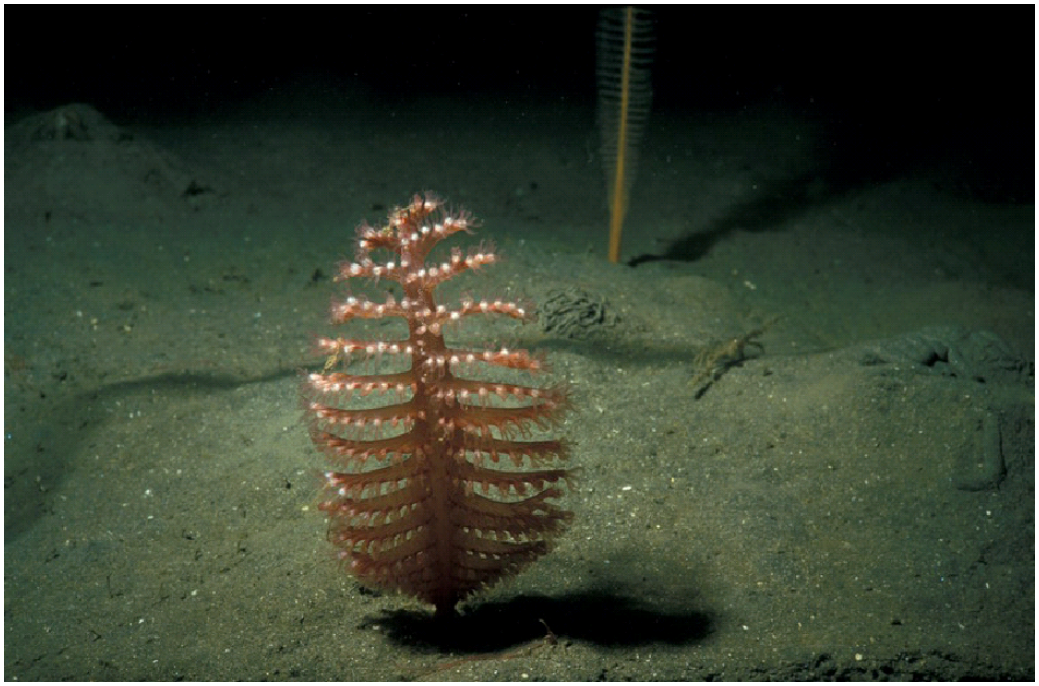
OSPAR COMMISSION

Background Document for Seapen and Burrowing megafauna communities



Biodiversity Series

2010

OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the “OSPAR Convention”) was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. It has been ratified by Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Sweden, Switzerland and the United Kingdom and approved by the European Community and Spain.

Convention OSPAR

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. La Convention a été ratifiée par l'Allemagne, la Belgique, le Danemark, la Finlande, la France, l’Irlande, l’Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d’Irlande du Nord, la Suède et la Suisse et approuvée par la Communauté européenne et l’Espagne.

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Background Document for Sea-pen and Burrowing megafauna communities

Executive Summary

This Background Document for sea-pen and burrowing megafauna communities has been developed by OSPAR following the inclusion of this habitat on the OSPAR List of threatened and/or declining species and habitats (OSPAR agreement 2008-6). The document provides a compilation of the reviews and assessments that have been prepared concerning this habitat since the agreement to include it in the OSPAR List in 2003. The original evaluation used to justify the inclusion of sea-pen and burrowing megafauna communities in the OSPAR List is followed by an assessment of the most recent information on its status (distribution, extent, condition) and key threats prepared during 2009-2010. Chapter 7 provides recommendations for the actions and measures that could be taken to improve the conservation status of the habitat. In agreeing to the publication of this document, Contracting Parties have indicated the need to further review these proposals. Publication of this background document does not, therefore, imply any formal endorsement of these proposals by the OSPAR Commission. On the basis of the further review of these proposals, OSPAR will continue its work to ensure the protection of sea-pen and burrowing megafauna communities, where necessary in cooperation with other competent organisations. This background document may be updated to reflect further developments or further information on the status of the habitat which becomes available.

Récapitulatif

Le présent document de fond sur les colonies de sea-pens et mégafaune fouisseuse a été élaboré par OSPAR à la suite de l'inclusion de cet habitat dans la liste OSPAR des espèces et habitats menacés et/ou en déclin (Accord OSPAR 2008-6). Ce document comporte une compilation des revues et des évaluations concernant cet habitat qui ont été préparées depuis qu'il a été convenu de l'inclure dans la Liste OSPAR en 2003. L'évaluation d'origine permettant de justifier l'inclusion des Colonies de sea-pens et mégafaune fouisseuse dans la Liste OSPAR est suivie d'une évaluation des informations les plus récentes sur son statut (distribution, étendue et condition) et des menaces clés, préparée en 2009-2010. Le chapitre 7 fournit des propositions d'actions et de mesures qui pourraient être prises afin d'améliorer l'état de conservation de l'habitat. En se mettant d'accord sur la publication de ce document, les Parties contractantes ont indiqué la nécessité de réviser de nouveau ces propositions. La publication de ce document ne signifie pas, par conséquent que la Commission OSPAR entérine ces propositions de manière formelle. A partir de la nouvelle révision de ces propositions, OSPAR poursuivra ses travaux afin de s'assurer de la protection des colonies de sea-pens et mégafaune fouisseuse le cas échéant avec la coopération d'autres organisations compétentes. Ce document de fond pourra être actualisé pour tenir compte de nouvelles avancées ou de nouvelles informations qui deviendront disponibles sur l'état de l'habitat.

1. Background Information

Name of habitat

Sea-pen and Burrowing Megafauna Communities.

Definition of habitat

Plains of fine mud, at water depths ranging from 15–200 m or more, which are heavily bioturbated by burrowing megafauna; burrows and mounds may form a prominent feature of the sediment surface with conspicuous populations of sea-pens, typically *Virgularia mirabilis* and *Pennatula phosphorea.* The burrowing crustaceans present may include *Nephrops norvegicus, Calocaris macandreae* or *Callianassa subterranea.* In the deeper fjordic lochs which are protected by an entrance sill, the tall sea-pen *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 and the Bay of Biscay. (OSPAR other agreement 2008-7)

2. Original Evaluation against the Texel-Faial selection criteria

List of OSPAR Regions where the habitat occurs

I, II, III & IV

List of OSPAR Regions and Dinter biogeographic zones where the habitat is under threat and/or in decline

OSPAR Regions: II & III

Dinter biogeographic zones: Lusitanean (Cold/Warm), Lusitanean-boreal, Boreal-lusitanean

Original evaluation against the Texel-Faial criteria for which the habitat was included on the OSPAR List

Sea-pen and burrowing megafauna communities were selected for inclusion on the OSPAR list on the basis of an evaluation of their status according to the Criteria for the Identification of Species and Habitats in need of Protection and their Method of Application (the Texel-Faial Criteria) (OSPAR 2003). The nomination for inclusion on the list cited the criteria decline and sensitivity, with information also provided on threat. It has been nominated for OSPAR Regions II & III. Table 1 provides an update on this evaluation. The main threats to this habitat are activities that physically disturb the seabed, such as demersal fisheries, marine pollution through organic enrichment and increased bottom water temperature due to climate change.

