Draft Fisheries Assessment – West of Scotland NCMPA

August 2024

Scottish Government
Riaghaltas na h-Alba

Draft Fisheries Assessment – West of Scotland NCMPA

Contents

Executive Summary

The scope of this fisheries assessment is West of Scotland NCMPA located to the west of Scotland, all the former features of Rosemary Banks Seamount NCMPA are now protected within this site. The protected features of the site are burrowed mud (including sea-pens), coral gardens, cold-water coral reefs (including *Lophelia pertusa* reefs), deep-sea sponge aggregations, offshore deep-sea muds, offshore sands and gravels, seamount communities, blue ling (*Molva dypterygia*), leafscale gulper shark (*Centrophorus squamosus*) / gulper shark (*Centrophorus granulosus*), orange roughy (*Hoplostethus atlanticus*), Portuguese dogfish (*Centroscymnus coelolepis*), round-nose grenadier (*Coryphaenoides rupestris*). The conservation objective for the NCMPA is to recover the protected features to 'Favourable Condition', except for Blue ling where the conservation objective is to conserve the feature at 'favourable condition'.

In Part A, fishing activities currently occurring within the site (data from 2015 – 2019) were screened and grouped into aggregated gear types. Throughout this draft fisheries assessment the data from 2015-2019 is referred to as the current levels of activity. The gear types considered relevant to the protected features were demersal trawls, demersal seines, anchored nets/lines and pelagic fishing. Based on the pressures associated with these fishing activities and the sensitivity of the protected features, the pressures considered capable of affecting were; abrasion/disturbance of the substrate on the surface of the seabed; penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion; smothering and

siltation rate changes (Light); changes in suspended solids (water clarity); removal of non-target species and removal of target species. All six pressures were taken through to Part B of the assessment.

In Part B, the assessment of fishing activities capable of affecting the protected features within the site determined that, at current fishing levels, pelagic fishing alone would not hinder the achievement of the conservation objectives for West of Scotland NCMPA. However, the achievement of the conservation objectives might be hindered where demersal trawling, demersal seines and anchored nets/lines fishing activities occurred. Scottish Ministers concluded that management measures were required to restrict mobile demersal and static demersal fishing within West of Scotland NCMPA.

In Part C, the in-combination assessment considered the residual potential impacts of pelagic fishing alongside other relevant offshore region activities happening in and near the site. Active telecommunications cables were present within the site, and these were assessed in combination with the pelagic fishing activity. However, there were found to be no pressures caused by pelagic activities or telecommunications cables that have the potential for in-combination effects. Therefore, Scottish Ministers concluded that the remaining fishing activities (pelagic fishing) in-combination with other relevant activities would not hinder the achievement of the conservation objectives for West of Scotland NCMPA.

Considering the need for management measures for demersal trawls and seines and anchored nets/lines, as identified in the assessment, measures were developed using further evidence and advice from the relevant Statutory Nature Conservation Body (SNCB), Joint Nature and Conservation Committee (JNCC). This advice which was developed using best available evidence outlined the impact from all demersal mobile gears and demersal static gears should they occur within the site. The option identified and under consideration by Scottish Ministers is a full site exclusion of mobile demersal and static demersal gear. Zonal management has not been identified by Scottish Ministers. The full site exclusion option would be considered sufficient to enable progress to be made towards achieving the conservation objectives for West of Scotland NCMPA.

The decision as to the management option to be taken forward will be made following a statutory public consultation exercise and will be taken in the light of all relevant obligations incumbent upon the Scottish Ministers in relation to the exercise of their functions.

1. Introduction

1.1 Scope of the West of Scotland NCMPA assessment

The geographic scope if this assessment covers the whole of the West of Scotland NCMPA (Figure 1 and 2). The purpose of this assessment is to determine whether the current levels of fishing activities would or might hinder the conservation objectives of West of Scotland NCMPA and to identify options for management measures.

In this assessment, the Scottish Ministers use the best available evidence to review the site characteristics and current fishing activity (Part A), both taken alone and in combination with other relevant activities (Part C), to determine if the fishing activities are capable of affecting the protected features. Any fishing activities capable of affecting the protected features, either alone or in combination with other relevant activities, are considered further to assess whether they would or might hinder the achievement of the conservation objectives (Part B).

Where there is the potential for the achievement of the conservation objectives to be hindered, management measures are identified for the site by the Scottish Ministers. These measures are considered in light of the conservation objectives, biological characteristics, current fishing, other activity levels and existing fisheries restrictions for West of Scotland NCMPA. A final decision on which measures, if any, are to be adopted, will follow upon a statutory consultation exercise and will take into account all relevant statutory obligations incumbent upon Scottish Ministers.

A methodology document has been prepared to aid understanding of these assessments.

1.2 Site description

The West of Scotland deep-sea marine reserve (Figure 1 and 2) is 107,718 km^2 in size. The shallowest area within the NCMPA is approximately 400 m below sea-level and the deepest section is 2,500 m below sea-level. It covers a diverse marine landscape to the west of Scotland; from the steep gradient of the continental slope across the sediment plains of the Rockall Trough, to the slopes of George Bligh Bank and Rockall Bank, with two isolated seamounts (Anton Dohrn and Rosemary Bank). It is the geological and geomorphological features that define this marine landscape, with volcanic igneous rock protrusions forming the seamounts and the large banks at the western extent of the deep-sea marine reserve. Slide deposits are a characteristic feature along the Scottish continental slope, while other geomorphological and glacial remnant features (such as sediment wave fields, scour moats, turbidite accumulations, and iceberg plough marks) form the landscape of the seabed (Brooks et al. 2011).

The West of Scotland NCMPA has been designated for the following protected features:

- Habitat features:
    - Burrowed mud (including sea-pens)
    - Coral gardens
    - Cold-water coral reefs (including *Lophelia pertusa* reefs)
    - Deep-sea sponge aggregations
    - Offshore deep-sea muds
    - Offshore sands and gravels
    - Seamount communities
- Species features:
    - Blue ling (*Molva dypterygia*)
    - Leafscale gulper shark (*Centrophorus squamosus*) / gulper shark (*Centrophorus granulosus*)

    - Orange roughy (*Hoplostethus atlanticus*)
    - Portuguese dogfish (*Centroscymnus coelolepis*)
    - Round-nose grenadier (*Coryphaenoides rupestris*)
- Large scale feature:
    - Seamount
- Geological and geomorphological features:
    - A range of features representative of the Key Geodiversity Areas

All of the protected biodiversity features of the deep-sea marine reserve are Priority Marine Features (PMFs); these are habitats and species considered to be of conservation priority in Scotland's seas. Coral gardens, cold-water coral reefs (including *Lophelia pertusa* reefs), deep-sea sponge aggregations, seamount communities, leafscale gulper shark (*Centrophorus squamosus*), gulper shark (*Centrophorus granulosus*), orange roughy (*Hoplostethus atlanticus*) and Portuguese dogfish (*Centroscymnus coelolepis*) are also listed as OSPAR Threatened and/or Declining habitats or species in the North-East Atlantic region. Burrowed mud (including sea-pens), coral gardens, cold-water coral reefs (including *Lophelia pertusa* reefs), deep-sea sponge aggregations and seamount communities are all Vulnerable Marine Ecosystems (VMEs) as identified by the joint International Council for the Exploration of the Sea (ICES) / North-west Atlantic Fisheries Organisation (NAFO) Working Group on Deep-Water Ecology (WGDEC) for the North-east Atlantic. These are habitats/ecosystems that are classified as vulnerable due to the characteristics they possess e.g. they may be fragile and susceptible to damage.

Deep-sea sponge aggregations, cold-water coral reefs and coral gardens are known as 'habitat formers'. The physical structures they create provide an environment that other species can colonise, and they support a diverse community of associated species (OSPAR 2009, 2010a, 2010b). Sponges may also play a significant role in silicon regulation by providing a long-term sink for silicon (Maldonado et al. 2012, Tréguer and Rocha, 2013), while coral skeletons act as a long-term store of carbon (OSPAR, 2009).

The deep-sea marine reserve protects six deep-sea fish species (blue ling (*Molva dypterygia*), orange roughy, Leafscale gulper shark / gulper shark, Portuguese dogfish, and round-nose grenadier (*Coryphaenoides rupestris*). Leafscale gulper shark and gulper shark are presented as a feature complex due to difficulties in their identification. The NCMPA contains characteristic habitat for round-nose grenadier, leafscale gulper shark, gulper shark, and Portuguese dogfish. Round-nose grenadier are resident within the MPA, and this is one of only 17 locations globally where gulper shark has been reported. The NCMPA protects important aspects of these species' life-cycles, such as spawning areas (Large et al. 2010; Moura et al. 2014). There is limited understanding on the majority of these species, however, and further scientific research is required to assess the importance of the site for these species.

The two seamounts (Rosemary Bank and Anton Dohrn) are protected as large-scale features of the deep-sea marine reserve and for the rich Seamount communities they support (Figure 1 and 2). The seamounts create a very different environment to the sedimentary plains of the Rockall Trough. The dynamic hydrographic environment surrounding the seamounts increases food availability to suspension feeders such as sponges and corals that colonise the seamounts. Many fish species such as blue ling, black scabbard (*Aphanopus carbo*) and mesopelagic lantern fish (*Lampanyctus* sp.) are attracted to seamounts for feeding or spawning. The concentrations of fish and other prey species around seamounts also attracts larger predators and marine mammals such as Atlantic white-sided dolphin (*Lagenorhynchus acutus*) and sperm whale (*Physeter macrocephalus*), which have been observed in high numbers around these features (Clarke 2007, Macleod et al. 2003, Weir et al. 2001). Further details of the NCMPA can be found in the West of Scotland NCMPA Ecological Overview document available on JNCC's site information centre.

The conservation objectives for the protected features within the West of Scotland NCMPA are: Subject to natural change, recover the burrowed mud, coral gardens, cold-water coral reefs, deep-sea sponge aggregations, offshore deep-sea muds, offshore sands and gravels and seamount communities to favourable condition, such that:

- their extent is stable or increasing;
- their structures and functions, quality, and the composition of their characteristic biological communities are such as to ensure that they are in a condition which is healthy and not deteriorating.

Subject to natural change, conserve the blue ling and recover the leafscale gulper shark, gulper shark, orange roughy, Portuguese dogfish and round-nose grenadier to favourable condition, such that:

- the quality and quantity of its habitat;
- the composition of its population is such to ensure that the population is maintained in numbers which enable it to thrive.

Subject to natural change, conserve the geological and geomorphological features characterising the protected Key Geodiversity Areas within the deep-sea marine reserve; bioherm reefs, continental slope turbidite canyons, erosional scour fields, iceberg ploughmarks, ice-distal and glacimarine facies, ice-proximal and ice-contact facies (e.g. mega-scale glacial lineations), large bank (Palaeogene igneous centre), parasitic cones, prograding wedge, scour moat, seamount, sediment drifts, sediment wave field, slide deposit, slide scars, small scale ridges, sub-glacial tills, turbidite accumulations and the large-scale feature seamounts, such that:

- their extent, component elements and integrity are maintained; Their structure and functioning are unimpaired; and
- their surface remains sufficiently unobscured for the purposes of determining whether the aforementioned points are satisfied.

For burrowed mud, coral gardens, cold-water coral reefs, deep-sea sponge aggregations, offshore deep-sea muds, offshore sands and gravels, seamount communities, leafscale gulper shark, gulper shark, orange roughy, Portuguese dogfish and round-nose grenadier, the feature condition has been assessed by JNCC as being 'Unfavourable'. For Blue ling, the feature condition has been assessed by JNCC as being 'Favourable'.

With regards to the scope of this assessment, JNCC considers that the large-scale feature and/or geomorphological features are unlikely to be impacted by fishing activities within the site. As such, these features are not considered further in this assessment. More information regarding the designation of the West of Scotland NCMPA is available in the Designation Order.

More information regarding the conservation objectives and feature condition for the protected features of West of Scotland NCMPA is available within the site's Conservation Objectives and Management Advice document.

With regards to the scope of this assessment, JNCC considers that the seamount large scale feature is unlikely to be impacted by fishing activities within the site. As such, this feature is not considered further in this assessment. For the geological and geomorphological features, iceberg plough mark fields and bioherm reefs may be sensitive to the pressures associated with fishing activities occurring within the MPA, however these geographically overlap with other features of the NCMPA (i.e. iceberg plough mark fields overlap Offshore sands and gravels, and bioherm reefs overlap Seamount communities, cold-water coral reefs, and coral garden features). Therefore, the assessment for the biodiversity features will also apply to these iceberg plough mark fields and bioherm reefs features, so these geological and geomorphological features have therefore not been considered further in this assessment. JNCC also considered the other geological and geomorphological features to be unlikely to be impacted by fishing activities within the site. As such, these other features are not considered further in this assessment.

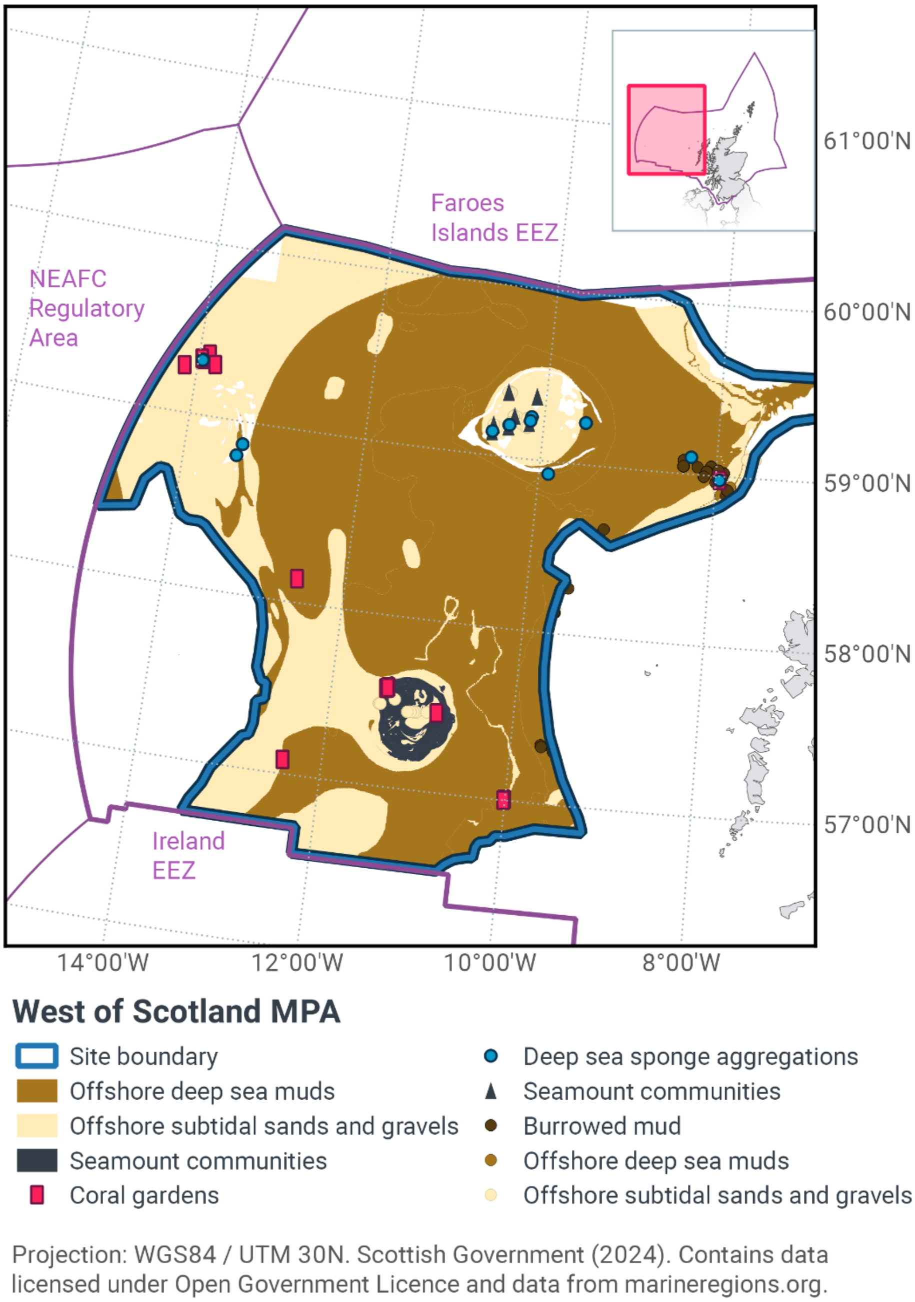

Figure 1. West of Scotland NCMPA site map including distribution of protected habitat features.

