OSPAR COMMISSION

Background Document on the Charlie-Gibbs Fracture Zone

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

Acknowledgement

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Contents

Executive summary

The Charlie-Gibbs Fracture Zone represents an especially complex section of the Mid-Atlantic Ridge between Iceland and the Azores, with three main features. The Mid Atlantic Ridge with its many peaks rises to summits shallower than 1500 m depth and provides the benthic fauna with the only hard substrate at relatively shallow depths in the North Atlantic open ocean. The major fracture zone in the area, the Charlie-Gibbs Fracture Zone, offsets the ridge by 5° to the east, opening a deep sea connection between the north-west and north-east Atlantic. In the water column cold Arctic and warm Atlantic waters create a permanent oceanographic feature, the meandering sub polar front, which separates the different faunal communities of the warm and the cold waters to the north and south of the front. The increased bioproductivity at the front attracts migratory species, such as whales and seabirds. The area is a major biogeographic east-west and north-south divide for deep sea species, and hosts seamount communities, with cold-water corals and deep sea sponges, and seamount-aggregating benthopelagic fishes such as roundnose grenadier, orange roughy and redfish.

In 2003, the OSPAR Commission agreed to establish a network of Marine Protected Areas (MPAs) with the aim that this should become an ecologically coherent network of well-managed sites. OSPAR agreed that the OSPAR Network of MPAs should comprise sites that are established as MPAs within the jurisdiction of OSPAR Contracting Parties as well as sites in the maritime area outside the jurisdiction of the Contracting Parties (area beyond national jurisdiction (ABNJ)). In the OSPAR Biodiversity and Ecosystems Strategy, OSPAR agreed to identify, on the basis of reports from Contracting Parties and observer organisations, possible components of the OSPAR Network in ABNJ in order to achieve the purposes of the network.

This background document makes available the information which has been compiled and evaluated within the OSPAR framework on the biodiversity and ecosystems of a section of the Charlie-Gibbs Fracture Zone and the adjacent sections of the Mid-Atlantic Ridge, which was proposed to OSPAR as a potential MPA in ABNJ in 2008. On the basis of this information, the 2010 Ministerial Meeting of the OSPAR Commission adopted OSPAR Decision 2010/2 on the establishment of the Charlie-Gibbs South MPA and agreed on work within the framework of OSPAR to resolve outstanding issues with regard to the high seas of the northern part of the Charlie-Gibbs Fracture Zone area.

This document also includes conservation objectives developed within the OSPAR framework for application to an MPA in the area of the Charlie-Gibbs Fracture Zone which have been formalised in OSPAR Recommendation 2010/13 on the management of the Charlie-Gibbs South MPA.

Récapitulatif

La zone de fracture Charlie-Gibbs représente une partie particulièrement complexe de la dorsale médio-atlantique, située entre l'Islande et les Açores, comportant trois caractéristiques principales. La dorsale médio-atlantique comporte de nombreux pics, ses sommets se situent à moins de 1500 m de profondeur et offrent à la faune benthique le seul substrat dur à des profondeurs relativement faibles en plein océan Atlantique Nord. La principale zone de fracture dans cette zone, la zone de fracture Charlie-Gibbs, compense la dorsale de 5° à l'est, ouvrant une faille en eaux profondes permettant une connexion majeure entre l'Atlantique du Nord-Ouest et l'Atlantique du Nord-Est. Les eaux froides de l'Arctique et les eaux plus chaudes de l'Atlantique créent dans la colonne d'eau une caractéristique océanographique permanente. Il s'agit du front subpolaire sinueux qui sépare les diverses communautés faunales des eaux chaudes et des eaux froides au nord et au sud du front. La bioproductivité accrue au front attire des espèces migratrices telles que les baleines et les oiseaux de

mer. Cette zone représente une division biogéographique majeure est-ouest et nord-sud pour les espèces d'eaux profondes et héberge des communautés de monts sous-marins telles que les coraux d'eau froide et les éponges d'eau profondes ainsi que des poissons bentopélagiques s'agrégeant sur les monts sous-marins tels que le grenadier de roche, l'hoplostète orange et le sébaste.

La Commission OSPAR est convenue, en 2003, de créer un réseau de zones marines protégées (ZMP) afin que celui-ci devienne un réseau de sites écologiquement cohérent et bien géré. OSPAR est convenue que le réseau OSPAR de ZMP devra englober les sites créés à titre de ZMP situés dans la juridiction des Parties contractantes OSPAR ainsi que les sites de la zone maritime situés au-delà de la juridiction des Parties contractantes (zone au-delà de la juridiction nationale (ABNJ)). OSPAR est convenue, dans sa Stratégie biodiversité et écosystèmes, de déterminer, en se fondant sur des rapports des Parties contractantes et d'organisations observatrices, des composantes éventuelles du réseau OSPAR situées dans des zones au-delà de la juridiction nationale afin de parvenir aux objectifs du réseau.

Le présent document de fond comporte les informations qui ont été recueillies et évaluées dans le cadre de travail d'OSPAR et portant sur la biodiversité et les écosystèmes d'une partie de la zone de fracture Charlie-Gibbs et des parties adjacentes de la dorsale médio-atlantique, qui a été proposée à OSPAR à titre de ZMP potentielle dans une ABNJ en 2008. La réunion ministérielle de 2010 de la Commission OSPAR a adopté, en se fondant sur ces informations, la Décision OSPAR 2010/2 sur la création de la ZMP Charlie-Gibbs méridionale et est convenue des travaux à entreprendre dans le cadre de travail d'OSPAR afin de résoudre les questions en suspens relatives à la haute mer de la partie septentrionale de la zone de fracture Charlie-Gibbs.

Le présent document comporte également des objectifs de conservation développés au sein du cadre de travail d'OSPAR à appliquer à une ZMP située dans la zone de fracture Charlie-Gibbs, objectifs qui ont été officialisés dans la Recommandation OSPAR 2010/13 sur la gestion de la ZMP Charlie-Gibbs méridionale.

A. General information

1. Area

Charlie-Gibbs Fracture Zone

2. Conservation Objectives

2.1 Conservation Vision[1]

"Maintenance and, where appropriate, restoration of the integrity and natural quality of the functions and biodiversity of the various ecosystems of the Charlie-Gibbs Fracture Zone so they are the result of natural environmental quality and ecological processes.[2]"

Cooperation between competent authorities, stakeholder participation, scientific progress and public learning are essential prerequisites to realize the vision and to establish a Marine Protected Area subject to good governance, sustainable utilization, and adequate regulations, in conformity with UNCLOS. Best available scientific knowledge and the precautionary principle form the basis for conservation.

2.2 General Conservation Objectives[3 4]

(1) To **protect and conserve** the range of habitats and ecosystems including the water column of the Charlie-Gibbs Fracture Zone for resident, visiting and migratory species as well as the marine communities associated with key habitats;

(2) To **prevent** loss of biodiversity, and promote its recovery where practicable, so as to maintain the natural richness and resilience of the ecosystems and habitats;

(3) To **prevent** degradation of, and damage to, species, habitats and ecological processes, in order to maintain the structure and functions - including the productivity - of the ecosystems;

(4) To **restore** the naturalness and richness of key ecosystems and habitats, in particular those hosting high natural biodiversity;

(5) To **provide a refuge** for wildlife within which there is minimal human influences and impact.

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[1] The conservation vision describes a desired long-term conservation condition and function for the ecosystems in the entire Charlie-Gibbs Fracture Zone. The vision aims to encourage relevant stakeholders to collaborate and contribute to reach the objectives set for the area.

[2] Recognizing that species abundances and community composition will change over time due to natural processes.

[3] Conservation objectives are meant to realize the vision. Conservation objectives are related to the entire Charlie-Gibbs Fracture Zone or, if it is decided to subdivide, for a zone or subdivision of the area, respectively.

[4] It is recognized that climate change may have effects in the area, and that the MPA may serve as a reference site to study these effects.

2.3 Specific Conservation Objectives[5]

2.3.1. Water Column

a. To prevent deterioration of the environmental quality of the bathypelagic and epipelagic water column (e.g. toxic and non-toxic contamination[6]) from levels characteristic of the ambient ecosystems;

b. To prevent other physical disturbance (e.g. acoustic);

c. To protect, maintain and, where in the past impacts have occurred, restore where appropriate the epipelagic and bathypelagic ecosystems, including their functions for resident, visiting and migratory species, such as: cetaceans, and mesopelagic and bathypelagic fish populations.

Special attention should be given to the area of the meandering **sub-polar frontal ecosystem.**

2.3.2. Benthopelagic Layer

To protect, maintain and, where in the past impacts have occurred, restore where appropriate:

a. Historically harvested **fish populations** (target and bycatch species) at/to levels corresponding to population sizes above safe biological limits[7] with special attention also given to **deep water elasmobranch species**, including threatened and/or declining species, such as Portuguese dogfish, Leafscale gulper shark and Gulper shark;

b. Benthopelagic habitats and associated communities.

2.3.3. Benthos

To protect, maintain and, where in the past impacts have occurred, restore where appropriate:

a. The **epibenthos and its hard and soft sediment habitats,** including threatened and/or declining species and habitats such as seamounts, deep-sea sponge aggregations, *Lophelia pertusa* reefs and coral garden;

b. The **infauna of the soft sediment benthos**, including threatened and/or declining species and habitats;

c. The **habitats associated with ridge structures.**

2.3.4. Habitats and species of specific concern

Those species and habitats of special interest for the Charlie-Gibbs Fracture Zone, which could also give an indication of specific management approaches, are listed at Annex 1.

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[5] Specific Conservation Objectives shall relate to a particular feature and define the conditions required to satisfy the general conservation objectives. Each of these specific conservation objectives will have to be supported by more management oriented, achievable, measurable and time bound targets.

[6] This includes synthetic compounds (e.g. PCBs and chemical discharge), solid synthetic waste and other litter (e.g. plastic) and non-synthetic compounds (e.g. heavy metals and oil).

[7] "Safe biological limits" used in the following context: "Populations are maintained above safe biological limits by ensuring the long-term conservation and sustainable use of marine living resources in the deep-seas and preventing significant adverse impacts on Vulnerable Marine Ecosystems (FAO International Guidelines for the Management of Deep-Sea Fisheries in the High Seas, 2008).

3. Status of the location

The area described in this background document was designed to be located beyond the limits of national jurisdiction of the coastal states in the OSPAR Maritime Area.

On 29 April 2009 the Republic of Iceland submitted to the UN Commission on the Limits of the Continental Shelf, information on the limits of the Icelandic continental shelf in the area of the Reykjanes ridge beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured, in accordance with Article 76, paragraph 8, of the Convention of the Law of the Sea.

The limits submitted by Iceland – if approved by the Commission - would encompass the seabed in part of the area of the area described in this background document.

The international legal regime that is applicable to the site is comprised of, *inter alia*, the UNCLOS, the Convention on Biological Diversity, the OSPAR Convention and other rules of international law. This regime contains, among other things, rights and obligations for states on the utilization, protection and preservation of the marine environment and the utilization and conservation of marine living resources and biodiversity as well as specifications of the competence of relevant international organizations.

4. Marine region

OSPAR Region V; Mid-Atlantic Ridge

5. Biogeographic region

Atlantic sub region; Cool-temperate waters; Warm temperate waters.

6. Location

The area described in this background document covers the northern part of the Mid-Atlantic Ridge, including the Charlie-Gibbs Fracture and Maxwell Fracture Zones (see Figure 1). The area includes the seamounts Faraday (1251 km^2) and Hecate (358 km^2), and corresponds broadly to the Middle MAR area where the use of fishing gear likely to contact the seafloor during the course of normal fishing operations has been prohibited since 2009 until presently 31st December 2015 (NEAFC Recommendation on the protection of vulnerable marine ecosystems from significant adverse impacts in the NEAFC regulatory area, 2009). The area described is slightly larger than the current NEAFC closures, with the purpose to represent a coherent area that includes all of the relevant biogeographic regions and a wide range of habitats, as well as countering the general lack of knowledge about deep-sea habitats by implementing the Precautionary Principle.

The coordinates originally proposed for the boundaries of an MPA in the area of the Charlie-Gibbs Fracture Zone[8] are:

Latitude N	Longitude W
55°	37.° W
55°	32° W
53.5°	32° W
53.5°	27° W
49°	27° W
49°	32° W
51°	32° W
51°	37° W
55°	37° W

[8] For boundary coordinates of the Charlie-Gibbs South MPA see OSPAR Decision 2010/2

These boundaries reflect a scientific agreement reached at OSPAR's Intersessional Correspondence Group MPA in April 2008 that the enclosed area will fully incorporate representative sections of the MAR north and south of the Charlie-Gibbs Fracture Zone, and the meandering subpolar front that separates cool northern from warmer southern waters and sustains a relatively high abundance and biomass across the food web. The subpolar front, usually lies just south of the Charlie-Gibbs Fracture Zone, but varies in position. The boundaries incorporate also a variety of seamount communities of different sizes and depths, including Faraday and Hecate, as well as three deep east-west trenches, the fracture zones. Overall, the summit depth of the MAR peaks increases from north to south.

In many forums deep-water fishing is described as that which occurs deeper than 400 m. Therefore, within the Charlie-Gibbs fracture Zone, areas have been mapped that can be potentially fished from 500 m to 2000 m (Fig. 2). 2000m delimits the maximum fishing depth of the predominant past and present fishing activities. This is quite a narrow area and most fishing on the MAR concentrates on the depths of less than 1000m on the tops and slopes of the shallower hills (Bergstad, O.A. pers comm.).