Table 1: Summary assessment of sea-pen and burrowing megafauna communities against the Texel-Faial criteria

Criterion	Comments	Evaluation
Global importance	Outside the OSPAR region, similar biotopes exist in the Adriatic and Aegean Seas, and probably occur in coastal and shelf sediments in many other areas of the world (Hughes, 1998).	Insufficient data
Regional importance	Given its patchy distribution within the OSPAR area, it seems unlikely that it would qualify against this criterion (>75% within a particular OSPAR region).	Does not qualify

Rarity	Although, there is no complete information about the distribution of this habitat throughout the OSPAR regions, it is not limited to a restricted number of areas, as specified in the habitat definition.	Does not qualify
Sensitivity	The findings from various studies on the sensitivity of this habitat have been brought together in a review by Hughes (1998). ***Mechanical damage*****:** Physical activities such as impacts by towed fishing gear are known to be damaging. Bottom trawling causes chronic and widespread disturbance to the seabed in shallow shelf seas and could lead to changes in the trophic structure and function of benthic communities. Studies evaluating trawling disturbance on soft-bottom communities biodiversity (Vergnon and Blanchard 2006, Blanchard *et al.,* 2004, Jennings *et al.*, 2001) reveal a lower species diversity and a shift in trophic structure in the most exploited fishing areas. This has important implications for the processing of primary production in shallow coastal areas and the wider functioning of the marine ecosystem. Anchoring can cause physical damage to static megafaunal species such as sea-pens . ***Biological events*****:** *Nephrops* fisheries exert significant modifications on this habitat as this species is part of the biological community of this biotope. Removal of targeted megafauna such as *Nephrops* can lead to irreversible shifts (Le Loc'h, 2004, Hiddink *et al*., 2006) in the benthic trophic structure of the habitat. In many regions, the *Nephrops* trawl fisheries use non-selective gears with small mesh sizes, generating unwanted bycatch that is thrown overboard, most of the time dead or dying (ICES, 2008). ***Physico-chemical events*****:** Substratum change: resuspension of fine particles due to trawling activity can lead to 1) an accumulation of fine sediments in the superficial layers in the absence of significant advective transport (Queiros *et al*., 2006) or 2) a removal of fine sediments by bottom currents, which combined with a decrease in terrestrial sediment influx lead to an overall increase in particle size. Oxygen depletion, due to either natural (warm summer temperature) or human (cage aquaculture, sewage disposal) events can also occur	Qualifies – rated as sensitive
Ecological significance	Nursery areas for a number of fish including hake (*Merluccius merluccius*). The 'mosaic' of disturbance patches created by megafaunal activity may be a factor acting to promote species diversity in the macrofaunal community. However, no single member of this biotope complex is known to be a 'keystone'species whose activity is essential to the maintenance of community structure (Hughes 1998, Widdicombe 2000).	Qualifies
Decline	OSPAR (2006a) indicates that the habitat was considered, in the initial 2001 assessment, to be threatened and/or declining across regions II and III. No detailed mapping of this biotope is available. However as decline issues are related to habitat quality rather than extent, it can still be said that it is likely to have been affected by the extensive demersal fisheries that take place inshore and on the shallow waters of the continental shelf.	Currently threatened for Regions II and III.

3. Current status of the habitat

Distribution in OSPAR maritime area

This habitat occurs extensively throughout the more sheltered basins of sea lochs and voes and is present at quite shallow depths, probably because they it is very sheltered from wave action (Hughes, 1998). This habitat also occurs in deeper offshore waters in the Irish Sea, North Sea, Norwegian fjords and North Bay of Biscay with high densities of *Nephrops norvegicus* present.

Habitat extent (current/trends/future prospects)

Figure 1 shows sea-pen and burrowing megafauna records compiled from the October 2009 version of the OSPAR habitat mapping data (http://www.searchnbn.net/hosted/ospar/ospar.html). Several countries did not submit shapefiles therefore the absence/presence depicted is inaccurate, as this habitat is undoubtedly present in the Celtic and Cantabrian seas.

Condition (current/trends/future prospects)

It is extremely difficult to forecast the likely changes to a habitat in the near future, i.e by the year 2020. Bottom-trawling has the greatest impact on this habitat. Although, *Nephrops* fisheries have decreased notably throughout the last fifteen years after economic cutbacks of 1993-1994 and according to different decommissioning schemes in areas such as the “grande vasière” and “vasière de la Gironde” in the Bay of Biscay (ICES 2009), further monitoring of the habitat alteration as a consequence of targeted *Nephrops* fisheries is needed in order to assess the conservation status of the communities it harbours.

Limitations in knowledge

The OSPAR working definition for this habitat potentially covers a wide range of communities and biotopes, stretching from Scottish sea lochs to the abyssal plain, as plains of fine mud with burrowing megafauna cover large areas at “200m or more” of depth. The bibliography in some of the OSPAR areas on this habitat is very limited. Furthermore, comparative studies on the management of similar zones outside the OSPAR region (eg: the Gulf of Maine) have not been carried out. Our understanding of the structure and dynamics of the habitat in question is still very patchy. Although considerable advances have been made in studies of some of the major characterizing species, there is still little information on ecological relationships at the population or community level (Hughes 1998), or on the spatial distribution of anthropogenic activities likely to alter these relationships.

The lack of long-term observational studies on this habitat means little is known about changes that might be the result of natural variability. Burrowing megafauna are difficult to sample using traditional ship-borne equipment, and most of our information on their ecology has been obtained in the last two decades using scuba diving and underwater video (Hughes, 1998). Subtidal sediment biotopes have not been studied in detail for enough time to assess their sensitivity to naturally-occurring environmental changes. Repeated disturbance from demersal fishing gear is however likely to mask such changes, especially if such disturbance occurs several times a year, as is the case for parts of the North Sea and the Bay of Biscay (Jennings & Kaiser, 1998).