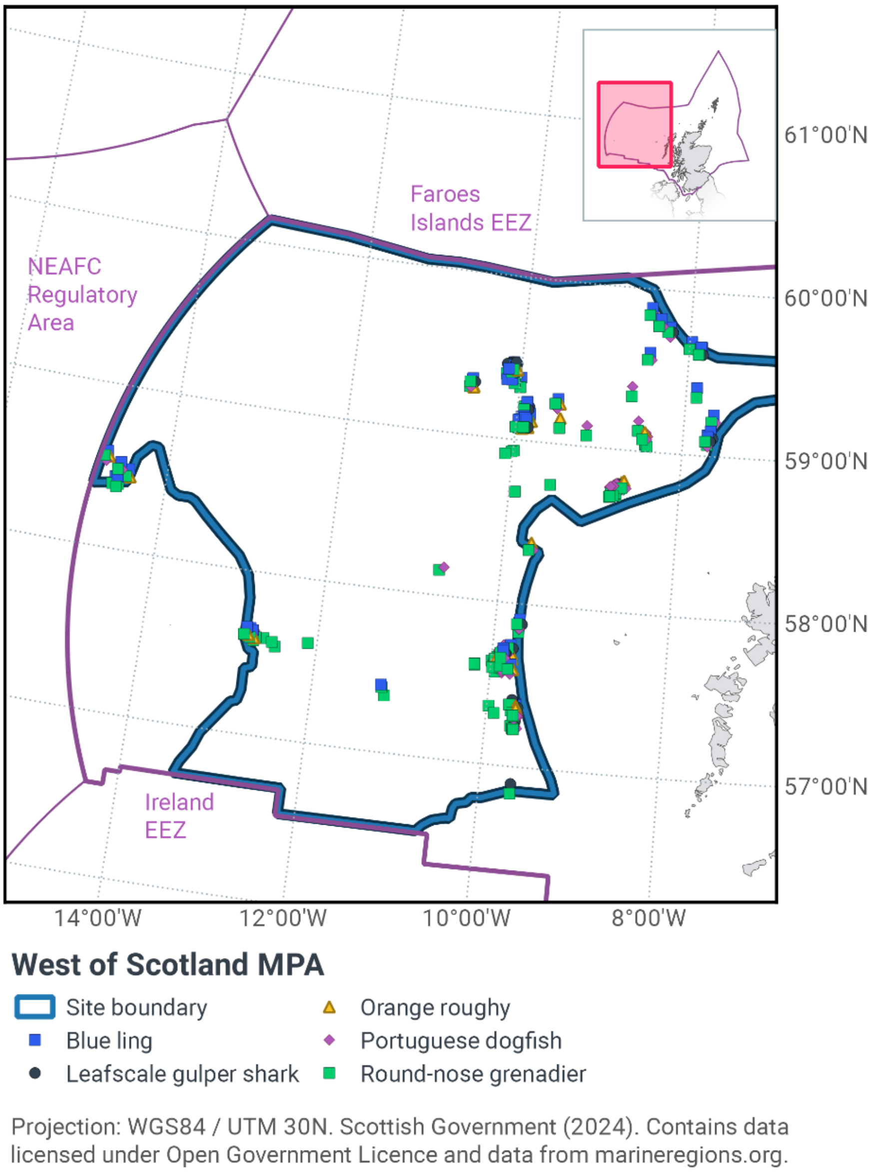

Figure 2. West of Scotland NCMPA site map including distribution of protected mobile species within the site.

1.3 Activities assessed

The assessments consider the impacts of fisheries activities at each NCMPA in terms of the conservation objectives stated for the protected sites. This was deemed appropriate/necessary to do, in order to assist in identifying potential management measures.

In this context, the implications of the fishing activity in view of the conservation objectives for the NCMPA are being assessed through the fisheries screening stage (Part A), the fisheries assessment (Part B), and the in combination (cumulative effect) assessment (Part C).

Fisheries assessments use the best available evidence to fully consider potential impacts of commercial fishing activity, and in-combination (cumulative) effects with other activities, against the conservation objectives for the site. If the assessment concludes that use of certain fishing gear types would or might hinder the achievement of the conservation objectives of the site, management measures will be considered.

Commercial sea fishing activity has the potential to vary in nature and intensity over time. This assessment considers fishing activity based on activity levels and type between 2015-2019. This date range was considered to provide the best available data on current fishing activity levels for the assessment. Using a five year date range provides an average view of fishing activity within the site; latter years (2020 – 2021) were not considered representative of regular fishing activity due to the Covid pandemic. The selected date range (2015 – 2019) was used consistently across all assessments within the consultation package. Changes in fishing activity after this time period may be considered in future reviews of this assessment (see Section 6).

2. Part A assessment – fisheries screening

2.1 Fisheries screening overview

Part A of this assessment considers whether the fishing activity would be capable of affecting the protected features of an NCMPA or any ecological or geomorphological process on which the conservation of any protected feature is dependent. This section looks at the pressures exerted by the fishing activity occurring in the site (within the assessment period) in relation to the sensitivities of the protected features. Activities potentially capable of affecting the protected feature were identified where there was both a medium-high risk of a pressure arising from the fishing activity and if any of the features were considered sensitive to that pressure. These pressure-features interactions were then taken forward to the fisheries assessment stage (Part B) to determine whether the fishing activity in question would or might hinder the achievement of the conservation objectives.

For each activity assessed in Part A, there were two possible outcomes for each identified pressure-feature interaction:

1. The pressure-feature interactions were not included for Part B:
    a. If the feature is not exposed to the pressure, and is not likely to be in the future; or
    b. If the effect/impact of the pressure is non-existent or insignificant.
2. The pressure-feature interactions were included for assessment in Part B:
    a. If the feature is exposed to the pressure, or is it likely to be in the future; and
    b. If the pressure is capable of affecting the feature; or

c. If it is not possible to determine whether the pressure is capable of affecting the feature.

Part B of the assessment considers the potential for activities to affect the feature by assessing the impact of fishing gears identified in Part A. This involves determining the potential level of interaction between the feature and the fishing activity, assessing the potential impact on the feature, and subsequently if fishing activities would or might hinder the achievement of the conservation objectives for the site.

Consideration of exposure to and the effect of a pressure on a protected feature of the NCMPA includes the consideration of exposure to and the effect of that pressure on any ecological or geomorphological process on which the conservation of the protected feature is wholly or in part dependant.

The JNCC West of Scotland NCMPA Conservation Objectives and Management Advice document and the West of Scotland NCMPA Fisheries Management Options paper have been used to inform this assessment. This is the most recent information and options paper available.

Where appropriate, this advice has been supplemented by information on pressures associated with fishing activity from the JNCC Marine Pressures-Activities Database (PAD) v1.5 2022 and the Feature Activity Sensitivity Tool (FeAST).

2.2 Activities taking place within West of Scotland NCMPA

To screen out fishing activities that were not taking place within the site or likely to take part in the future, Vessel Monitoring System (VMS) data within West of Scotland NCMPA from 2015 – 2019 were analysed to identify the gear types being used in the site and the aggregated gear method (Table 1). The fishing gears screened out at this stage were not taken forward to Part B of the assessment.

On reviewing the ICES gridded data, which includes EU and Norwegian vessels, demersal seine activity was also found to occur within the site.

Table 1. Gear types recorded from the site based on VMS data from 2015 – 2019.

Gear type	Specific Gear Type	Gear code	Aggregated gear method
Towed	Bottom otter trawl	OTB	Demersal trawls
	Multi-rig trawls	OTT	
	Bottom trawls (not specified)	TB	
Towed (pelagic)	Mid-water trawl (single)	OTM	Pelagic fishing
Static- fixed nets	Set gillnets	GNS	Anchored nets/lines
Lines	Set longlines	LLS	

2.3 Potential pressures exerted by site fishing activity

According to the JNCC West of Scotland NCMPA Management Options Paper (2023) the existing fishing activity believed to take place within or close to West of

Scotland NCMPA considered capable of affecting the protected features are demersal trawls; demersal seines; purse seines; pelagic trawls; unknown trawls; gillnets; hooks and lines and pots and traps.

The potential pressures that could be exerted by fishing activities (demersal trawls, pelagic fishing, anchored nets/lines and demersal seines) considered capable of affecting protected features were determined using information on activity-pressure relationships in the JNCC Marine Pressures-Activities Database (PAD) v1.5 2022. The potential pressures that could be exerted by demersal trawls, pelagic fishing, anchored nets/lines and demersal seines are summarised in Table 2.

The aggregated gear type of ‘anchored nets/lines’ spans two categories in the PAD: set (fixed) net fishing and line fishing. Subsequently, potential pressures for this aggregated gear type were listed under the two PAD categories (Table 2). The risk profiling of pressures was the same for set (fixed) net fishing and line fishing within PAD, confirming that these categories could be considered together under the aggregated gear type of ‘anchored nets/lines’ in later sections of the assessment.

Within the PAD, the above water noise and collision above water pressures both had low risk profiles for all fishing activity types, however these were not considered capable of affecting the protected features and were excluded.

Table 2. Potential pressures exerted by demersal trawls, demersal seines, pelagic fishing and anchored nets/lines taken from the JNCC Marine Pressures-Activities Database (PAD) v1.5 2022. The PAD risk profiling of pressures score represents the general risk the pressures pose to the environment under normal conditions. Pressures are categorised as posing a medium/high risk (dark blue) or low risk (light blue). Pressures that are not exerted by the fishing activity are classed as not relevant (white).

PAD Pressure	Demersal trawls	Demersal seines	Pelagic fishing	Anchored nets/lines
Transition elements and organo-metal (e.g. TBT) contamination. Includes those priority substances listed in Annex II of Directive 2008/105/EC	Low	Low	Low	Low
Hydrocarbon & PAH contamination. Includes those priority substances listed in Annex II of Directive 2008/105/EC.	Low	Low	Low	Low
Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals). Includes those priority substances listed in Annex II of Directive 2008/105/EC.	Low	Low	Low	Low
Deoxygenation	Low	Low	Low	Low
Nutrient enrichment	Low	Low	Not relevant	Not relevant
Organic enrichment	Low	Low	Low	Low
Physical change (to another seabed type)	Low	Low	Not relevant	Not relevant
Physical change (to another sediment type)	Low	Low	Not relevant	Not relevant
Abrasion/disturbance of the substrate on the surface of the seabed	Medium-high	Medium-high	Not relevant	Medium-high
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Medium-high	Medium-high	Not relevant	Low
Changes in suspended solids (water clarity)	Medium-high	Medium-high	Not relevant	Not relevant

Smothering and siltation rate changes (Light)	Medium-high	Medium-high	Not relevant	Not relevant
Litter	Low	Low	Low	Low
Underwater noise changes	Low	Low	Low	Low
Introduction of light	Low	Low	Low	Low
Barrier to species movement	Not relevant	Not relevant	Low	Low
Collision BELOW water with static or moving objects not naturally found in the marine environment (e.g. boats, machinery and structures)	Low	Low	Low	Low
Visual disturbance	Low	Low	Low	Low
Introduction or spread of invasive non-indigenous species (INIS)	Low	Low	Low	Low
Removal of target species	Medium-high	Medium-high	Medium-high	Medium-high
Removal of non-target species	Medium-high	Medium-high	Medium-high	Medium-high

2.4 Significance of effects/impacts to protected features

In the absence of a JNCC Advice on Operations advice package for this site, the Feature Activity Sensitivity Tool (FeAST) and JNCC Marine Pressures-Activities Database (PAD) v1.5 2022 were used to determine the potential sensitivity of the protected features (Table 3) to the pressures exerted by the relevant fishing activities (Table 2).

Table 3 identifies the pressures from particular gears that could be capable of affecting each feature. Where a pressure from a particular gear is identified as being capable of affecting a feature, justification is provided. To ensure the effects of fishing activities in-combination with other activities (including other fishing activities) are fully assessed, the pressures from fishing activities which were not identified being capable of affecting a feature but which do interact with the feature are considered in the in-combination aspect of the assessment (Part C).

Table 3. Summary of the FeAST sensitivity assessment for Habitat protected features within West of Scotland NCMPA**:** Burrowed Mud (including sea pens); Coral gardens; Cold-water coral reefs (including *Lopehlia pertusa* reefs); Deep-sea sponge aggregations; Offshore deep-sea muds; Offshore sands and gravels and Seamount Communities. As no single sensitivity assessment exists for Offshore sands and gravels, a combination of 'Deep-sea mixed sediments', 'Deep-sea muddy sands' and 'Deep-sea sands' from FeAST were used instead, and the most precautionary score was used where sensitivity differed. For Offshore deep-sea muds, the 'Deep-sea muds' feature from FeAST was used. The habitats are categorised as having High Sensitivity (dark blue), Medium Sensitivity (dark blue), Sensitive (light blue), Low sensitivity (white), Not Sensitive (white), Not Exposed (white), Not Assessed (white), and Unknown (white). *An asterisk is used to denote an underlaying range of sensitivities for habitat features (e.g. due to the feature including species with a range of different sensitivities to a pressure). High* denotes that the highest sensitivity score for the features is High; Medium* denotes that the highest sensitivity score for the feature is Medium. Unknown is used where there is no information in FeAST about the sensitivity of this habitat to the pressure listed. Further details on these categories are available in the associated methods document.

Potential pressures	**Burrowed mud (including sea-pens)**	**Coral gardens**	**Cold-water coral reefs (including *Lophelia pertusa* reefs)**	**Deep-sea sponge aggregations**	**Offshore deep-sea muds**	**Offshore sands and gravels**	**Seamount communities**
Abrasion/disturbance of the substrate on the surface of the seabed	Medium Sensitivity	High sensitivity	Not assessed	High sensitivity	High sensitivity*	High sensitivity	High sensitivity
Changes in suspended solids (water clarity)	Low	Sensitive	Not assessed	Sensitive	Not Exposed	Not Exposed	Sensitive
Collision BELOW water with static or moving objects not	No Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed

naturally found in the marine environment (e.g., boats, machinery, and structures)							
Deoxygenation	Low	Not Exposed	Not Assessed	Not Exposed	Not Exposed	Not Exposed	Not Exposed
Hydrocarbon & PAH contamination. Includes those priority substances listed in Annex II of Directive 2008/105/EC.	Sensitive	Sensitive	Not Assessed	Sensitive	Sensitive	Sensitive	Sensitive
Introduction of light	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Introduction or spread of invasive non-indigenous species (INIS)	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Sensitive	Not Assessed
Litter	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Nutrient enrichment	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Sensitive	Not Sensitive	Not Assessed
Organic enrichment	Medium Sensitivity	High Sensitivity	Not assessed	High Sensitivity	High Sensitivity	High Sensitivity	Not Assessed
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Medium Sensitivity	High Sensitivity	Not Assessed	High Sensitivity	High Sensitivity	High Sensitivity	High Sensitivity

Physical change (to another seabed type)	High Sensitivity	High Sensitivity	Not Assessed	High Sensitivity	High Sensitivity	High Sensitivity	High Sensitivity
Physical change (to another sediment type)	High Sensitivity	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not assessed
Removal of non-target species	Medium Sensitivity*	High Sensitivity	Not Assessed	High Sensitivity	High Sensitivity	High Sensitivity	High Sensitivity
Removal of target species	Medium Sensitivity	Not Exposed	Not Assessed	Not Exposed	Not Exposed	Not Exposed	Not Exposed
Smothering and siltation rate changes (Light)	Low	High Sensitivity	Not Assessed	High Sensitivity	High Sensitivity	High Sensitivity*	High Sensitivity
Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals). Includes those priority substances listed in Annex II of Directive 2008/105/EC.	Sensitive	Sensitive	Not Assessed	Sensitive	Sensitive	Sensitive	Sensitive
Transition elements & organo-metal (e.g. TBT) contamination. Includes those priority substances listed in Annex II of Directive 2008/105/EC.	Sensitive	Sensitive	Not assessed	Sensitive	Sensitive	Sensitive	Sensitive

Underwater noise changes	Not Sensitive	Sensitive	Not assessed	Sensitive	Not sensitive	Not sensitive	Sensitive
Visual disturbance	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed

Table 4. Summary of the FeAST sensitivity assessment for mobile species protected features within West of Scotland NCMPA: orange roughy; blue ling; round-nose grenadier; leafscale gulper shark/ gulper shark and Portuguese dogfish. The mobile species are categorised as having Sensitive (dark blue); Not sensitive (white); Not Assessed (white); Not Relevant (White) or Insufficient Evidence (White). Further details on these categories are available in the associated methods document.

