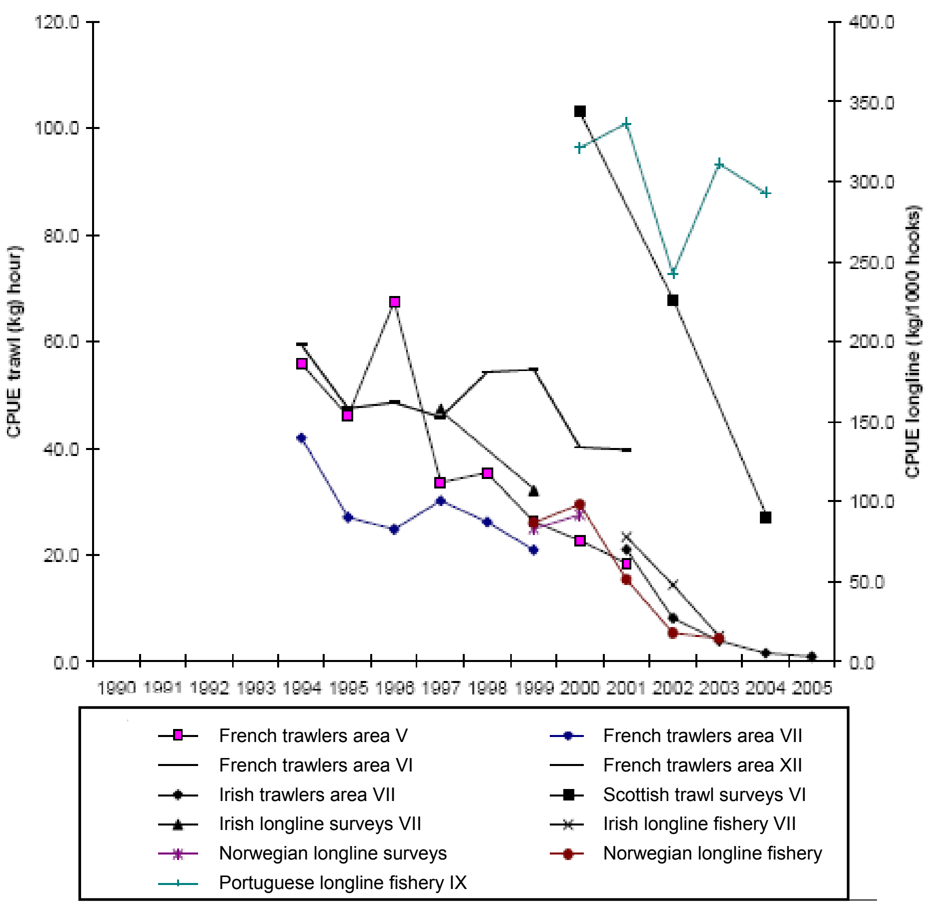


Figure 3: CPUE series for *Centroscymnus coelolepis* from trawl and longline fisheries and surveys (ICES WGEF 2005).



The status of Portuguese dogfish outside the fishing grounds illustrated in Figure 3 is unknown. It is also unclear how the commercial time series information is affected by any changes in fishing patterns. Fishing effort is continuing to move into new areas before stock assessments are undertaken and sustainable catches evaluated (for example as a result of the redirection of effort following a ban on gillnet fishing in other areas).

Threat

Centroscymnus coelolepis is an important component of mixed trawl fisheries, and mixed and directed longline and gillnet shark fisheries on the continental slope to the west of Ireland, Spain, Portugal and France (ICES WGEF 2005). The flesh and liver are marketed from this species in many areas. The fresh meat is in high demand as 'siki' in Europe and is also utilized as fishmeal, dried and salted for human consumption. The liver oil is a source of squalene (Compagno in prep.). Discarding was negligible after the early years of the fishery, once markets had developed for the flesh, but may be increasing now as a result of restrictive quotas for deepwater sharks in some southern areas, where deepwater mixed fisheries are still underway and these sharks are still fairly commonly taken as bycatch. Some discard of decaying carcasses occurs from deepwater net fisheries when soak times are excessive (STECF 2006).

Deepwater shark fisheries in the OSPAR Area were described in detail by ICES WGEF (2005, updated in 2006 and in prep.) and Hareide *et al*. (2004). Most catches have been from the northern area (ICES subareas V-VII, OSPAR Regions I and the northern part of V). Some 12 countries report landings (Figure 2). IUU fishing also occurs in international waters (ICES WGEF in prep.).

In 2005, ICES WGEF advised that the current level of these fisheries is unsustainable, and should cease. In 2006, this advice was repeated: no target fisheries should be permitted unless there are reliable estimates of current exploitation rates and stock productivity. The TAC should be set at zero for the entire distribution area of the stocks and additional measures should be taken to prevent by catch of Portuguese dogfish and leafscale gulper shark in fisheries targeting other species. In 2007, the WGEF noted that management measures had resulted in diversion of effort to previously unexploited fishing grounds inside and outside the OSPAR/ICES Area, and expressed concern that these new fisheries are developing without prior evaluation of sustainable catches having been carried out (ICES WGEF in preparation).

Relevant additional considerations

Sufficiency of data

As noted above, species-specific data on *Centroscymnus coelolepis* are limited; the species is often recorded with other deepwater shark species (particularly *Centrophorus squamosus*), with no separate statistics are available. However, the ICES WGEF has provided sufficient species-specific data on the declines caused by unsustainable fisheries exploitation to demonstrate the urgent need for conservation measures for this species.

Changes in relation to natural variability

Nothing has been published on natural variability, but the low intrinsic rate of population increase in this species and its apparently largely sedentary nature demonstrate that population size and distribution are unlikely to fluctuate naturally. Nothing is known about the population genetics of *Centroscymnus coelolepis*. Studies of the population genetics of this species are urgently needed to determine whether populations in different areas are genetically distinct.

Expert judgement

The shortage of information on population size and trends for this species in the OSPAR Maritime Area means that expert judgement has also played a part in this nomination. It rests on recognition that the threats to this deepwater shark are known, that such threats occur in the OSPAR Maritime Area, that they have already led to significant declines in the number of this and other deepwater shark species in this Area and elsewhere, and that further declines are likely to take place as fishing effort moves to previously un-exploited grounds – unless new management measures are introduced and enforced.

ICES Evaluation

The DELASS Report (Heessen 2003) presented the first stock assessment for this species. The ICES Working Group on Elasmobranch Fisheries reviewed information on this and other important species of deepwater shark in 2005, 2006 and 2007. *C. coelolepis* and other deepwater sharks are mostly caught in mixed trawl fisheries for deepwater species, particularly in northern areas of the Northeast Atlantic, as well as in directed shark fisheries using longlines and gillnets. Gillnet and longline fisheries targeting sharks and deepwater crab are now developing in previously unexploited fishing grounds due to displacement of effort from areas where gillnet fishing has been banned. In northern areas, catches have increased, but catch per unit effort has decreased. Landings and CPUE in southern areas are more stable.

Since 2005, the ICES Advisory Committee on Fisheries Management (ACFM) has advised that stocks of Portuguese dogfish and leafscale gulper shark are depleted and likely to be below any candidate limit reference point. They have recommended that the total allowable catch (TAC) for deep water sharks in mixed fisheries should be set at zero for the entire distribution area of the stocks, with no target fisheries permitted unless there are reliable estimates of current exploitation rates and stock productivity. Catches of sharks are generally not recorded to the species level; they should be. Additional measures should be taken to prevent by catch of Portuguese dogfish and leafscale gulper shark in fisheries targeting other species. ICES WGEF (in prep.) notes that there are no obvious measures that could mitigate by-catch of this shark in commercial fisheries.

Preventing bycatch mortality will be very difficult to achieve, requiring the identification and implementation of measures to avoid any by-catches of deep water sharks in these fisheries. If this is not possible, reduction of catches in the mixed fisheries that take deep water sharks as a by-catch will require a reduction in overall fishing effort to the lowest possible level. Current quotas are higher than total catches and only restrict the catches of deepwater sharks in a few areas.

ICES WGEF (in prep.) reviewed an earlier draft of this nomination, concluding that it is appropriate to list Portuguese dogfish as a Threatened and Declining species in OSPAR regions I-V.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; *Category of effect of human activity:* Biological – removal as target and non-target species by fisheries.

Where catch per unit effort data are available for this species, these demonstrate that steep population declines have taken place in several OSPAR Regions. These declines result directly from unsustainable target and bycatch fisheries. Since total catches are significantly lower than total quotas available, and fisheries management is not underway in all fishing areas, declining deepwater shark catches in the Northeast Atlantic are also believed to represent falling yields from declining stocks in many regions, rather than a reduction in overall fishing effort. The population decline is therefore a threat that is linked to human activity.

This pattern of steeply declining catches is also familiar in other fisheries for sharks where there are better records of catch per unit effort.

Preliminary information from retrieval surveys of gillnets suggests that excessive soak time leads to high discard rates of sharks. Lost or discarded gillnets (ghost fishing) may also add to deepwater shark mortality (ICES ACFM 2005).

Management considerations

There is no agreed management plan for these stocks. They are managed by a combination of TACs, effort regulations and technical measures (fishing gear restrictions) in different OSPAR/ICES areas.

In 2007, the TAC for deepwater sharks in international waters of ICES Sub-areas V, VI, VII, VIII and IX (parts of OSPAR regions IV and V) is 2,472 t. In 2008, the TAC for these species in these areas will be reduced to 1,646 t. In 2007 and 2008, the TAC for deepwater sharks is set at 20 t annually in ICES Sub-area X, and 99 t in Sub-area XII (part of OSPAR region V). These TACs apply to a list of 13 deepwater shark species, including Portuguese dogfish. They are not restrictive in all sub-areas, but quota restrictions have contributed towards the decline in landings from around 10,000 t in 2004, to about 2000 t in 2006. Gillnet bans have also resulted in a decline in the proportion of international landings from the gillnet fishing countries (UK and Germany). Overall, recent landings are the lowest since the fishery reached full development in the early 1990s, and much lower than the total 7,100 t of TACs available. (ICES WGEF in prep.) ICES ACFM has, since 2005, recommended a zero quota for deepwater sharks.

European Council Regulations have regulated effort in deepwater fisheries. Regulation (EC) No 2347/2002 set maximum capacity and power (kW) ceilings on individual Member States' fleets fishing for deepwater species, and Regulation (EC) No 27/2005 set a limit of effort (kilowatt days) at 90% of the 2003 level for 2005, and 80% for 2006.

Regulation (EC) 1568/2005 banned the use of trawls and gillnets in waters deeper than 200 m in the Azores, Madeira and Canary Island areas. In 2006, a ban on gillnetting was applied to waters deeper than 200 m in ICES Divisions VIa, b, VII b, c, j, k and Sub-area XII following concern over excessive deepwater shark mortality. Following a review by STECF in 2006, Regulation (EC) No 41/2007 revised this measure, banning the use of gill nets by Community vessels at depths greater than 600 m (thus permitting hake and monk netting, but protecting many deepwater shark stocks previously targeted). A maximum by-catch of deepwater shark of 5% is allowed in hake and monkfish gillnet catches above 600 m. This ban does not cover Sub-areas VIII or IX.

A gillnet ban in waters deeper than 200 m is also in operation in the NEAFC regulatory Area (international waters of the ICES/OSPAR Areas).

Bycatch mortality, whether discarded or utilised, poses a particular challenge for the management of deepwater sharks; these species cannot be returned alive following capture in commercial fisheries. Deepwater trawls, in particular, are not species-selective and take a bycatch of non-commercial species, including deepwater sharks (Allain *et al*. 2003). The long soak times and discards of nets from gillnet fisheries increase bycatch mortality (Hareide *et al*. 2005). There are no obvious measures that could mitigate the by-catch of this shark in these commercial fisheries

This species was classified as Near Threatened globally on the 2003 IUCN Red List (Stevens & Correia 2003). It is currently in the process of being uplisted to Vulnerable globally and Endangered in the Northeast Atlantic (IUCN SSC Shark Specialist Group in prep.).

Further information

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Nomination

Cetorhinus maximus, Basking Shark

There are morphological differences between some populations of basking sharks and it has been suggested that there may be several species, including two in the North Atlantic (Siccardi, 1960, 1971). Others consider there to be insufficient evidence to separate these species at the present time and genetic research is underway that may help to clarify the situation (eg. Hoelzel, 2001).

Geographical extent

OSPAR Region; All
Biogeographic zones: 1,2,5,6,10
Region & Biogeographic zones specified for decline and/or threat: as above

C.maximus occurs in temperate waters of the north and south Pacific and Atlantic, the Indian Ocean and the Mediterranean. In the OSPAR Maritime Area it is probably least often reported from the North Sea. It is a migratory species, moving into coastal waters where it is known to congregate in a few favoured areas at certain times of the year (e.g. Compagno, 1984). In UK waters and the Irish Sea, hotspots have been identified off the coast of Cornwall and Devon, the Isle of Man and the Isle of Arran (MCS, *in press*). Satellite tagging work has shown that the sharks remain in continental shelf edges during winter spending more of their time at greater depths than near the surface (Sims *et al.,* in prep).

Application of the Texel-Faial criteria

C.maximus was nominated for inclusion by several Contracting Parties and Observers. The criteria common to all nominations were decline and sensitivity with information also provided on threat.

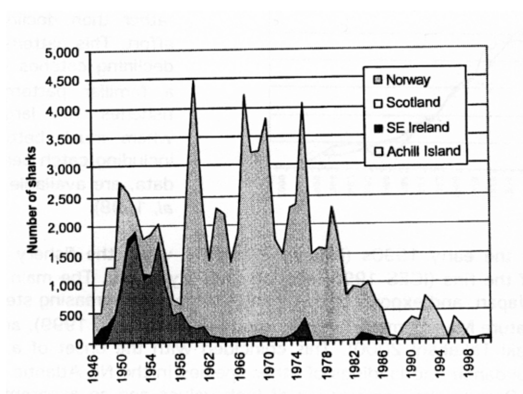
Decline

There are no firm estimates for the total global population or regional populations of basking shark. Where observations have been made, the total annual number of records is usually in tens, hundreds or, at most, low thousands, including repeat sightings. The total number removed from the whole of the NE Atlantic during the past 50 years is probably between 80-106,000 animals (Sims & Reid, 2002).

Most basking shark fisheries appear to have collapsed after initial high yields, and this species is considered by Compagno (1984) to be extremely vulnerable to over-fishing - perhaps more so than most other sharks.

There are some well-documented declines in catches by basking shark fisheries, usually over a very short period. These have resulted in long-term (lasing several decades) reductions in local populations. In the NE Atlantic, for example, catches between 1946-1990s declined by 90% from peak catches in the 1960s (Figure A).

<u>FIGURE A</u>. Targeted Northeast Atlantic basking shark catches (1946-2000) (Anon, 2002)



There remains a debate on whether the decline in catches also reflects a decline in the population (see section on threat linked to human activities).

Sensitivity

The basking shark is a very large, long-lived species with a reproductive capacity that is considered to be relatively low even for an elasmobranch.

Compagno (1984) considers it to be extremely vulnerable to overfishing and ascribes this to a slow growth rate, lengthy maturation time, long gestation period, probably low fecundity and probable small size of existing populations.

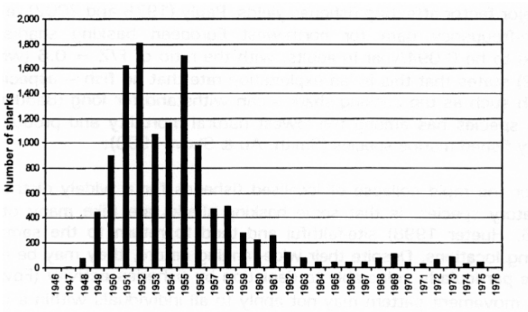
The fact that large numbers are found concentrated in a few favoured coastal areas also makes them particularly vulnerable to exploitation by fisheries (Camhi *et al.,* 1998). There is a possibility that there are local stocks (Fowler, 1996 & *in press*), if that is the case, they would particularly vulnerable to depletion by fisheries activity.

Threat

The basking shark is targeted by fishing operations in several parts of its range including a small number in ICES area IIa in the OSPAR Maritime Area. This was originally driven by demand for the high-grade oil in the liver of the shark, but today it is the market for fins that are the most valuable (Fowler, *in press*).

Fisheries statistics reveal a boom and bust fishery for this species (McNally, 1976) (Figure B).

FIGURE B. Number of basking sharks landed at Achill Island, Ireland , 1947-75 (McNally, 1976)



Incidental catches of basking shark have also been recorded. These are most common in coastal waters and mainly recorded in set nets and trawls (e.g. Berrow, 1994; Fairfax 1998). Take from incidental catch may be significant and either contribute to declines from targeted catch or prevent the recovery of over-fished populations. They do however appear to be resilient to being released, apparently unharmed although subsequent survival rates are not known. Because basking sharks congregate in bays and shallow water they are also at risk from collisions with vessels and may be harassed by shark watchers (Fowler, *in press*).

Relevant additional considerations

Sufficiency of data

Most of the historic data on basking sharks comes from fisheries landing records. Observation schemes are a more recent source of information although it is difficult to determine population size from these data as the animals are widely distributed and therefore infrequently recorded except in a few favoured coastal areas, where they are usually seen in relatively large numbers for only part of the year. Tagging studies are providing further fisheries-independent data on basking shark behaviour and distribution.

Changes in relation to natural variability

Cyclical variations in patterns of sighting or catches of this species have been reported. These may be linked to alterations in ocean currents, water temperature and zooplankton aggregations. This may have affected patterns of basking shark catches, but it is proposed that these have been superimposed upon a general downward trend caused by fishing (Anon, 2002).

Expert judgement

Calculations of natural mortality and fishery mortality derived from north-west European landings (Pauly, 1978 & 2000) strongly suggest this species is unable to withstand targeted exploitation for long, and confirm that stock depletion is likely to be a major factor affecting fisheries yields. This species has among the lowest natural mortality and productivity yet calculated for a commercially fished marine species (Smith *et al.,* 1998).

Where similar patterns of exploitation and declining catches are recorded during fisheries for other large sharks, and fishery independent data and stock assessments are available, these have demonstrated that such crashes are the result of depletion of these vulnerable species (Camhi *et al.,* 1998).

ICES evaluation

The ICES review of this nomination by the Study Group on Elasmobranch Fishes (SGEF) raised the question of whether there were sufficient fishery-independent data sets providing evidence of a decline in basking shark numbers over the OSPAR area and pointed to the fact that observed declines in basking shark fisheries could be due to other factors such as local depletion of the fishable population, a change in basking shark distribution or economic factors. This is discussed further in the section linking threats to human activities.

SGEF report that there are no targeted fisheries for basking sharks in the OSPAR region at the present time. Latest figures from ICES, which were made available in 2002 and cover landings up to the year 2000, show a small number of basking sharks continue to be landed in Area IIa (Anon, 2002).

In relation to the sensitivity of basking sharks, SGEF noted that biological data area limited, although all lamniform sharks have a very low fecundity and late age at maturity, and they are likely to be sensitive to additional mortality.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; shipping & navigation. *Category of effect* *of human activity:* Biological – removal of target species, removal of non-target species, physical damage to species.

The decline in catches of many of the basking shark fisheries, including the NE Atlantic fishery is believed to be an indication of a decline in the population and therefore a threat that is linked to human activity.

Although no catch per unit effort data are available, the declining catches in the NE Atlantic from 1970-1980 are believed to represent falling yields from declining stocks rather than declining fishing effort (Anon, 2002). This is because declining catches coincided with a period of peak demand along with high value for basking shark oil, encouraging the establishment of new fisheries in southern Ireland and the Firth of Clyde.

In the early 1990s, landings increased slightly, coinciding with the onset of a North Sea regime shift, and increased abundance and landings of other species in the NE Atlantic. Despite the combination of high values and demand in international markets, an increase in the number of vessels fishing for basing sharks, and an apparent increased availability of sharks (ICES, 1995), the highest catches in the early 1990's still represented only 10-20% of peak catches in the 1960s and increased landings were short-lived.

This pattern of steeply declining catches is familiar in other fisheries for large sharks where there are better records including catch per unit effort, and has been shown to reflect a decline in the population (Camhi *et al.,* 1998).

Management considerations

The basking shark is already protected in some parts of the OSPAR Maritime Area e.g. UK waters and around the Isle of Man. An annual quota for Norwegian catch of basking shark in EC waters has existed since 1978 however no part of this quota has been taken for several years and the Total Allowable Catch was reduced to zero in 2001. Outside EC waters, there are some landings of basking sharks in ICES area IIa.

Useful management measures to consider within the OSPAR Maritime Area should focus on the remaining fishery, preventing incidental capture (including subsequent removal of fins), collisions, and harassment of sharks. This could include seasonal gear restrictions, prohibition in trade of shark products, such as fins, even if the capture of animals is not deliberate, recommended routing measures and Codes of Conduct in areas known to be favoured by the sharks. The issue of whether any basking shark fishery should continue in the OSPAR area is primarily a consideration for fisheries organisations rather than OSPAR, although OSPAR can communicate an opinion on this to the relevant bodies. As basking sharks are highly migratory it is also important that OSPAR supports conservation measures for this species when it occurs outside the Maritime Area.

IUCN assess the global status of the basking shark as Vulnerable in the 2000 IUCN Red List.

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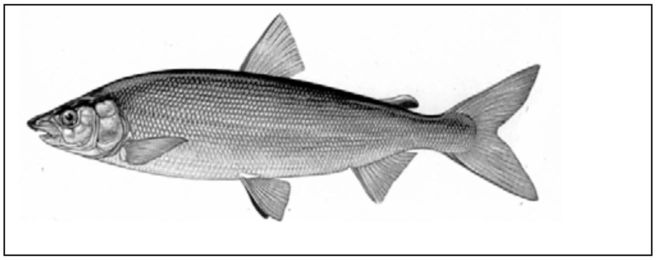
Nomination

Coregonus lavaretus oxyrhynchus, Houting



Geographical extent

OSPAR Region; II
Biogeographic zone: 11
Region & Biogeographic zones specified for decline and/or threat: II/11

The houting *Coregonus lavaretus oxyrhynchus,* is a migratory species that swims upriver in the autumn to spawn in fresh water and then returns to estuarine areas. It was known to have had a distribution in the southern North Sea and the western Baltic and in the rivers Rhine, Weser and Elbe as well as being present in large lakes in southern Sweden (Wheeler, 1978). In the North Sea it is typically estuarine, rarely moving into fully marine conditions and a large part of the population today is found in Danish waters

Application of the Texel-Faial criteria

C.l.oxyrhynchus was nominated for inclusion on the OSPAR list by two parties. Criteria common to both were rarity and decline with information also provided on threat.

Decline

There is no total estimate of the population size of houting in the OSPAR Maritime Area but a survey between 1994-1997 of Danish waters, which hold most of the North Sea population, recorded 8,700 houting returning to the watercourses as spawners (Amt & Amt, 1997). Population numbers are known to have been greatly reduced in recent decades. It is no longer recorded in the southern North Sea for example. The last record for the UK was from the River Colne in 1925 and it is thought to be extinct in British waters (Ratcliffe, 1977). It was fished in the Scheldt estuary in the 19th century but was reported as uncommon along the Belgian coast in the mid-1800's (Van Beneden, 1871; De Selys Longchamps, 1842) and there have been no records from Belgian waters since the mid-1900's (Gilson, 1921; Poll, 1947). By the late 1980's it was nearly extinct in the Wadden Sea area but the status has since improved as a result of a reintroduction programme.

Rarity

C.l.oxyrhynchus has been reported as becoming increasing rare in European rivers and estuaries. Today, the most significant population in the North Sea is believed to be centred on the Danish river Vidåen where numbers have been supplemented through a restocking programme however the houting is still classified as endangered on the Danish Red List and the Wadden Sea Red List (Anon, 1998; Berg *et al*., 1996).

Threat

The main threats to houting in the OSPAR Maritime Area are obstruction of migration routes, pollution of lower river reaches, incidental capture, and damage to spawning grounds.

The majority of these threats take place on the inland waters used by the migrating fish. The construction of dams and artificial embankments prevent the fish migrating freely, while extraction of water for irrigation can also make spawning grounds inaccessible and create difficulties for fish returning downstream. Houting are also a bycatch in trap and fyke nets such as those used in the Wadden Sea.

The spawning grounds themselves have been degraded by extraction of gravel and stones from the river bed, and modifications in water flow caused by channelling and fluctuating water levels below dams. Poor water quality is another concern affecting the fish directly and indirectly through effects on their food.

Relevant additional considerations

Sufficiency of data

The numbers of houting recorded in the rivers and estuaries known to have been used by the migrating fish reveal a decline in the population and local extinctions in parts of its former range.

Changes in relation to natural variability

Little is known about the natural variability in the population of houting and therefore whether the decline and local extinctions are greater than might be expected through natural change. The fact that human activity is known to have affected the ability of adults to reach spawning sites does however suggest that the decline is at least in part due to human activity rather than natural variability.

Expert judgement

The decline in records and local extinctions have provided the data on which this species has been given international protection through the EC Habitats and Species Directive and a number of international conventions.

ICES Evaluation

The ICES review of this nomination by the Working Group on Fish Ecology (WGFE) reached the following conclusions (ICES, 2003).

There is evidence of a decrease in both the area of distribution and the abundance of houting, within the OSPAR maritime area and the species is restricted to a very few locations. A great part of the population is found in Danish waters. In great Britain this species is classified as Extinct and in Europe, as a whole, it is considered Endangered. It is listed in Appendix III of the Bern Convention. In the UK, a Biodiversity Action Plan has been developed to raise awareness that the species will need protection if it becomes established.

The species is protected in the Danish Red List and has been protected since 1983 by the Danish Ministry of Fisheries making it illegal to deliberately catch houting. Habitat degradation is still a major threat to the survival of the species. Essential habitats for juveniles in estuaries have been characterized, however, pollution and by-catch pose a continual threat

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; extraction of sand, stone and gravel; constructions, land-based activities. *Category of effect of human activity:* Physical – substratum removal and change, water flow rate changes, Biological – removal of target species

The main threats to this species come from the degradation of spawning habitat, poor water quality, and incidental capture all which are linked to human activities. Specific examples include records compiled during a survey between 1994-1997 of 3,400 houting (including 800 spawners) being caught in eel fyke nets in the Danish Wadden Sea (Amt & Amt 1997)

Management considerations

The main management measures that would assist the recovery of houting populations in the OSPAR Maritime Area are improvement of water quality, habitat conditions, and access to suitable spawning grounds in the estuaries and rivers of Europe as well as reducing the bycatch of houting in nets used for other fisheries. There is an ongoing restoration programme in Denmark through captive breeding and the stocking of rivers where houting used to be more numerous.

The work programme agreed at the eight Trilateral Governmental Conference on the Protection of the Wadded Sea in 1997 included the evaluation of the running reintroduction project of the Houting in Denmark and Schleswig-Holstein and the consideration of further actions in other rivers of the Wadden Sea.
Reintroduction programmes will only be successful in the long term if conditions that led to the decline in the first place have been tackled.

The houting is listed on Annexes II & V of the EC Habitats & Species Directive, and Annex III of the Bern Convention.

Further information

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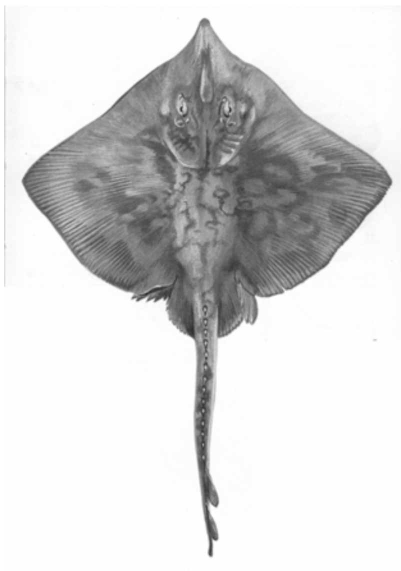
Nomination

Dipturus (Raja) batis, Common Skate



Geographical extent

OSPAR Regions; All
Biogeographic zones: 1,2,4,6-9,11-14
Region & Biogeographic zones specified for decline and/or threat: as above

The Common Stake has a distribution that extends from Iceland, the Faeroe islands and northern Norway, through the Irish Sea and North Sea to the waters off Ireland, Spain and Portugal. It is also found in the western Mediterranean (Wheeler, 1978). Its westward distribution is less well documented, but it is being found in developing fisheries in the mid-Atlantic Ridge, and in deeper parts of ICES of Sub-areas VI and VII (ICES, 2002). The Greater North Sea/Celtic Sea was thought to be the most important region for this species, amounting to around 75% of the population in the North Atlantic, but further confirmation is required (Daan, *pers comm*.).

Application of the Texel-Faial criteria

D.batis was nominated for inclusion by several Contracting Parties and Observers. The criteria common to all nominations were, decline, sensitivity and rarity, with information also provided on threat.

Decline

The Common Skate has declined throughout its range. The magnitude of decline is differentially well documented in various areas, but it is known to have severely declined in most shelf areas (ICES, 2002). For example, *D.batis* has been commercially extinct in the Irish Sea for some years (Brander, 1981) and has declined severely in the North Sea (Walker & Hislop, 1998). This skate was once an abundant constituent of the demersal fish community of north-west Europe. Fisheries data indicate that populations of *Dipturus batis* have undergone an extremely high level of depletion in the central part of its range around the British Isles since the early part of this century. Although landings appear stable in other parts of the species' range, this is attributed to the redirection of fishing effort from shelf seas, where populations have been very heavily depleted, into deeper water where previously unfished populations are now being taken (Ellis & Walker, *in press*).

Catch statistics reveal a major decline in landings of all skates and rays since the beginning of the 20th century but there are some difficulties with interpretation at the species level, as the data have sometimes been combined. There are some records, however, that distinguish between catches of the different species such as the Scottish sampling programme carried out in the North Sea between 1929-1956 and 1981-1995. The results show that *D.batis* was caught regularly in the North Sea during the first period, but had apparently disappeared from the area before the second sampling period although there are occasional incidental catches (Walker & Hislop, 1998; Walker & Heessen, 1996) (Figure A). In the southern North Sea *D.batis* was considered to be common in Belgian waters in the early 1900's (e.g. Gilson, 1921; Lameere, 1936), but there are no recent records (J.Haelters & F.Kerckhof *pers comm*).

Fishing pressure in the North Sea has been calculated to have resulted in a 34-37% decrease in numbers annually and *D.batis* is believed to have been replaced in much of its former range by smaller, faster-maturing and more fecund *Dipturis* species (Camhi *et al.* 1998). Modelling of the long-term impact of otter trawling in the North Sea, based on by-catch records delivered to the Dutch Zoological station between 1947-1981, suggest that numbers of *D.batis* decreased by more than 75% during this period (Rumohr *et al.,* 1998).

FIGURE A Abundance (average catch/hour) of seven skate and ray species in the North Sea. (from Walker & Hislop, 1998).

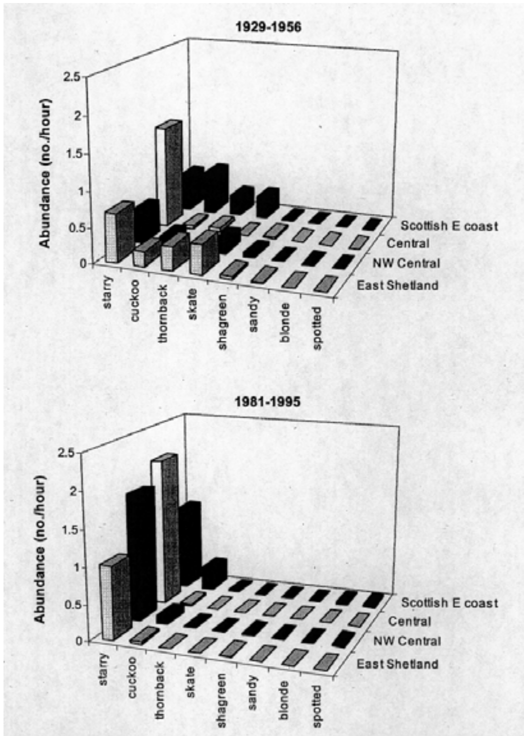
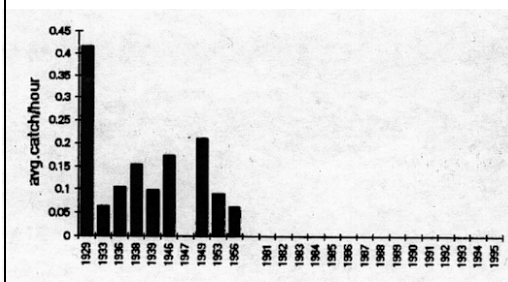


Figure B. Average catch/hour of *D.batis* 1929-1956 and 1981-1995 (from Walker & Hislop, 1998)



Sensitivity

The Common Skate is a large, long-lived species with a low fecundity. Its age and very large size at maturity makes it especially vulnerable to capture by bottom trawl fisheries. Most size classes are taken in fishing nets, and mortality of the large juveniles is high (Camhi *et al.,* 1998).

Rarity

The status of the Common Skate in the North Sea has changed from a species that was relatively common and commercially important, to being quite rare. At the end of the last century, for example, it was considered to be one of the more common elasmobranchs in Scottish waters, comprising nearly 40% of landings. In the 1930's *D.batis* comprised nearly 40% of the tonnage of skates landed by Dutch fishermen from near the Dogger Bank, although only juveniles were being landed. This figure dropped to 10% in 1970 the last year in which it was recorded separately (Camhi *et al.,* 1998). The fall in catch per unit effort in the North Sea is illustrated in Figure B. The species has also been commercially extinct in the Irish Sea for some years (Brander, 1981).

Threat

Directed and by-catch fishing mortality is the major threat to Common Skate. Its vulnerable life history makes the threat to population status posed by even only by-catch mortality potentially serious. The recent expansion of fishing into deep-water areas of ICES Sub-areas VI and VII, and along the Mid-Atlantic Ridge, exploits previously unharvested portions of this species. Depending on unknown relationships between deep-water and shelf "populations" of skates, it is possible that these fisheries could be reducing the remaining spawning population for Common Skate (ICES, 2002).

Other possible threats such as an increased risk of damaging embryos by trawling on spawning areas and of bioaccumulation of contaminants are unconfirmed at the present time but may warrant further investigation (ICES, 2002).

Relevant additional considerations

Sufficiency of data

Fisheries data, including catch per unit effort, and benthic surveys provide the information on which the decline of *D.batis* has been determined although in some cases the information is grouped for several species of skates and rays making it difficult to distinguish species-specific trends.

Changes in relation to natural variability

The dramatic decline in abundance of common Skate following exploitation by fisheries, points to changes beyond that which would be expected through natural variability.

Expert judgement

The overall decline in abundance and commercial extinction in at least one part of its range is the basis on which this species has been classified by IUCN as endangered throughout its range and "critically endangered" in shelf sea areas.

ICES evaluation

The ICES review of this nomination by the Study Group on Elasmobranch Fishes (SGEF) confirms that the impacts of directed fisheries and by-catches are well documented and that the decline of the Common Skate is also widespread and well documented. ICES agree that it should be a priority across its full range, which is much of OSPAR area, and that the designation of Common Skate as threatened or declining is consistent with the scientific evidence (ICES, 2002).

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; shipping & navigation. *Category of effect of human activity:* Biological – removal of target species, removal of non-target species, physical damage to species.

The principle threat to *D.batis* is from fisheries and therefore clearly linked to human activity. European fisheries for skates and rays have been in existence since at least the 1800's although not a highly valued species at that time. Today fishing pressure on skates from target and multi-species fisheries in the NE Atlantic is so intensive that few of the species can survive to maturity (Camhi *et al* 1998). Another fisheries related effect is the change in the length distribution of skates and rays in the North Sea (with the exception of the starry ray). These show a shift to few fish about 80cm now, whereas individuals of more than 100cms used to be common. For the common skate this has meant a loss of all or some of the reproducing females (Walker & Hislop, 1998).

Management considerations

Useful management measures for *D.batis* in the OSPAR Maritime Area should address directed fishing and by-catch of the Common Skate. This could include gear restrictions and closed areas. These are issues that fall within the remit fisheries organisations rather than OSPAR, although OSPAR can communicate an opinion on this to the relevant bodies.

The Common Skate is considered to be a globally endangered species by IUCN with inshore European populations "critically endangered" (IUCN, 2002).

Further information

Nominated by:
Belgium, Netherlands, UK.

Contact persons:

Niels Daan, Netherlands Institute for Fisheries Research, P.O.Box 68, 1970 AB Ijmuiden, The Netherlands.

Jan Haelters & Francis Kerckhof, Management Unit of the North Sea Mathematical Models, 3[e] en 23[e] Linieregimentsplein, 8400 Oostende, Belgium.

Mark Tasker, Joint Nature Conservation Committee, Monkstone House, Peterborough PE1 1UA, UK.

Useful References:

Anon (1999) UK Biodiversity Group Tranche 2 Action Plans. Volume V – maritime species and habitats. Published by English Nature on behalf of the UK Biodiversity Group.

Brander, K. (1981) Disappearance of Common Skate, *Dipturis batis* from the Irish Sea. Nature 290:48-49.

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ICES (2002) Report of the Working Group on Ecosystem Effects of Fisheries. Advisory Committee on Ecosystems. ICES CM 2002/ACE:03.

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Rumohr, H., Ehrich, S., Knust, R., Kujawsik, T., Philippart, C.J.M. & Schroeder, A. (1998) Long term trends in demersal fish and benthic invertebrates. In: Lindeboom, H.J. & de Groot, S.J. (1998) The effects of different types of fisheries on the North Sea and Irish Sea benthic ecosystems. IMPACT – II. NIOZ-RAPPORT 1998-1.

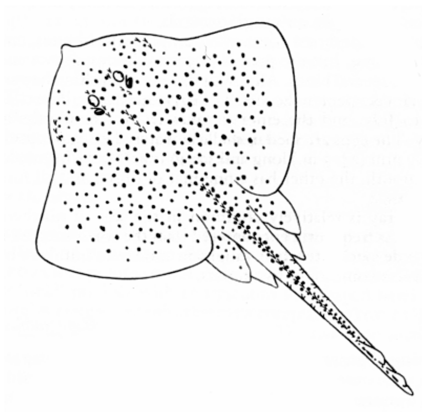
Walker P.A. & Heessen, H.J.L. (1996) Long-term changes in ray populations in the North Sea. *ICES J.Mar.Sci*. 53:1085-1093.

Walker, P.A. & Hislop, J. (1998) Sensitive skates or resilient rays? Spatial and temporal shifts in ray species composition in the central and north-western North Sea between 1930 and the present day. *ICES J.Mar.Sci*. 55:392-402.

Wheeler, A. (1978) Key to the fishes of Northern Europe. Frederick Warne & Co, London.

Nomination

Dipturus (Raja) montagui, Spotted Ray



Geographical extent

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

The Spotted Ray is widely distributed through the southern North Sea and adjacent shelf waters. It is found around the west coast of the British Isles, from Scotland and the Shetland Isles, the southern North Sea, English Channel and off the coasts of Spain and Portugal. It also occurs in the western Mediterranean. It is a Lusitanian species whose distribution appears to have extended into the North Sea in recent years with two possible centres of distribution, one off the NE coast of Scotland and the other off the south-east coast of England (Walker & Heesen, 1996). This species of ray lives in moderately deep water, mainly between 60-120m and is most common on sandy seabed (Wheeler, 1978).

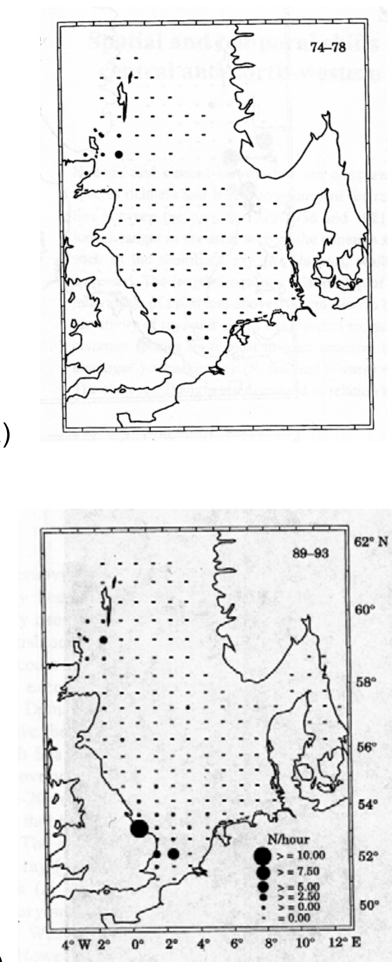
Application of the Texel-Faial criteria

D.montagui was nominated for inclusion with particular reference to decline, sensitivity, rarity, and threat in Belgian waters.

Decline

The precise status of the spotted ray in the North Sea is difficult to quantify but data from a Scottish survey and the International Bottom Trawl Survey (IBTS) point to it becoming more abundant along the SE coast of England during the mid to late 1970's (Walker & Heessen, 1996; Walker & Hislop, 1998) (Figure A). At the same time it may have become less abundant is some areas. The Spotted Ray was considered to be a commonly occurring species in Belgian waters in the mid-1900s for example (Poll, 1947), but there has been a severe decline since then and it is now very rare in Belgian waters (J.Haelters & F.Kerckhof, *pers.com*).

<u>FIGURE A.</u> Distribution of spotted ray by 5-year period. (a) 74-78, (b) 89-93). Figure 5 from Walker & Heesen, 1996).



(a)

(b)

Sensitivity

Like all elasmobranchs, the spotted ray is a large, long-lived species with a low fecundity when compared to other groups of fish, however, it is less sensitive than some of the other rays found in the OSPAR Maritime Area. A sampling programme conducted in the North Sea revealed that the size of the spotted ray at the onset of maturity is less than that of the thornback ray *(R.clavata*), but larger that the cuckoo ray (*R.naevus*) or starry ray (*R.radiata*) .

On the other hand it is more fecund than the starry ray and less so than the cuckoo ray (Walker & Ellis, 1998). The size at maturity of this and other rays makes them vulnerable to capture by bottom trawl fisheries.

Rarity

The spotted ray is a Lusitanean species, reaching the northern limit of its range in the OSPAR Maritime Area. Most detailed studies of its abundance have taken place in the North Sea and the Irish Sea where it does not appear to be particularly common.

Threat

D.montagui not as vulnerable as some of the other skates and rays in the OSPAR Maritime Area, but the same threats are relevant. *D.montagui* is taken as bycatch in the demersal fisheries and it is landed for consumption along with a number of other rays. This is the main threat to the species at the present time (ICES, 2002).

Relevant additional considerations

Sufficiency of data

Fisheries data and benthic surveys provide the information on which the status of *D.montagui* has been determined although in some cases the information is grouped for several species of skates and rays making it difficult to distinguish species-specific trends.

Changes in relation to natural variability

High catches of juveniles have been observed off the south-east coast of England in the 1990's following a series of warm winters in the late 1980's (Walker & Heessen, 1996). As it is a southerly species, the northerly limits of its distribution are in the North Sea and are determined by water temperature.

Expert judgement

Current data and expert judgement suggests that this species is probably not in overall decline in the OSPAR Maritime Area. It is subject to the same threats as other ray species and the identification of Spotted Ray as a species highly sensitive to mortality due to fishing is consistent with the scientific evidence (ICES, 2002).

ICES evaluation

The ICES review of this nomination by the Study Group on Elasmobranch Fishes (SGEF) notes that declines have been documented in the southern and eastern North Sea, but that no trends are apparent in the western North Sea. There is some documentation of impacts of fisheries that also take the Spotted Ray as by-catch. ICES conclude that this species should only be a priority for specific regions rather than the whole OSPAR Maritime area (ICES, 2002).

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; shipping & navigation. *Category of effect of human activity:* Biological – removal of target species, removal of non-target species, physical damage to species.

The principle threat to *D.montagui* is from fisheries and therefore clearly linked to human activity. European fisheries for skates and rays have been in existence since at least the 1800's although not a highly valued species at that time. Today fishing pressure on skates from target and multi-species fisheries in the NE Atlantic is so intensive that few of the species can survive to maturity (Camhi *et al* 1998). Another fisheries related effect is the change in the length distribution of skates and rays in the North Sea (with the exception of the starry ray). These show a shift to few fish about 80cm now, whereas individuals of more than 100cms used to be common (Walker & Hislop, 1998).

Management considerations

Useful management measures for *D.montagui* in the OSPAR Maritime Area should address directed fishing and by-catch of the Spotted Ray. This could include gear restrictions and closed areas. These are issues that fall within the remit fisheries organisations rather than OSPAR, although OSPAR can communicate an opinion on this to the relevant bodies.

Further information

Nominated by:
Belgium

Contact persons:

Jan Haelters & Francis Kerckhof, Management Unit of the North Sea Mathematical Models, 3^{e} en 23^{e} Linieregimentsplein, 8400 Oostende, Belgium.

Useful References:

Camhi, M. Fowler, S., Musick, J., Brautigam, A. & Fordham, S. (1998). Sharks and their relatives. Ecology and Conservation. Occasional Paper of the IUCN Species Survival Commission No.20.

ICES (2002) Report of the Working Group on Ecosystem Effects of Fisheries. Advisory Committee on Ecosystems. ICES CM 2002/ACE:03.

Poll, M. (1947) Poissons marins. Faune de Belgique. Musée Royal d'Histoire Naturelle de Belgique, Brussels, 452pp.

Walker, P.A. & Ellis, J (1998) Long-term changes in rays populations in the North Sea. ICES J.Mar.Sci 53:1085-1093.

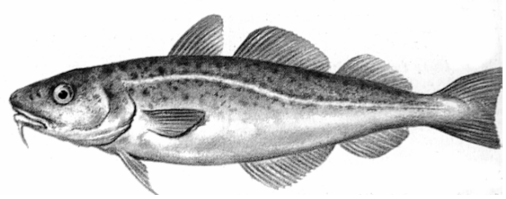
Walker P.A. & Heessen, H.J.L. (1996) Long-term changes in ray populations in the North Sea. ICES J.Mar.Sci. 53:1085-1093.

Walker, P.A. & Hislop, J. (1998) Sensitive skates or resilient rays? Spatial and temporal shifts in ray species composition in the central and north-western North Sea between 1930 and the present day. ICES J.Mar.Sci. 55:392-402.

Wheeler, A. (1978) Key to the fishes of Northern Europe. Frederick Warne & Co, London.

Nomination

Gadus morhua, Cod



Geographical extent

OSPAR Regions; All
Biogeographic zones: 1-20,
Region & Biogeographic zones specified for decline and/or threat: I, II, III/1-20

Gadus morhua has a distribution in the OSPAR Maritime Area that extends through the Barents Sea, to the North Sea, the Irish Sea, the waters around Iceland and the North East Atlantic (Wheeler, 1978). It is found close to shore and well down the continental shelf with adults making considerable migrations to reach spawning grounds. In the NE Atlantic, the Norwegian-Arctic stock in the Barents Sea, the Icelandic stock and the much smaller North Sea stock range widely. There are also local, stationary races which always remain close inshore.

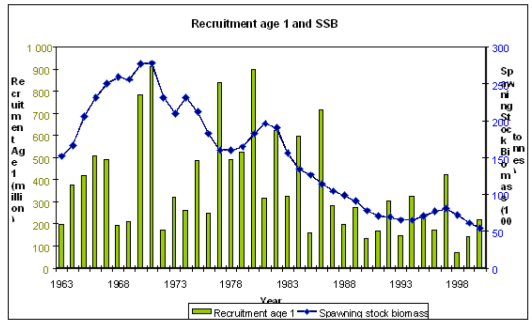
Application of the Texel-Faial criteria

There were two nominations for cod to be placed on the OSPAR list. The criteria common to both were decline with information also provided on threat.

Decline

Cod stocks have declined substantially in the OSPAR Area and the status of many individual stocks is poor. From the beginning of this century until the 1960s, landings of cod fluctuated between 50 000 tonnes and 100 000 tonnes in the North Sea. In the 1960s landings increased and reached a maximum of 350 000 tonnes in 1972. They then declined steadily from 1981 to 1991, since when they have shown a small increase to 140 000 tonnes in 1995. Apart from the 1993 year class, all year classes from 1987 onwards have been below average (Figure A). All the indications are that the current exploitation rate for cod in the North Sea is not sustainable and that a collapse of the stock is possible, unless there is a significant reduction in fishing pressure to bring the stock within Safe Biological Limits (IMM, 1997).