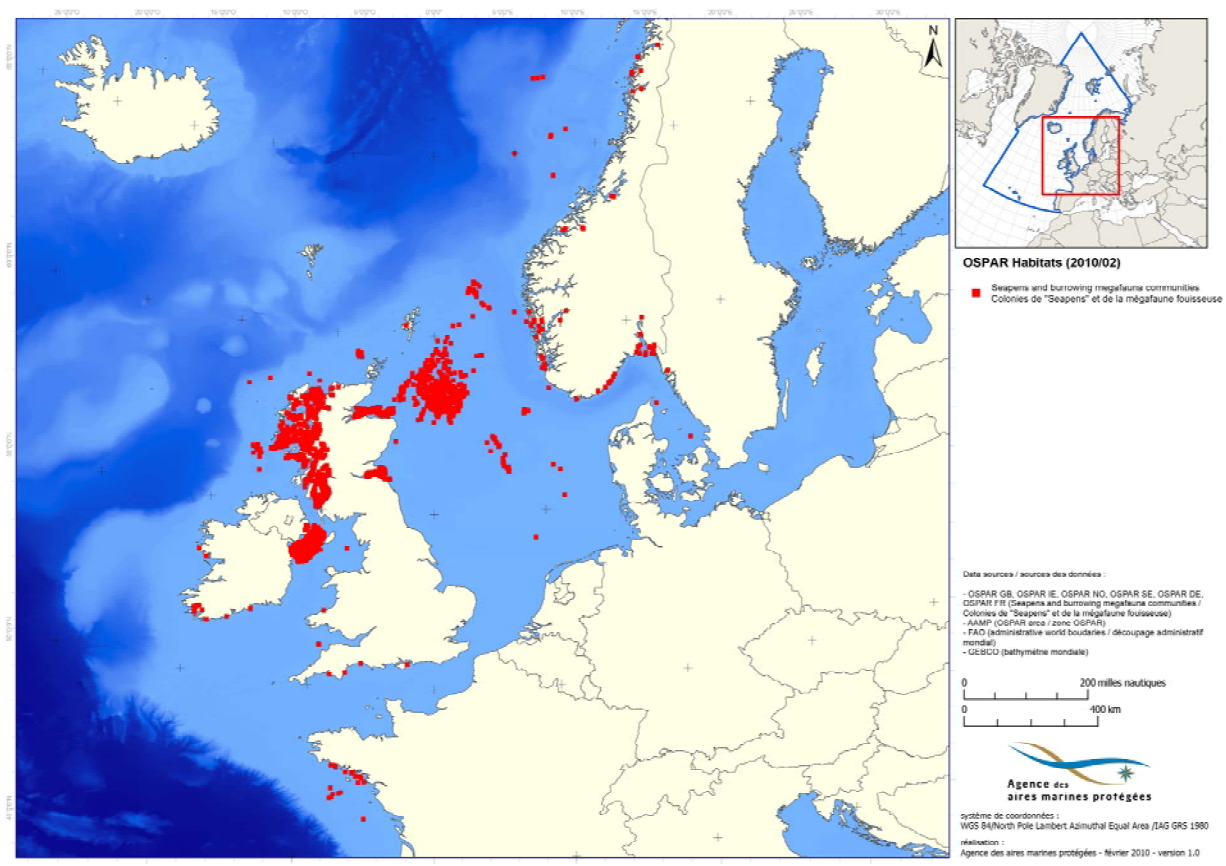

Figure 1: Preliminary distribution of sea-pen and burrowing megafauna communities in the OSPAR maritime area (based on data supplied by Contracting Parties up until October 2009).

4. Evaluation of threats and impacts

A summary of the key activities which can cause impacts to sea-pen and burrowing megafauna communities is given in Table 2.

Fishing is a major disturbance factor of the continental shelf communities of OSPAR Region II, III and IV and in some zones the area disturbed has increased. The Great Mud Bank (Grande Vasière) stretching from north to south in the centre of the Bay of Biscay is heavily trawled especially by the *Nephrops* trawler fleet. On average, the northern part is swept three to six times a year and the trawling impact is considered to be at the same scale as the natural resuspension of silt particles caused by storm activities. However, the decrease in the proportion of the silt fraction found on the Grande Vasière bank has not been directly linked to fishing activity (Bourillet *et al*., 2005). Such changes to the physical habitat have the potential to cause substantial and long-term changes to benthic ecosystems, including negative impacts on burrowing animals such as *Nephrops* (ICES, 2008). In the heavily exploited areas, the dominant benthic species are opportunistic carnivorous species and there were no fragile invertebrates (Blanchard *et al.,* 2004). Figure 2 illustrates the modelled recovery time for benthic communities in the North Sea after the pass of one beam trawl, calculated from VMS records (Hiddink *et al.,* 2006). Analysis of beam trawling impacts in the southern and central North Sea has shown that the impacts of trawling were greatest in areas with low levels of natural disturbance (i.e muddy habitats), while the impact of trawling was relatively small in areas with high rates of natural disturbance (i.e sand and gravel habitats). Based on this model, mud habitats on average took longer to recover (~4 years) than sand and gravel habitats (~2 years).

Table 2. Summary of key threats and impacts to sea-pen and burrowing megafauna communities.

Type of impact	Cause of threat	Comment	Scale of threat
Habitat degradation through nutrient changes	Aquaculture organic pollution	Marine fin-fish farms are often sited within Scottish sea lochs and may have direct effects on mud communities, including smothering and increasing the Biological Oxygen Demand of the mud. Nutrient enrichment leading to eutrophication can have significant but localised detrimental effects.	Low
Habitat alteration through community shifts	Climate change	A change in climate could lead to variable recruitment through changes in mortality rates of early life stages, for example, differences in sea temperature and wind induced wave action might affect the survival of larval *Nephrops* either directly or by regulating food supply. This threat is largely theoretical at present and not of immediate concern.	Low
Habitat degradation through physical damage	Bottom trawling fisheries	In terms of habitat function, bottom trawling acts by removing some species, rejecting non-commercial species and by damaging the more fragile benthic species. A shift in the benthic community interactions therefore ensues. Bottom trawling has many direct and indirect impacts, the latter of which have a greater impact (Le Loc'h, 2004). The mortality of benthic invertebrates that are removed as trawl bycatch is high but the mortality rates caused by bottom trawling are significantly higher for animals that remain on the seabed (Queiros, 2006). Large, slow-growing species such as sea-pens are particularly vulnerable to trawling disturbance, while smaller individuals and species suffer lower mortality rates (Dinmore et al., 2003). Considering the global benthic community, differential vulnerability to trawling leads to lower biomass and production of communities in heavily trawled areas and a dominance by smaller, faster growing individuals and species (Jennings et al., 2001). Nevertheless, Vergnon and Blanchard 2006 note that megafauna (both *Nephrops* and other non-commercial crustaceans) do not experience any reduction of their total biomass or abundance in highly exploited sites.	High
Habitat loss or alteration	Infrastructure development (dam construction, coastal development, oil & gas exploitation)	The construction of roads, bridges and barrages may affect the local hydrodynamic and sediment transport regimes of inshore enclosed areas and consequently affect the deep mud substratum. Offshore oil rigs and other oil installations can cause a variety of disturbance effects such as smothering due to disposal of drill cuttings, localised disturbance of sediments due to anchors and rig feet implacement and trench digging for pipelines.	Low

Type of impact	Cause of threat	Comment	Scale of threat
Pollution	Land-based and marine industrial or commercial sources	Riverine loads of pollutants include inputs from point sources and diffuse sources (such as agriculture, man-aged forestry, and natural backgrund sources) within the catchment area. Silty environments are known to accumulate contaminants, such as heavy metals. The main sources of heavy metals to the marine environment are diffuse sources such as forest and agricultural soils as well as industrial and municipal waste, which is either discharged directly or transported via rivers and atmospheric deposition to the sea. Heavy metals can accumulate in the marine food web up to levels which are toxic to marine organisms, particularly predators, and they may also represent a health risk for humans.	Low