Potential pressures	**Orange roughy**	**Blue ling**	**Round-nose grenadier**	**Leafscale gulper shark/Gulper shark**	**Portuguese dogfish**
Abrasion/disturbance of the substrate on the surface of the seabed	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Barrier to species movement	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Changes in suspended solids (water clarity)	Not Sensitive	Not Sensitive	Not Assessed	Not Assessed	Not Assessed
Collision BELOW water with static or moving objects not naturally found in the marine environment (e.g., boats, machinery, and structures)	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Deoxygenation	Not Exposed	Not Exposed	Not Assessed	Not Assessed	Not Assessed
Hydrocarbon & PAH contamination. Includes those priority substances listed in Annex II of Directive 2008/105/EC.	Sensitive	Sensitive	Not Assessed	Not Assessed	Not Assessed
Introduction of light	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed

Introduction or spread of invasive non-indigenous species (INIS)	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Litter	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Nutrient enrichment	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Organic enrichment	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Physical change (to another seabed type)	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Physical change (to another sediment type)	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Removal of non-target species	Low Sensitivity	Medium Sensitivity	Not Assessed	Not Assessed	Not Assessed
Removal of target species	High Sensitivity	High Sensitivity	Not Assessed	Not Assessed	Not Assessed
Smothering and siltation rate changes (Light)	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals). Includes those priority substances listed in Annex II of Directive 2008/105/EC.	Sensitive	Sensitive	Not Assessed	Not Assessed	Not Assessed
Transition elements & organo-metal (e.g. TBT) contamination. Includes those priority substances listed in	Sensitive	Sensitive	Not Assessed	Not Assessed	Not Assessed

Annex II of Directive 2008/105/EC.					
Underwater noise changes	Not Sensitive	Not Sensitive	Not Assessed	Not Assessed	Not Assessed
Visual disturbance	Not Assessed	Not Assessed	Not Assessed	Not Assessed	Not Assessed

Considering both the information on the pressure activity association (Table 2) and the sensitivity of protected habitats features (Table 3) and protected mobile species features (Table 4) pressures that have the potential to affect the feature are summarised in Table 5. Table 3 and 4 list the sensitivity of the protected features to the pressures caused by each type of fishing gear occurring within West of Scotland NCMPA.

Table 5 identifies the pressures from particular gears that are capable of affecting each protected feature. Where a pressure from a particular gear is identified as not being capable of affecting the feature, justification is provided. Pressures with a medium-high risk profile in PAD and to which FeAST assessed the feature as being Sensitive, Medium Sensitivity or High Sensitivity have the potential to affect the feature.

Pressures that are not relevant to demersal trawls, demersal seines, pelagic fishing, and anchored nets/lines (pressures that are not exerted by that fishing activity: 'not relevant to the activity' in Table 4) do not need to be considered further in the assessment. According to the PAD methods document (Robson et al., 2018), pressures with low risk profiles (i.e. 'low' risk profile for the activity: Tables 2 & 4) generally do not occur at a level of concern and should not require consideration as part of an assessment, unless there are evidence-based cases or site-specific factors that increase the risk, or there is uncertainty on the level of pressure on a receptor. Pressures with 'medium-high' risk profiles are commonly induced by the activity at a level that needs to be considered further as part of an assessment.

Of all the pressures considered, six have medium-high risk profiles (PAD) for either all, or some of the fishing activities that occur within the site, and the protected features have are sensitive to either all, or some, of these pressures (FeAST). The six pressures are abrasion/disturbance of the substrate on the surface of the seabed; penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion; smothering and siltation rate changes (light); changes in suspended solids (water clarity); removal of target species and removal of non-target species (Table 5). These six pressures are subsequently considered to have the potential to affect a combination of the protected habitat and mobile species features. All six of these pressures are exerted by either all, or some of the fishing activities that occur within the site (demersal trawls, demersal seines, pelagic fishing and anchored nets/lines).

To ensure the effects of fishing activities in-combination with other activities (including other fishing activities) are fully assessed, the pressures from fishing activities which were not considered capable of affecting but which do interact with the features are considered in the in-combination aspect of the assessment (Part C).

Table 5. Summary of pressures that could be capable of affecting the protected habitat and/or mobile species features, based on pressure-activity associations and sensitivity. Pressures that are capable of affecting are in dark blue; these will be taken through to the Part B assessment.

Potential pressure	**Demersal trawls**	**Demersal seines**	**Pelagic fishing**	**Anchored nets/lines**
Transition elements and organo-metal (e.g. TBT) contamination. Includes those priority substances listed in Annex II of Directive 2008/105/EC	No – although some features may be sensitive, there is a low risk profile for the activities.			
Hydrocarbon & PAH contamination. Includes those priority substances listed in Annex II of Directive 2008/105/EC.	No - although some features may be sensitive, there is a low risk profile for the activities.			
Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals). Includes those priority substances listed in Annex II of Directive 2008/105/EC.	No - although some features may be sensitive, there is a low risk profile for the activities.			
Deoxygenation	No – the pressure has a low risk profile for the activities, and Burrowed mud has low sensitivity to this pressure (the other protected habitat and mobile species features are either not exposed or sensitivity is not assessed).			
Nutrient enrichment	No - low risk profile for demersal trawls and seines activities (and is not relevant for pelagic fishing or anchored nets/lines) and the protected habitat and mobile species features are either not assessed or not sensitive.			
Organic enrichment	No – although Coral gardens, Deep-sea sponge aggregations, Offshore deep-sea muds and Offshore sands and gravels have high sensitivity and Burrowed mud has medium sensitivity to this pressure, the pressure has a low risk profile for the activities (the mobile species features, and Seamount communities and Cold-water coral reefs are not assessed)			
Physical change (to another seabed type)	No – although the habitat features have high sensitivity to this pressure, the pressure has a low risk profile for demersal trawls and seines activities (and is not			

	relevant for pelagic fishing or anchored nets/lines). Mobile species features and Cold-water coral reefs are not assessed.
Physical change (to another sediment type)	No – although Burrowed mud has high sensitivity to this pressure, the pressure has a low risk profile for the demersal trawls and seines activities (and is not relevant for pelagic fishing or anchored nets/lines). Other protected habitat and mobile species features are not assessed.
Abrasion/disturbance of the substrate on the surface of the seabed	Yes – the pressure has a Medium-high risk profile for demersal trawls, seines and anchored nets/lines (it is not relevant for pelagic fishing) AND the habitat features have either high sensitivity (Coral gardens, Deep-sea sponge aggregations, Offshore deep-sea muds, Offshore sands and gravels, and Seamount communities) of medium sensitivity (Burrowed mud) to this pressure (mobile species features and Cold-water coral reefs are not assessed).
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Yes – the pressure has a Medium-high risk profile for demersal trawls and seines, and a low risk profile for anchored nets/lines (it is not relevant for pelagic fishing) AND the habitat features have either high sensitivity (Coral gardens, Deep-sea sponge aggregations, Offshore deep-sea muds, Offshore sands and gravels, and Seamount communities) or medium sensitivity (Burrowed mud) to this pressure (mobile species features and Cold-water coral reefs are not assessed)
Changes in suspended solids (water clarity)	Yes – the pressure has a Medium-high risk profile for demersal trawls and seines activities (although it is not relevant for pelagic fishing or anchored nets/lines), AND Coral gardens, Seamount communities and Deep-sea sponge aggregations are sensitive, and Burrowed mud has low sensitivity to this pressure. Cold-water coral reefs, Round-nose grenadier, Leafscale gulper shark/Gulper shark and Portuguese dogfish are not assessed, Offshore deep-sea muds and Offshore sands and gravels are not exposed, and Orange roughy and Blue ling are not sensitive.
Smothering and siltation rate changes (Light)	Yes – the pressure has a Medium-high risk profile for demersal trawls and seines activities (although it is not relevant for pelagic fishing or anchored nets/lines), AND the protected habitat features have either high (Coral gardens, Deep-sea sponge aggregations, Offshore deep-sea muds, Offshore sands and gravels, and Seamount communities) or low sensitivity (Burrowed mud). Cold-water coral reefs and mobile species features are not assessed.
Litter	No - low risk profile for activities (protected feature sensitivity is not assessed)

Underwater noise changes	No – although Coral gardens, Deep-sea sponge aggregations and Seamount communities are sensitive, there is a low risk profile for activities. (Orange roughy, Blue ling, Burrowed mud, Offshore deep-sea muds, and Offshore sands and gravels are not sensitive, and the other features are not assessed).
Introduction of light	No – sensitivity of all protected features is not assessed but there is a low risk profile for activities
Collision BELOW water with static or moving objects not naturally found in the marine environment (e.g. boats, machinery and structures)	No – sensitivity of all protected features is not assessed but there is a low risk profile for activities
Visual disturbance	No – sensitivity of all protected features is not assessed but there is a low risk profile for activities
Introduction or spread of invasive non-indigenous species (INIS)	No – sensitivity of protected features is not assessed (except Offshore sands and gravels which is Not sensitive), but there is a low risk profile for activities.
Removal of target species	Yes – the pressure has a Medium-high risk profile AND Orange roughy and Blue ling have high sensitivity, and Burrowed mud has Medium sensitivity (all other protected features are either not assessed or not exposed).
Removal of non-target species	Yes – the pressure has a Medium-high risk profile AND Coral gardens, Deep-sea sponge aggregations, Offshore deep-sea muds, Offshore sands and gravels and Seamount communities have high sensitivity, Burrowed mud and Blue ling have Medium sensitivity, and Orange roughy has low sensitivity (all other protected features are either not assessed or not exposed).

2.5 Part A conclusion

Considering the information on pressures and sensitivity above demersal trawls, demersal seines, pelagic fishing and anchored nets/lines have the potential to affect the Burrowed mud (including Sea-pens); Coral gardens; Cold-water coral reefs (including *Lophelia pertusa* reefs); Deep-sea sponge aggregations; Offshore deep-sea muds; Offshore sands and gravels; Seamount communities; Blue ling (*Molva dypterygia*); Leafscale gulper shark (*Centrophorus squamosus*) / Gulper shark (*Centrophorus granulosus*); Orange roughy (*Hoplostethus atlanticus*); Portuguese dogfish (*Centroscymnus coelolepis*) and Round-nose grenadier (*Coryphaenoides rupestris*) within West of Scotland NCMPA through abrasion/disturbance of the substrate on the surface of the seabed; penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion; changes in suspended solids (water clarity); removal of non-target species; removal of target species; and smothering and siltation rate changes (light). These six pressures are considered to affect the features and are taken through to Part B of the assessment.

3. Part B Assessment – Fisheries Assessment

3.1 Fisheries assessment overview

Part B of this assessment considers if there would be a risk of the fishing activities identified in Part A, at the levels identified in the relevant date range, hindering the achievement of the conservation objectives for the MPA, in order to consider whether, and if so, which, management measures might be appropriate for the MPA, taking into account all relevant statutory obligations incumbent upon the Scottish Ministers.

The fishing activities and pressures identified in Part A which have been included for assessment in Part B, are demersal trawls, demersal seines, pelagic fishing and anchored nets/lines. The pressures associated with these fishing activities that have been included in Part B are;

- abrasion/disturbance of the substrate on the surface of the seabed;
- penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion;
- smothering and siltation rate changes (Light);
- changes in suspended solids (water clarity);
- removal of non-target species and
- removal of target species.

3.2 Fishing Activity Descriptions

3.2.1 Existing management within West of Scotland NCMPA

In compliance with Part 5, Chapter 7 of The Common Fisheries Policy and Aquaculture (Amendment etc.) (EU Exit) Statutory Instrument (S.I.) 2019 No. 753, there is a ban on the use of all bottom-contacting mobile gear below 800 m depth across all UK waters. This applies across the area of West of Scotland NCMPA where the depth falls below 800 m. Part 5 Chapter 7 of S.I. 2019, No. 753 also implements restrictions on fishing between 400 m and 800 m where Vulnerable Marine Ecosystems (VMEs) are present, or are likely to occur. These rules aim to minimise the impact of fishing activities on VMEs. Under The Common Fisheries Policy and Animals (Amendment etc.) (EU Exit) Regulations 2019 S.I. 2019, No. 1312 (amending S.I. 2019, No. 753) there is a prohibition on the use of bottom-set gillnets, entangling nets, and trammel nets at depths greater than 200 m for the protection of deepwater shark species. These protective measures are also applied in the North-East Atlantic Fisheries Commission (NEAFC) technical measures regulatory area (beyond European Union waters) through the same Statutory Instrument. In the areas close to Anton Dohrn Seamount, Rosemary Bank and George Bligh Bank these gillnet restrictions are only seasonal. There are also seasonal restrictions placed in certain areas for blue ling and herring.

3.2.2 Fishing activity within the NCMPA

The West of Scotland NCMPA is a large area that overlaps ICES rectangles 42D6, 42D7, 42D8, 42D9, 42E0, 43D6, 43D7, 43D8, 43D9, 43E0, 44D7, 44D8, 44D9, 44E0, 45D5, 45D6, 45D7, 45D8, 45D9, 45E0, 46D5, 46D6, 46D7, 46D8, 46D9, 46E0, 46E1, 46E2, 47D5, 47D6, 47D7, 47D8, 47D9, 47E0, 47E1, 47E2, 47E3, 48D5, 48D6, 48D7, 48D8, 48D9, 48E0, 48E1, 48E2, 48E3, 49D6, 49D7, 49D8 and 49D9 which cross the Faroe Grounds (ICES Division 5b), West of Scotland (ICES Division 6a) and Rockall (ICES Division 6b), in the Rockall, Hebrides, Bailey, Hatton and North Scotland Coast regions. The main gear types for UK vessels are midwater trawls, demersal trawls and hooks and lines.

The VMS-based estimates and ICES rectangle landings statistics indicate that over-12 m midwater trawls and demersal trawls are the predominant UK vessels that operated within the site over the period 2015-2019.

For the over-12 m vessels, based on the VMS data from 2015-2019, demersal trawls operate predominantly in the southern part of the site, as well as along the eastern arc boundary, with midwater trawls concentrated mainly towards the south-eastern boundary. Set net activity is found mainly in a relatively small area over in the western edge of the site where shallower water persists. The distribution of under-12 m vessels' effort within these ICES rectangles indicates that landings recorded in these rectangles are unlikely to be taken from within the site itself.

In addition to UK activity, vessels from Norway (80 vessels), Ireland (57 vessels), Faroes (32 vessels), France (26 vessels), Spain (15 vessels), Germany (13 vessels), Denmark (10 vessels), Netherlands (8 vessels), Lithuania (6 vessels) and Poland (number of vessels cannot be disclosed) may also operate in the site, based on the VMS data from 2015-2019. However, it is not clear what gear types these vessels operate, nor whether they were actively fishing at the time.

3.2.3 Demersal trawls

The aggregated gear method of demersal trawls includes multiple gears that operated within the West of Scotland NCMPA between 2015 and 2019. These include bottom otter trawls, multi-rig trawls and other not specified bottom trawl types (Table 1). The target species for these gear types are demersal fish, molluscs or nephrops. Similar pressures are exerted by the different gears used for demersal trawling, subsequently the aggregated gear type of ‘demersal trawl’ was used to map activity across the site.