FIGURE A Historical data on recruitment and spawning stock biomass of North Sea Cod (Eurostat, 2002).



ICES (2002a) has reported the current status of the different stocks of cod that occur in the OSPAR Maritime Area as follows:

Icelandic Cod (Va) – Safe biological limits have not been defined for this stock; spawning biomass has been relatively stable for nearly twenty years, but is lower than biomasses observed prior to the 1980s.
Faroe Plateau (Vb1) – The spawning stock biomass (SSB) is above safe biological limits, but fishing mortality is so high that it is being harvested outside of safe biological limits.
Faroe Bank cod (Vb2) – Safe biological limits have not been determined for this stock but the biomass is above the long-term average.
Northeast Arctic cod (I and II) – The stock is outside safe biological limits, and SSB declined substantially through the 1990s.
Kattegat cod – The stock is outside safe biological limits, and SSB has declined substantially from the 1970s to the 1990s, with a few brief periods of improved status.
North Sea and Skagerrak (IV, VIId, and IIIa) The stock is outside safe biological limits. SSB has declined fairly consistently since the 1970s.
Cod West of Scotland (VIa) – The stock is outside safe biological limits. SSB has declined markedly since the 1980s.
Cod in the Irish Sea (VIIa) – The stock is outside safe biological limits. SSB declined markedly between 1989 and 1990, and slightly more thereafter.
Cod in VIIe–k – The stock is outside safe biological limits. SSB has undergone two periods of increase and subsequent decrease since the late 1970s, and is currently near its historic low.

The OSPAR nominations did not distinguish between stocks when listing cod but raised the question of whether some stocks off Norway might be excluded. The ICES evaluation (above) reports that all except the Faroe Plateau cod are outside Safe Biological Limits at the present time and that the SSB for Icelandic and Faroe Bank cod have yet to be determined. It is reasonable to consider that stocks need to be at least above Safe Biological Limits not to qualify as threatened or declining, and that they are not being harvested outside such limits, as in the case of the Faroe Plateau cod. As a minimum, this listing is therefore relevant to all but the Icelandic and Faroe Bank cod stocks at the present time.

Threat

By far the largest threat to cod stocks comes from fisheries. This is due to overfishing in directed fisheries as well as bycatch in mixed fisheries where juvenile cod in particular may be caught and then discarded. The scale of this threat is very significant. In the North Sea, for example, the combination of the very high exploitation rate and the relatively advanced age at which cod mature (3 to 6 years), means that fewer than 1% of the 1-year-old fish in the North Sea are believed to survive to maturity. Landings of cod in this area therefore mainly consist of juvenile fish of two to three years of age (IMM, 1997). Depletion of food sources and global warming have also been suggested as contributory factors in the decline but any effects are likely to be minor compared to that from fishing.

Relevant additional considerations

Sufficiency of data

There is a substantive body of information on the status of the different cod stocks in the OSPAR Maritime Area from surveys and landings data. These go back for many decades and have been used by ICES to assess the status of the different stocks.

Changes in relation to natural variability

Natural variability will have played a part in the changing status of the cod. The evidence that depletion of food supplies and global warming have played an important role in declines of cod stocks is nevertheless incomplete and sometimes speculative. Although cod stocks are clearly affected by ocean conditions and food supply, evidence that these factors would have caused major declines in cod stocks, without overfishing, is weak (ICES, 2002a).

Expert judgement

Landings and survey data have been used to model changes in cod stocks and recommend fishing quotas. The scientific advice is provided by ICES and final decisions are taken by Member States of the European Community, Norwegian and Icelandic fisheries ministries. The first part of this exercise therefore uses scientific data and expert judgement. The second stage is a political process.

ICES evaluation

ICES confirms that cod stocks have declined substantially overall in the OSPAR area although they note that even for the most depressed stocks, populations are sufficiently large that there is no risk of extirpation, and for most or all stocks, declines appear to have ceased. The rebuilding of these stocks has been slow however, and in many cases promising increases in abundance in the 1980s or 1990s have not resulted in lasting improvements in stock status. As a result ICES have advised the European Commission and national governments that all fisheries that target cod in the North Sea, Skagerrak, Irish Sea and waters west of Scotland should be closed (ICES, 2002b – ACFM report October 2002). Cod stocks in these areas are now so depleted that the chance of a collapse must be seriously considered.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; *Category of effect of human activity:* Biological – removal of target and non-target species.

The principle threat to cod stocks in the OSPAR Maritime Area is fishing. Overexploitation is a clear threat and has been identified as the cause of the decline in stocks that are currently below Safe Biological Limits by ICES. This threat is clearly linked to human activities.

Management considerations

All cod stocks are already subject to management plans and several, including North Sea cod and Irish Sea cod, have Rebuilding Plans in place that focus on reducing fishing mortality. ICES did not consider listing by OSPAR would aid the recovery of these cod stocks as the above measures fall within the remit of fisheries organisations (ICES, 2002). OSPAR can however communicate an opinion on its concern about this species to the relevant bodies and introduce any relevant supporting measures that fall within its own remit if such measures exist or are introduced in the future.

Further information

Nominated by:
UK, WWF.

Contact person:

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Mathew Carden, DEFRA, Ashdown House, 123 Victoria Street London SW1E 6DE, UK.

Useful References:

EUROSTAT (2002). http://europa.eu.int/comm/eurostat

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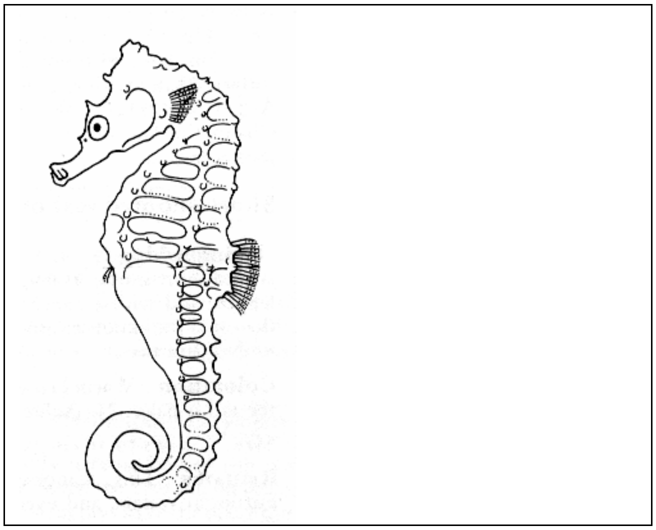
Wheeler, A. (1978). Key to the fishes of Northern Europe. Frederick Warne & Co, London.

Nomination

Hippocampus guttulatus (formerly *ramulosus,)*
Long-snouted Seahorse



Geographical extent

OSPAR Regions; II, III, IV, V
Biogeographic zones: 5,6,7,9,
Region & Biogeographic zones specified for decline and/or threat: as above

This species of seahorse has a distribution that includes the Eastern Atlantic, the Bay of Biscay, the Wadden Sea, the southern North Sea, English Channel, and south western coasts of the British Isles, through the Mediterranean to North Africa. It is not known to occur in Swedish waters. *H. guttulatus* also occurs in the Black Sea. It occurs mostly in shallow inshore waters among seagrass and algae but may overwinter in deeper waters (Fishbase, 2002; Lourie *et al*.1999).

Application of the Texel-Faial criteria

Nominations of this species of *Hippocampus* to be placed on the OSPAR list cited regional importance, decline, and sensitivity. Information was also provided on threat.

Regional/Local importance

This species of seahorse has been reported from four of the five OSPAR Maritime Areas where it is found close inshore. It also occurs elsewhere and is threatened by similar activities outside the OSPAR Maritime Area.

Decline

There are reports and strong circumstantial evidence of declining numbers and diminishing size in catches among a number of the commonly traded species of *Hippocampus* (TRAFFIC, 2002). There are no specific figures for this species in the OSPAR Maritime Area although important habitat for seahorses (seagrass) is known to have become less extensive.

Sensitivity

The life history characteristics of *Hippocampus* spp. make populations particularly sensitive to activities which deplete the number of individuals in a particular area. The fragility of the juveniles also makes the seahorse very sensitive to perturbations of its natural environment (Beaufort, 1987). Seahorse biology is such that populations will be particularly susceptible to overfishing (Vincent 1996, Schmid & Senn 2002):

(a) pregnant seahorses must survive if the young are to survive;
(b) lengthy parental care combined with small brood size limit reproductive rates;
(c) low mobility and small home ranges restrict recolonisation of depleted areas;
(d) sparse distribution means that lost partners are not quickly replaced;
(e) strict monogamy means that social structure is easily disrupted; and
(f) typically low rates of adult mortality mean that fishing exerts a relatively substantial selective pressure.

Threat

Directed fisheries are known to occur in Portugal and in the British Isles, Jersey and Guernsey, and are usually the source of live specimens for the aquarium trade, as well as a portion of the dried specimen trade (TRAFFIC, 2002). A significant number are collected in southern England and the Channel Isles to contribute to an aquarium trade estimated to take over one million seahorses per year.

Seahorses are also taken as by-catch in a variety of fishing gear (trawls, beach seines, push nets, gill and trammel nets, and pots). By-catch currently accounts for the majority of specimens in international trade, destined for the traditional medicine and curio markets. In excess of 30 million seahorses per year are taken world-wide for the traditional medicine trade (Vincent 1995). The scale of this trade in more than 65 countries provides increasing pressure for new populations to be found.

The destruction of sea grass beds, which are an important habitat for the seahorse is another threat. The density of *H.guttulaus* has been found to be positively correlated with vegetation cover (including seagrass and macroalgae) and epibenthos (including ascidians and tube-dwelling polychaetes) (J.Curtis, *pers. comm*.); therefore any decline in cover is likely to affect the abundance of this species.

Relevant additional considerations

Sufficiency of data

There are limited data on seahorses in the OSPAR Maritime Area. There is also little information on population dynamics, reproductive rate and ecology of this species in the NE Atlantic.

Changes in relation to natural variability

Little is known about the natural variability of the population of *H.guttulatus* in the NE Atlantic. However, in other parts of the world where it is collected for the medicine, curio and aquarium trade, the dramatic decline in numbers due to human activity totally overshadows any changes that are likely to be due to natural variability.

Expert judgement

The absence of precise information on the population size of this species in the OSPAR Maritime Area means that expert judgement has played a significant part in this nomination. It rests on a recognition that the threats to the long-snouted seahorse are known, that such threats occur in the OSPAR Maritime Area, and that they have led to significant declines in the number of other seahorse species elsewhere.

ICES Evaluation

The Advisory Committee of Ecosystems of ICES reviewed information on this species (ICES 2003), and concluded that there was no evidence for decline although the extent of the seagrass habitat used by this species has decreased. There was considered to be sound evidence of threat to seagrass habitats but no evidence of threats to this species of seahorse. The sensitivity of the genus has been well-documented.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; *Category of effect of human activity:* Biological – removal as target and non-target species by fisheries.

There is a clear link between the decline of seahorses and human activities in parts of the world where it is collected for the curio, medicine and aquarium trade. Although collection is not as intensive in the North East Atlantic it still takes place and is a significant long-term threat to the species along with degradation and loss of important seagrass habitat.

Management considerations

Management actions that are essential for the conservation of this species are control and monitoring of collection and trade in seahorses. It is important that collection and trade is not allowed to increase in the OSPAR Maritime Area as numbers become depleted due to trade in other parts of the world.

Ongoing management action for seagrass bed habitat in the North East Atlantic should consider the protection of seahorses, as well as for the seagrass habitat. Protection of seahorses should also be considered in other habitats in which they occur (kelp and seaweed habitats).

This species is classified as Vulnerable in the IUCN Red List (2002) and has recently been added to Appendix II of CITES, and the UK is considering listing this species on Schedule V of the UK Wildlife and Countryside Act 1981.

Further information

Nominated by:
Portugal

Contact person:

Fatima Brito, Direcção Geral do Ambiente, Rua Murgueira-Zambujal, 2720-865 Amadora, Portugal

Useful References:

Beaufort, F. de. (1987) Livre Rouge des Espèces Menacees en France. Vol 2: Espèces Marines et Littorales Menacées. Museum National d'Histoire Naturelle, Paris.

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Garrick-Maidment, N. (1994) Seahorses, conservation and care. TFH

Garrick-Maidment, N. (1997) British seahorse survey report. The Seahorse Trust.

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Lourie, S.A., A.C.J. Vincent & H.J. Hall, (1999). Seahorses: an identification guide to the world's species and their conservation.. Project Seahorse, London. 214 p.

ICES (2003) Report of the ICES Advisory Committee on Ecosystems. ICES Cooperative Research Report No.262. Copenhagen. 220pp.

IUCN (2002). *2002 IUCN Red List of Threatened Species*

Janelle Curtis, McGill University, Project Seahorse

Schmid, M.S. & Senn, D.G. (2002) Seahorses – masters of adaptation. Vie Milieu, 52: 201-207.

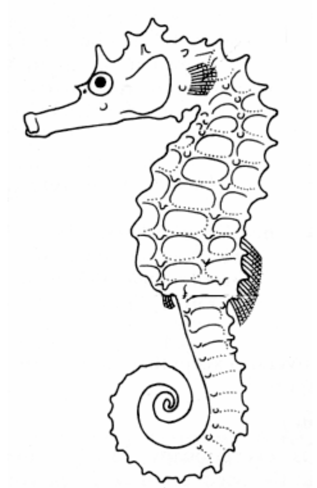
TRAFFIC (2002) CoP12 Prop.37 [USA] *Hippocampus* spp. Inclusion in Appendix II. Recommendations by TRAFFIC to proposals for the 12th Meeting of the Conference of the Parties to CITES.

Vincent, A.C.J. (1996) The international trade in seahorses. TRAFFIC International. 163pp.

Wheeler, A. (1978) Key to the fishes of northern Europe. Frederick Warne, London, 380pp.

Nomination

Hippocampus hippocampus, Short-snouted Seahorse



Geographical extent

OSPAR Regions; II, III, IV, V
Biogeographic zones: 5,6,7,9,
Region & Biogeographic zones specified for decline and/or threat: as above

This species of seahorse has a distribution that includes the Eastern Atlantic, the Bay of Biscay, the Wadden Sea, the southern North Sea, English Channel, and south western coasts of the British Isles, through the Mediterranean to North Africa. It is not known to occur in Swedish waters. *H.hippocampus* occurs mostly in shallow inshore waters among seagrass and algae but may overwinter in deeper waters (Fishbase, 2002; Lourie *et al*.1999).

Application of the Texel-Faial criteria

Nominations of this species of *Hippocampus* to be placed on the OSPAR list cited regional importance, decline, and sensitivity. Information was also provided on threat.

Regional/Local importance

This species of seahorse has been reported from four of the five OSPAR Maritime Areas where it is found close inshore. It also occurs elsewhere and is threatened by similar activities outside the OSPAR Maritime Area.

Decline

There are reports and strong circumstantial evidence of declining numbers and diminishing size in catches among a number of the commonly traded species of *Hippocampus* (TRAFFIC, 2002). There are no specific figures for this species in the OSPAR Maritime Area although important habitat for seahorses (seagrass) is known to have become less extensive.

Sensitivity

The life history characteristics of *Hippocampus* spp. make populations particularly sensitive to activities which deplete the number of individuals in a particular area. The fragility of the juveniles also makes the seahorse very sensitive to perturbations of its natural environment (Beaufort, 1987). Seahorse biology is such that populations will be particularly susceptible to overfishing (Vincent 1996, Schmid & Senn 2002):

(a) pregnant seahorses must survive if the young are to survive;
(b) lengthy parental care combined with small brood size limit reproductive rates;
(c) low mobility and small home ranges restrict recolonisation of depleted areas;
(d) sparse distribution means that lost partners are not quickly replaced;
(e) strict monogamy means that social structure is easily disrupted; and
(f) typically low rates of adult mortality mean that fishing exerts a relatively substantial selective pressure.

Threat

Directed fisheries are known to occur in Portugal and in the British Isles, Jersey and Guernsey, and are usually the source of live specimens for the aquarium trade, as well as a portion of the dried specimen trade (TRAFFIC, 2002). A significant number are collected in southern England and the Channel Isles to contribute to an aquarium trade estimated to take over one million seahorses per year.

Seahorses are taken as by-catch in a variety of fishing gear (trawls, beach seines, push nets, gill and trammel nets, and pots). By-catch currently accounts for the majority of specimens in international trade, destined for the traditional medicine and curio markets. In excess of 30 million seahorses per year are taken world-wide for the traditional medicine trade (Vincent 1995). The scale of this trade in more than 65 countries provides increasing pressure for new populations to be found.

The destruction of sea grass beds, which are an important habitat for the seahorse is another threat.

Relevant additional considerations

Sufficiency of data

There are limited data on seahorses in the OSPAR Maritime Area. There is also little information on population dynamics, reproductive rate and ecology of this species in the NE Atlantic.

Changes in relation to natural variability

Little is known about the natural variability of the population of *H.hippocampus* in the NE Atlantic. However, in other parts of the world where it is collected for the medicine, curio and aquarium trade, the dramatic decline in numbers due to human activity totally overshadows any changes that are likely to be due to natural variability.

Expert judgement

The absence of precise information on the population size of this species in the OSPAR Maritime Area means that expert judgement has played a significant part in this nomination. It rests on a recognition that the threats to the short-snouted seahorse are known, that such threats occur in the OSPAR Maritime Area and that they have led to significant declines in the number of other seahorse species elsewhere.

ICES Evaluation

The Advisory Committee of Ecosystems of ICES reviewed information on this species (ICES 2003), and concluded that there was no evidence for decline although the extent of the seagrass habitat used by this species has decreased. There was considered to be sound evidence of threat to seagrass habitats but no evidence of threats to this species of seahorse. The sensitivity of the genus has been well-documented.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; *Category of effect of human activity:* Biological – removal as target and non-target species by fisheries.

There is a clear link between the decline of seahorses and human activities in parts of the world where it is collected for the curio, medicine and aquarium trade. Although collection is not as intensive in the North East Atlantic it still takes place and is a significant long-term threat to the species along with degradation and loss of important seagrass habitat.

Management considerations

Management actions that are essential for the conservation of this species are control and monitoring of collection and trade in seahorses. It is important that collection and trade is not allowed to increase in the OSPAR Maritime Area as numbers become depleted due to trade in other parts of the world.

Ongoing management action for seagrass bed habitat in the North East Atlantic should consider the protection of seahorses, as well as for the seagrass habitat. Protection of seahorses should also be considered in other habitats in which they occur (kelp and seaweed habitats).

This species is classified as Vulnerable in the IUCN Red List (2002) and has recently been added to Appendix II of CITES. The UK is considering listing this species on Schedule V of the UK Wildlife and Countryside Act 1981.

Further information

Nominated by:

Portugal

Contact person:

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Useful References:

Beaufort, F. de. (1987) Livre Rouge des Espèces Menacees en France. Vol 2: Espèces Marines et Littorales Menacées. Museum National d'Histoire Naturelle, Paris.

Fishbase (2002). http://www.fishbase.org

Garrick-Maidment, N. (1994) Seahorses, conservation and care. TFH

Garrick-Maidment, N. (1997) British seahorse survey report. The Seahorse Trust.

Lourie, S.A., A.C.J. Vincent & H.J. Hall, (1999). Seahorses: an identification guide to the world's species and their conservation.. Project Seahorse, London. 214 p.

ICES (2003) Report of the ICES Advisory Committee on Ecosystems. ICES Cooperative Research Report No.262. Copenhagen. 220pp.

IUCN (2002). *2002 IUCN Red List of Threatened Species*

Janelle Curtis, McGill University, Project Seahorse

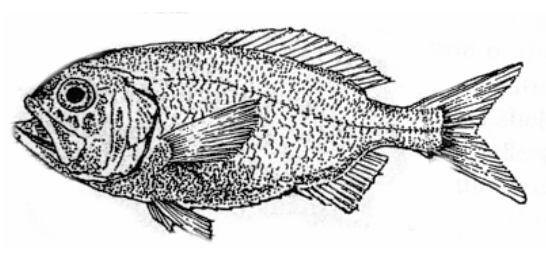
Schmid, M.S. & Senn, D.G. (2002) Seahorses – masters of adaptation. Vie Milieu, 52: 201-207.

TRAFFIC (2002) CoP12 Prop.37 [USA] *Hippocampus* spp. Inclusion in Appendix II. Recommendations by TRAFFIC to proposals for the 12th Meeting of the Conference of the Parties to CITES.

Vincent, A.C.J. (1996) The international trade in seahorses. TRAFFIC International. 163pp.

Wheeler, A. 1978 Key to the fishes of northern Europe. Frederick Warne, London, 380pp.

Nomination
Hoplostethus atlanticus, Orange Roughy



Geographical extent

OSPAR Region: I,V
Biogeographic zones: 1,2,7,8,10
Regions specified for decline and/or threat: I, V

The orange roughy, *H.atlanticus* is a benthopelagic species, found in deep, cold waters, over steep continental slopes, ocean ridges and seamounts. The main known populations are in the South West Pacific. It also occurs in the North East Atlantic but at much lower levels of abundance than in the Pacific.

Application of the Texel-Faial criteria

There were two nominations for orange roughy to be placed on the OSPAR list. The criteria common to both were decline and sensitivity, with information also provided on threat.

Decline

Rapid declines in abundance have been documented in all areas where the orange roughy is fished and several populations have been overexploited (e.g. Branch, 2001; Clark, 2001; Koslow *et al*., 1997; Lorance & Dupouy, 2001). Most orange roughy fisheries have been fished down within 5-10 years to less than 20% of their original stock size (Koslow, 2001).

In the OSPAR Maritime Area and particularly the North Eastern Atlantic some aggregations have been severely depleted. The stocks in ICES sub-area VI (North eastern part of OSPAR Region V) are outside safe biological limits. In deep water areas northwest of the UK (ICES Area VI), the CPUE for this species declined quite quickly after the fishery commenced in 1991, and by 1994 it was 25% of initial catch rates. In recent years CPUE has increased slightly and has stabilised. The apparent stabilisation may simply reflect the discovery and subsequent fishing of previously unexploited aggregations of fish. (ICES, 2002a).

The situation in ICES sub-area VII (off the south west) appears to be less serious as catch levels increased in 2001, however this is due to fishing newly discovered aggregations. There is therefore a high probably of a severe depletion of the species in the future. The state of stocks in other areas is not known (ICES, 2002a).

Sensitivity

The orange roughy is a sedentary species, which grows very slowly, and is one of the longest lived fish species known, living for more than 130 years (Allain & Lorance, 2000). Due to the distribution of the species in discrete and dense aggregations from which high catch rates can be obtained, fisheries can rapidly deplete the stocks. The slow growth and high longevity of orange roughy means that recovery of depleted population can only be very slow.

Threat

The main threat to the orange roughy is from fishing of the dense spawning and non-spawning aggregations which form sporadically. Newly discovered aggregations are being exploited and as the fishery remains unregulated, this continues to pose a threat. Well-established fisheries in the OSPAR Maritime Area are on the mid-Atlantic ridge off Iceland. It is also caught on the Hatton Bank.

Relevant additional considerations

Sufficiency of data

There is sporadic exploitation of populations along the Mid-Atlantic ridge but the data on landings and fishing effort are often limited or relatively poor. Landing statistics may not reflect the true scale of fishing activity outside national EEZs. The degree to which the abundance of the species depends on the exploited aggregations is also unknown (ICES, 2002a).

Changes in relation to natural variability

Little is known about natural variability in populations of orange roughy or the biology of the larvae and juveniles.

Expert judgement

The Working Group on the Biology and Assessment of Deep Sea Fisheries in ICES notes that the smallest units on which data are reported are ICES Areas and Subdivisions. Fishing for species like the orange roughy, that have relatively isolated concentrations and catch rates, can therefore only be maintained by sequential depletion of these concentrations. Data on effort and catches need to be recorded on a much finer temporal and geographical scale to improve assessments. The opinion of ICES is that most of the exploited deepwater species are being harvested outside safe biological limits and that there should be an immediate reduction in these fisheries unless they can be shown to be sustainable (ICES, 2002a).

ICES evaluation

The ICES evaluation of this nomination confirmed that fishing is the main threat to orange roughy and that the stock in ICES Sub-area VI is outside safe biological limits. The status of stocks in other areas is unquantified, but the available evidence suggests that many have been depleted (ICES 2002b).

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; *Category of effect of human activity:* Biological – removal of target and non-target species.

The principle threat to orange roughy in the OSPAR Maritime Area is fishing. The entire depth range is accessible to trawling and the major populations of this species are probably already known and most are exploited.

ICES report that there has been a pattern in some parts of the OSPAR area and other parts of the world for aggregations to be discovered, exploited intensively, and depleted faster than the information needed for managing the fisheries be collected and effective management implemented. The threat to this species is clearly linked to human activity.

Management considerations

Useful management measures for the orange roughy 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 are one possibility.

Further information

Nominated by:

UK and Joint Submission from Iceland, Portugal & UK

Contact person:

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Useful References:

Allain V., & Lorance P., (2000). Age estimation and growth of some deep-sea fish from the Northeast Atlantic ocean. *Sybil*, 24 (3 Suppl.), 7-16.

Branch, T.A. (2001). A review of orange roughy *Hoplostethus atlanticus* fisheries, estimation methods, biology and stock structure. *South.Afr.J.Aquat.Sci*. 23:181-203.

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Koslow, J.A., Bax, N.J., Bulman, C.M., Kloser, R.J., Smith, A.D.M., Williams, A., (1997). Managing the fishdown of the Australian orange roughy resource. In: Hancock D.A., *et al*. (Eds) Developing and sustaining world fisheries resources. The sate of science and management. CSIRO, Victoria, Australia.

Koslow, J.A. (2001). Fish stocks and benthos of seamounts. In: Thiel, H. & Koslow, J.A. (Eds). Managing Risks to Biodiversity and the Environment on the High Sea, including tools such as Marine Protected Areas – Scientific Requirements and Legal Aspects. Expert Workshop, Vilm, Germany. BFN – Skripten 43.

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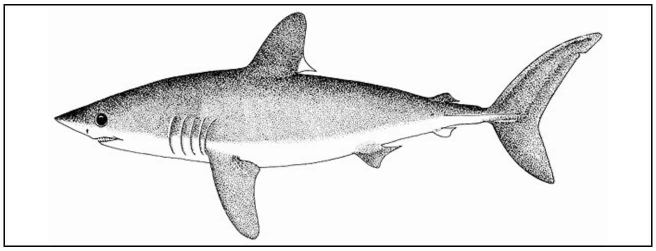
Nomination

Lamna nasus, Porbeagle shark

Porbeagle shark (*Lamna nasus*) (Bonnaterre, 1788)



Geographical extent

- OSPAR Regions: I, II, III, IV, V
- Biogeographic zones: 8,9,10,11,12,13,14,15,16,17,22,23
- Region & Biogeographic zones specified for decline and/or threat: as above

Lamna nasus is a wide-ranging, coastal and oceanic shark, but with apparently little exchange between adjacent populations. It has an antitropical distribution in the North Atlantic and Mediterranean Sea, and in the Southern Oceans (Figure 1; Compagno 2001; Compagno *et al*. 2005). There are generally considered to be two separate stocks in the Northeast and the Northwest Atlantic, on the basis of tagging studies (Heessen 2003; Campana *et al*., 1999, 2001), although a trans-Atlantic migration has been recorded (Green 2007 in ICES WGEF in prep.) and there is minimal genetic population differentiation across the North Atlantic (Pade *et al*. 2006). FAO (2007) noted that evidence from Japanese catches in high seas longline fishing fleets (Matsumoto 2005) indicates the potential for a third North Atlantic stock off Iceland (if correct, two stocks will occur within the OSPAR Area). The species is very rare in the Mediterranean, which is considered to be a separate stock.

Application of the Texel-Faial criteria

Global importance

Lamna nasus is a wide-ranging, coastal and oceanic shark. Most of its distribution lies outside the OSPAR Area, which is not of global importance for the whole species.

Regional importance

Despite very occasional trans-Atlantic migrations, at least one stock of *L. nasus* (possibly two) is largely restricted to the OSPAR Area. If the Texel-Faial criteria applied to stocks, the OSPAR Area would be of regional, if not global importance.

Rarity

This species is very seriously depleted and only rarely encountered over most of its former OSPAR range although, because of its aggregating nature, seasonal target fisheries are still possible. It is not possible to estimate its population size in the OSPAR Area, and there is no guidance for the application of this criterion to highly mobile species.

Sensitivity

Very Sensitive. *Lamna nasus* is relatively slow growing, late maturing, and long-lived, bears small litters of pups and has a generation period of 20–50 years and an intrinsic rate of population increase of 5–7% per annum. It is also of high commercial value at all age classes (mature and immature). These factors, combined with its aggregating habit, make it highly vulnerable to over-exploitation and population depletion by target and incidental fisheries. Its resilience is also very low. The Canadian Recovery Assessment Report for the Northwest Atlantic stock of *Lamna nasus* (DFO 2005) projected that a recovery to maximum sustainable yield would take some 25 to 55 years if the fishery is closed, or over 100 years if fisheries mortality remained at 4%. ICES WGEF (in prep.) confirmed that this species is biologically sensitive and highly susceptible to exploitation.

Keystone species

L. nasus is an apex predator, occupying a position near the top of the marine food web (it feeds on fishes, squid and small sharks (Compagno 2001; Joyce *et al*. 2002)). Under natural conditions, it may have a role in ecosystem function and regulation. As in the Northwest Atlantic, however, its greatly reduced abundance in the OSPAR Area is presumably now too low for this species still to have any indirect value through its role in ecosystem function or regulation (Fisheries and Oceans Canada 2006) Stevens *et al*. (2000) warn that the removal of populations of top marine predators may have a disproportionate and counter-intuitive impact on trophic interactions and fish population dynamics, including by causing decreases in some of their prey species.

Decline

Lack of data and fisheries stock assessment make it difficult to quantify the decline of *Lamna nasus* in the OSPAR Area, but both ICES and STECF consider stocks to be depleted. The species is listed by IUCN as Critically Endangered in the Northeast Atlantic because of stock declines (Stevens *et al*. 2006). BfN (2007) summarised declines in catches in the Northeast Atlantic (Table 1).

ICES WGEF (2006) describes the unregulated *Lamna nasus* fisheries in the OSPAR Area and the trends observed. Porbeagle has been fished by many countries, principally Denmark, France, Norway and Spain. The Northeast Atlantic fishery began when Norway started targeting porbeagle in 1926, using longlines. Catches were about 500 t in the early years, then peaked at around 4,000 t in 1933, before declining. The fishery was reopened after the Second World War by Norwegian, Faeroese and Danish vessels, with Norway taking about 3,000 t in 1947, followed by a progressive decline to about 1,200-1,900t from 1953–1960, then 500 t per annum by the mid 1970s. The decline of this fishery led to the redirection of fishing effort by Norwegian and Danish longline shark fishing vessels into the Northwest Atlantic, where most of the stock was harvested during the mid-1960s before that fishery also collapsed. Norwegian landings from the Northeast Atlantic continued to decrease to only 10–40t/year in the late 1980s/early 1990s. Norway closed their target fishery in 2007, following ICES advice. The Danish target longline fishery in the North Sea displayed declining landings from about 2,000 t in the early 1950s to around 200 t in the 1970s. Landings fluctuated around 80 t in the 1980s, and this fishery has now closed.

Although opportunistic target fisheries may arise from time to time, targeting aggregations of *L. nasus* as these appear, the only remaining regular, directed target fishery is the French fishery. Data presented by the ICES WGEF (2006 and in prep.) suggest that the number of vessels landing more than 5 t has been stable since 1990, at between 8 and 11 vessels. Landings and catch per unit effort both increased to a peak of over 700 t and about 3 t/vessel, respectively, in 1994. CPUE then declined to about 1 t per vessel by 1999. The decline since 1999 has been more marked, despite the relatively constant number of vessels involved. Most recent CPUE is the lowest since the early years of the fishery (Figure 2). ICES WGEF (in prep.) considers that the stock in this southern area has declined.

In the high seas of the North Atlantic (including OSPAR Region V), standardized Japanese longline CPUE from bycatch declined at a rate equivalent to a 60% decline over 10 years during 1993–2000 (Matsunaga and Nakano 2002). High seas North Atlantic catches during 1994–2003 were low but catches from 1999–2003 were near zero compared to catches of near 1000 individuals per year 1994–1997 (Matsunaga and Nakano 2005).

Overall, annual landings in the ICES/OSPAR areas have declined ~90%, from near 4,000 t in the 1930s to <400 t (disregarding anomalous high catch reports from Spain in the 1970s & 2000).

There are more accurate data and stock assessments available for the Northwest Atlantic stock. Trends reported here may also be applicable in the Northeast Atlantic, although the area occupied and fishing effort differ. The Northwest Atlantic fishery in the 1960s removed most of the original biomass in about six years. Some recovery took place during the 1970s and 1980s, but renewed fishing pressure in the 1990s led to a decline to some 11–17% of virgin biomass. Other than in the 1960s, the Northwestern stock has never been subject to intensive fishing pressure. In contrast, the stock in the OSPAR Area, where fishing effort remains unregulated, could be more seriously depleted.

Threat

Porbeagle is a highly migratory and aggregating species. Its aggregating habit makes it particularly vulnerable to target fisheries, particularly in the absence of fisheries regulation. Although the former large target fisheries for this species within the OSPAR Area have collapsed (see above), much smaller and sporadic targeted fisheries still regularly develop on aggregations. Such fisheries are highly profitable. ICES WGEF (in prep.) states: “Given the high value of the species, these fisheries are likely to continue”.

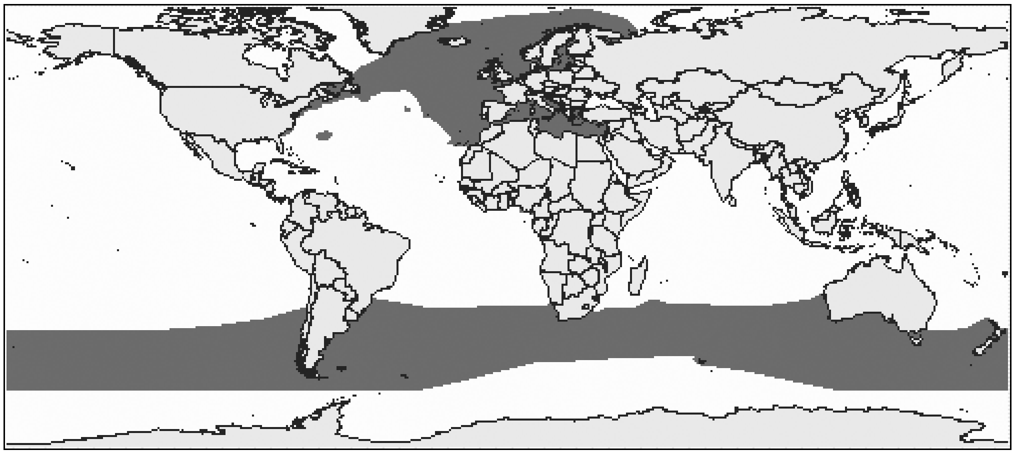


Figure 1: Global distribution of *Lamna nasus* (FAO FIGIS 2007)

Table 1. Summary of population and catch trend data in the Northeast Atlantic (BfN 2007)

Year	Data used	Trend	Source
1936–2005	Norwegian landings	99% decline from baseline	Norwegian and ICES data
1936–2005	Target fishery catches	90% decline from baseline	Norwegian, French & ICES data
1936–2005	All landings data	85% decline from baseline	Norwegian (pre-1973) & ICES
1978–2005	French landings	~50% decline in ~30 yrs	French & ICES data
1994–2005	Landings per vessel	~70% decline in ~10 years	French data

Figure 2: Total catch per unit effort (kg per vessel) in the French porbeagle fishery, 1989–2005. (Source: Biseau 2006, cited in ICES WGEF in prep.)

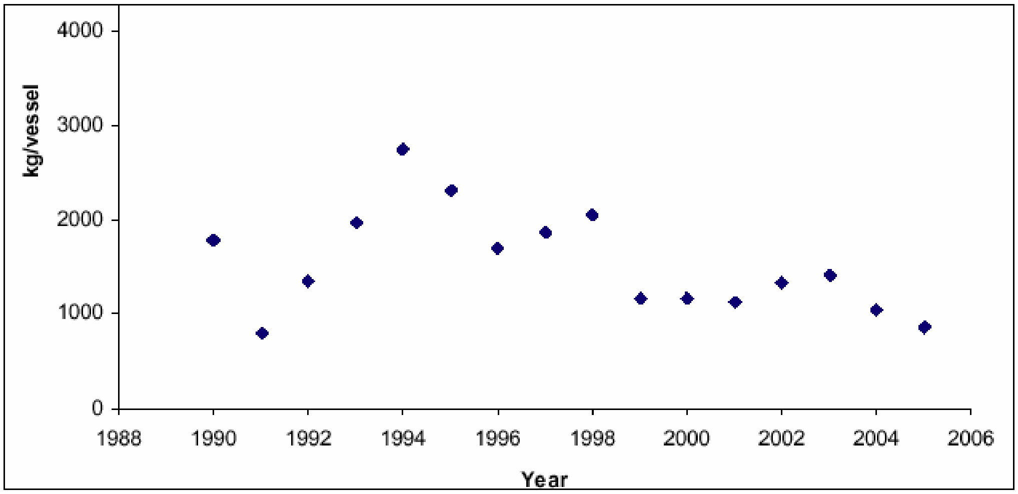
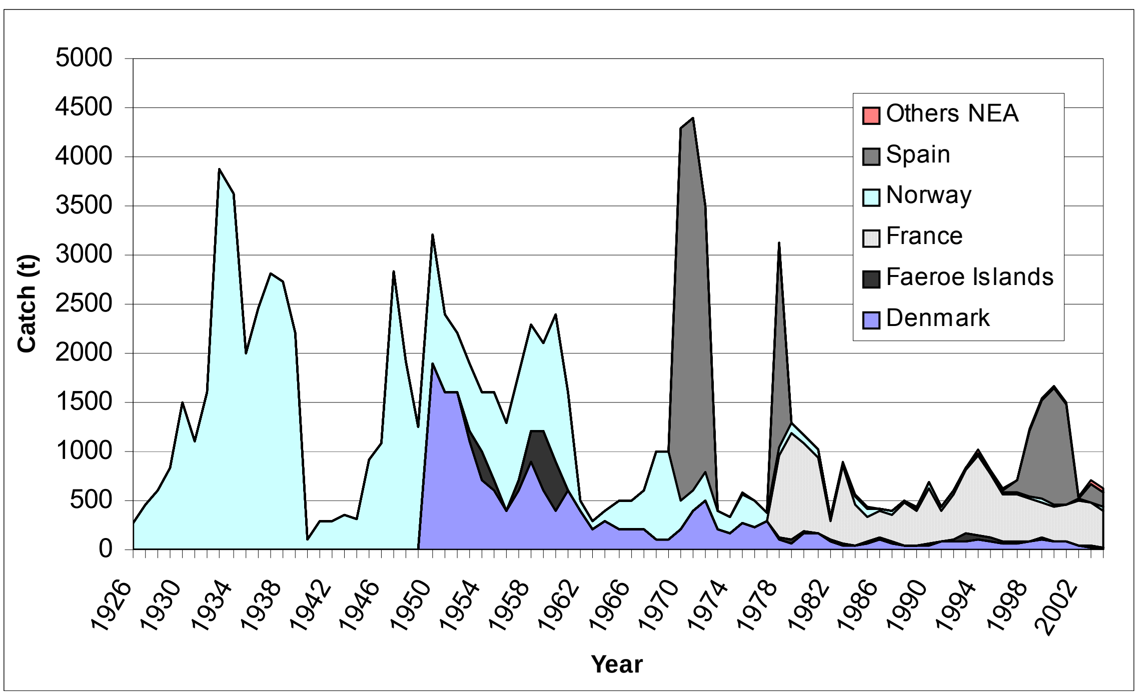


Figure 3: Landings (tonnes) of *Lamna nasus* from the Northeast Atlantic by major fishing States, 1926–2004. (Source: ICES WGEF 2006)



(Note: The three peaks in Spanish landings after 1970 may be represent misidentifications of other species.)

The species is also a valuable utilized bycatch in demersal trawl and longline fisheries, although these catches are not always recorded at species level. Effort has increased in recent years in pelagic longline fisheries for bluefin tuna and swordfish. Reports of landings by Spanish longliners are sporadic but sometimes high, but these peaks may be the result of misidentification. The fleets of Japan, Republic of Korea and Taiwan Province of China also fish in OSPAR Region V and take porbeagle as a bycatch. The catch per unit effort of bycatch in the well-recorded Japanese fishery has declined steeply over the past decade (see above).

Porbeagles are also taken as bycatch in a variety of other fishing gears, including pelagic and demersal trawl fisheries, which take them as they follow schools of their prey species (herring, sardines and clupeid fishes).

ICES WGFE (2006) states that the maximum age and size of *Lamna nasus* have decreased dramatically, as a result of fishing pressure. These were 46 years and 3.5 m in length 25 years ago, but maximum length today is now only 1.8 m. This species matures at 14 years old and a length of 1.2 m.

While porbeagle continues to be such a high value species in European and international markets and fisheries remain unregulated, seasonal target fisheries and utilised bycatch fisheries are both likely to continue. Unfortunately, these catches are often only recorded as sharks, without further detail of the species. If fishing is permitted to continue in the OSPAR Area, a minimum requirement must be to record catches by species and to collect biological data on catches. It would, however, be preferable to adopt ICES and STECF advice. This is to close all directed fisheries for porbeagles and take additional measures to prevent bycatch of porbeagles in fisheries targeting other species (ICES ACFM 2006; STECF 2006).

Relevant additional considerations

Sufficiency of data

ICES WGEF (in prep.) states: “Though there are insufficient data to assess the North-East Atlantic stock of porbeagle shark, this species has likely declined, is not expected to recover in the short-term and is considered very sensitive to over-exploitation.

Changes in relation to natural variability
There is minimal genetic population differentiation across the North Atlantic, possibly as a result of occasional genetic exchange by sharks that undertake trans-Atlantic migrations. There is not considered to be any exchange with porbeagle populations in the southern hemisphere, which are genetically-distinct (Pade *et al*. 2006).

Expert judgement
The absence of precise information on the population size of this species in the OSPAR Maritime Area means that expert judgement has played a significant part in this nomination. It rests on a recognition that the threats to the porbeagle are known, that such threats occur in the OSPAR Maritime Area and that they have led to significant declines in porbeagle stocks. Expert judgement has also played a part in the recognition of the threatened and declining status of this species by ICES, STECF, and IUCN.

ICES Evaluation

In 2005, ICES advised that, given the apparent depleted state of this stock, no fishery should be permitted on this stock. This advice was further considered by STECF in 2006 (see Section 3 of STECF, 2006), and STECF reiterated that no directed fishing for porbeagle in the NE Atlantic be permitted and that additional measures be taken to prevent by catch of porbeagles in fisheries targeting other species.

In 2006, ICES advised that no targeted fishing for porbeagle should be permitted on the basis of its life history and vulnerability to fishing. In addition, measures should be taken to prevent by catch of porbeagle in fisheries targeting other species, particularly in the depleted northern areas.

The ICES Working Group on Elasmobranch Fishes (in prep.) supported an earlier draft of this nomination. ICES has also recommended the closure of directed fisheries and minimisation of bycatch of this species, particularly in the northern part of the OSPAR/ICES Area.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; *Category of effect of human activity:* Biological – removal as target and non-target species by fisheries.

The decline in catches and catch per unit effort in many porbeagle fisheries, in the Northeast Atlantic and elsewhere, is interpreted by fisheries experts as an indication of a decline in the population caused by fisheries. This threat is therefore linked to human activity.

Management considerations

Detailed management advice was provided by ICES in 2006 and is reproduced here:

“No targeted fishing for porbeagle should be permitted on the basis of their life history and vulnerability to fishing. In addition, measures should be taken to prevent bycatch of porbeagle in fisheries targeting other species, particularly in the depleted northern areas.

“Porbeagles are long-lived, slow-growing, have a high age-at-maturity, and are particularly vulnerable to fishing mortality. Population productivity is low, with low fecundity and a protracted gestation period. In the light of this, risk of depletion of reproduction potential is high. It is recommended that exploitation of this species should only be allowed when indicators and reference points for stock status and future harvest have been identified and a management strategy, including appropriate monitoring requirements has been decided upon and is implemented.

“A long-term management strategy for fisheries on this species would consist of an initial low scientific fishery. This initial low fishery level should aim at identifying harvest rates that are sustainable in the long term. A gradual expansion of the fishery from the initial low level should only be allowed if harvest rates that are sustainable in the long term are clearly identified and a management strategy has been identified and decided upon. Such gradual expansion should be accompanied by close monitoring, enabling adjustment of the management plan according to the outcome of the fisheries.

“Information from surface longline fishing shows that porbeagles are usually captured alive. Therefore, a mitigation policy might be implemented by releasing porbeagle.

“Porbeagle is a highly migratory and schooling species. Sporadic targeted fisheries develop on these schools and such fisheries are highly profitable.

“Porbeagle is highly vulnerable to longline fisheries.

“Countries fishing for porbeagle need to provide better data. All fisheries-dependent data should be provided by EU member states that have fisheries for this stock as well as other countries longlining in the ICES area. Landings data for porbeagle may be reported as porbeagle , as various sharks nei , or as Sharks, rays, skates, etc. nei in the official statistics. This means that the reported landings of porbeagle are likely an underestimation of the total landing of the species from the NE Atlantic.”

ICES Advice for 2007 was not available at the time of writing.

Management actions essential for the conservation of this species are control and monitoring of fisheries porbeagles. It is important that fisheries is not allowed in the OSPAR Maritime Area, and that fishing techniques should be designed to reduce porbeagle bycatch. Porbeagles incidentally caught as by-catch should be immediately returned alive to the sea.

This species is classified as Critically Endangered in the IUCN Red List (Stevens *et al*., 2006) and in Turkey (Fricke *et al*. in press). It is Critically Endangered in the Baltic Sea (where it is at the edge of its range), and listed on the HELCOM 2006 Red List as a priority species (Fricke 2007). Fishing for this species has been prohibited in Sweden and Norway.

EC Regulation 1185/2003 prohibits the removal of shark fins of this species, and subsequent discarding of the body. This regulation is binding on EC vessels in all waters and non-EC vessels in Community waters (ICES, 2005).

Further information

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Nomination

Petromyzon marinus, Sea Lamprey

Geographical extent

OSPAR Region; I, II, III, IV
Biogeographic zone: 6,7,9,11,13,14,15,
Region & Biogeographic zones where the species is declining and/or under threat: as above but mainly in freshwater.

The sea lamprey *Petromyzon marinus* occurs in estuaries and easily accessible rivers over much of the Atlantic coastal area of western and northern Europe. It is found around Iceland, Norway, the Barents Sea and south to Northern Africa, and also occurs in the western Mediterranean and eastern North America (Hardisty, 1986).

P.marinus is a migratory species which breeds and passes an extended larval life in freshwater and migrates to the sea to feed. Adults feed on dead or netted fish, as well as being parasitic on healthy fish (Farmer, 1980). In the open sea they have been found attached to shad, cod, haddock and salmon (Kelly & King, 2001).

Application of the Texel-Faial criteria

P.marinus was nominated for inclusion on the OSPAR list with particular reference to decline, sensitivity, and rarity as well as threat.

Decline

There is no total estimate of the population size of sea lamprey in the OSPAR Maritime Area but it is known to have declined in many parts of Europe and particularly so in the last 30 years. It was found in the Scheldt estuary and along the Belgian coast, for example, but is only rarely caught in this area today (Poll, 1945). It was also present in the Dutch Rhine and Meuse but, because of declines, is now on the Red Data list of freshwater fishes in the Netherlands as an endangered species. There are also reports of a decline in Ireland in recent years (Kurz & Costello, 1999) but no substantive baseline information to quantify this (Kelly & King, 2001).

Rarity

The sea lamprey is much scarcer in western Europe than it was formerly, and is rare in much of its range today (Wheeler, 1978).

Sensitivity

The sea lamprey is probably most sensitive to human activity during its freshwater stage where poor water quality and degraded spawning habitat can have an impact on the species. The larvae may however be fairly resilient during the period when they burrow into the silt or rivers and streams, sometimes for several years.