Trawling on muddy sediments is a significant physical intervention in an otherwise stable, low-energy environment (Greathead *et al*., 2007) that reduces sediment complexity and habitat homogenisation which, by definition, leads to a decrease in biodiversity. The breakage of slow-growing benthic species such as the once-characteristic sea-pens is the main disturbance. It leads to a facilitated predation on dead or damaged individuals by opportunistic carnivores and necrophagous species. In addition, the fishery is characterised by high discard levels of many species. The bay of Biscay *Nephrops* fishery has a major impact on the Northern Stock of Hake, because the *Nephrops* fishing grounds are on a hake nursery. Hake discards are very important. By-catch of other species is not as large. In this area *Nephrops* trawlers thus discard between 41% and 65%of their *Nephrops* catches in numbers (a third in weight) of which only 30% survive (Guéguen et Charuau 1975 in Macher 2008). Ongoing studies may lead to an update of those figures (IFREMER, pers. comm.) – cf section 7.

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. Organic pollution is therefore a highly-localised phenomenon which can only occur in sheltered water bodies such as lochs and fjords, whereas the majority of this habitat is present in open ground (i.e the Fladen Ground in Scotland or the Grande Vasière in France). It is worth noting that work is underway to evaluate the impact of organic enrichment in the lochs on Scotland's West Coast. The Scottish Aquaculture Research Forum (SARF) has funded a series of camera surveys of the seafloor around fish farms to assess their zone of impact on megafaunal distribution and abundance (D. Hughes, pers. comm).

The conservation importance of this habitat is increasingly recognised, due to its high natural biodiversity and the value it signifies in the Ecosystem Approach to Fisheries (EAF). *Nephrops* fisheries have decreased notably throughout the recent fifteen years after conflicts in 1993-1994 and according to different decommissioning schemes in areas such as the Grande Vasière and Vasière de la Gironde in the Bay of Biscay (ICES 2009). Global fuel prices, and hence fuel costs for the fishing industry, have also increased dramatically in recent years and this is affecting both the grounds fishers exploit (reducing the time spent travelling between fishing opportunities), but also more fundamental shifts to using fishing gears that are less energy demanding (ICES, 2008).

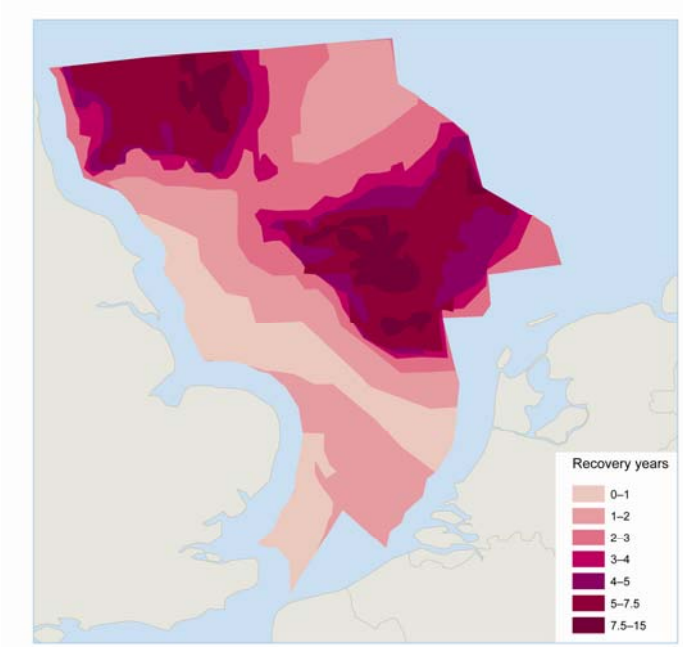

Figure 2 Estimated recovery time (years) for southern North Sea benthic communities following one pass of a beam trawl. Recovery is a measure of the time required for benthic production to return to 90% of the production in the absence of trawling disturbance. Hiddink *et al.* (2006) in ICES 2008.

5. Existing Management measures

In addition to its listing by OSPAR, this habitat is the subject of several national plans, the details of which are listed in Annex 2. Such listing processes generally serve to highlight the conservation needs of the habitat to relevant authorities for management and licensing issues, but can have varying success depending on specific actions that follow. There is no single habitat type listed in Annex I of the EU Habitats Directive which corresponds to the OSPAR working definition: a limited proportion of this habitat lies within areas that can be protected as “Large shallow inlets and bays” (Natura 2000 code 1160), but as this is not the main reason for designation the effectiveness of the management in providing protection is variable and consequently the habitat is largely unprotected.. Also, these Annex I habitats are generally limited to 30 m, whereas the OSPAR working definition extends to 200m depth or more, Currently the three species of sea-pens listed in the OSPAR working definition have no statutory protection under EC legislation.

The Loch Torridon *Nephrops* Fishery management group in Scotland has actively sought to close an area to trawling. In this area *Nephrops* are exclusively caught with creels (cf Annex I).

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. EAF management plans can take soft-bottom communities into account (D. Donnan, pers. comm.). 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). The sea-pen and burrowing megafauna habitat may benefit indirectly in areas where seabed damage is limited by fisheries regulations such as cod recovery zones in UK waters.

Where appropriate, further protection of sea-pen and burrowing megafauna communities within national, European (Habitats Directive) or OSPAR marine protected area mechanisms should be

considered. Where this habitat already occurs within designated sites, management systems may need improvement to ensure adequate protection.

6. Conclusion on overall status

There is little evidence that global warming or organic enrichment have played much of a role in benthic community structure changes. Sedimentary modifications, due to several processes including the resuspension of the fine mud particles by bottom trawling, are undoubtedly the main factor explaining the modifications observed in the macrobenthic fauna. The direct effects of the trawling activities, facilitating some species (particularly small mobile deposit feeders and carnivores) but destroying some others (particularly epibenthic non-mobile fauna) also played a role in macrobenthic community changes (Hily *et al;* 2008). At a regional scale these processes have led to the dominance of a few species, including burrowing megafauna (*Nephrops*), that are tolerant to the physical constraints of trawling, modifications of the suspended matter levels in the bottom waters, and the changes in the granulometry of the sediments. The consequences are a homogenisation and standardisation of the sediments and associated communities, accompanied by a decrease in biodiversity. In all, studies reveal that the fauna associated with this habitat are, in areas where *Nephrops* stocks are fully exploited, undergoing a community shift. However knowledge on this habitat's distribution, composition and uses is poor. Important variations, in terms of community composition, biodiversity, or fisheries impacts may exist, in particular in south-western waters.