Based on the VMS, demersal trawl activity within West of Scotland NCMPA occurs at relatively low levels. Effort is concentrated along the continental slope, particularly in the north-east of the site, on the topographic features of the seamounts and George Bligh Bank, and also in a small area in the south of the site near Rockall Bank (Figures 1 and 2). Activity within the site boundary peaked at less than 12 hours per year per grid cell between 2015-2019 (Figure 3). Fishing activity tends to be concentrated along the easter boundary of the site (continental shelf edge) and average activity is between 12 to 24 hours per year per grid cell. The remainder of the site has no demersal trawling activity.

Swept-Area Ratio (SAR) information averaged over the same time period shows similar patterns of fishing intensity as the VMS data. Around the topographic features and the eastern boundary of the site (continental shelf edge), cells were swept only once per year between 2015-2019 (Figure 3). Again, evidence of fishing along the boundary of the site is shown where there are small areas of slightly higher SAR information, with cells swept 1-2 times per year. The rest of the site had no SAR values indicating no demersal trawling occurs.

3.2.4 Demersal seines

The aggregated gear method of demersal seines operated within the West of Scotland NCMPA between 2015 and 2019, as shown on the ICES gridded data (Figure 4). It was not possible to identify the specific gear types, however, as data from EU and Norwegian vessels was not available at this level of granularity. The target species for demersal seines are demersal fish.

Based on the ICES gridded data, demersal seine activity within West of Scotland NCMPA occurs at relatively low levels. Effort is concentrated in a line across the south of the site, with activity peaking at less than 12 hours per year per grid cell between 2015-2019 (Figure 4). The remainder of the site has no demersal seine fishing activity.

Swept-Area Ratio (SAR) information averaged over the same time period shows similar patterns of fishing intensity as the VMS data. There is a single line of demersal seine activity across the south of the site, where cells were swept less than once per year between 2015-2019 (Figure 4). The rest of the site had no SAR values indicating no demersal seine fishing occurs.

3.2.5 Pelagic fishing

The aggregated gear method of pelagic fishing included mid-water trawls (single) that operated within the West of Scotland NCMPA between 2015 and 2019 (Table 1). The target species for these gear types are pelagic fish.

Based on the VMS, pelagic fishing activity within West of Scotland NCMPA occurs at relatively low levels, however there are a number of limitations with the interpretation of the VMS for pelagic fishing estimates that should be considered here. Effort of pelagic fishing is therefore likely to be underestimated from the VMS activity maps (Figure 5) alone. The rationale for this underestimation is due to the operation of the fishing activity being relatively short in comparison to, for example, demersal trawls. There is generally a two hour reporting frequency of the VMS that means the pelagic fishing activity is likely to be under-estimated. In addition pelagic shoals may be fishes in different areas in different years, resulting in average cell values can be low. Lastly this data is for UK vessels only, there is pelagic activity effort by a variety of other nationals along the edge of the continental shelf which the VMS activity cannot be accessed.

Effort is concentrated along the south-eastern edge of the site and in a small area in the north eastern corner, with activity peaking at less than 12 hours per year per grid cell between 2015-2019 (Figure 5). The remainder of the site has no pelagic fishing activity.

3.2.6 Anchored nets/lines

The aggregated gear method of anchored nets/lines includes multiple gears that operated within the West of Scotland NCMPA between 2015 and 2019. These include set gillnets and set longlines (Table 1). The target species for these gear types are demersal fish. Similar pressures are exerted by the different gears used for anchored nets/lines fishing, subsequently the aggregated gear type of ‘anchored nets/lines’ was used to map activity across the site.

Based on the VMS, anchored nets/lines activity within West of Scotland NCMPA occurs at relatively low levels. Effort is concentrated over the topographic feature of George Bligh Bank, and within a small area in the south of the site near Rockall Bank, with activity peaking at less than 12 hours per year per grid cell between 2015-2019 (Figures 1 and 6). The remainder of the site has no anchored nets/lines fishing activity.

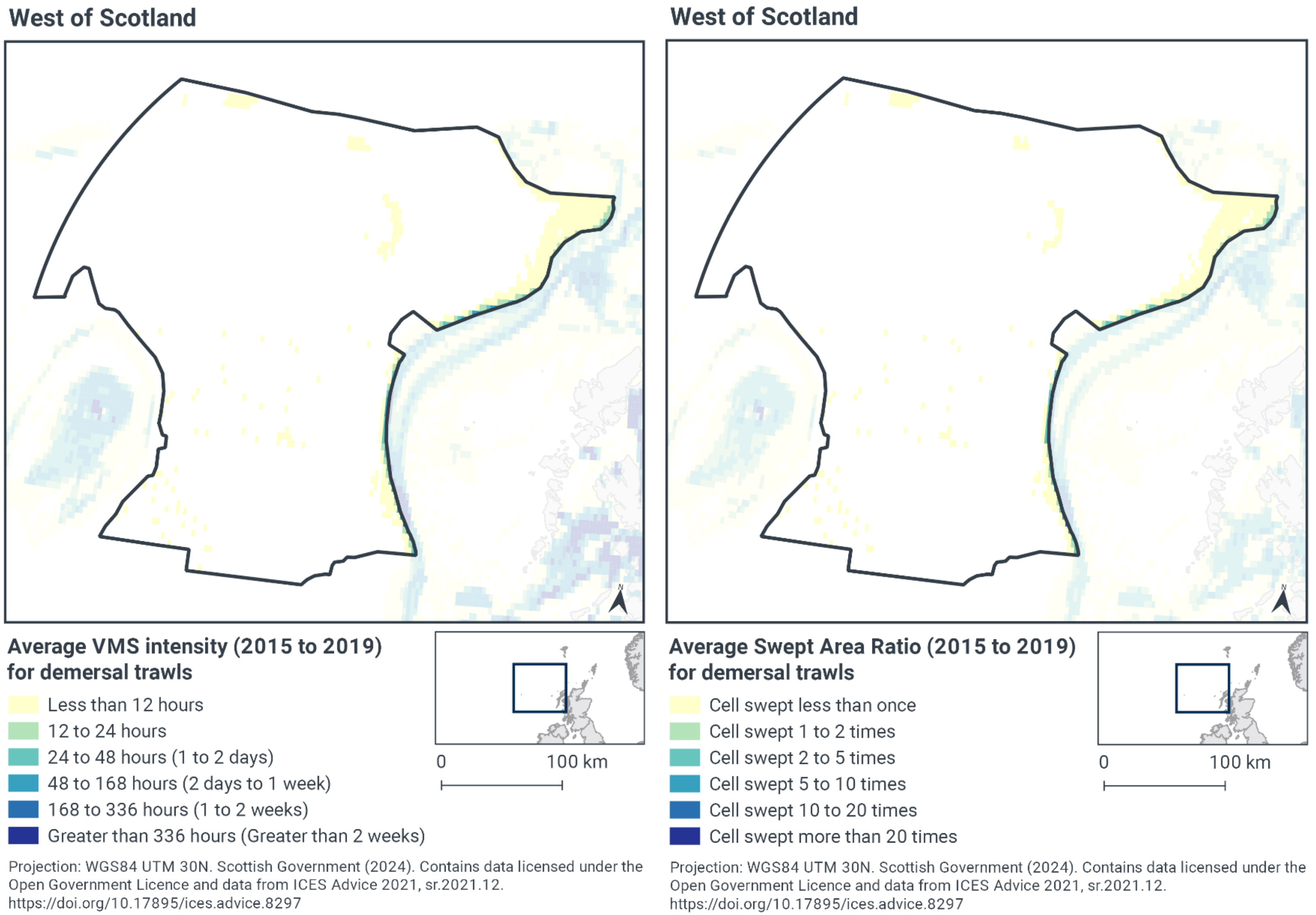

Figure 3. Annual Fishing intensity averaged over 2015 to 2019 for demersal trawls based on the VMS data (left) and Swept Area Ratio (right).

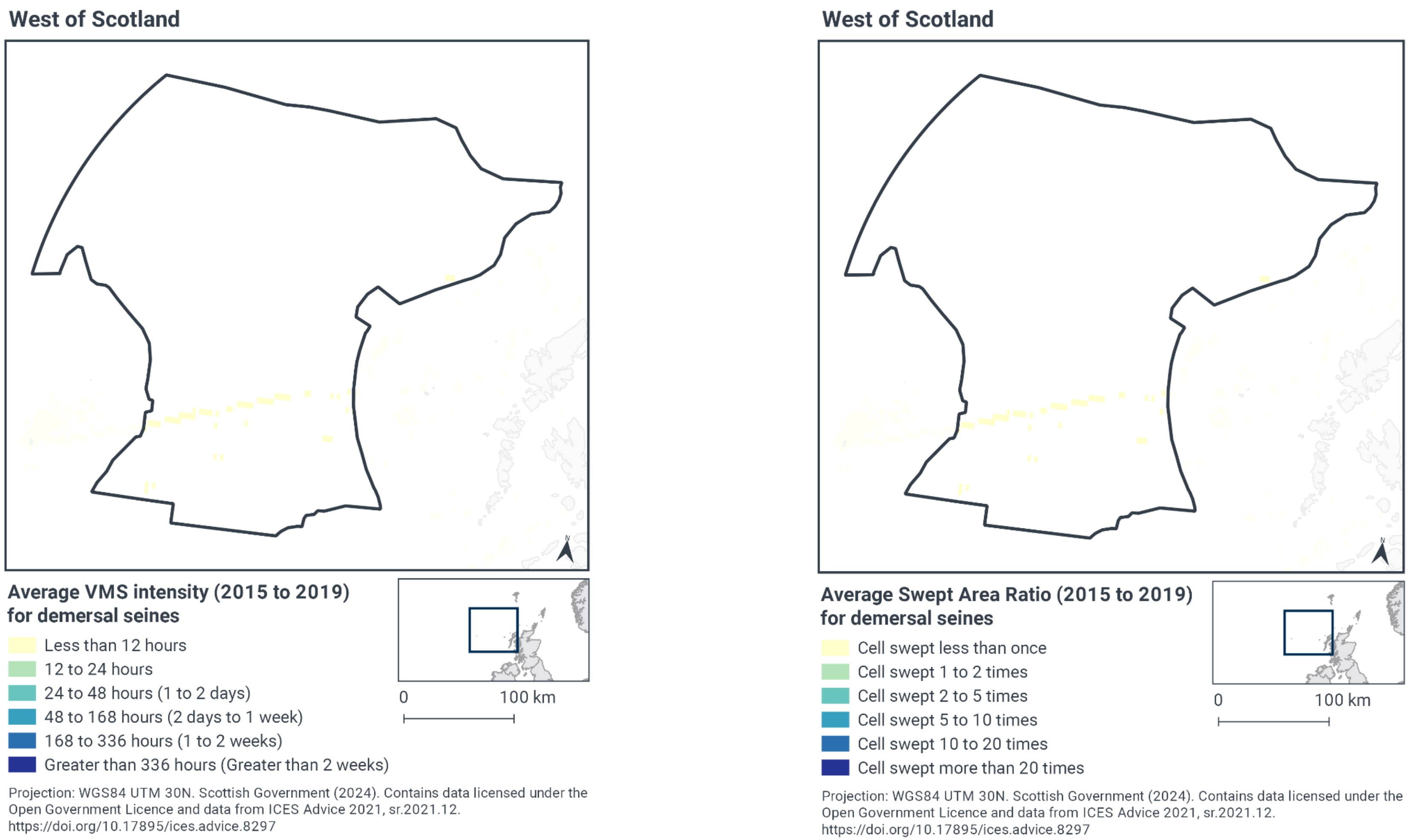

Figure 4. Annual Fishing intensity averaged over 2015 to 2019 for demersal seines based on the VMS data (left) and Swept Area Ratio (right).

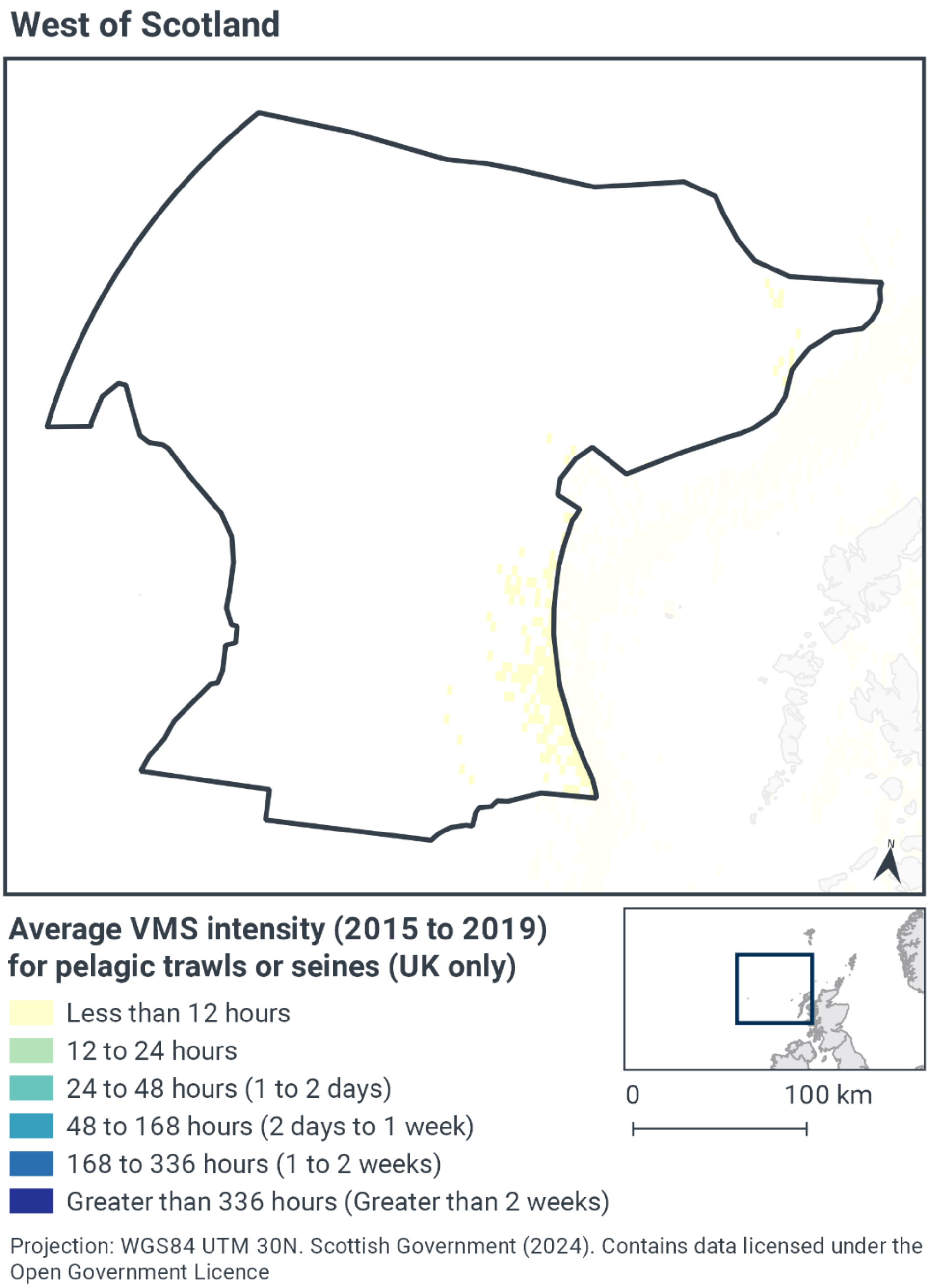

Figure 5. Annual Fishing intensity averaged over 2015 to 2019 for pelagic fishing based on the VMS data.