Threat

The main threats to sea lamprey in the OSPAR Maritime Area take place on the inland waters used by the mature fish ready to spawn, larvae and young adults. The construction of dams and artificial embankments prevent the fish migrating freely, while extraction of water for irrigation can also make spawning grounds inaccessible and create difficulties fish returning downstream. The spawning grounds themselves have been degraded by extraction of gravel and stones from the river bed, siltation, and modifications in water flow caused by channelling and fluctuating water levels below dams. Poor water quality is another concern (e.g. Araújo *et al*., 2000; Hardisty & Huggins, 1973; Hunn & Youngs, 1980: Meyer & Brunken, 1997; Witkowski, 1992).

The sea lamprey has been commercially fished throughout its European range although this is now much reduced. In the OSPAR Maritime Area these include former fisheries in Sweden, UK, France, Spain & Portugal (Maitland & Campbell, 1992) but this is now generally limited to fisheries in Spain and Portugal. The overriding reasons for its decline are considered to be poor water quality, and obstructions in rivers, and degradation of spawning grounds rather than overexploitation (Potts & Swaby, 1993).

Relevant additional considerations

Sufficiency of data

The decline in records in its freshwater habitat have provided the data on which this species has been given international protection through the EC Habitats and Species Directive and the Bern Convention.

Changes in relation to natural variability

Little is known about the natural variability in the population of sea lamprey and therefore whether the decline is greater than might be expected through natural change. The fact that activities on river systems are known to have affected the ability of adults to migrate up river does however suggest that the decline is at least in part due to human activity rather than natural variability.

Studies of the larval stage have concluded that natural mortality may be high immediately after the larvae leave the nest but then relatively low and uniform during the rest of the larval stage (Hardisty, 1961).

Expert judgement

The decline in records have provided the data on which this species has been given international protection through the EC Habitats and Species Directive.

ICES Evaluation

The ICES review of this nomination by the Working Group on Fish Ecology (WGFE) reached the following conclusions (ICES, 2003).

The main threats to this species come from the continual loss of access, the degradation of spawning habitat, and poor water quality.

Quantitative data indicating a decline in either the range or in the size of the population were considered lacking. The statistics from the FAO indicate a decline, as do qualitative statements in the literature. However, it is evident that the FAO statistics underestimate, at least in France, the true level of captures and thus interpretation of the data must be made with caution.

There is certainly much circumstantial evidence that human activity can have a detrimental effect on sea lamprey populations and in some cases there is strong historical evidence, for example, in the Severn, that the species was more abundant in the past. In the absence of quantitative data, it is recommended that further efforts, in particular a search of the grey literature to confirm the current status of this species, be undertaken.

In those rivers where a self-maintaining population still exists, the lack of data will make it difficult to detect changes as a result of management action. In those rivers where the population has become extinct, the effect of any intervention will be more easily quantified.

Most of the environmental problems affecting sea lamprey are in freshwater and estuarine environments, and there is no evidence that anthropogenic activities in fully marine environments are threatening sea lamprey populations.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; extraction of sand, stone and gravel; constructions, land-based activities. *Category of effect of human activity:* Physical – substratum removal and change, water flow rate changes, Biological – removal of target species

The main threats to this species come from the degradation of spawning habitat, poor water quality. Two examples where threats such as these have been linked to human activities are the decline of *P.marinus* in the Dordogne (France) due to water pollution, erection of dams and dredging of the channel (Ducasse & Leprince, 1982) and the blocking of access by the fish to parts of the River Tagus. *P. marinus* is common in the Portuguese portion of the river Tagus it cannot move through to Spain because of dams lacking appropriate fish passes (Assis, 1990).

Management considerations

The main management measures that would assist the recovery of sea lamprey populations in the OSPAR Maritime Area are improvement of water quality, habitat conditions, and access to suitable spawning grounds in the estuaries and rivers of Europe. Artificial rearing in hatchery facilities may also have a role in conservation of this species but will only be successful in the long term if conditions that led to the decline in the first place have been tackled.

The sea lamprey is listed on Annexe II of the EC Habitats & Species Directive, and Annex III of the Bern Convention.

Further information

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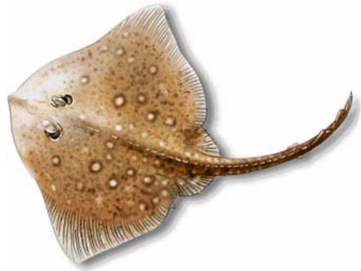
Nomination

Thornback ray *Raja clavata* (Linnaeus, 1758)



Geographical extent

OSPAR Regions: I, II, III, IV, V[7]

Biogeographic zones: 8,10,11,12,13,14,15,16

Region & Biogeographic zones specified for decline and/or threat: II & III.

Raja clavata inhabits mud, sand, shingle, gravel and rocky areas on the shelf and upper slope in the Northeast Atlantic and Mediterranean, also entering the Baltic and Black Seas, to West Africa. The southern limit of the range of *R. clavata* is uncertain. Southern African records may be *R. stralaeni* (Stehmann 1995; Compagno pers. comm.). It is most abundant in coastal areas at 10–60 m depth (shallower in cold temperate waters, deeper in warmer waters), commonly recorded to 100 m, and occasionally to at least 300 m. Estuaries and large shallow bays are important spring/summer spawning and feeding areas (Wheeler 1969; Stehmann & Buerkel 1984; Ellis *et al*. 2005a; Hunter *et al*. 2006).

The distribution of *R. clavata* in the centre of its North Sea range is contracting. At the beginning of the 20th Century, it was widely distributed over the southern North Sea, with centres of abundance in the southwestern North Sea and in the German Bight, north of Helgoland. Its area of occupancy is now only 44% of that in the 1980s (ICES WGEF in prep.). It is no longer present in the southeastern North Sea (German Bight), and catches in the Southern Bight now occur only in the west (ICES SGEF 2002). Distribution in the Mediterranean and Black Seas may be contracting (IUCN SSG in prep.).

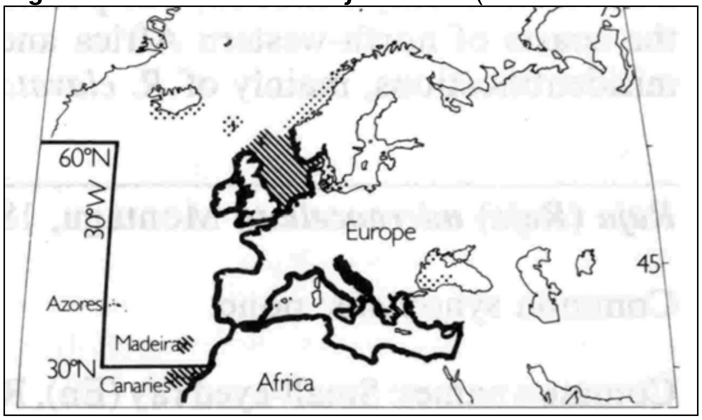
Application of the Texel-Faial criteria

Global importance

The centre of distribution of *Raja clavata* is in the North Sea, where the species was formerly widespread and abundant, and the Celtic and Iberian Seas. The proportion of the global population located in the Mediterranean and on the African coast is uncertain, due to lack of data and widespread misidentification of skates and rays in these areas, but is estimated that at least 50% of the global population occurs in the OSPAR Maritime Area. Although this species is not of global importance under the Texel-Faial criteria, it should be noted that it is comprised of several genetically-distinct stocks, some of which (such as the important North Sea stock) occur wholly or primarily within the OSPAR Area. When applying OSPAR/Faial criteria, this is not enough to list *Raja clavata* as of global importance, but its relevance to OSPAR is clear.

[7] *There is some taxonomic debate over the occurrence in Region V*

Figure 1: Distribution of *Raja clavata* (from Stehmann & Bürkel in Whitehead *et al*. 1984)



Regional importance

Raja clavata is not of regional importance under the Texel-Faial criteria, although it is important to note that this species is comprised of several distinct genetic stocks which have some important centres of distribution and areas of essential habitat for *Raja clavata* within the OSPAR Area, including the Thames Estuary and Southeast English Channel (ICES WGEF in prep.; Martin *et al*. 2005).

Rarity

The species is decreasing in abundance or no longer present in several regions, but not rare.

Sensitivity

Sensitive to very sensitive. *R. clavata* has a slow growth rate (Cannizzaro *et al*. 1995; Walker 1999), reaching maturity at 7–10 years of age and a relatively large size (maximum length is 118 cm), and attaining a maximum age of at least 15 years (Walker 1999, ICES-FishMap). This species is oviparous, but has relatively low fecundity, laying on average fewer than 100 eggs *per annum* (estimates of ovarian fecundity vary widely: 38–167 *per annum* (Ellis *et al*. 2005c; ICES WGEF in prep.)). These biological constraints make this species susceptible to overexploitation when fishing pressure is high (Dulvy & Reynolds 2002, Abella & Serena 2005). Recovery from a depleted state and the recolonisation of areas from which it has been extirpated will also be very slow (the latter possibly greater than 25 years). Dulvy & Reynolds (2002) noted that *R. clavata* is sufficiently large-bodied to be vulnerable to local extinction, which has already occurred in parts of its range, and believed that “this species should be watched carefully”. Walker & Hislop (1998) considered the average fishing pressure in the North Sea to be “probably too high for a steady population of *R. clavata*”.

Raja clavata feeds on all kinds of benthic animals, preferably crustaceans. This species is not sensitive to moderate eutrophication.

Keystone species

No information.

Decline

Patterns of decline in *Raja clavata* vary across the OSPAR Maritime Area, where this is one of the most important species of skate and ray in commercial fisheries. Trends are difficult to determine in most areas, since skates and rays are generally not distinguished by species in landings data and identification of *R. clavata* has been poor in some areas where species-specific data are available. However, there is little doubt that total ray landings have declined in some parts of the OSPAR Area (Figures 4 and 5), that declines have affected the largest species of rays most seriously (these have been replaced in landings by smaller less valuable species), and that *R. clavata* is sufficiently large-bodied to be vulnerable to depletion by the high levels of fishing effort prevalent in this region (Dulvy & Reynolds 2002).

Declines in this species have been most marked in OSPAR Region II. However, the species has also undergone historic declines elsewhere (Rogers & Ellis 2000; Ellis *et al*. 2005b,c; ICES WGEF 2006). The decline trend is less marked in OSPAR Region III, and unclear in IV (where some data indicate an increase). The following paragraphs review declines in OSPAR Regions II and III separately.

<u>OSPAR Region II</u>

Where data are available, the long term trend in abundance of *R. clavata* in historical and recent fishery-independent surveys in the North Sea and Eastern Channel has been markedly downward since the start of the 20th Century (Heessen 2003). Declines in abundance and contraction in the distribution of thornback ray stocks have been reported by Walker & Heessen (1996). Walker & Hislop (1998), several reports of the ICES WGEF, and in the ICES FishMap. The species is now considered by ICES to be depleted in this region, although local abundance is still high in some areas. ICES WGEF (2007 warns that the area of occurrence of *R. clavata* in the North Sea is becoming concentrated in the centre of its range (Figure 2). It is presently only 44% of the extent of the species in the 1980s (Figure 3). This patter should be regarded with caution particularly if the species is becoming more concentrated where fishing effort is high (it can result in unexpected fishery collapse, as for the Canadian cod stock (Rose & Kulka 1999)).

Figure 2: Distribution of *Raja clavata* in the North Sea 1980–2006 (from ICES WGEF in prep.)

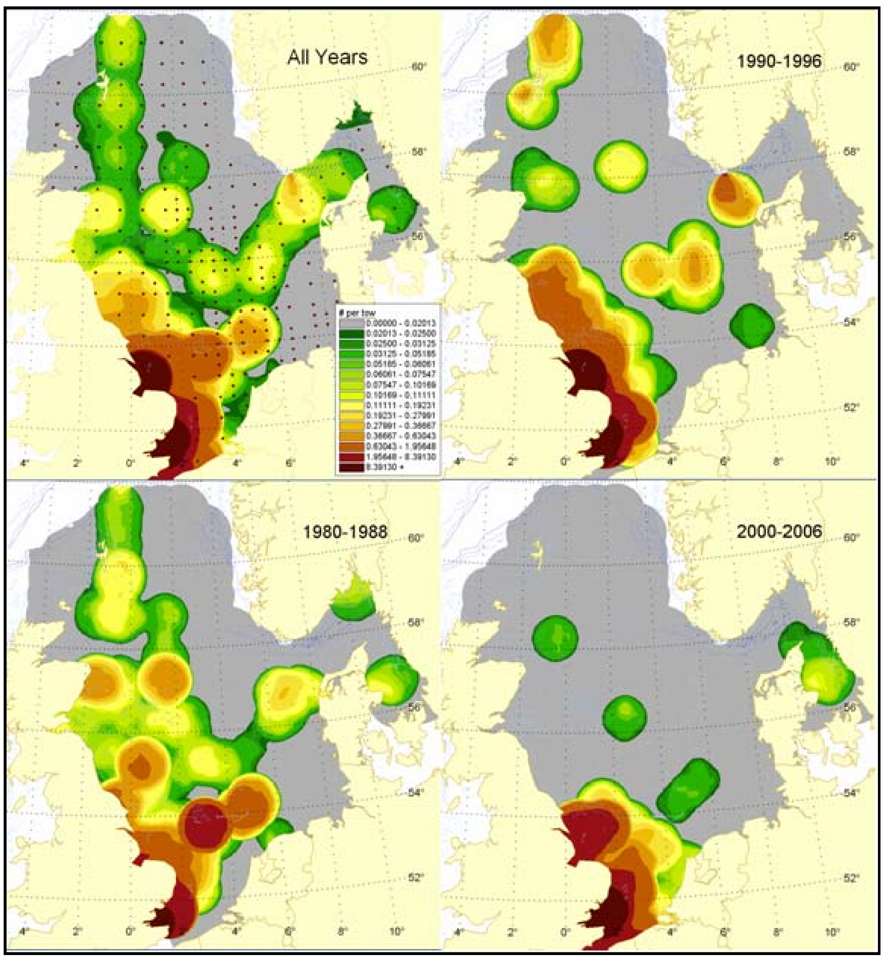
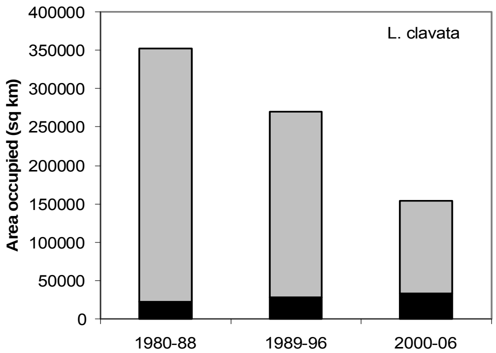


Figure 3: Area of North Sea (km^2) occupied by *Raja clavata* during the three periods 1980–2006 illustrated in Figure 2. (Source: ICES WGEF in prep.)



Key: Light shading represents total area of distribution, dark shading represents area with high abundance.

The DELASS project (Heessen 2003) reported that the “probability of having a haul with at least one *R. clavata* is estimated to be 16 times higher for the period 1967-1976 compared to the most recent years, 1993-2002. One hundred years ago, the distribution area of the stock included almost the whole North Sea. Today, survey data show a stock concentrated in the waters around the Thames Estuary.” The DELASS report remarked: “Apparently, there are still patches left in the North Sea with stable local populations. Whether the number of patches will remain high enough to sustain a North Sea population in the long-term is, however, unknown” (Heessen 2003).

Commercial catch records (which represent combined landings of all species of skates and rays) from the North Sea, Skaggerrak, Kattegat and Eastern Channel also exhibit a steep downward trend (Figure 4). The interpretation of these aggregated data, which show a clear decline in the weight of total landings, needs to take into account a change in the overall species composition of catches. The largest species of skate and ray have declined most seriously over this period. Common skate *Dipturus batis* has been extirpated. *Raja clavata* has undergone a serious decline and contraction of range (as described above), while smaller species have become more abundant in surveys and landings (Walker & Heessen 1996). Figure 4 therefore likely under-represents the decline in the proportion of *R. clavata* in commercial landings. However, the lack of long-term data on the species composition in commercial catches prevents further analyses.

<u>OSPAR Region III</u>

Although *Raja clavata* is still one of the most important commercial species in the inshore fishing grounds of the Celtic Sea, historic declines have occurred in some areas in Region III, including in the NW Irish Sea (Rogers & Ellis 2000; Ellis *et al*. 2005b; ICES WGEF 2006). Dulvy *et al*. (2000) identified a decline in abundance of this species in surveys in the Irish Sea from 52.8% of skate catches in 1958-64, to 42.7% in 1988-97. The relative abundance of *R. clavata* declined from 64.4% in 1988 to 44.7% in 1997, and biomass also fell (all landings declined gradually, but the abundance and biomass of smaller species rose). ICES WGEF (2008) notes that changes in trawl method and sampling strategies mean that drawing definitive conclusions on the basis of these comparisons is difficult.

Catch rates in the coastal waters of the Irish Sea appear steady in recent years according to beam trawl survey data (Ellis *et al*. 2005b), but these data tend to sample juveniles more effectively and do not provide appropriate trends for the relative abundance of adult fish (IUCN SSG in prep.). Additionally, although preliminary analyses of recent survey data indicate that the relative abundance of *R. clavata* has been stable in recent years, Celtic Seas catches of all skates and rays combined have been falling (Figure 5), despite the absence of catch quotas or any relevant gear restrictions. These declines in landings are associated with changes in species composition and relative abundance (ICES WGEF in prep.). Because larger species have declined more seriously than smaller, more fecund and abundant species, which have partially replaced the former in catches, the decline in the proportion of *R. clavata* in commercial landings may be under-represented by Figure 5. However, ICES WGEF point out that further work on temporal trends in species composition is required.

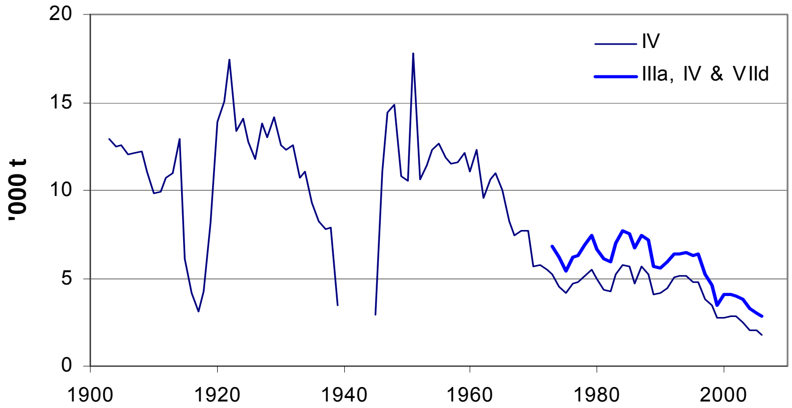
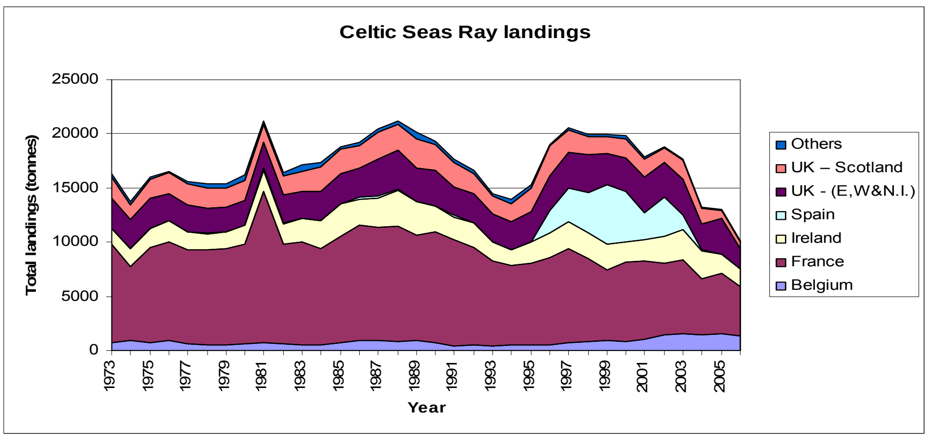


Figure 4: Total international landings of skates and rays in the North Sea, Skaggerrak, Kattegat and Eastern Channel since 1903. (Source ICES WGEF in prep.)

Figure 5: Total combined landings (t) of all species of skates and rays in the Celtic Seas, 1973–2006. (Source ICES WGEF in prep.)



<u>Other Regions</u>

ICES WGEF (in prep.) reports that in OSPAR Region IV (Bay of Biscay and Iberian waters) an analysis of trawler fleet landings per unit effort since 1996 indicates that there has been a decrease in skate abundance (mainly cuckoo ray *Leucoraja naevus* and thornback ray *Raja clavata*) in most parts of ICES Area VIII since the maximum reached in 1998. Landings have also shown a decrease from 1996, but have been more stable in recent years. Other data series show no trend or recent increases. Overall, there is no clear trend in this Region. Data from Region I are poor. There is no target fishery here for skates and rays, which are taken as bycatch in other demersal fisheries. Fishery-independent surveys have not recorded large numbers of *R. clavata*, but this species may have been misidentified as a smaller and more abundant ray.

Threat

The primary threat to *Raja clavata* is from commercial fisheries, both target and bycatch. Even when target ray fisheries are closed, bycatch in demersal fisheries targeting other species will continue to cause mortality of this species. This combination of target fisheries and bycatch in demersal fisheries has resulted in the widespread extirpation of some larger bodied species of rays from the OSPAR Area, and has the potential to drive highly sensitive species to extinction.
Despite historic declines, this is still one of the most abundant rajids in the North-eastern Atlantic and Mediterranean, and an important component of some mixed demersal trawl fisheries. It is also taken by longlines and in set nets, which may be used to target seasonal aggregations of mature females as these enter coastal nursery grounds to deposit eggs. The flesh is utilized fresh or frozen. *R. clavata* is also targeted by recreational anglers (Ellis &

Walker 2000) and very small numbers are taken for display in public aquariums. The IUCN Red List Assessment for this species is Near Threatened (Ellis & Walker 2000).

<u>OSPAR Region II</u>

Capture in commercial fisheries has resulted in the extirpation of this species from large areas of its former range in the North Sea. Improved awareness of these declines have resulted in the reduction of quotas for all skates and rays in this area and closure of target ray fisheries, but there is no species-specific management for *R. clavata*.

<u>OSPAR Region III</u>

Historic stock declines have been reported in the Celtic Seas, although these are not as severe as in Region II. The threat to *R. clavata* in the Celtic Seas has been suggested to be higher than in Region II because there is no TAC for rays in this region and mesh-size regulations are probably not restrictive as there are very few directed fisheries for this and other ray species.

Relevant additional considerations

Sufficiency of data

No accurate and complete species-specific landings data are available for *Raja clavata* in the OSPAR Maritime Area, where all species of skates and rays are combined in catch records. Fishery-independent survey data are available in the form of the various groundfish and beam trawl surveys conducted by national fisheries laboratories as *R. clavata* is most abundant on the inner continental shelf. However, it may still not be possible to assess acurately the status of *R. clavata* throughout its range. Data for the North Sea (OSPAR Region II) are, however, sufficient to demonstrate a serious decline in its abundance and distribution. There is also some evidence of declines elsewhere, particularly in some areas of the Celtic Seas (OSPAR Region III).

Changes in relation to natural variability

Though little is known about stock structure, recent genetic studies (Chevolot *et al*. 2005, 2006; Ragazzini 2005; Ragazzini *et al*. submitted) show high variability. This evidence, combined with the results of tagging studies (Steven 1936; Walker *et al*. 1997; Hunter *et al*., 2006) suggest that there may be several genetically-discrete stocks in North European and Mediterranean waters.

Expert judgement

As the information on population size is incomplete for this species in the OSPAR Maritime Area, expert judgement has played a significant part in this nomination. It rests on recognition that threats to the thornback skate are known, that such threats occur in the Area, and that they have led to significant declines of the species in some Regions, which could also occur or have already occurred elsewhere.

ICES Evaluation

The ICES Working Group on Elasmobranch Fisheries has regularly reviewed information on this species. Management advice has been provided for the North Sea stock since 2005, and will be developed for the Celtic Seas stock for the first time later in 2007. Historical and contemporary fishery-independent survey data indicate that *R. clavata* have declined in the North Sea, especially in terms of the area occupied (ICES-FishMap).

ICES advice for the North Sea stock is as follows: "*R. clavata* abundance has decreased significantly over the past century in the North Sea, and that the area occupied here has significantly decreased since 1990. Although local abundance remains high, the North Sea stock is considered depleted. Target fisheries should not be permitted, and by-catch in mixed fisheries should be reduced to the lowest possible level. If the fisheries for rays continue to be managed with a common TAC for all ray species, this TAC should be set at zero."

ICES management advice for rays in OSPAR Region III, requested for the first time in 2007, was in preparation while this nomination was being prepared.

In reviewing the nomination for *R. clavata* ICES confirmed that the North Sea stocks have declined and there is sufficient information to justify listing the species for the OSPAR Region II (Greater North Sea). ICES considered, however, that there was insufficient data to conclude that *R. clavata* should be listed as a threatened and/or declining species in OSPAR Region III.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; *Category of effect of human activity:* Biological – removal as target and non-target species by fisheries.

There is a clear link between the decline of *Raja clavata* and fisheries. *R. clavata* was so common in the German Wadden Sea at the end of the 19th Century that a target fishery developed in Ostfriesland. At Amrum, Föhr and Norderney, up to 1000 specimens were caught per low tide. Since the beginning of the 1950s, landings in Germany and the Netherlands decreased dramatically, and the stocks showed clear signals of overfishing (large specimens were no longer caught). The species is now extinct in the Wadden Sea (Westernhagen 1998), and mostly restricted to the south-western North Sea, from the Thames to the Wash (ICES WGEF 2006; ICES-Fishmap). The threat from fisheries in the North Sea (OSPAR Region II) should be falling with reductions in quotas and in fishing effort. The threat from fisheries in the Celtic Seas (OSPAR Region III), however, is not yet under similar mitigation efforts: there is no quota for ray species here and mesh-size restrictions are not considered to be effective.

Management considerations

In 1999, a Total Allowable Catch was introduced for all species of North Sea skates and rays combined (Table 1). This was almost twice actual landings in 1999 and 2000 and had no impact on fishing effort. The TAC was reduced significantly in subsequent years, but remained significantly higher than catches until 2006. Management advice has been provided by ICES for the North Sea stock of *R. clavata* since 2005, as follows:

- Target fisheries should not be permitted, and by-catch in mixed fisheries should be reduced to the lowest possible level.
- If fisheries for rays continue to be managed with a common TAC for all ray species, this TAC should be set at zero.

In 2006, the skate and ray TAC became slightly lower than the previous year's landings (but was exceeded). In 2007, the TAC set is for by-catch only. It is again lower than the previous year's landings and likely restrictive. However, bycatch is defined as not more than 25% by live weight of the catch retained on board, which is too high. ICES advice has not been adopted, other than in Sweden where *R. clavata* fisheries and landings are not permitted. ICES Advice for the North Sea stocks of skates and rays should be adopted. If species-specific TACs are set, these should be zero for *Raja clavata* and other large-bodied species. Bycatch of *R. clavata* should be minimized through gear restrictions and/or seasonal closures of critical areas in the Southern North Sea (including the Wash and outer Thames Estuary) and the English Channel. Incidentally caught specimens should be immediately returned alive into the sea.

ICES Advice for the Celtic Seas is still awaited, but should also be adopted when available. Management measures desirable here include species-specific quotas for skates and rays, set at zero for the largest-bodied species, seasonal closures of inshore spawning, nursery and feeding grounds, and other measures to minimize bycatch.

Quotas should also be adopted elsewhere in the ICES/OSPAR Areas, covering all regions fished. All catch and landings records should be species-specific. Locations of critical habitat should be identified where seasonal closures could contribute to the management of this species.

This species is classified as Near Threatened in the IUCN Red List (Ellis & Walker, 2000), though this is currently under review. In the HELCOM area, at the edge of its range, *Raja clavata* is classified as endangered under IUCN regional criteria (Fricke in press).

HELCOM have included *R. clavata* in the HELCOM List of threatened and/or declining species and biotope/habitats in the Baltic Sea area.

Further information

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Table 1. Total Allowable Catch (TAC, tonnes) for North Sea rays and skates, and EC landings. (Source: ICES WGEF in prep.)

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007
TAC	6060	6060	4848	4848	4121	3503	3220	2737	2190*
Landings	3038	3708	3684	3649	3502	2322	2846	2793	

* The 2007 TAC is a by-catch quota only. These species shall not comprise more than 25% by live weight of the catch retained on board.

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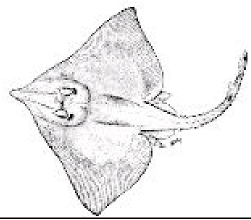
Nomination

Rostroraja alba, White skate

White skate *Rostroraja alba* (Lacepède 1803)



Geographical extent

- OSPAR Regions: II, III, IV
- Biogeographic zones: 12,13,14,15,16
- Region & Biogeographic zones specified for decline and/or threat: as above

Rostroraja alba is (or was) distributed in the Eastern Atlantic from the British Isles southward around the Cape of Good Hope (South Africa) to central Mozambique, including most of the Mediterranean (to Tunisia and Turkey). (Dulvy *et al*. 2006; Froese & Pauly 2006; Fricke *et al*. in press.) It occurs on the seabed from coastal waters and across the shelf to the upper slope, from 40-400m and exceptionally down to 500m (Capape 1976; Stehmann and Burkel 1984; Serena 2005). It is found on sandy and detrital bottoms, often close to rocks, but Du Buit (1974) reports it to be more prevalent in rocky habitats (Dulvy *et al*. 2006).

Application of the Texel-Faial criteria

Global importance

The historic distribution of this species includes OSPAR areas II, III and IV, southwards from the British Isles. Since its range is more extensive along the coast of Africa, it is not of global importance in the OSPAR Area. Nevertheless, as available information suggests that the populations of this and other large-bodied species of elasmobranch are likely to be declining throughout all or most of their range, OSPAR members play a globally important role in the conservation of this large skate species.

Regional importance

Rostroraja alba may possibly have been of regional importance in the past, when it was reportedly abundant in a few localities (Irish Sea, English Channel, off Brittany) where target fisheries occurred, but these have been fished out and this species is no longer of regional importance.

Rarity

Although formerly abundant around the British Isles and southwards, *R. alba* is now absent from research vessel surveys (ICES WGFE 2006) and very rarely recorded in commercial catches (ICES WGEF 2006).

Sensitivity

Rostroraja alba inhabits shelf and slope waters. It is found on sand bottom, often close to rocks. This species has one of the largest body sizes of Northeast Atlantic skates, surpassed only by the common skate *Dipturus batis*. There is a strong correlation between large body size and extinction risk in skates; all those skate species that have disappeared from substantial parts of their ranges have large body sizes compared with other skates with a similar distribution (Dulvy and Reynolds 2002). This is attributed to large-bodied animals having life history parameters, such as large size at birth, slow growth and late age at maturity, that make them particularly vulnerable to over-exploitation (Dulvy *et al*. 2000 & 2003; Dulvy and Reynolds 2002). Large-bodied animals are likely to be captured and utilised in fisheries for many years before they reach maturity; they are thus subject to higher mortality rates at all age classes than are smaller species, and they also have a lower reproductive rate. *R. alba* is therefore biologically highly sensitive to capture in benthic fisheries, especially trawling, and has been extirpated from large areas of its former range through bycatch in demersal fisheries targeting other more abundant species.

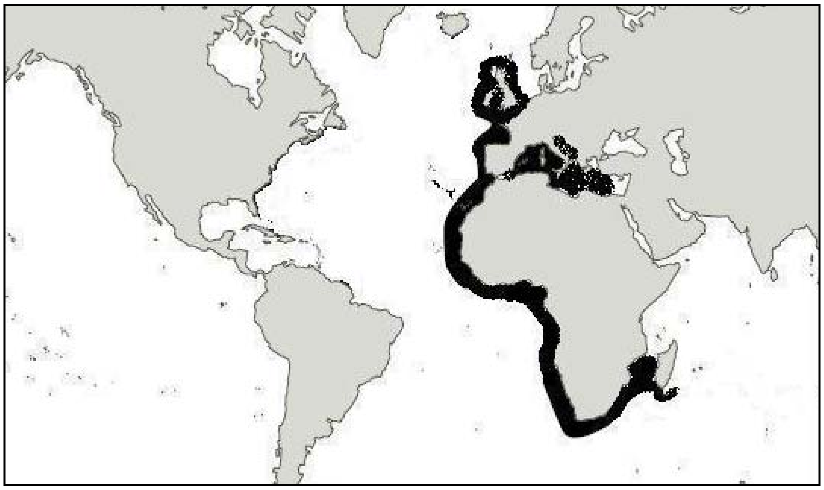
Keystone species

No.

Decline

Rostroraja alba was reportedly once sufficiently abundant (at least in localised populations) to support target fisheries in parts of its range off the British Isles, northern France. A few references in historic literature, recent observations and anecdotal information suggests that this species, including formerly abundant localized populations, has declined severely during the past 50 to 100 years. It was apparently taken relatively commonly in fisheries in the 19th century (ICES 2005; Dulvy *et al*. 2000, 2006), but records largely ceased during the 20th Century. It is now very infrequent, if not locally extinct in most of its former range.

Figure 1: Global distribution of *Rostroraja alba* (adapted from van der Elst 1998)



Day (1880-84) described the white skate as occurring all around the UK and 'not uncommon', although most recent literature states that its northern limits of distribution were in the Irish Sea and English Channel (areas from which it has now also been extirpated). The species was sufficiently common in the Irish Sea for a longline fishery to target white skate off the Isle of Man during the 1880s (Dulvy *et al*. 2000). The species was still being recorded during the early 1900s (Bruce *et al*. 1963, Stehmann and Bürkel 1984, Rogers and Ellis 2000), but has been absent from recent research vessel surveys and commercial landings from the waters of the British Isles (Rogers and Ellis 2000). A directed long-line fishery in the Baie de Douarnanez (Brittany) in the 1960s collapsed and white skate is no longer listed on French fishery statistics (Quéro and Cendrero 1996). The status of *R. alba* further south is uncertain; they may still be landed around the Iberian Peninsula (if these records are not misidentifications of shagreen ray *Leucoraja fullonica* and sandy ray *L. circularis*) (ICES 2006).

Outside the OSPAR Area, *R. alba* has also undergone marked declines in abundance and geographic range in the Mediterranean, where it was formerly captured frequently in the northwestern Mediterranean during the 1960s and off Tunisia and Morocco in the early to mid 1970s, but is now considered rare (Dulvy *et al*. 2006). Its status on the continental shelf off West and South Africa is unknown, but this species' vulnerability to capture in trawl gears combined with increased levels of industrial fishing effort off the coast of Africa, including hake fisheries off southern Africa, suggests that *R. alba* has no few or no refuges from fisheries (hence the global IUCN assessment of Endangered (Dulvy *et al*. 2006).

Threat

Following the collapse of target fisheries, the greatest threat to *R. alba* is now bycatch in demersal fisheries targeting other species. Such fisheries have the potential to drive this large-bodied biologically- and morphologically-vulnerable species to extinction.

Where it still exists, *R. alba* is highly likely to be caught as bycatch in the intensive multi-species trawl fisheries that operate over much of the continental shelf and slope habitat of this species. As described above, this species has undergone dramatic declines in abundance and substantial reductions in its geographic range within the Mediterranean and the Northeast Atlantic; it is therefore listed in the Barcelona and Bern Conventions. The IUCN Shark Specialist Group has assessed the species as Endangered globally and in the Mediterranean, and Critically Endangered in the Northeast Atlantic (OSPAR Maritime Area) (Dulvy *et al*. 2006).

Relevant additional considerations

Sufficiency of data

Data on *Rostroraja alba* are very limited in OSPAR Maritime Area, though the species was known to be more common in the past. There is little information on remaining populations, stock dynamics, reproductive rate and ecology of this species in the NE Atlantic.

Changes in relation to natural variability

No data about the natural variability of the populations of *Rostroraja alba* are available. The species is now so rarely recorded that it is unlikely to be feasible to study genetic variation within the OSPAR Maritime Area. It would, however, be useful to study genetic variation in this species from different areas of its range (e.g. the OSPAR Area, Mediterranean, western and southern Africa) in order to inform conservation strategies across its global range.

Expert judgement

The shortage of scientific data on the current population size and distribution of this species in the OSPAR Maritime Area, and reliance upon fairly limited historic and anecdotal information, means that expert judgement has played a significant part in this nomination. The case rests on recognition that the threats to the white skate are known, that such threats occur in the OSPAR Maritime Area and that they have led to significant declines in the number of this and other large-bodied skate species in the Area and elsewhere.

ICES Evaluation

In 2002, the ICES Study Group on Elasmobranch Fishes was asked to comment on the status of white skate and "considered that there was a high probability of population decline, both in the Bay of Biscay and Iberian coast, and in the Celtic Seas. For example, there was a directed long-line fishery in the Baie de Douarnanez (Brittany) in the 1960s that collapsed (white skate are no longer listed on French fishery statistics), and a similar decline is thought to have occurred in the Irish Sea" (ICES 2002).

In its review of an earlier version of this nomination, ICES WGEF (in prep.) noted that "There are insufficient data to quantify declines in *Rostroraja alba* over its entire range, though there is consistent anecdotal evidence of widespread declines in OSPAR regions III and IV." The WGEF concluded: "Although heavily dependent on anecdotal information and expert judgement, WGEF considered that there was a justifiable rationale in the nomination for listing white skate as a Threatened and Declining species in OSPAR regions II-IV."

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; *Category of effect of human activity:* Biological – removal as target and non-target species by fisheries.

The collapse of target fisheries for the white skate, followed by a decline and cessation of records in scientific surveys and commercial bycatch in the OSPAR Maritime Area is believed to indicate a decline in the population caused by fishing activity. This threat is directly linked to human activity.

Although no catch per unit effort data are available, the declining catches in the Northeast Atlantic are believed to represent falling yields from declining stocks rather than declining fishing effort.

This pattern of steeply declining catches is familiar in other fisheries for large skates where there are better records, including catch per unit effort.

Management considerations

Management actions essential for the conservation of this species are the identification and protection of any relict white skate populations, control of the fisheries that capture large-bodied skate species (particularly reduction of fishing effort), and the monitoring of fisheries and trade in large species of skate. Fisheries and trade in this species should not be permitted in the OSPAR Maritime Area, and fishing techniques should be designed to reduce white skate bycatch and maximise the opportunities for returning any incidental catch alive to the sea.

This species is classified on the IUCN Red List as Endangered globally, and Critically Endangered in the Northeast Atlantic, in the IUCN Red List (Dulvy *et al*., 2006).

R. clavata is also listed on Appendix III (protected fauna) of the Bern Convention on the Conservation of European Wildlife and natural habitats and listed on Annex III (species whose exploitation is regulated) of the Barcelona Convention for the Protection of the Mediterranean Sea.

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Nomination

Salmo salar, Atlantic Salmon

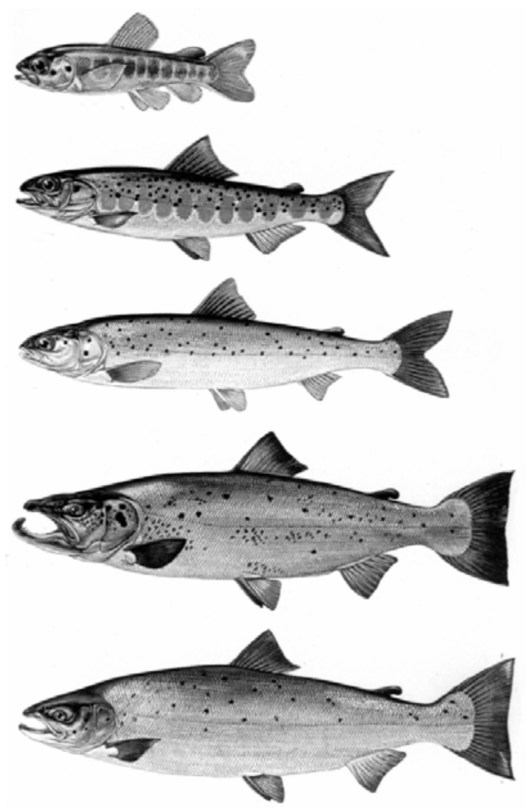


Illustration (from top) of fry, parr, smolt, male and female adult salmon. From Maitland (1977)

Geographical extent

OSPAR Region; I,II,III,IV
Biogeographic zones: 1-4,6-9, 11-15
Region & Biogeographic zones specified for decline and/or threat: as above

The Atlantic salmon is an anadromous species. Most of its growth takes place in the sea but the salmon migrate up rivers to spawn in freshwater. There are four main genetic groups of Atlantic salmon. Two of these, the Eastern Atlantic and the Northern Atlantic salmon, occur in the OSPAR Maritime Area.

On mainland Europe the Atlantic salmon is known to have had a freshwater distribution that included most of the large rivers from Portugal to NW Russia as well as in the UK, Ireland and Iceland. It is widely distributed in the marine environment.

Atlantic salmon are globally and regionally important to the fish farming industry. Many thousands of farmed fish are known to have escaped into the wild and now mix and interbreed with wild Atlantic salmon in the NE Atlantic.

Application of the Texel-Faial criteria

S.salar was nominated for inclusion on the OSPAR list with particular reference to its global/regional importance, sensitivity, and decline, with information also provided on threat.

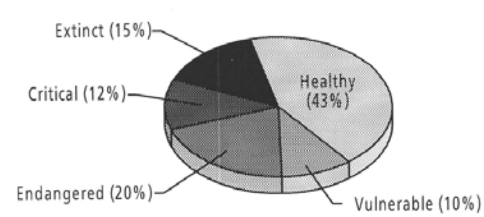
Global/Regional importance

The results of a river by river assessment of the status of Atlantic salmon in Europe and North America concludes that nearly 90% of the known healthy populations of wild salmon are found in Norway, Iceland, Scotland and Ireland (WWF, 2001). This makes the OSPAR Maritime Area of global importance for this species.

Decline

An assessment of the status of Atlantic salmon populations in rivers throughout its range, for which there are sufficient data, concludes that 43% can be categorised as healthy. The remainder are vulnerable, endangered, critical or extinct (Figure A).

FIGURE A._Status of wild salmon populations in 2,005 rivers in 19 countries throughout its range (WWF, 2001).



Poor water quality and habitat damage in the 18th and 19th century contributed to the decline of the salmon population in rivers such as the Rhine, the Thames and the Seine. Records show that the Rhine was once the largest and most important salmon river in Europe. Catches of the order of 250,000 fish were reported in the late 1880's but this had fallen to zero by 1960 (ICPR, 2000). Rivers in Belgium, Germany and Netherlands had entirely lost salmon populations by the 1960s (MacCrimmon & Gots, 1979). In Portugal catches in the Minato river fell by 97% from 1,400 in 1914, to less than 50 in 1989 (Correia & Fidalgo, 1995) and this population is now considered to be in critical condition. The Atlantic salmon is considered to be extinct in the other six historic Portuguese salmon rivers (WWF, 2001).

There has been an improvement in the status of Atlantic salmon in some of the rivers of northern Europe in recent years. Better water quality, installation of fish passes and reintroduction programmes have had some success in bringing wild salmon back to these waters. Small numbers have been caught in Dutch rivers since the mid-late 1990's for example (Pringnon *et al*., 1999), and catches in the Thames which were non-existent in the 1970s, are now of the order of few hundred a year (Environment Agency, 1999). In other cases, such as Numedal and Namsen rivers in central Norway, catch statistics suggest that the populations have remained fairly stable.

ICES report that although there is variation among rivers, in general, the total returns of salmon and spawning stock to rivers in the northern North East Atlantic Commission (NEAC) area (Finland, Iceland, Norway, Russia, Sweden) have fluctuated for the past 20 years, but show an increase in recent years. In contrast, wild salmon stocks in Iceland have declined since the 1980s. Salmon stocks in the southern NEAC area show a consistent decline over the past 20–30 years. This relates especially to salmon that spend more than one winter at sea (ICES, 2002a & b).

Sensitivity

The Atlantic salmon is known to be highly sensitivity to water quality when migrating up river particularly in relation to eutrophication, chemical contaminants and increased sedimentation of salmon rivers.

Threat

Threats to Atlantic salmon occur in both the freshwater and marine environment. Changes in land use, agricultural and forestry practices have affected salmon rivers where they result in changes in run-off, water flow and sedimentation of watercourses. Other threats include the construction of dams, navigation locks, and hydroelectric power stations that have impeded the progress of salmon migrating up river. Poor water quality as a result of sewage pollution, chemical contamination and acid rain are also a threat to salmon in rivers. Loss or deterioration of freshwater habitat by factors such as these are implicated in the decline of pre-smolts. for example (ICES, 2002a).

The directed fishery for salmon in both the freshwater and marine environment is another threat. Exploitation has not been kept below sustainable levels and therefore has contributed to the decline in abundance of Atlantic salmon (ICES, 2002a). An additional consideration is that there are still some salmon fisheries in the marine environment. These are the drift net fisheries that target salmon around the entrances to rivers so they are unable to reach spawning grounds. These are a threat to wild salmon stocks in particular locations such as the North East coast of England and off the coast of Ireland .

The marine fish farming industry poses another threat to wild salmon. The large number of escaped fish from fish farms are know to interbreed with wild salmon and dilute the genetic stock. The intensive nature of the industry has also been implicated in the spread of sea lice infestations to wild salmon stocks affecting their survivability.

Coastal and open sea fisheries such as those carried out around the UK, Ireland, the Faeroes and Norway are another threat to the Atlantic salmon. There is concern that herring and mackerel fisheries in the Norwegian Sea may be taking salmon smolts as a by-catch, for example, but the impact of this has not been quantified (NASCO, 1998). In 2001 the reported catch in the NEAC area was 2,887 tonnes and the estimated unreported catch 1,079 tonnes (ICES, 2002b).

Relevant additional considerations

Sufficiency of data

There are many sources of data on the abundance and distribution of Atlantic salmon in the OSPAR Maritime Area. This includes more than a century of records of salmon catches in some rivers, extensive monitoring data linked to reintroduction programmes, collation of landings data and estimates of unreported catches for the region through the North Atlantic Salmon Conservation Organisation (NASCO).

Changes in relation to natural variability

Natural variability through factors such as recruitment and natural mortality, will have undoubtedly had an influence on the status of the Atlantic Salmon however this was probably masked by the considerable impact of human activity on salmon in the 18^{th} and 19^{th} centuries. Now, with a much lower overall population size, the effects of natural variability may be a much more significant component in fluctuations in the population of wild salmon.

Marine survival of wild (and hatchery-reared) smolts in both northern and southern North East NEAC areas (which cover the OSPAR Maritime Area) has declined constantly over the past twenty years. The steepest decline is in the wild smolts in the southern NEAC area (France, Ireland, UK). The survival of both wild and hatchery fish returning after two winters at sea in the northern NEAC area has increased slightly in most recent years (ICES, 2002b).

The cause of this decline is uncertain but reduction in marine survival is thought to be a likely contributory factor, probably coupled with changing conditions in the freshwater environment of juveniles (ICES, 1996). Climate change is one possible influence as the surface water temperature of the Norwegian coast and the North Sea has been correlated with salmon survival (Friedland *et al.,* 1998). Some of the large-scale variations in salmon populations in the past may also have coincided with a general cooling of the North Atlantic (Friedland *et al*., 2000).

Expert judgement

There are a considerable amount of data on the status and trends of Atlantic salmon. These come from commercial catch statistics, recreational landings figures, river surveys etc. The work of ICES and NASCO in collating and assessing these data are particularly relevant in relation to Atlantic salmon in the OSPAR Maritime Area. There is therefore considered to be a sound information base on which to judge the status and threats to the Atlantic salmon.

ICES evaluation

The ICES evaluation of the case for including the Atlantic salmon on the OSPAR list confirms that some degree of decline has been documented for *S.salar* throughout its range. There is support for the view that this species should be a priority throughout entire OSPAR Maritime Area (ICES, 2002a). There may be a case for giving priority to stocks from some individual rivers or groups of rivers. The rationale for excluding salmon stocks in Norway and Iceland is weak and not readily reconciled with the assessment material because, although it is the case that trends in Norwegian rivers are not all downward, this is also the case for rivers of many other countries.