Fisheries research was traditionally driven by the requirement to manage single stocks of exploited species. However in the last 2 decades, however, research efforts have increasingly been focused on the wider environmental global effects of fishing on non-target fauna and marine habitats (Hiddink *et al.*, 2006); this focus is consistent with political commitments to take account of the environmental impacts of fishing in management plans. The need to adopt and operationalize the EAF (Hall & Mainprize 2004) has prompted a wider review of the range and suitability of management indicators that might describe the state of ecosystem components or attributes and provide guidance for management decision making. To date no existing management measures have taken into account habitat quality, but rather the protection of (*Nephrops*) resources (D.Atkinson, pers.comm.).

The necessity to move from a traditional fishery management to an ecosystem approach is now acknowledged. The management of marine resources, including Nephrops stocks, in an ecosystem context, and the achievement of Good Environmental Status (GES) are commitments that have been made at both national and European levels (FAO, 2003). There is consequently a need to balance the sustainable use of the Nephrops stocks with the setting of targets to improve the quality of this habitat in a range of areas where it occurs. In this context, discussions are needed around whether setting aside some of the habitat from fishing effort could also contribute to sustaining/improving the Nephrops stocks.

7. Action to be taken by OSPAR

Action/measures that OSPAR could take, subject to OSPAR agreement

As set out in Article 4 of Annex V of the Convention, OSPAR has agreed that no programme or measure concerning a question relating to the management of fisheries shall be adopted under this Annex. However where the Commission considers that action is desirable in relation to such a question, it shall draw that question to the attention of the authority or international body competent for that question. Where action within the competence of the Commission is desirable to complement or support action by those authorities or bodies, the Commission shall endeavour to cooperate with them.

Background considerations

Conservation efforts need to be balanced across all areas for the habitat. In semi-enclosed water bodies, local management of the potential human impacts is a feasible prospect (Hughes, 1998). Measures may also be taken in open-sea areas supporting the biotope complex, but these come within the framework of fishery management of *Nephrops* stocks.

The results of a study by Queiros *et al.* (2006) corroborate the idea that any management policy that would increase the homogeneity of fishing effort distribution within one fishing ground could have severe consequences on marine communities (Dinmore et al., 2003). As the initial effects of fishing benthic communities are known to be stronger (Jennings and Kaiser, 1998; Hiddink et al., 2006), the redistribution of fishing effort to areas that were previously not fished would have greater damage than maintaining effort distributions and preserving small, lightly disturbed areas within one fishing ground (Dinmore et al.,2003). The redistribution of fishing effort within one fishing ground will have an even stronger impact if fragile habitats, such as soft-sediment communities, become disturbed.

A transition from a trawl to a creel *Nephrops* fishery is being considered by several national fishing authorities. Not only does creel fishing have a lower fuel consumption but it also leads to a better quality catch with a lower discard rate. Creeling has grown over the past decade along with the development of the live market in France and especially Spain. Considering the regional context, this transition is economically interesting. The trawl-creel transition, in order to be effective, would have to apply to all fleets fishing in the same zone, and many trawling vessels would not be equipped to switch fishing gears. An overhaul in existing fishing fleets together with a total closure period would be necessary. It is important to note that such a modification of practices requires a very accurate regional assessment of the socio-economics conditions , which vary greatly between relatively small enclosed areas such as lochs or fjords and open ones such as the Bay of Biscay or in the North Sea

WWF's North-East Atlantic Programme (WWF-NEAP, 2002) proposes the designation of a recovery area in the Grande Vasière, designed as a cross-shelf transect from the coast to the outer continental shelf. The transect could also serve as an experimental site for testing management measures and time-scales required to restore natural community patterns that are characteristic for the respective environments, and the *Nephrops* stock. Similar sites could be designated in the North Sea and Celtic Sea, e.g. the Fladen Ground, Oyster Ground, around Viking Banken or in the Central North Sea. In the southern North Sea, the *Nephrops* habitat exists, however, no sea-pens were found (see figure 3), most likely due to the constant bottom trawling activities (A Dutch scientist, Han Lindeboom considers these areas as being in a permanent "ploughed" state).

There is a role for MPAs in both the protection and restoration of this habitat. If necessary, areas could be closed to improve habitat quality (and age structure of target species) and potentially benefit fisheries.

The French, Portuguese and Spanish Interreg Project PRESPO (Sustainable Development of Artisanal Fisheries in the Atlantic Area - http://atlanticprojects.inescporto.pt/project-area/prespo) is

structured around 6 activities. Activity n°5 concerns the certification of seafood caught with fishing gears that respect the marine environment. In July and October 2009 joint research campaigns were carried out by the French fishing industry, Ifremer and AGLIA (Association du Grand Littoral Atlantique) in order to obtain updated figures on *Nephrops* trawler discard survival.

Proposals for actions and measures

It is proposed that OSPAR should recommend that relevant Contracting Parties (i.e. those having seabeds in their EEZ which host fauna listed in the OSPAR working definition of this habitat) take into account the need for the protection of sea-pen and burrowing megafauna communities in the development and application of seabed exploitation and fishery policies and plans with a view to:

a. halting the damage of the sub-littoral mud communities by decreasing mechanical disturbances where appropriate (ie in the areas where the habitat is threatened);

b. giving special protection to highly impacted areas important for the persistence of this habitat and the populations it supports;

c. supporting pilot projects with stakeholders in such areas in order to improve management;

d. encouraging Marine Stewardship Council certification.

OSPAR should require that Contracting Parties report back to the OSPAR Commission on the implementation of the above recommendations so that the development of the necessary measures can be evaluated. As a first step Contracting Parties whose EEZ contains sea-pen and burrowing megafauna communities should make an assessment of the effectiveness of the regulations they already have in place for the protection of this habitat, consider how those regulations might be made more effective through improved monitoring, control and surveillance and report the results to the OSPAR Commission. In areas where no existing regulations are in place, scientific knowledge should be increased in order to help regulators to take appropriate measures.

To complement these actions, the OSPAR Commission should:

a. communicate to the EC and the relevant fishing authorities the need for increased spatialised knowledge of fishing intensity without compromising personal data confidentiality;

b. emphasise to relevant scientific funding bodies the following research needs with respect to sea-pen and burrowing megafauna communities*:*

   (i) further community and habitat description (species characterisation, geographical distribution, sedimentation)

   (ii) further population dynamic studies in order to assess the resilience of populations to natural or human-induced changes to this habitat

   (iii) further assessment of all the trophic levels that are affected by bottom-trawling over this habitat, beyond target-species

c. emphasise to relevant fishing authorities the following management needs with respect to sea-pen and burrowing megafauna communities*:*

   (i) the development of a pluri-specific recovery programme, using a combination of area management and fishing gear selectivity tools.

   (ii) the evaluation of environmental parameters from existing commercial *Nephrops* stock assessment data, as well as from other forms of industrial ROV footage.