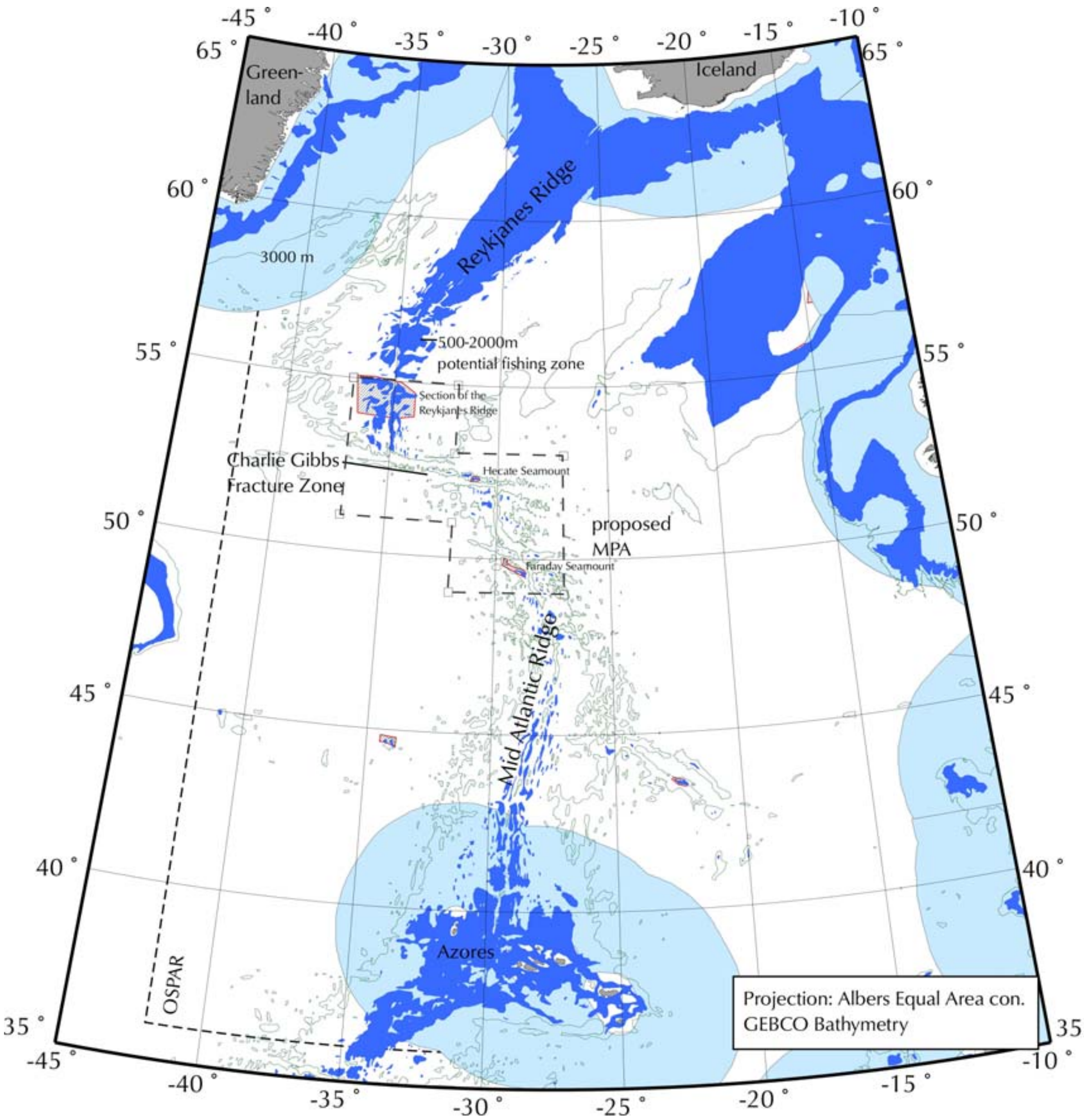

Figure 1. *Location of the proposed Charlie-Gibbs Fracture Zone MPA on the Mid-Atlantic Ridge. The NEAFC closures within the proposed area between 2005 and 2009 are outlined in red (Hecate, Faraday Seamounts and Reykjanes Ridge). A much larger area, the Middle MAR, was closed to bottom fishing by NEAFC in 2009, corresponding more closely to the CGFZ.*

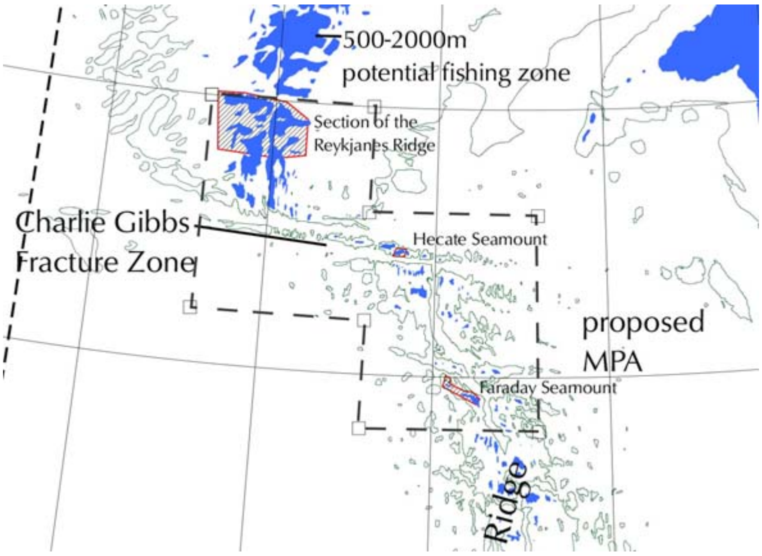

Figure 2. *The fishable area within the proposed CGFZ MPA on the Mid-Atlantic Ridge (in blue). The NEAFC closures (2005-2009) are outlined in red (Hecate, Faraday Seamounts and Reykjanes Ridge).*

7. Size

323 900 km^2

8. Characteristics of the area

The Mid-Atlantic Ridge (MAR) is the major topographic feature of the Atlantic Ocean extending within the OSPAR Maritime Area, from the Lomonossov Ridge in the Arctic Ocean to its southern boundary. The MAR is a slow-spreading ridge where new oceanic floor is formed, and western and eastern parts of the North Atlantic basin spread at a speed of 2-6 cm/year (Dinter, 2001; Heger *et al*., 2008; Hosia *et al*., 2008). Its shallower part is found south of Iceland towards the Azores, both groups of islands being the top of ridge-associated seamounts. Rising from bathyal and abyssal depths, the Mid-Atlantic Ridge dominates the seafloor topography in the High Seas of the OSPAR region. The topography is highly differentiated with depths ranging from 4500 m in the deepest channel to only 700-800 m on top of adjacent seamounts (Dinter, 2001).

The relief of the axial part of the MAR is presented by systems of separated volcanic rocky mountains. More than 170 seamounts with summit depths less than 1500 metres were found in the northern part of the MAR between 43° and 60°N during Russian explorations in 1972-1984 (Shibanov *et al.,* 2002). The majority of seamounts are concentrated in the central (rift) zone of the ridge and in the zone of the transversal (transformed) cracks. Intermountain slashes and smooth slopes are covered with irregular granular sand aleurite, silt, coral, shelly and benthos detritus (Shibanov *et al.,* 2002 and literature therein). With its deep, sometimes abyssal valleys and intermittent shallow hills and islands, the ridge can be compared to a mountain chain on land. Apart from the rocky and mountainous areas, there are extensive areas of soft sediment (Feller *et al.,* 2008) in particular at greater depth.

Ecologically, ridges are fundamentally different from both isolated seamounts surrounded by deep ocean and from continental slopes where effects of coastal processes are pronounced. They affect not only the availability of suitable habitats for benthic or benthopelagic species, but the topography strongly shapes also the habitat characteristics in the water column through modification of currents and production patterns (see e.g. Opdal *et al.,* 2008). The Mid-Atlantic Ridge has a profound role in the circulation of the water masses in the North Atlantic (Rossby, 1999; Bower *et al.,* 2002; Heger *et al.,* 2008; Søiland *et al.,* 2008). The complex hydrographic setting around the Mid-Atlantic Ridge in general and the presence of the ridge itself leads to enhanced vertical mixing and turbulence that results in areas of increased productivity over the MAR (Falkowski *et al.,* 1998; Heger *et al.,* 2008; for a more detailed description see the Ecological Significance criterion B3 below). Despite generally limited surface production, there is evidence of enhanced near ridge demersal fish biomass above the Mid-Atlantic Ridge (Fock *et al.,* 2002; Bergstad *et al.,* 2008) and that the mid-ocean ridges are ecologically important for higher trophic levels relative to the surrounding abyssal plains and the open ocean (e.g., blue ling and roundnose grenadier spawning aggregations on the northern MAR (Magnusson & Magnusson 1995, Vinnichenko & Khlivnoy 2004).

The proposed MPA covers an especially complex section of the Mid-Atlantic Ridge (Søiland *et al.,* 2008) and as such is expected to be home to diverse and interesting deep-sea fauna (Tabachnick & Collins, 2008). From the north, the Reykjanes Ridge stretches south-westwards from Iceland to approximately 52°N, where a major fracture zone known as the Charlie-Gibbs Fracture Zone (Felley *et al*., 2008; Heger *et al*., 2008) offsets the ridge by 5o to the east and opens the deepest (maximum depth 4500 m) connection between the northwest and northeast Atlantic (Felley *et al*., 2008; Heger *et al*., 2008; Mortensen *et al*., 2008; Søiland *et al*., 2008). South of the Charlie-Gibbs Fracture zone, two pronounced deep rift valleys at 32.25°W and 31.75°W (Opdal *et al*., 2008) and two further fracture zones (Faraday and Maxwell Fracture Zones, at 50°N and 48°N respectively) create an enormous topographic – and fairly unknown – ecological complexity.

The general circulation in the epipelagic zone (0-200 m) is well understood as the warm North Atlantic current flowing north-eastwards from the subtropical gyre in the southwest Atlantic towards the European shelf with two to four branches crossing the MAR between 45° and 52° N, approximately coinciding with the three fracture zones (Sy *et al.,* 1992, Søiland *et al.,* 2008). Where the warm, saline North Atlantic water meets the cold, less saline water of the subpolar gyre from the Labrador and Irminger Seas, the subpolar front is a permanent feature (Figure 2). The meandering of the subpolar front between 48-53°N coincides with temporal variation in the character and spatial distribution of the watermasses and frontal features (Søiland *et al.,* 2008). This front is one of the major oceanic features in the OSPAR region, being an area of elevated abundance and diversity of many taxa, including an elevated standing stock of phytoplankton (Clark *et al*., 2001; Gallienne *et al*., 2001; Gaard *et al*., 2008; Opdal *et al*., 2008; Sutton *et al*., 2008,) biological production and biomass in the pelagial and benthal (see e.g. Gislasson *et al.,* 2008, Opdal *et al.,* 2008, Pierrot-Bults 2008, Younbluth *et al.,* 2008). Due to the influence of the subpolar front on the ecosystem, Heger *et al.,* (2008) saw indications for the region near the Charlie-Gibbs Fracture Zone to be distinct from the areas north and south of the frontal zone on the ridge.

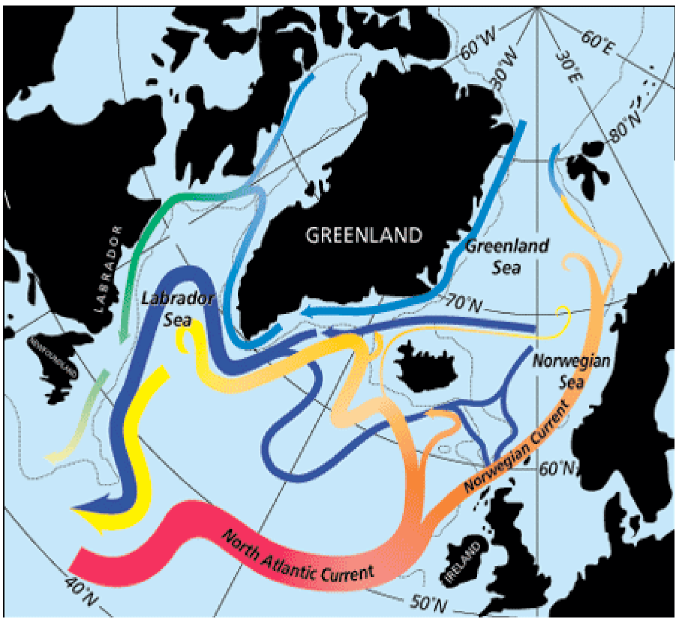

Figure 3. *Pathways associated with the transformation of warm subtropical waters into colder subpolar and polar waters in the northern North Atlantic. Along the subpolar gyre pathway the red to yellow transition indicates the cooling to Labrador Sea Water, which flows back to the subtropical gyre in the west as an intermediate depth current (yellow). Credit: ©Jack Cook, Woods Hole OI*

http://www.nasa.gov/centers/goddard/images/content/95324main_v39n2-ccartneycurry1en.gif

Only over the last 5 years, substantial new discoveries and new knowledge on the ecosystems of the northern part of Mid-Atlantic Ridge within the OSPAR Maritime area have started to fill up the blank pages of our understanding of this remote area. This is due to a cooperative, multinational, large scale investigation programme focusing on ‘Patterns and Processes of the Ecosystem of the Northern mid-Atlantic’, acronym MarEco, as part of the global Census of Marine Life Initiative (Bergstad *et al*., 2008a, duration until end 2010). Many scientific papers have been published in the years since the project’s inception that span ecological zones and taxonomic ranges in particular in 3 focal areas, one of these being the Charlie-Gibbs Fracture Zone area (see Fig. 4 and Scientific Value criterion for a full description) (Bergstad *et al*., 2008a). Numerous new species have been discovered, information has been derived that has allowed taxonomic revisions, and species that were not known to exist in this region have been uncovered (Gebruk *et al*., 2008). Despite the numerous publications the information remains preliminary and represents a first look at the Mid-Atlantic Ridge. Further field campaigns, such as the UK research programme EcoMar (http://www.oceanlab.abdn.ac.uk/ecomar) are ongoing, and more publications will follow (Bergstad *et al*., 2008a). Much of the information used in this proposal is from recently published papers by scientists involved in the MarEco project.

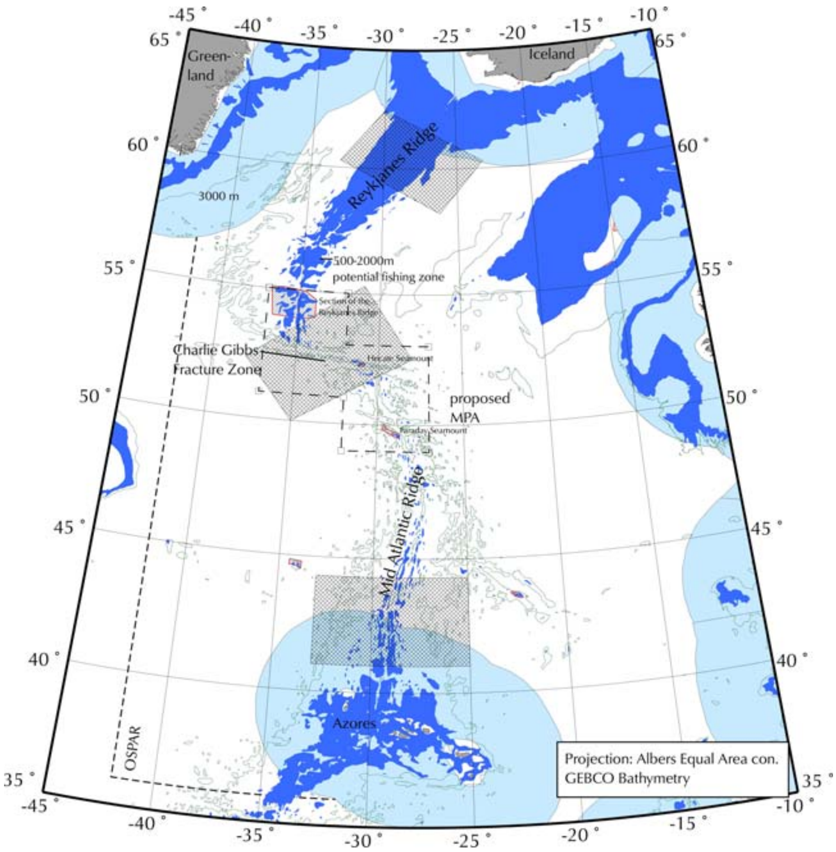

Figure 4. *The MarEco Study area on the Mid-Atlantic Ridge, the three sub-areas selected for focused investigations shown as hatched area.* (source: MarEco)

Bathymetry

For the benefit of the MarEco project and other users, the bathymetry of the Mid-Atlantic Ridge (between Iceland and the Azores) has been compiled from all publicly available sources until 2004 and updated with the results of modern mapping techniques employed during the cruises (by B. J. Murton, National Oceanography Centre, Southampton, UK)

http://www.mar-eco.no/sci/bibliographies_and_background_papers/regional_bathymetry_for_the_mar .