ICES also confirm that there is good documentation of threats linked to fishing and low marine survival but that documentation of other threats are generally concerned with local impacts. Declines in marine survival may have been compensated for, at least partially, by decreases in harvest, to maintain spawning escapement to rivers (ICES, 2002a).

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; extraction of sand, stone and gravel; constructions, land-based activities. *Category of effect of human activity:* Physical – substratum removal and change, water flow rate changes, Biological – removal of target species; Chemical – nutrient changes, synthetic compound contamination.

Degradation of freshwater habitat by human activity has been a significant factor in the decline of catches of salmon in European rivers. In France for example, an estimated 800,000 fish returned to the rivers to spawn in the 18th century but by 1900, 75% of the spawning sites had become inaccessible because of dams. In the Meuse in the Netherlands and Belgium the construction of navigation locks at the beginning of the 19th century have been identified as the main cause of the disappearance of salmon from this river (MacCrimmon & Gots, 1979).

In the marine environment, commercial fishing for salmon is another threat linked to human activity. Overexploitation is believed to be the greatest single threat to Irish salmon stocks for example and takes place on the High Seas, around the Irish coast with drift nets, at estuaries with specialised nets, and by angling and poaching once the fish are in freshwater (WWF, 2001).

In more recent years the decline in wild salmon has been linked to salmon farming operations particularly in Norway, Ireland and the UK. Escapees from salmon farms, which number in the millions every year, compete with natural stocks for spawning partners and sites, yet their reproductive success (especially males) may be lower) (Lura, 1995). The young can also be more aggressive and have been shown to displace the young of wild salmon (McGinnity *et al.,* 1997). Another consideration is that the incidence of sea lice infestation in wild salmon using rivers near fish farms has increased dramatically. A Norwegian study of smolts in Sognefjorden reported infection rates in 86% of smolts returning to the sea to be so bad that these fish were likely to suffer a high mortality (Marine Research Institute, 1999).

Little is known about the interaction of wild and farmed fish in the open sea but they do now make up a significant part of some catches (e.g. in the Faeroes fishery 20%) (Hansen *et al.,* 1997).

Management considerations

Significant scientific effort, management actions, and community-based conservation programmes are already implemented for salmon throughout much of its range (ICES, 2002). These include clean up and reintroduction programmes (e.g. in the Meuse and the Rhine), which are having some success as adult fish are returning to the rivers to spawn. In the marine environment the phasing out (or buy-out) of drift net fisheries that catch salmon at the mouths of rivers, is helping to restore numbers but there are still major management issues to address such as the effect of fish farming on wild salmon and targeted and mixed stock commercial fishing for salmon.

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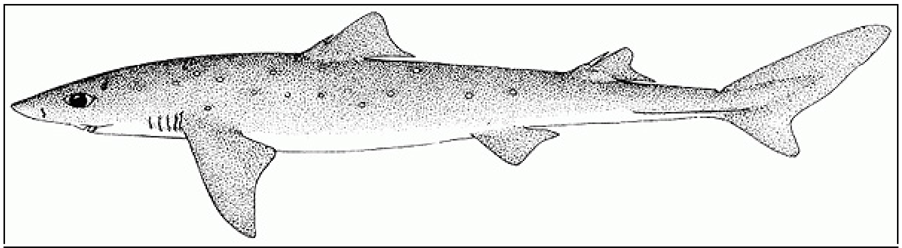
Nomination

Squalus acanthias, Spurdog or Piked dogfish

Spurdog or Piked dogfish *Squalus acanthias* **(**Linnaeus 1758**)**



Geographical extent

- OSPAR Regions: I, II, III, IV, V
- Biogeographic zones: 5,8,9,10,11,12,13,14,15,16
- Region & Biogeographic zones specified for decline and/or threat: as above

Squalus acanthias occurs in temperate and boreal waters along continental shelves and slopes. It is most common on or near the seabed in coastal waters. In the OSPAR Area, it occurs from Iceland and Murmansk south to Gibraltar. Elsewhere, it is found in the Mediterranean and Black Seas, South Atlantic, North and Southeast Pacific, New Zealand and Australia (Figure 1). Seasonal migrations take place in coastal waters, but trans-Atlantic genetic exchange is very limited (Hammond and Ellis 2005).

Application of the Texel-Faial criteria

Global importance

Squalus acanthias occurs on all temperate and boreal continental shelves and slopes. Most of its distribution lies outside the OSPAR Area, which is not of global importance for the whole species.

Regional importance

Heessen (2003) identified a single Northeast Atlantic stock of spurdog, distributed from the north of the Bay of Biscay to the Norwegian Sea. Trans-Atlantic genetic exchange is very limited, indicating that Northeast and Northwest Atlantic stocks are separate (Hammond and Ellis 2005, ICES WGEF in prep.). If the Texel-Faial criteria applied to stocks, the OSPAR Area would be of regional, if not global importance for this species.

Rarity

No.

Sensitivity

Very sensitive. This species' slow growth rate, late maturation, longevity, low fecundity and long gestation period results in very low resistance to fisheries. This is intensified by the aggregating nature of mature and pregnant females, which are the highest value segment of the stock and preferentially targeted in fisheries. It is also sensitive to bycatch in demersal fisheries. Its life history characteristics also result in one of the lowest known potential intrinsic rate of population rebound of any shark species (Smith *et al*. 1998), hence very low resilience and extremely slow potential for recovery following depletion. ICES WGEF (in prep.) confirmed that this species is biologically sensitive and highly susceptible to exploitation.

Keystone species

No.

Decline

Severely declined and still currently threatened. Fisheries statistics have been recorded for *Squalus acanthias* in the OSPAR Area since 1906 (Figure 2).

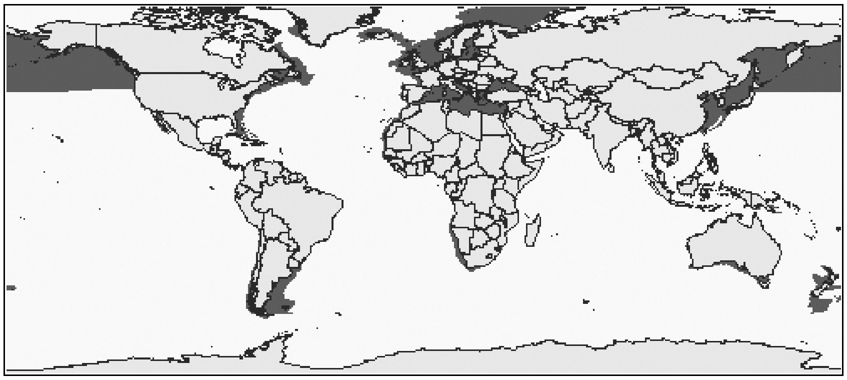


Figure 1: Global distribution of *Squalus acanthias* (from FAO FIGIS 2007)

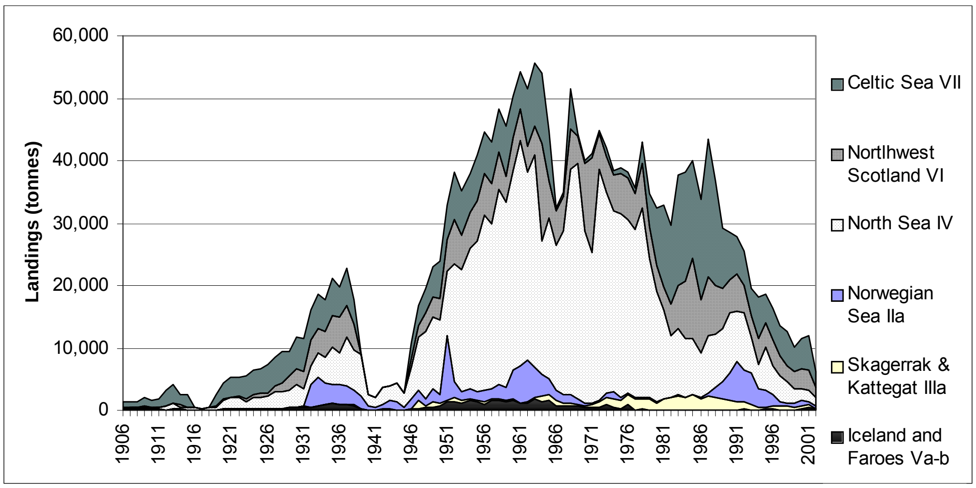


Figure 2: *Squalus acanthias* landings in ICES areas, 1906-1999. (Source ICES WGEF)

Biological investigations commenced in the Northeast Atlantic in the 1950s. More recently, this stock has been the subject of detailed fisheries assessment since 2002 (e.g. research and stock assessments summarised in ICES SGEF 2002, 2004; Heessen 2003; Hammond and Ellis 2004; ICES WGEF 2005, 2006 and in prep.; Figures 3 and 4). These report that current total biomass throughout the Northeast Atlantic (OSPAR Area) is approximately 5% of the pre-exploitation level in 1905 and 7% of that in 1955 (lightly exploited). Total recent landings have been about 15–17% of their peak values.

Warnings of overfishing of the Scottish-Norwegian sector of the Northeast Atlantic stock commenced in the 1960s (Holden 1968). The Norwegian fishery had collapsed by 1978 (Hjertenes 1980). The North Sea fishery declined steeply from a peak in the early 1970s to 10% of former landings in recent years, and target fisheries here were closed in 2007. The Celtic Seas fisheries peaked in 1987, before declining steeply.

Iberian Peninsula spurdogs are near the edge of range of the main Northeast Atlantic stock and may be distinct, but are experiencing similar trends. Landings per unit effort have declined steeply in recent years (ICES WGEF 2006). Portuguese landings declined 51% between 1957 and 2000 (DGPA), and future projections predict that, at current exploitation effort, a further 80% decline of landed biomass will take place over the next three generation period due to stock depletion (Fordham *et al*. 2006). The IUCN Red List Assessment for the Northeast Atlantic stock is, therefore, Critically Endangered.

Figure 3: Typical total biomass (left) and recruitment (right) trends for Northeast Atlantic *Squalus acanthias*, 1900–2005, from a population dynamic model (Source: ICES WGEF 2006)

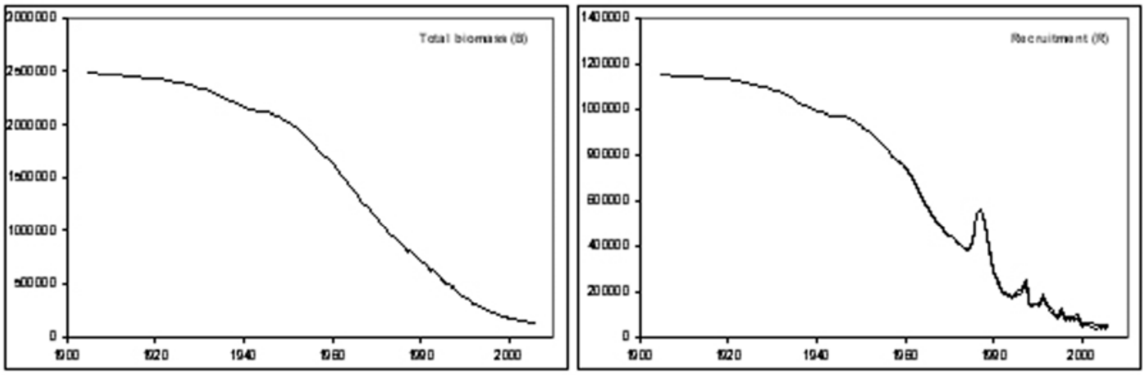
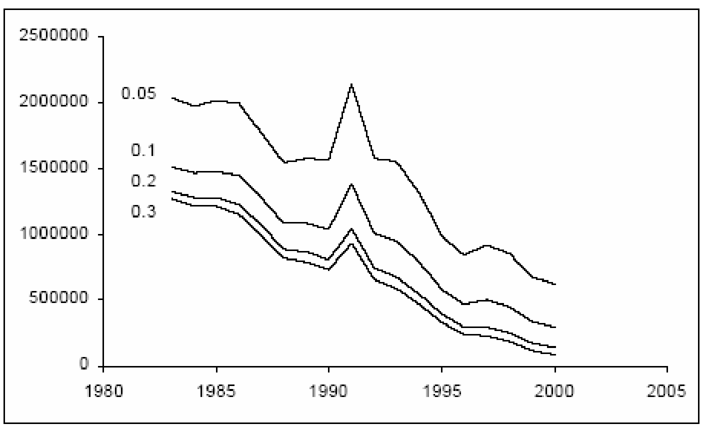


Figure 4: Trends in total numbers of mature fish in the Northeast Atlantic, 1980–2000. (Source: Heessen 2003)



A Separable VPA analysis of the catch numbers at age was used to estimate these trends in total population numbers. Each line represents a different assumption for terminal F (0.05–0.3) on the reference age in the final year (Heessen 2003).

Threat

Spurdog is a highly migratory and aggregating species with high market value and demand in Europe. It was, until very recently, the most important commercially-fished elasmobranch species in the OSPAR Area. Although the majority of large-scale target fisheries here have now collapsed, this species' aggregating habit makes it highly vulnerable to localised, seasonal fisheries. These fisheries still target aggregations of mature and gravid females, other than in the North Sea where target fisheries were closed in January 2007 (ICES WGEF in prep.). It is also a valuable utilised bycatch in other demersal fisheries. Target and bycatch fisheries for this species are continuing despite ICES advice that a zero TAC should be set throughout the OSPAR/ICES Area.

Relevant additional considerations

Sufficiency of data

Very good. Fisheries data for spurdog have been collected in the OSPAR Area since the beginning of the 1900s, fisheries research commenced in the 1950s, and detailed stock assessments have been undertaken during the 2000s (e.g. ICES SGEF 2002; Heessen 2003; ICES WGEF 2003, 2004, 2005, 2006 and in prep.).

Changes in relation to natural variability

There is little natural variability known for this species, but it is probable that geographically separated populations differ in their population genetics. Tagging research suggests that spurdog in the OSPAR Area are comprised of a single stock, ranging from the Barents Sea to the south (ICES WGEF 2006). Genetic exchange across the Atlantic is considered very limited (Hammond and Ellis 2005). Franks *et al*. (2005) found two major lineages in *Squalus acanthias* stocks, one in the North Pacific, and another in the South Pacific and Atlantic. Detailed population genetics need further research.

Expert judgement

Survey data, species-specific landings data and stock assessments are available. The latter have explored a number of different methods, including surplus production models, separable age-based assessments, length-structured approaches and frequency of occurrence in survey hauls. All methods indicate similar stock trends and a seriously depleted stock that is in danger of collapse. Seasonal target fisheries exploit aggregations of mature female spurdog, but the majority of landings in the OSPAR Area are as utilised bycatch in mixed demersal fisheries (these are reported in landings data). Bycatches of spurdog in other fisheries (e.g. pelagic trawl) are likely but these will not generally be landed (ICES, 2005).

ICES Evaluation

ICES has been reviewing fisheries and stock status for this species for several years. All experimental assessments indicate that the stock is at a record low level. Frequency of occurrence in trawl surveys has declined and, although large shoals are still caught, the frequency of these has declined. Survey CPUE also indicate a declining trend. Trends in fishing mortality and the continuous decline in landings indicates that exploitation has been, and continues to be well above sustainable levels (e.g. ICES WGEF 2006 and in prep.). Management advice has been provided annually since 2005, with repeated warnings that the stock is depleted and in danger of collapse. Although ICES has recommended a zero quota for this species throughout the OSPAR Area, TACs are still being set for spurdog, although only bycatch fisheries are still permitted in the North Sea (see 'Management considerations', below).

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; *Category of effect of human activity:* Biological – removal as target and non-target species by fisheries.

ICES has presented strong evidence that the observed depletion and near-collapse of the Northeast Atlantic stock of spurdog was caused by over-exploitation in fisheries (Figure 5). This exploitation continues at unsustainable levels and is therefore a threat that is linked to human activity.

Management considerations

A total allowable catch (TAC) was set for the North Sea (ICES Areas IIa and IV) in the late 1990s, but at a level significantly higher than recent landings. The North Sea TAC was reduced significantly and may have become restrictive in 2005.

ICES advice was first requested in 2005. This recognised the threats to spurdog and recommended an extension of the TAC to cover the entire stock distribution area (ICES ACFM 2005). Other management measures suggested including regulating fisheries that take a high proportion of mature female spurdogs and implementing a maximum landing size to protect this highly vulnerable part of the stock. In 2006, ICES warned that "the stock is depleted and may be in danger of collapse. Targeted fisheries should not be permitted to continue, and by-catch in mixed fisheries should be reduced to the lowest possible level. The TAC should cover all areas where spurdog are caught in the northeast Atlantic and should be set at zero for 2007."

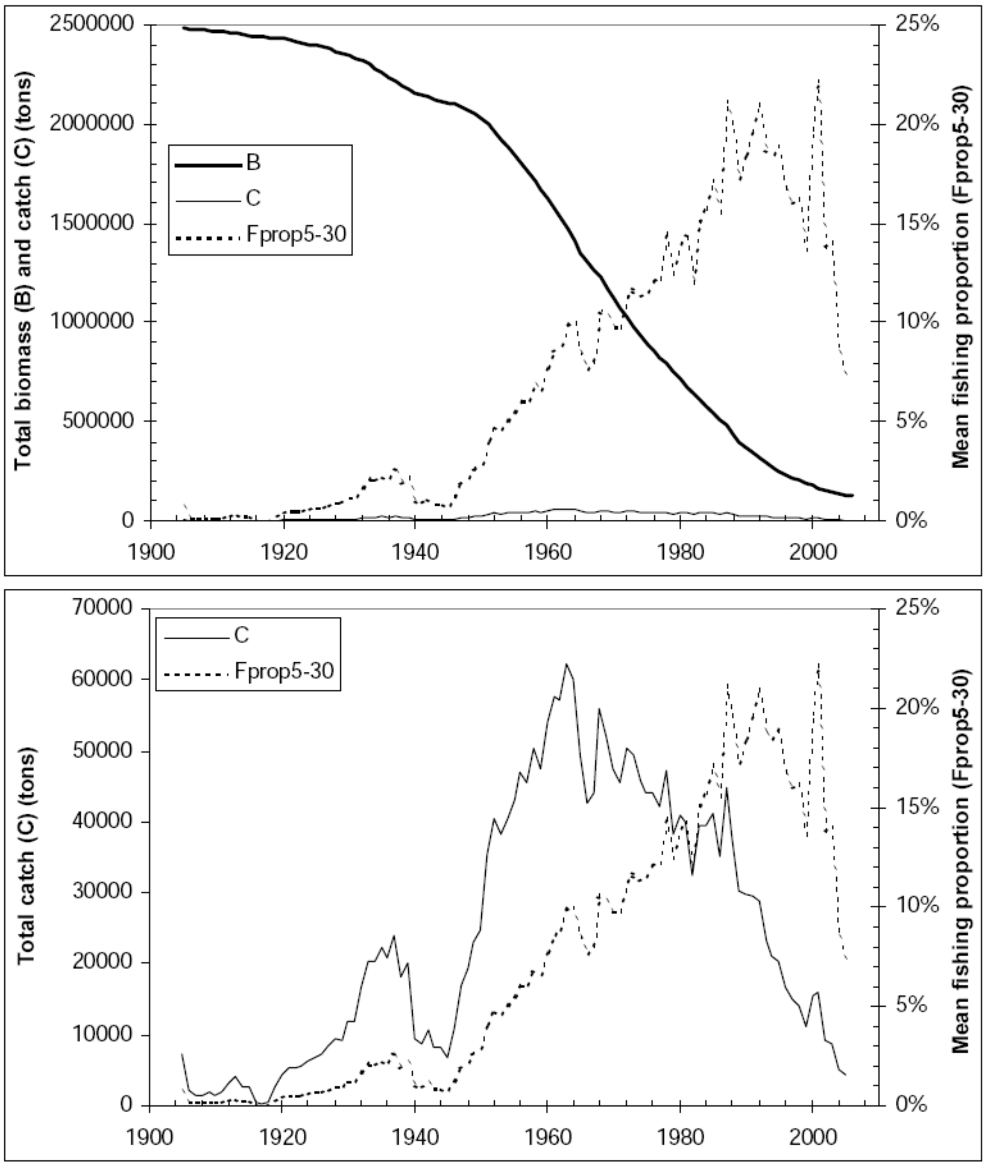
Management measures adopted in 2007 included a further reduction in the TAC for the North Sea and closure of target fisheries in this region. Fisheries were also prevented from targeting vulnerable aggregations; spurdog "*shall not comprise more than 5 % by live weight of the catch retained on board*". A TAC has also been set for the remainder of the stock area, as advised by ICES in 2005. This quota may be restrictive (i.e. lower than recent reported landings). Although management measures are being more widely adopted, ICES advice for a zero quota throughout the ICES/OSPAR Area has not been adopted. ICES advice needs to be followed and all fisheries closed if the stock is to recover.

In regions where spurdog are taken largely as by-catch, a low TAC (which only regulates landings) could increase discard levels. Discard survival is unknown. Because spurdog is caught as a bycatch in demersal fisheries, they would benefit from a reduction in overall demersal fishing effort. Spurdog forms size and sex specific schools and these have been subject to directed fisheries specifically targeted large females.

Additional management measures which would deter the targeting of mature females could include, for example, a minimum landing length (ICES WGEF 2006). The minimum landing size established in Norway in order to protect mature females is of limited value for a migratory species that is intensively fished in other parts of its range (Fordham *et al*. 2006).

This species is classified as Critically Endangered in the Northeastern Atlantic in the IUCN Red List, and Vulnerable worldwide (Fordham *et al*. 2006). It is Critically Endangered in the Baltic Sea (at the edge of its range), and listed on the HELCOM 2006 Red List as a priority species.

Figure 5: Top: Base-case model estimates of total biomass (*B*), mean fishing proportion ($F_{prop5\text{-}30}$) and total annual catch (*C*). Bottom: as above but without total biomass. (ICES WGEF 2006)



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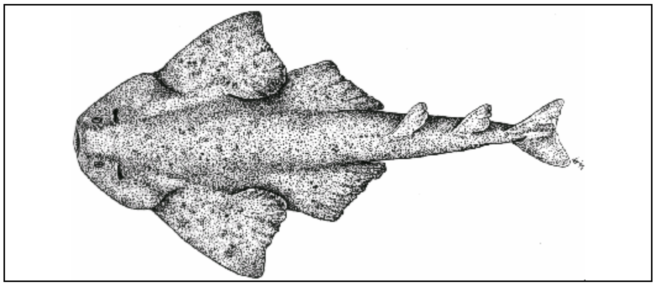
Nomination

Squatina squatina, Angel shark

Angel shark, *Squatina squatina* (Linnaeus, 1758)



Geographical extent

- **OSPAR Regions: II, III, IV**
- Biogeographic zones: 10,11,12,13,14,15,16
- Region & Biogeographic zones specified for decline and/or threat: as above

This species was historically common over large areas of the coastal, continental and insular shelf of Northeast Atlantic, from southern Norway, Sweden and the Shetland Islands to Morocco, West Sahara and the Canary Islands, and in the Mediterranean and Black Seas. It occurs on or near mud or sandy seabed from close inshore to the outer shelf (5 m to at least 150 m depth) and may penetrate estuaries and brackish water. It rests on the seabed by day and is active by night. Seasonal migrations occur in the northern part of its range. (Compagno in preparation; Compagno *et al*. 2005.)

Its distribution has contracted significantly over the past 50–100 years; intensive demersal fishing pressure has resulted in local extirpations and some contractions in range both inside and outside the OSPAR Area (Morey *et al*. 2006, Dulvy *et al*. 2003).

Inside the OSPAR Area: the species is now considered to be locally extinct in the North Sea (ICES ACFM 2005), Bay of Biscay (Quero 1998), and Irish Sea/Bristol Channel (Rogers and Ellis 2000).

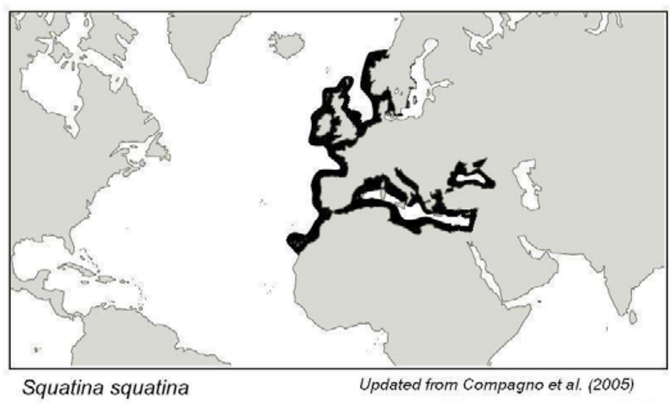
Outside the OSPAR Area: Records of the species occurring inside the Baltic Sea, north along the coast of Sweden into the Bothnian Sea (e.g. Compagno 1984; Compagno *et al*. 2005), may be mistaken, rather than a former historic distribution.

Confirmed occurrences are recorded only in the Kattegat and Skagerrak (Helcom 2005), inside the OSPAR Area.

It is no longer encountered in most areas of the northern Mediterranean, where it is extirpated or at least commercially-extinct (Froese & Pauly 2006; Morey *et al*. 2006). The last record from the Adriatic Sea was in 1948 (Jukic-Peladic *et al*. 2001). No recent records have been identified from its former Black Sea range. It is also now extremely uncommon throughout most of the remainder of its range for which data are available, with the exception of the Canary Islands. Its current status in the southern Mediterranean and northwest Africa is unknown, but it may still be more common off parts of the North Africa coastline (e.g. Tunisia (Bradai 2000)) than elsewhere.

Squatina species were common in Russian surveys off Northwest Africa during the 1970s and 1980s (F. Litvinov pers. comm. to IUCN SSG 2006). They are reportedly now very rare in this area, where intensive artisanal and industrial fisheries operate over much of the coastline (Morey *et al*. in prep.),

Figure 1: Historic distribution of *Squatina squatina* (updated from Compagno *et al*. 2005).



Application of the Texel-Faial criteria

Global importance

Populations of *Squatina squatina* occur in OSPAR areas II, III and IV, which encompass close to half of the historic global distribution of this species, and likely over half of its current distribution. The global historic distribution outside the OSPAR Area lies within the adjacent Atlantic off Morocco, Western Sahara and the Canary Islands, and in the Mediterranean and Black Seas. Although information on the current distribution of *S. squatina* is limited, best available information indicates that some populations that historically occurred outside the OSPAR Area, in the Northern Mediterranean and Black Seas, have since been extirpated.

Off the North Africa Mediterranean coastline the species may be more common, e.g., as reported off the coast of Tunisia (although considered rare in the Gulf of Gabès) (Bradai 2000), and was found to be extremely rare near Tabarca (Fricke, pers. comm., observed in 1998). Catch and survey data indicate serious depletion of *Squatina* stocks off the Northwest coast of Africa (Morey *et al*. in prep.).

Although populations have also been seriously depleted (and in some locations extirpated) within the OSPAR Area, it is possible that the remaining stocks here now represent 75% of the global population. Current distribution and abundance data are, however, inadequate to confirm this.

Looking into the future, the ongoing declines and extirpations that have occurred outside the OSPAR Area, particularly on the North and West coast of Africa, are unlikely to cease or be reversed under current or foreseeable management regimes. The exception to this is in the Canary Islands, where the species is reportedly still relatively common. In contrast, there is potential for management to improve the status of *S. squatina* within the OSPAR Area, making the latter increasingly likely to become globally important for this species under the Texel-Faial Criteria.

Regional importance

Since this species is reported to be locally abundant (ICES WGEF 2007), it is possible that the surviving populations within the OSPAR Area could be of Regional importance under the Texel-Faial Criteria. Lack of information on the current distribution and abundance of *S. squatina* makes it impossible, however, to determine whether 90% of the population in the OSPAR Area is now restricted to a small number of locations.

Rarity

This species is now only very rarely recorded within its historic distribution in the OSPAR Area and elsewhere. ICES WGEF (2007) noted that this species could be considered as now being rare due to its absence in research vessel surveys (ICES WGFE 2006) and extremely scarce in commercial catches (ICES WGEF 2006).

Sensitivity

Very sensitive. *Squatina squatina* has many of the limiting life history characteristics common to elasmobranch species and hence a very low resistance to human activity. Angel sharks reach maturity at a large size (128–169 cm in females) and likely several years old (life history information is lacking). Once mature, they give birth to a relatively small number (7–25) of large pups after an 8–10 month gestation (litter size increases with the size of the female). Their large size, flattened bodies and expanded pectoral fins make angel sharks highly vulnerable to bycatch in trawl and net fisheries from birth. Trawl fisheries are also likely to damage their benthic habitat. Elasmobranchs also have a very low resilience because of their low intrinsic rate of population increase, meaning that recovery of depleted populations will be slow and likely take longer than 25 years even if all bycatch ceases.

Genetic and tagging studies have demonstrated that another species of *Squatina* exhibits significant genetic divergence over relatively small geographic distances, and a high site-specificity consistent with isolated sub-populations (Gaida 1997; Standora and Nelson 1977). Despite records of some long-distance movements of tagged *Squatina* within the OSPAR Area (Green 2007), the same may be true to some extent for *S. squatina*. If so, recolonisation of extirpated stocks will also be extremely slow, and most unlikely to take place within 25 years.

Keystone species

Squatina squatina may formerly have been sufficiently common and important a demersal predator to have had a controlling influence upon its community, but is now probably ecologically-extinct throughout the OSPAR Area.

Decline

Severely declined in all three of the OSPAR regions where this species occurs during the past 50–100 years. It has now been declared extinct in the substantial areas of its former range in the OSPAR Area, and is now extremely uncommon throughout most of the remainder of this range. The population is clearly becoming increasingly fragmented and records are now extremely infrequent. Declines are also reported from elsewhere in its global range.

Squatina squatina was reported to be common, or at least frequently or regularly recorded, in many areas during the 19th and early 20th Centuries. For example, it was particularly common on the south and east English coasts (Yarrell 1835-36, Day 1880-84), and also common in the North Sea, on the Dogger Bank, in the Bristol Channel and Cornwall, and 'by no means uncommon' in the Firth of Clyde (Day 1880-84). It was still being caught regularly and considered common in the UK at the beginning of the 20th Century (Garstang, 1903). Although more common off the Atlantic Iberian coasts, *Squatina squatina* was also reported as frequent in the Mediterranean during the first half of the 20th century by Lozano Rey (1928).

Steep population declines have, however, now been reported from several parts of this species' range in OSPAR waters, including in the North Sea (ICES ACFM 2005), UK coastal waters (Rogers and Ellis 2000), and on the French coast (Quero and Cendrero 1996; Quero 1998; Capapé *et al*. 2000). During the early 1900s, an average of one specimen was taken during every ten hours of trawl survey on the British coast, but in recent years the species has virtually vanished (Rogers and Ellis 2000). CEFAS surveys recorded angel sharks in low numbers in Cardigan Bay during the 1980s (Ellis *et al*. 1996) but report just one individual in the last 15 years.

Commercial landings data compiled by ICES WGEF (2007) (Figure 2) demonstrate a decline in Celtic Seas landings from over 30 t in the 1970s to less than one tonne in recent years. French landings have declined from > 20 t in 1978 to 1 t in 2000.

Historically, *Squatina* has been caught in Tralee Bay and Clew Bay, Ireland, where it was also, until recently, caught by recreational anglers. The Irish Central Fisheries Board has recorded effort by charter-angling vessels in Tralee Bay since 1981. Catches of *Squatina* by two vessels have declined from over 100 per year in 1981, to 20 in 1984, before increasing to 100 again in the late 1990s. Catches subsequently declined to very low levels in the 1990s and there have been none at all in the most recent years (ICES WGEF 2007, Figure 3). It was taken off the Irish Specimen Fish List in 2005.

Declines have also occurred in parts of its global range outside the OSPAR area, including the Mediterranean and Black Seas (see above and Morey *et al*. 2006), and Northwest African coast. Vacchi *et al*. (2002) reported a decline in catches of *Squatina* species in a tuna trap in the Northern Tyrrhenian Sea from an average of 134 specimens from the period 1898-1905, to 95 between 1906-1913, and 15 between 1914-1922. The last record from the Adriatic Sea was in 1948 (Jukic-Peladic *et al*. 2001). Off the Balearic Islands, *Squatina squatina* was historically documented in checklists (Delaroche, 1809; Ramis, 1814; Barceló i Combis, 1868; Fage, 1907; De Buen, 1935). Captures of *S. squatina spp.* were relatively frequent until the 1970's, becoming increasingly sporadic during the 1980's in coastal artisanal fisheries (trammel nets and gillnets), lobster tanglenets, trawls and bottom longline fisheries. Since the mid 1990's no reports of *Squatina spp.* have been reported in the area and it may be absent (Gabriel Morey, pers. comm.). Recently, Massutí and Moranta (2003) reported no captures of *Squatina* spp. from four bottom trawl fishing surveys (131 hauls, at a depth range of 46-1,800m) carried out between 1996 and 2001 around the Balearic Islands.

Squatina species were common in Russian surveys off Northwest Africa during the 1970s and 1980s (F. Litvinov pers. comm. to IUCN SSG 2006), but are reportedly now very rare in this area (Morey *et al*. in prep.). Portuguese landings data from the fleet operating off Morocco and Mauritania, aggregated for *S. squatina* and the other two *Squatina* species occurring in this region, peaked at 35 t in 1990. When the fishery was closed in 1998 the total landings had declined to 1.7 t, but the pattern of effort associated with these landings is unknown. Intense fishing pressure appears to have significantly affected other *Squatina* species off Senegal and Sierra Leone, where artisanal fishermen remember them as common in catches 30 years ago. They have now almost disappeared and catches are very rare, according to artisanal fishermen and industrial demersal trawl fleet observers (M. Ducrocq pers. comm. to IUCN SSG 2006). Although *Squatina squatina* does not occur south of the Western Sahara, intensive fisheries operate throughout the Northwest African coast and this species has presumably been similarly affected there (Morey *et al*. in prep.).

Threat

Capture mortality in target and bycatch fisheries poses the greatest threat to *Squatina squatina*. Its meat is/was consumed fresh, salted or dried, its skin used as sand-paper, and its liver used for oil (Lozano Rey 1928; Notarbartolo di Sciara and Bianchi 1998). It is also sometimes taken as 'curios' for fishmongers stalls, for display in public aquaria, and by trophy anglers.

This was formerly a common and important demersal predator over much of the coastal and outer continental shelf sediment habitat in the OSPAR Area. Most of this region is now subject to intense demersal fisheries, and the species is highly vulnerable from birth onwards to bycatch in the benthic trawls, set nets and bottom longlines operating through most of its range and habitat. Its abundance has declined dramatically during the past 50–100 years during a period of steadily increasing fishing effort and capacity. As a result, *Squatina* has changed from being a utilised commercial target species, to a bycatch species of low or no commercial value in those areas where it has not been completely extirpated. Although commercial fisheries pose the greatest threat to this species, sport angling also has the potential to damage relict populations if animals are not carefully released alive.

Relevant additional considerations

Sufficiency of data

Despite the efforts of the ICES Working Group on Elasmobranch Fishes and the IUCN Species Survival Commission's Shark Specialist Group to collate available information for this species, population data are limited and declines not fully quantified within the OSPAR Area. Such a lack of data is very common for severely depleted fish species. There are a few historical assessments on landings as target or bycatch species, but most reports are anecdotal (particularly for OSPAR regions II and IV). Semi-quantitative data are available for OSPAR region III. However, given the observed pattern of severe depletion of most stocks, there is sufficient evidence that declines have been severe and are due to human activity.

Changes in relation to natural variability

Nothing has been published on natural variability, but the likely low intrinsic rate of population increase in this species means that populations are unlikely to fluctuate naturally. In the northern part of its range, this species has been recorded as undertaking short-distance seasonal migrations. Tagging data have also demonstrated some long-distance migrations (Figure 4, Green 2007), but this does not necessarily preclude a low capacity for dispersal and recolonisation.

The population genetics of the species requires further study in order to determine whether there are genetic differences between populations, as identified for *Squatina californica* (Gaida 1997).

Expert judgement

The absence of precise information on the population size of this species in the OSPAR Maritime Area means that expert judgement has played a significant part in this nomination. It rests on recognition that the threats to the angel shark are known, that such threats occur in the OSPAR Maritime Area and that they have led to significant declines in the number of angel sharks in the area and elsewhere.

ICES Evaluation

The ICES Working Group on Elasmobranch Fishes (WGEF 2007) considered that there was a justifiable rationale in the nomination for listing angel shark as a Threatened and Declining species in OSPAR regions II-IV. The WGEF also stated, in 2006 and 2007, that, "given the concerm over *S. squatina* in this and adjacent ecoregions, and that it is not subject to any conservation legislation, a zero TAC for Subareas VII–VIII may benefit this species".

Threat and link to human activities

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

Relevant human activity: Fishing, harvesting. *Category of effect of human activity:* Biological – removal of target species, removal of non-target species, physical damage to species and its habitat.

The decline in catches of angel shark fisheries, including the NE Atlantic fishery, is believed to be an indication of a decline in the populations and therefore a threat that is linked to human activity.

Although no catch per unit effort data are available, other than in a single sports fishery in Ireland, the declining catches in the NE Atlantic are believed to represent falling yields from declining stocks rather than declining fishing effort.

This pattern of steeply declining catches is familiar in other fisheries for large sharks where there are better records, including catch per unit effort.

Management considerations

Management actions essential for the conservation of this species are control and monitoring of fisheries mortality and trade in angel sharks. As noted by the ICES WGEF, this inshore species is distinctive and may have a relatively good discard survivorship. It is important that the scientific advice from the ICES Working Group on Elasmobranch Fisheries (ICES WGEF 2006 & 2007) be adopted and a zero TAC established. Neither fisheries nor trade in this species should be allowed in the OSPAR Maritime Area, and fishing techniques should be designed to minimise angel shark bycatch. Angel sharks incidentally caught as by-catch or by sports anglers should be immediately returned alive to the sea.

This species is classified as critically endangered in the IUCN Red List (Morey *et al*., 2006). It is also listed as critically endangered in Turkey (Fricke *et al*. in press), and as endangered under IUCN criteria in HELCOM area (Fricke 2007).

Figure 2: Landings in the Celtic Seas compiled by ICES WGEF (2007) from 1973 to 2006.
The UK record in 1997 is most likely misrecorded anglerfish (*Lophius*)

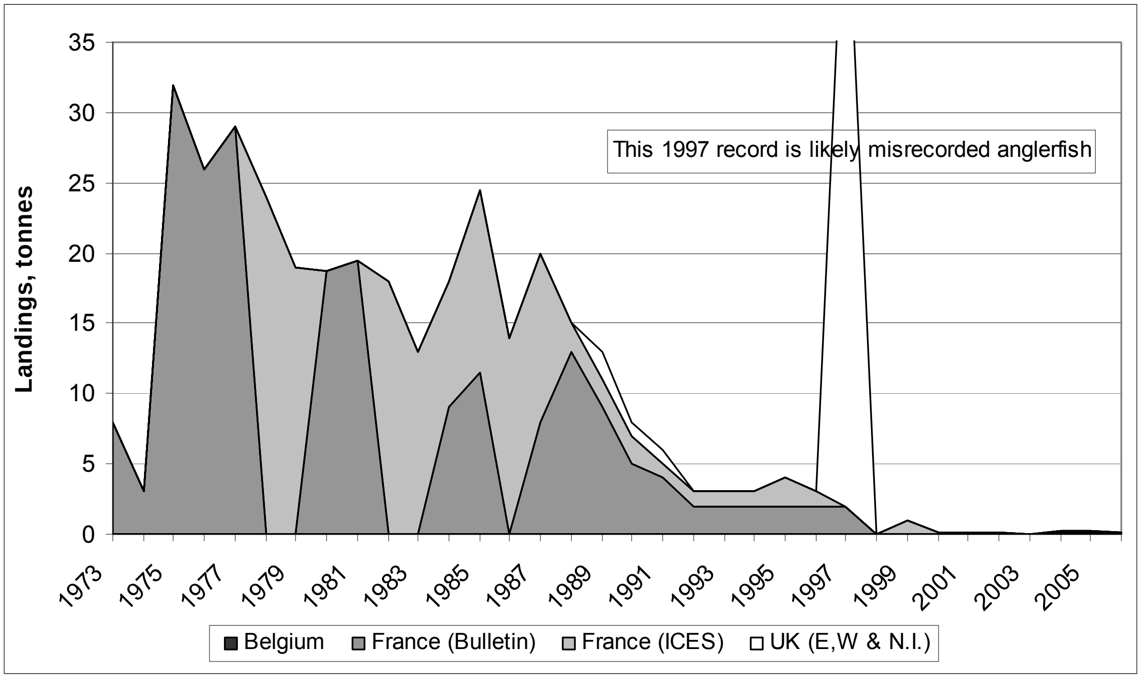


Figure 3: Captures by two charter boats in Tralee Bay 1981–2005 of angel shark *Squatina squatina*. Source: Irish Central Fisheries Board, from ICES WGEF 2007.

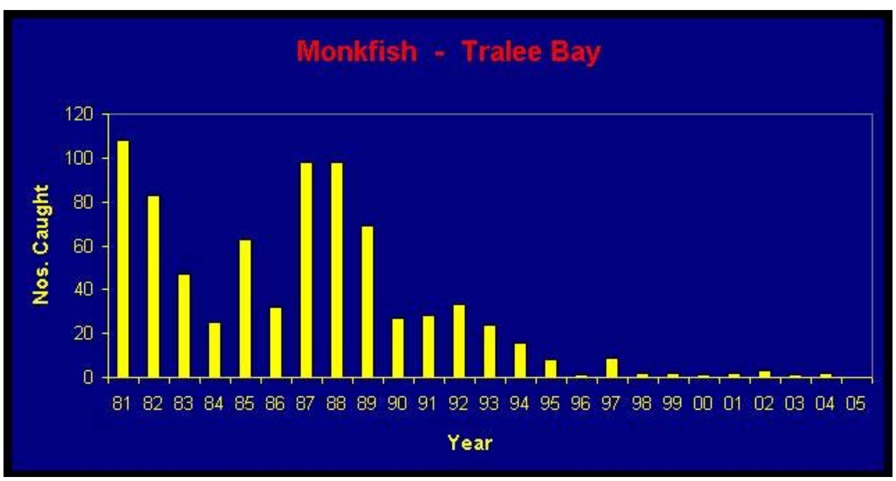
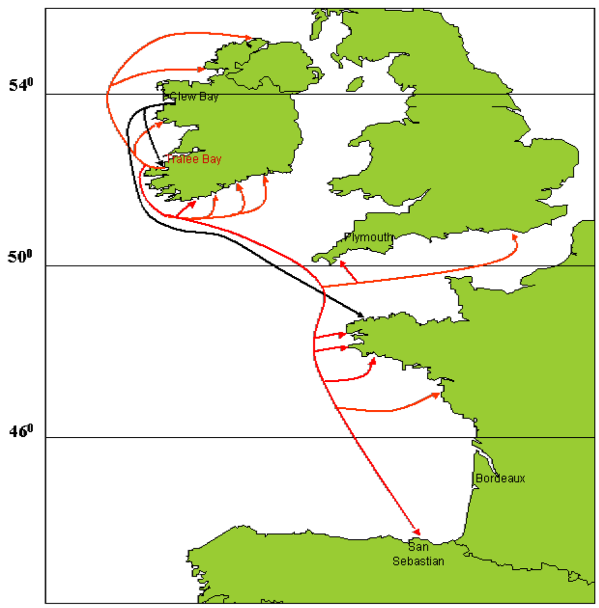


Figure 4: Angel shark *Squatina squatina* migration patterns, 1970–2006. n=190. Source Irish Central Fisheries Board, from ICES WGEF 2007.



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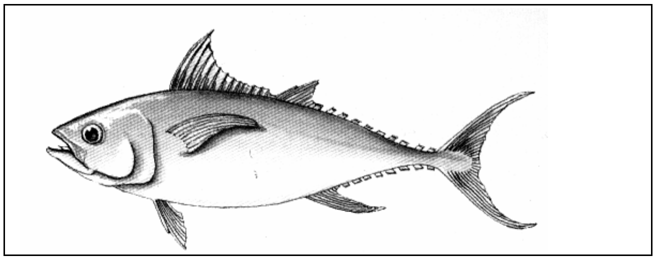
Nomination

Thunnus thynnus, Atlantic Bluefin tuna



Geographical extent

OSPAR Regions; V
Biogeographic zones:1,2,4-8
Region & Biogeographic zones specified for decline and/or threat: as above

The Atlantic Bluefin tuna is an oceanic species that comes close to shore on a seasonal basis. Current management regimes work on the basis of their being two stocks, an Eastern Atlantic and a Western Atlantic stock, although some intermingling is thought to occur along the Gulf Stream in the mid-Atlantic at the northern end of their respective ranges (ICCAT, 2002). The eastern North Atlantic stock ranges from the southern coasts of Iceland to the Canary Islands and spawns in the Mediterranean. The bluefin is mainly a summertime visitor to northern European waters (Wheeler, 1978).

Application of the Texel-Faial criteria

There were two nominations for bluefin tuna to be placed on the OSPAR list, citing decline, and sensitivity. Information was also provided on threat.

Decline

The Atlantic Bluefin Tuna used to be common in the Norwegian Sea, North Sea, Skagerrak, and Kattegat, and supported major sport and commercial fisheries in these areas between the 1930-1950's. The total weight of tunas brought to Danish fishing harbours in 1959 was 772 000 kg, (approximately 8000 bluefins), for example. Today there is no fishing at all for tuna in Danish waters or any part of the North Sea.

Although much reduced compared to the early part of the 20th century, the abundance of the Eastern Atlantic stock of bluefin tuna appeared to be relatively stable in the 1980s. This has been followed by a strong decline in number and biomass of older fish since 1993. The reported catch for the East Atlantic and Mediterranean stocks in 2000 was 33,754 MT, about 60% of the peak catch in 1996 although this is probably an under-estimate because of increasing uncertainty about catch statistics (ICCAT, 2002).

The best current determination of the state of the stock is that the Spawning Stock Biomass is 86% of the 1970 level. This is similar to the results obtained in 1998 in terms of trends, but more optimistic in terms of current depletion. Nevertheless, the International Commission for the Conservation of Atlantic Tunas (ICCAT) considers that current catch levels are not sustainable in the long-term (ICCAT, 2002).

Sensitivity

The Atlantic bluefin tuna has a slow growth rate, long life span (up to 20 years) and late age of maturity for a fish (4-5 years for the eastern stock) resulting in a large number of juvenile classes. These characteristics make it more vulnerable to fishing pressure than rapidly growing tropical tuna species (ICCAT, 2002).

Threat

The main threats to the Atlantic Bluefin tuna are overexploitation of older fish and a high fishing pressure on small fish that is contributing to growth over-fishing and threatening natural recruitment. Bluefin tuna are also taken as by-catch in some longline fisheries.

A regulatory recommendation to limit the fishing mortality came into force in 1975 (and was subsequently extended indefinitely for the East Atlantic) yet fishing mortality rates have exceeded that of 1974 in most years. The recommended minimum sizes have also been poorly enforced and as a result the threat to this species remains high.

In 2000 the level of fishing mortality was almost 2.5 times higher than that which maximises yield per recruit. ICCAT therefore repeated the advice given in their 1998 report that current catch levels cannot be sustained in the long-term under the current selectivity pattern and current fishing mortality rate for the stock. They also continue to be concerned about the intensity of fishing pressure on small fish and noted that the recent abrupt increase of catches of large fish since 1994 is of grave concern.

Relevant additional considerations

Sufficiency of data

ICCAT compile fisheries statistics, carry out assessments and provide management advice on catch levels for a number of species including the

Atlantic bluefin tuna. The most recent assessments for the Eastern Atlantic stock were carried out in 1998 and 2002. The Committee suspects that there was over-reporting between 1993-1997 and increased under reporting in the last few years, especially since 1998, which affects confidence in the assessments based on these data. An assessment was not completed in 2000 because of uncertainties in the basic catch data (primarily in the Mediterranean). Uncertainties remain in 2002 and are a central issue in the East plus Mediterranean assessment. Because of these uncertainties the Committee was not in a position to give or suggest any strong management recommendations for the short or medium term in its 2002 report.