Table 3: Summary of key priority actions and measures which could be taken for sea-pen and burrowing megafauna communities. Where relevant, the OSPAR Commission should draw the need for action in relation to questions of fisheries management to the attention of the competent authorities. Where action within the competence of the Commission is desirable to complement or support action by those authorities or bodies, the Commission shall endeavour to cooperate with them.

Key threats	**Trawling gear** **Aquaculture organic pollution** **Climate change**	
Other responsible authorities	EC, NEAFC, RFMOs	
Already protected? **Measures adequate?**	EUNIS code A5.361 and A5.362 Some areas qualify as "Sandbanks which are slightly covered by seawater at all times" (Natura 2000 code 1110), others as "Estuaries" (Natura 2000 code 1130), and the Scottish sealochs in particular, as "Large shallow inlets and bays" (Natura 2000 code 1160)	Vast areas of this habitat are not protected by any form of legislation.
Recommended OSPAR Actions and Measures	♦ Encourage the improvement of scientific spatialised knowledge concerning this habitat and the communities it harbours, their dynamics and their resilience. ♦ Develop and assess management rules and encourage pilot projects with stakeholders ♦ Pluri-specific to fisheries assessment and management: improvement of trawl selectivity combined with MPA designation/ rotating no-take-zones (OSPAR should communicate this to the EC/relevant fishing authorities) ♦ Encourage an ecosystem approach for the concerned areas including improvement of knowledge, technical experimentations on gears and preservation of lightly impacted areas of sea-pens communities. ♦ Protection of heavily impacted sites as OSPAR MPAs (Contracting Parties) ♦ Better use of commercial *Nephrops* stock assessment data and commercial ROV footage to evaluate other environmental parameters (OSPAR should communicate this to the EC/relevant fishing authorities) ♦ Increased access and detail for fishing intensity data made available to scientists. (OSPAR should communicate this to the EC/relevant fishing authorities)	

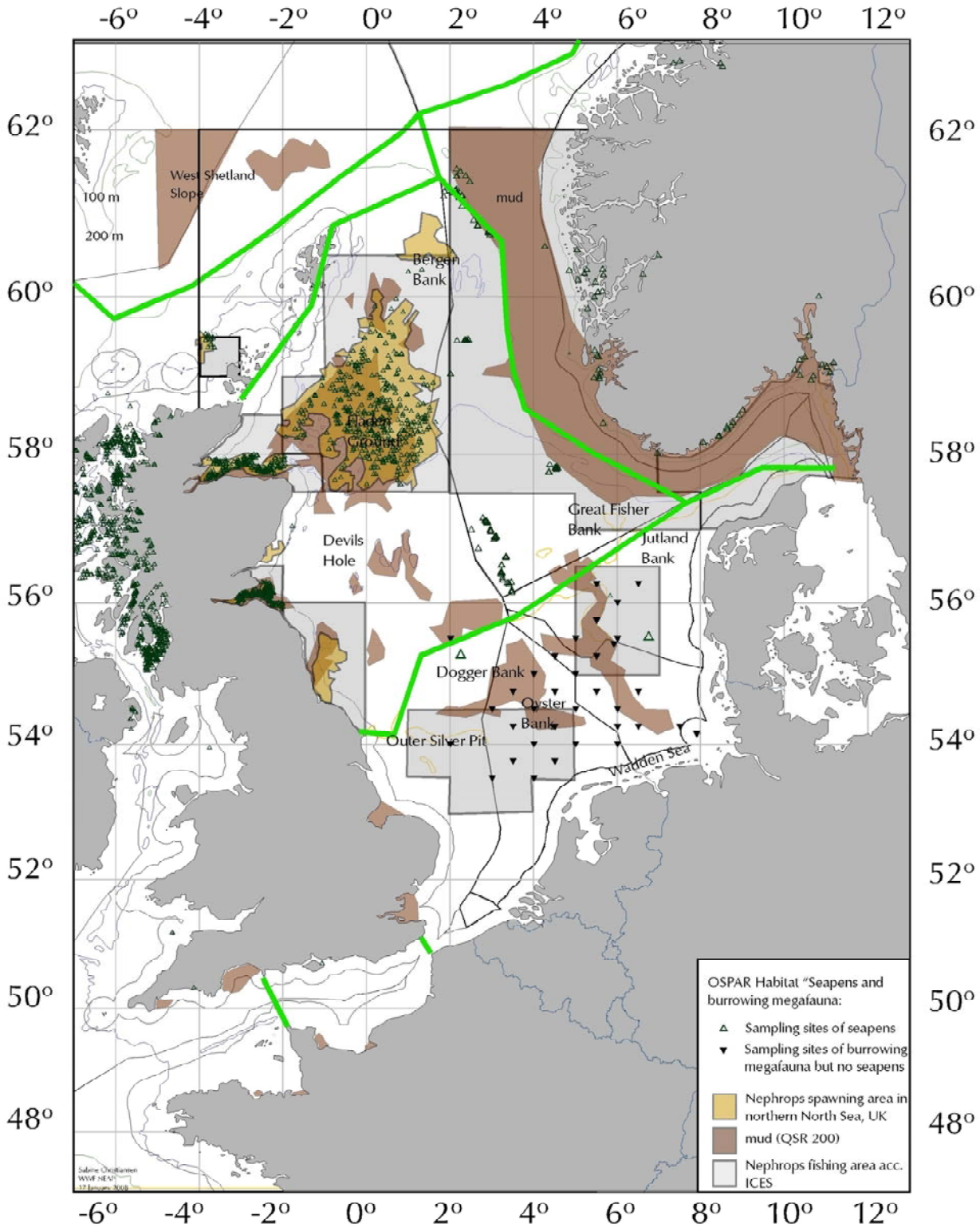

Figure 3: Sea-pen and burrowing megafauna habitat distribution in the North Sea (S.Christiansen, pers.comm).

Brief summary of proposed monitoring system

In addition to identifying the distribution area of this habitat, it is essential to designate no-take areas in order to investigate its recovery time. The study of these closed areas is needed as a first step to delivering action plans towards the recovery of the habitat, by monitoring the alteration in fishing effort and distribution.