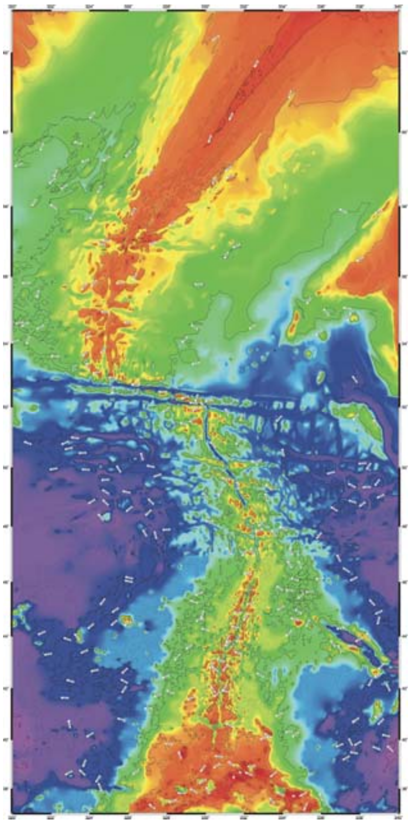

***Figure 5.** One of the bathymetric maps produced in the MarEco Project (source: www.mareco.no, Murton unpublished). Elevations in red. The Charlie-Gibbs Fracture Zone is clearly indicated as the blue east-west trench in the middle of the figure.*

Pelagic system

The pelagic productivity of the northern part of the Mid-Atlantic Ridge (Reykjanes Ridge) and nearby areas (Irminger Sea and Iceland Basin), which form a part of the offshore North Atlantic Ocean, is considered to be very high (Gjøsæter & Kawaguchi, 1980; Magnusson, 1996), in particular when compared to the region north of the Azores (*i.e.* Longhurst 1998). More or less continuous **deep-scattering layers** exist in the area (mostly at 300–800 m depth) consisting of a great variety of organisms, including a large stock size of the commercially important pelagic redfish, *Sebastes mentella* (Travin, 1951; Magnusson, 1996; Anonymous, 1999; Sigurdsson *et al.*, 2002; Anderson *et al.*, 2005; Gislason *et al.*, 2007). Abundant taxa in these layers are, for example, fishes belonging to the family of Myctophidae and various species of shrimps, euphausiids, cephalopods and medusae (Magnusson, 1996).

Zooplankton (mainly copepods) is a very important part of the diet of small mesopelagic oceanic fish (Mauchline & Gordon, 1983; Roe & Badcock, 1984; Sameoto, 1988). The *Sebastes mentella* stock also mainly feeds on zooplankton, of which euphausiids, chaetognaths, amphipods and gastropods are most important. Myctophids also form a part of their diet, although in much smaller quantities than the zooplankton (Magnusson & Magnusson, 1995; Petursdottir *et al.,* 2008). Petursdottir *et al.,* (2008) found this pattern confirmed in their 2003/4 investigations. Further up the food web, the abundance and biomass of deep demersal fishes showed a mid-water maximum near the summit of the ridge (Bergstad *et al.,* 2008), coinciding with the maximal deep-pelagic fish biomass, their prey, as reported by Sutton *et al.,* (2008).

The dominant **zooplanktonic** organisms occurring throughout the water column were crustaceans, ctenophores, siphonophores, appendicularians, medusae and chaetognaths (Vinogradov, 2005, Gaard *et al.,* 2008, Stemman *et al.,* 2008, Youngbluth *et al.,* 2008). The boreal copepod species *Calanus finmarchicus* is one of the most important components of the zooplankton in the North Atlantic as it is at the basis of one major food pathway in the pelagic ecosystem through to small mesopelagic fish and shrimp (Petursdottir *et al.,* 2008) and baleen whales (Skov *et al.,* 2008). The copepod directly transfers the energy taken up by feeding into egg production which is therefore used as an indicator of pelagic productivity. Nowhere along the Mid-Atlantic Ridge were the egg production rates higher than in the Charlie-Gibbs Fracture Zone and subpolar front (Gislason *et al.,* 2008). The subpolar front acts as a biogeographic boundary for several species, reflecting vertically and horizontally the different water masses and this is also clearly reflected in the zooplankton community structure north and south of Charlie-Gibbs Fracture Zone (Hosia *et al.,* 2008, Gaard *et al.,* 2008, Stemmann *et al.,* 2008). Topographically-induced aggregation mechanisms may play a crucial role in creating a suitable habitat for plankton feeders (Skov *et al.,* 2008).

Fock & John (2006) indicate a strong relationship between the **larval fish** community and hydrography and topography, species richness being highest on the Mid-Atlantic Ridge proper and lowest in the adjacent Irminger Sea. Contrary to the adjacent basins, the distribution of fish larvae was shallower over the Mid-Atlantic Ridge, indicating that the Ridge does exert a measurable effect even on pelagic fauna.

Approximately 53 species of **cephalopods** were found, representing 43 genera in 29 families. As with many taxonomic groups north-south differences were apparent in the cephalopod fauna. For example, two different squid species, *Gonatus* spp.and *Heteroteuthis dispar* occurred north/within and south of the frontal zone, respectively. The highest number of species was collected in the southern sampling area (see Fig 6). Conversely, the maximum overall abundance (number collected per trawl) came from farther north, especially from the middle-box transect located south-east of the Charlie-Gibbs Fracture Zone. Five of the ten most commonly collected cephalopod taxa were cirrate octopods. These large animals appear to be an important component of the benthopelagic and deep bathypelagic nekton in MAR ecosystems (Piatkowski *et al.,* 2006).

Sigur∂sson *et al.,* (2002) identified a total of 99 species of **pelagic fish** from 43 families which group into 5 main assemblages from trawl-acoustic redfish surveys south of Iceland. From the acoustic surveys it is evident that the deep scattering layer formed by among other things deep pelagic fishes is most dense over the northern Mid-Atlantic Ridge (Figure 6). Both, the latitudinal and the cross-ridge patterns were confirmed by Opdal *et al.,*(2008), who observed a maximum of backscatter just south of the CGFZ related to meso- and bathypelagic fish biomass, and likely related to elevated primary productivity in the frontal zone.

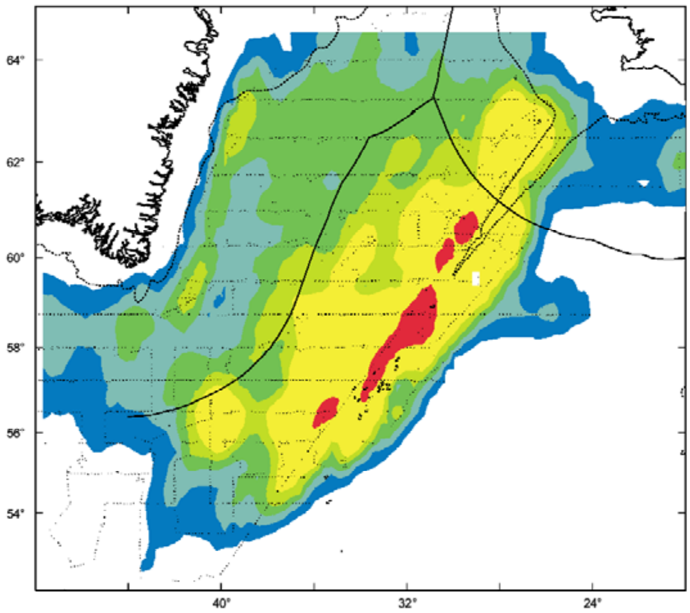

Figure 6. *Deep scattering layer of pelagic fish except redfish (red shows highest concentration) over the northern Mid-Atlantic Ridge, north of 56° N (June-July 2001). Source: Sigur∂sson et al. (2002, his Fig. 3).*

Altogether 13 species of **cetaceans**, with 1433 individuals were observed along the entire section of the Mid-Atlantic Ridge studied during the MarEco cruise (Skov *et al.,* 2008). About half of the individuals (727) belonged to 7 species of dolphins (Doksaeter *et al.,* 2008): Two of the four most frequently observed species (pilot whale *Globicephala melas*, white-sided dolphin *Lagenorhynchus acutus*), occurred only north of the Charlie-Gibbs Fracture Zone, the other two species (common dophin *Delphinus delphis*), and striped dolphins *Stenella coeruleoalba*) were found in the warmer, more saline water south of the Charlie-Gibbs Fracture Zone. Dolphins tended to aggregate over the slope of the ridge, independent of water depth, following the distribution of their most important prey, various species of mesopelagic fishes and squid.

The ecosystem associated with the Mid-Atlantic Ridge seems to be of particular importance to sei (*Balaenoptera boralis*) and sperm whales (*Physeter macrocephalus*). The highest aggregations of baleen whales and especially sei whales (*B. boralis*) were observed north of and in relation to the CGFZ, which overlaps with earlier observations of Sigurjónsson *et al.,* (1991, in Skov *et al.,* 2008). *B. boralis* in particular were most abundant over the slopes of steep seamounts and rises in water depths between 1500 and 3000 m, whereas *P. macrocephalus* were most common in waters shallower than 2000 m and often seen above high rising seamounts where they presumably found the best feeding conditions, *i.e.* the highest squid density (Nøttestad *et al.,* 2005).

The MarEco cruise provided a snapshot of **seabird** distribution along the Mid-Atlantic Ridge in summer 2004: 22 species of seabirds were identified, however only the northern fulmar (*Fulmarus glacialis*), great shearwater (*Puffinus gravis*) and Cory´s shearwater (*Calonectris diomedea*) were observed by the hundreds. The distribution of these species reflects the 3 broad characters of water masses in the area (from Mar-Eco cruise report Nøttestad *et al.,* 2004) and in particular the boundary effect of the frontal zone and the limited nesting sites available only on the Azores and Iceland (Skov *et al.,* 1994). *F. glacialis* were distributed along most of the study transect north of 47° N, and they were by far the most common species of seabird along the central and northern parts of the Mid-Atlantic Ridge. Densities were generally below 1 bird per km^2, and no large-scale concentrations were noted. However, discrete elevations in densities were recorded both in the Reykjanes and the Charlie-Gibbs Fracture Zone regions. *P. gravis* were observed only in the vicinity of the subpolar front just north of the Charlie-Gibbs Fracture Zone. Most of the birds recorded were found in the area of the subpolar front, where concentrations of both sitting and flying birds were observed. The largest flock seen was of 160 birds, but flock sizes were generally between 3 and 10 birds. Outside the frontal area *P. gravis* were mainly seen in singles. *C. diomedea* on the other hand is found only south of the *P. gravis* distribution area – usually not in flocks except for an area where warm Gulf Stream water surfaced. *C. diomedea* were commonly observed with cetaceans, most notably dolphins, but also with other species, *e.g.* sperm whales.

There is only anecdotal evidence on the observation of **sea turtles** over the Mid-Atlantic Ridge (Skov, pers.com), in particular enhanced abundances over the Charlie-Gibbs Fracture Zone and subpolar front regions (see Threatened/Declining Species and Habitats criterion B.a.1. below for more information.

Benthic system

Ridges like the Mid-Atlantic Ridge provide a large variety of benthic habitats. The hard bottom areas are often colonised by erect megafauna such as gorgonians, sponges, hydroids, and black corals (Grigg, 1997). Mortensen *et al.,* (2008) presume that to a large degree, the topography of the seabed controls the distribution of habitats along the Mid-Atlantic Ridge by providing different settings for sedimentation and retention of particulate matter. They found this illustrated by the accumulation of coral rubble near the bases of volcanic ledges, and deposits of pteropod shells on level sandy bottom some tens of metres away from rocky obstructions where currents will not sweep the light shells away.

The topography also controls the current patterns and velocity (Genin *et al.*, 1986), and hence the transport rate and concentration of food particle for suspension feeders. For the benthic fauna, the Mid-Atlantic Ridge is a major barrier for east-west dispersal (see *e.g.* Mironov & Gebruk 2002, 2006). Gebruk *et al.,* (2006) noted that in particular in the area south of the Charlie-Gibbs Fracture Zone 48% of the 150 identified species occurred only to the west of the ridge, whereas 19% of the species were restricted to the eastern Atlantic. Likewise, the Charlie-Gibbs Fracture Zone acts as a barrier in north-south direction: The areas south and north of the Charlie-Gibbs Fracture Zone share only 27% of the species (of the groups used as indicators). Due to the transition of water masses at 800-1000m depth there is also a vertical zonation of the bathyal fauna. Comprehensive sponge grounds are known to occur off south Iceland, especially on the Reykjanes Ridge (Klitgaard & Tendal 2004). *In situ* observations revealed that clumped patterns of distribution were the rule for soft-bottomed features in sediment-filled areas and for sessile organisms in rocky areas (Felley *et al.,* 2008).

Cold water corals

The Reykjanes Ridge south of Iceland is an area where cold-water corals *(L. pertusa, M. oculata, S. variabilis)* are frequently dredged (Copley *et al.,* 1996). In Icelandic waters, most of the existing coral areas are found on the shelf slope and on the Reykjanes Ridge. In some of the shelf areas off south Iceland remains of trawl nets and trawl marks were observed, providing evidence of the effects of trawling activities (ICES ACE 2005). Until the MarEco project cruise (2004), the coral records mainly came from the upper ridge at depths of less than 1000 m (ICES ACE 2005). Video inspections in the areas south and north of the Charlie-Gibbs Fracture Zone found cold water corals at all sites, at depths of 772-2355 m, most commonly between 800 and 1400 m. 27 of the 40 coral taxa were octocorals among which the gorgonacea were the most diverse (Mortensen *et al.,* 2008). Molodtsova *et al.,* (2008) found very little overlap in species composition of the coral fauna in the sampling areas north, near and south of the CGFZ. Mortensen *et al.,* (2008) observed four of the coral taxa only in the Charlie-Gibbs Fracture Zone area. Otter trawls sampling at 826-3510 m depth came up with a bycatch of 10 coral taxa, and also the longlining experiments (433- 4200 m depth) brought up 11 coral taxa.

Lophelia pertusa and *Solenosmilia variabilis* were found to act as the main structure corals, probably *Solenosmilia* was most common in the deeper parts of the study areas. All *Lophelia/Solenosmilia* colonies were relatively small with a maximum diameter of less than 0.5 m. *Lophelia/Solenosmilia* were most common on the video of the north and central sample sites, but rare on video of the southern site. The video observations indicated that the diversity of corals is higher in the southern than the middle and northern study areas. Bycatch of corals was recorded in bottom trawl and on longline from all areas, but most species were caught in the southern area. (Mortensen *et al.,* 2008). The number of megafaunal species was higher in areas where corals dominated compared to areas without coral. Typical taxa that co-occurred with Lophelia were crinoids, certain sponges, the bivalve *Acesta excavata*, and squat lobster (Mortensen *et al.,* 2008).

Mortensen *et al., (*2008) found that rubble from scleractinian corals can be a pronounced feature of the habitat on the tops of seamounts, and may represent an important habitat for various attached and cryptic invertebrate species. No conclusive answer is possible on the likely cause of the disintegration of the corals, which may be an accumulation of naturally degraded scleractinian corals over long periods. It may, however, also have been caused by human impact, though no signs of trawling were found. The video inspections of the seafloor revealed lost fishing gear in several places (Mortensen *et al.,* 2008, see also Dyb & Bergstad 2004) which, given the very few stations sampled, may point to a very high number of lost gear potentially ghost-fishing for a long time. This leads to the conclusion that extensive longlining activities may have led also to substantial coral bycatch.

Demersal (benthopelagic) fish fauna

The actual number of demersal fish species depends on the fishing gear used and the definition of "demersal" employed. In a review, Bergstad *et al.,* (2008) estimate some 80 demersal fish species to occur on the northern MAR between Iceland and the Azores. The biogeography of the seamount-related fish fauna of the North Atlantic, caught mainly as bycatch in roundnose grenadier (*Coryphaenoides rupestres*) and alfonsino (*Beryx splendens*) trawls down to 1500 m depth in over 20 years of commercial exploitation by Russian fisheries is described by Kukuev (2004). He accounts for 68 species of mainly mesobenthopelagic bathyal fishes associated to the seamounts of the northern MAR (45-55° N, *i.e.* within the proposed marine protected area), including 44 species of deepwater sharks such as Chlamydoselachidae, Pseudotriakidae, Scyliorinidae and Squalidae, including Leafscale gulper shark (*Centrophorus squamosus*), Gulper shark (*C. granulosus*) and Portuguese dogfish (*Centroscymnus coelepis*)[9].