Changes in relation to natural variability

Although the status of bluefin tuna will be affected by ocean conditions, food supply, and other natural changes, there is little to suggest that that these factors would have caused the major declines in bluefine tuna that have been observed, without overfishing.

Expert judgement

Due to the diversity of tuna fisheries in OSPAR Region V, landing statistics are difficult to obtain and have to be interpreted with caution, as it is believed that large quantities of undersized fish are caught but not reported. In addition, most of the ICCAT statistics and projections treat the smaller Eastern Atlantic stock together with the larger Mediterranean stock.

ICCAT has been concerned for some years about the quality of catch, effort and catch at size data available to conduct quantitative assessments for East Atlantic bluefin tuna. This remains a concern and unless the situation improves, they have reported that the quality of the advice that the Committee can provide will continue to deteriorate.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; *Category of effect of human activity:* Biological – removal of target and non-target species.

In the OSPAR Maritime Area fisheries for bluefin tuna operate in the Bay of Biscay and off the Iberian Peninsula. Fisheries in the North Sea collapsed many years ago. In its 2002 advice, ICCAT, recorded its concern about the introduction in 2003 of new gears such as purse seines and longlines that are replacing albacore driftnets in the Bay of Biscay that could be targeting or increasing by-catch of juvenile bluefin in this area. The threat to this species is clearly linked to human activities and this situation does not seem likely to change in the near future either in the OSPAR Maritime Area or in other parts of its range.

Management considerations

The International Commission for the Conservation of Atlantic Tunas (ICCAT) is an inter-governmental fishery organization responsible for the conservation of tunas and tuna-like species in the Atlantic Ocean and its adjacent seas. One of its functions is to provide a mechanism for Contracting Parties to agree on management measures. 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.

Further information

Nominated by:
Joint submission by Iceland, Portugal and UK and submission by WWF.

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Useful References:

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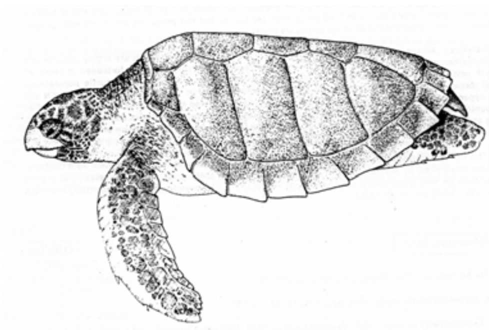
Nomination

Caretta caretta, Loggerhead Turtle



Geographical extent

OSPAR Regions; IV & V
Biogeographic zones: 1,4,5,6
Region & Biogeographic zones specified for decline and/or threat: as above

C.caretta occurs throughout the temperate and tropical regions of the Atlantic, Pacific and Indian Oceans (Dodd, 1988). The major nesting grounds in northern latitudes are on the coasts of Florida and South Carolina where at least four genetically distinct nesting subpopulations have been identified (NOAA, 2000).

Loggerhead turtles that occur in the NE Atlantic (including the OSPAR Maritime Area) are mostly juveniles in their oceanic life stage (Musick & Limpus, 1997). They are believed to belong to the breeding population of the SE United States from where they enter the NE Atlantic Gyre System as hatchlings, and may stay in this system for 7-12 years (e.g. Carr., 1986; Bolten *et al*., 1993; Bjorndal *et al.,* 2000). This species is known to occur in large numbers around the Azores and in the seas north of these islands, as well as along the Atlantic coast of southern Spain in late summer (Brongersma, 1995). Some of the latter could possibly be hatchings from nesting beaches along the coast of Morocco.

There are no loggerhead nesting beaches in the OSPAR Maritime Area.

Application of the Texel-Faial criteria

C.caretta was nominated for inclusion on the OSPAR list with particular reference to decline and sensitivity with information also provided on threat.

Decline

Detailed information on population sizes and trends is difficult to obtain and interpret, especially for the younger age classes that may spend several years adrift in the North Atlantic. It is generally believed that there has been a historical decline in the numbers of loggerhead in several areas such as the Bahamas, Cuba, Honduras and Mexico (Ross, 1982; Frazer, 1995).

The most suitable index to population stability at the current time is believed to be the numbers of females nesting at a given rookery from year to year. Bolten *et al*. (1998) demonstrated that the juvenile loggerheads encountered in Azorean waters are primarily derived from the nesting populations of the southeast U.S. and represent the size classes missing in that region (Carr,1986). A recent assessment of these populations is shown in Table A.

TABLE A: Assessment of loggerhead populations on US nesting beaches made by the US Turtle Expert Working Group of NOAA (NOAA, 2000).

Sub-Population	Approx No of nests (1998)	Assessment
Northern	7,500	Stable or declining
South Florida	83,400	Stable or increasing
Florida panhandle	1,200	Increasing*
Yucatan	1,000	Not determined

* thought to be due to expanded beach monitoring.

Sensitivity

The loggerhead turtle is a long-lived, late-maturing animal with growth rates dependant on temperature, food quantity and food quality. It is sensitive to marine pollution, particularly oil, which has been observed in the mouth and stomach of both juvenile and adult turtles.

Threat

C.caretta is threatened by actions on nesting beaches, habitat loss, disturbance, and egg collecting (e.g. Frazer, 1995). At sea the main threats come from incidental capture and entanglement in fishing gear, ingestion of persistent marine debris and marine pollution (e.g. Lutcavage *et al.*, 1997). The loggerhead also used to be collected for human consumption/ sale to tourists in the Azores and Madeira during the late 1960's-70's (Brongersma, 1995).

In the OSPAR Maritime Area, the main threats to this species come from fisheries activity, and marine litter. Two fisheries which are known to result in the incidental capture of loggerhead turtles in the OSPAR Maritime Area are the tuna drift net fishery and the swordfish longline fishery. In 1998, for example, the estimated total capture of loggerhead turtles was 4,190 from surface longlines targeting swordfish in the EEZ of the Azores (Ferreira *et al*., 2001). Other studies point to mortality rates from long line fisheries of somewhere between 10-30% of turtles caught. It can be concluded that there has been and continues to be a threat to this species across its range within the OSPAR Area.

Relevant additional considerations

Sufficiency of data

Estimates of the world population of loggerhead turtles rely on information about the number of adult nesting females at the major nesting sites. In many cases the data set covers more than a decade. There are also data on the incidental capture of turtles (including loggerhead), strandings, and sightings records.

The annual fluctuations in the number of nesting females in a given rookery from year to year makes it difficult to assess trends in population size based on number of nesting females. Such annual fluctuations may mask general trends in population size unless studies are carried out over several decades (Richardson 1982 in Frazer, 1995), however most estimates of population increase, stability or decline, currently rely on monitoring numbers. It is generally agreed that this is the most suitable index to population size at the present time (Frazer, 1995).

Changes in relation to natural variability

It is not unusual to observe large fluctuations in numbers of nesting loggerheads from year to year in a given locality (NRC, 1990). The causes are not understood but are presumed to be environmentally induced, perhaps involving the accumulation of resources necessary for reproduction (Wilbur & Morin, 1988).

Expert judgement

In a species with a long age to maturity, such as the loggerhead, nesting trends alone may give an incomplete picture of population status. It is conceivable for a population with no new recruitment to the benthic juvenile stage to continue to show increases in nesting for a number of years as benthic juveniles from past cohorts mature. Conversely a population could continue to show declines in nesting over time due to losses of adults while the immature population is increasing. Thus multiple lines of evidence must be considered in order to determine true population status (NOAA, 2000).

It is difficult to ascertain whether occasional years of heavy depredation of loggerhead eggs and hatchlings is a normal or abnormal occurrence in a particular areas, but it is believed that sustained levels of heavy predation on these early life stages can severely threaten loggerhead populations if, as a result of human induced mortality, the adults and larger juveniles are not experiencing their typically high natural survival (Crouse *et al.,* 1987).

ICES evaluation

The ICES Advisory Committee on Ecosystems (ICES 2003) concluded that the data for loggerhead turtles meets the Texel-Faial criteria for declining and threatened species.

Threat and link to human activities

Cross-reference to checklist of human activities in OSPAR MPA Guidelines
Relevant human activity: Fishing, hunting, harvesting; land-based activities, tourism & recreational activities; *Category of effect of human activity:* Physical – visual disturbance, litter; Biological – removal of target and non-target species.

Both direct and indirect links between human activities and the threat to loggerhead turtles are well known. The clearest of these are harvesting of eggs and incidental capture of both juvenile and adult turtles in fishing gear.

Because of their feeding behaviour and their habitat of over-wintering in shallow waters, loggerhead turtles are particularly vulnerable to capture by shrimp trawlers and gill nets. In US Atlantic and Gulf of Mexico waters many thousands of loggerheads drowned each year in shrimp trawl nets (Henwood & Stuntz, 1987), a situation which led to the development and introduction of Turtle Excluder Devices in shrimp nets. A current major threat linked to human activity in the OSPAR Maritime Area is the incidental capture of loggerhead turtles in pelagic longline fisheries.

Management considerations

Management measures that would aid the conservation of *C.caretta* are protection of nesting sites, including from egg collection, reduction in the direct and incidental capture of adults and the larger juveniles in the oceanic stage of their life cycle, and improvements in water quality (litter and pollution). All but the first of these is relevant to turtle conservation in the OSPAR Maritime Area. Much work has been done on the development and introduction of turtle excluder devices to reduce by-catch of turtles in shrimp trawl nets in US waters. Within the OSPAR Maritime Area, experimental work is currently underway in the Azores to evaluate the effects of hook type on sea turtle bycatch in the swordfish longline fishery (Bolten *et al*., 2000).

The loggerhead turtle is classified as Endangered by the IUCN (Hilton-Taylor, 2000). This species is also listed for protection on the EC Habitats & Species Directive, the Bern Convention and the Bonn Convention. International Trade in sea turtle products and sub-products is also forbidden under CITES except for certain countries where they are considered to be part of internal traditional customs or rituals.

Further information

Nominated by:
Joint submission from Iceland, Portugal, UK for OSPAR Area V and from Portugal for OSPAR Area IV.

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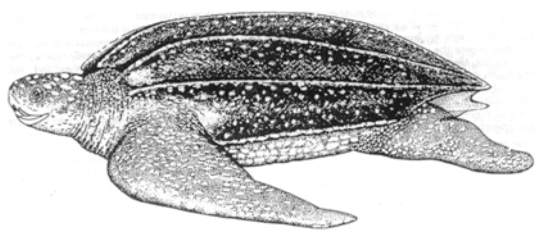
Nomination
Dermochelys coriacea,
Leatherback Turtle



Geographical extent
OSPAR Region; All
OSPAR Biogeographic zones: All
Region & Biogeographic zones specified for decline and/or threat: as above

D.coriacea is a highly pelagic species with a global distribution that extends across temperate and tropical latitudes. Today, the largest populations are in the Atlantic and Caribbean . The major breeding grounds for this species are in the eastern Pacific and western Atlantic. There are no nesting beaches in the OSPAR Maritime Area. Adult leatherbacks have been recorded in the Barents Sea, the North Sea and the NE Atlantic (Brongersma, 1972; Márquez, 1990). These are not considered to be vagrants and hence the OSPAR Maritime Area is within the natural foraging range of this species.

Application of the Texel-Faial criteria
D.coriacea was nominated for inclusion on the OSPAR list with particular reference to decline and sensitivity with information also provided on threat.

Decline

Using data from nesting beaches, the global population of adult female leatherback turtles was estimated to be around 115,000 in the early 1980's and the population as a whole was considered to be endangered (Pritchard, 1982). A more recent estimate gives a figure of around 34,500 (with confidence limits giving lowest and highest estimates between 26,200– 42,900) of which the eastern Atlantic population of nesting females was estimated to be around 4,638 (±763) (Spotila *et al* 1996). These figures point to a possible decline of around 60% in the intervening period. There are no estimates of the likely population size in the OSPAR Maritime Area.

Losses of entire nesting colonies and dramatic declines at other colonies, compared to fluctuations and increases at others, have raised concern about the status of this species. A first attempt at mathematical modelling suggests that the Indian Ocean and western Pacific cannot withstand even moderate levels of adult mortality and that even the Atlantic populations are being exploited at a rate that cannot be sustained (Spotila *et al* 1996). It has been suggested that leatherback turtles are being exploited at an unsustainable levels and are "on the road to extinction" however the precise situation remains unclear at the present time because of the difficulties of developing and running population models for this species (Pritchard, 1996).

Sensitivity

Mathematically modelling of population dynamics suggest that an increase in adult mortality of more than 1% above background levels in a stable population cannot be sustained (Spotila *et al.,* 1996). There is also the view that the leatherback is a vigorous and dynamic species and able to show quite rapid response to protection (Pritchard, 1996). The sensitivity of *D.coriacea* to pollutants such as crude oil and pesticides has yet to be determined.

Threat

Legal and illegal, commercial and subsistence, exploitation in some parts of the world, targeting both adult turtles and their eggs, is a significant threat to the leatherback and has led to massive declines in the number of adult females on some well-studied nesting beaches (e.g. Spotila *et al.,* 1996). The other main threats are from habitat damage to nesting beaches, incidental capture and entanglement in fishing gear, ingestion of persistent marine debris and marine pollution (e.g. Lutcavage *et al*., 1997).

In the OSPAR Maritime Area, the main threats to this species come from fisheries activity and marine litter. There are records of leatherbacks captured in driftnets, trawls, set gill nets, purse seines, long line fisheries and lines of pot fishing gear (e.g. Brongersma, 1972; Godley *et al*., 1998; Pierpoint, 2000). The ingestion of plastic bags, presumably mistaken for jellyfish, can also be fatal and has been reported from post-mortem examinations on stranded turtles (e.g. Duron & Duron 1980; Berrow & Rogan, 1995). There is also a possibility that some turtle mortality is caused by collisions with vessels (Haelters *et al*., 2001). It can be concluded that there has been and continues to be a threat to this species across its range within the OSPAR Area.

Relevant additional considerations

Sufficiency of data

Estimates of the world population of leatherback turtles rely on information about the number of adult females at the major nesting sites. In many cases the data set covers more than a decade. There are also data on the incidental capture of turtles (including leatherback), strandings, and sightings records.

Modelling the population dynamics of *D.coriacea* is in the early stages of development with the main input data being records of the number of nesting adult females. Important areas of uncertainty include knowledge about the intermediate life-stages, the longevity of the species, and the limited number of years of available data to examine for trends.

Changes in relation to natural variability

Leatherback numbers on nesting beaches are known to fluctuate greatly from year to year (e.g. Girondot & Fretey, 1996), with the possibility of long-term natural cycles of considerable amplitude (Pritchard, 1996). This may be due to variations in reproductive cycles, food supply, environmental conditions on their foraging grounds and effects of mortality at various stages of their life histories. Natural fluctuations also occur in relation to the success rate of hatching. Storm events and seasonal erosion can degrade or destroying nesting beaches and result in egg losses for example. Females digging into nests constructed earlier in the season may also destroy eggs. These factors mean that there is some uncertainty about how the scale of the current declining trend relates to natural variability of the population.

Expert judgement

Current population estimates are derived from figures of the number of nesting adults and it is not clear how much, if any of this, can be attributed to a natural fluctuation (perhaps related to El Nino) or a warning that the population is in serious jeopardy (Eckert, 1995). Some nesting populations have been virtually extirpated however. This is the case in Mexico which has the largest breeding colony of leatherback turtles in the western hemisphere, and where there have been enormous losses of both adults and eggs in recent decades (Pritchard, 1982; Eckert, 1993).

ICES evaluation

The ICES Advisory Committee on Ecosystems (ICES 2003) concluded that the data for loggerhead turtles meets the Texel-Faial criteria for declining and threatened species, although some available data for by-catch.

Threat and link to human activities

Cross-reference to checklist of human activities in OSPAR MPA Guidelines
Relevant human activity: Fishing, hunting, harvesting; land-based activities, tourism & recreational activities; *Category of effect of human activity:* Physical – visual disturbance, litter; Biological – removal of target and non-target species

Both direct and indirect links between human activities and the threat to leatherback turtles are well known. The clearest of these are harvesting of eggs which has been recognised as the main cause for the collapse in some areas (e.g. Chan & Liew, 1996). Incidental capture of adult turtles in fishing gear is also well reported, although the mortality rate of individuals that are subsequently released is not known. Links have also been made between activities on the High Seas and the decline in numbers of leatherbacks nesting on particular beaches (Eckert, 1997). An indirect cause of mortality is the ingestion of plastic debris.

Management considerations

Management measures that would aid the conservation of *D.coriacea* are protection of nesting sites including from egg collection, reduction in the direct and incidental capture of adults, and improvements in water quality (litter and pollution). All but the first of these is relevant to turtle conservation in the OSPAR Maritime Area.

The leatherback turtle is classified as Critically Endangered by the IUCN (Hilton-Taylor, 2000). This species is also listed for protection on the EC Habitats & Species Directive, the Bern Convention and the Bonn Convention. International Trade in sea turtle products and sub-products is also forbidden under CITES except for certain countries where they are considered to be part of internal traditional customs or rituals.

Further information

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United Kingdom

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Useful References:

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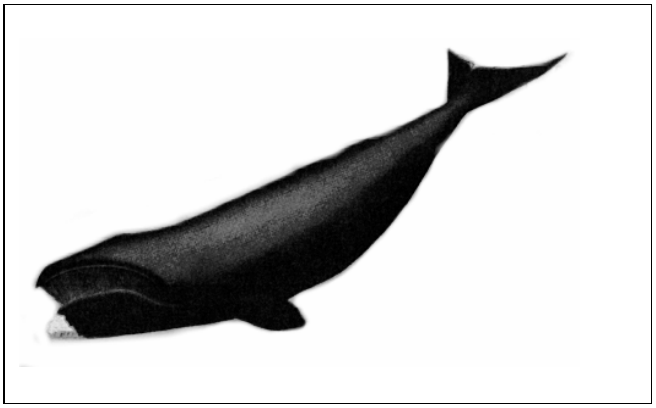
Nomination

Balaena mysticetus, Bowhead whale



Geographical extent

OSPAR Region; I
Biogeographic zones: 3,12,18-20
Region & Biogeographic zones specified for decline and/or threat: as above

Bowhead whales inhabit arctic and sub-arctic waters between 55º and 80ºN. There are believed to be four different stocks; Spitsbergen, Hudson Bay/Davis Strait, Bering/Chukchi/Beaufort Seas and Okhotsk Sea. The animals migrate to northerly feeding grounds in spring and summer, returning to the southern parts of their range in late autumn (Christensen *et al,* 1992). The Spitsbergen stock is found in the waters around Greenland, Norway and Russian but centred in the Greenland and Barents Seas (IUCN, 2002).

Application of the Texel-Faial criteria

B.mysticetus was nominated for inclusion by one Contracting Party citing rarity, decline and sensitivity, with information also provided on threat.

Decline

Before hunting started in the 17th century the population of the Spitsbergen stock of the bowhead whale was estimated to be about 25,000 (Klinkowka, 1991). Populations were quickly depleted because of the ease with which this species could be caught. Today there are believed to be only a few tens of individuals (only 24 sightings, including one dead animal, between 1958 and 1983) (Klinkowka, 1991, Zeh *et al.,* 1993). Sightings in the Russian region of the Arctic suggest that there may be more whales in this area but it is unclear whether these are a few remaining individuals from the original Spitsbergen stock or immigration from another stock.

Sensitivity

Ice-associated animals, such as the bowhead whale, may be sensitive to changes in Arctic weather, sea-surface temperatures or ice extent. Like other marine mammals they are generally characterised by low annual mortality and long life spans. There are believed to be less than 50 mature individuals in the Spitsbergen stock, which makes the whole stock very vulnerable to extinction.

Cetaceans use sound to provide information about the physical environment, to communicate between individuals and for the detection of potential prey. Baleen whales, such as the bowhead emit low frequency sound that can travel hundreds of kilometres (Evans, 2000). This makes them sensitive to acoustic disturbance from military activities such as naval sonars (particularly low frequency acoustics), as well as other sources such as seismic exploration. The whales will be particularly vulnerable if the zone of influence coincides with migration and breeding areas.

Threat

In the past the main threat to this species was commercial whaling whereas today it is pollution. Oil pollution is of particular concern because oil spilled in polar regions tends to accumulate at the ice edges, the preferred habitat of these whales. One of their main methods of feeding involves skimming the water at the surface, making them more likely to ingest oil.

Synthetic toxins such as DDT and PCBs are another threat. High levels of these compounds have been found in the blubber of several whale species. Although the detrimental effects of chlorine compounds on whales has not been proven, birth abnormalities have been reported in seals in association with high levels of these chemicals. The population may also be exposed to radionuclides in the food chain in Arctic waters. Acoustic disturbance from shipping, military and research activities adds to the pressures on this species.

Any shifts in regional weather patterns which affect sea-surface temperature and the extent of sea ice, are another potential threat but it is not possible to make reliable predictions of the effects of Arctic climate change on bowhead whales at the present time.

Relevant additional considerations

Sufficiency of data

Data from past whaling activities in the Arctic confirm that large numbers of bowhead whale were taken by whalers. There is some uncertainty about the precise size of the population today as the species is very rare.

Changes in relation to natural variability

The large numbers of bowhead whales that were fished during earlier centuries will have masked any changes in the population caused by natural variability. With such a small number remaining, natural variability may however become a major contributory factor in its local extinction.

Expert judgement

Information on the catches of bowhead whale in the Arctic reveal the historic decline in this species, its vulnerable status today, and the threat of it becoming extinct in the OSPAR Maritime Area.

ICES Evaluation

The ICES Advisory Committee on Ecosystems (2003) concluded that there is good evidence of a decline in populations of the Bowhead Whale but currently rather little evidence of direct threat.

Threat and link to human activities

Cross-reference to checklist of human activities in OSPAR MPA Guidelines
Relevant human activity: Shipping & navigation, military activities; fishing, hunting, harvesting, research. *Category of effect of human activity:* Physical – Noise disturbance, Biological – removal of target species, removal of non-target species, physical damage to species.

Commercial whaling, and therefore human activity, is known to have caused the significant decline of the bowhead whale. Current threats from poor water quality and acoustic disturbance are also linked to human activities.

Management considerations

All states whose waters this species is found in are members of the International Whaling Commission (IWC). and two of them (Norway and Greenland) are also members of the North Atlantic Marine Mammal Commission (NAMMCO). The IWC have banned commercial whaling of the bowhead whale since 1975 however some aboriginal whaling does take place. Apart from protection from whaling, other measures that would help safeguard this species are more indirect such as minimising the risk of marine pollution and ensuring a high water quality in the Arctic. OSPAR does not deal with whaling issues directly but can communicate an opinion on it to the IWC and members of the North Atlantic Marine Mammal Commission (NAMMCO).

The Spitsbergen stock of bowhead whale has been classified as Critically Endangered by IUCN (IUCN, 2002).

Further information

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Useful References:

Christensen, I., Haug, T, & Oyen, N. (1992). Seasonal distribution, exploitation and present abundance of stocks of large baleen whales (Mysticeti) and sperm whales (*Physeter macrocephalus*) in Norwegian waters. *ICES J.Mar.Sci*. 49:341-355.

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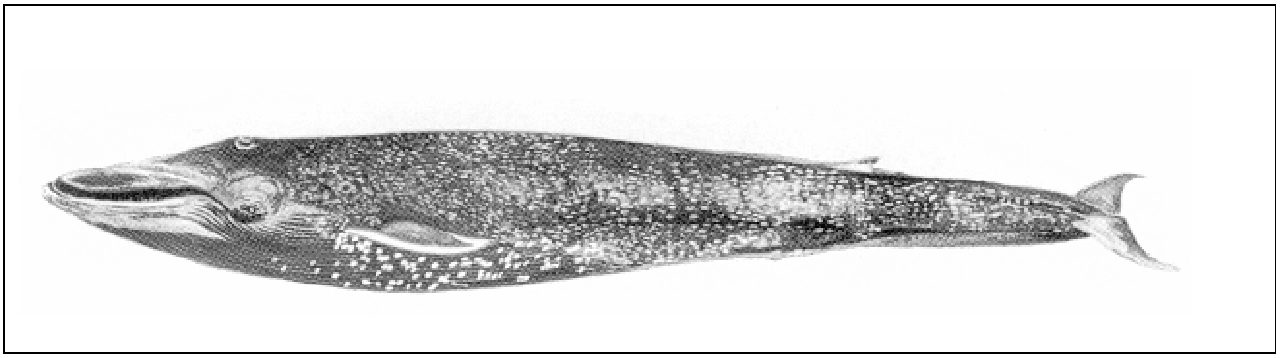
Nomination

Balaenoptera musculus, Blue whale



Geographical extent

OSPAR Region; All
Biogeographic zones: 1-20
Region & Biogeographic zones specified for decline and/or threat: as above

The blue whale is found in all major oceans of the world. There are considered to be two stocks in the North Atlantic and it is the east Atlantic stock that occurs in the OSPAR Maritime Area. The migration patterns of this stock are poorly known. Some blue whales are known to winter off the Azores and Cape Verde Islands. In spring blue whales migrate to the productive feeding grounds around Iceland, in the Barents Sea and around Spitzbergen.

Application of the Texel-Faial criteria

B.musculus was nominated for inclusion in a joint submission by three Contracting Parties citing sensitivity, keystone role and decline with information also provided on threat.

Decline

The blue whale has been severely depleted throughout its range. Whaling during the late 1800s and early 1900s targeted stocks in the North Atlantic and the North Pacific and then moved to other areas leading to a drastic reduction of the population throughout the world. The North Atlantic stock is estimated to have been made up of around 3,500 whales in Northern Norway and 10,000 in the Denmark Strait (FAO, 1978; Yochem & Leatherwood, 1985). Large scale sightings surveys in the North Atlantic in 1987 and 1989 gave estimates of the population around Iceland as 442 and 878 respectively with very few observations in other parts of the survey area (i.e. off Norway, Greenland, the Faeroes and Spain). Gunnlaugsson & Sigurjónsson, 1990; Sigurjónsson & Víkingsson 1997).

There are no agreed figures for the population of the blue whale in the northern hemisphere at the present time. The IWC only makes an estimate for blue whales in the southern hemisphere and Randall *et al*., (2002) have recently suggested that there are perhaps a few hundred to a thousand Blue Whales remaining in the North Atlantic.

Keystone species

The blue whale is a baleen whale that feeds almost exclusively on a few species of euphausiids and copepods in highly productive polar waters. There is evidence to suggest they also feed on shallow banks in the Azores before resuming migratory movements and where they probably have a significant impact on plankton numbers, consuming around 2-4 tonnes of food a day.

Sensitivity

Like other cetaceans the blue whale has a low reproductive rate and late age of maturity. This means that recovery of depleted populations will take many decades rather than years. Cetaceans use sound to provide information about the physical environment, to communicate between individuals and for the detection of potential prey. Baleen whales, such as the blue whale emit low frequency sound that can travel hundreds of kilometres. This makes them sensitive to acoustic disturbance from military activities such as naval sonars (particularly low frequency acoustics), as well as other sources such as seismic exploration. The whales will be particularly vulnerable if the zone of influence coincides with migration and breeding areas. In the case of the blue whale this would include the edge of the continental shelf that may be an important migration route for this species (Evans, 2000).

Threat

The blue whale was the preferred target of modern whalers because of its size and, once they could be taken and processed on factory ships, they were hunted in all the world's oceans. Catches peaked in 1930-31 when nearly 30,000 were taken worldwide. It has also been estimated that over 280,000 blue whales (including pygmy blues) were taken between 1924-5 and 1970-71, mostly in the Southern Hemisphere (Chapman (1974) in Klinowska 1991). Commercial whaling was therefore the overriding threat to this species until it was banned in 1964. Current threats come from acoustic disturbance and habitat degradation. Depletion of food resources is an issue in the Antarctic where krill are harvested. This is not the case in the Arctic however there are also other influences on krill abundance and therefore it is not clear if this is a threat to blue whales in the Arctic. Boat collisions also pose some threat to the whales during their spring and autumn migrations.

Relevant additional considerations

Sufficiency of data

Data are available on the numbers of whales taken during the period when they were subject to commercial exploitation. Since then sightings data have been collected to determine population size and trends. Given the current rarity of the species, with the exception of a few areas, the population density is too thin to enable any recovery to be detected from surveys except over a very long period (Klinowska, 1991).

Changes in relation to natural variability

The large numbers of blue whales that were taken by commercial whalers will have masked any changes caused by natural variability. With such a small number remaining, natural variability may however become a major contributory factor in any further decline.

Expert judgement

There is overwhelming evidence of the severe decline in blue whale numbers as a result of past commercial whaling activity. Current threats are known but there is uncertainty about precise trends in the North East Atlantic stock. The IWC gives no estimate of population size for blue whales in the Northern Hemisphere at the present time.

ICES Evaluation

The species occurs in all regions of the OSPAR area, but in Region II is peripheral to the range of the species. The ICES Advisory Committee on Ecosystems (ICES, 2003) concluded that there is good evidence of decline but there is no evidence of a direct threat currently although indirect threats such as pollutant effects may be present.

Threat and link to human activities

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

Relevant human activity: Shipping & navigation; military activity; fishing, hunting, harvesting; research. *Category of effect of human activity:* Physical – Noise disturbance. Biological – removal of target species, removal of non-target species, physical damage to species.

Commercial whaling was undoubtedly the cause of the decline in blue whale numbers in the last century and therefore there was a clear link between the threat to this species and human activities. Today the threats that may lead to further decline or failure to recover are more indirect unless whaling resumes. They include marine pollution, poor water quality, acoustic disturbance, and collisions with vessels.

Management considerations

The population was severely depleted before it was given protection by the IWC in 1964 and, while it is too rare to be the main target species of any fishery it is vulnerable to illegal whaling. OSPAR does not deal with whaling issues directly but can communicate an opinion on it to the IWC and members of the North Atlantic Marine Mammal Commission (NAMMCO). Management measures need to be geared towards enabling the recovery of the population and, apart from direct protection this could include actions to minimise acoustic disturbance.

The IUCN have classified the Blue Whale as an endangered species (IUCN, 2002).

Further information

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Contact persons:
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Useful References:

Chapman, D.G. (1974. Estimation of population parameters of Antarctic baleen whales. In: W.E. Schevill (Ed) The Whale Problem: A Status Report. Harvard University Press, Cambridge Mass, USA.

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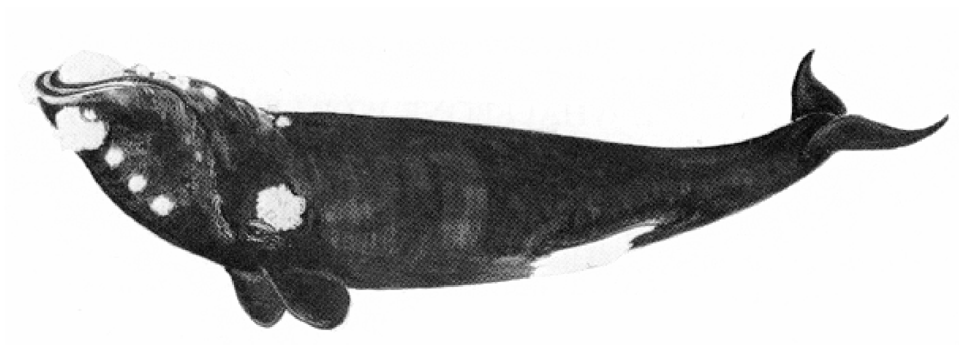
Nomination

Eubalaena glacialis, Northern Right whale



Geographical extent

OSPAR Region; All
Biogeographic zones: 1,2,3
Region & Biogeographic zones specified for decline and/or threat: as above

The North Atlantic population of this species is usually divided into an eastern and western stock although photo-identification and preliminary genetics data from recent work suggests that there may be links between animals found in the western and eastern Atlantic (Knowlton *et al.,* 1992; Evans, 2000).

In the OSPAR Maritime Area there have been sightings of the northern right whale on or near continental shelf edges off the Iberian Peninsula, the Irish Sea, west of Scotland and Ireland, in Norway and south of Iceland (Evans, 2000). The whales use northern feeding grounds in the spring then move to temperate waters in autumn and winter. Historically the main calving grounds included the Bay of Biscay and there were feeding areas in Scandinavian waters (Collet, 1909; Thompson, 1928; Fairley, 1981).

Application of the Texel-Faial criteria

E.glacialis was nominated for inclusion by one Contracting Party citing regional importance, rarity, decline and sensitivity, with information also provided on threat.

Regional importance

The historic distribution of the eastern stock of *E.glacialis* included areas both inside and outside the OSPAR Maritime Area. Given the current endangered status of this species the remaining whales within the OSPAR Area are of regional importance.

Decline

Tens of thousands of northern right whales were caught in earlier centuries (mostly before 1800) but historic records are not complete enough for pre-whaling population numbers to be estimated accurately. The current size of the North Eastern Atlantic population is unknown but it is estimated to be no more than the low tens of individuals (Brownell, *et al*. 1986; Kraus *et al.,* in Evans, 2000). The species was believed to be near extinction in the late 1980’s, with possibly only a few individuals remaining, and there is no evidence of recovery (Klinowska, 1991).

Sensitivity

Many populations of *E.glacialis* occurred in coastal waters of temperate regions and appeared to depend on inshore areas for reproductive activities. This species may therefore be more vulnerable to the detrimental effects of human activity than many other cetaceans (Klinowska, 1991).

Cetaceans use sound to provide information about the physical environment, to communicate between individuals and for the detection of potential prey. Baleen whales, such as the northern right whale emit low frequency sound that can travel hundreds of kilometres. This makes them sensitive to acoustic disturbance from military activities such as naval sonars (particularly low frequency acoustics), as well as other sources such as seismic exploration. The whales will be particularly vulnerable if the zone of influence coincides with migration and breeding areas (Evans, 2000).

Threat

The northern right whale has been hunted in the North Atlantic since the 10-11th centuries. The population has been severely depleted as a result and it is now probably the most endangered of the large whale species (Klinowska, 1991). The main current threats are from entanglement in fishing gear, ship strikes and pollution (bioaccumulation of heavy metals and organochlorines, oil pollution, and radioactivity) and acoustic disturbance.

Relevant additional considerations

Sufficiency of data

Most of the historic data on northern right whales comes from whaling records. Sightings schemes are a more recent source of information but it is difficult to determine population size from these data as the animals are so rare.

Changes in relation to natural variability

The large numbers of northern right whales that were fished during earlier centuries will have masked any changes in the population caused by natural variability. With such a small number remaining, natural variability may however become a major contributory factor in its local extinction.

Expert judgement

Historic records show that tens of thousands of whales were caught when it was the target of whaling during earlier centuries leading to the historic decline in this species. It is also clear that it remains vulnerable today, and that there is a threat of it becoming extinct in the OSPAR Maritime Area.

ICES Evaluation

The species occurs in all regions of the OSPAR area, but in Region II is peripheral to the range of the species. The ICES Advisory Committee on Ecosystems (ICES, 2003) concluded that there is good evidence of decline but there little evidence of direct threats currently, owing to the extremely low populations size.

Threat and link to human activities

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

Relevant human activity: Shipping & navigation, military activity, research; fishing, hunting, harvesting; *Category of effect of human activity:* Physical – noise disturbance. Biological – removal of target species, removal of non-target species, physical damage to species.

Whaling, and therefore human activity, is known to have caused the significant decline of the northern right whale. Current threats from ship collisions, marine pollution, water quality (through bioaccumulation), acoustic disturbance, and entanglement in fishing gear are also linked to human activities.

Management considerations

The population was severely depleted before it was given protection by the International Whaling Commission (IWC). The ban needs to remain in place and management measures need to be geared towards enabling the recovery of the population. OSPAR does not deal with whaling issues directly but can communicate an opinion on it to the IWC and members of the North Atlantic Marine Mammal Commission (NAMMCO).

The IUCN have classified the northern right whale as an endangered species (IUCN, 2002).

Further information

Nominated by:
UK

Contact persons:
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Useful References:

Collett, R. (1909). A few notes on the whale *Baleana glacialis* and its capture in recent years in the North Atlantic by Norwegian whalers. *Proc.Zool.Soc.Lond*. 1909:91-98.

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IUCN (2002). *2002 IUCN Red List of Threatened Species*

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Kraus, S.D., Hamilton, P.K., Kenney, R.D., Knowlton, A.R. & Slay, C.K. (*in press*) Status and trends in reproduction of the northern right whale. *J.Cet.Res.Mmnt*.

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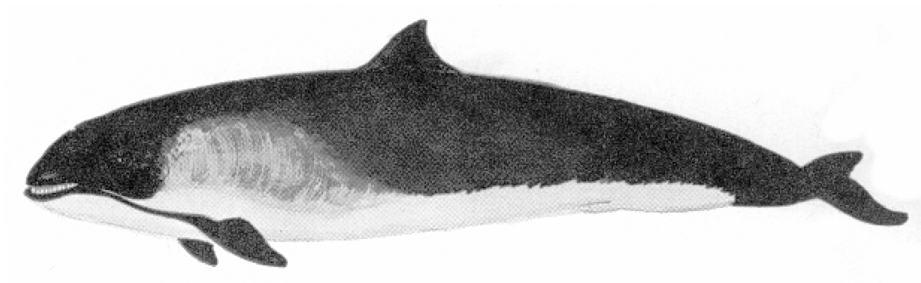
Nomination

Phocoena phocoena, Harbour porpoise



Geographical extent

OSPAR Region; All
Biogeographic zones: 1-9, 11-15
Region & Biogeographic zones specified for decline and/or threat: Decline in areas II, III, & IV, threat in all OSPAR areas.

The harbour porpoise is generally a coastal species distributed in cold temperate and subarctic waters in the Northern Hemisphere (Klinowska, 1991). In the eastern North Atlantic, it is common and widely distributed on the continental shelf from the Barents Sea and Iceland south to the coasts of France and Spain. There are thought to be a number of subpopulations in the Atlantic and possibly also in the North Sea and adjacent waters, with separate populations occurring in the Irish Sea, northern North Sea and southern North Sea (Kinze, 1990; IWC, 1996; Walton, 1997; Lockyer, 1999, Andersen *et al.,* 1999; Rosel *et al.,* 1999).

Application of the Texel-Faial criteria

There were five nominations for *P.phocoena* to be put on the OSPAR list. The criteria common to all of these were decline and sensitivity, with information also provided on threat.

Decline

A number of surveys covering different parts of the OSPAR Maritime Area have been carried out to determine the size and trends in the population of the harbour porpoise. Surveys carried out in 1988/89 estimated harbour porpoise numbers of 10,994 in the Lofoten-Barents Sea area 82,619 in the northern North Sea although these may be underestimates (Bjørge & Øien, 1995; IWC, 1990). The only dedicated survey for estimating harbour pour porpoise abundance in the region was conducted in 1994 and covered the North Sea, the English Channel and Celtic Sea (Hammond *et al.,* 2002). This resulted in an abundance estimate of between 260,000–449,000 (a suggested population of approximately 350,000) of which around 300,000 occurred in the North Sea and the remainder in the Channel and Celtic Sea. Estimates for the Barents Sea and Northern Norwegian waters were 11,000 and for southern Norway and the northern North Sea, 82,600 (Bjørge & Øien, 1995).

Declines in abundance have been reported since the 1940's as well as in more recent studies in various parts of the range of *P.phocoena*. The harbour porpoise has become scarce in the southernmost North Sea, English Channel and Bay of Biscay for example (Evans, 2000), and has declined in the Skagerrak & Kattegat (Berggren & Arrhenius, 1995a & b). It was considered to be one of the most common cetaceans in Region IV of the OSPAR Maritime Area but sightings and strandings are now only common in certain areas e.g. western Galician and northern Portuguese coasts (OSPAR, 2000).

The harbour porpoise is believed to have been common in waters off the coast of Belgium in the 19th and first half of the 20th century with data suggesting a decline in the southern North Sea between the 1970s-1990s. Since 1997 there has been an increase in the number of sightings and strandings in Belgian waters and the Netherlands but it is not clear whether this reflects an improvement in the status of the population in this area (Haelters *et al.,* 2000, Camphuysen, 1994, Witte *et al.,* 1998).

Sensitivity

The harbour porpoise is known to be sensitive to poor water quality, especially toxic contaminants which bioaccumulate and, in the case of organochlorine contamination this has been linked to reproductive failures (Addison, 1989).

Like all cetaceans they use sound for navigation, finding food, and communication and are therefore sensitive to acoustic pollution. Harbour porpoise are amongst the fastest reproducing cetaceans but depleted populations are nevertheless likely to take decades rather than years to recover.

Threat

Small cetaceans, including the harbour porpoise were taken for human consumption from the OSPAR Maritime Area until this was made illegal from 1970 (Klinowska, 1991).

The main threat to this species in the OSPAR Maritime Area today is incidental capture and drowning in fishing nets. For example, the Danish gill net fishery has been estimated to take more than 4,600 animals a year (IWC, 1996), in the Celtic Sea, by-catch rates have been estimated at more than 6% of the population per year (Tregenza *et al*. 1997), while in the Swedish Kateggat and Kattegat surveys in 1996 & 1997 calculated by-catch levels of 1.2% and 2.4% of the population in the set net fishery for cod and pollock. The International Whaling Commission/ ASCOBANS working group on harbour porpoise advised a maximum annual by-catch, assuming no uncertainty in any parameter, of 1.7% of the population size per year if the population is to be sustainable (ASCOBANS, 2000).

Other threats to this species are marine pollution, for example from toxic substances that bioaccumulate and are known to reduce reproductive fitness, as well as acoustic disturbance (from shipping traffic, oil exploration, military activities etc.) which may reduce available habitat. A reduction in prey species may also be a threat as the diet of harbour porpoises includes herring, mackerel and sandeel which are also targeted by commercial fisheries in the North Sea.

Relevant additional considerations

Sufficiency of data

Data on the status and trends of the harbour porpoise have come from sightings programmes and from observers at sea. This includes information on by-catch that has been used to estimate the impact on the population of harbour porpoises in parts of the OSPAR Maritime Area. Tagging studies have also been a source of information on the range and behaviour of harbour porpoise. The SCANS survey (Hammond et al 2002) yielded the first reliable abundance estimate of harbour porpoises in the North Sea and adjacent waters. This estimate is a good basis for estimating the threat imposed by the bycatch rates in the region and in the long run to detect changes in abundance by repeating the survey.

Changes in relation to natural variability

Little is known about the natural variability of harbour porpoise populations or whether such variability has played a role in the decline of this species in particular areas.

Expert judgement

There is a good understanding of the threats to harbour porpoise throughout the OSPAR Maritime Area but less comprehensive information on population status. The best studied area is OSPAR Region II where there is good evidence for changes in the status of the population in recent decades. There is least information on population trends in Region I. Because of this lack of information Region I has only been cited as an area where this species is threatened rather than one where it has declined.

ICES Evaluation.

The harbour porpoise occurs in all regions but the core of the range is Regions II and III. The population structure in the OSPAR area is complex. The ICES Advisory Committee on Ecosystems (ICES, 2003) concluded that there is good evidence of a declines in the past in the Channel and southern North Sea and more recently in the Baltic and good evidence that the main threat is by-catch, particularly bottom-set gillnets. The by-catch is likely to be unsustainable on the Celtic shelf, in the Baltic, and probably in parts of the North Sea

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting. military activity, research. *Category of effect of human activity:* Physical – noise disturbance. Biological – removal of target species, removal of non-target species.

The most significant threat to harbour porpoise at the present time is fishing because of the large numbers of animals that are taken as by-catch by a variety of fisheries. This threat is clearly linked to human activity and one which can be addressed through management actions directed at these fisheries.

Management considerations

The top priority for management to improve the status of this species must be aimed at reducing the incidental capture of harbour porpoise. This may include technical measures, such as acoustic deterrents, closed areas or closed seasons. More general measures concerned with fisheries management such as effort control may also be required. Other management measures should be targeted at improving coastal water quality by reducing the discharge of substances that are toxic, persistent and liable to bioaccumulate.

In the North Sea the harbour porpoise is covered by the terms of the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS), a regional agreement under the Bonn Convention. Many of the useful potential measures fall within the remit of fisheries organisations or ASCOBANS. OSPAR can however communicate an opinion on its concern about this species to the relevant bodies and introduce any relevant supporting measures that fall within its own remit if such measures exist or are introduced in the future.

The harbour porpoise is listed on Appendix II of the Bern Convention and Annexes II and IV of the Bonn Convention. IUCN assess the global status of the harbour porpoise as Vulnerable (IUCN, 2002).

Further information

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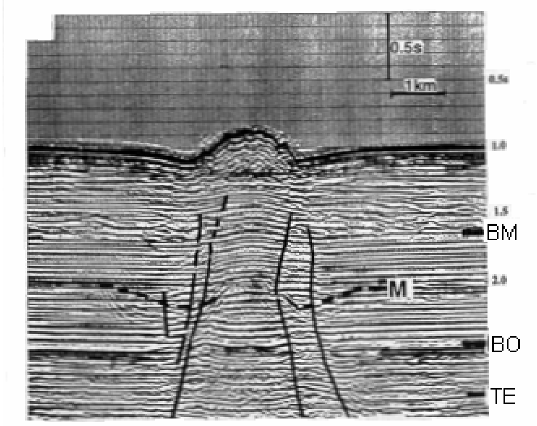
Nomination

Carbonate mounds
EUNIS code: A6.75
National Marine Habitat Classification for UK & Ireland code: Not defined



Seismic profile of carbonate mounds and sub-surface fault traces (from Hovland *et al.,* 1994).

Definition for habitat mapping

Carbonate mounds are distinct elevations of various shapes, which may be up to 350m high and 2km wide at their base (Weering *et al*, 2003). They occur offshore in water depths of 500-1100m with examples present in the Porcupine Seabight and Rockall Trough (Kenyon *et al,* 2003). Carbonate mounds may have a sediment veneer, typically composed of carbonate sands, muds and silts. The cold-water reef-building corals *Lophelia pertusa* and *Madrepora oculata*, as well as echiuran worms are characteristic fauna of carbonate mounds. Where cold-water corals (such as *Lophelia*) are present on the mound summit, coral debris may form a significant component of the overlying substratum.
There is currently speculation on the origin of carbonate mounds, with possible associations with fault-controlled methane seepage from deep hydrocarbon reservoirs, or gas-hydrate dissociation (Henriet *et al*, 1998) through to the debris from ‘cold-water’ coral colonies such as *Lophelia*.

Geographical extent

OSPAR Regions; I, V
Biogeographic zones: 21, 23, 35
Region & Biogeographic zones specified for decline and/or threat: V, 23 & 25

In recent years large clusters of giant carbonate mud mounds, some more than 300m high, have been discovered off the continental margins of Europe. They are biogenic accumulations, which generally occur, in localised clusters and which vary in size and shape, being conical, ridged and ring shaped and, in some cases, having very steep sides. Large and small dome-shaped knolls, which lie on the surface of the seabed, have been described as well as complex knolls and pinnacle knolls (Hovland *et al*., 1994). The examples in the Porcupine Basin are up to 2km long and 350m high (Kenyon *et al.,* 1998). Seismic profiles have also revealed buried mounds in the Porcupine Basin (the Magellan reefs) some 50-100m high, but covered by tens of metres of sediment (Henriet *et al.,* 1998).

Application of the Texel-Faial criteria

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

Decline

The occurrence of carbonate mounds in the OSPAR Maritime Area is not fully known. Because of this there is little information on any changes in the extent of the habitat and associated species. If mounds occur in areas targeted by demersal fisheries the habitat and associated epifauna may suffer physical damage.

Rarity

Carbonate mounds are widely distributed on the eastern margin of the North Atlantic from the Iberian Peninsula to offshore Norway in water depths of 50m to perhaps 2,000m, (Masson *et al.,* 1998). They generally occur in small, localised clusters. The findings of deep sea surveys undertaken in the last few years suggest that the European slopes of the Rockall and Porcupine Basins may be the most prolific area for the formation of carbonate mounds in the world (Anon, 1999). Recent discoveries include a giant cluster of reefs including hundreds of buried mounds off south-west Ireland (Kenyon *et al.,* 1998) and a new field of seafloor mounds in 1000m of water in the northern Rockall Trough (Masson *et al.,* 1998). The full extent of these features in the OSPAR Maritime Area is not known at the present time.