Annex 1: Overview of data and information provided by Contracting Parties

Contracting Party	**Feature occurs in CP's Maritime Area**	**Contribution made to the assessment (e.g. data/information provided)**	**National reports References or weblinks**
Belgium			
Denmark			
European Commission	Y		NECESSITY: Nephrops and Cetacean Species Selection Information and Technology http://cordis.europa.eu/fetch?CALLER=FP6_PROJ&ACTION=D&DOC=2745&CAT=PROJ&QUERY=1170700786535&RCN=73838&DOC=1&QUERY=011bbc5e8b9d:08dc:48a8c130
France	Y	Y	Le Loc'h, F; 2004.Structure, fonctionnement, évolutiondes communautés benthiques des fonds meubles exploités du plateau continental Nord Gascogne. PhD thesis for the Université de Bretagne Occidentale. 378 pp.
Germany			
Iceland			
Ireland	Y		
Netherlands			
Norway	Y		
Portugal	Y		
Spain	Y		
Sweden	Y		Ziegler, F., 2006. Environmental Life Cycle Assessment of Norway lobster (*Nephrops norvegicus*) fished by creels, conventional and species-selective trawls along the Swedish west coast. A data report. SIK report 746. 40pp.
UK	Y	Y	-Hughes, D.J. 1998. Sea pens & burrowing megafauna (volume III). An overview of dynamics and sensitivity characteristics for conservation management of marine SACs. Scottish Association for Marine Science (UK Marine SACs Project). 105 pp. -UK Biodiversity Action Plan for Mud habitats in deep water http://www.ukbap.org.uk/UKPlans.aspx?ID=41

Summaries of country-specific information provided

France: The northern part of the continental shelf of the Bay of Biscay is covered by a sedimentary bank known as the Grande Vasière (i.e. "Great mud bank"). The Grande Vasière is home to a commercially exploited *Nephrops* population, but also an important area for young *Merluccius merluccius,* the most wide spread and abundant bottom dwelling fish species in the Bay of Biscay (Trenkel, 2007). A study comparing macrofauna between 1966 and 2001 (Hily *et al.*, 2008) shows that deep modifications have taken place within the northern part of this area. Sediment comparisons between the two periods revealed very large changes to the relative levels of the main grain size fraction. The bottom trawling effort contributes significantly to the resuspension of fine mud particles. The current shift in sediment type is the main force driving benthic community evolution. Human activities have also reduced fine particle influx: recent damming of main rivers has decreased the amount of terrigenous effluents evacuated offshore in storm swells.

Fishing effort in 2001 estimated that each m^2 of the "Grande Vasière" is trawled on average 3 to 5 times a year. The number of trawlers has declined over the past few years which has led to a decrease in anthropogenic pressure, the consequence of which on the state of the habitat should be precisely evaluated.

Although there is evidence of the impact of trawling on benthic communities and re-suspension of sediments, there is no overall study of the Bay of Biscay that can lead to a firm conclusion on the threatened status of this habitat for region IV. Studies have to be carried out in order to achieve a global assessment of the status of the habitat in this region.

In the Bay of Biscay, a diversity of measures have been adopted either by the French administration or by the producers' organisations (POs) themselves. Studies and experiments carried out at sea in 2003-2004 resulted in the obligation for all ships to use hake (*Merluccius merluccius*)-specific gear as of 2005 (a compulsory prerequisite for obtaining a fishing license). A 9 cm minimum landing size regulation was established in December 2005, together with a 70 mm codend mesh size since 2000. A license system was adopted in 2004 resulting in a cap (230 maximum in 2010) on the number of *Nephrops* trawlers operating in this area; in addition, trawling is prohibited during week-ends, and individual quotas have been imposed by the French POs since 2006. Since April 2008 selective devices have been introduced into the *Nephrops* fishery (ICES, 2008). The AGLIA (Association du Grand Littoral Atlantique) has worked together for several years with the French Comité National des Pêches Maritimes et des Elevages Marins to promote selective devices and to organise large scale trials at sea. The project has successfully engaged all the fishermen from the Bay of Biscay nephrops' fishery, 230 trawlers, and reduced the catch of undersize *Nephrops* and other marine life.

Ireland: The Irish *Nephrops* fishery is extremely valuable with landings in recent years worth around €30 m at first sale supporting an important indigenous processing industry. The Marine Institute in co-operation with Northern Ireland scientists commenced an UWTV survey for Nephrops in the Irish Sea in 2003. The surveys indicates that the biomass and density has declined by around 40% since 2003 but is still relatively high compared to other Nephrops stocks. Other indicators such as size distributions and indicate rather stable trends over a long time.

Spain: The Scientific, Technical and Economic Committee for Fisheries (STECF) was established by Commission Decision n° 93/619/EC, renewed in 2005 by Commission Decision n° 2005/629/EC. Recovery plans for southern hake and Norway lobster off the Iberian peninsula were adopted by the Council in October 2005, and came into force on 1 January 2006. establishing measures for the recovery of the Southern hake and Nephrops stocks in the Cantabrian Sea and Western Iberian peninsula and amending Regulation (EC) No 850/98.

Sweden: A study comparing the environmental performance of three different Nephrops fishing methods for the Swedish Institute for Food and Biotechnology (SIK) (Ziegler, 2006) shows that diesel consumption of the trawlers was more than four times as high as of the creel fishing vessels (9.0 and 2.2 l/kg of *Nephrops,*respectively, Figure 4). The same study noted with regard to seafloor impact that the difference between fishing gears was even more pronounced: the entire Swedish west coast creel fishery affetcs the same seafloor area during one year as does one hour of trawling.

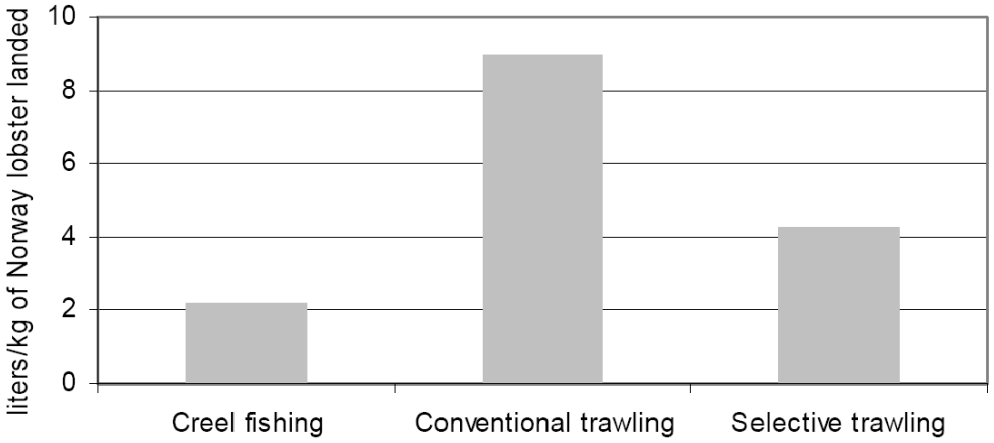

Figure 4: Fuel consumption from three Nephrops (Norway lobster) fishing gear types (Ziegler, 2006) In creel fisheries 2.2 l of diesel were burnt per kg of Nephrops landed. In the conventional trawl fishery, 9.0 l diesel were burnt per kg of Nephrops landed and in the trawl fishery with selective trawls, 4.3 l of diesel were burnt per kg of *Nephrops* landed.

United Kingdom: Within the existing SAC network, mud habitats in deep water are represented within sites such as Strangford Lough, Loch Maddy and Lochs Duich, Long and Alsh. Some of the Scottish Marine Consultation Areas include areas of circalittoral mud.

The majority of deep mud habitats are subject to some demersal fishing effort, principally for *Nephrops norvegicus. Nephrops* is one of most important fisheries in Scotland and benthic trawls or pots/creels are the two methods of fishing employed.