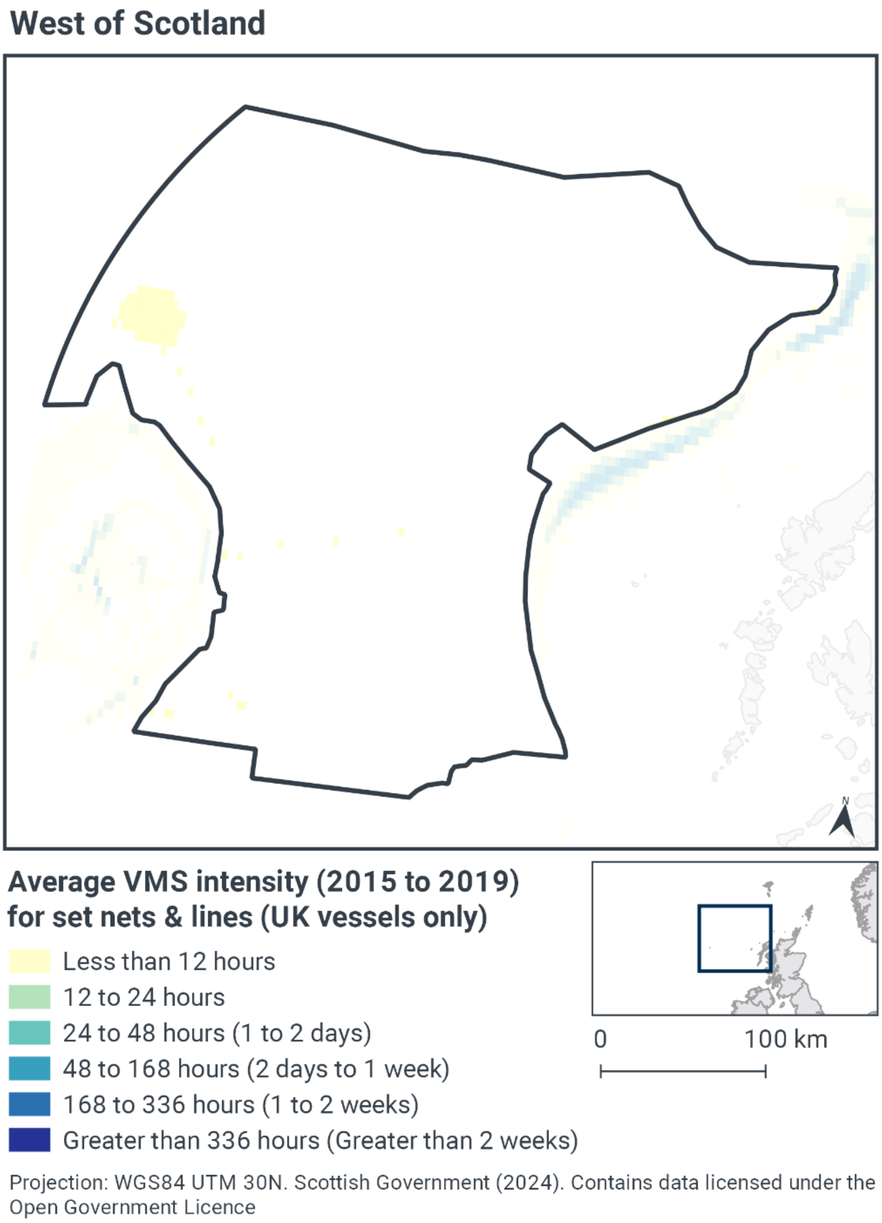

Figure 6. Annual **fi**shing intensity averaged over 2015 to 2019 for anchored nets/lines based on the VMS data (left) and Swept Area Ratio (right).

3.2.7 Summary of fishing activity within West of Scotland NCMPA

Fishing activity within the West of Scotland NCMPA is relatively low, with only limited demersal trawl, demersal seine, pelagic and anchored nets/lines activity occurring. Where activity does occur, it appears to be concentrated around the topographic features of the site, such as the seamounts, and/or along the continental shelf edge (eastern boundary of the site). These low levels of activity for demersal mobile and static gear are reflective of the existing management measures that are already in place within the site, as described in Section 3.2.1 above.

3.3 Fishing activity effects overview

The following sections explore the pressures associated with fishing activity (demersal trawl, demersal seine, pelagic fishing and anchored nets/line) within the West of Scotland NCMPA that were considered capable of impacting the protected features. The pressures considered are:

- Abrasion/disturbance of the substrate on the surface of the seabed;
- Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion;
- Smothering and siltation rate changes (Light);
- Changes in suspended solids (water clarity);
- Removal of non-target species and
- Removal of target species.

These six pressures were exerted by a combination of demersal trawl, demersal seine, pelagic fishing and anchored nets/line, and were considered capable of impacting the protected features.

Given the similarity between 'abrasion/disturbance of the substrate on the surface of the seabed' and 'penetration and/or disturbance of the substrate below the surface of the seabed', these two pressures are considered together in the text below.

Information on the sensitivity of the protected features to each of these pressures is presented below and is taken from FeAST, the West of Scotland NCMPA Fisheries Management Options Paper and the feature specific fisheries management guidance prepared by JNCC and NatureScot. At the end of this section, a summary of the overall potential impacts associated with the demersal trawls, demersal seines, pelagic fishing and anchored nets/lines fishing activity is presented.

3.3.1 Impacts of demersal mobile gear (trawls and seines) on habitat features

The species associated with Seamount communities tend to be composed of erect and fragile species that are sensitive to physical disturbance, particularly deep-sea stony corals, gorgonians and black corals, sea anemones, hydroids and sponges (Clark et al. 2010; Clark and Tittensor, 2010). Significant reductions in stony coral cover and associated species abundance and diversity have been observed on trawled seamounts in New Zealand and Australia (Goode et al. 2020). Clark and Tittensor (2010) found that roughly 100 trawl tows can reduce coral to very low mean levels (<1%) on New Zealand seamounts. Between approximately 100 and 800 tows would remove coral cover entirely. However, mean coral cover on some seamounts can be reduced to less than 1% with far fewer tows. Single passes of trawls can themselves cause more than half of sponges and corals present to be visibly damaged (Freese et al. 1999). Mortality of species can occur both by disturbance at the seabed from trawls or through being brought to the surface, resulting in a reduction in abundance (ICES, 2010; Jennings and Kaiser, 1998; Kaiser and Spencer, 1996).

Despite some seamount taxa being more resistance to the direct effects of bottom-trawling, Goode et al. (2020) concluded that seamount benthic communities overall appear to have low resistance. Recovery from damage is estimated to be measured in decades, depending on the environmental conditions and biological variables, although the species present on seamounts can exhibit varying recovery rates (ICES, 2010; Clark et al. 2010; Goode et al. 2020). Species with higher longevity, such as habitat-forming corals and sponges, take much longer to recover. As these can form a key part of Seamount communities, any impacts to those species can significantly alter the structure and function of the Seamount communities feature (Goode et al. 2020). These features (Deep-sea sponge aggregations, Cold-water coral reefs and Coral gardens), which are also protected in their own right within the West of Scotland NCMPA, are discussed below.

There is no evidence of impacted Seamount communities regaining their pre-disturbance condition in terms of community composition, megafaunal abundance or species diversity (Goode et al. 2020), indicating the importance of management prior to impacts occurring where possible. Based on the evidence above, there is a high risk that mobile bottom contact gear will affect the extent and distribution of Seamount community features, as well as their structure and function.

Deep-sea sponge aggregations are highly sensitive to bycatch, abrasion, and penetration pressures (Dinwoodie, 2021a, 2021b, Last et al. 2019a, 2019b). Studies on Deep-sea sponge aggregations have found that trawling damages, displaces and removes sponges through direct physical impact, as well as from disturbed sediment resettling and causing smothering beyond the path of the trawl itself (Buhl-Mortensen et al. 2016; ICES, 2007, 2010; Kędra et al. 2017; OSPAR, 2010a). Deep-sea sponges have some capacity for recovery from mild damage, but significant disturbance, damage or smothering may result in sponges being unlikely to survive (Fang et al. 2018; Freese, 2001; ICES, 2007, 2010; Jones et al. 2012; Malecha and Heifetz, 2017). Pham et al. (2019) modelled the impact of bottom trawling on sponge grounds dominated by *Geodia* sp. in Canadian waters, finding that a simulation of 30 trawls would remove 884 tonnes of sponges. Similarly, a scientific experiment on the effects of an Agassi bottom trawl on deep-sea sponge grounds in the Arctic Ocean significantly reduced megafaunal densities, including large sponge species (Morrison et al. 2020). Although smaller morphotype sponges showed lower trawling impacts, it is the large sponges that have the greatest contribution to the structural complexity of Deep-sea sponge aggregations (Morrison et al. 2020). In addition to reductions in numbers, *Geodia* spp. sponges in areas impacted by trawling may also have reduced mean individual sponge biomasses (Kędra et al. 2017). Viera et al. (2020) inferred a relationship between increased bottom trawl fishing activity and decreased aggregation-forming sponge *Pheronema carpenteri* condition (individual mass, sponge equatorial diameter, and geometric mean densities). Morrison et al. (2020) found no signs of recovery of impacted deep-sea sponge grounds four years after the trawling occurred, whilst Malecha and Heifetz (2017) found significant damage to sponges evident in the deep-sea sponge communities after 13-years following trawling impact. Sedimentation events, which can also be caused by trawling activity, similarly resulted in negligible recovery over a 10-year period (Jones et al. 2012). Recovery of structure and function following damage is therefore likely to take at least 25 years (Dinwoodie, 2021a, 2021b, Last et al. 2019a, 2019b). Deep-sea sponge aggregations dominated by *Geodia* spp. play a key functional role in the wider deep-sea environment, filtering approximately 56,000 million litres of seawater on a daily basis, consuming roughly 63 tonnes of organic carbon through respiration and contributing to the turnover of several nitrogen nutrients (Pham et al. 2019). Based on the evidence above, there is a high risk that mobile bottom contact gear will affect the extent and distribution of Deep-sea sponge aggregation features, as well as their structure and function.

Cold-water coral reefs are highly sensitive to bycatch, abrasion and penetration pressures (Garrard et al. 2020). Bottom trawling has been found to severely damage reefs, breaking up the structure, fragmenting the reef, and potentially resulting in the complete disintegration of the coral matrix, and loss of the associated species (Fosså et al. 2002; Grehan et al. 2005; Hall-Spencer et al. 2002; Roberts et al. 2009; Rogers, 1999). Cold-water coral specimens can also be bycaught in trawls (Durán Muñoz et al. 2012). Cold-water coral reefs can occur on seamounts, and as stated above, significant reductions in stony coral cover and associated species abundance and diversity have been observed on trawled seamounts in New Zealand and Australia (Goode et al. 2020). Clark and Tittensor (2010) found that roughly 100 trawl tows can reduce coral to very low mean levels (<1%) on New Zealand seamounts. Between approximately 100 and 800 tows would remove coral cover entirely. However, mean coral cover on some seamounts can be reduced to less than 1% with far fewer tows. Cold-water coral reef habitats completely damaged by physical pressures such as those associated with benthic trawling do not show signs of recovery even a decade after such pressure has been removed (Althaus et al. 2009; Buhl-Mortensen et al. 2013; Buhl-Mortensen, 2017; Hall-Spencer et al. 2002; Howell et al. 2014; Huvenne et al. 2016; Williams et al. 2010). However, recovery (or regrowth) has been observed in areas where some living coral remains after impact (Buhl-Mortensen et al. 2013; Buhl-Mortensen, 2017; Huvenne et al. 2016). If coral colonies are killed, any recovery of extent and distribution will be influenced by the method of reproduction, dispersal potential, the relative location of a potential source population of reproductive adults and the presence of suitable supporting habitat (Dahl et al. 2012; Fox et al. 2016). Evidence indicates that for some species of cold-water corals, successful recruitment events may only occur once a decade (Stone et al. 2015), which could limit the opportunities for recovery. Based on the evidence above, there is a high risk that mobile bottom contact gear will affect the extent and distribution of Cold-water coral reef features, as well as their structure and function.

Coral gardens are highly sensitive to physical disturbance and bycatch (Yoklavich et al. 2018). Mobile benthic gears can result in significant damage and mortality (Durán Muñoz et al. 2012; OSPAR, 2010b) and over time, the structural and biological diversity of the habitat will be reduced. Coral gardens on soft bottoms within fishing depths are particularly vulnerable (Edinger and Sherwood, 2009), however, where they occur on low relief hard substrate Coral gardens may also be accessible to rockhopper gears (OSPAR, 2010b). Re-establishment of individual specimens of corals may occur within 50 to 100 years but the time taken for complex coral garden habitat to develop is likely to be longer (ICES, 2010). Based on this evidence, there is a high risk that mobile bottom contact gear will affect the extent and distribution of Coral garden features, as well as their structure and function.

In lower energy deep water locations, such as in the West of Scotland NCMPA, sedimentary habitats tend to be more stable and their associated fauna less tolerant of disturbance (Hiddink et al. 2006; Kaiser et al. 2006). Studies have shown that areas of mud habitats (which includes Offshore deep-sea mud and Burrowed mud including sea-pens) subject to mobile fishing activity, support a modified biological community with lower diversity, reduction or loss of long-lived filter-feeding species and increased abundance of opportunistic scavengers (Ball et al. 2000; Tuck et al. 1998). This effect is often greatest in the more heavily fished offshore areas suggesting that impact is related to the intensity of fishing (Ball et al. 2000). Furthermore, modelling studies suggest that the greatest impact is produced by the first pass of a trawl (Hiddink et al. 2006). Trawling on these deep-sea sedimentary habitats can cause significant decreases in organic matter content, slower organic carbon turnover, reduced meiofauna abundance, biodiversity and nematode species richness (Pusceddu et al. 2014). The use of penetrative gear over soft substrates, can further cause removal or re-stratification of sediment layers and homogenisation of sedimentary habitats (Goode et al. 2020; Martín et al. 2014). Sediment resuspension can also occur, resulting in increases in turbidity and risks of smothering to benthic fauna (Martín et al. 2014). The physical integrity of the seabed can also be altered, becoming flattened in trawled areas with less bioturbation (fewer and smaller burrows, mounds and faunal tracks) compared to non-trawled areas (Ramalho et al. 2017). Other physical impacts include scars created by the trawl doors (Goode et al. 2020). These alterations to the seafloor structure can be long lasting, with scars remaining visible for more than 10 years after trawling ceases (Goode et al. 2020). Based on the evidence above, it is likely that mobile bottom contact gear will affect the extent and distribution, and structure and function of Burrowed mud (including sea-pens) and Offshore deep-sea mud features, including the sediment composition and finer scale topology. Such sedimentary habitats also provide an important blue carbon store and although the interaction between mobile fishing gear and sediments is complex (Epstein et al. 2021), research has shown that the west coast of Scotland is a key area where sedimentary carbon is potentially at greatest risk from bottom trawling activity (Black et al. 2022).

Deep-sea sea-pens, associated with Burrowed mud and Offshore deep-sea mud habitats, are likely to have medium sensitivity to bycatch, abrasion and penetration pressures and are highly sensitivity to heavy levels of smothering (up to 30cm) (Last et al. 2020a, 2020b). Although some sea-pen species have behavioural adaptations and can recover from minor damage (Kenchington et al. 2011; Malecha and Stone, 2009; Troffe et al. 2005), high levels of bycatch in trawl nets can occur and incidental mortality is a concern for those remaining on the seafloor (Last et al. 2020a, 2020b). Otter trawls have been found to catch the greatest frequency of sea-pens compared to other gear types, e.g., twin trawl, triple trawl, shrimp trawl, and static gears (Wareham and Edinger, 2007). Dredges can also catch high numbers of sea-pens (Pires et al. 2009). A number of studies indicate that the abundance of sea-pen species are negatively correlated with bottom trawling (Adey, 2007; Buhl-Mortensen et al. 2016; Hixon and Tissot, 2007). In addition to sea-pens, Nephrops may be an important component of the benthic community associated with Offshore deep-sea mud and Burrowed mud. Any fisheries, such as mobile bottom-contact gears, that greatly alter the abundance or size composition of this species may therefore have a negative impact on the biological structure of the features. This evidence further suggests that mobile bottom contact gear will likely affect the biological assemblages and biological structure of the features, resulting in impacts to the extent and distribution, and the structure and function of the Burrowed mud (including sea-pens) and Offshore deep-sea mud habitat features.