Sensitivity

Sampling of the biological communities associated with carbonate mounds have revealed that they are often dominated by suspension feeders and can support rich deepwater coral communities. Living corals have colonised some of these mounds and debris from the deep-water colonial coral (*Lophelia* sp.) have been recovered from cores as well as the surface of mounds (Kenyon *et al.,* 1998).

As the biological communities on carbonate mounds are dominated by filter feeding communities they are likely to be sensitive to siltation. Physical damage by fishing gear is known to break up corals that colonise this habitat. The delicate structure and slow growth rate of *Lophelia* makes this coral particularly vulnerable to physical damage. The growth rate is thought to be about 6mm per year implying that normal sized colonies of around 1.5m high are about 250 years old, and the reef structures seem to be relatively stable within a time scale of hundreds of years (ICES, 1999). The potential for *Lophelia* to recover after physical damage is uncertain but is probably dependent on the severity of damage and the size of the surviving coral fragments.

Ecological significance

The elevation and substrate of carbonate mounds provide a suitable surface for colonisation for many species that require hard surfaces for attachment. Because of this they can be areas of high species diversity in the deep sea and therefore of particular ecological significance. Surveys of the Porcupine Bank and Rockall Bank, have indicated that the summits and upper slopes of most of carbonate mounds and knolls identified on sidescan sonar were covered by a carpet of coral debris. Living coral was also present with the most abundant species being the colonial corals *Lophelia pertusa* and *Madrepora oculata* which formed colonies up to 30cm high. The solitary coral *Desmophyllum cristagalli* and the octocoral *Stylaster* sp. were also occasionally present and nearby areas of cobbles and small boulders provided a surface for settlement of individual coral colonies (Wilson & Vina Herbon, 1998).

Sampling of the fauna from Porcupine Basin carbonate mounds revealed that although most of the animals were suspension feeders there were also deposit feeding, carnivorous or omnivorous species (SumiNa & Kennedy, 1998). The branching structure of dead coral underlying the living colonies provided a surface for settlement which was also elevated from the seabed and was extensively colonised by sponges, bryozoans, hydroids, soft corals, ascidians, calcareous tube worms, zoanthids, crinoids and bivalves. Many large eunicid worms and sipunculids were also found burrowing inside the coral material perhaps using the coral for shelter. The suspension feeding ophiuroid *Ophiactis balli* was also abundant sheltering in the dead coral material and the suspension feeding bivalve *Astarte* sp. abundant in the sediment underlying the thickets at some sites.

The area around carbonate mounds can also support an abundance of species. In the case of the Porcupine Basin there was extensive evidence of the working of the sediment apparently by echiuran worms, cerianthid anemones and caridean shrimps (Wilson & Vina Herbon, 1998). The tail-like features downstream of carbonate mounds in the northern Rockall Trough showed high densities of the xenophyophore *Syringammina fragilissima* compared to numbers in the background sediments. There was also a slight increased in the density of metazoan invertebrates on the tails and mounds relative to the background (Masson *et al.,* 1998). The reason for this clustering is unclear at the present time.

Threat

Although information about carbonate mounds and the associated communities is limited it can be expected that demersal trawling operations have a physical impact. Fishing activity is very intensive in some of the areas where mounds occur and repeated trawling does not allow time for the continual growth of coral colonies. Recovery may therefore only be possible over a long period of time, if at all.

Relevant additional considerations

Sufficiency of data

The mapping of carbonate mounds is an ongoing task and as a consequence the full extent and distribution of these features in the OSPAR Maritime Area is still to be determined. Major clusters are already known to occur in the Porcupine Basin and the Rockall Trough however, and it is these sites for which most is known. Much also remains to be learnt the biological communities found on carbonate mounds.

Changes in relation to natural variability

Some surveys have reported an extensive carpet of dead corals and only small colonies of living coral on carbonate mounds suggesting that conditions were suitable for the growth and development of the coral banks at some stage but that this is no longer the case (Kenyon *et al.,* 1998). Possible reasons put forward to explain this include natural changes in the current regime, sea temperature and food supply to the area as well as damage from deep-sea trawling.

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 threat to this habitat. The main consideration is that carbonate mounds and their associated fauna are potentially threatened by certain fishing operations and should therefore be listed by OSPAR.

ICES evaluation

ICES requested that further information on the biological communities associated with carbonate mounds be cited in the nomination. (This has been provided in the section on ecological significance.) They note there is no evidence that carbonate mound substrates are at any greater risk than other reef-supporting substrates but that they may be at lower risk than other features such the sand mounds underlying the Darwin Mounds to the west of Shetland (ICES, 2002). In particular, ICES consider there is no evidence of direct “clear and present” threats to the mounds but that there is evidence of a threat to biota growing on the mounds from fishing activities.

They conclude there is insufficient evidence for the nomination. In light of this it is necessary to determine whether there is a strong enough case for the nomination on the basis of expert judgement.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; Category of effect of human activity: Biological – removal of target and non-target species.

Commercial exploitation of deepwater fish started to gain momentum in the 1960s and is now at the point where an estimated 40% of the world’s trawling grounds are in water deeper than continental shelves (McAllister *et al.* in Roberts 2002). Where deep sea fishing grounds coincide with carbonate mound structures, human activity will be the principal threat to these features and their associated communities.

Management considerations

Management measures should be targeted at preventing physical damage to carbonate mound structures and the associated communities as this is believed to be the principle threat at the present time. Closed areas for particular types of fishing have been introduced in some areas and could be applied more widely to protect this habitat. This is a matter that falls within the remit fisheries organisations rather than OSPAR, although OSPAR can communicate an opinion on this to the relevant bodies and introduce any relevant supporting measures that fall within its own remit if such measures exist or are introduced in the future.

Further information

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Useful References:

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Nomination

Coral Gardens

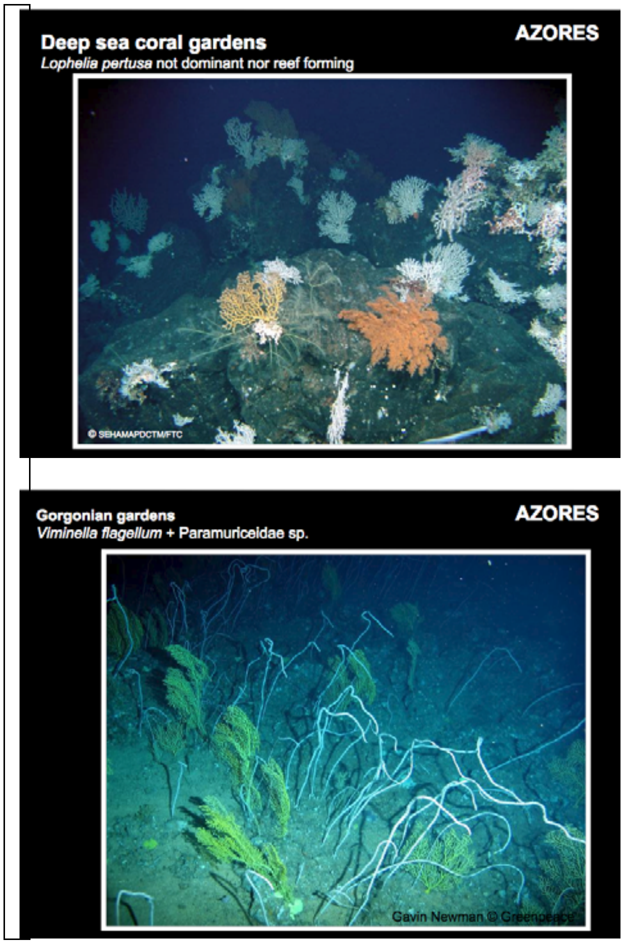


Fig. 1: Example of a coral gardens around the Azores. Upper photo: – on hard substrate, taken at the Menez Gwen hydrothermal vent field during the campaign SEHAMA, and the lower photo: hard substrate with a thin soft sediment veneer on Condor de Terra seamount, during the "Defending Our Oceans" campaign by Greenpeace International, with the collaboration of the DOP/UAç Azores.. Pictures courtesy of IMAP/DOP

Definition for habitat mapping

Coral gardens

Habitat occurs within each of the following deep seabed EUNIS types:

A6.1 Deep-sea rock and artificial hard substrata

A6.2 Deep-sea mixed substrata

A6.3 Deep-sea sand

A6.4 Deep-sea muddy sand

A6.5 Deep-sea mud

A6.7 Raised features of the deep sea bed

A6.8. Deep sea trenches and canyons, channels, slope failures and slumps on the continental slope

A6.9 Vents, seeps, hypoxic and anoxic habitats of the deep sea

Where the coral garden communities found in the above EUNIS deep water habitats occur also in shallower water, such as in fjords or on the flanks of islands and seamounts (A6.7), they are also included in this definition

National Marine Habitat Classification for UK & Ireland code: Not defined

The main characteristic of a coral garden is a relatively dense aggregation of colonies or individuals of one or more coral species. Coral gardens can occur on a wide range of soft and hard seabed substrata. For example, soft-bottom coral gardens may be dominated by solitary scleractinians, sea pens or certain types of bamboo corals, whereas hard-bottom coral gardens are often found to be dominated by gorgonians, stylasterids, and/or black corals (ICES 2007).

The biological diversity of coral garden communities is typically high and often contains several species of coral belonging to different taxonomic groups, such as leather corals (Alcyonacea), gorgonians (Gorgonacea), sea pens (Pennatulacea), black corals (Antipatharia), hard corals (Scleractinia) and, in some places, stony hydroids (lace or hydrocorals: Stylasteridae). However, reef-forming hard corals (e.g. *Lophelia, Madrepora* and *Solenosmilia*), if present, occur only as small or scattered colonies and not as a dominating habitat component. The habitat can also include relatively large numbers of sponge species, although they are not a dominant component of the community. Other commonly associated fauna include basket stars (*Gorgonocephalus*), brittle stars, crinoids, molluscs, crustaceans and deep-water fish (Krieger and Wing 2002). Krieger and Wing (2002) conclude that the gorgonian coral *Primnoa* is both habitat and prey for fish and invertebrates and that its removal or damage may affect the populations of associated species.

Densities of coral species in the habitat vary depending on taxa and abiotic conditions, e.g. depth, current exposure, substrate). The few scientific investigations available indicate that smaller species (e.g. the gorgonians *Acanthogorgia* and *Primnoa*, and stylasterids) can occur in higher densities, e.g. 50 – 200 colonies per·100m^2, compared to larger species, such as *Paragorgia,* which may not reach densities of 1 or 2 per 100 m^2. Depending on biogeographic area and depth, coral gardens containing several coral species may in some places reach densities between 100 and 700 colonies per·100m^2. These densities merely indicate the biodiversity richness potential of coral gardens. In areas where the habitat has been disturbed, by for example, fishing activities, densities may be significantly reduced. Currently, it is not possible to determine threshold values for the presence of a coral garden as knowledge of the *in situ* growth forms and densities of coral gardens (or abundance of coral by-catch in fishing gear) is very limited, due to technical or operational restrictions. Visual survey techniques will hopefully add to our knowledge in the coming years.

Non-reef-forming cold-water corals occur in most regions of the North Atlantic, most commonly in water with temperatures between 3 and 8ºC (Madsen, 1944; Mortensen *et al*., 2006) in the north, but also in much warmer water in the south, e.g. around the Azores. Their bathymetric distribution varies between regions according to different hydrographic conditions, but also locally as an effect of topographic features and substrate composition. They can be found as shallow as 30 m depth (in Norwegian fjords) and down to several thousand meters on open ocean seamounts. The habitat is often subject to strong or moderate currents, which prevents silt deposition on the hard substrata that most coral species need for attachment. The hard substrata may be composed of bedrock or gravel/boulder, the latter often derived from glacial moraine deposition, whilst soft sandy/clayey sediments can also support cold-water corals (mostly seapens and some gorgonians within the Isididae).

Notes on practical identification and mapping of the habitat: Given the diversity of possible appearances of the habitat across the North East Atlantic, a more precise description of the habitat as it occurs in relation to different substrates, depths and regions will need to be developed. For individual locations, expert judgement is required to distinguish this habitat from surrounding habitats, including an assessment of the appropriate densities of octocoral species to constitute this habitat. As a first step to further clarification a site-by-site description of coral gardens is required that will lead to further refinement of this habitat definition and its inclusion in national and European habitat classifications. The habitat definition above does not encompass shelf and coastal water habitats with seapen and octocoral communities (for example *Alcyonium* spp. *Caryopyllia* spp.), including the OSPAR habitat 'seapens and burrowing megafauna' or deeper-water habitats where colonial scleractinian corals (*Lophelia pertusa* reefs) or sponges (Deep-sea sponge aggregations) dominate.

The main feature of a coral garden is a relatively dense aggregation of colonies or individuals of one or more coral species, supporting a rich associated fauna of benthic and epi-benthic species. Scleractinian corals such as *Lophelia*, *Madrepora*, and *Solensosmilia*, may also be present but not as a dominating habitat component. Habitats where colonial scleractinians dominate are defined as coral reef. Coral gardens can occur on a wide range of soft and hard seabed substrata. For example, soft bottom coral gardens may be dominated by solitary scleractinians, sea pens, or some representatives of bamboo corals, whereas hard bottom coral gardens are most often found to be dominated by gorgonians, stylasterids, and/or black corals (ICES 2007).

The biological diversity of coral garden communities is typically high and often contains several species of coral belonging to different taxonomic groups, such as such as "leather corals" (Alcyoniidae), "bamboo corals" (Isididae), "anemones" (Actinaria), "precious corals" (*Corallium*), non-reef building colonies of Scleractinia, and stony corals (*Lophelia, Madreporia, Solensosmilia*). However, these potentially reef-forming species occur only as small colonies. In some areas the coral gardens can also include stony hydroids /"lace corals" (Stylasteridae). The habitat can also include relatively large, although not dominant, numbers of sponge species. Other commonly associated fauna include basket stars (*Gorgonocephalus*), brittle stars, crinoids, molluscs, crustaceans and deep-water fish (e.g. Krieger and Wing 2002). They concluded that, "*Primnoa* is both habitat and prey for fish and invertebrates" and that "removal or damage of *Primnoa* may affect the populations of associated species, especially at depths >300 m, where species were using *Primnoa* almost exclusively".

ICES (2007) attempted a first characterisation of 'coral gardens' based on the density of stands and faunistic associations in order to aid objective and comparable characterisations: They note that the quantification of the *in situ* density (or abundance of coral by-catch in fishing gear) is often not possible due to technical or operational restrictions. Qualitative or semi-quantitative approaches will in many cases be more appropriate which is the reason why the definition of 'coral gardens' (see first paragraph) does not include mention of the densities of colonies. To enable comparisons between studies from different sites it would be useful to provide, as a minimum, relative densities.

Quantitative density estimates are given by Mortensen and Buhl-Mortensen (2004) for the Northeast Channel, off Nova Scotia with peak values of *Paragorgia arborea* between roughly 10 and 50 colonies per 100m^2. For *Primnoa resedaeformis* maximum values were higher, between 50 and 140 per 100m^2. The average densities were much lower (0.6 colonies per·100m^2 for *Paragorgia* and 4.8 colonies per·100m^2 for *Primnoa*). In the Gully, a submarine canyon off Nova Scotia, Mortensen and Buhl-Mortensen (2005a) found lower densities of these two species compared to the Northeast Channel, but in stands comprising several gorgonian species they found peak values between 100 and 600 colonies per 100m^2. In Alaska, where the term 'coral garden' was first used to describe dense stands of non-reefal corals, the densities are comparable to the studies by Mortensen and Buhl-Mortensen (2004; 2005a), with a maximum for gorgonians of 232 colonies per 100m^2 (652 colonies per 100m^2 including stylasterids).

Based on this limited information it is evident that the densities of developed coral gardens vary with taxonomic composition of the habitat forming corals. Smaller species (e.g. the gorgonians *Acanthogorgia* and *Primnoa* and stylasterids occur in higher densities [50 – 200 colonies per·100m^2]), compared to larger species such as *Paragorgia*. Coral gardens with several species may have densities between 100 and 700 colonies per·100m^2). These values could be used as a background for distinguishing between sparse and dense coral gardens (ICES 2007).

Probably the tallest coral gardens are found within the sea fans, or gorgonian corals. Sea fans are anchored to the bottom on cobbles and boulders in glacial deposits and often have both mobile and sessile associated species, including fishes. The sea fans grow like a tree with a central flexible trunk that branches up into the water column, oriented towards prevailing currents. Colonies that are several centuries old can be as tall as 5 metres thus, and in a descriptive way, being comparable with "trees" in the cold-water environment (Andrews *et al*. 2002). Common genera with a cosmopolitan distribution are *Paramuricea*, *Paragorgia* and *Primnoa.* An analysis of the associated fauna of *Paragorgia arborea* yielded 97 species whilst 47 species were identified associated with *Primnoa resedaeformis* (Buhl-Mortensen and Mortensen 2004). They conclude that the diversity of cold-water gorgonians is comparable with that found for shallow water gorgonians, but in general lower than for cold-water coral reefs. However, as cold-water gorgonians are known to host several symbiontic species, negative impacts on cold-water gorgonians will also affect their associated species. to a larger degree than for the scleractinian species, due to the larger degree of host-specific occurrence. These observations underline the importance of these corals as major habitat-formers and providers.

Current status

- Neither coral gardens as defined above nor any of the soft coral species which characterise coral gardens are subject to a national or international protection regime in the OSPAR area.

Geographical extent

- OSPAR Regions: I, II, IV, V
- Biogeographic zones: 9 , 11, 13, 15, 16, 22, 23 – full distribution not known
- Region & Biogeographic zones specified for decline and/or threat: anywhere within demersal fishing depth

The occurrence and distribution of coral gardens in the North East Atlantic is insufficiently known at present. The current scientific information on the occurrence of non-reefal corals is patchy and is not based on systematic surveys, nor do characterisations of the density of occurrences exist for most of the sampling locations. However recently, ICES (2007) compiled a first inventory of where corals are known to occur in the North Atlantic (see Figure 2). The description of the observed habitat preferences and the regional distribution of soft corals potentially occurring in coral gardens in the North East Atlantic is taken from this review.

Non-reefal coldwater corals occur in most regions of the North Atlantic, most commonly in water with temperatures between 3 and 8ºC (Madsen, 1944; Mortensen *et al*., 2006)) in the north, but also in much warmer water in the south, e.g. around the Azores. The bathymetric distribution of such cold-water corals varies between regions with different hydrographic settings, but also locally as an effect of topographic features and substrate composition. On the Norwegian continental shelf corals occur mainly between 200 and 500 m depth restricted by seasonal hydrographic variations above, and cold Arctic Intermediate Water below. In the Norwegian fjords, gorgonians such as *Paramuricea placomus* occur in waters as shallow as 30m due to stratification of the water column and good supply of Atlantic water. On the northern Mid Atlantic Ridge cold-water corals are found from 800 to 2100m, with the highest number of coral taxa observed shallower than 1400m depth (Mortensen *et al*., in press).

Such habitats are often subject to strong or moderate currents that prevent silt deposition on the hard substrates that most coral species need as an attachment. The hard substrate may be constituted of exposed bedrock or gravel/boulder, often from morainic deposition, but also soft sandy/clayey sediments can be used as substrate for cold-water corals (most seapens and some gorgonians within the Isididae. Areas with a high diversity of substrates support a higher diversity of corals. This is, for example, reflected in the depth distribution of coral taxa on the Mid Atlantic Ridge (Mortensen *et al*., in press) where taxa like scleractinians, predominantly occur in the shallower depths where the percentage of hard bottom in a variety of substrata is high, whereas the soft sediment flanks of the sampled seamounts were occupied by seapens (the distribution intervals reflect the discontinuous sampling effort).

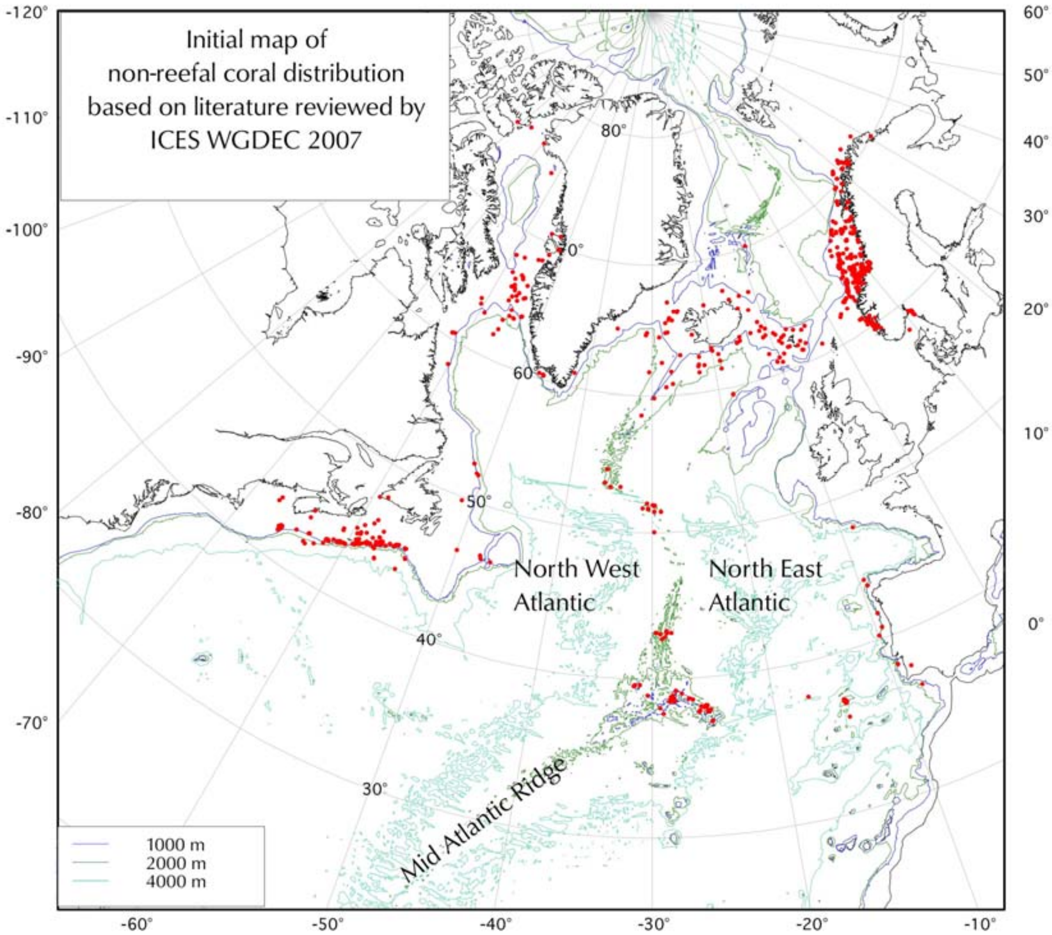


Figure 2: Initial map of the currently known occurrence of soft corals in the North Atlantic Ocean. Data compiled by ICES WGDEC 2007).

The distribution of cold-water corals (including non-reefal species) in the North Atlantic have been reviewed earlier by (Madsen 1944; Zibrowius, 1980; Cairns and Chapman, 2001; Watling and Auster, 2005; Mortensen *et al*., 2006). Grasshoff (in several publications 1972-1986, see ICES 2007) especially focused on the distribution of Gorgonaria, Anthipatharia and Pennatularia in the Northeast Atlantic.

Norway

In their compilation of benthic macro-organisms in Norway, Brattegard and Holthe (1997) lists 38 cold-water coral species from the Norwegian coast. The majority of these (31 species) are octocorals. Of these, sea pens comprise most species rich (12 species). Species known to form habitats are represented among seven gorgonian species: *Paragorgia arborea*, *Primnoa resedaeformis* and *Paramuricea placomus* are known to occur in relatively high densities. These habitats have been referred to as 'coral forest' among fishers. Because of the abundant occurrence of *Lophelia* reefs off Norway, most recent research on cold-water corals has been directed to studies on the distribution, ecology and fisheries impact on reefs. The large gorgonians mentioned here are all typical components of the associated fauna on *Lophelia* reefs off Norway. The distribution of 'coral forests' or coral gardens, outside reefs is poorly known, but it is known that Trondheimsfjord has areas with such habitats (Strømgren, 1970). Indeed, there are coral gardens also offshore, indicated by local fishers off the coast of Finnmark and observed on the continental shelf break off mid-Norway during research cruises directed by the Institute of Marine Research (Pål Buhl-Mortensen pers. comm.).

Sweden and southern Norway

In several locations in the Skagerrak, mostly in the channels connecting the Oslofjord proper with the open Skagerrak, and in one area (Bratten) in the open Skagerrak, Lundälv (2004), Lundälv & Johnsson (2005) and Sköld et al (2007) found rich communities of gorgonian corals (*Primnoa resedaeformis, Paramuricea placomus and Muriceides kuekenthali*) and basket stars (*Gorgonocephalus caputmedusae*). On soft bottom, dense stands of *Funiculina quadrangularis* and other seapens, were observed. New records of the gorgonian *Anthothela grandiflora* in the Skagerrak and Swedish waters were established.

Faroe Islands and nearby Banks

Much of the information about the distribution of cold-water corals in the Faroe region comes from the research programme BIOFAR (Bruntse and Tendal, 2001; Tendal et al, 2005). Figure 3 shows the distribution of the gorgonians *Paragorgia arborea* and *Primnoa resedaeformis* around the Faroes. Also the majority of the stylasterid samples are from the outer shelf and upper slope fauna zones of the Faroe plateau and outer banks, an area characterised by diverse hard substrate, good water movement, low fine sediment load and temperatures above 6 °C. This area also holds the greatest diversity of those coral groups that are slow-growing, long-lived and reliant on long-term environmental stability. Faroese fishermen reported colonies of *Paragorgia arborea* of 2.5 m height (estimated to be at least 1500 years old). *Primnoa resaediformes* is more widespread around the Faroes and was first recorded in 1906. Most records, including the present ones, come from 200-500 m depth, in North Atlantic water. Specimens of 1 m size were recorded, corresponding to an estimated age of about 500 years.

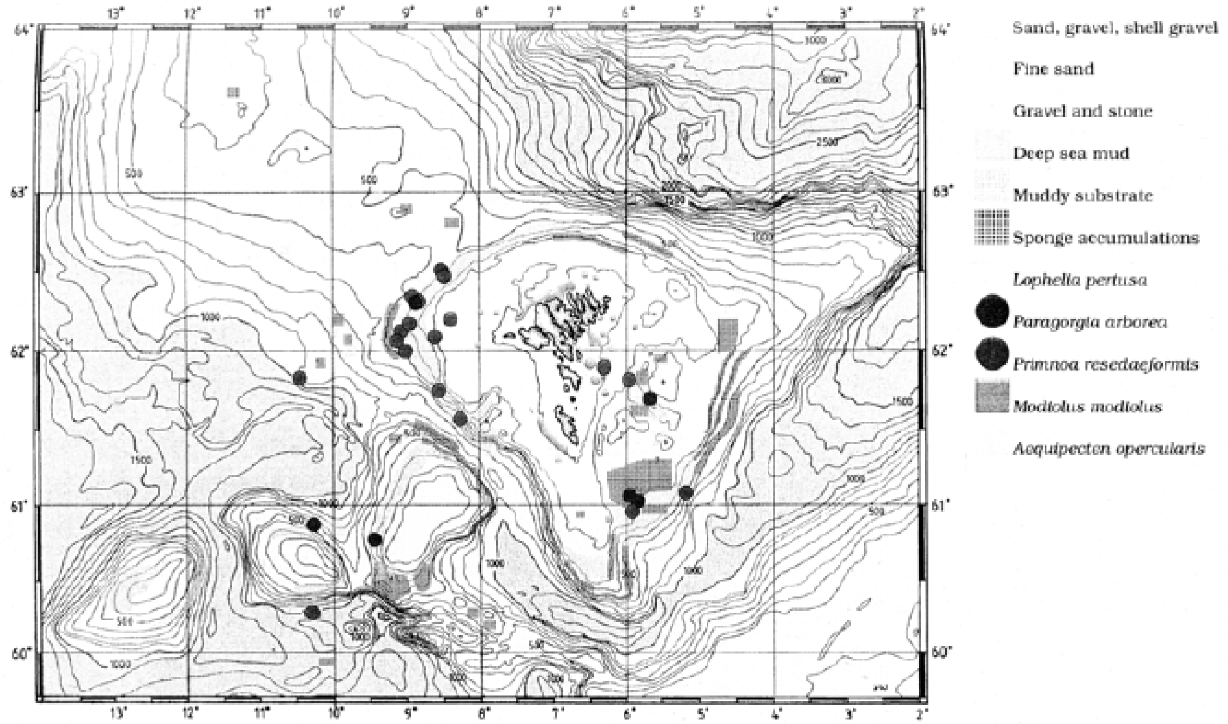
Iceland

Around Iceland, Ragnarsson and Steingrimsson (2003) mapped the present occurrence of octocorals in relation to fishing pressure with otter trawl gear (Figure 4). However, ICES WGDEC was unable to obtain information on the taxonomic composition of the coral community.

United Kingdom and nearby Banks
Hatton Bank

Durán Muñoz et al. (2007) recorded soft corals as part of the bycatch occurring in the Spanish bottom trawl and bottom longline cooperative surveys on the Hatton Bank and adjacent waters and in the Spanish bottom trawl commercial fishery on the Hatton slope (1000-1500m). The frequency and volume of soft-corals (Gorgonians and Antipatharians) in the catches was low on the regularly-used fishing grounds. Most of the Gorgonian records were obtained at shallow depths (<1000m), but Antipatharians were found over a wide depth range.

Figure 3: Locations of corals around the Faroe Islands (from Bruntse and Tendal, 2001)



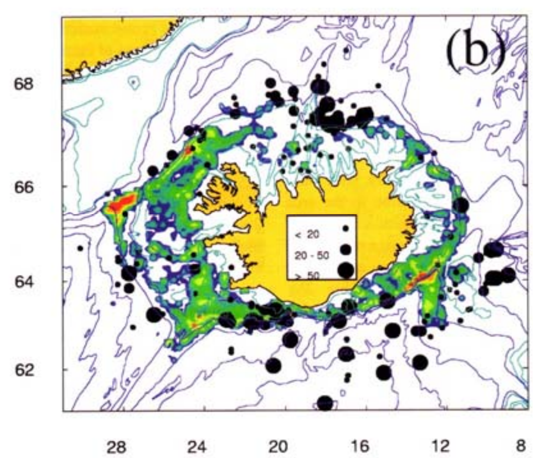


Figure 4: Total number of octocorals per sample collected in the BIOICE project superimposed over otter trawling effort(Steingrimsson and López-Conzález, unpublished data in: Ragnarsson and Steingrimsson, 2003). The colour scale of fishing effort ranges from blue (low effort) to red (high effort). The size of the dots represents abundance.

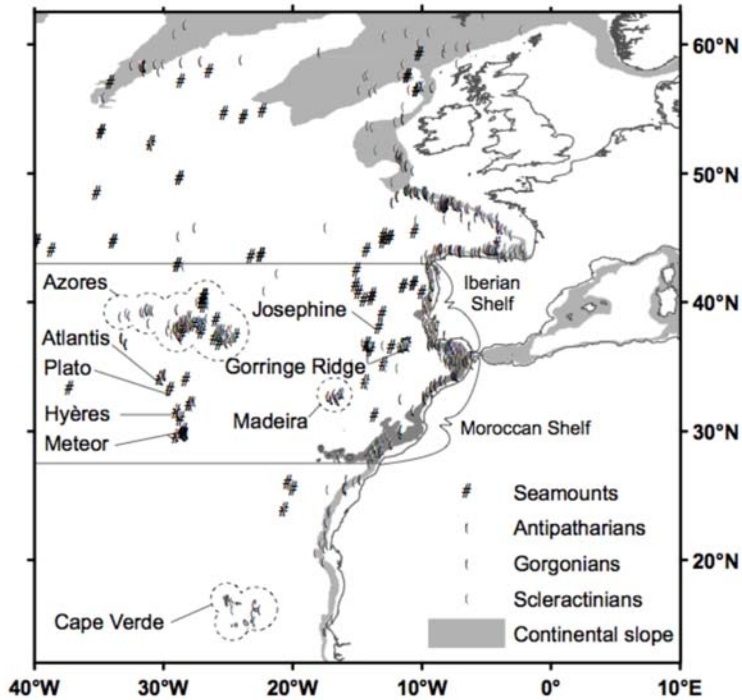


Figure 5: Records of deep-water corals in the north-east Atlantic south of 60°N from historic samples taken prior to 1985 (from Hall-Spencer *et al*. 2007)

North-east Atlantic south of 61°N

Hall-Spencer et al. (2007) reviewed the literature and compiled a database of deep-water (> 200m) anthipatharians, scleractinians and gorgonians of the north-east Atlantic south of 60°N, including 2547 records from benthic sampling expeditions between 1868 and 1985 (Figure 5). The majority of records came from steeply-sloping seabed types around seamounts, oceanic islands and the continental slope and confirmed the importance of the Mid-Atlantic Ridge as a biogeographic boundary between corals characterising the American boreal continental slope to the west and the European continental slope communities to the east (see e.g. Cairns and Chapman 2001, Watling and Auster 2005, Schröder-Ritzrau et al. 2005). North Atlantic antipatharians appear to be restricted to open ocean areas, with Antipathes erinaceus, Distichopathes sp., Phanopathes sp. and Stauropathes punctata only recorded on Josephine seamount, the Azores and Cape Verde Islands (Molodtsova 2006).

Spain

From several locations in Spanish waters, at least 13 octocoral species are described and several coral associations can be recognised (see e.g. Aguirrezabalaga et al. 1984, Sánchez & Olaso 2004, and pers. com. Sánchez to P. Marcos 2006). These associations can include species of scleractinians (e.g. Madrepora oculata with Lophelia pertusa) mixed with gorgonians (e.g. Paramuricea spp) and stony hydroids. The composition of these associations is probably depth related. (e.g. on Galicia Bank, Spain). In Northern Spain (Galician coasts), gorgonian and black corals occur with Dendrophyllia cornigera (Sánchez pers.com.). Dendrophyllia ramea with gorgonians (Paramuricea clavata) occurs below 20 m in the Gulf of Cádiz, south-west Spain (Templado et al. 1993).

Mid-Atlantic Ridge

The non-hydrothermal hard bottom areas of oceanic ridges are often colonised by erect megafauna such as gorgonians, sponges, hydroids, and black corals (Grigg, 1997). Mortensen et al. (in press) observed corals on all sites surveyed with ROVs at depths between 800 and 2400 m on the northern Mid-Atlantic Ridge. The species richness of corals was high with a total of 40 taxa. Octocorals (Alcyonacea, Gorgonacea, Pennatulacea) were taxonomically richer than hexacorals (Antipatharia and Scleractinia) with 27 versus 14 taxa. Gorgonacea was the most diverse order comprising 14 taxa, whereas Antipatharia and Alcyonacea were represented with the lowest number of taxa (two and three taxa, respectively).

Oceanic islands

Overall, deep-sea corals are common around the Azores, particularly in the steep volcanic biotopes of the insular slopes and offshore seamounts (e.g. Braga-Henriques et al. 2006). The most commonly-sampled gorgonians include large Callogorgia verticillata, Dentomuricea spp., Acanthogorgia hirsuta and A. armata, Viminella flagellum. The substrate availability may influence the patchy occurrence of the species: Viminella flagellum is the dominant species on boulder beds (Figure 6), whereas Paramuriceidae were relatively more abundant in bottoms with a sediment veneer (Figure 7). The Antipatharian fauna is apparently dominated by the Antipathella wollastoni in the littoral of the islands and shallow seamounts below ca. 20m. The black coral Leiopathes glaberrima can reach up to 2m high and it probably forms dense forests between 200 and 800m.

Figure 6 *Viminella flagellum* dominated coral gardens on Condor da Terra seamount, Azores (Braga-Henriques *et al*. 2006, Copyright Gevin Newman, Greenpeace).

Figure 7. Paramuriceidae spp. dominated coral gardens on Condor da Terra seamount, Azores (Braga-Henriques *et al*. 2006, Copyright Gevin Newman, Greenpeace)

Several coral associations can be recognised. These associations can include species of the same group (e.g. Madrepora oculata with Lophelia pertusa) mixed with gorgonians (e.g. Paramuricea spp), stony hydroids, etc. The composition of those associations is probably depth related. The associated non-coral fauna was abundant and highly diverse.

Isolated North East Atlantic seamounts

Josephine Seamount

The summit region of Josephine Seamount, a seamount rising from more than 4000m to less than 200m depth is characterised by dense gorgonian beds on gravelly substrate (Gage & Tyler 1991, Figure 8). The species rich fauna of Josephine Seamount is typical for the eastern Atlantic, more closely related to the islands than to the continental shelf. This particularly well investigated summit region offers a wide variety of substrates which are readily populated by sometimes high densities of mostly sessile filter feeding species. Sixteen species of horny and black corals, thirteen species of stony corals, but no pennatulids and neither shelf nor deep sea benthic species were found. Dense beds of the gorgonian Callogorgia verticillata, coincide with large sponges on the summit of Josephine, quite different from other seamounts (Grasshoff 1985).

Figure 8 Gorgonian bed on the summit of Josephine Seamount (ca. 200m, Photograph by A.L. Rice, copyright: DEEPSEAS Group, NOC)

Application of the Texel-Faial criteria

Global/regional importance

Many of the habitat forming taxa of coral gardens, like e.g. *Paramuricea, Paragorgia or Primnoa* , but also most of the anthipatharians and stylasterid corals have a cosmopolitan distribution. Therefore the OSPAR area does not have specific global or regional importance for their occurrence. However, due to the high fishing pressure in deep waters in the OSPAR area, the probability of decline and the degree of threat may be higher than in other oceans.

Decline

Probability of significant decline.

There are no known scientific records or time series about decline in this habitat or bycatch of corals in the OSPAR area. Unlike scleractinian reefs, these corals do not leave clear evidence of trawling damage so it is not possible to determine their historical distribution and abundance based on post-fishing surveys (Hall-Spencer et al. 2007). Pooling data on the distributions of sensitive benthic species with data on the distribution of deep-water trawling to highlight areas where pristine habitats are likely to still be found are only beginning.

However, fishermen's experience indicates a significant decline in areas where bottom trawling occurs, with observations off Iceland and the Faroes (Bruntse and Tendal 2001 quote fishermen) and in the Skagerrak (off Sweden/Norway, Lundälf pers. com), as well as probably on all the "good" fishing places for redfish which lives within the habitat. This is also known from Canada, where fishermen reported significant changes to the seafloor over the duration of their fishing careers, including a decrease in the size and number of corals they caught (Gass & Willison 2005). Mortensen *et al.*

(2005) observed broken live corals, tilted corals, scattered skeletons and lost fishing gear entangled in corals off Nova Soctia.

In other regions, the volume of gorgonian bycatch in bottom fisheries was estimated (e.g. off Alaska 200 000 kg of mostly gorgonian and antipatharian corals between 1990 and 2002) giving a further indication for the likely significant decline of this habitat caused by bottom fisheries. Long-line gear is also noted to tip and dislodge corals (Krieger 2001). Bycatch data from a long-line survey in the Gulf of Alaska and Aleutian Islands showed *Primnoa* and other coral taxa were caught on 619 of 541,350 hooks •shed at 150-900 m depths (Krieger 2001).

Sensitivity

Very sensitive – for several reasons:

1. **Longevity**: Analysis of the life span of octocorals indicates that some of the large colony-forming species, such as *Primnoa resedaeformis*, can live for centuries (Risk *et al.* 2002, Andrews 2002). However, gorgonian corals are difficult to age. Growth rate estimations indicate that off Nova Scotia a *Primnoa resaediformes* of 80 cm is an estimated 46 years old (Mortensen & Buhl-Mortensen 2005b). Acc. to Bruntse & Tendal (2001), Faroese fishermen reported of *Paragorgia arborea* colonies of 2.5 m hight, which is assumed to correspond to an individual age of at least 1500 years. *Primnoa resaediformes* specimens of 1 m size were recorded, corresponding to the maximum size for the species allover the North Atlantic. Specimens of that size are at least 500 years old (all acc. to literature quoted by Bruntse & Tendal 2001).
2. **Unknown reproductive patterns**: Knowledge on recruitment patterns is very limited. Bruntse & Tendal (2001) reviewed the literature finding that *Primnoa resaediformis* was reported to be viviparous (Strömgren 1979, Risk *et al*. 1989). Acc. to their review, the reproduction frequency of both *Primnoa resedaeiformis* and *Paragorgia arborea* is unknown . A single series of observations in the Gulf of Alaska suggest that recruitment of *Primnoa* sp. is patchy and aperiodic (Krieger 2001).
3. **Uncertain recovery**: Knowledge on recovery patterns is sparse: Krieger (2001) observed no recruitment of new colonies in an area where *Primnoa* was removed by trawling after seven years. However, six new colonies were observed at a second site one year after trawling. Four of these colonies were attached to the bases of colonies removed by trawling. Recruits of *Primnoa* were also observed on two 7 cm diameter cables (>15 colonies each). On the other hand, in the Gulf of Maine and in submarine canyons limited observations have revealed abundant new recruits of both *Primnoa resedaeformis and Paramuricea* spp. (Watling, Auster, and France, unpublished observations, in Watling & Auster 2005). Whether these young colonies were produced by larval recruitment or branch dropping (as in shallow-water gorgonians) "is impossible to say at this time" (Watling & Auster 2005). However, studies from deep water, high latitudinal, hard bottom communiities are lacking (Mortensen et al. 2005).
4. **Large size perpendicular to the seafloor**: The most prominent gorgonian coral species can grow to a size of several meters up into the water column, their delicate branches being highly susceptible to physical damage (Bruntse & Tendal 2001). Probert *et al*. (1997) examined benthic invertebrate by-catch from a deep-water trawl fishery off New Zealand, and found that Gorgonacea was one of the best represented groups in the catch. They concluded that large sessile epibenthic species were among taxa especially vulnerable to impacts from commercial trawling, and that large gorgonians such as *Paragorgia arborea* would be unlikely to recover “within a foreseeable future”.

Threat

Currently threatened.

There are indications from a Canadian (DFO) fisheries observer programme that all the most frequently-used fishing gears (gill nets, trawls, long lines) cause damage to the corals. Coral gardens on soft bottoms within fishing depths are subject to the highest threat, however, advances in fisheries technology such as "rock hopper" gear on bottom trawls have eliminated some of the areas that would have been refuges from trawling (Watling & Norse 1998).

Evidence from Canada suggests that there, long-lining is the most significant threat to gorgonian corals to date, as otter trawling may be restricted in boulder areas which provide the substrate for the gorgonian corals. Video transects e.g. off Nova Scotia, Canada, revealed long-lines entangled in damaged corals. This was confirmed by fishermen.

Secondary damage may occur from the long free end of a snagged long-line (Mortensen et al. 2005).

Around Iceland, Ragnarsson & Steingrimsson (2003) mapped the present occurrence of octocorals in relation to fishing pressure from otter trawl gear (see Fig. 3). Trawling and occurrence of corals mostly did not coincide, which either indicates that no trawling occurs in boulder areas, or that decades of trawling may have diminished the previously wider distribution of these corals. An indication for the latter hypothesis comes from evidence given by German fishermen who targeted redfish around Iceland in the 1970s. They reported having caught as a bycatch huge fragments of "bubble gum trees" (*Paragorgia*), for example in an area called "Rosengarten" to the south east of Iceland. Fishing in this area continued for many years with decreasing catches of both fish and coral bycatch (pers. com. to S. Christiansen, WWF, in 2004).

Apart from directly smashing or tilting the gorgonians, fishing also weakens the structure of individual colonies by damaging the tissue resulting in a higher rate of epibiont and parasite colonisation, increasing the mortality and lowering the fertility.

Among other species, redfish live associated with corals in the boulder fields which they use for rest and shelter. Decreasing availability of such three-dimensional current-reducing structure may have an effect on the competitiveness/success of redfish.

Relevant additional considerations

Sufficiency of data

Although there are some records of the occurrence of coral garden habitat-forming species in the North East Atlantic, the habitat as such has not been described so far. It will be necessary to revisit the existing data for likely locations and extent of coral gardens. Considering octocorals in general, data are absolutely insufficient, in particular as concerns the more southerly/warmer species. However, the species *Paragorgia arborea and Primnoa resaediformes* are in some areas well described (e.g. Faroes, Iceland, partially Norway). The overall distribution is yet not entirely known.

Changes in relation to natural variability

No knowledge

ICES WG DEC Evaluation

Despite an obvious lack of information about the current distribution and thus potential threat to the habitat in the OSPAR area, the two reviewers of the nomination both consider it appropriate to include "coral gardens" on the OSPAR list of threatened and/or declining species and habitats. Evidence from other parts of the world, and initial reports of coral bycatch from around Iceland indicate the vulnerability of the habitat to demersal fishing operations. A more in depth habitat definition and indications of coral garden occurrences in the OSPAR area were requested in order to enable targeted protection measures.

Threat and link to human activities

Relevant human activity: fishing (all demersal fishing operations) and other physically impacting activities (locally e.g. oil installations, pipeline construction)

Category of effect of human activity: physical damage or destruction of individuals and their habitat, potentially also indirect effect of reduced viability due to increased sediment suspension

Management considerations

Current management

No current management apart from the likely protection from trawling in areas designated for the protection of scleractinian corals. However, demersal long-lining in these areas is still allowed.

Required further management

1. Information collection from scientific and fisheries sources, and mapping of presently known records
2. Designation of protected areas
3. Fisheries management to prohibit use of damaging gear (trawls, bottom long-lines, bottom-set gill nets) in known areas of coral occurrence
4. New research and habitat mapping, including predictive mapping of the likely occurrence of coral gardens.

Further information

Nominated by:

Submitted by WWF to OSPAR’s Working Group on Marine Protected Areas, Species and Habitats in 2006 and OSPAR’s Biodiversity Committee in 2007. This case report was compiled from the nomination as revised by MASH 2006, incorporating comments received from ICES WGDEC in 2007, and also drawing upon ICES ACE (2007), based on a report of the working group on Deep Water Ecology, WGDEC (2007) .

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Nomination

Cymodocea meadows

Cymodocea beds, Cymodocea meadows, Seagrass beds (Cymodocea nodosa Ucria (Ascherson), 1869

EUNIS Code: A5.531, A5.5312, A5.53131 and A5.53132

Definition for Habitat Mapping

Cymodocea nodosa Ucria (Ascherson), 1869

Cymodocea nodosa forms large and dense patches with green leaves that can reach 100 cm long and 8 mm wide in well sorted fine sands or on superficial muddy sands in sheltered waters at depths of 1-30 meters. Frequently is mixed with other habitat forming phanerogams (*Zostera noltii* and *Zostera marina*) at muddy sands rich in organic nutrients. Shallow meadows of *Cymodocea* and *Zostera* are usually found in sheltered bays close to harbours, e.g. Cadiz Bay, or in areas subject to human impact.

C. nodosa has a tropical origin, nowadays restricted to the Mediterranean and scattered locations in the North Atlantic from southern Portugal and Spain to Senegal, including Canary Island and Madeira. Southern Portugal constitutes the current northern geographic limit of its distribution.

Cymodocea beds, Cymodocea meadows, Seagrass beds (Cymodocea nodosa Ucria (Ascherson), 1869

Cymodocea nodosa forms large and dense patches with green leaves that can reach 100 cm long and 8 mm wide in well sorted fine sands or on superficial muddy sands in sheltered waters at depths of 1-30 meters. Frequently is mixed with another phanerogams (*Zostera noltii* and *Zostera marina)* beds at muddy sands rich in organic nutrients.

C. *nodosa* has a tropical origin, nowadays restricted to the Mediterranean and scattered locations in the North Atlantic from South Portugal to Senegal, including Canary Island and Madeira. Southern Portugal constitutes the geographic limit of its distribution.

Shallow meadows of *Cymodocea* and *Zostera* are usually found in sheltered bays close to harbours, e.g. Cadiz Bay, or in areas subject to human impact.