The biogeographic divide at the Charlie-Gibbs Fracture Zone is also evident in the distribution of commercially relevant deepwater fish (Hareide & Garnes 2001, Shibanov *et al.,* 2002): North of 52° N[10], sub-Arctic species such as giant redfish (*Sebastes marinus)*, tusk (*Brosme brosme*) and Greenland halibut (*Reinhardtius hippoglossoides*) are dominant in longline catches. The largest catches of Greenland halibut were made on and in the vicinity of coral reefs at approximately 1600 m depth; catches were extremely small in coral-free areas. In the southern part (south of 48° N), subtropical species such as golden eye perch (*Beryx splendens*) and cardinal fish (*Epigonus telescopus*) are the dominant species. The area between 48 and 52° N is a region of faunal change with species mixtures according to the species-specific distribution limits. The authors observed that all along the investigation area (43 – 61° N) there was always one dominant species forming dense schools close to the top of seamounts: In the north, this is redfish (*Sebastes marinus*), between 53 and 46° N this niche is taken by roundnose grenadier (*Coryphaenoides rupestris*) and south of 46° N by goldeneye perch (*Beryx splendens*). The authors report the quick exhaustion[11] of redfish and alfonsino when commercially fished in the early 1990s and speculate about a changing balance between the species of the fish community. King *et al.,* (2006) confirm the biogeographic zones, however emphasize the importance of the Charlie-Gibbs Fracture Zone and the subpolar front for the location of the split between northern and transitional communities.

The demersal fish species, in particular those of commercial interest like redfish, alfonsino, roundnose grenadier and orange roughy are not evenly distributed within their respective biogeographic focal area on the Mid-Atlantic Ridge. Rather, all these species form temporal aggregations for mating and spawning over the summits and/or flanks of seamounts and the peaks of the MAR, respectively. Figure 7 composed by Shivanov *et al.,* (2002) illustrates the interaction between seamount topography, hydrography and the aggregation of roundnose grenadiers in an area near the CGFZ. Fishing on these aggregations therefore exploits otherwise low overall population densities of these species and may lead to overexploitation, in particular in combination with serial depletion of individual fishing sites.

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9 These three shark species have been included in the OSPAR List of threatened and/or declining species and habitats by OSPAR 2008.

10 Including the area on the Reykjanes Ridge and Hecate Seamount closed by NEAFC since 2004.

11 1 year of longlining on *Sebaste marinus*, 2 years of *Beryx splendens* fishery.

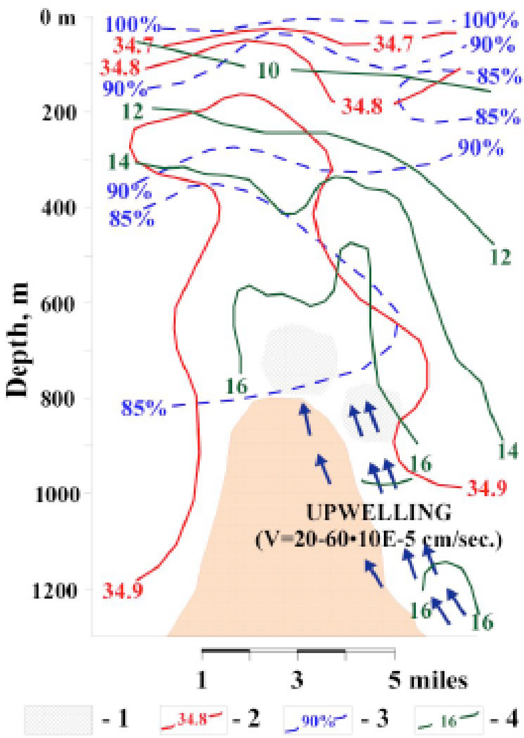

Figure 7. *The distribution of roundnose grenadier (1-hatched) in relation to environmental parameters (2-salinity, 3-dissolved oxygen, 4-biogenes in meg at/l) and the seamount peak and slope in the area of the CGFZ at 53° N (Shibanov et al. 2002)*

In particular Russian fisheries research (*i.e.* Vinnichenko 2002 and literature therein), but also other recent scientific investigations (*i.e.* Hareide & Garnes 2001, Bergstad *et al.,* 2008, Fossen *et al.,* 2008, Sotton *et al.,* 2008) demonstrate that the overall abundance of potentially commercially relevant fish stocks on the seamounts of the MAR is rather low. It is assumed that most fish species on the seamounts form local groupings, which means that there is only a limited genetic exchange between the local populations. Vinnichenko (2002) concluded, "*Investigations and fishery indicate a high vulnerability of fish populations inhabiting the seamounts. These stocks are comparatively low and highly susceptible to overfishing. This is particularly true for deepwater species with a retarded maturation and low fecundity*".

Since 1998, ICES ACFM has continuously advised the North-East Atlantic Fisheries Commission and the European Commission on a strict regulation (in 2000 even on the temporary cessation) of deepwater fisheries. In 2001, ICES ranked deepwater fishes, mostly demersal species, with regards to their vulnerability, based on their longevity, growth, natural mortality, fecundity and length and age at first maturity. The deepwater sqalid sharks *Centroscymnus coelolepis* and *Centrophorus squamosus*, together with orange roughy (*Hoplostethus atlanticus*) came out as by far the most vulnerable. Roundnose grenadier (*Coryphaenoides rupestres*), redfish (Sebastes spp.) and Greenland halibut (*R. hippoglossoides*) were considered the next most vulnerable species (ICES ACFM 2001, advice to EC and NEAFC).

B. Selection criteria

1. Ecological criteria/considerations

1.1 Threatened and/or declining species and habitats

(The area is important for species, habitats/biotopes and ecological processes that appear to be under immediate threat or subject to rapid decline as identified by the ongoing OSPAR (Texel-Faial) selection process.)

The following species and habitats on the OSPAR List of Threatened and/or Declining Species and Habitats (Reference Number: 2008-06) occur within the boundaries proposed for the MPA:

SPECIES SCIENTIFIC NAME	COMMON NAME		OSPAR Regions where the species occurs	OSPAR Regions where the species is under threat and/or in decline
	English	French		
**Hoplostethus atlanticus* (Collett, 1889)	Orange roughy	*hoplostète orange*	I, V	All where it occurs
Centroscymnus coelolepis	Portuguese dogfish	Pailona commun	All	All where it occurs
Centrophorus granulosus	Gulper shark	Squale-chagrin commun	IV, V	All where it occurs
Centrophorus squamosus	Leafscale gulper shark	Petit squale	All	All where it occurs
Dermochelys coriacea (Vandelli, 1761)	Leatherback turtle	*tortue luth*	All	All where it occurs
Balaenoptera musculus (Linnæus, 1758)	Blue whale	*baleine bleue*	All	All where it occurs

HABITATS	OSPAR region where habitat occurs	OSPAR region where such habitats are under threat and/or decline
Deep-sea sponge aggregations	I, III, IV, V	All where they occur
Lophelia pertusa reefs	All	All where they occur
Seamounts	I, IV, V	All where they occur
Coral garden	I, II, III, IV, V	All where they occur

Importance of the proposed area to the species on the OSPAR List:

All of the above mentioned species and habitats occur in the area of the CGFZ, however, there is insufficient knowledge to prove the special importance of the MAR section proposed to the life and success of populations and communities. The state of knowledge is summarised below:

***Hoplostethus atlanticus* (Orange roughy)**

ICES (2002) considers orange roughy to be one of the most sensitive deepwater fish species due to its life history traits. The main threat to the species is from fishing, though the dependence of the overall populations on the exploited temporal aggregations of the species is still unclear. With the genetic techniques of today, no significant differentiation between orange roughy from the Atlantic or Pacific can be established (Smith 2006). However, adults are assumed to migrate no more than 200 km to their spawning site (Francis & Clark 1998), and given the weak dispersal potential of orange roughy recruits (the pelagic eggs sink and hatch near the bottom (Zeldis *et al.*, 1994), Smith (2006) suggests that only a limited gene exchange may take place between ecologically distinct population units (Smith *et al.,* 2001, Smith 2006), possibly depending globally on exchange via stepping stones across the oceans (Elliott *et al.,* 1994).

Currently a project seeking to unravel population connectivity of selected deepwater species is underway (DEECON, see http://www.imr.no/deecon/home).

Orange roughy is considered to be an obligate seamount associated fish, depending on the seamount topography-induced hydrographic patterns for spawning aggregations and spawning. This category of fish has the highest vulnerability to fishing (Morato *et al.,* 2006, Morato & Clark 2007). On the MAR, orange roughy was taken as a bycatch in the fisheries for roundnose grenadier and alfonsino since the 1970s (Shibanov *et al.,* 2002), but a directed fishery for this species in the North Atlantic did not develop until the 1990s, primarily by one to a few boats from the Faroese Islands. In 1992, the Faroe Islands began a series of exploratory cruises for orange roughy, exploitable concentrations being found in late 1994 (annual catch 260 t) and early 1995 (1040 t), mostly on the MAR. The fishery took place on five features on the MAR and Hatton Bank. Catches peaked in 1996 at 1320 t, and since then have generally been less than 500 t (ICES, 2006, and Clark *et al.,* 2007 and literature therein).

The extent to which Orange roughy has been targeted in the area proposed remains unknown (Hareide & Garnes, 2001). Today, the fishery is regulated by NEAFC (see measures 2008).

Leatherback Turtle (Dermochelys coriacea)

The Leatherback turtle occurs in the region and feeds primarily on gelatinous zooplankton (Hays *et al.,* 2006; Doyle, 2007), high concentrations of which have been recorded several times around the Charlie-Gibbs Fracture Zone and subpolar front (Fock *et al.,* 2004; Youngbluth *et al.,* 2008). This species of turtle can be found foraging at oceanic fronts during their long trans-Atlantic migrations (Eckert, 2006). One study has tracked individuals to the subpolar front area of the North-East Atlantic, presumably to feed in this plankton rich environment (Ferraroli *et al.,* 2004; Hays *et al.,* 2004). It is probable therefore, that this species of turtle visits the proposed area to feed (see Sensitivity criterion also).

Blue Whale (Balaenoptera musculus)

Blue whales are roaming all oceans. As plankton feeders, they particularly depend on zones of rich plankton production during their migrations. Blue whales are known to occur along the north Mid-Atlantic Ridge from old whaling log books (Reeves *et al.*, 2004). They were sighted in the vicinity of the Mid-Atlantic Ridge during the MAR-ECO (Doksæter *et al.,* 2008). It is likely that blue whales spend some time in the subpolar frontal area with its increased pelagic biomass (Opdal *et al.*, 2008) as the sei whale does (Doksæter *et al.,* 2008; Skov *et al.,* 2008). Tagging experiments showed that sei whales migrate directly from the Azores to the CGFZ (Olsen *et al.,* 2005; Skov *et al.*, 2008) (see Ecological Significance criterion; Skov *et al.,* 2008).

Deepwater sharks

Detailed studies of seamount ichthyofauna, even in the relatively well-investigated northern Atlantic Ocean, are only thirty years old (Kukuev, 2004). The ichthyofauna sampled by Kukuev (2004) consisted of approximately 20 elasmobranch species including Leafscale gulper shark (*C. squamosus*), Gulper shark (C. granulosus) and the Portuguese dogfish (*C. coelolepis*). The ICES Working Group of Elasmobranch Fisheries (WGEF) considers the elasmobranch fauna of the MAR to be poorly understood (ICES, 2007b).

Deep-water sharks are caught in several mixed trawl fisheries and directed long-line and gillnet fisheries in the North-East Atlantic (ICES, 2007b). Of the deepwater sharks, *C. squamosus* and *C. coelolepis* are the commercially most important species in the North-East Atlantic (ICES, 2007b). *C.*

squamosus and *C. coelolepis* stocks on the northern Mid-Atlantic Ridge are considered to be depleted (ICES, 2007b) although the species found here are likely to have been little exploited in comparison to continental Europe and the whole ecoregion is considered to be a sensitive area (ICES, 2007b). In 2005 ICES advised a zero catch limit for both species in the entire ICES area (the North-East Atlantic) (Kyne & Simpfendorfer, 2007). As the quotas for these two species of deepwater sharks and others become more restrictive it is likely that there will be increased discarding of them as they are caught as bycatch in other fisheries (ICES, 2007b). Illegal, unreported and unregulated fishing is also known to take place for deepwater sharks especially in international waters (ICES, 2007b). Given the bycatch problem, and the vulnerability of deepwater sharks (see below B.2.), there is an urgent need to establish deepwater refuges from fishing.

Deepwater sponge aggregations

The sponge fauna of the proposed area is poorly known. However, video dives and sampling in the proposed area revealed rich hexactinellid sponge communities or ‘gardens’ around the Charlie-Gibbs Fracture Zone and the associated seamounts down to 3000 m depth, and depending more on the availability of hard substrate than depth (Felley *et al.,* 2008; ICES, 2007a; Tabachnick & Collins, 2008).

Beds of large demosponges (up to 70 cm in diameter) occur widely distributed in patches in the North-East Atlantic, often slightly deeper than the coral banks (Klitgaard & Tendal 2004). These authors showed in their review that large, structural sponges are known from the Reykjanes Ridge south to at least 60° N. There was no sampling further south, however it can be assumed that the potential distribution area of the boreal type of deepwater sponge beds extends further south (Fosså 2005). The associated fauna (about 250 species) poses the same possiblilities and problems as in the case of corals, but hitherto only one area has been investigated in detail (Klitgaard 1995). In particular young redfish (Sebastes spp.) is known to seek shelter in sponge beds which is why many of the sponge bed occurrences known stem from fishermens’ records.

ICES (2007a) considers structural sponge habitat as being *"extremely vulnerable to commercial trawling suffering immediate declines through direct removal of sponges and further reductions in population densities of sponges due to delayed mortality (Freese, 2001"*).

***Lophelia pertusa* reefs**

One of the preconditions for scleractinian corals like *Lophelia pertusa* to grow is hard substrate. Overall hard bottom is scarce in the world oceans and only usually steep-sided seamounts and the mid ocean ridges provide for substantial hard substrate in the overall sedimentary ocean basins. The MAR is therefore a very important habitat and stepping stone for the regional dispersal of hard bottom dwelling suspension feeders. Depending therefore on the local topography and topographically induced hydrography, as well as the general level of surface production and sedimentation (food concentration and value), a more or less dense coral fauna develops. On the MAR sections investigated by Mortensen *et al.,* (2008), living *Lophelia pertusa and* 40 taxa of other corals have been observed at all depths and locations surveyed although not in the extensive reef-type structures found off the coast of Norway (Hall-Spencer *et al.,* 2002). Mortensen *et al.,*(2008) state that the observed species richness of corals on the Mid-Atlantic Ridge was comparable with other regions of the North Atlantic, however because of uncertainties with visual identifications it was suggested that the species richness of corals on the Ridge is higher than in high latitude areas of the continental margin.

Coral Gardens

There is no agreement yet as to what will constitute a coral garden in a remote area like the MAR. However, the richness in ecological niches provided by the MAR topographic structure is also favourable for octocorals constituting 27 of the 40 taxa recorded (Mortensen *et al.,* 2008).

Seamounts

Seamounts as a "habitat" on the OSPAR List is a substitute for the range of habitats seamounts provide vertically and horizontally not only to benthic fauna, but also functionally up the food web and to migratory species (see Pitcher *et al.,* 2007). As such seamounts are similar to the MAR, which is basically a chain of more or less high mountains, intercepted by meridional or transversal valleys. Usually, seamounts are considered to be isolated features of >1000 m elevation (see *e.g.* ICES 2006) whereas the elevations on the ridge are more like peaks of a mountain chain. Nonetheless, the summit areas of these elevations are usually very steep-sided, provide substantial exposed hard substrate and generate special topographically-induced hydrographic conditions with enhanced current speed and eventually particular current patterns. The ecological importance of these features is illustrated in the justifications above and below for a broad range of species and communities, most of these, though for different reasons, being more abundant on the MAR than in adjacent areas.