Similar to the above, trawling on Offshore sands and gravels also can cause significant decreases in organic matter content, slower organic carbon turnover, reduced meiofauna abundance, biodiversity and nematode species richness (Pusceddu et al. 2014). Stable Offshore sands and gravels often support a ‘turf’ of fragile species which are easily damaged by trawling and recover slowly (Collie et al. 2005; Foden et al. 2010). Trawling and dredging tends to cause increased mortality of fragile and long lived species and favour opportunistic, disturbance-tolerant species (Bergmann and Van Santbrink, 2000; Eleftheriou and Robertson, 1992). Some particularly sensitive species may disappear entirely (Bergmann and Van Santbrink, 2000). The net result is benthic communities modified to varying degrees relative to the un-impacted state (Bergmann and Van Santbrink, 2000; Kaiser et al. 2006). The use of penetrative gear over soft substrates, can further cause removal or re-stratification of sediment layers and homogenisation of sedimentary habitats (Goode et al. 2020; Martín et al. 2014). Sediment resuspension can also occur, resulting in increases in turbidity and risks of smothering to benthic fauna (Martín et al. 2014). Other physical impacts include scars created by the trawl doors and dislodgment or removal of boulders, rocks and biogenic substrates (Goode et al. 2020). These alterations to the seafloor structure can be long lasting, with scars remaining visible for more than 10 years after trawling ceases (Goode et al. 2020). Based on this evidence, it is likely that mobile bottom contact gear will affect the extent and distribution, and structure and function of Offshore sands and gravels, including the sediment composition, finer scale topology, biological assemblages, and biological structure.

Activity from demersal trawling and demersal seines within West of Scotland NCMPA occurs at relatively low levels and over a very limited spatial scale, and existing management is in place which already restricts the activity permitted within the site (see Section 3.2.1 above). However, the protected habitat features of the site, in particular Deep-sea sponge aggregations, Coral gardens, Cold-water coral reefs (including *Lophelia pertusa* reefs) or Seamount communities, as described above, are highly sensitive to demersal mobile gear activity.

Given the evidence above, the impacts of mobile demersal gear (including demersal trawls and demersal seines) alone within West of Scotland NCMPA at current levels of activity carry a risk of hindering the restoration of the protected habitat features offshore sands and gravels, burrowed mud, offshore deep-sea muds, deep-sea sponge aggregations, coral gardens, cold-water coral reefs (including *Lophelia pertusa* reefs) or seamount communities, such that the extent and distribution, structure and function and supporting processes are maintained or restored. Accordingly, Scottish Ministers conclude that demersal mobile gear alone are capable of impacting the protected features and, at current levels, would or might hinder the achievement of the conservation objectives of the MPA.

3.3.2 Impacts of anchored nets/lines fishing on habitat features

No studies providing evidence of the effects of static gears on Scottish seamount communities were found, however impacts occurring on analogous vulnerable habitats and species, such as sponges and corals in Scottish waters are applicable (Durán Muñoz et al. 2011). Impacts can arise from hooks, lines, nets and ropes becoming entangled with corals and other fragile species, including ‘plucking’ them from the seabed during hauling (Durán Muñoz et al. 2011; Mortensen et al. 2005; OSPAR, 2010b). While the degree of damage from individual fishing operations is likely to be lower than for trawling, cumulative damage may be significant. Based on the evidence above, there is a high risk that static bottom contact gear will affect the extent and distribution of Seamount community features, as well as their structure and function.

The Deep-sea sponge aggregation feature is considered to be sensitive to static gear activity, notably because sponges may become caught or entangled in static gears and damaged on the seabed or brought to the surface (OSPAR, 2010a). Such by-catch by demersal longliners of hexactinellid and demospongid sponges has been documented within the North-east Atlantic (Durán Muñoz et al. 2011), the Azores (Cyr, 2018) and in the Antarctic (Parker and Bowden, 2010). One study on Hatton Bank collected 3.5 kg of sponges from a total of 38 longline sets (Durán Muñoz et al. 2011), however this only contributed < 0.1% of the total catch: 65.8% of the total sponge catch was obtained with monofilament gear, compared to 34.2% with multifilament gear. In the Azores, low bycatch rates were recorded overall (0.07 sponge per 1000 hooks), however on average per 1000m^2, 1 out of 4 individuals remaining on the seafloor were left damaged by the longline activities (e.g., fragmented, dislodged, entangled or dead; Cyr, 2018). These in-situ impacts, causing incidental mortality and abrasive damages, were greater for sponges with higher structural complexities, such as those with massive, flabellate and pedunculate morphologies (Cyr, 2018). Where sponges are dislodged, this is likely to impact a sponge’s ability to filter water (Parker and Bowden, 2010). While these evidence source show that the extent of damage caused by individual static gear fishing events is likely to be lower than that for trawling, the effect of cumulative damage may be significant. Recovery from damage is likely to take at least 25 years (Dinwoodie, 2021a, 2021b, Last et al. 2019a, 2019b). Based on the evidence above, particularly considering cumulative effects, there is a high risk that static bottom contact gear will affect the extent and distribution of Deep-sea sponge aggregation features, as well as their structure and function.

Damage to Cold-water coral reefs and Coral gardens can occur from static fishing gear such as gill nets and long-line fisheries, where corals can become entangled in ropes/lines or nets and can be plucked off the seabed during hauling (Fosså et al. 2002; ICES, 2010; Mortensen et al. 2005; OSPAR, 2010b; Parker and Bowden, 2010; Wareham and Edinger, 2007). Bottom longlining poses a high risk to large erect species such as gorgonians, cup corals, soft corals, black corals and lace corals (Durán Muñoz et al. 2011; OSPAR, 2010b). In a study off Portugal, 85% of bottom-set gillnet deployments caught cold-water corals, 45% of which were entire colonies and overall 22 different coral species were recorded as bycatch (Dias et al. 2020). Coral bycatch was higher when the nets were deployed on or nearby areas where rocky substrate is known to occur. The average coral CPUE was 0.92 per day with a 100 m net length (31.1 corals per set), however this increased to 13.02 over rocky substrates. A study in the Ionian Sea similarly found that 72% of longline sets captured corals (Mytilineou et al. 2014). In comparison, in the Azores, Sampaio et al. (2012) reported that 15.2% of 297 commercial longline fishing trips landed corals and deep-sea longline fishing removed 0.32 corals per 1000 hooks (1.14 corals per set; Pham et al. 2014). Where static gears do cause mortality or damage to coral garden habitats, the recovery and re-establishment characteristics are the same as those for mobile gears above. Traps are unlikely to catch any bycatch in comparison (Shester and Micheli, 2011). It is worth noting that these coral removal rates are much lower than those reported for bottom trawling (Clark et al. 2016). Site specific difference in coral density will also affect the bycatch rates. Based on the evidence above, there is a high risk that static bottom contact gear will affect the extent and distribution of Cold-water coral reef and Coral garden features, as well as their structure and function.

Offshore sands and gravels within subtidal areas are not considered to be sensitive to the level of abrasion caused by static demersal gears, with minimal impact on the faunal communities and seabed structure (Tillin et al. 2010; Tyler-Walters et al. 2009). However, in lower energy deep water locations, such as in the West of Scotland NCMPA, sediments tend to be more stable and their associated fauna less tolerant of disturbance (Hiddink et al. 2006; Kaiser et al. 2006). Bycatch of associated communities, such as invertebrates also poses a risk. Overall, the risk from low levels of static bottom contact gear on the abundance and distribution, and the structure and function of Offshore sands and gravels is likely to be limited, however higher levels of fishing activity will pose a greater risk to the features and their attributes.

Bycatch of deep-sea sea-pen species (associated with Offshore deep-sea mud and Burrowed mud) has been recorded in gillnets and longlines, although at a lower frequency than otter trawls (Wareham and Edinger, 2007). Longline hooks of varied sizes can catch specimens of all size ranges, including larger specimens (de Moura

Neves et al. 2018). If static fishing activity is low, direct impact on the habitat is likely to be minimal and seabed structure is likely to be maintained in a slightly modified state (Adey, 2007). In addition to sea-pens, *Nephrops* may be an important component of the benthic community associated with Offshore deep-sea mud and Burrowed mud. Any fisheries, such as static gears, that greatly alter the abundance or size composition of this species may therefore have a negative impact on the biological structure of the features. Based on the evidence above, the risk from low levels of static bottom contact gear on the abundance and distribution, and the structure and function of Burrowed mud (including sea-pens) and Offshore deep-sea mud is likely to be limited, however higher levels of fishing activity will pose a greater risk to the features and their attributes.

Activity from anchored nets/lines within West of Scotland NCMPA occurs at relatively low levels and over a very limited spatial scale, and existing management is in place which already restricts the activity permitted within the site (see Section 3.2.1 above). However, the protected habitat features of the site, in particular deep-sea sponge aggregations, coral gardens, cold-water coral reefs (including *Lophelia pertusa* reefs) and seamount communities, as described above, are highly sensitive to anchored nets/lines activity.

Given the evidence above, the impacts of anchored nets/lines alone within West of Scotland NCMPA at current levels of activity carry a risk of hindering the conservation objectives of the protected habitat features deep-sea sponge aggregations, coral gardens, cold-water coral reefs (including *Lophelia pertusa* reefs) or seamount communities. Anchored nets/lines are capable of impacting the burrowed mud, offshore deep-sea mud features but would not hinder the achievement of the conservation objectives of the site at current levels of activity.

Accordingly, Scottish Ministers conclude that anchored nets/lines alone are capable of impacting the protected features; deep-sea sponge aggregations, coral gardens, cold-water coral reefs (including *Lophelia pertusa* reefs) or seamount communities, and at current levels, would or might hinder but would or might hinder the achievement of the conservation objectives of the NCMPA.

3.3.3 Impacts of demersal mobile gear on mobile species features

Orange roughy (*Hoplostethus atlanticus*) occurs in a depth band between 180-1800 m (Priede, 2019), corresponding with an area about 20 nautical miles (nm) wide in the West of Scotland NCMPA. The species has historically been targeted in a directed demersal otter trawl fishery in deep water west of Scotland, which resulted in a strong decline in the stock (ICES, 2019a, 2020a). This fishery targeted the spawning aggregations that occur around steep slope and seamount environments, allowing very large catches to be taken over a short period of time, leading to local depletions (FeAST, 2013). However, since 2003 no direct fishery has been permitted for Orange roughy, with limited bycatch allowed in mixed fisheries until 2010 when a zero Total Allowable Catch (TAC) was implemented across all ICES subareas. In addition to the spawning aggregations around seamounts and steep slopes, Scottish deep-water trawl surveys found several juvenile cohorts were present on the gentle slopes of the continental slope (Dransfeld et al. 2013; ICES, 2019a). The species' long life-span, slow growth rate, late maturity (27.5 years; Minto and Nolan, 2006), low fecundity and episodic recruitment characteristics contribute to its vulnerability, making the species particularly susceptible to population declines if mature adults are removed (Dransfeld et al. 2013). Fishing pressure can also disrupt the schooling behaviour of Orange roughy (Clark and Tracey 1991, cited in Branch, 2001). In areas where fishing is prohibited, smaller and denser aggregations have been observed (Clark et al. 2000). Based on the evidence above, mobile bottom contact gear may affect the presence and distribution of the Orange roughy feature, due to the risk associated with accidental bycatch.

The Roundnose grenadier (*Coryphaenoides rupestris*) is typically a bottom-living, demersal fish, occurring at depths from 180-2,600 m (Priede, 2019). The species is known to move seasonally up and down the continental slope (Cohen et al. 1990). They are also poor swimmers, so are vulnerable to target and non-target fisheries (Simpson et al. 2011). The long tapering tail of the Roundnose grenadier is also easily damaged after trawling (Priede, 2019; Simpson et al. 2011), suggesting that bycatch incidents can be fatal. The species was first targeted in the North Atlantic by deep-sea fishing fleets in the 1960s and landings peaked in the early 1970s, before declining sharply (Devine and Haedrich, 2008; Priede, 2019). Over a 26-year period from 1978-2003, there was a 99.6% decline in the relative abundance of Roundnose grenadier in the Canadian waters of the northwest Atlantic, as sampled through scientific surveys (Devine et al. 2006). Over 17-years (1978-1994), the individual mean size of Roundnose grenadier declined by 54.9% (Devine et al. 2006). These declines were found to be best explained by fisheries selection, although large-scale atmospheric conditions also played a role (Devine et al. 2006). Catches of Roundnose grenadier in the Rockall Trough have previously represented 28% of entire fish hauls (Mauchline and Gordon, 1984) and on the Hatton Bank the species represented 64% of the catch composition, indicating that the species is at high risk of exploitation. High discards have also been recorded due to catches being comprised of small sized individuals, representing up to 50% of the catch by number and 30% by weight (Durán Muñoz et al. 2012; Pawlowski and Lorance, 2014). Bycatch of Roundnose grenadier most notably occurs in demersal trawl fisheries targeting Greenland halibut, *Reinhardtius hippoglossoides* and redfish, Sebastes spp. (Devine and Haedrich, 2008; Devine et al. 2006; Jørgensen et al. 2014). Assuming a fisheries catch equal to 5% of the total population, recovery rates of the Roundnose grenadier (based on life history characteristics) are estimated to be between 16 and 136 years (Baker et al. 2009). All size classes are found within the West of Scotland NCMPA (Priede, 2019), so there is a risk of a decline in the mean size of individuals, in addition to there being high discard rates of the smaller individuals. Although there is currently a zero TAC in place for Roundnose grenadier within ICES area 6, based on the evidence above, mobile bottom contact gear may affect the presence and distribution of the Roundnose grenadier feature, due to the risk associated with accidental bycatch.

Blue ling (*Molva dypterygia*) occur at 500 to 1,250m depths in the Rockall Trough (Priede, 2019) and all Blue ling in the ICES subareas 5b, 6 and 7 (including the whole West of Scotland area) are deemed to be mature (Lorance, 2020). The species has mainly been targeted during their spawning season, due to higher catchability, using standard deep-water trawling techniques, gillnets and longlines (FeAST, 2013). From 1970 to 1990, the bulk of the fishery for Blue ling was seasonal fisheries targeting these aggregations (Lorance, 2020). This has previously led to local depletions of aggregations and in 2009 a seasonal closure (1st March to 31st May each year) was introduced to protect spawning aggregations. Outside the spawning season Blue ling is taken in mixed trawl fisheries (targeting shelf species such as saithe, hake, monkfish and megrim; Lorance, 2020). ICES (2018) found that the spawning-stock biomass has increased since 2004 and the fishing mortality has decreased since 2004. Blue ling recruitment is thought to be stable. In 2017, 95% of landings in ICES subareas 6-7 were in trawl fisheries, with 5% longline fisheries. Discards are thought to be negligible as no undersized Blue ling are caught, and due to low fishing activity, catches have been lower than TACs. Based on the evidence available, a precautionary approach is recommended as there is a risk that the presence and distribution of Blue ling would be impacted if mobile bottom contact gear activity increases.

Evidence for the three deep-sea shark species features, Gulper shark (*Centrophorus granulosus*), Leafscale gulper shark (*Centrophorus squamosus*) and Portuguese dogfish (*Centroscymnus coelolepis*) are presented together below. Literature reviews by Wilson et al. (2009) and Kyne and Simpfendorfer (2007) suggest many long-lived deep-water shark species are unable to self-sustain populations at catch rates exceeding 5% of total biomass. The populations are therefore likely to continue to decline for as long as the species are targeted or taken as bycatch (OSPAR, 2010c). Due to their life history characteristics of very slow growth rates, late maturity, low reproductive potential, long intervals between litters and extreme longevity (Priede, 2019), deep-sea shark species are likely to be very slow to recover (exceeding 25 years), even if deep-water fisheries and all bycatch ceases. There are not known to be any measures that could mitigate the bycatch of sharks in commercial deep-water fisheries, therefore preventing mortality will be very difficult or impossible to achieve whilst fisheries continue in deep-water shark habitats (OSPAR, 2010c). OSPAR (2010d) recommended that a zero by-catch TAC is introduced, but also that bycatch is minimised through depth and effort restrictions, gear controls and area closures, as appropriate. Furthermore, they recommended restricting overall fishing effort in deep-water shark habitat to the lowest possible level.