The fishery for *Nephrops* in Scottish waters has developed since the early 1960s, and *Nephrops* is currently one of the most valuable species landed (about £50 million in recent years). There are *Nephrops* fisheries in a number of areas around Scotland, the largest being the Fladen Ground. Most are caught by trawlers, but in inshore west coast areas, creeling is also important. Scotland takes about one third of the total world *Nephrops* landings, and is allocated the majority of the North Sea and Scottish west coast Total Allowable Catches (TAC) (FRS website).

One fishing group in the OSPAR area has actively sought to close an area to trawling. The Loch Torridon *Nephrops* creel fishery in Scotland was first certified as sustainable in 2003 and recertified in 2008 by the Marine Stewardship Council (MSC). (http://www.msc.org/track-a-fishery/certified/north-east-atlantic/loch-torridon-nephrops-creel) .The MSC environmental standard for sustainable fishing is the standard that a fishery must meet to become certified, and is based on 3 principles (sustainable fish stocks, minimising environmental impact and effective management) and 31 performance indicators.

The Loch Torridon *Nephrops* have been caught using baited creel pots deployed on lines for over thirty years. When the Inshore Fishing Act removed the three-mile limit that banned the use of mobile gear, the creel fishers actively sought to close the area to other fishing methods. On November 1, 2000 the Scottish Executive announced that a closed area was to be established between Red Point and the south end of the BUTEC Range in the Inner Sound of Rona. This took effect on 30th May 2001 and the creel fishers from Loch Torridon set up a company, Shieldaig Export Limited the client for certification, based in Ardheslaig, to collectively supply live nephrops, research markets, control handling and arrange airfreight to European markets, adding value to the landings. This has resulted in greater price stability and relatively secure markets.

Considerable research is undertaken by the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) and Marine Scotland Science into the effects of fishing gear on benthic habitats and communities. Deep mud communities are being studied as part of the UK National Monitoring Programme.

A broad variety of research into deep mud communities, sea-pens and burrowing megafauna is being undertaken by a number of research institutions, principally the University Marine Biological Station Millport, Scottish Association for Marine Science, Oban and the University of Newcastle (long-term studies off the Northumberland coast).

A number of proposed national plans are underway, the objectives of which are to protect a representative range of 8 to 10 sites, illustrating typical mud biotopes in deep water, by 2009.

Annex 2: Description of the proposed monitoring and assessment strategy

Rationale for the proposed monitoring

Sea-pen and megafauna communities are known to be impacted by, and therefore threatened by, bottom-trawling operations. Evidence of the high impact of demersal fisheries is abundant in the literature and well-recognised. Although closed areas for fishing fall within the remits of fisheries organisations rather than OSPAR, monitoring resources could be used to support any relevant measures introduced such as the surveying of no-take-zones. If protective measures such as fishery closures are brought in, monitoring will be needed to assess their effectiveness.

Use of existing monitoring programmes

A recent study by Greathead *et al.* (2007) sucessfully demonstrates the value of obtaining biodiversity information from video footage derived from *Nephrops* stock assessment surveys. There is considerable potential for extracting data from other sources of video surveys (pipeline surveys, pre-development environmental assessments, etc...) which could be re-analysed for large epifauna, thereby providing an additional layer of biodiversity information that would be beneficial in implementing ecosystem-based management. For example, the recovery of benthic communities after disturbance by marine sediment extraction has been studied more extensively than recovery after bottom-fishing disturbance (Hiddink et al., 2006), therefore use of sediment-mining data could be useful for comparison with modeled recovery rates.

OSPAR's support to international projects utilising commercial data such as the SERPENT (Scientific and Environmental ROV Partnership using Existing iNdustrial Technology - www.serpentproject.com) project would be desirable. The SERPENT project centres around the opportunistic use of ROVs (Remotely Operated Vehicles) in operational settings during periods of stand-by time and the wider utilisation of data collected as part of routine offshore work and environmental assessment studies.

Synergies with monitoring of other species or habitats.

The monitoring of this OSPAR habitat, which includes *Nephrops norvegicus* as one of its characteristic species, should be closely linked with commercial *Nephrops* fishery stock assessments. It is imperative that fishery management begins to incorporate all the levels that are affected by fisheries within the ecosystem, beyond target-species.

VMS data might be used more effectively in cooperation with stakeholders if the frequency of signals was increased and the fishing tracks of individual vessels could be reconstructed. This would allow swept areas to be calculated at any scale from the total distance of trawl track crossing a specified area in a specified time period (Dinmore *et al*., 2003).

Assessment criteria

It is essential to link the monitoring output to effective measures in order to realise adaptive management

Techniques/approaches

Towed body high-resolution video surveys of sea floor (Trenkel *et al.*, 2007, Greathead *et al*. 2007)

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Annex 4: Summary of EU-NECESSITY Project (WWF)

Project acronym: NECESSITY

Title: **NE**phrops and
CEtacean
Species
Selection
Information and
Technolog**Y**

Subject

This project addresses current selectivity and bycatch issues in *Nephrops* and pelagic fisheries. The project started in 2004 and lasts for 38 months. Main objective is the development of effective and acceptable gear modifications and acoustic deterrents to reduce discard and bycatch of non target fish and cetaceans as well as alternative fishing tactics in co-operation with the fishery industry. Biological effects and socio-economics repercussions are determined. During sea trials in the Kattegat and Skagerak *Nephrops* fishery, a significant decrease of discard had been observed by the implementation of a developed escape window. EU legislation requires the use of this window in *Nephrops* fishery from February 2005 onwards. The EU-project NECESSITY works on the improvement of selectivity of *Nephrops* trawls.

NECESSITY will develop ways of modifying trawls to enable by-catch species to escape from the trawl unharmed. The project will:

- Study the behavioural characteristics that make small cetaceans (i.e. porpoises and dolphins), and certain fish species or age groups vulnerable to capture in trawl fisheries
- Develop alternative fishing strategies, or fishing gear modifications, to reduce the bycatch in trawl fisheries
- Consider the biological and socio-economic ramifications of modifying the fishing gear and practices
- Transfer the information gathered to other fisheries subject to similar concerns

Contribution to policy development:

- By reducing by-catch, NECESSITY will help the EU meet its commitments under the Common Fisheries Policy “to protect and conserve available and accessible living marine aquatic resources”
- By reducing by-catch of cetaceans, NECESSITY will support the EU Council Regulation requiring Member States to take steps to ensure that incidental capture does not have a negative impact on cetacean species
- The socio-economic aspects of the project will help “provide for rational and responsible exploitation, on a sustainable basis”.
- It will increase understanding of the consequences of adopting or varying particular fishery management measures

Project deliverables:

- Design and tests of fishing gear and cetacean exclusion devices – December 2004
- Development of cost-benefit analysis (CBA) methods and models – September 2005
- Modified fishing gear selectivity trials – December 2006
- Sea trials of acoustic deterrents – June 2006
- Assessment of cetacean behaviour and reactions to deterrents – June 2006.

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