All of the commercially most relevant demersal fish species are fished while aggregating over the flanks and/or summits of seamounts and the MAR peaks, respectively (see Part A.9). Therefore the MAR provides the most extensive habitat for the reproduction of these aggregation-forming deepwater fish species off the continental shelves in the OSPAR maritime area.

1.2 Important species and habitats

(*The area is important for species, habitats/biotopes and ecological processes as identified by the ongoing OSPAR (Texel-Faial) selection process*)

As noted above, the proposed area includes deep-sea sponge aggregations and seamount habitats listed by OSPAR in 2003 as priority threatened or declining habitats (OSPAR Commission 2008). These cold-water coral and sponge habitats would qualify as Vulnerable Marine Ecosystems in relation to high seas fisheries according to draft criteria developed by FAO (FAO 2007, Rogers *et al.,* 2008). The area also contains seamount communities, coral and sponge aggregations, a frontal area (the subpolar front) and potential areas of upwelling among the habitats listed as examples of ecologically or biological significant marine areas according to draft criteria developed by the CBD for identifying candidate sites for protection on the high seas (UNEP 2007).

Additionally the Mid-Atlantic Ridge in general provides the only extensive hard substrate available for propagation of benthic suspension feeders off the continental shelves and the isolated seamounts. The northern MAR is considered to be a major reproduction area of *i.e.* roundnose grenadier (*Coryphaenoides rupestris*, see *e.g.*Vinnichenco & Khlivnoy 2004), and may be crucial for the reproduction of bathypelagic fish (Sutton *et al.,* 2008). Fock & John (2004) clearly demonstrated the influence of the MAR on fish larval vertical and horizontal distribution and a peak in species richness, reflecting the pattern of adult mesopelagic fish distribution on and off the ridge. The number of species that were recorded by Kukuev (2004) over the seamounts of the northern Mid-Atlantic Ridge was higher than the numbers recorded for the Corner Rise Mounts (34° – 35° N, 48° to 52° W) and the same as on the seamounts near Rockall (56° to 59° N, 13° to 18° W).

Elasmobranchs

Kukuev (2004) recorded approximately 20 elasmobranch species as a bycatch of the Russian roundnose grenadier trawling on the MAR, including frilled shark (*Chlamydoselachus anguineus*), Greenland shark (*Somniosus microcephalus*), leafscale gulper shark (*Centrophorus squamosus*), great lanternshark (*Etmopterus princeps*) and the Portuguese dogfish (*Centroscymnus coelolepis*), all of which have been described by Froese & Pauly (2007) as having very low resilience to population reductions by fishing.

Chondrichthyan fishes, including deepwater sharks, are K-selected species, having life history characteristics that include slow growth, late maturity and a low reproductive output (Kyne & Simpfendorfer, 2007). With a few exceptions, like *C. coelolepis,* which was recorded down to 3700 m, sharks are confined to the high energy regions of the upper 2500 m of the oceans (Priede *et al.,* 2006 and literature therein): They conclude that due to high energy requirements, sharks are apparently confined to *ca*. 30% of the total ocean and distribution of many species is fragmented around seamounts, ocean ridges and ocean margins, particular conspicuous on slopes down to 2000 m where they profit from an increased food supply including from food falls such as dead whales. This indicates that the Mid-Atlantic Ridge, particularly the highly productive seamount/ridge peaks and frontal zones are of particular importance to deepwater sharks – their distribution being not at all homogenous across the oceans but concentrated around high biomass zones. Therefore deepwater sharks may concentrate in areas where commercially targeted teleost species aggregate, as both taxa benefit from the same ecological patterns. Therefore, the vulnerability of deepwater sharks to overexploitation is even higher than can be deduced from their life history strategy alone. Deepwater sharks species do not have a "refuge" below fishing depth (Priede *et al.,* 2006).

1.3 Ecological significance

The area has:

a) High proportion of habitat in the OSPAR area

The proposed MPA is a significant portion of the mid-ocean ridge habitat within the OSPAR area. As a major comparatively shallow feature in the middle of the ocean away from continental slopes, the mid-ocean ridge has a special significance among the range of oceanic habitats. Within the proposed MPA the species communities change gradually from north to south. However, the Charlie-Gibbs Fracture Zone and the subpolar front represent an important barrier to this along-ridge dispersal. The proposed boundaries aim to incorporate diversity from the northern and southern communities along with the subpolar front boundary area.

b) High Natural Biological Productivity of Features being represented

Frontal systems are usually areas of increased primary production, often also of elevated biomass of phytoplankton, translating into higher biomass in the food web. The subpolar front at about 52° N is a typical high production convergence zone of subpolar and Atlantic water. It was suggested that this frontal zone between cold and warm water masses is a mixing area that provides favourable conditions for plankton growth, consequently attracting other pelagic fauna (Opdal *et al.,* 2008). (The subpolar front is not a static feature and moves latitudinal on a time scale of days, but is normally found just south of the Charlie-Gibbs Fracture Zone (Bergstad *et al.,* 2008). Therefore the boundaries of the proposed protected area were drawn to incorporate this oceanographic feature.

As a surrogate for phytoplankton biomass, surface chlorophyll a concentrations measured around the subpolar front, usually in the vicinity of the Charlie-Gibbs Fracture Zone, were found to be elevated compared to the adjacent oceanic areas (Clark *et al.*, 2001; Gallienne *et al.*, 2001; Gaard *et al.*, 2008; Opdal *et al.*, 2008; Sutton *et al.*, 2008). Opdal *et al.*, (2008) hypothesise that the latitudinal gradient in Chl a concentrations and backscatter may be an indication of different productivity patterns, finding in particular that phytoplankton abundance around the Charlie-Gibbs Fracture Zone (53 – 46° N) is significantly higher than in the northern area of the Mid-Atlantic Ridge and supports what appears to be a higher standing stock of fish.

Fock *et al.,*(2004) noted a greater abundance of gelatinous zooplankton over the Mid-Atlantic Ridge than the rest of their Atlantic sample sites, which they linked to higher primary production. Further evidence of increased faunal densities in the area of the Charlie-Gibbs Fracture Zone was also found by other scientists working on the MAR-ECO research project for a range of species: Youngbluth *et al.,*(2008) found the highest abundance of gelatinous zooplankton occurring at a depth range of 350 to 730 m in the region just south of the Charlie-Gibbs Fracture Zone; Pierrot-Bults (2008) observed a peak in abundance for chaetognath species just north of the Charlie-Gibbs Fracture Zone; Gislasson *et al.,*(2008) found a peak in copepod egg production near the subpolar front area; Heger *et al.,* (2008) recorded increased deep-sea pelagic bioluminescent activity in the water column over both the Faraday Seamounts and the subpolar front region; Opdal *et al.,* (2008) noted a pronounced maximum in the backscattering and therefore presumably fish density, in the area of the Charlie-Gibbs Fracture Zone.

The deep-pelagic ecosystem over the MAR is different from ‘typical’ open ocean regimes, at least in respect to fishes, in that there is a dramatic increase in fish biomass in the benthic boundary layer (0 to 200 metres above the seafloor) not seen in other areas (Sutton *et al.*, 2008). The reason for this difference is thought to be the enlarged bathypelagic food sources that are available in the shallower depths of the Ridge as compared to the abyssal plains (Sutton *et al.*, 2008).

The MarEco project has been extended to 2010, with future field time to be spent studying the ecological processes around the subpolar front, because of the apparent high concentrations of megafauna (Bergstad *et al.*, 2008a). Despite more research being required, today’s knowledge as reviewed here clearly indicates that the Mid-Atlantic Ridge and in particular the Charlie-Gibbs Fracture Zone and subpolar front provide important ecological processes to support an elevated autochtonous standing stock of deep-sea fauna there, as well as pelagic species.

c) Important Feeding Aggregations

The elevated plankton production at the subpolar front attracts a large number and variety of secondary consumers and top predators. Groups of feeding sperm (*Physeter macrocephalus*) and sei whales (Balenoptera borealis) were observed in areas of high zooplankton abundance (Sigurjónsson *et al.*, 1991, Skov *et al.*, 2008). Sei whales are planktivorous and it is likely that the observed aggregations are linked to the high concentration of the calanoid copepod *Calanus finmarchicus*, just north of the Charlie-Gibbs Fracture Zone (Gaard *et al.*, 2008). These observed sperm whales (*Physeter macrocephalus*) likely benefit of an elevated abundance of other elements of the food web, *e.g.* cephalopods. Several species of dolphins have also been recorded feeding along the Mid-Atlantic Ridge, and it is thought that their distribution is also influenced by prey availability (Doksæter *et al.*, 2008).

The Charlie-Gibbs Fracture zone may also be of importance to the great shearwater (*Puffinus gravis*) which was observed in highest densities in the frontal area.

1.4 High natural biological diversity

(*The area has a naturally high variety of species (in comparison to similar habitat/biotope features elsewhere) or includes a wide variety of habitats/biotopes (in comparison to similar habitat/biotope complexes elsewhere*).

The recent MarEco expeditions have reported a diverse and extensive range of taxonomic information regarding the benthos of the Mid-Atlantic Ridge in general (Bergstad & Gebruk, 2008). In this one expedition taxa have been found that are new to science, new to the geographic region and others that have contributed to taxonomic re-descriptions and revisions of known species (Gebruk *et al.*, 2008). For example, the Hexactinellid fauna of the northern Mid-Atlantic Ridge has been poorly investigated in the past. Recent work has shown that it is relatively rich, with fourteen new species described in one report and similarities being found between the fauna in the Charlie-Gibbs Fracture Zone and the fauna of the Indian Ocean and Indo-Pacific (Tabachnick & Collins, 2008).

Increased diversity was also seen in the gelatinous zooplankton of the Mid-Atlantic Ridge. Visual observations of what appeared to be undescribed species were made in submersible dives along the entire length of the Mid-Atlantic Ridge (Youngbluth *et al.*, 2008).

In comparison to adjacent abyssal plains and other studies from the North Atlantic, Sutton *et al.,*(2008) found that the deep-pelagic fish assemblage along the entire Mid-Atlantic Ridge is taxonomically diverse, with 205 species from 52 families. Between 70 and 80 deepwater benthopelagic fish species were caught by Bergstad *et al.,* (2008) during experimental trawls over the Mid-Atlantic Ridge. This sample was described by the authors as being a substantial subset of the demersal fish species listed by both Haedrich & Merrett (1988) and Kukuev (2004) for the North Atlantic deep sea. Bergstad *et al.,* (2008) were unable to statistically compare the sites along the Mid-Atlantic Ridge that they sampled due to a lack of replication. However, twelve out of the nineteen stations are within this proposed protected area.

The Charlie-Gibbs Fracture Zone marks a biogeographic boundary for numerous taxa (Bergstad *et al.*, 2008; Doksæter *et al.*, 2008; Gaard *et al.*, 2008; Sutton *et al.*, 2008) and it is an especially complex area that is likely to be home to diverse deep-sea fauna (Søiland *et al.*, 2008; Tabachnick & Collins, 2008). This proposal incorporates sections north and south of the Charlie-Gibbs Fracture Zone to allow the diversity of the species assemblages either side to benefit from protection. The diversity information now coming forward for a range of taxa documents what species occur in the area and adds to previous knowledge of ranges, habitat uses and abundance patterns. The diversity is extensive within the proposed MPA, but a full account is not yet available. Whether the proposed area has particularly high diversity is unclear, but the ranges of habitats and the inclusion of at least two faunal provinces raises the diversity above similar or smaller areas comprising fewer habitats and *e.g.* only a single province. The diversity of the Mid-Atlantic Ridge in general has been understudied, both in terms of the pelagic ecosystem (Youngbluth *et al.*, 2008) and the benthos (Tabachnick & Collins, 2008). The findings of the MarEco expedition have allowed glimpses into the structure and patterns of fauna there (Mortensen *et al.*, 2008; Opdal *et al.*, 2008) and have furthered our understanding of this important region (Gebruk *et al.*, 2008).

1.5 Representativity

(*The area contains a number of habitat/biotope types, habitat/biotope complexes, species, ecological processes or other natural characteristics that are representative for the OSPAR maritime area as a whole or for its different biogeographic regions and sub-regions*.)

The Mid-Atlantic Ridge is the only mid-ocean ridge in the OSPAR maritime region and is representative of this type of geological feature (Dinter, 2001). The area is nominated for its importance as a section of the northern Mid-Atlantic Ridge, including a major biogeographic east-west and north-south divide. The Mid-Atlantic Ridge provides the only hard substrate and relatively shallow depths in the otherwise sedimentary abyssal plains of the North Atlantic. The most recently accepted biogeographical classification of the OSPAR maritime area shows that an MPA over the Charlie-Gibbs Fracture Zone and the areas north and south will include both warm and cool-temperate pelagic waters (Dinter, 2001). In terms of the deep-sea region the whole of the Mid-Atlantic Ridge is within what is described by Dinter (2001) as the Atlantic sub region.

Fock *et al.,* (2004) found that the fish assemblages along the Mid-Atlantic Ridge were as expected for each water mass (*i.e.* representative). The deep-sea fish assemblages that have been caught over this area of the Ridge in experimental trawls are described as being 'typical' of those found in the North Atlantic (Bergstad *et al.*, 2008). In terms of benthic habitat the coral taxa observed during submersible dives performed by Mortensen *et al.,* (2008) revealed a similar species richness as seen on continental shelf areas of the OSPAR region. Felley *et al.,* (2008) described the cnidarian and sponge morphotypes observed in the Charlie-Gibbs Fracture Zone area as being characteristic of deepsea habitats.

1.6 Sensitivity

(*The area contains a high proportion of very sensitive or sensitive habitats/biotopes or species*.)

The proposed area on the Mid-Atlantic Ridge through its associated substrate, current and feeding conditions, provides a habitat to a number of particularly sensitive/vulnerable species and communities both on soft and hard substrate and in the water column. In particular deepwater species such as orange roughy (*H. atlanticus*), and biogenic habitats such as formed by cold water corals and sponges are considered vulnerable, as often fragile, and slow (if at all) to recover due to slow growth, retarded maturity, irregular reproduction and high generation length, as well as community characteristics of high diversity at low biomass. This is an adaptation to stable, low food environments. Propagation and dispersal of larvae is largely unknown and therefore little can be said about a possible recovery of either invertebrates or fishes.

Benthic Habitat

a) Site Specific Information

The most abundant and diverse order of corals in the Charlie-Gibbs Fracture Zone area was the Gorgonacea (Mortensen *et al.*, 2008). Mortensen *et al.,* (2008) observed corals on all sites on the Mid-Atlantic Ridge surveyed with ROVs at depths between 800 and 2400m, and reported a high species richness of corals with a total of 40 taxa observed. *Lophelia pertusa* was repeatedly observed on seamounts around the Charlie-Gibbs Fracture Zone, although, as noted earlier, not in the reef structures observed elsewhere (Mortensen *et al.*, 2008). Rich hexactinellid sponge communities or 'gardens' have been observed on the Mid-Atlantic Ridge around the Charlie-Gibbs Fracture Zone and the associated seamounts (Felley *et al.*, 2008; ICES, 2007a; Tabachnick & Collins, 2008).

b) General Evidence of Vulnerability/Sensitivity

Cold-water deep-sea corals and other associated sessile benthic fauna are vulnerable because they have a low capacity to recover from disturbance (Rogers *et al*., 2008). Growth rates for such structural species are slow (a few millimetres per year) and some patches of *L. pertusa* have been estimated to be 200 – 366 years old (Rogers *et al*., 2008). For the extensive *L. pertusa* reefs seen around Norway, estimates indicate they are approximately 10,000 years old (Schröder-Ritzau *et al*., 2005; Rogers *et al*., 2008). Fecundity of deep-sea corals varies and *L. pertusa* is known to have a relatively high fecundity. However most recruitment probably occurs from larvae produced near to the same site. Therefore damage to a site may have long-lasting effects on population replenishment (Le Goff-Vitry *et al*., 2004; Rogers *et al*., 2008). There is, however paucity in the information about *L. pertusa* reproduction and therefore these results may reflect just regional and sub-regional patterns.