Gulper shark, Leafscale gulper shark and Portuguese dogfish have historically been landed as bycatch in the mixed deep-water bottom trawl fisheries targeting Roundnose grenadier, Blue ling, black scabbardfish and Orange roughy off the west of Scotland (Priede, 2019), which resulted in significant population declines. In the 1998-2004, a scientific deep-water trawl survey dataset collected by Fishery Research Services (FRS) Marine Laboratory within the 1,200 m depth band (i.e., middle of the species' depth range), found that population declines were evident for Portuguese dogfish and Leafscale gulper shark (Jones et al. 2005a). Peak catch rates for these species were found to be 62-99% lower compared to pre-fishery values. In 1975, 72% of hauls by Scottish Association for Marine Science surveys in the North-East Atlantic contained at least one Portuguese dogfish specimen, but this declined to 12% in 1999 (OSPAR, 2010d). A bycatch only TAC for deep-sea sharks (including Gulper shark, Leafscale gulper shark and Portuguese dogfish, amongst other species) was introduced in 2007, which was then reduced annually until it became zero in 2010 (ICES WGEF, 2020). No directed fisheries were permitted under these quotas and the landings subsequently declined sharply (Priede, 2019). Between 2009 and 2017, Scottish deep-water survey data has shown no trend in the abundance for Portuguese dogfish (ICES WGEF, 2019). Data from the Scottish deep-water bottom trawl surveys in ICES subarea 6 at depths from 300-2040 m showed a decreasing trend from 2005 to 2011 for Leafscale gulper shark, however abundance has increased and stabilized between 2011 and 2017 (ICES WGEF, 2019).

In general, sharks tend to be fast swimmers so catch rates will be strongly influenced by fishing gear characteristics. Small trawls on a single warp at low speed will be less efficient at catching sharks, compared to larger paired warp trawls used by commercial vessels (Gordon and Swan, 1997; Jones et al. 2005b). However, evidence shows that the deep-sea shark species features are nonetheless at risk from bycatch in the West of Scotland NCMPA. On average, Portuguese dogfish and Leafscale gulper sharks were respectively caught as bycatch in 11% and 15% of deep-water trawl hauls taken by French vessels in the Northeast Atlantic (subareas 4-14) during 2005-2014 (ICES WGEF 2017, Table 3.6). Discards of Portuguese dogfish and Leafscale gulper shark from the fleet in 2018 were estimated to be 172 tonnes, with the majority, if not all of this being from the west of Scotland (ICES WGEF, 2020). In contrast, Portuguese dogfish discards data from Irish trawl fleets operating in the area since 2009 was recorded as being negligible (<1 tonne most years; ICES WGEF, 2020). The 2020 report by the ICES Working Group on Bycatch of Protected Species (ICES, 2020b), which presented data on bycatch of elasmobranchs from 2018, found that Gulper shark, Leafscale gulper shark and Portuguese dogfish were all bycaught in bottom trawl fisheries. For Leafscale gulper shark, the bottom trawl bycatch rate (number of specimens observed per day at sea) in the oceanic Northeast Atlantic was 0.094. For Gulper shark, highest bycatch rates from bottom trawls were in the western Mediterranean Sea and the Aegean-Levantine Sea, both at 0.071. For Portuguese dogfish, highest bycatch rates from bottom trawl were 0.113 in the Greenland Sea. Based on the evidence presented, including the species slow recovery rates, it is likely that mobile bottom contact gear will affect the presence and distribution of the Gulper shark, Leafscale gulper shark and Portuguese dogfish features due to the associated bycatch risk.

Activity from demersal trawling and demersal seines within West of Scotland NCMPA occurs at relatively low levels and over a very limited spatial scale, and existing management is in place which already restricts the activity permitted within the site (see Section 3.2.1 above). However, the protected mobile species features of the site, as described above, are highly sensitive to demersal mobile gear activity.

Given the evidence above, the impacts from demersal mobile gears (including demersal trawls and demersal seines) alone within West of Scotland NCMPA at current levels of activity carry a risk of hindering the restoration of the Leafscale gulper shark/Gulper shark, Portuguese dogfish, Roundnose grenadier and Orange roughy features, and maintaining the Blue ling feature, such that the quality and quantity of their habitat and the composition of their population are maintained or restored. Accordingly, Scottish Ministers conclude that demersal mobile gear alone are capable of impacting the protected features and, at current levels, would or might hinder the achievement of the conservation objectives of the NCMPA.

3.3.4 Impacts of anchored nets on mobile species features

Orange roughy were only targeted using specialised bottom trawling techniques and are not commercially targeted with other gear types (FeAST, 2013), however, the species has also been recorded as bycatch in other fisheries. In the northwest Atlantic, there are records of Orange roughy caught in gillnets, with the vast majority of these at depths greater than 500 m and 800 m (96% and 92%, respectively; Kulka et al. 2001). In gillnet sets below 500 m, 0.26% of these caught Orange roughy (Kulka et al. 2001). In comparison, Orange roughy was caught in 0.49% of otter trawls below 500 m (Kulka et al. 2001). Although there is a zero TAC in place for Orange roughy, based on the evidence above, static nets may pose a risk to the presence and distribution of the species, due to the associated bycatch risk.

Although Roundnose grenadier were previously only targeted using mobile bottom contact gears in the west of Scotland area, the species can be taken using gillnets (e.g., in Canada; Simpson et al. 2011). Although there is a zero TAC in place for Roundnose grenadier, static nets may therefore pose a risk to the presence and distribution of the species, due to the associated bycatch risk.

Blue ling is landed as bycatch in Norwegian longline and gillnet fisheries targeting ling, tusk, and saithe (ICES, 2019b). However, landings from these gear types have been small since 2000 (Lorance, 2020) (ICES, 2020d). One gillnetter in the area of Hatton and Rockall Banks in 2006 caught 19 tonnes of Blue ling (Bensch et al. 2009). Trammel nets deployed between 1-25 m depth off Norway have also caught the species (Vea Salvanes, 1986) and Blue ling are bycaught in the monkfish tangle net fishery that operates to the west of Scotland (STECF, 2006). In the area to the northwest and west of Rockall, Blue ling comprised 5% of catches in 2006 (compared with 16% for the target monkfish species; STECF, 2006). At George Bligh Bank and Lousy Bank, Blue ling accounted for around 8% and 12% of the total catches, respectively. However, a high proportion of these catches were discarded due to spoilage, as Blue ling deteriorate very quickly, even with short-soak times, due to their soft-flesh. Discards were around 60% at Rockall and George Bligh Banks, although only 12% at Lousy Bank. Blue ling were previously bycaught in deep-water gillnet fisheries targeting Leafscale gulper sharks and Portuguese dogfish (Hareide et al. 2017; STECF, 2006), however this fishery has now ceased. Only minimal bycatch of Blue ling, comprising 1% of total catch, occurred in deep-water crab gillnet fisheries operating to the west of Scotland, again with high levels of discards (40%; Hareide et al. 2017; STECF, 2006). Based on the evidence available, there is a risk that the presence and distribution of Blue ling would be impacted by static nets, either as a target species or as bycatch.

Leafscale gulper shark were previously targeted in Scotland using gillnets or tangle net hybrids (Hareide et al. 2017; STECF, 2006). These fisheries have now ceased, however bycatch still occurs and the long soak times and discards of nets from gillnet fisheries are known to increase bycatch mortality (Hareide et al. 2005). There are records of Leafscale gulper shark being bycaught in monkfish tangle net fisheries in the area to the west of Scotland from observer data (STECF, 2006). At Rosemary Bank and to the northwest and west of Rockall, deep-water sharks comprised 1% of total catches, mainly comprising Leafscale gulper shark, of which 6% to 11% were discarded. Similarly, Leafscale gulper sharks are bycaught in deep-water crab gillnet fisheries on Rosemary Bank. However, deep-sea sharks comprised less than 1% of total catches, with 11% of the Leafscale gulper sharks being discarded (STECF, 2006). In a survey to retrieve lost gillnet gear in the Rockall and Porcupine Bank areas, 6,209 kg of Leafscale gulper shark were recorded from 150 gillnets/tangle nets at depths of 1,000-1,100 m in the South Porcupine area, with only 7 kg from 350 nets between 650-800 m in the SE Rockall area (Rihan et al. 2005). Over 70% of the Leafscale gulper sharks from the South Porcupine area were decayed. In terms of the selectivity of nets, only Leafscale gulper sharks with lengths in excess of 85 cm were found to be retained in retrieved nets with 160 mm mesh size (Rihan et al. 2005). Based on the evidence available, there is a risk that the presence and distribution of Leafscale gulper shark would be impacted by static nets, due to the associated bycatch risk.

Gulper shark were previously targeted in Scotland using gillnets or tangle net hybrids (Hareide et al. 2017; STECF, 2006). These fisheries have now ceased, however, bycatch still occurs targeting other species and the long soak times and discards of nets from gillnet fisheries are known to increase bycatch mortality (Hareide et al. 2005). In a study by (Moura et al. 2018) off Portugal, one Gulper shark specimen was found bycaught in the trammel net fishery targeting anglerfish in the 300-400 m depth range, however no survival information was available. Based on the evidence available, there is a risk that the presence and distribution of Gulper shark would be impacted by static nets, due to the associated bycatch risk.

Similar to the other shark species, Portuguese dogfish were previously targeted in Scotland using gillnets or tangle net hybrids (Hareide et al. 2017; STECF, 2006). These fisheries have now ceased, however, bycatch still occurs and the long soak times and discards of nets from gillnet fisheries are also known to increase bycatch mortality (Hareide et al. 2005). In a survey to retrieve lost gillnet gear in the Rockall and Porcupine Bank areas, 240 kg of Portuguese dogfish were recorded as being caught in 150 gillnets/tangle nets retrieved from depths of 1,000-1,100 m in the South Porcupine area (Rihan et al. 2005). This is much lower than the records of Leafscale gulper shark mentioned above, which is likely to be due to depleted stocks of Portuguese dogfish. Moura et al. (2018) found that off Portugal, the trammel net fishery targeting anglerfish had a very low impact on deep-water shark populations, presumably due to the species preferring deeper depths. Bycatch was recorded as <5% by weight of the total catch in 98% of the hauls at depths <600 m. The largest proportion of deep-water sharks caught (by weight and number) consisted of Portuguese dogfish, with 29 females and 1 male caught during 4 hauls in 400-500 m depth at the top of an underwater knoll. Where information on survival was available, 81% were in “poor” condition, i.e. dead, or nearly dead, or had no body movement.

In the case of Portuguese dogfish, all three available specimens were classed as being in this “poor” condition category. Based on the evidence available, there is a risk that the presence and distribution of Portuguese dogfish would be impacted by static nets, due to the associated bycatch risk.

Overall there is potential for impacts on the protected mobile species features from anchored nets. It is worth noting that activity using these gear types within West of Scotland NCMPA occurs at relatively low levels and over a very limited spatial scale. Existing management is in place which already restricts the activity permitted within the site (see Section 3.2.1 above).

Given the evidence above, the impacts from anchored nets alone within West of Scotland NCMPA at current levels of activity carry a risk of hindering the restoration of the Leafscale gulper shark/Gulper shark, Portuguese dogfish, Roundnose grenadier and Orange roughy features, and maintaining the Blue ling feature, such that the quality and quantity of their habitat and the composition of their population are maintained or restored. Accordingly, Scottish Ministers conclude that anchored nets alone are capable of impacting the protected features and, at current level, would or might hinder the conservation objectives of the NCMPA.

3.3.5 Impacts of anchored lines on mobile species features

Orange roughy were only targeted using specialised bottom trawling techniques and the species is not commercially catchable by other gear types such as longlines (FeAST, 2013). For example, there were no catches of Orange roughy in 4,998 longlines sets monitored by fisheries observers between 1991 and 2000 in the Northwest Atlantic (Kulka et al. 2001). Therefore, this species is not considered further in this section.

As Roundnose grenadier are not attracted to the odour of baits, they can only be caught by trawl, rather than longlines (Priede, 2018). Jørgensen (1995) for example, didn’t record any catches of Roundnose grenadier in longlines, despite being present in large numbers in bottom trawls off west Greenland. Therefore, this species is not considered further in this section.

Blue ling are caught both as a target species and as bycatch in longline fisheries, including around Rockall and the Hatton Bank (Clark, 2006; Gordon, 2003; ICES, 2019c, 2019b, 2020c; Lorance, 2020). In the Porcupine Bank and Seabight, 597 kg (2.12% of total catch) of Blue ling were caught across 20 deep-water commercial longline deployments, with the peak catch rate occurring at 700-1,100 m (Clarke et al. 2001b). Another study found that longlines deployed in the Rockall Trough caught larger specimens of Blue ling compared to trawls (Kelly et al. 1998). From three longline sets on the Hatton Bank, catches of Blue ling ranged from 6% to 10.2% of total catch by weight (Stene and Buner, 1991 cited in Gordon, 2003). In another longline survey on the Hatton Bank at depths of 600 to 1800 m, the proportion of Blue ling caught from 67 deployments was 7.05% (by weight), compared to 1.4% from trawl (Gordon, 2003). Based on the evidence available, there is a risk that the presence and distribution of Blue ling would be impacted by static gears, either as a target species or as bycatch.

Leafscale gulper shark has previously been targeted by Irish longline, Norwegian longline and Portuguese longline fisheries, which resulted in a rapid decline in stocks (OSPAR, 2010e, 2010d). Although there is now a zero TAC in place, there remains a risk of accidental bycatch in longline fisheries and evidence shows that catch rates can be relatively high for the species. AZTI survey data in the Bay of Biscay using a former commercial deep-water shark longline (for which the number of hooks was reduced), found that Leafscale gulper sharks were caught at a rate of almost 20 kg per hook per minute between 2016 and 2018 (ICES WGEF, 2020). Individuals were more frequently caught in the bottom sections of the longline compared to the floating sections. Although the black scabbardfish longline fishery off Portugal is known to be concentrated on fishing locations where the proportion of Leafscale gulper shark catch is low (Veiga et al. 2013), data collected between 2009 to 2018 showed that the relative occurrence of Leafscale gulper sharks varied between 17% and 100%, depending on year, haul, vessel and location (ICES WGEF, 2020). From a study of three longline sets on Hatton Bank, catches of Leafscale gulper shark ranged from 15.8 to 46.2% of total catch by weight (Stene and Buner, 1991 cited in Gordon, 2003). In another longline survey on the Hatton Bank, the proportion of Leafscale gulper shark caught by longlines was 25.97% (by weight) from 67 deployments, compared to 0% by trawls (Gordon, 2003). In the Rockall Trough, evidence shows that longlines and trawls catch the same size ranges of the species (Kelly et al. 1998).

In a scientific tagging survey off Spain, Rodríguez-Cabello and Sánchez (2017) found that Leafscale gulper sharks could survive being bycaught on deep-water bottom longlines when the soaking time was restricted to 2-3 hours and lines were hauled back at very slow speeds (0.4-0.5 m/s). 1.2% of Leafscale gulper shark were dead when brought on board, with a further number being in ‘poor’ condition; the total ‘at vessel mortality’ being reported as 18.9% for this species. This species had the highest vitality rate, with 37.3% in good condition and 43.8% in moderate condition. Three out of nine Leafscale gulper sharks died within 3-10 weeks after release, however, whilst the others survived until the tags were released (45-120 days). Although this paper found that at-vessel mortality was lower than expected for deep-water sharks (i.e. <10%), post-release mortality over short and relatively long periods was sometimes high. Leafscale gulper shark was found to have the highest survival rate of all the deep-water sharks sampled (> 66%). It is worth noting however that these fishing practices are different to those normally used by commercial vessels. Research into the survival rates of *Centrophorus* spp. (this family includes Leafscale gulper shark and Gulper shark) taken on demersal longline gear (Wilson et al. 2009) have shown that, if handled appropriately before being released (without using automatic de-hooking gear), individuals have a high rate of survival. Another study on survival rates of *Centrophorus* sp. bycaught in demersal longlines in the Gulf of Mexico however found that the at-vessel mortality rate was 30.8% and the 24 hour post-release mortality rate was 83.0% (±16.0) (Talwar et al. 2017). None of the sharks exhibited correct orientation or regular, sustained swimming behaviours during the caged monitoring period underwater. Soak times were 3.5 hours and longline were hauled at a rate of 0.3 m/s. An earlier demersal longline study found similar at vessel mortality rates for *Centrophorus* sp. (29.41%)

and data indicated that post-release predation <200 m from the surface had also occurred (Brooks et al. 2015). This predation, likely to be from pelagic sharks, therefore presents an additional risk to any individuals released. Based on the evidence presented above for Leafscale gulper sharks and *Centrophorus* spp., post-release mortality poses a key risk to the species. Therefore, the presence and distribution of Leafscale gulper sharks may be impacted by static gears, based on this associated bycatch risk.