Current status

Geographical extent

- OSPAR Regions: IV
- Biogeographic zones: South European Atlantic shelf (IXa ICES Area); Benthic and neritic of the shelf and upper continental shelf (<1000 m depth) (from Dinter, 2001)
- Region & Biogeographic zones specified for decline and/or threat: as above

Application of the Texel-Faial criteria

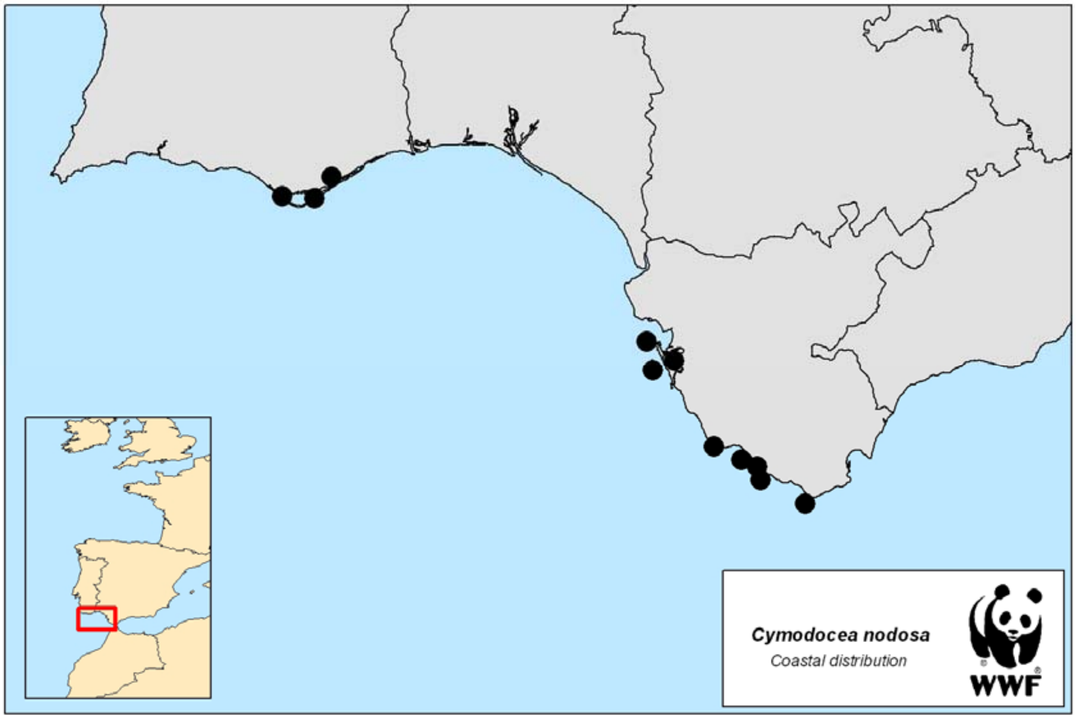
Global importance
No

Regional importance

Yes. The distribution range of the Atlantic population fall entirely on Region IV, limited to Portugal and Spain

Decline
Significantly declined.
It has been reported the decrease of *Cymodocea* at the Strait of Gibraltar during 30 years (Luque and Templado, 2004) as a result of industrial and coastal destruction that have increased turbidity to the system for a long-term period that estimated the decline by between 15% and 80% of its former natural distribution at the Gulf of Cadiz. There is a severe reduction in effective population size caused by habitat fragmentation and isolation. The absence of reproductive success of Ria Formosa Natural Park (Portugal) and its low genetic variability led to affect to the habitat quality. In other areas the decline is not well documented due to the lack of previous mapping studies.

After *Cymodocea* regression, it is replaced by invasive and opportunistic *Caulerpa prolifera,* that reduces significantly the associated fauna and produces great densities of the polychaete worm *Capitella* capitata.



Sensitivity

Sensitive
Cymodocean meadows are much influenced by physical stress caused by hydrodynamic forces. Mayor disturbances such as dredging or water pollution cause extensive damage. Apparently healthy *Cymodocea nodosa* beds are know to exist in areas subject to low-level contamination using this bed as water-quality bio-indicators (Schneider *et al*. 2002). Since sexual reproduction is not successful, disturbed areas will only recover by horizontal vegetative propagation from residual meadows (Alberto *et al.* 2001). It has a low resistance to turbidity that would reduce light penetration and prevent adequate photosynthesis. It has to be permanently submerged.

The habitat is rare, as there are only a limited number of locations where it occurs, based on Red List of Spanish Vascular Flora (evaluation according to IUCN categories)

Ecological significance

Seagrass meadows constitute a complex ecosystem, which play a pivotal role in the coastal benthos. They strongly influence the local environment by amplifying the primary substrate, supplying nutrients to the seafloor and by providing a spatially diverse habitat structure and resources for rich algal and animal communities. Also contributes to global marine productivity. Where the habitat is well-developed algae, actinians, ascidians and hydroids as *Aglaophenia harpago* or *Plumularia obliqua*, might colonize the leaves. The main taxonomic groups of macrofauna associated with the seagrass are generally similar to species occurring in shallow areas in a variety of substrata (e.g. amphipods, polychaeta, worms, bivalves and echinoderms). The mollusks gastropods are the most abundant within the community (Cancemi *et al.* 2002). The shelter provided by seagrass beds makes them an important nursery area for cuttlefish (*Sepia officinalis*) or the common octopus (*Octopus vulgaris*) an fishes as the gilthead seabream (*Sparus aurata*) or the stripped red mullet (*Mullus surmuletus*).

Relevant additional considerations

Sufficiency of data

There are many studies on seagrass beds and mainly general mapping of their extent and of the associated communities has been carried out in particular locations. Despite this, there is still a poor spatial analysis of the habitat.

Changes in relation to natural variability

The extent of seagrass beds may change as a result of natural factors such as severe storms, exposure to air and freshwater pulses. Warm sea temperatures coupled with low level of sunlight may cause significant stress and mortality of seagrass.

ICES Evaluation

ICES (BDC 07/3/6) advised on including the Cymodocea meadows on the OSPAR List. It was considered that there was good evidence of decline for this species on the edge of its distribution range. The interaction of *Cymodocea* beds with the spreading *Caulerpa prolifera* green algae would deserve further investigation. The evidence of threat from a variety of human activities (particularly from construction and associated changes in local water flow/chemistry was considered reasonable for inclusion on the list.

Threat and link to human activities

A number of the threats to *Cymodocea* beds are directly linked to human activities. There are extraction of sediments, dumping of solid waste and dredged spoils, constructions, land-based activities, placement of submarine cables and pipelines, anchoring and mobile fishing gears or fish cage farms. In Cadiz Bay, *Cymodocea* meadows are suffering from different impacts, including construction works, eutrophication, dredging and increased water turbidity due to shell-fishing. Another potential threat to *Cymodocea* beds comes from the spreading of *Caulerpa prolifera*, however the ecological links are not yet established (Hernandez in ICES review of habitat).

Management considerations

Due to genetic isolation in some areas all plans and management affecting the seagrass habitat should consider *C. nodosa* dynamics in a metapopulation perspective (i.e. the seagrass patch extinction and recolonization) with selected patches preserved to allow vegetative recolonization in disturbed areas. Management could also include the establishment of protected areas, restoration and the control of substratum removal or physical damage to the habitat. Research actions might be implemented. Promoting awareness of the importance of seagrass beds could assist in minimizing anchor damage. Protected areas could be designated under the proposed OSPAR MPA network although the EU Habitats Directive and the Bern Convention cover seagrass.

Further information

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Nomination

Deep sea sponge aggregations

EUNIS code: A6.62
National Marine Habitat Classification for UK & Ireland code: Not defined

Geodia sponge ©Tomas Lundälf , Tjaernoe Centre for Underwater Documentation

Definition for habitat mapping

Deep sea sponge aggregations are principally composed of sponges from two classes: Hexactinellida and Demospongia. They are known to occur between water depths of 250-1300m (Bett & Rice, 1992), where the water temperature ranges from 4-10°C and there is moderate current velocity (0.5 knots). Deep-sea sponge aggregations may be found on soft substrata or hard substrata, such as boulders and cobbles which may lie on sediment. Iceberg plough-mark zones provide an ideal habitat for sponges because stable boulders and cobbles, exposed on the seabed, provide numerous attachment/settlement points (B. Bett, *pers comm.*). However, with 3.5kg of pure siliceous spicule material per m^2 reported from some sites (Gubbay, 2002), the occurrence of sponge fields can alter the characteristics of surrounding muddy sediments. Densities of occurrence are hard to quantify, but sponges in the class Hexactinellida have been reported at densities of 4-5 per m^2, whilst 'massive' growth forms of sponges from the class Demospongia have been reported at densities of 0.5-1 per m^2 (B. Bett, *pers comm.*).
Deep-sea sponges have similar habitat preferences to cold-water corals, and hence are often found at the same location. Research has shown that the dense mats of spicules present around sponge fields may inhibit colonisation by infaunal animals, resulting in a dominance of epifaunal elements (Gubbay, 2002). Sponge fields also support ophiuroids, which use the sponges as elevated perches.

Geographical extent

OSPAR Regions; I, III, IV, V
Biogeographic zones: 22, 23
Region & Biogeographic zones specified for decline and/or threat: V, 22 & 23

Glass sponges (Hexactinellidae) tend to be the dominant group of sponges in the deep sea although demospongids such as *Cladorhiza* and *Asbestopluma* are also present. The massive sponges that dominate some areas include *Geodia barretti, G.macandrewi,* and *Isops phlegraei*. All are widely distributed in the NE Atlantic and reach considerable sizes with body weights of more than 20kg (Hougaard *et al.,* 1991; Klitgaard, 1995). They can occur at very high densities, particularly on the slope in areas where substrate and hydrographic conditions are favourable, and have been described as ostur "a restricted area where large sponges are strikingly common" (Klitgaard *et al.,* 1995). Sponges make up more than 90% of the biomass, excluding benthic fish and the sponges show high diversity with up to 50 species found in at least some of these areas.

Dense aggregations of deep sea sponges are known to occur in various places in the Northeast Atlantic (Klitgaard & Tendal, 2001). Examples have been found close to the shelf break (250m to 500m depth) around the Faroe Islands (Klitgaard & Tendal, 2001), along the Norwegian coast up to West Spitzbergen and Bjørnoya (Blacker, 1957; Dyer *et al.*, 1984; Fosså & Mortensen, 1998) and from the Porcupine Seabight (Rice *et al.*, 1990).

The diversity and abundance of sponges in some locations in the OSPAR Maritime Area rivals that of tropical reef systems. One study off the coast of northern Norway took grab samples from an area of less than $3m^2$, yielding 4,000 sponge specimens belonging to 206 species, 26 of which were undescribed (Konnecker, 2002). Material from a sponge field in the northern North Sea and other locations had a comparable diversity and density of sponges. The sponges also influence the density and occurrence of other species by providing shelter to small epifauna, within the oscula and canal system, and an elevated perch, for example for brittlestars (Konnecker, 2002). A study of 11 species of massive sponges from around the Faroe Islands found 242 associated species, 25% of which were recorded for the first time from Faroese waters (Klitgaard, 1995). There is also an affect on the habitat as the spicules remain in or on the sediment after sponges die forming dense mats, stabilising soft sediments or transforming others (Konnecker, 2002).

Application of the Texel-Faial criteria

Deep sea sponge aggregations were nominated in a joint submission by three Contracting Parties citing rarity, decline, and sensitivity, with information also provided on threat. The nomination was for Region V.

Rarity

There is no comprehensive overview of the distribution of deep-sea sponge aggregations within the OSPAR area but they appear to be limited to particular areas where hydrographic conditions are favourable, as they need a supply of current-borne organic particles (Klitgaard et al., 1995; Konnecker, 2002). This is thought to be the reason for the abrupt upper and lower bathymetric limits of a sponge field mapped in the Porcupine Seabight and around the Faroes for example (Rice *et al.,* 1990; Klitgaard et al., 1995). As the recorded localities of specific sponges are often separated by large distances, and as they generally have short-lived larval stages, there are likely to be widespread breeding populations of sponge fields across the North Atlantic (Konnecker, 2002). The extent to which the limited records of dense aggregations are an artefact of sampling programmes is not clear at the present time.

Decline

There are no quantitative data on decline of sponge aggregations in the OSPAR Maritime Area but they are known to be taken in fishing nets. Analysis of questionnaire returns from fishermen operating around the Faroe Islands indicate that this habitat existed in the past, but that there are now fewer areas with dense sponge aggregations (Klitgaard & Tendal, 2001). Where demersal fisheries and sponge aggregations occur in the same locations there is a high probability of impact and decline.

Sensitivity

Due to their body structure, sponges are sensitive to increased turbidity, which can lead to smothering. Little is known about the tolerance of sponges to toxic pollution of the water column although this may result in a higher than normal rate of abnormal and deformed spicules in a couple of species (Konnecker, 2002). This may be an issue if there are sponge fields in the vicinity of offshore oil and gas facilities.

Information indicates that dominant sponge species are slow growing and take several decades to reach large size (Klitgaard & Tendal, 2001). The habitat and the rich diverse associated fauna is therefore likely to take many years to recover if adversely affected (Konnecker, 2002).

Threat

Physical disturbance to the seabed is the main threat to deep sea sponge aggregations but the extent to which this takes place is not clear. Sponges are known to be taken in fishing nets but less is known about the effects of those that are not brought up, for example, dislodging or smothering. There are anecdotal reports of sponges being brought up less and less frequently as the same area is fished, which also suggests some impact.

A more recent potential threat is the collection of large numbers of sponges as part of bioprospecting operations. They are of particular interest because of the many different chemical compounds found in their tissues, and may have important pharmaceutical properties, especially as antibiotic and anti-cancer agents (Konnecker, 2002).

Relevant additional considerations

Sufficiency of data

The existence of sponge fields in the deep Atlantic and continental shelf has long been known and documented with detailed taxonomic records from the 19th century. In more recent years film taken by Remotely Operated Vehicles has provided more information on the appearance and density of the sponges on the seabed. Despite this little is known about the vast majority of the sponges beyond the locality where they have been recorded and, in many cases, this may be the only record.

Changes in relation to natural variability

Little is known about the natural variability in abundance, extent and ecology of deep sea sponge fields.

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 threat to this habitat. The main consideration is that sponge fields are known to be impacted by, and therefore threatened by, certain fishing operations and should therefore be listed by OSPAR.

ICES evaluation

ICES confirmed that there are no quantitative data on either a threat or decline to the habitat apart from a single report from OSPAR Region I indicating a decline. They conclude that there is insufficient evidence for the nomination but note that in many areas, there is a common pattern of bottom trawling in increasingly deeper water where sponge aggregations are known to occur. Taking this into account, they consider it seems reasonable to expect that the vulnerability and threat to the habitat is high (ICES, 2002). This is consistent with the case being made on the basis of expert judgement.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; bioprospecting. *Category of effect of human activity:* Physical – substratum change including smothering, Biological – removal of target and non-target species, physical damage to species.

Deep sea fishing is the main human activity that is a threat to this habitat. The extent to which it is causing damage to sponge fields is difficult to quantify.

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.

Further information

Nominated by:

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Nomination

Oceanic ridges with hydrothermal vents/fields

EUNIS code: A6.94

National Marine Habitat Classification for UK & Ireland code: Not defined

Definition for habitat mapping

Hydrothermal vents occur along spreading ridges (such as the mid-Atlantic ridge), subduction zones, fracture zones and back-arc basins (Gage & Tyler, 1991), and are caused by seawater penetrating the upper levels of the Earth's crust through channels formed in cooling lava flows, reacting chemically with hot basalt in the Earth's crust and then rising back to the sea-bed to vent as superheated water containing compounds such as sulphides, metals, CO_2 and methane (Tunnicliffe *et al*, 1998 in Gubbay, 2002). The water may trickle out from cracks and crevices on the seabed as hot springs (5-250°C), or as very concentrated jets of superheated water (270-380°C). As these concentrated jets of water cool, minerals dissolved in the water precipitate out in black clouds, giving them their common name of 'black smokers'. At lower temperatures, sulphides are mostly precipitated within the rocks, making the venting fluids appear cloudier. These are known as 'white smokers' (Gage & Tyler, 1991). Hydrothermal vent fields cover relatively small areas of the seabed in water depths of 850-4,000m. The biological communities associated with hydrothermal vents are unusual as they are able to derive energy under conditions where photosynthesis is not possible. These habitats contain a huge diversity of chemoautotrophic bacteria, which form the core of the trophic structure around the vent. Characteristic species include the mussel *Bathymodiolus azoricus* and its commensal worm *Branchipolynoe seepensis*, the shrimps *Mirocaris fortunata, Chorocaris chacei* and *Rimicaris exoculata* (this last one is dominant on the southern vent fields of Lucky Strike), the crab *Segonzacia mesatlantic*, the polychaete *Amathys lutzi*, the amphipod *Luckia strike* and the limpet *Lepetodrilus atlanticus*

Geographical extent

OSPAR Regions; I, V

Biogeographic zones: 24

Region & Biogeographic zones specified for decline and/or threat: V

Hydrothermal vents/fields have been found in areas of deep sea tectonic activity in the Pacific, Indian and Atlantic Oceans. In the Atlantic they are associated with the Mid-Atlantic Ridge (MAR).

The hydrothermal activity around vents is caused by seawater penetrating the upper layers of the earths crust through channels formed in cooling lava flows. The tall chimneys formed around the vents and the surrounding sediments are almost pure metallic sulphides and are a unique geological feature of hydrothermal vents (Tunnicliffe *et al.,* 1998). The associated animal communities are particularly unusual as the species derive energy under conditions where photosynthesis is not possible, tolerate great extremes and variability in the temperature and the chemical composition of the surrounding water, and cope with potentially toxic concentrations of various heavy metals.

Application of the Texel-Faial criteria

Hydrothermal vents/fields were nominated in a joint submission by three Contracting Parties citing regional importance, decline, rarity, and sensitivity, with information also provided on threat. The nomination was for Region V.

Regional importance

Hydrothermal vents are most commonly found where ridge of the earths plates are activity spreading but only occupy a small portion of the spreading ridges. The habitat is therefore only present at irregular intervals and the distance in between depending on nature of both volcanism and tectonism of that ridge. At the present time there are four known vent fields in the OSPAR area which are to the south-west of the Azores. These are the Menez Gwen, Lucky Strike, Saldanha and Rainbow vents.

Decline

The extent and distribution of active hydrothermal vents in the MAR is not fully known and will, in any case, change with time over a variety of time scales. As many of these sites only cover a small geographic area and include relatively fragile structures they can be under considerable exploration pressure. At some sites this has already reached a point where man-induced changes in the distribution and occurrence of vent fluid flows and of associated vent communities have been documented (Mullineaux *et al.,* 1998).

Rarity

Most, if not all the known hydrothermal vent fields in the OSPAR Maritime Area, occur in Region V. They cover very small areas in relatively shallow depths compared to fields outside the OSPAR area. These factors make them a rare habitat in the area under consideration.

Rarity is also a consideration in relation to the animal communities associated with hydrothermal vents. At the Lucky Strike vent field, for example, the fauna is dominated by dense beds of a new species of mussel of the genus Bathymodiolus, as well as supporting a totally novel amphipod fauna including a new genus, and the echinoderm *Echinus alexandri*. These vent communities have a sufficiently unique fauna to be considered as representing a different biogeographic hydrothermal province to those previously described (Van Dover *et al.,* 1996).

Sensitivity

The specialised adaptations which allow organisms to exploit vent habitats include major reorganisation of internal tissues and physiologies to house microbial symbionts, biochemical adaptations to cope with sulphide poisoning, behavioural and molecular responses to high temperature, presence of metal-binding proteins and development of specialised sensory organs to locate hot chimneys (Tunnicliffe *et al.,* 1998). The result has been specialised faunas, which are rarely found in other environments. They are also not a very diverse group of species but because they can exploit an abundant energy source around vents they are often present in very high densities (Childress & Fisher, 1992). Vent species are therefore not as sensitive to fluctuations in environmental conditions as many other deep sea fauna but are specially adapted to these extreme conditions. They may also be sensitive to factors that have still to be studied such as blinding due to extensive use of lights and flash photography and damage to the vent chimneys.

Threat

The main threats to hydrothermal vent systems and their associated biological communities are from scientific research (including collecting), seabed mining, tourism and bioprospecting (InterRidge, 2000). The unusual nature of the marine communities that occur around hydrothermal vents makes them a focus for deep sea research. There are regular expeditions to the well-known sites to make observations and measurements, deploy instruments, and collect specimens of the marine life, seawater and rocks. As many of these sites only cover a small geographic area and include relatively fragile structures they can be under considerable exploration pressure (Mullineaux *et al.,* 1998).
Apart from research expeditions, it can be expected that hydrothermal vents will also be subject to pressures from other activities. The first tourist trips to deep sea hydrothermal vents took place in the OSPAR Maritime Area in 1999, at the Rainbow vent site, and are already reputed to have caused some damage to vent chimneys. The vent system on the Dom João de Castro Seamount in the Azores is in shallow waters and subject to some tourist use.

Seabed mining is a potential threat with mining companies seriously investigating the possibility of mining metal sulphide deposits. An exploration licence for such activity has been granted to one company already, but outside the OSPAR Maritime Area (Butler *et al.,* 2001). Bioprospecting, and particularly microbial sampling, is another threat. This usually causes less habitat destruction than many other types of sampling, but the ecological impact of redistribution micro-organisms between sites remains to be evaluated (InterRidge, 2000).

Relevant additional considerations

Sufficiency of data

Hydothermal vents and their associated animal communities were discovered in the late 1970's. Given the relatively short history of research, and the difficulties of conducting such research in the deep sea, it is clear that the study of vent habitat and faunas is at a relatively early stage. This relates to both the extent of active vents in the OSPAR Maritime Area and knowledge of the associated communities. The situation is different for particular vents, such as those to the west of the Azores, which have been the focus of intensive research programmes and it is work in these locations that has led to concerns about threats to vent habitats and their associated communities.

Changes in relation to natural variability

Hydrothermal vents are most commonly found where ridges of the earths' plates are actively spreading. On fast spreading ridges, such as the East Pacific Rise at 13°N vent sites appear to have a short lifetime (generally no longer than about 100yrs) and the zone of hydrothermal activity shifts along the ridge. On slow spreading ridges such as the Mid-Atlantic Ridge, the hydrothermal activity is spatially more focused and stable over the long term, even if the lifetime of an individual vent site is similar to that on fast spreading ridges (Comtet & Desbruyeres, 1998).

Vents and their associated communities are transient and variable not only on short time scales of days and seconds but also over decades. Variability in the hydrothermal discharge causes changes in the animals communities associated with vents. As a consequence, the vent fauna must adapt to unstable environmental conditions and nutrient supply by rapidly colonising new vents (Comtet & Desbruyeres, 1998). Evidence for the longer term variability can be seen in accumulations of dead giant bivalve shells which, as they are known to only persist for about 15yrs before being dissolved, must indicate quite recent change in conditions. Geophysical and geochemical evidence suggests short bursts of hydrothermal activity lasting decades or less. The habitat is neither permanent nor contiguous; dispersal and migration are the major links between neighbouring vents (Tunnicliffe *et al.,* 1998).

Expert judgement

There is ample information to confirm the unique nature of hydrothermal vents and their associated community, and a good basis for considering them to be a rare habitat in the OSPAR Maritime Area. The threats to these habitats have been observed in particular locations and have led to calls by scientists for the co-ordination and management of research programmes to avoid damage. This has been taken up by the Regional Government of the Azores in particular, who are preparing a management plan for the first hydrothermal vent Marine Protected Area in the Atlantic. A combination of research data and expert judgement therefore suggests that hydrothermal vents/fields should be on the OSPAR list of threatened and/or declining species and habitats.

ICES evaluation

The ICES review of this nomination agrees that there is no empirical evidence to suggest that hydrothermal vents are in decline (ICES, 2002). In relation to threat, ICES consider that this habitat has not been proven to be under threat from present-day human activities and that potential future threats such as mining and bioprospecting will be localised and of relatively low impact.

This assessment needs to be viewed in context, as the habitat itself is relatively localised. The limited extent of current and potential threats could therefore still cause serious damage to vent fields and associated communities, and have a significant impact. The threats to hydrothermal vents have been described above and are believed to be a realistic description of human activities, which can have an impact on this habitat.

Threat and link to human activities

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

Relevant human activity: mineral extraction, research, bio-prospecting, tourism. *Category of effect of human activity:* Physical – substratum removal, visual disturbance. Biological – physical damage to species, displacement of species, removal of target and non-target species, changes in population or community structure, introduction of microbial pathogens or parasites

Scientific research around hydrothermal vents can cause physical damage to the habitats and associated organism through sampling programmes, accidental damage and monitoring techniques. Tourist trips to hydrothermal vents and commercial mining activity are other potential threats that would be a result of human activity.

Management considerations

Research protocols, co-ordinated studies and protected areas are amongst the ideas being taken forward by scientists working on hydrothermal vents and the associated biological communities. Similar measures may also be required to manage and future tourist activity while issues concerning seabed mining will need to be raised with the International Seabed Authority if it is to take place beyond EEZs. Measures such as these can be supported by OSPAR to address concerns that the ecological quality of the hydrothermal vent habitats in OSPAR Region V might significantly decline if no protection or management measures are taken

Further information

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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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Nomination

Intertidal *Mytilus edulis* beds on mixed and sandy sediments

EUNIS Code: A2.7211 and A2.7212

National Marine Habitat Classification for UK & Ireland code: LS.LMX.LMus.Myt.Mx and LS.LMX.LMus.Myt.Sa

Mytilus edulis beds are composed of layers of living and dead mussels at high densities, bound together by the byssus threads secreted by the mussels and sometimes overlaying a great deal of accumulated sediment. The three main components are a physical matrix of living and dead shells; a bottom layer of accumulated sediments, mussel faeces and pseudofaeces, organic detritus and shell debris; and an assemblage of associated flora and fauna (Suchanek, 1979).

Definition for habitat mapping

Sediment shores characterised by beds of the mussel *Mytilus edulis* occur principally on mid and lower shore mixed substrata (mainly cobbles and pebbles on muddy sediments) but also on sands and muds. In high densities (at least 30% cover) the mussels bind the substratum and provide a habitat for many infaunal and epibiota species. This habitat is also found in lower shore tide-swept areas, such as in the tidal narrows of sealochs. A fauna of dense juvenile mussels may be found in sheltered firths, attached to algae on shores of pebbles, gravel, sand, mud and shell debris with a strandline of fucoids. Mussel beds on intertidal sediments have been reported all along the coast of Europe, particularly in UK, France, Netherlands and Germany.

Geographical extent

OSPAR Regions: OSPAR Region II, III

Biogeographic zones: 11

Region & Biogeographic zones specified for decline and/or threat: as above

The distribution of *Mytilus edulis* species complex is circumpolar in boreal and temperate waters, in both the southern and northern hemispheres extending from the Arctic to the Mediterranean in the north-east Atlantic (Soot-Ryen, 1955). Intertidal beds of the blue mussel *Mytilus edulis* are specific to the OSPAR area. The majority are found in the Waddensea (Netherlands, Germany and Denmark) and in British coastal waters although they also present all along the coast of France and Ireland (Jones *et al.*, 2000).

The species occurs in intertidal and sometimes subtidal habitats, under conditions ranging from fully saline to highly estuarine, and is capable of forming dense beds over much of its range. *Mytilus edulis* is found in a wide range of wave exposures, from all but the very most exposed shores to extremely sheltered habitats. It forms clumps and dense beds on a variety of sediment types, usually in more wave-sheltered conditions. These areas provide increased oxygen and food supplies, and may also help to prevent 'mussel mud' (silt, faeces and pseudofaeces) from building up too quickly.

Application of the Texel-Faial criteria

Nomination of intertidal mussel beds to be placed on the OSPAR list cited global and regional importance, rarity, sensitivity, ecological significance and keystone role, with information also provided on threat.

Decline

Significant declines in the extent and biomass of intertidal mussel beds have been reported in the OSPAR Maritime Area and particularly in Region II.

In Germany, a series of surveys covering the whole littoral of Niedersachsen revealed a decrease in the extent of beds and, more drastically, in biomass from roughly 5,000ha in extent in the late 1950s (100,000t fresh weight), 2,700ha in 1989/91, 1,300ha (10,000t) in 1994 to 170ha (1,000t) in 1996. Following some good spatfalls an area of 1,280ha survived the severe winter of 1996/7 (Michaelis *et al* 1996; Herlyn & Michaelis 1996; Zen *et al* 1997). Beds in the Ameland region are also reported to have disappeared after intensive fisheries (Dankers 1993).

Details on the mussel populations of Schleswig-Holstein for a period of nine years are also available and a decrease in biomass of approximately 50% was reported between 1989 and 1990 (Ruth, 1994; Dankers *et al.* 1999).

In the Netherlands, Higler *et al*. (1998) observed a serious decline in the populations of mussels between 1988 and 1990, mainly caused by fisheries. The extent of mussel beds decreased from the 1970s to the 1990s. In Denmark, intensive fisheries during 1984 to 1987 almost led to a complete disappearance of the mussel population (Kristensen, 1994, 1995).

Rarity

Intertidal beds are now rare in some parts of their former range in the Waddensea due to fisheries in a period with low spatfall, when mature beds were destroyed. In some areas they are returning very slowly and in others there has been no recovery at all in the last 12 years. Less than 10% of the original area in the Wadden Sea is now present (de Jong, 1999).

Sensitivity

M. edulis is widely recognised as being tolerant of a wide variety of environmental variables including salinity, oxygen, temperature and desiccation (Seed & Suchanek, 1992). It is capable of responding to wide fluctuations in food quantity and quality, including variations in inorganic particle content of the water, with a range of morphological, behavioural and physiological responses but is not necessarily particularly tolerant of anthropogenic chemicals (Hawkins & Bayne, 1992; Holt *et al.,* 1998).

Excessive levels of silt and inorganic detritus are thought to be damaging to *Mytilus* once they accumulate too heavily within the reef matrix (Seed & Suchanek, 1992), although the degree to which this might be influenced directly by water quality rather than production of faeces and pseudofaeces is unclear. *Mytilus* is capable of re-surfacing through a shallow covering of sediment and, in general, is considered to have a strong ability to recover from disturbance (Seed & Suchanek, 1992). Dense phytoplankton blooms can, on occasion, be detrimental to *Mytilus edulis*, although serious effects at the population level have only occasionally been reported (Holt *et al.,* 1998)

Ecological significance

Mussel beds are important in sediment dynamics of coastal systems. They collect sediment and are able to keep up with sea level rise. They protrude from the surrounding mudflats and are important as food source for birds. In the Waddensea 25% of the bird numbers used to occur on mussel beds which only occupied 3% of the area (Zwarts, 1991). The morphological structure of littoral areas are also enhanced by the mussel beds even where absent, as remnants are visible as elevations of clay banks or shell layers. In the Waddensea these are often a good basis for new spatfall. Very old beds may also stabilise creek patterns because clay and shell layers are relatively erosion resistant.

Mussel beds provide shelter for a large number of species and form an often rare area of hard substrata in areas of soft sediment. Asmus (1987) and Dittmann (1990) found respectively, 41 and 96 allied species. For some species such as sea anemones, hydroids and eelgrass, the bed provides shelter or permanent water in the tidal pools between the ridges. Others, especially deposit feeding worms, profit from the organic matter that is deposited as pseudofaeces (de Jong *et al.,* 1999).

Threat

Although the mussel beds occur in most of the OSPAR area, the majority of *Mytilus* beds under threat occur in the Waddensea and southern British coastal waters.

The extensive, heavily exploited mussel fisheries (especially spat collecting for aquaculture) removed close to the entire stock in the Waddensea between 1988 and 1990 (Dankers *et al*., 1999), as well as having knock on effects such as an increased mortality for seabirds (e.g., eider ducks) (Kaiser *et al*., 1998) and affecting the benthic diversity. Jones *et al.* (2000), Dankers *et al.* (1999), and others consider that this habitat is under pressure from fisheries activities especially when settlement of spatfall is low.

Phytoplankton blooms, produced by nutrient enrichment (e.g., industrial and residential sewage discharge, agriculture), are another potential threat to to mussel beds (de Jonge, 1997) and Jones *et al.* (1999) have suggested that mussel beds could also have intermediate sensitivity to anti-fouling substances and heavy metal contaminants. The decrease of mussel beds has profound effects on predators such as eider ducks and oystercatchers (Kaiser *et al*., 1998).

Relevant additional considerations

Sufficiency of data

Because of its widespread distribution, intertidal habit, its abundance and ecological importance in many places, its use as a bio-indicator, its commercial importance, and the relative ease with which it can be kept alive in the laboratory, *Mytilus edulis* has been extremely widely studied. There are also good records of the locality and size of mussel beds especially in the Waddensea, where they have been mapped since the 1950s or even earlier.

Changes in relation to natural variability

There can be significant variability in the occurrence and persistence of mussel beds as a result of natural factors. The presence and scale of the mussel bed mounds is governed by the interplay of factors that cause them to build up or break them down. Stock density is influenced by recruitment, predation and density dependent mortality, together with factors that affect feeding; the production of faeces and growth all build up the mounds. Waves, currents, predation and sometimes ice scour or sand burial, limit, erode or carry away the mounds.

Many mussel beds are subject to total destruction by storms and tidal surges and on occasion, this may involve hundreds of hectares. The number of mussel beds in the Schleswig-Holstein part of the Wadden Sea mapped by aerial survey decreased from 94 in 1989 to 49 in 1991 as a result of severe storms in early 1990 (Nehls & Thiel, 1993).

Ice flows can sweep away beds in the Wash and the Wadden Sea in the most severe winters and sand burial of *Mytilus* reefs occurs occasionally in Morecambe Bay (Dare, pers. comm. in Holt *et al.,* 1998). Large scale sand movements are also common in other places, such as parts of the Cumbrian Coast and Solway Firth (e.g. Perkins, 1967; 1968; 1970; 1971; Perkins et al., 1980), and can be expected to bury *Mytilus* beds on occasion.

Spatfall and recruitment in some beds of mussels is very variable year on year. Recruitment is favoured by cold preceding winters caused by decreases in predator populations and delays in the arrival of newly settled crabs and shrimps on the flats which allows the spat to reach a larger size before the onset of predation. Although a bed as a whole may be a persistent feature, the formation of patches within it is a dynamic process (Svane & Ompi, 1993). Those on the outside of patches tend to be larger and there are complex density dependent influences on a small scale on recruitment, growth and mortality.

Predation is an important influence on all mussel populations. However, Nehls & Thiel (1993) considered that bird predation was less important in causing losses of entire adult mussel populations than factors such as storm damage.

Over time, beds in particular places may for natural reasons vary in the positions they occupy on the continuum between thin, patchy beds and well developed reefs. Because mussel mud is highly cohesive, once it has consolidated, the deposits may last for years after the mussels have largely gone.

Expert judgement

There is good evidence of the threat to mussel beds from fisheries, especially when this coincides with periods of low spatfall. The detailed records of the decline of extensive beds in the Waddensea provide scientific evidence of the threat to this habitat and its decline along southern North Sea coasts. Further evidence of the link to fisheries, which can also inhibit recovery, can be found in the work of Herlyn & Millat (1999) who reported that on 12 non-fished beds, none had disappeared in the year after settling, whereas 7 out of the 8 fished beds had almost or completely disappeared.

ICES evaluation

OSPAR (2001) considered this habitat to be threatened and/or in decline across the whole OSPAR area. The Leiden Workshop concluded that evidence for the decline and threat of intertidal mussel beds was “strong” across the whole OSPAR area. ICES has found sufficient evidence for the decline and threat of this habitat over the whole OSPAR area.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting & harvesting, land-based activities, aquaculture/mariculture. *Category of effect of human activity;* Physical – substratum change, substratum change, increased siltation, turbidity changes, emergence regime changes, water flow rate, temperature and wave exposure changes. Chemical – Contamination by synthetic compounds, heavy metals and hydrocarbons, nutrient changes. Biological – physical damage to the species, removal of target and non-target species.

There is clear evidence for a decline of mussel beds in areas of intensive fisheries, especially when associated with low recruitment events (Dankers *et al.,* 1999; Jones *et al*., 2000). The best reported example is of the extensive, heavily exploited mussel fisheries (especially spat collecting for aquaculture), in the Waddensea, which removed close to the entire stock between 1988 and 1990 (Dankers *et al*., 1999). The decrease of mussel beds was also reported to have profound effects on predators such as eider ducks and oystercatchers (Kaiser *et al.,* 1998).

Management considerations

The main management measures which would assist the conservation of this habitat are the regulation of fisheries (including spat collection for aquaculture) and protection from physical damage.

Intertidal mussel beds have been placed on the red list of biotopes and biotope complexes of the Waddensea. In some locations the beds are also a key feature within some of the Annex I habitats listed in the EC Habitats Directive and therefore given protection through the designation of Special Areas of Conservation.

Further information

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Useful References:

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Nomination

Littoral chalk communities
EUNIS Code: Various including A1.126, A1.2143, A1.441, B3.114 and B3.115
National Marine Habitat Classification for UK & Ireland code: Littoral chalk biotopes (various including LR.HLR.FR.Osm, LR.MLR.BF.Fser.Pid, LR.FLR.CvOv.ChrHap, LR.FLR.Lic.Bli and LR.FLR.Lic.UloUro)

Definition for habitat mapping

The erosion of chalk exposures on the coast has resulted in the formation of vertical cliffs and gently-sloping intertidal platforms with a range of micro-habitats of biological importance. Supralittoral and littoral fringe chalk cliffs and sea caves support various algal communities unique to this soft rock type. Orange, brownish or blackish gelatinous bands of algae, composed of an assemblage of Haptophyceae species such as *Apistonema* spp., *Pleurochrysis carterae* and the orange *Chrysotila lamellosa*, but other genera and species of Chrysophyceae, Haptophyceae and Prasinophyceae are likely to be present as well. The lower littoral fringe may be characterised by a dense mat of green algae *Enteromorpha* spp. and *Ulva lactuca*. Lower down the shore in the eulittoral the generally soft nature of the chalk results in the presence of a characteristic flora and fauna, notably 'rock-boring' invertebrates such as piddocks, overlain by mostly algal-dominated communities (fucoids and red algal turfs) (Gubbay, 2002). Such coastal exposures of chalk are rare in Europe, with those occurring on the southern and eastern coasts of England accounting for the greatest proportion (57%) (ICES, 2003). Elsewhere, this habitat occurs in France, Denmark and Germany.

Geographical extent

OSPAR Regions; II
Biogeographic zones: 4, 6-9, 11-14
Region & Biogeographic zones specified for decline and/or threat: II

The erosion of chalk exposures at the coast has resulted in the formation of vertical cliffs and gently sloping shore platforms with a range of micro-habitats of biological importance. Littoral fringe and supralittoral chalk cliffs and sea caves support algal communities unique to the substrate. The generally soft nature of the chalk results in the presence of a characteristic flora and fauna, notably rock-boring invertebrates. Littoral chalk also supports distinct successive zones of algae and animals (Anon, 2000). In the OSPAR Maritime Area littoral chalk habitats are found on the coasts of England, France and Denmark.

Application of the Texel-Faial criteria

Littoral chalk communities were nominated by one Contracting Party, citing decline, rarity and sensitivity, with information also provided on threat.

Decline

A recent survey of chalk cliffs throughout England revealed that 56% of coastal chalk in Kent, and 33% in Sussex has been modified by coastal defence and other works. On the Isle of Thanet (Kent) this increases to 74%. There has been less alteration of chalk at lower shore levels except at some large port and harbour developments (e.g. Dover & Folkestone) (Doody *et al.,* 1991; Fowler & Tittley, 1993). Elsewhere in England, coastal chalk remains in a largely natural state.

Rarity

Coastal exposures of chalk are a rare in Europe with the greatest proportion (57%) and many of the best examples of littoral chalk habitats located on the coast of England. There is around 120km of chalk coastline on the French coast of Upper Normandy and Picardy and some chalk exposures at the coast in Denmark.

Sensitivity

The marine communities associated with littoral chalk habitats are generally tolerant of a high degree of turbidity. The most sensitive elements of the marine communities are probably the algae that are found in the splash zone of cliffed coasts.

Threat

The main threats to littoral chalk communities are from coast protection works, toxic contaminants and physical loss (Anon, 2000; Fletcher, 1974; Fowler & Tittley, 1993; Wood & Wood, 1986). Coast protection work has led to the loss of micro-habitats on the upper shore and the removal of splash-zone communities, including the unique algal communities. The deterioration of waters quality by pollutants and nutrients has caused respectively the replacement of fucoid dominated biotopes by mussel-dominated biotopes, and the occurrence of nuisance *Enteromorpha* spp. blooms.

A potential factor affecting the chalk biota is human disturbance especially be trampling, stone-turning, small-scale fishery and damage to rocks though removal of piddocks. Chalk exposures in the Straits of Dover are also vulnerable to oil spills due to the proximity of major shipping lands. Native species along the English Channel have also been displaced, for example by *Sargassum muticum* and *Undaria pinnatifida*. These threats are significant primarily mainly because of the relatively restricted distribution and small total area of this habitat type.

Relevant additional considerations

Sufficiency of data

There is a limited but good basis for assessing the extent and status of littoral chalk habitat in the OSPAR Area. It is also clear that some areas of habitat have been lost to development and coastal protection works, but in many other areas the habitat has undergone a degree of modification

Changes in relation to natural variability

The natural erosion of chalk coastlines will result in changes in the extent of the habitat and has caused some dramatic cliff falls such as those at Ault (Somme) in October 1998, and at Le Tilleul (Seine Maritime) on November 1998. Falls at Beach Head in January 1999 resulted and estimated 100,000 m^3 of chalk debris and 150,000 m^3 at Puys in 2000 (Duperret *et al.,* 2001). Sea level rise and post-glacial land adjustment will submerge areas of intertidal chalk platforms.

Expert judgement

There is clear evidence of threats and declines of this habitat in some areas (OSPAR Region II) and therefore a good case for listing without much emphasis on the need for expert judgement to assess the significance of any qualitative or anecdotal information.

ICES evaluation

ICES finds that there is good evidence of declines and threat in some OSPAR regions and the precautionary approach would see this consideration extended to the whole OSPAR area (ICES 2002). This is based on the view that there is a clear and present danger to the existence of this habitat, primarily from physical threats such as development of ports or coastal protection works and from water quality threats, including those arising from maritime accidents, as many of the sites are in regions of high shipping activity.

Threat and link to human activities

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

Relevant human activity: Constructions, coastal defence measures, landbased activities, shipping & navigation, tourism and recreational activities. *Category of effect of human activity:* Physical: substratum removal, increased siltation, turbidity changes. Chemical – hydrocarbon contamination, nutrient changes. Biological – physical damage to species, introduction of non-indigenous species.

There is a clear link between certain human activities and threats to littoral chalk habitats. This is particularly in cases where there has been coastal development or coastal protection works adjacent to this habitat type. Other threats such as post-glacial land adjustment are naturally occurring.

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 siting 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 littoral chalk habitats are covered by the EU Habitats Directive under the category of “reefs” and could therefore be included in the *Natura 2000* network.

Further information

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UK

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Useful References:

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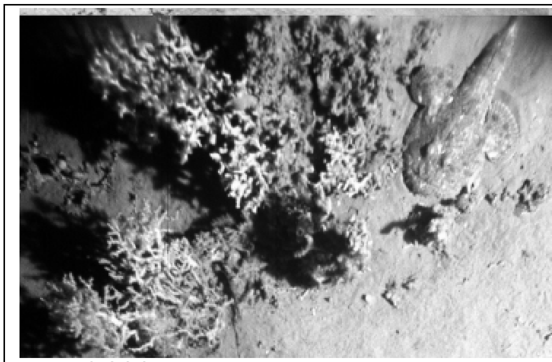
Nomination

Lophelia pertusa reefs
EUNIS Code: A5.631 and A6.611
National Marine Habitat Classification for UK & Ireland code: SS.SBR.Crl.Lop



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Definition for habitat mapping

Lophelia pertusa, a cold water, reef-forming coral, has a wide geographic distribution ranging from 55°S to 70°N, where water temperatures typically remain between 4-8°C. These reefs are generally subject to moderate current velocities (0.5 knots). The majority of records occur in the north-east Atlantic. The extent of *L. pertusa* reefs vary, with examples off Norway several km long and more than 20m high. These reefs occur within a depth range of 200->2000m on the continental slope, and in shallower waters in Norwegian fjords and Swedish west coast. In Norwegian waters, *L. pertusa* reefs occur on the shelf and shelf break off the western and northern parts on local elevations of the sea floor and on the edges of escarpments. The biological diversity of the reef community can be three times as high as the surrounding soft sediment (ICES, 2003), suggesting that these cold-water coral reefs may be biodiversity hotspots. Characteristic species include other hard corals, such as *Madrepora oculata* and *Solenosmilia variabilis*, the redfish *Sebastes viviparous* and the squat lobster *Munida sarsi*. *L. pertusa* reefs occur on hard substrata; this may be *Lophelia* rubble from an old colony or on glacial deposits. For this reason, *L. pertusa* reefs can be associated with iceberg plough-mark zones. Areas of dead coral reef indicate the site supported coral reef habitat in the past and should be reported as this habitat type.

Geographical extent

OSPAR Regions; All
Biogeographic zones: 12-14, 25
Region & Biogeographic zones specified for decline and/or threat: All

Lophelia pertusa, the reef-forming cold water coral, has a wide geographical distribution, ranging from 55ºS to 71ºN (Dons, 1944; Cairns, 1994). It is present in the Atlantic, Pacific and Indian Oceans and in the Mediterranean. In the OSPAR Maritime Area it is found from the Iberian Peninsula to Ireland, around the Rockall Bank, the Faroe Islands, and near the coast and on the shelf along the Norwegian coast (ICES, 199, 2002a) (Figure A). Currently the largest known *L.pertusa* reef lies off the coast of Norway on the Sula Ridge (Freiwald *et al.,* 1999). Patches and mounds of the coral appear to be more common that large reefs.

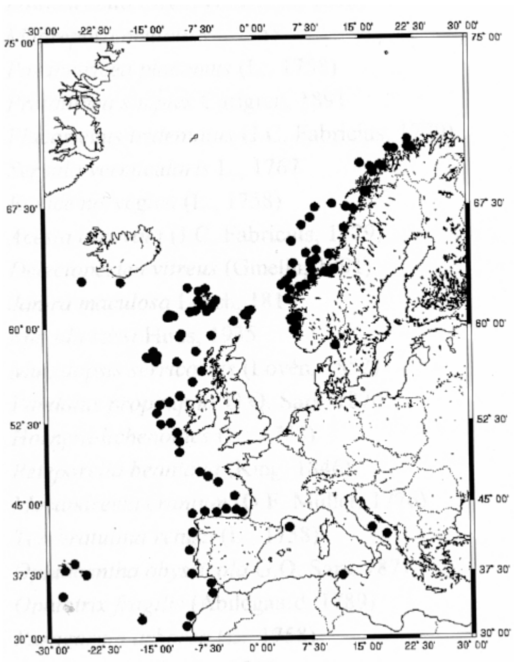
Application of the Texel-Faial criteria

There were three nominations for *L.pertusa* to be included on the OSPAR list. The criteria common to all were the global or regional importance, decline, and sensitivity, with information also provided on threat.

Global/regional importance

The OSPAR area appears to be particularly important for *L. pertusa* because of the high proportion of the known occurrences of these reefs in the NE Atlantic. There is still uncertainty about how well the distribution of *L.pertusa* has been mapped in other oceans because of the widely scattered reported occurrences elsewhere.

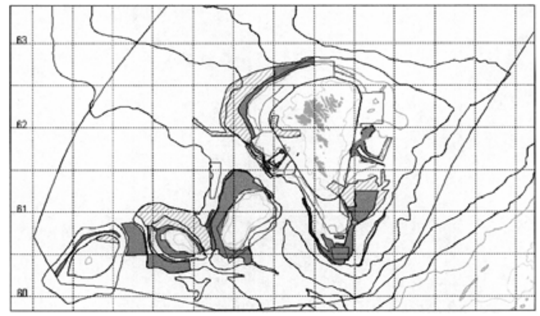
FIGURE A. Distribution of *L.pertusa* reefs in Europe. In ICES (1999) based on Freiwald (1998) and Hovland & Mortensen (1999).