The high financial cost of investigating the deep-sea limits our understanding of the impacts of deep-sea fishing (Hall-Spencer *et al.*, 2002). However, evidence of trawl marks in the deep-sea region (200 – 1400m depth) of the European continental margin indicates that the potential impact of towed gears on deepwater corals is high (Hall-Spencer *et al.*, 2002), as does evidence of removal of these corals from deep continental slopes by fisheries in the past (*e.g.* Joubin, 1922; Pechenik & Troyanovskii, 1971). Towed gear has had long-lasting detrimental effects on shallow biogenic reefs in European waters (Hall-Spencer & Moore, 2000) and has caused extensive damage to deepwater reefs in other parts of the world, including off the coasts of Norway, Australia, USA and Canada, among many other nations (Hall-Spencer *et al*., 2002; Roberts 2007). Fosså *et al.,* (2002) estimated that 30-50% of Norwegian Lophelia reefs had been seriously damaged or destroyed by trawls. The scars of trawl passes have been widely reported in deepwater (Roberts *et al.,* 2000, 2003 and references therein) and trawls are responsible for destroying many of the Darwin Mounds, deepwater coral habitats off the North West Coast of Scotland which were given protection from bottom trawling by the EU in 2004 (Duncan & Roberts 2001; Davies *et al.*, 2007). There is great concern over the damage, actual and potential, caused to corals that have built up over centuries and millennia (Hall-Spencer *et al.*, 2002). With growth rates for *L. pertusa* in the North Atlantic estimated as being between 2 and 25 mm yr-1, the build up of reefs is slow (Mortensen, 2001; Hall-Spencer *et al.*, 2002). As yet there is no clear evidence of recruitment of new coral individuals to sites damaged by trawling (Waller *et al.*, 2007; Rogers *et al.*, 2008). Therefore despite no large reefs being found during the MarEco expeditions it is possible that patchy damage may have already occurred decades ago if trawling activity has been ongoing since the 1970s in this region (Hareide & Garnes, 2001; ICES, 2007c).

Structural sponge habitat is also extremely vulnerable to trawling, suffering immediate declines through direct removal of sponges and further reductions in population densities due to delayed mortalities (Freese, 2001; ICES, 2007a). Experimental trawling of sponge communities in the Gulf of Alaska showed similar results to those found for coral communities. After one year no damaged sponges showed signs of repair or regrowth and there was no sign of recovery of the community (Freese *et al*., 1999).

Koslow *et al*., (2001) compared invertebrate assemblages on pristine, unexploited seamounts in Tasmanian waters with nearby seamounts that had been fished by trawlers targeting orange roughy (*H. atlanticus*). They found dense, species rich assemblages of bottom living invertebrates on unfished seamounts. By contrast, trawling operations had removed these communities from exploited seamounts. The corals and coral aggregate had been scraped off, or crushed and pulverised. Unfished seamounts supported on average twice the biomass of bottom living invertebrates and supported 46% more species per sample. The bare rock, rubble and sand characteristic of trawled seamounts were not seen on any of the unexploited seamounts. High bycatch of deepwater corals and associated organisms has also been reported from seamount fisheries for orange roughy (*H. atlanticus*) in New Zealand (Probert *et al*., 1997; Anderson & Clark 2003). Very similar findings of serious damage were made by Waller *et al.,* (2007) on the North Atlantic Corner Rise seamounts. The bare summits of trawled seamounts were in marked contrast to unfished (or at least very little fished) seamounts nearby that were rich in invertebrates and exploitable fish. The latter were virtually absent from fished peaks.

Fish Species

a) Site Specific Information

The northern Mid-Atlantic Ridge is considered to contain more than forty seamounts of commercial importance, in terms of fisheries (ICES, 2007c). The deepwater fishery along the Mid-Atlantic Ridge began in 1973 when dense concentrations of Roundnose grenadier (*C. rupestris*) were discovered (ICES, 2007c). Later concentrations of orange roughy (*H. atlanticus*), alfonsino (*B. splendens*), cardinal fish (*Epigonus telescopus*), tusk (*B. brosme*) and blue ling (*Molva dypterigia*) were also discovered (ICES, 2007c). Significant schools of C. rupestris have been observed over Hecate Seamount in the past and it is thought that they are the 'summit-living species' for this seamount (Hareide & Garnes, 2001; see ecological significance criterion for a more detailed description). The fact that they are known to school over seamounts makes them vulnerable to over-fishing (Hareide &

Garnes, 2001, Morato *et al.,* 2006, Morato & Clark 2007). Even following closure to fishing by the North East Atlantic Fisheries Commission (NEAFC), the Faraday and Antialtair seamounts were still targeted by fishermen, perhaps legally using mid-water trawls (which can still touch bottom from time to time causing damage to benthos) (ICES 2007a).

b) General Evidence of Vulnerability/Sensitivity

Many deep-sea fish species and communities are particularly susceptible to over-exploitation due to their having generally slow growth, late maturity and great longevity, and often intermittent recruitment success (Roberts, 2002; Fossen *et al*., 2008). ICES attempted to rank seamount species in order of their vulnerability to fishing based on their longevity and orange roughy (*H. atlanticus*) and roundnose grenadier (*C. rupestris*) were ranked the top two most vulnerable species, respectively (ICES, 2002). Froese & Pauly (2007) also classify both species as being highly vulnerable and having very low resilience to fishing pressure. In addition to this it is probable that based on geographical patterns the stocks of the Mid-Atlantic Ridge in general are isolated from others in the North Atlantic making them particularly vulnerable (ICES, 2007c). Devine *et al.,*(2006) studied catch data for *C. rupestris* from eastern Canada (see also Ecological Significance criterion) and concluded that if it were to be assessed by the IUCN it would be classified as critically endangered because it has experienced drastic reductions in abundance since the onset of targeted fisheries.

Black scabbardfish (*A. carbo*) is known from the bycatch of trawl fisheries on and around the Mid-Atlantic Ridge. This species is described as having low resilience and high vulnerability by Froese & Pauly (2007) and ICES (2002) (it was ranked fourth most vulnerable species by ICES). A. carbo is a valuable species of fish in markets of the UK, Ireland, northern France, Spain and in particular Portugal (Stefanni & Knutsen, 2007). It is the target of two Portuguese long-line fisheries, a long established (since the 19th century) Madeira fishery and a more recent fishery off the Portuguese mainland (Figuieredo *et al*., 2003). It reaches northern European markets primarily through the multi-species trawl fisheries of the UK and France (Figuieredo *et al*., 2003). In Madeira the specialised long-line fleet is dedicated to taking this species and it makes up 55% of their total landings (Stefanni & Knutsen, 2007). Despite the commercial interest in this species, little is known about its life cycle, information about the biology, maturity, growth and spawning of this species is scattered (Figueiredo *et al*., 203; Stefanni & Knutsen, 2007). *A. carbo* is widely distributed around the world, in the Atlantic it is found in temperate-cold waters, from Iceland to Madeira, at depths between 200 and 1800m (Figueiredo *et al*., 2003; Stefanni & Knutsen, 2007).

Sharks

a) Site Specific Information

Deepwater sharks are caught in several mixed trawl fisheries and directed long-line and gillnet fisheries in the North East Atlantic (ICES, 2007b). The most important species are the Portuguese dogfish (*Centroscymnus coelolepis*) and the Leafscale Gulper shark (*Centrophorus squamosus*) (ICES, 2007b). Both of which have been caught in experimental fishing on the seamounts of the northern Mid-Atlantic Ridge (Kukuev, 2004). Both species are migratory and are found widely distributed through the North East Atlantic and can be found on the Mid-Atlantic Ridge from Iceland to the Azores (Clarke *et al*., 2001b; Froese & Pauly, 2007; Hareide & Garnes, 2001; ICES 2007b). When surveying the seamounts of the Mid-Atlantic Ridge Kukuev (2004) identified approximately twenty species of elasmobranch (see ecological significance criterion). All of these species are described as being vulnerable and having low resilience to fishing pressure by Froese & Pauly (2007).

b) General Evidence of Vulnerability/Sensitivity

ICES intend to assess the status of deepwater sharks in its 2008 report (ICES, 2007b). Unfortunately at the time of preparing this proposal that report was unavailable, but the World Conservation Union's

Shark Specialist Group has recently assessed the threatened status of deepwater sharks globally (Kyne & Simpendorfer, 2007). It was concluded within this report that all deepwater chondrichthyan species have limited productivity and therefore should be considered as having little ability to sustain fishing pressure and be slow to recover from overfishing (Kyne & Simpendorfer, 2007). The most commercially important species in the North East Atlantic are *C. squamosus* and *C. coelolepis* (ICES, 2007b). Less than 20 years of fishing for these two species in the deep waters west of the UK has led to their depletion, to the point where a zero catch limit has been introduced, i.e. a moratorium on deepwater shark fishing (Kyne, & Simpendorfer, 2007). *C. squamosus* and *C. coelolepis* stocks on the northern Mid-Atlantic Ridge are also considered to be depleted (ICES, 2007b). As the quotas for these two species of deepwater sharks and others become more restrictive it is likely that there will be increased discarding of them as they are caught as bycatch in other fisheries (ICES, 2007b). Illegal, unreported and unregulated fishing is also known to take place for deepwater sharks especially in international waters (ICES, 2007b). Given the bycatch problem, there is therefore an urgent need to establish deepwater refuges from fishing for shark species and other vulnerable fishes.

Cetaceans

a) Site Specific Information

In total 14 species of cetaceans were observed during the MAR-ECO 2004 expedition along the Mid-Atlantic Ridge, including Blue (*Balenoptera musculus*), Fin (*Balenoptera physalus*) and Humpback (*Megaptera novaengliae*) whales (Doksæter *et al*., 2008). The most frequent whale species seen were Sperm (*Physeter macrocephalus*) and Sei (*Balaenoptera borealis*) whales, of which more than 80 individuals of each species were observed (Doksæter *et al*., 2008). Skov *et al.,*(2008) observed schools of Sperm and Sei whales feeding in the nutrient rich waters just north of the subpolar front (around the Charlie-Gibbs Fracture Zone), which overlaps with similar observations made almost a decade earlier by Sigurjónsson *et al.,*(1991). The current hypothesis is that the Mid-Atlantic Ridge is an area that whale species use as a migration corridor and the frontal zones are used as feeding areas (O.A. Bergstad, pers comm.).

The distribution of dolphin species recorded along the Mid-Atlantic Ridge during the 2004 MarEco cruise was linked to sea-surface temperature and salinity (Doksæter *et al*., 2008). The species composition of dolphins, fish, cephalopods and zooplankton changes abruptly around the Charlie-Gibbs Fracture Zone (Bergstad *et al*., 2008; Gaard *et al*., 2008; Sutton *et al*., 2008), which is more evidence that the Subpolar front acts as a distribution barrier (Doksæter *et al*., 2008). Common (*Delphinus delphis*) and striped (*Stenella coeruleoalba*) dolphins were most frequently found in the waters south of the Charlie-Gibbs Fracture Zone, whereas white-sided dolphins (*Lagenortiynchus acutus*) and, to a certain degree, pilot whales (both *Globicephala melas/macrorhynchus*) were found to the north of the Zone (Doksæter *et al*., 2008). The proposed protected area incorporates habitat areas used by all the species observed, see Figure 8.

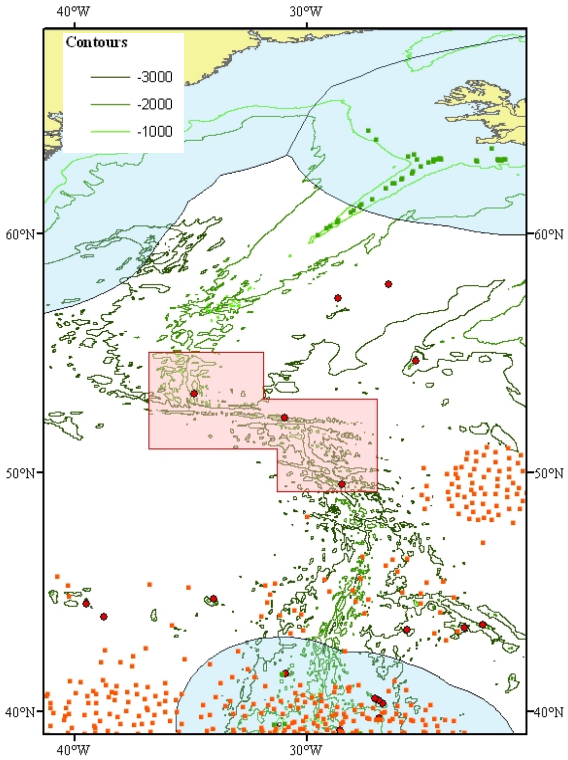

Figure 8. *Historical Sperm whale (Physeter macrocephalus) catch data around the proposed CGFZ MPA. Orange squares are recorded catch locations, red circles are known seamount locations. Data from Townsend (1935)*

b) General Evidence of Vulnerability/Sensitivity

Sperm whales have a long history of exploitation and today's population levels make them a high priority for management (Reeves *et al*., 2003). Observations made by Skov *et al.,* (2008) indicate that feeding aggregations have been observed in the Charlie-Gibbs Fracture Zone and subpolar front region. Abundances will have been much greater prior to the onset of commercial whaling. It is possible that poor recruitment may occur as a residual effect of historic whaling (Whitehead & Weilgart, 2000). Although the sperm whale is not immediately threatened, some regional populations may require close evaluation and monitoring (Whitehead *et al*., 1997). The IUCN has evaluated sperm whales in 2008. Their assessment listed them as vulnerable on the IUCN Red List (Cetacean Specialist Group, 2008).

Sei whales were classified by the IUCN as endangered in 1996, based on an estimated decline of 50% in worldwide abundances over the last three generations (Cetacean Specialist Group, 1996). This is a species that is widely distributed in temperate oceanic waters globally and was heavily exploited before gaining full protection from commercial whaling in the 1970s and 1980s (Reeves *et al*., 2003). The International Whaling Commission (IWC) recognises three stock divisions for sei whales in the North Atlantic: Nova Scotia; Iceland – Denmark Strait; and Eastern (Donovan 1991). These stocks of sei whale differ in their status. There are indications that that the Sei whales in the Iceland – Denmark Strait area is considerably better than inferred from the global perspective taken by the IUCN listing (Cattanach *et al* 1993). In the eastern North Atlantic, however, the species seems to be virtually absent now. Areas of seai whale abundance seem to shift markedly between years relative to the northern extent of the distribution, more so than for other baleen whale species (Gunnlaugsson *et al* 2004). Sei whales were observed feeding in the same areas near the subpolar front as sperm whales (Skov *et al*., 2008).