Decline

A number of studies have estimated the extent of *L.pertusa* in parts of the NE Atlantic and the changes that have taken place in recent years. This has been summarised by the ICES Study Group on mapping the occurrence of cold water corals (ICES 2000a). In the Norwegian EEZ, for example, *L.pertusa* is estimated to cover somewhere between 1,500 to 2,000km^2 of seabed, mostly concentrated between depths of 200-400m (Fosså *et al.,* 2000). Analysis of information collected by direct observation and fishermen's interviews suggest that between one-third and one half of the total reef area of Norway has been damaged to an observable extent (Ottesen *et al.,* 2000). The current and past distribution of *L.pertusa* reefs around the Faroe Islands also show changes, and these are thought to be due to fishing activity (S.H.í Jákupsstovu in ICES, 2002a) (FIGURE B).

FIGURE B. Distribution of current and past areas containing *L.pertusa* reefs around the Faroe Islands (S.H.í Jákupsstovu in ICES 2002a).



Solid shading - current distribution, hatched shading – known past distribution.

Sensitivity

The delicate structure and slow growth rate of *Lophelia* makes these coral reefs particularly vulnerable to physical damage. The growth rate is thought to be about 6mm per year implying that normal sized colonies of around 1.5m high are about 250 years old, and the reef structures seem to be relatively stable within a time scale of hundreds of years (ICES, 1999). The potential for *Lophelia* to recover after physical damage is uncertain but is probably dependent on the severity of damage and the size of the surviving coral fragments.

The effects of drill cuttings, water-based and synthetic drilling muds, and the variety of chemicals and contaminants including dissolved and dispersed oil which is known to enter the environment around offshore oil operations may have lethal and sublethal effects on corals, but there are few studies on this as yet (Rogers, 1999).

Threat

The principal threat to *L.pertusa* reefs is physical damage by fishing gear. There are documented instances of damage in N.W.European waters but these are most likely a minute fraction of the number of instances where such reefs have been damaged, given how widespread trawling has been, and the amount of habitat that is potentially suitable for corals in the NE Atlantic (ICES, 2002a). Petroleum industry developments with associated discharges of drilling mud and drill cuttings may also negatively affect the corals. Given the slow growth rate of the reefs, they may take centuries to recover from damage, if at all.

Relevant additional considerations

Sufficiency of data

Offshore surveys, sampling programmes and anecdotal reports have provided information on the occurrence of *L.pertusa,* while sidescan sonar images and photographs have been particularly useful in showing the damage to reefs from trawling activity. Large parts of the OSPAR Maritime Area do however remain unexplored and it is therefore likely that both damaged and undamaged reefs have still to be discovered.

Changes in relation to natural variability

The damage observed on *Lophelia* reefs affected by trawling is extensive and in some cases totally crushed reefs are all that remain. This is undoubtedly greater than any changes which would be expected through natural fluctuations in the extent of *L.pertusa* reefs.

Expert judgement

The dramatic effects of trawling damage on *L.pertusa* reefs, and the widespread occurrence of this activity, suggests that *L.pertusa* reefs are under considerable threat. This is supported by scientific evidence. The extent of damage and decline in extent of *L.pertusa* reefs is well known in some areas but is based on expert judgement in others.

ICES evaluation

The ICES review of this nomination finds that there is good evidence of declines and threat to *Lophelia* reefs. In particular, ICES report that there is good evidence of decline in OSPAR Regions I, II, III, and V. Occurrence in Region IV is not well known, but given the distribution of deep-water trawling it is likely that damage/decline has occurred there as well. ICES also note that there is good evidence that the principal current threat comes from bottom trawling. As the technology to undertake such trawling in hard habitats develops further, areas of *Lophelia* reefs have come under threat (ICES, 2002b).

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; oil & gas exploration and exploitation. *Category of effect of human activity:* Biological – physical damage to species; Chemical – hydrocarbon contamination, Physical, - substratum change.

Trawling is very widespread in areas where *L.pertusa* occurs and damage to reefs from the activity of trawlers has been documented in a number of places. The best known examples are probably off the coast of Norway where there were anecdotal reports of trawlers using their gear to crush the corals to clear areas before fishing before these reefs were protected by the Norwegian government (Fosså *et al.,* 1999). Here and elsewhere there are also sidescan sonar images and photographs revealing the extent of damage to these and other reefs including furrows, mostly likely caused by trawl doors moving through areas of coral, lost nets tangled with corals, crushed reefs and broken coral strewn on the seabed (e.g. Bett *et al*., 2001: Wheeler *et al.,* 2001; Fosså *et al.,* 2000)

Another indication that trawling is the cause of damage to *Lophelia*, and that such damage is widespread, comes from that many records of *Lophelia* in commercial trawl hauls, where the coral was only known to occur because of the broken pieces brought to the surface by fishing gear (Hall-Spencer *et al.,* 2002).

Management considerations

Closed areas for particular types of fishing have been introduced in some areas to protect *L.pertusa* reefs and could be applied more widely to protect this habitat. This is a matter that falls within the remit fisheries organisations rather than OSPAR, although OSPAR can communicate an opinion on this to the relevant bodies and introduce any relevant supporting measures that fall within its own remit if such measures exist or are introduced in the future.

Further information

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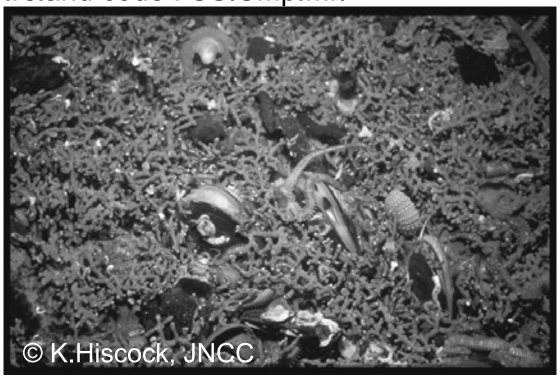
Nomination

Maerl beds
EUNIS Code: A5.51
National Marine Habitat Classification for UK & Ireland code : SS.SMp.Mrl



Definition for habitat mapping

"Maerl" is a collective term for several species of calcified red seaweed (e.g. *Phymatolithon calcareum*, *Lithothamnion glaciale*, *Lithothamnion corallioides* and *Lithophyllum fasciculatum*) which live unattached on sediments. In favourable conditions, these species can form extensive beds, typically 30% cover or more, mostly in coarse clean sediments of gravels and clean sands or muddy mixed sediments, which occur either on the open coast or in tide-swept channels of marine inlets, where it grows as unattached nodules or 'rhodoliths'. Maerl beds have been recorded from a variety of depths, ranging from the lower shore to 30m depth. As maerl requires light to photosynthesize, depth is determined by water turbidity. In fully marine conditions the dominant species is typically *P. calcareum*, whilst under variable salinity conditions such as sealochs, beds of *L. glaciale* may develop. Maerl beds have been recorded off the southern and western coasts of the British Isles, north to Shetland, in France and other western European waters.

Geographical extent

OSPAR Regions; Entire OSPAR Area
Biogeographic zones 4,6-9,11
Region & Biogeographic zones specified for decline and/or threat: Region III.

In the OSPAR area, maerl is common on Atlantic coasts from Norway and Denmark in the north, to Portugal in the south. In Spain maerl deposits are confined mainly to the Ria de Vigo and Ria de Arosa. In Ireland, maerl is widely distributed in the south and south-west, and in the UK it occurs off the southern and western coasts and north to Shetland. It is particularly abundant in Brittany but absent from large areas of Europe, such as most of the North Sea, the Baltic, the Irish Sea and eastern English Channel (Birkett *et al.,* 1998).

Live maerl has been found at depths up to 40m (and up to 100m near Corsica and Malta) but beds are typically much shallower, usually above 20m and can extend onto the lower shore.

Application of the Texel-Faial criteria

Nomination of maerl beds to be placed on the OSPAR list cited sensitivity, ecological significance and decline. Information was also provided on threat.

Decline

A number of studies indicate that maerl beds have declined in both extent and quality in the OSPAR Area. Hall-Spencer & Moore (2000), recorded declines on a maerl bed off the west coast of Scotland, related to the expansion of the scallop fishing industry there. Similar evidence exists off the Irish coast, where the situation was complicated as species came and went on maerl beds according to seasonal influences. Extraction of both living and fossil deposits have depleted beds in the Fal estuary in England and at least four maerl beds in Brittany have been completely destroyed by extraction (Hily & Le Foll,1990; Hall-Spencer,1995).

Most Breton maerl beds are affected by human activities and the only pristine grounds remaining are small compared to the extensive maerl beds that covered several square kilometres in the 1960s (Grall & Hall-Spencer, 2003). For example, one of the largest maerl beds in Brittany (Glenan) was covered in living maerl until maerl extraction started 35 years ago. When surveyed in 1999 live maerl was very rare over most the bank and no macrofauna were observed in grab and core samples in the extraction zone (Grall & Hall-Spencer, 2003). Some of Breton's extensive maerl beds have disappeared, not only because of extraction but also because of sewage discharge (Grall & Glémarec, 1997).

A review of historical data and the current situation at a maerl bed on the west coast of Scotland (Firth of Clyde) has revealed extensive changes over the last 100 years. A living maerl bed with abundant large thalli and nests of the gaping file shell *Limaria hians* has become a bed of predominantly dead maerl with few, small, live thalli and no *L.hians* (Hall-Spencer & Moore, 2003).

Sensitivity

The three commonest species of maerl are very sensitive to substrata loss, smothering, increase in suspended sediment, abrasion and physical disturbance which can prevent light reaching the living maerl and therefore halt photosynthesis (Jones *et al.,* 2000).

The impacts of any damage to maerl beds are long lasting because the key habitat structuring species has a very poor regenerative ability (Hall-Spencer & Moore, 2003). Extremely slow growth rates for maerl have been recorded in data from Ireland, England, France, Norway, Scotland and Spain. These are of the order of tenths of millimetres to one millimetre per year (Bosence & Wilson, 2003).

Maerl beds in the Sound of Iona are recorded as containing dead nodules up to 4,000 years old (Farrow, 1983, cited in Maggs *et al*., 1998). Adey (1970) estimates the life-span of individual plants of *L.glaciale* to be from 10-50 years and little is known about the reproductive mechanisms of this species. Spores can potentially disperse long distances although if dispersal is dependent on vegetative propagation, then distances will be extremely limited.

Ecological significance

Maerl beds are an important habitat for a wide variety of marine animals and plants which live amongst or are attached to the nodules, or which burrow in the coarse gravel or fossil maerl beneath the top living layer (Grall & Gélmarec, 1997). The beds studied to date have been found to harbour a disproportionately high diversity and abundance of associated species in comparison with surrounding habitats, and some of these species are confined to the maerl habitat or rarely found elsewhere. Dead maerl also has an ecological importance, supporting diverse communities, although these have been reported to be less rich than those which in live maerl beds (Keegan, 1974). Both dead and living maerl deposits are also considered to be an important source of subtidal and beach-forming calcareous sediments (Farrow *et al.,* 1978).

Maerl beds may also be important nursery areas for commercially valuable molluscs and crustaceans. This aspect has not been well studied but there is good evidence that they are nurseries for at least a few species e.g. the black sea urchin *Paracentrotus lividus* in maerl deposits in Ireland and scallops on maerl beds in France and the west of Scotland (Thouzeau, 1991; Keegan, 1974; Birkett *et al*., 1998). They also provide structurally complex feeding areas for juvenile fish such as Atlantic cod, and reserves of commercial brood stock for species such as *Pecten maximus, Venus verrucosa* and *Ensis* spp. (Hall-Spencer *et al*., 2003).

Threat

In Europe, maerl has been dredged from both living beds and fossilised deposits for use as an agricultural soil conditioner as well as use in animal food additives and water filtration systems. Although quantities were initially small, by the 1970s a peak of around 600,000 tonnes were extracted per year in France (Briand, 1991). Due to the very slow rate of growth, maerl is considered to be a non-renewable resource and, even if the proportion of living maerl in commercially collected material is low, extraction has major effects on the wide range of species present in both live and dead maerl deposits (Hall-Spencer, 1998; Barbera *et al.,* 2003)

As well as the direct effect of the physical removal of the maerl during extraction, there are other direct and indirect impacts from muddy plumes and excessive sediment load, caused by the dredging activity, which later settle out and smother associated and surrounding communities.

Damage to the surface of beds is also caused by heavy demersal fishing gear, from pollution by finfish and shellfish aquaculture operations in inshore waters, and suction dredging for bivalves. Coastal construction and increases in agricultural and sewage discharges may also have some impact if they increase sediment loads or result in the excessive growth of ephemeral species of macroalgae around maerl beds (Birkett *et al.,* 1998; De Grave *et al.*, 2000).

Impacts have also been reported on benthic communities at and around extraction sites. In Brittany large scale maerl extraction over the last 30 years has removed and degraded the habitat. Other major impacts include the spread of the invasive gastropod *Crepidula fornicata*, industrial waste, sewage pollution, aquaculture and demersal fishing, all of which have increased sharply since the 1970s and are causing widespread damage to Breton beds (Grall & Hall-Spencer, 2003, BIOMAERL team, 2003). For example at Glenan in France there was a clear change from 1969 (before suction dredging started) to 1999 (Grall & Hall-Spencer 2003). Before intense dredging the community was diverse and typical of Breton maerl beds but it has since become an impoverished muddy sand community. In 1969 the habitat was described as a clean maerl gravel with low silt content supporting abundant suspension feeding bivalves. Now the habitat is of muddy sand dominated by deposit feeders and omnivores. Similar changes have also been recorded in Ireland (De Grave & Whittaker, 1999). Habitat complexity is also much reduced by bivalve dredging (Hall-Spencer *et al.,* 2003).

Relevant additional considerations

Sufficiency of data

There is a good body of information on the rich biodiversity of maerl beds from studies on the maerl itself, as well as associated flora, infauna and epifauna, and an extensive inventory of maerl-associated biota from sites throughout Europe. The functional diversity of maerl beds has been described as has the potential role as nursery grounds for commercial species of fish and shellfish. Work has also been carried out on the growth rate of different species of maerl using a variety of methods.

The principle threats to maerl beds from physical, chemical, and biological impacts have been described in general terms as well as being documented or confirmed in the OSPAR Area by experimental studies on maerl beds in the UK, Ireland, France and Spain while the recently concluded EC-funded BIOMAERL project was perhaps the largest single concerted research programme carried out to date on maerl and has drawn upon the experience of researchers from across Europe covering the wider range of maerl beds and associated impacts (Donnan & Moore, 2003).

The information available provides clear evidence of the threat and to damage to maerl beds from activities such as maerl extraction, scallop dredging and poor water quality.

Changes in relation to natural variability

The ecological niche of *L.corallioides* and *P,.calcareum* is relatively narrow and subject to many controlling environmental factors. The requirement of moderate current and wave action on the one hand, but moderate turbidity and sedimentation on the other, help to explain the limited spatial distribution of these species. Little is known about changes in maerl beds in relation to natural variability.

Expert judgement

Studies within the OSPAR Area have confirmed threat, impacts and decline of maerl beds associated with a range of human activities.

ICES evaluation

OSPAR (2001) considered this habitat to be threatened and/or declining over the whole OSPAR area. The Leiden Workshop concluded that evidence for the decline and threat of maerl beds was “strong” over the whole OSPAR area. ICES agreed that evidence for decline and threat of this habitat was sufficient, but only for the OSPAR Region III area. Results from the four-year EC funded BIOMAERL project have since been published (2003) and show that both the threat to maerl beds and their decline is more widespread. Maerl beds are therefore still nominated for the entire OSPAR area.

Threat and link to human activities

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

Relevant human activity: Extraction of sand, stone and gravel, constructions, landbased activities, aquaculture/mariculture, traffic infrastructure (dredging), placement and operation of cables and pipelines, fishing, hunting, harvesting, tourism and recreational activities.

Category of effect of human activity: Physical – Substratum removal, substratum change, increased siltation, turbidity changes, water flow rate changes; Biological – physical damage to species, displacement of species, removal of non-target species, introduction of alien species, changes in population or community structure or dynamics.

There is no doubt that many human activities can and do damage to maerl beds. Commercial dredging of maerl deposits is particularly destructive since this removes the productive surface layer and dumps sediment on any plants which escape dredging, inhibiting habitat recovery (Hall-Spencer, 1994). Fishing activities can also cause damage with scallop dredging on French and UK maerl beds having significantly reduced the complexity, biodiversity and long-term viability of these habitats (Hall-Spencer *et al*., 2003; Hily *et al.,* 1993; MacDonald *et al.,* 1996). Video and direct observation of the effects of scallop dredging in the Upper Firth of Clyde (UK) have revealed dredge teeth penetrating 10cm into the maerl, crushing maerl fragments and killing them by burial. Four months later there were less than half as many live maerl thalli as in control undredged areas (Hall-Spencer, 1995, 1998). Scallop dredging activity has also been reported to result in severe disruption to the maerl bed and associated flora and fauna in France although where there are restrictions certain types of damage may be reduced so some areas have remained productive for commercial bivalves and deep-burrowing organisms can survive in large numbers (Hily & Le Fol, 1990; Hall-Spencer *et al.,* 2003).

Sewage pollution has also been directly linked to the loss of maerl beds. In the Bay of Brest, for example, two maerl beds studied 50 years ago have changed from dense deposits of living maerl on sandy mud mixed with dead maerl to heterogeneous mud with maerl fragments buried under several centimetres of fine sediment with species-poor communities dominated by opportunists (Grall & Glemarec, 1997; Grall & Hall-Spencer, 2003).

Management considerations

The main management measure which would assist the conservation of this habitat is protection from physical damage. This would require halting direct extraction from maerl beds and stopping fishing in maerl beds using gears that damage the structure of the beds and the associated species. A recently concluded four year EU project on maerl in Europe has recommended a presumption of protection of all maerl beds as they are effectively non-renewable resources. Other proposals from this work include the prohibition on the use of towed gear on maerl grounds, moratoria on the issue of further permits for the siting of aquaculture units above maerl grounds and measures to limit the impacts that might affect water quality above maerl beds (Barbera *et al.,* 2003)

Closed areas for particular types of fishing are used to protect certain habitats and species in the NE Atlantic and could also 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).

Two of the more common maerl forming species *L.corallioides* and *P.calcareum* are listed in Annex V of the EC Habitats Directive. In some locations it is also a key habitat within some of the Annex I habitats of the Directive and therefore given protection through the designation of Special Areas of Conservation. In the UK maerl is the subject of a habitat action plan under the UK Biodiversity Action Plan.

Further information

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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 haves 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 threats 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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Nomination

Ostrea edulis beds
EUNIS Code: A5.435
National Marine Habitat Classification for UK & Ireland code: SS.SMx.IMx.Ost

Definition for habitat mapping

Beds of the oyster *Ostrea edulis* occurring at densities of 5 or more per m^2 on shallow mostly sheltered sediments (typically 0-10m depth, but occasionally down to 30m). There may be considerable quantities of dead oyster shell making up a substantial portion of the substratum. The clumps of dead shells and oysters can support large numbers of the ascidians *Ascidiella aspersa* and *Ascidiella scabra*. Several conspicuously large polychaetes, such as *Chaetopterus variopedatus* and terebellids, may be present as well as additional suspension-feeding polychaetes such as *Myxicola infundibulum*, *Sabella pavonina* and *Lanice conchilega*. A turf of seaweeds such as *Plocamium cartilagineum*, *Nitophyllum punctatum* and *Spyridia filamentosa* may also be present (Connor *et al*, 2004).

Geographical extent

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

Natural oyster beds of the species *O.edulis*, are found in estuarine areas from 0-6m depth on sheltered but not muddy sediments, where clean and hard substrates are available for settlement. They used to occur in deeper water, down to 50m, on beds in the North Sea.

Application of the Texel-Faial criteria

O.edulis beds were nominated by two Contracting Parties and are being cited for OSPAR Region II. The criteria common to both nominations were decline and sensitivity, with information also provided on threat.

Decline

Naturally occurring beds of *O.edulis* are known to have been more abundant and widespread in OSPAR Region II in the 18th and 19th centuries when there were large offshore oyster grounds in the southern North Sea and the Channel. During the 20th century there was a significant decline in their abundance in European waters (e.g. Korringa, 1952; Yonge, 1960; Svelle *et al*., 1997; Kennedy & Roberts, 1999). Around 700 million oysters were consumed in London alone in 1864, for example, and the UK landings fell from 40 million in 1920 to 3 million in the 1960s, and have never returned to these levels (Edwards, 1997).

The northern 'coldwater' population, which used to thrive in areas such as the Firth of Forth, Schleswig-Holstein and the Dutch Wadden Sea is extirpated and the southern warmer water population has declined (Korringa, 1976). *O.edulis* has also virtually disappeared from Belgian waters (Svelle *et al.,* 1997). It was believed to be extinct in the Dutch Wadden Sea from 1940 although a small number were found in 1992 (Dankers *et al.,* 1999). In recent years natural beds have become re-established in the Danish Limfjord and now support a fishery.

Sensitivity

An assessment of the sensitivity of *O.edulis* based on a literature review by the Marine Life Information Network for Britain & Ireland (MarLIN) (Jackson, 2001), lists this species as being highly sensitive to substrate loss, smothering (eg. Yonge, 1960), synthetic compound contamination (e.g. Rees *et al.,* 2001), introduction of microbial pathogens/parasites (Edwards 1997), introduction of non-native species and direct extraction. The best evidence relates to it sensitivity to synthetic compounds and in particular tributyl tin (TBT).

Recovery is dependant on larval recruitment since the adults are permanently attached and incapable of migration. Recruitment is sporadic and dependent on the local environmental conditions, hydrographic regime and the presence of suitable substratum, especially adult shells or shell debris. Recoverability is considered to be very low from substratum loss, smothering, extraction and introduction of microbial pathogens/parasites, in one case taking around 20 years (Spärck 1951, in Jackson 2001).
Oyster spat usually settle on the shells of adult oysters so substantial removal of an existing bed reduces suitable settlement areas for subsequent generations.

Threat

The main threats to naturally occurring *O.edulis* beds in the Greater North Sea have been over-exploitation for targeted fisheries as well as bycatch in beam trawling for other species,, poor water quality, and the introduction of other (warm water) races as well as of other oyster species. The dramatic declines seen in stock abundance in the middle of the 19th century are attributed mainly to over-exploitation but there has also been damage by beam trawlers targeting other fisheries. By the late 19th century stocks were beginning to be depleted so that by the 1950s the native oyster beds were regarded as scarce. Overfishing in areas such as the Wadden Sea have been cited as a major contributing factor to the decline. The parasitic protozoan *Bonamia ostreae* is also known to have caused massive mortalities of *O.edulis* in France, the Netherlands, Spain, Iceland and England (Edwards, 1997).

Poor water quality and the resulting pollution specifically in the case of tributyl tin antifouling paints is known to have stunted growth of *O.edulis* and may also have affected reproductive capacity (Rees *et al.,* 2001)

Oyster grounds have been degraded in some areas by the introduced alien species *Crepidula fornicata*. This species is a filter feeder creating 'mussel mud' which degrades the grounds and hinders recruitment to oyster beds although the dead shells provide a surface on which the oyster spat do settle. The American oyster drill *Urosalpinx cinerea* is another alien species and is a predator of the flat oyster.

The cultivation and spread into the wild of the Pacific oyster *Crassostrea gigas* is another threat as there is a possibility that it may take over the niche of the native oyster and therefore limit the opportunities for recolonisation by *O.edulis*. At the present time it is unclear whether this is likely to happen (eg. Drinkwaard, 1999; Reise, 1998; Nehring, 1998).

Relevant additional considerations

Sufficiency of data

Data on the status of naturally occurring stocks of *O.edulis* is available from a number of sources including landings records, benthic sampling and detailed studies at particular locations. Changes in the distribution and abundance of *O.edulis* and *O.edulis* beds, have been recorded in many parts of its former range in the North Sea. This includes information from studies of specific areas such as the Wadden Sea and national records, as in the case of Belgium. The data provide a sound basis on which to get an accurate view of its status and decline in the Greater North Sea.

Changes in relation to natural variability

Natural causes such as disease and severe winters may have contributed to the decline of *O.edulis* in the North Sea. There were high mortalities following severe winters such as those experienced in 1947 and 1963, for example and in the UK the east coast stock has not recovered to the pre-1963 levels (Anon, 1999). Many other factors also affect oyster stock abundance, as the species has a very variable recruitment from year to year. These include temperature, food supply, and hydrodynamic containment in a favourable environment. It may also be the case that spawning stock density or biomass may be too low in many areas to ensure synchronous spawning or sufficient larval production for successful settlement (Jackson, 2001). Habitat conditions in areas which previously supported oysters may also have changed and become unsuitable settlement areas.

Expert judgement

Changes in the distribution and abundance of *O.edulis* and *O.edulis* beds, have been recorded in many parts of its former range in the North Sea. This includes information from studies of specific areas such as the Wadden Sea (Reise & Schubert, 1987; Reise *et al.,* 1989) and national records, as in the case of Belgium (eg. Svelle *et al.,* 1997). The data provide a sound basis on which to report the threat to naturally occurring flat oyster beds and their decline in OSPAR Area II.

ICES evaluation

The ICES review of this nomination finds that there is good evidence of decline and threats to *O.edulis* beds in OSPAR Region II (ICES, 2002). The ICES review of the case for *O.edulis* to be listed as a species as well as a habitat is also relevant. This states that there is good evidence of widespread decline of natural stocks of *O.edulis* and that overexploitation, the introduction of other (warm water) races and other oyster species, disease, and severe winters have all contributed to the decline of this species (ICES, 2002). ICES also report that there are some signs of recovery, eg. in the outer Skagerrak area, and along the Normandy coast, where specimens are occasionally found.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting; landbased activities; aquaculture/mariculture. *Category of effect of* *human activity:* Biological – removal of target and non-target species, introduction of microbial pathogens or parasites, introduction of non-indigenous species; Chemical – synthetic compound contamination

There is a long history of collection and cultivation of *O.edulis* in northern Europe. The dramatic declines seen in stock abundance and naturally occurring beds in the middle of the 19^{th} century are attributed mainly to over-exploitation. By the late 19th century stocks were beginning to be depleted so that by the 1950s the native oyster beds were regarded as scarce (Korringa, 1952; Yonge, 1960; Edwards, 1997). Overfishing in areas such as the Wadden Sea have been cited as a major contributing factor to the decline (e.g. Reise, 1982; Jackson, 2001) and beds have also been affected by beam trawling for other fisheries. More recent effects, such as those caused by TBT pollution, are also directly linked to human activities.

The main threats to *O.edulis* beds and the reason for their decline can be clearly linked to manageable human activities although natural causes such as disease and severe winters in the 1930's and 1940's have also played a part in their decline in the North Sea. Other studies in North America have reached the same conclusion, which is that destructive harvesting and overfishing can reduce the habitat extent of oyster reefs (e.g. Coen *et al.,* 1998)

Management considerations

The flat oyster has been subject to exploitation and cultivation in countries surrounding the North Sea for many centuries. Management measures need to take account of the fact that it was,, and continues to be, subject to husbandry and cultivation practices as well as fishing (Anon, 1999). Useful management measures include continued regulation of the directed fishery as well as other fisheries that can damage oyster beds, control of the spread of introduced species, reduction of the risk of transmission of disease, and maintenance of suitable habitat to support successful spatfall.

Further information

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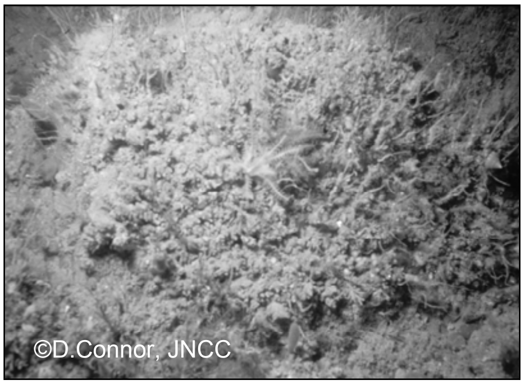
Nomination

Sabellaria spinulosa reefs
EUNIS Code: A4.22 and A5.611
National Marine Habitat Classification for UK & Ireland code: SS.SBR.PoR.SspiMx and CR.MCR.CSab



S.spinulosa is a small, tube-building polychaete worm found in the subtidal and lower intertidal/sublittoral fringe. In most parts of its geographic range it does not form reefs but is solitary or found in small groups, encrusting pebbles, shell, kelp holdfasts and bedrock. When conditions are favourable dense aggregations may be found, forming reefs up to about 60cms high and extending over several hectares; these are often raised above the surrounding seabed. Reefs may persist in an area for many years although individual clumps may regularly form and disintegrate (Jackson & Hiscock, 2003; Jones *et al.,* 2000).

Definition for habitat mapping

The tube-building polychaete *Sabellaria spinulosa* can form dense aggregations on mixed substrata and on rocky habitats. In mixed substrata habitats, comprised variously of sand, gravel, pebble and cobble, the *Sabellaria* covers 30% or more of the substrata and needs to be sufficiently thick and persistent to support an associated epibiota community which is distinct from surrounding habitats. On rocky habitats of bedrock, boulder and cobble, the *Sabellaria* covers 50% or more of the rock and may form a crust or be thicker in structure. In some areas, these two variations of reef type may grade into each other. *Sabellaria* reefs have been recorded in depths between 10-50m BCD or more. The reef infauna typically comprises polychaete species such as *Protodorvillea kefersteini*, *Scoloplos armiger*, *Harmothoe* spp., *Mediomastus fragilis*, *Lanice conchilega* and cirratulids together with the bivalves *Abra alba* and *Nucula* spp. and tube-building amphipods such as *Ampelisca* spp. Epifauna comprise calcareous tubeworms, pycnogonids, hermit crabs, amphipods, hydroids, bryozoans, sponges and ascidians. *S. spinulosa* reefs are often found in areas with quite high levels of natural sediment disturbance; in some areas of reef, individual clumps of *Sabellaria* may periodically break down and rebuild following storm events. *S. spinulosa* reefs have been recorded from all European coasts except the Baltic Sea, Skagerrak and Kattegat. Areas of dead *Sabellaria* reef indicate the site supported reef habitat in the past and should be reported as this habitat type

Geographical extent

OSPAR Regions; Entire OSPAR area.
Biogeographic zones 4, 6-9,11-14
Region & Biogeographic zones specified for decline and/or threat: Regions II and III.

S. spinulosa reefs are known from all European coasts, except the Baltic and the waters of the Kattegat and Skagerrak, but are typically limited to areas with very high levels of suspended sediment. In the UK aggregations of *S. spinulosa* are reported to occur at a number of locations around the British Isles (OSPAR Regions II and III), although there are few records for Scottish waters. Not all of these aggregations could be described as “reefs”, for instance where the species may only form superficial crusts on mixed substrata. On the German coast, intertidal and subtidal reefs have been reported from the Wadden Sea (OSPAR Region II) (Berghahn & Vorberg, 1993) and from the southern North Sea where Linke (1951) reported reefs up to 60 cm thick, 8m wide and 60m long. *S. spinulosa* has also been reported from the French coast, but without precise locations (Holt *et al.,* 1998).

Application of the Texel-Faial criteria

Nomination of *Sabellaria spinulosa* reefs to be placed on the OSPAR list cited sensitivity, rarity, ecological significance and decline, with information also provided on threat. The nomination was for all OSPAR regions but this has been modified in light of ICES advice and the habitat is now nominated for OSPAR Regions II & III as this is where most information is available.

Decline

Subtidal *S. spinulosa* reefs are reported to have been lost in at least five areas of the north east Atlantic (Jones *et al.,* 2000).

Large subtidal *S.spinulosa* reefs were common along the slopes of the northern tidal inlets of the German Waddensea in the 1920s (Hagmeier & Kändler, 1927) but have been largely lost since that time. Riesen & Reise (1982) reported that extensive subtidal *S. spinulosa* reefs were lost from the Lister Ley, island of Sylt, between 1924 and 1982 and Reise & Schubert (1987) reported similar losses from the Norderau area. Only three living reefs were found during surveys in the early 1990's compared to about twenty during the 19th century and, in the late 1990's, samples taken from the subtidal reefs consisted largely of compact lumps of empty tubes. Undetected living reefs may occur in the Wadden Sea but none were found during these surveys (de Jong *et al*., 1999). In the UK there are reports of reefs being lost in Morecambe Bay (Taylor & Parker, 1993), the Wash and the Thames (Warren & Sheldon 1967).

Rarity

True stable reefs, as opposed to crusts of *S.spinulosa*, are believed to be rare or have a very restricted distribution (Holt *et al.,* 1998).

Sensitivity

The findings from many studies on the sensitivity of *S.spinulosa* have been brought together in reviews by Holt *et al* (1998), Jones *et al* (2000) and Jackson & Hiscock (2003) and can be found on the MarLIN website www.marlin.ac.uk. The highest sensitivity is to substratum loss and displacement as the worms are fixed to the substratum and cannot reattach once dislodged, or rebuild their tubes if removed from them. Recruitment rates are high however and recovery could be quite rapid as this species is often one of the first to settle on newly exposed surfaces.

S.spinulosa does not appear to be particularly sensitive to changes in water quality (Holt *et al.,* 1998), but is both sensitive and vulnerable to physical damage. It is probably tolerant to smothering in the short term although this will affect feeding and growth and may interfere with reproduction depending on the timing.

S. spinulosa appears to be very tolerant of water quality variation, but is potentially vulnerable to the short-term and localized effects of mineral extraction and the effects of oil dispersants on the larvae. Overall, however, it has been concluded that *S. spinulosa* seemed unlikely to show any special sensitivity to chemical contaminants (Jackson & Hiscock, 2003).

Well-developed, more stable reefs seem to be very scarce, and this apparent rarity suggests that an unusual set of environmental factors and/or circumstances is required for their formation. It might, therefore, be expected that they would display sensitivity to some factor or factors, but Jones *et al.,* (2000) report there is little information from which to gain any insight into this

Ecological significance

S.spinulosa reefs can provide a biogenic habitat that allows many other associated species to become established and acts to stabilize cobble, pebble and gravel habitats. They contain a more diverse fauna with sometimes more than twice as many species and almost three times as many individuals than nearby areas where *S.spinulosa* is absent (NRA, 1994). The reefs are of particular nature conservation significance when they occur on sediment or mixed substrata areas as they enable a range of other species to occur that would not otherwise be found in such areas.

Threat

The greatest impact on this biogenic habitat is considered to be physical disturbance. Dredging, trawling, net fishing and potting can all cause physical damage to erect reef communities (Riesen & Riese, 1982) although studies by Vorberg (2000) on a similar species (*S.alveolata*) indicated only minor damage to tubes from shrimp fisheries and rapid recovery. Vorberg (2000) has also suggested that shrimp vessels used around the mid-20th century would have had insufficient force to damage robust *S.spinulosa* reefs. Nevertheless, populations, especially if as loose aggregations, may be displaced by mobile fishing gear and therefore a precautionary intolerance rating of 'intermediate' has been suggested for this species in the sensitivity assessments carried out for the Marine Biological Information Network (*MarLIN*). Other physical disturbance from the installation of infrastructure such as pipelines and wind turbines may also have a deterimental effect.

Aggregate dredging often takes place in areas of mixed sediment where *S. spinulosa* reefs may occur and could therefore damage reefs. Apart from direct removal, the impact of this activity on their long-term survival is unknown, but suspension of fine material during adjacent dredging activity is not considered likely to have detrimental effect. Pollution has been listed as one of the major threats to *S. spinulosa* in the Waddensea and may have partly contributed to their replacement by *Mytilus edulis* beds.

Coastal engineering works (mainly dike and dam building) may have also had a negative influence by changing the hydrological regime in parts of the Waddensea (Voberg, 2000).

Relevant additional considerations

Sufficiency of data

Changes in the extent of *S.spinulosa* reefs have been recorded in some parts of its range. There is limited information of the sensitivity of *S.spinulosa* particularly in relation to chemical contamination and on rates of recovery in areas where reefs have been damaged. A better knowledge of the natural variation in extent, density and population structure of reefs, is also required (Jackson & Hiscock, 2003).

Changes in relation to natural variability

Natural variability will play a part in changes in the extent of this habitat type. *S.spinulosa* occurs in high densities on subtidal gravels that are likely to be disturbed every year or perhaps once every few years due to storms. Where it exists as loose crusts, death may occur through break-up due to wave action. Increased wave action may also mobilize the pebble and gravel substrata on which *S.spinulosa* often occurs, resulting in abrasion and mortality. High levels of recruitment mean that recovery could be quite rapid, say within a year but timescales for the re-establishment of reefs are not clear (Jackson & Hiscock, 2003). Changes may also take place in response to changes in circulation patterns caused by tidal currents, storm tides or ice winters (Vorberg, 2000).

Expert judgement

Expert judgement has played a part in putting forward this nomination because data on the extent and decline of this habitat are limited to a few well studied locations. There is however a good basis on which to consider it to be threatened given the clear link between certain activities and damage to *S.spinulosa* reefs and the widespread nature of some of those activities 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 both the decline of and threat to *Sabellaria spinulosa* reefs was strong across the whole OSPAR area. ICES agrees that evidence for both decline and threat to this habitat is sufficient, but only in OSPAR Regions II and III.

Threat and link to human activities

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

Relevant human activity: Fishing, hunting, harvesting, extraction of sand, stone and gravel, constructions, coastal defence measures, aquaculture/mariculture, dumping of solid waste and dredged spoils, placement and operation of submarine cables and of pipelines.
Category of effect of human activity: Physical - substratum removal, substratum change, water flow rate changes, Biological – physical damage to species, removal of non-target species.

There are clear links between human activity and threat to *S.spinulosa* reefs. The most significant is physical damage caused by benthic trawling. The loss of the large *S.spinulosa* reefs in the Waddensea has been attributed to the long-term effects of fishing activity and it has been noted that in the Thames and Wash commercial fishermen sought out areas of *S.spinulosa* before trawling for shrimp, and appear to have destroyed the reefs along with their associated shrimp fishery in the process (Warren & Sheldon, 1967 Reise & Schubert, 1987). There are also reports of fishermen destroying such reefs (as potential obstacles to trawls) with heavy gear prior to shrimp fishing Riesen & Reise (1982). A similar detrimental effect was reported during the 1950s in Morecambe Bay (UKBAP, 2000).

Management considerations

Management of marine activities and, in particular, certain fishing practices will be important in preventing further threat and decline of this habitat. Known reef areas could be protected through site safeguard for example under the OSPAR MPA programme or as part of the *Natura 2000* network being established through the EU Habitats Directive. It should also be noted that as the larvae are strongly stimulated to metamorphose and settle on the tubes of both living and dead worms conservation management could usefully be directed towards the protection of both living and dead reefs. Zoning to ensure that aggregate extraction does not take place on reef habitats is another management option and will depend on sufficient knowledge of the distribution of reef habitat. Research into the stability, rate of establishment, and recovery of damaged reefs will also be important as will better knowledge of the natural variation in extent, density and population structure of *S.spinulosa* reefs

S. spinulosa has been placed on the Red List of Macrofaunal Benthic Invertebrates of the Wadden Sea, and the reefs are the subject of a specific UK Biodiversity Action Plan.

Further information

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UK

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Useful References:

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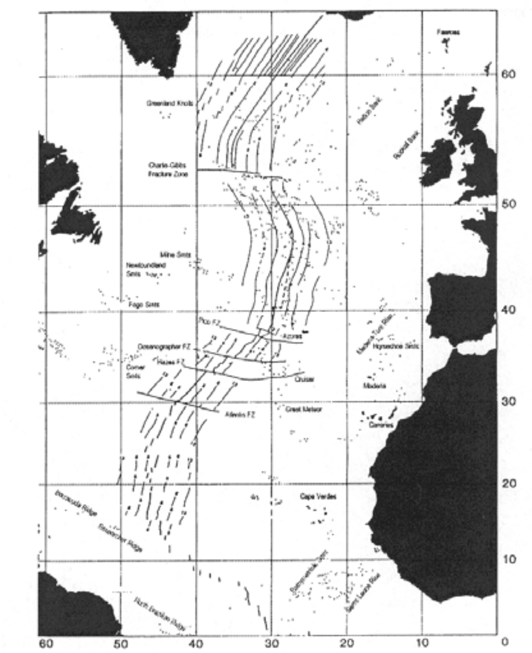
Nomination

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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Useful References:

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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.

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Nomination

Zostera beds, Seagrass beds
EUNIS Code: A2.611, A5.533 and A5.545
National Marine Habitat Classification for UK & Ireland code: LS.LMP.LSgr and SS.SMP.SSgr

Definition for habitat mapping

Two sub-types :
Zostera marina beds
Zostera noltii beds

i. ***Zostera marina***

Zostera marina forms dense beds, with trailing leaves up to 1m long, in sheltered bays and lagoons from the lower shore to about 4m depth, typically on sand and sandy mud (occasionally with an admixture of gravel). Where their geographical range overlaps, such as the Solent in the UK, *Z. marina* passes upshore to *Z. noltii*.

ii. ***Zostera noltii***

Z. noltii forms dense beds, with leaves up to 20cm long, typically in the intertidal region (although it can occur in the very shallow subtidal), on mud/sand mixtures of varying consistency.
To qualify as a *Zostera* 'bed', plant densities should provide at least 5% cover (although when *Zostera* densities are this low, expert judgement should be sought to define the bed). More typically, however, *Zostera* plant densities provide greater than 30% cover. Seagrass beds stabilise the substratum as well as providing a habitat for many other species. As well as an important source of organic matter, seagrass beds may also provide an important nursery habitat for juvenile fish (ICES, 2003).

Geographical extent

OSPAR Regions: I, II, III, IV
Biogeographic zones: 4, 6-9, 11-14
Region & Biogeographic zones specified for decline and/or threat: II & II for decline, threat in all areas

Seagrass beds develop in intertidal and shallow subtidal areas on sands and muds. They may be found in marine inlets and bays but also in other areas, such as lagoons and channels, which are sheltered from significant wave action. They can survive and reproduce under conditions of occasional inundation or total submergence with the different species found at different shore levels or on different substrata. *Zostera nolti* is generally found highest on the shore, often adjacent to lower saltmarsh communities. *Z.angustifolia* is more common further down the shore and *Z.marina* is essentially a sublittoral species extending from low water to depths of several metres (Gubbay, 1988). *Z.marina* is the most widespread of the genus, with a distribution that extends from the Arctic down to Gibraltar.

Where conditions are favourable *Zostera* may cover extensive areas, forming seagrass 'beds' or 'meadows'.

Application of the Texel-Faial criteria

Zostera beds were nominated by two Contracting Parties. The criteria common to both nominations were decline, ecological significance and sensitivity, with information also provided on threat.

Decline

There was mass die-back of *Z. marina* throughout western Europe and elsewhere during the 1920s and mid-1930s due to a wasting disease. More recently, declines have been also been reported in the Wadden Sea and the UK for both *Z. marina* and *Z. noltii* (Den Hartog & Polderman, 1975; Jones *et al.*, 2000; Davison and Hughes, 1998). Affected areas are slow to recovery.

Ecological significance

Seagrass stabilises the substratum as well as providing shelter and a substrate for many organisms. Where the habitat is well developed the leaves may be colonised by diatoms and algae, as well as stalked jellyfish and anemones. The infauna are generally similar to species occurring in shallow areas in a variety of substrata (e.g. amphipods, polychaete worms, bivalves and echinoderms), and can be rich within the bed. The shelter provided by seagrass beds makes them important nursery areas for flatfish and, in some areas, for cephalopods. The diversity of the species will depend on environmental factors such as exposure and density of the microhabitats, but it is potentially highest in the perennial, fully marine, subtidal communities and may be lowest in intertidal, estuarine, annual beds (Anon, 2000).

Seagrass beds are very productive (an estimated 2g C/m^2/day during the growing season in temperate areas) and often contain a large biomass (up to 5kg/m^2) (Barnes & Hughes, 1982). The living plant is a major source of food for wildfowl, particularly Brent goose and widgeon but also for mute and whooper swans that congregate in areas where *Zostera* is abundant. Only about 5% of seagrass production is thought to be consumed directly and it may be that the dead plant is more important because it is an abundant source of organic matter for marine systems (Barnes & Hughes, 1982).

Sensitivity

The findings from many studies on the sensitivity of *Zostera* beds have been brought together in a review by Davison, & Hughes (1998) . They include the following information about sensitivity of *Zostera* to different factors.

Sensitivity to turbidity is considered to be high as prolonged increases in turbidity would reduce light penetration and prevent adequate photosynthesis by deeper populations of *Zostera marina*. There may also be a high sensitivity to oxygen depletion but no detailed information is available on this at the present time.

Zostera was considered to have an ‘intermediate’ sensitivity to other factors such as contamination by synthetic compounds and hydrocarbons, changes in nutrient levels and abrasion (Davison & Hughes, 1998).

Terrestrial herbicides have been found to inhibit growth and cause decline in *Zostera marina* (Delistraty & Hershner 1984). Some effects may be indirect. For instance *Zostera marina* readily takes up heavy metals and TBT (Williams *et al.* 1994). Whilst plants appeared unaffected, any loss of grazing prosobranchs due to TBT contamination in the leaves or externally would result in excessive algal fouling of leaves, poor productivity and possible smothering.

High nitrate concentrations have been implicated in the decline of *Zostera marina* by Burkholder *et al.* (1993). Such eutrophication may increase the cover of epiphytic algae and prevent photosynthesis of sea grass plants. Eutrophication may increase abundance of *Labrynthula macrocystis* however, nutrient enrichment may stimulate growth of *Zostera marina* (Fonesca *et al.* 1994)

Apparently healthy *Zostera marina* beds are known to exist in areas subject to low-level chronic hydrocarbon contamination (see, for instance, Howard *et al*., 1989). Smothering by stranded oil is likely to occur on lower shore populations but little is known of its long-term effects on seagrass beds.

Threat

Physical disturbance, nutrient enrichment, marine pollution, disease, increased turbidity, disease, introduction and competition from alien species and natural cycles, are all factors which affect *Zostera* beds and can threaten the extent and quality of this habitat (Anon, 2000).

Physical disturbance occurs on both intertidal and subtidal beds. It may be caused by trampling, dredging, the use of mobile fishing gear, anchoring, as well as land claim and adjacent coastal development. Zostera is generally not physically robust. As the root systems are typically located within the top 20cm, of the sediment and can therefore be dislodged easily (Fonseca 1992). Increased turbidity is another threat, and Geisen *et al.* (1990) suggest that turbidity caused by eutrophication, deposit extraction and dredging activities were major factors in the decline of *Zostera* in the Wadden Sea.

Relevant additional considerations

Sufficiency of data

There are many studies on seagrass beds and both general and detailed mapping of their extent and of the associated communities has been carried out in particular locations. Despite this, there are still aspects for which there is a poor understanding. The precise triggers causing the major die-back of *Z.marina* from the wasting disease is one example which is possibly some combination of the occurrence of the fungus *Labyrinthula ma*crocystis, increased turbidity and environmental factors such as water temperature or water quality but this remains unclear (Short *et al.,* 1988)

Changes in relation to natural variability

The extent of seagrass beds may change as a result of natural factors such as severe storms, exposure to air and freshwater pulses. Grazing by wildfowl can have a dramatic seasonal effect with more than 60% reduction in leaf cover reported from some sites. Warm sea temperatures coupled with low level of sunlight may cause significant stress and die back of seagrass (Anon, 2002).

Expert judgement

There is good evidence of decline and threat to *Zostera* beds in particular locations within the OSPAR Maritime Area with the most detailed studies revealing the decline relating to the North Sea. Factors that threaten *Zostera* beds occur through the OSPAR Maritime Area.

ICES evaluation

ICES finds that there is good evidence of declines and threat to this habitat. However, they advise that the available literature only covers parts of Regions II and III; hence, a more robust classification might be to confine the classification to these regions rather than regions II and IV as originally proposed. ICES also note that given the long list of threats, the possibility of combined effects, and the long recovery time of affected beds, it seems reasonable to expect a great vulnerability of *Zostera* beds in the future.

Threat and link to human activities

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

A number of the threats to *Zostera* beds are directly linked to human activities. These are physical disturbance, increased turbidity, nutrient enrichment and marine pollution. The deliberate introduction of the alien species *Spartina anglica* no longer takes place but existing stands continue to spread.

Management considerations

Management considerations for seagrass beds could include establishment of protected areas, possible reintroduction or restoration, controlling inputs of pollutants from surrounding land. Promoting awareness of the importance of seagrass beds could assist in minimising trampling and anchor damage. Protected areas could be designated under the proposed OSPAR MPA programme although it should be noted that seagrass beds are covered by the EU Habitats Directive and could therefore be included in the *Natura 2000* network.

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