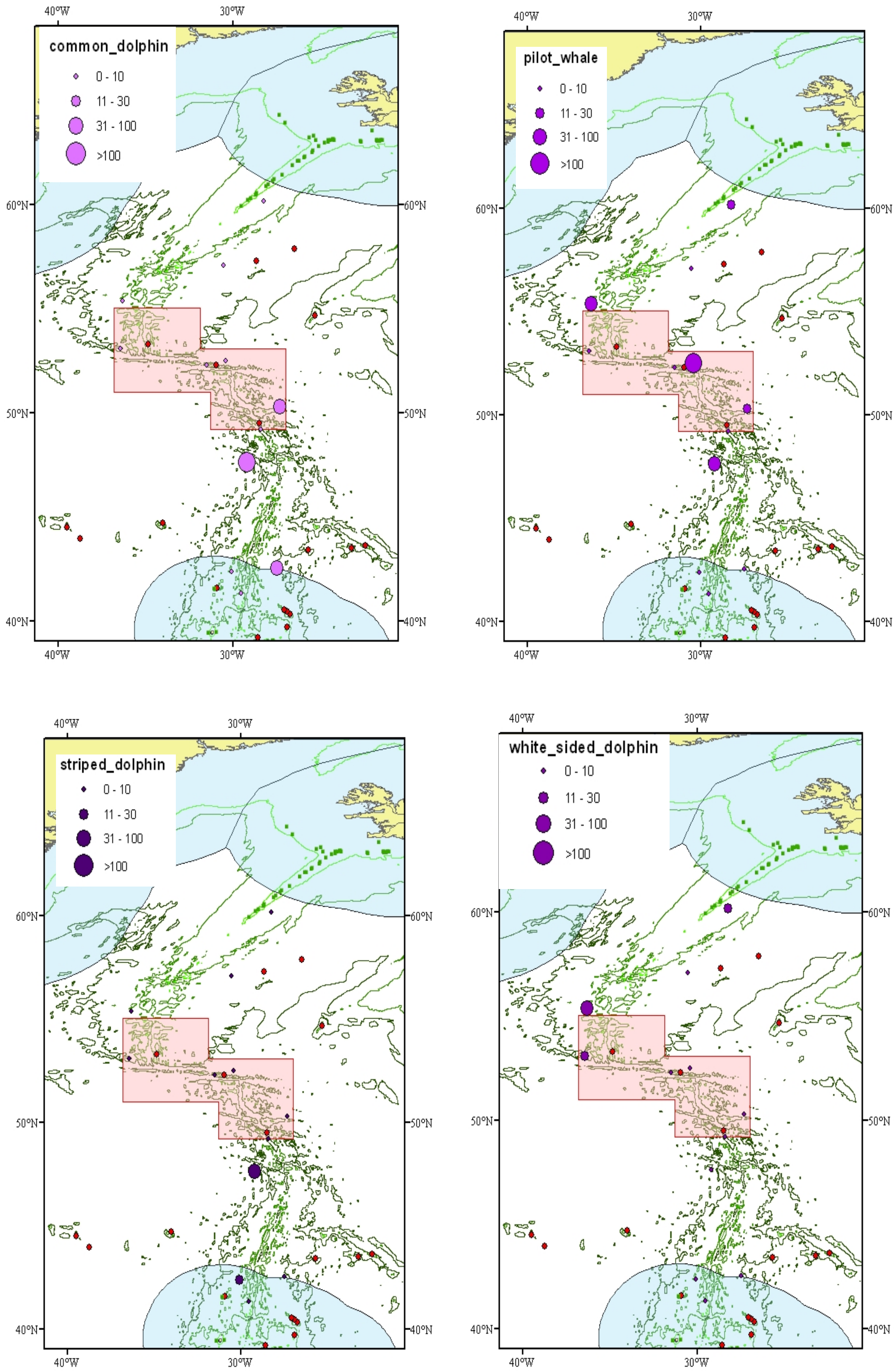

Figure 9. *Mapped distributions of cetaceans observed during the first leg of the MAR-ECO expedition on the R.V. G.O. Sars in 2004, data are taken from Doksæter et al.(2008). Common dolphins (Delphinus delphis) (n = 273) and striped dolphins (Stenella coeruleoalba) (n = 86) were observed in the warmer more saline waters to the south of the Sub Polar Front. Pilot whales (Globicephala melas) (n = 326) and white sided dolphins (Lagenoryhnchus acutus) (n = 103) were observed in the colder and less saline water masses to the north of the Sub Polar Front. All species preferred the steep slopes of the Mid-Atlantic Ridge. Red shaded area is the proposed MPA boundary and red circles are known seamount locations.*

Sea Turtles

a) Site Specific Information

Leatherback turtles (*Dermochelys coriacea*) are known to forage at oceanic fronts during migration (Eckert, 2006). One study has tracked individuals to the subpolar front area of the North East Atlantic, presumably to feed in this plankton rich environment (Ferraroli *et al*., 2004; Hays *et al*., 2004). Indeed an area just south of the Charlie-Gibbs Fracture Zone (coinciding with the subpolar front) had the highest abundance of gelatinous zooplankton as compared to the rest of the Mid-Atlantic Ridge in 2004 (Youngbluth *et al*., 2008). Therefore it is possible that *D. coriacea* migrating across the Atlantic visit the subpolar front area of the Mid-Atlantic Ridge to feed.

b) General Evidence of Vulnerability/Sensitivity

The entire North Atlantic is considered priority habitat for the critically endangered (Sarti Martinez, 2000) Leatherback turtle (*D. coriacea*) (Hays *et al*., 2004; Doyle, 2007; Doyle *et al*., 2008). The dramatic worldwide decline in *D. coriacea* is primarily because of the high mortality from their interaction with fisheries (Ferraroli *et al*., 2004). Recently an observer programme with the albacore tuna (*Thunnus alalunga*) drift net fishery found in the Bay of Biscay region of the North East Atlantic recorded 6 turtles being caught as bycatch, one of which was positively identified as *D. coriacea* (Rogan & Mackey, 2007).

In the Pacific Ocean conservation priorities can focus on foraging and nesting grounds and a relatively narrow oceanic migratory corridor (Ferraroli *et al*., 2004). However, in the Atlantic Ocean leatherback migration is much more widely dispersed. They tend to follow two main patterns after breeding in the tropics, either heading towards the Gulf Stream area or dispersing east and remaining in tropical waters (Ferraroli *et al*., 2004). Several high use foraging areas have been identified, including off the coast of Nova Scotia, Canada (James *et al*., 2005), and the Iberian Peninsula/Bay of Biscay area (Eckert, 2006).

D. coriacea primarily feeds on gelatinous zooplankton (Hays *et al*., 2006; Doyle, 2007) and a study to try and identify their primary foraging grounds in the North East Atlantic by Witt *et al.,* (2007) was done by mapping the distribution of gelatinous zooplankton. This study identified the European Continental Shelf and Rockall Bank as probable foraging grounds (Witt *et al*., 2007). Hays *et al.,* (2006) showed that individuals that left breeding grounds in the Caribbean sometimes travelled all the way across the Atlantic into European waters, continually foraging as they travelled.

1.7 Naturalness

The area has a high degree of naturalness, with species and habitats/biotope types still in a very natural state as a result of the lack of human-induced disturbance or degradation.

Despite the remoteness of the Mid-Atlantic Ridge, the area is not pristine anymore. Starting in the early 1970 with Soviet/Russian trawlers the roundnose grenadier (*C. rupestris*), orange roughy (*H. atlanticus*) and alfonsino (*B. splendens*) stocks of the Mid-Atlantic Ridge were exploited (Shibanov *et al.,* 2002, Clark *et al.,* 2007, ICES 2007). It can be assumed that most hills along the ridge were at least explored (usually by midwater trawl close to the seafloor), and at least 30 seamounts were exploited for *C. rupestris*. After 1982, the targeted fishery for redfish developed, dwarfing the catches of roundnose grenadier. After the transition from Soviet to Russian fisheries, the Russian fishing effort and absolute catch on the MAR was significantly reduced, however catch per fishing day settled at relatively low levels end of the 1990s (see Fig. 10) and the fishery was conducted only periodically (ICES 2007). The fishery on *C. rupestris* takes deepwater redfish (*Sebastes spp*), orange roughy (*H. atlanticus*), blackscabbard fish (*A. carbo*) and deepwater sharks as bycatch (Shibonov *et al.,* 2002, Clark *et al.,* 2007). In the 1980s, a significant longline fishery for tusk developed on the seamounts between 51 and 57° N, including on Hecate Seamount. In 1992, the Faroe Islands began a series of exploratory cruises for orange roughy (*H. atlanticus*), exploitable concentrations being found in late 1994 (annual catch 260 t) and early 1995 (1040 t), mostly on the Mid-Atlantic Ridge. The (trawl) fishery took place on five features on the Mid-Atlantic Ridge, incl. Faraday Seamount, and Hatton Bank. Catches peaked in 1996 at 1320 t, and since then have generally been less than 500 t (ICES, 2006, and Clark *et al.,* 2007 and literature therein). The Faroese fishery was the only one of the many experimental fisheries in the 1980s and 90s from many countries which lasted more than a few years (Bergstad, pers. com.). Also the exploratory longline and trawl surveys on the MAR conducted by Norway between 1993 and 1997 (Hareide & Garnes 2001) were not further developed as the fishery did not seem economically viable: Already after one year of fishery for "giant" redfish, (*Sebastes marinus*) and two year of fishery for alfonsino (*Beryx* spp.), catch rates dropped drastically, indicating the limitations of the resource (ICES 1998 quoted in Hareide & Garnes 2001).

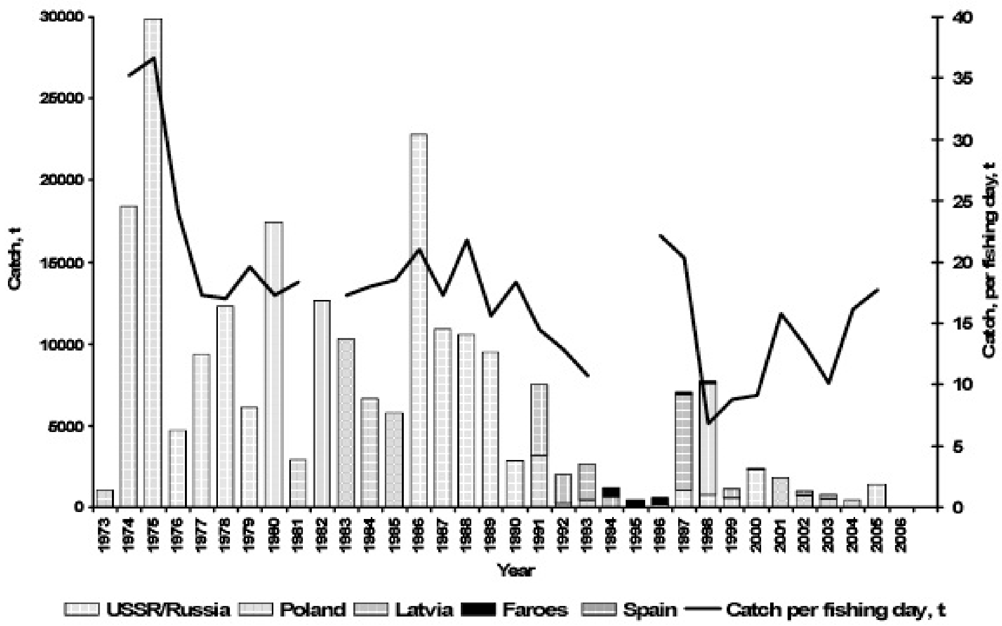

Figure 10. *International catch and Soviet/Russian CPUE of roundnose grenadier on the MAR 1973-2006 (ICES 2007, Report WGDEEP Fig. 11.2.1)*

Table 1 summarises the seamount-related fisheries on the MAR by species and year. Evidently, the fishery for roundnose grenadier affected the highest number of the MAR seamounts and revealed by far the largest catches. It is unclear to what extent the seamounts fished for different species were the same or different.

Table 1: Summary data on seamount fisheries on the MAR (ICES WGDEEP 2007)

Main species	Discovery		No. of commercial seamounts	Maximum catch/yr (^{x}000t)
	Year	**Country**		
Coryphaenoides rupestris	1973	USSR	34	29.9
Beryx splendens	1977	USSR	4	1.1
Hoplostethus atlanticus	1979	USSR	5	0.8
Molva dypterygia	1979	Iceland	1	8.0
Epigonus telescopus	1981	USSR	1	0.1
Aphanopus carbo	1981	USSR	2	1.2?
Brosme brosme	1984	USSR	15	0.3
Sebastes marinus (giant)	1996	Norway	10	1.0

It can be concluded that past fishing activities have significantly impacted on the natural ecosystem of the MAR by removing large quantities of highly vulnerable fish species (Hareide & Garnes 2001, ICES WG RED 2006, 2007)., Of particular concern are aggregation-forming fish species such as orange roughy (*H. atlanticus*), alfonsino (*B. splendens*), redfish (*Sebastes spp*) and roundnose grenadier (*C. rupestris*), where relatively stable catch rates may be maintained by serial exploitation of aggregation sites. However, currently available figures on the CPUE rates for roundnose grenadier do not allow for conclusive evidence on a depletion of this species – the strongly reduced (known) fishing effort on this species since the 1990s may have stabilized the biomass (ICES 2007).

There is no evidence yet of any human-caused physical damage to the seafloor and its habitats and species (possibly because of poor data coverage), however, lost fishing gear was found entangled with corals on the seafloor, and large fields of *Lophelia* rubble on the Mid-Atlantic Ridge, which raises questions about the possible cause of disintegration or destruction.

Destruction is not completely unlikely since Waller *et al.,* (2007) documented extensive human–caused impacts on two of the Corner Rise seamounts to the west of the MAR, which were also subject to exploitation by Russian trawling since the 1970s. They found multiple scars, scleractinian debris, broken soft coral branches and broken manganese crusts.

So although the scale of human impacts are unclear and similar habitats on the continental slope have probably been impacted to a much higher degree, it is unlikely that areas shallower than 2000 metres on the Mid-Atlantic Ridge are pristine.

2. Practical criteria/considerations

2.1 Potential for restoration

The need for restoration measures, *i.e.* recovery from human impacts by excluding further human pressure, is not known. There is some documentation for depletion to non-economical levels of alfonsinos and giant redfish. The former species (mainly *Beryx splendens*) was however not fished in the proposed area. The collateral damage to corals and other erect megafauna on the hills has not been well quantified, but has likely happened to some extent. The giant redfish that were located at some northern hills were probably accumulated concentrations of old fish. The species is still abundant in the adjacent Irminger Sea where it is being monitored by international ICES-coordinated surveys. The orange roughy is likely to be the most vulnerable teleost fish in the area due to its extensive longevity and late maturation, and tendency to aggregate. The abundance of this species within the proposed area is unknown. The potential for restoration of damaged erect sessile fauna exists but it is likely to take very long time. The fishes that have been targeted by past fisheries, *e.g.*

grenadier, redfish, tusk, orange roughy a. o. may recover substantially faster than *e.g.* coldwater corals and sponges, but some may require decades of reduced mortality and good recruitment.

2.2 Degree of acceptance

As noted earlier, the proposed area includes habitats and species listed as priority concern for OSPAR (OSPAR Commission 2003), and which qualify as Vulnerable Marine Ecosystems in relation to high seas fisheries according to the draft criteria developed by FAO (FAO 2007, Rogers *et al.,* 2008). The represented seamount communities, coral and sponge aggregations, a frontal area (in the form of the Sub Polar Front) and potential areas of upwelling all correspond to habitats listed as examples of ecologically or biological significant marine areas according to criteria developed by the CBD for identifying candidate sites for protection on the high seas (UNEP 2007). Therefore there are strong scientific grounds warranting protection of the area.

a) Fishing

North East Atlantic Fisheries Commission (NEAFC) fishery closures already exist in this region of the Mid-Atlantic Ridge incorporating the Faraday Seamounts, Hecate Seamounts and a section of the Mid-Atlantic Ridge (Figure 2)(NEAFC, 2008). A first set of closures were instigated in 2004 and were in effect until 31st December 2008 (NEAFC, 2008). Compliance with these closures appears to have been relatively good. No fishing activity was recorded for the entire first year of the closures in the area of the Reykjanes Ridge and Hecate Seamount (ICES, 2007a). The story is different for Faraday Seamount, which actually experienced increased fishing in the year following protection as compared to when it was unprotected (ICES, 2007a). No information is available for subsequent years. A much larger closure to bottom-contact gear, the middle MAR, which broadly corresponds to the proposed area, was introduced in 2009 and will run until 31 December 2015.

The Mid-Atlantic Ridge within the proposed protected area has been described as difficult to fish with bottom gear (even using rock-hopper trawls) due to the topography (Magnússon & Magnússon, 1995a; Bergstad *et al.,* 2008). Fishing has been attempted in the region, but has been sporadic (Hareide & Garnes, 2001). Commercial landings in the area have declined since 1996 (see *e.g.* ICES 2007) and Gordon *et al.,* (2003) suggest that this is due to a reduction in yields, indicating that the fisheries were not sustainable at their previous level.

The fishing effort exerted on the Mid-Atlantic Ridge has tended to be very low. ICES (2005) in its advice to NEAFC summarizes the number of European and Russian vessels currently operating in the area. These were in 2004 1 Norwegian, 4 Russian, 1 Spanish, 1 Faroe, 1 Irish and 2 Portuguese vessels. Therefore, a MPA safeguarding not only sensitive benthic habitats but also critical deepwater species and stocks should be acceptable to all North Atlantic coastal states. Another point is displacement of fishing effort, the Mid-Atlantic Ridge is relatively unexplored (Bergstad *et al.,* 2008), and the precautionary principle dictates that efforts should be made not to displace fishing effort from an area of high intensity to an area of little or no fishing without good reason. By incorporating the NEAFC closures into the proposed area, combined with the fact that fishers appear to avoid some sections of the Mid-Atlantic Ridge completely, it is thought that minimal displacement will occur.

The already existing closures, the currently low fishing effort in the proposed area and an increasingly stricter management of deepwater fishery by NEAFC and the European Community (see *e.g.* NEAFC recommendations 2007, EC 2015/2006, European Parliament 2007) may indicate a certain degree of acceptance of measures related to the establishment of an MPA on the Mid-Atlantic Ridge. The measures required will have to be proportionate to the conservation objectives of the MPA and will be in the responsibility of NEAFC.

b) Science

Science will not be affected by any management regime other than being bound to a code of conduct to minimize impacts – see OSPAR Code of Conduct for Responsible Marine Research in the Deep Seas and High Seas of the OSPAR Maritime Area (Agreement 2008-1).

c) Tourism

No tourism present.

d) Bioprospection

The extent of this activity within the proposed area is currently unknown.

e) Mining

Subject to ISA licensing, no exploration or exploitation plans known as yet.

f) Transport

Will not be affected.

g) Cable laying

Not known, however it seems likely that an agreement can be reached.

2.3 Potential for success of management measures

On the one hand, high seas marine protection will be more difficult to implement than in places closer to land, where patrols and enforcement measures can be easily administered. However, on the other hand, protection may be easier to achieve because the number of users of the areas is much more limited, and their activities can be monitored remotely and in a cost-effective way by Vessel Monitoring Systems and satellites (Kourti *et al.*, 2001; Marr and Hall-Spencer, 2002; Deng *et al.*, 2005; Kourti *et al.*, 2005; Murawski *et al.*, 2005; Davies *et al.,* 2007; Rogers *et al.,* 2008). Any management or enforcement of fisheries will be the responsibility of NEAFC, however cooperation will be needed. The challenge will be to bring illegal and unregulated fishing under control although some progress is being made on this within the NEAFC region. Because the area in question incorporates the current NEAFC fishery closures, which include a section of the Mid-Atlantic Ridge, the Faraday Seamounts and the Hecate Seamount (NEAFC, 2008) the management or at least enforcement of measures may be easier.

2.4 Potential damage to the area by human activities

For the habitats included in this area, the most damaging industry operating in the North East Atlantic is deep-sea and high seas fishing (OSPAR, 2007). Recent underwater video footage of the area was collected during the 2004 MarEco cruise of the Mid-Atlantic Ridge. Mortensen *et al.,* (2008) recorded evidence of fishing at a couple of stations during their sampling . At approximately 53^{o}N, 35^{o}W a pelagic gillnet was found in a small mound with dead coral skeleton pieces. At a station slightly further away from the Charlie-Gibbs Fracture Zone, at 51.5^{o}N, 30.3^{o}W ropes from fishing gear were found on the seabed and entangled in a large and partly broken colony of *Paragorgia arborea*. However, there were no clear marks on the seabed from contact with heavy fishing gear such as trawl doors (Mortensen *et al.,* 2008). Lost longlines were also caught when fishing on hills of the Mid-Atlantic Ridge by the chartered longliner *MS Loran* (Dyb & Bergstad, 2004) that was operating as part of the MarEco programme at the same time in the same areas as sampled by Mortensen *et al.,*(2008). Loss of longlines and gillnets from commercial vessels is almost certainly frequent (Hareide *et al.,* 2005). Remains of former large *Lophelia* reefs were observed at several locations during the sampling undertaken by Mortensen *et al.,* (2008), the causality of the degradation of these reefs could not be ascertained, however it was noted by the authors that there were no obvious natural causes that could account for such dramatic reductions in the extent of the reefs seen. Les Watling of the Darling Marine Center at the University of Maine and his colleagues discovered massive damage to deepwater seamounts at the nearby Corner Rise in 2006. There, great blocks of seabed had been "*torn up, crushed and crumbled. It had evidently been covered by a crust of some sort that had been slashed by deep gouges which were everywhere*." (Watling quoted in Roberts 2007). Watling attributed this damage to fishing by Soviet vessels fishing there between the 1970s and 1990s (Waller *et al.,* 2007).

The results from MarEco cruises must be regarded as first glances at the status of deep-sea corals along the Mid-Atlantic Ridge and Mortensen *et al.,*(2008) state that their results regarding fishing activity are inconclusive.

As noted earlier, there has been commercial fishing activity on the Mid-Atlantic Ridge since 1973, when dense concentrations of *C. rupestris* were discovered by USSR exploratory trawlers (ICES, 2007c). Aggregations of *C. rupestris* may have occurred on over 70 seamount peaks between 46^{o} and 62° N , but only 30 of them were commercially important and subsequently exploited (ICES, 2007c). The primary gear used in this area has been semi-pelagic trawl close to the bottom, but bottom gear, longlines and gillnets have also been used (ICES, 2007c; Mortensen *et al.,* 2008). This fishery ended in the 1990s due to the break-up of the Soviet Union rather than a lack of yields (Hareide & Garnes, 2001; Gordon *et al.,* 2003; ICES, 2007c). In 1994 a Russian fishery for alfonsino (*B. splendens*) developed in the same year as a Faroese fishery for orange roughy (*H. atlanticus*) (Hareide & Garnes, 2001; Gordon *et al.,* 2003). In 1996, Norwegian and Icelandic longliners began a fishery for *Sebastes marinus* (Giant redfish), *B. brosme* (Tusk), *Reinhartius hippoglossoides* (Greenland halibut) and *Hippoglossus hippoglossus* (Halibut) in the area between 54 and 61^{o}N (Hareide & Garnes, 2001; Gordon *et al.,* 2003).

The true extent of fishing activity in the area is hard to document, however ICES (2007). The closures relevant to this proposal are the closure of the Hecate and Faraday Seamounts and a part of the Reykjanes Ridge to all bottom trawling and fishing with static gears (NEAFC, 2008). As noted earlier, Gordon *et al.,*(2003), however, attributed the reduction in activity over the Mid-Atlantic Ridge around the beginning of the 21st century as an indication that yields of commercially important species such as redfish, tusk and halibut, have dropped, as opposed to the introduction of regulations. Many of the deepwater fish stocks in the entire North-East Atlantic are heavily exploited and some are severely depleted (Anon, 2001; Gordon *et al.,* 2003). The realisation of this led ICES in 2000 to provide the management advice that recommended '*immediate reductions in these* (deepwater) *fisheries unless they can be shown to be sustainable*' (Gordon *et al.,* 2003). Since then restrictions and closures (such as the prior mentioned NEAFC closures) have occurred to attempt to create sustainable deepwater fisheries (ICES, 2007c).

The actual scale of the impact that fishing and other human activities have had on the Mid-Atlantic Ridge is largely unquantified. Magnússon & Magnússon (1995a) reported that the Reykjanes Ridge section of the Mid-Atlantic Ridge is in general a very difficult area for bottom trawling mainly because of its extremely irregular bottom topography. They reported that on both sides of the ridge huge quantities of sponges can be encountered in some places and loose mud in others (Magnússon & Magnússon, 1995a). In 2004 fishing effort was recorded to a small extent over the Reykjanes Ridge and over Faraday Seamount and more frequently above Hecate seamount (ICES, 2007a). In 2005, when the NEAFC fisheries closures in this area came into force, no bottom fishing was observed over the Reykjanes Ridge and Hecate Seamount during the entire year, however fishing effort increased over Faraday seamount (ICES, 2007a).

Threats from future fishing activity to this area are high. As inshore stocks are depleted and fishing technology advances deepwater fish stocks in general are being increasingly exploited (Turner *et al.,* 2001; Roberts, 2002). Deep-sea fish species such as *H. atlanticus* and *C. rupestris* are long-lived and highly vulnerable to fishing. While catches early on in such fisheries can be highly rewarding and encourage increased effort, fishing soon leads to stock collapses such as those that have happened in the fisheries for *H. atlanticus* in New Zealand (Roberts, 2002).

Deepwater fishing gear does not just deplete target species it causes damage to the benthic habitat, decreasing habitat heterogeneity, simplifying ecosystems and reducing the number of micro-habitats available (Turner *et al.,* 2001; Roberts, 2002). These benthic habitats can take decades or even centuries to recover (Freese *et al.,* 1999; Freese *et al.,* 2001; Hall-Spencer *et al.,* 2002; Waller *et al.,* 2007; Rogers *et al.,* 2008) and there is evidence that this simplification of benthic habitat reduces the overall diversity of the ecosystem (Turner *et al.,* 2001; Roberts, 2002). Investigations of *Lophelia pertusa* reefs in the North East Atlantic have shown that they are host to rich fauna, with as many as 800 - 1300 species being associated with the coral, this is estimated as being three times higher than the number of species associated with the surrounding seabed (Husebø *et al.,* 2002; Roberts *et al.,* 2006).

There is no information available regarding prospecting for minerals from the seabed or bioprospecting in the Charlie-Gibbs Fracture Zone area. It is likely that both of these activities are more of a threat to areas of hydrothermal activity (Glowka, 2003; Synnes, 2007) on the Mid-Atlantic Ridge than the Charlie-Gibbs Fracture Zone. Likewise tourism is a highly unlikely threat in this remote part of the Atlantic Ocean. Scientific investigations in the area will continue, and establishment of an MPA is likely to enable co-ordinated effort that can be sustainably conducted.

2.5 Scientific value

Mid-ocean ridges are vast features of all oceans (Heger *et al.,* 2008; Hosia *et al.,* 2008). Despite their importance, the fauna and ecological significance of mid-ocean ridges remains poorly understood, mainly because ridge studies in the past have been understandably biased towards newly discovered chemosynthetic ecosystems (Bergstad *et al.,* 2008a).

The high scientific value of the Charlie-Gibbs Fracture Zone and the area of the Mid-Atlantic Ridge within the OSPAR region is illustrated by the fact that there is a major scientific research project underway focusing on the 'Patterns and Processes of the Ecosystem of the northern mid-Atlantic', (MarEco, Bergstad *et al.,* 2008a). Many papers have been published, some early on in the project (Fock *et al.,* 2004; Holland *et al.,* 2005; Sanamyan & Sanamyan, 2005; Vinogradov, 2005; King *et al.,* 2006; Fock & John, 2006; Fossen & Bergstad, 2006; Priede *et al.,* 2006; Vecchione & Young, 2006; Young *et al.,* 2006a, b). Others, after substantial field research, were published recently in the journal Deep-Sea Research II (see reference list) and others have been published in Marine Biology Research in February 2008 (Bergstad & Gebruk, 2008; Brandt & Andres, 2008; Dilman, 2008; Gebruk, 2008; Gebruk *et al.,* 2008; Martynov & Litvinova, 2008; Mironov, 2008; Molodtsova *et al.,* 2008; Murina, 2008; Tabachnick & Collins, 2008; Zezina, 2008).

In this issue of Marine Biology Research, 15 new species and one new genus were described, which represented about 10% of the total number of benthic species sampled during the expedition (Gebruk *et al.,* 2008). Some specimens were recorded in the North Atlantic for the first time (Dilman, 2008; Zezina, 2008), while others added information to records of species only sampled a few times before (Molodtsova *et al.,* 2008).

The MarEco project is still underway and the UK consortium has been successful in initiating a second field campaign from 2007-2009, focusing on the subpolar front. This research will investigate the transition zone between northern and southern faunal provinces, constituting a sub-area of apparent concentration of macrofauna and presumably high production levels (Bergstad *et al.,* 2008a). As a result of these ship-time commitments MarEco has been extended to 2010, when a final report will be issued as an element of the Census of Marine Life (CoML) (Bergstad *et al.,* 2008a).

Our knowledge of mid-ocean ridges remains sparse at best. Even with the MarEco project ongoing many questions remain unanswered or partially answered (Bergstad *et al.,* 2008a). Ongoing monitoring and research is required but, as any research, is very expensive (Hall-Spencer *et al.,* 2002). The vulnerability of the deep-sea to human impacts may mean that, without swift protection, much of the diversity that is as yet unknown will be lost before we can catalogue it (Roberts, 2002).

C. Management Issues

1. Human activities

The following actual or potential human activities in the area will or might need regulation through a management plan:

Deep sea and high seas fishing using fixed and mobile gears (both at the seabed and in the water column)

Vessel traffic

Seabed mining or other resource exploitation

Bioprospecting

Cable laying

Underwater noise

2. Any existing or proposed legal status

2.1 National legal status (e.g., nature reserve, national park):

On 29 April 2009 the Republic of Iceland submitted to the Commission on the Limits of the Continental Shelf, information on the limits of the Icelandic continental shelf in the area of the Reykjanes ridge beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured, in accordance with Article 76, paragraph 8, of the Convention of the Law of the Sea.

The limits submitted by Iceland – if approved by the Commission - would encompass the seabed in part of the area of the proposed Charlie-Gibbs MPA

2.2 Other international legal status (e.g., NATURA 2000, Ramsar):

In 2009, the North-East Atlantic Fisheries Commission adopted a recommendation prohibiting until 31 December 2015 the use of fishing gear which is likely to contact the seafloor during the normal course of fishing operations in, *inter alia*, an area known as Middle MAR Area (Charlie-Gibbs Fracture Zone and subpolar frontal region). This area covers a large part of the proposed area.

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Annex 1

Species and habitats of special interest for the proposed CGFZ-MPA

A. Habitats

Threatened and/or declining Habitats[12]

- Seamounts
- Deep Sea Sponge Aggregations
- *Lophelia pertusa* Reefs
- Coral Gardens

Other features of interest

- Deepwater and epipelagic ecosystems, including their function for migratory species
- Habitats associated with ridge structures, including their function as recruitment and spawning areas
- Benthopelagic habitats and associated communities, including commercially fished species
- Hard substrate habitats and associated epibenthos, including cold water corals and sponges
- Soft sediment habitats and associated benthos, including "coral gardens" of non-scleractinian corals
- The meandering sub-polar frontal ecosystem

B. Species

Threatened and/or declining Species[13]

- Orange roughy (Hoplostethus *atlanticus*)
- Blue whale (*Balaenoptera musculus*)
- Leatherback turtle (*Dermochelys coriacea*)
- Portuguese dogfish (*Centroscymnus coelolepis*)
- Gulper shark (*Centrophorus granulosus*)
- Leafscale gulper shark (*Centrophorus squamosus*)

[12] As included on the OSPAR List of threatened and/or declining Species and Habitats (OSPAR Agreement 2008-6)

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OSPAR's vision is of a healthy and diverse North-East Atlantic ecosystem, used sustainably

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