Gulper shark have previously been targeted by longline fisheries and their abundance was estimated to have declined 80-95% from baseline, based on data from a target longline fishery for deep-water sharks in the north of Portugal from 1990-2004 (OSPAR, 2010c, 2010d). Although there is now a zero TAC in place, there remains a risk of accidental bycatch in longline fisheries. The 2020 report by the ICES Working Group on Bycatch of Protected Species (WGBYC; ICES, 2020c), which collated data on bycatch of elasmobranchs, found that Gulper shark was bycaught in longline fisheries. Highest bycatch rates (specimens per day at sea observed) were in the Azores at 0.019. Based on the evidence presented above and the information on survival rates for *Centrophorus* spp., post-release mortality poses a key risk to the species. Therefore, the presence and distribution of Gulper sharks may be impacted by static gears, based on this associated bycatch risk.

Portuguese dogfish have been targeted by Irish longline, Norwegian longline and Portuguese longline fisheries, which resulted in a rapid decline in stocks (OSPAR, 2010e, 2010d). Although there is now a zero TAC in place, there remains a risk of accidental bycatch in longline fisheries. AZTI survey data in the Bay of Biscay using a former commercial deep-water shark longline (for which the number of hooks was reduced), found that Portuguese dogfish were more frequently caught in the bottom sections of longlines compared to the floating sections (ICES WGEF, 2020). From a study of three longline sets on Hatton Bank, catches of Portuguese dogfish ranged from 1.6% to 17.7% of total catch by weight (Stene and Buner, 1991 cited in Gordon, 2003). In another longline survey on the Hatton Bank at depths of 600 to 1800 m, the proportion of Portuguese dogfish caught from 67 deployments was 17.16% (by weight), compared to 10.9% from trawl (Gordon, 2003). Although the deep-water black scabbardfish longline fishery off Portugal is known to operate at locations where Portuguese dogfish have lower abundances (Veiga et al. 2015, WD, cited in ICES WGEF, 2020), data collected between 2009 to 2018 showed that the relative occurrence of Portuguese dogfish was between 33 and 100% (ICES WGEF, 2020). Although these rates varied by haul, year, vessel and location, high numbers of specimens were consistently recorded in some places. In the Rockall Trough, evidence shows that longlines and trawls catch the same size ranges of the species (Kelly et al. 1998). In a scientific tagging survey off Spain, Rodríguez-Cabello and Sánchez (2017) found that 4.5% of Portuguese dogfish were dead when brought on board after being bycatch in deep-water bottom longlines. However, a further number of specimens were in ‘poor’ condition, increasing the at vessel mortality to 38.6%. Only 6.8% of Portuguese dogfish were in good condition, and 54.5% were in moderate condition. Two out of four Portuguese dogfish died immediately after release. Although this paper found that at-vessel mortality was lower than expected for deep-water sharks (i.e. <10%), post-release mortality over short and relatively long periods was sometimes high. It is worth noting however that these fishing practices are different to those normally used by commercial vessels. Based on the evidence above, there is a risk that the presence and distribution of Portuguese dogfish may be impacted by static gears, due to the associated bycatch risk.

Despite the potential for impacts on the protected mobile species features from anchored lines, activity using these gear types within West of Scotland NCMPA occurs at relatively low levels and over a very limited spatial scale. Existing management is in place which already restricts the activity permitted within the site (see Section 3.2.1 above).

Given the evidence above, the impacts from anchored lines alone within West of Scotland NCMPA at current levels of activity carry a risk of hindering the restoration of the Leafscale gulper shark/Gulper shark, and Portuguese dogfish features, and maintaining the Blue ling feature, such that the quality and quantity of their habitat and the composition of their population are maintained or restored. Anchored lines are unlikely to pose a significant risk at current levels of activity on the Roundnose grenadier and Orange roughy features, however. Accordingly, Scottish Ministers conclude that anchored lines alone are capable of impacting the protected features Leafscale gulper shark/Gulper shark, Portuguese dogfish, and Blue ling and, at current levels, would or might hinder the conservation objectives of the MPA.

3.3.6 Impacts of pelagic fishing on mobile species feature

Orange roughy have previously solely been targeted in the west of Scotland area using specialised bottom trawling techniques (FeAST, 2013), however, the species is known to feed on bentho-pelagic prey (Gordon and Duncan, 1987). Furthermore, the species can be caught by pelagic gear, for example the Faroese fleet’s fishery for Orange roughy uses semi-pelagic trawls (ICES, 2020c) and in other parts of the world mid-water trawls are also used (Bensch et al. 2009). Post-larval growth in Orange roughy is thought to occur in the mesopelagic, with active foraging at 700-800 m depth (Shephard et al. 2007). Spawning aggregations can also form into dynamic plumes, extending 200 m off the seabed (Branch, 2001). Although there is a zero TAC in place for Orange roughy, based on the evidence above, pelagic fishing gear may affect the presence and distribution of the species due to the associated bycatch risk at all life-stages.

Although the Roundnose grenadier is typically a bottom-dwelling, demersal fish, there are records of the species being caught in pelagic nets fished at depths between 1,000 and 2,000 m and 270 -1,440 m above the seafloor in the Denmark Strait (Haedrich, 1974). In the Rockall Trough, one study caught only small numbers of Roundnose grenadier between 3 and 60 m above the seabed in pelagic trawls (Merrit et al. 1986). The species is known to feed on pelagic prey, which descends through the water column during their daytime diel vertical migration and concentrates at the sea floor (Mauchline and Gordon, 1991). Juveniles are also thought to feed bentho-pelagically (Priede, 2019). Roundnose grenadiers may therefore play an important role in the transfer of food energy from the pelagic to the deep sea floor (Haedrich, 1974). Roundnose grenadier are thought to only exhibit vertical migrations to a few hundred metres above the seabed to intercept their prey during the day, remaining on the sea floor at night (Atkinson, 1995 cited in Priede, 2019). This pelagic behaviour appears to be rare, or only for short time periods (Mauchline and Gordon, 1991), however it does put the species at risk of being bycaught by pelagic fisheries. Furthermore, pelagic fisheries may pose an indirect threat to Roundnose grenadier, by the removal of pelagic prey species upon which Roundnose grenadier rely. Although there is a zero TAC in place for Roundnose grenadier, based on the evidence above, pelagic fishing gear may affect the presence and distribution of the species due to the associated bycatch risk at all life-stages.

Blue ling are a demersal fish and there is no evidence of the species being caught in pelagic nets, either as bycatch or as a target species. The species is therefore not considered further in this section.

Leafscale gulper shark are found at or near the seabed on continental slopes at depths of 230-2400 m, however the species has also been reported from the upper 1,250 m of oceanic water, well above the seabed in ocean depths of around 4,000 m (OSPAR, 2010e). Tagging studies have shown that the species can travel over long distances (maximum estimated at 990 nm), with some individuals making large slow vertical displacements throughout the water column, lasting several hours (Rodríguez-Cabello et al. 2016; Rodríguez-Cabello and Sánchez, 2014). In some instances, individuals travelled in midwater thousands of metres above abyssal plains. This species is therefore at risk of being bycaught by pelagic fisheries. Furthermore, the species also appears to be highly migratory and exhibits size, maturity and sex related distribution patterns (Clarke et al. 2001a, 2005; Moura et al. 2014). Within the NE Atlantic, there is a lack of juveniles and pregnant females recorded, but late stage pregnant females appear to segregate from the general population in other areas with pupping occurring in various locations, including potentially off Ireland (Priede, 2019). This puts the species at risk from fisheries impacts over a wide area, with an increased risk of bycatch occurring when the species is migrating. In an experimental midwater drifting longline fishing survey for black scabbardfish off the Canary Islands, Leafscale gulper shark were the most captured species, with 170 individuals caught over twenty hauls (one with a line containing around 500 hooks and the second with a line containing 5000 hooks; Freitas et al. 2018) The 2020 report by the ICES Working Group on Bycatch of Protected Species (ICES, 2020b), which collated data on bycatch of elasmobranchs, found that Leafscale gulper shark were bycaught in pelagic trawl fisheries. Bycatch rates (number of specimens observed per day at sea) were highest in the Celtic Seas and were recorded as 0.111. Although there is a zero TAC in place for Leafscale gulper shark, based on the evidence above, pelagic fishing gear may affect the presence and distribution of the species due to the associated bycatch risk at all life-stages.

Gulper shark have been recorded at depths from 98 to 1700 m, suggesting that they may use the water column (Priede, 2019). Although there is no reliable information on migrations or the pupping grounds of Gulper shark, pregnant females appear to segregate from the rest of the population along the outer edge of continental shelves and in canyons (Priede, 2019). This poses a greater risk for the species, as there is a risk of bycatch occurring when over a wider area. In an experimental midwater drifting longline fishing survey for black scabbardfish off the Canary Islands, 10 Gulper sharks were caught from 20 hauls, one with a line containing around 500 hooks and the second with a line containing 5000 hooks (Freitas et al. 2018). The 2020 report by the ICES Working Group on Bycatch of Protected Species (ICES, 2020b), which collated data on bycatch of elasmobranchs, found that Gulper shark were bycaught in pelagic trawl fisheries. Bycatch rates (number of specimens observed per day at sea) were highest in the Celtic Seas and were recorded as 0.333. Although there is a zero TAC in place for Gulper shark, based on the evidence above, pelagic fishing gear may pose a risk to the presence and distribution of the species, due to the associated bycatch risk at all life-stages.

Portuguese dogfish are one of the deepest living sharks and are known to occur on or near the seabed, from 700 –1900 m, in the area to the west of Scotland (Priede, 2019). There is evidence of the species exhibiting vertical migration and females are known to move to shallower waters to give birth (500-1000 m), increasing risks of interactions with fisheries (Clarke et al. 2001a; Girard and Du Buit, 1999; Moura et al. 2014; OSPAR, 2010f; STECF, 2006). Mature females have been found dominating some catches, for example. This species is known to feed on fish and squid, including Roundnose grenadier, indicating bentho-pelagic foraging (Mauchline and Gordon, 1983, cited in Priede, 2019), putting the species at risk of being bycaught by pelagic fisheries. Furthermore, pelagic fisheries may pose an indirect threat to Portuguese dogfish, by the removal of pelagic prey species upon which Portuguese dogfish rely. The species is not thought to be highly migratory as different maturity stages and sizes are found in the same geographical areas, so it is likely that the species can complete its life cycle within the same area (Moura et al. 2014). Recolonization from neighbouring areas will therefore be extremely slow, with recovery likely to take longer than 25 years (OSPAR, 2010d), similar to that of the other deep-water shark species discussed here. Although there is a zero TAC in place for Portuguese dogfish, based on the evidence above, pelagic fishing gear may pose a risk to the presence and distribution of the species, due to the associated bycatch risk at all life-stages.

Despite the potential for impacts on the protected mobile species features from pelagic fishing, activity using these gear types within West of Scotland NCMPA occurs at relatively low levels and over a very limited spatial scale. Existing management is in place which already restricts the activity permitted within the site (see Section 3.2.1 above).

Given the evidence above, the impacts from pelagic fishing alone within West of Scotland NCMPA at current levels of activity would not hinder restoring the Leafscale gulper shark/Gulper shark, Portuguese dogfish, Roundnose grenadier, Blue ling and Orange roughy features, such that the quality and quantity of their habitat and the composition of their population are maintained or restored. Accordingly, Scottish Ministers conclude that pelagic fishing alone is capable of impacting the protected mobile species features but would not hinder the achievement of the conservation objectives of the site at current levels of activity.

3.4 Part B Conclusion

The assessment of fishing pressures on the protected features of West of Scotland NCMPA has indicated that demersal trawling, demersal seines and anchored net/line activities would or might hinder the achievement of the conservation objectives of the site.

However, there are a number of exceptions for some of the protected features. Anchored net/lines, at current activity levels has indicated that for orange roughy and roundnose grenadier, burrowed mud, offshore sands and gravels and offshore deep-sea muds the activity would not hinder the achievement of the conservation objectives for the for West of Scotland NCMPA.

As such the Scottish Ministers concludes that management measures are required to restrict demersal trawling, demersal seines, and anchored nets/lines within West of Scotland NCMPA. Section 5 contains further details on these measures.

Scottish Ministers conclude that the remaining fisheries activities (pelagic fishing), when considered in isolation and at current levels, will not hinder the achievement of the conservation objectives for West of Scotland NCMPA.

4. Part C Assessment- In combination assessment

4.1 In combination assessment overview

Part C of this considers the cumulative impacts, which may occur over space and time, in relation activities occurring within the MPA. Activities assessed in this section include the following:

- Fishing activity/pressure combinations which were excluded in Part A of this assessment as not being capable of impacting the feature;
- Fishing interactions assessed in Part B that would not hinder the conservation objectives for the site; and
- Activities occurring within West of Scotland NCMPA that are not related to fishing.

Fishing activities including demersal trawls, demersal seines and anchored nets/lines have been identified in Part B as requiring management and will therefore not be considered in Part C. Pelagic fishing however was not considered to have a significant effect on their own and is assessed in combination with other activities occurring at the site in Part C.

4.2 Other offshore region activities screening

To determine activities, not related to fishing activities, to be included within this part of the assessment, a distance of 5 km was selected as suitable to capture any potential source receptor pathways that could impact the site in combination with effects of the fishing activities assessed. A 5 km buffer was therefore applied to the site boundary to identify relevant activities.

Activities not related to fishing activities were identified using the Scottish Government's marine mapping tool. The JNCC Conservation Advice package, and other resources on the JNCC Site Information Centre for West of Scotland MPA, were also screened for activities occurring in the site that should be considered in the in-combination assessment.

The map to display offshore region activities (see Figure 7) was derived from OceanWise's Marine Themes Vector data (July 2023 version), Crown Estate Scotland leases (September 2023 version), Kingfisher Information Services Offshore Renewable Cable Awareness (KIS-ORCA, as of December 2023 held under licence) and North Sea Transition Authority (NSTA, as of December 2023, data held under Oil and Gas Authority open licence). The Marine Themes "Industrial" was filtered to show offshore region platforms, wellheads, piles, turbines, cables, and pipelines. Features marked as "not in use", "not present", "decommissioned", or "removed" were excluded. The "Administrative" data were filtered to only show military exercise areas which included danger areas.

4.3 Other offshore region activities occurring within West of Scotland NCMPA

The screening exercise using the Scottish Government's marine mapping tool identified the presence of cables and wellheads within the site, and a military danger area overlapping a large proportion of the site (see Figure 7). Table 6 provides a list of the relevant activities, including cable, wellheads and military activity which were considered in combination with the fishing activities occurring within West of Scotland NCMPA.

The Activities and Management section of the JNCC Site Information Centre for West of Scotland did not indicate any other activities occurring within the site.

Table 6. Activities considered in combination with fishing activities in West of Scotland NCMPA.

Relevant activity	Description
Oil and gas infrastructure (wellheads)	A number of wellheads are located within the north east corner of the MPA, however these are all suspended or decommissioned.
Telecommunication cables	Five telecommunications cables run through the site, and these are a mixture of both active, proposed and inactive cables.
Military danger areas	A large proportion of the site overlaps a military danger area, including that associated with Military of Defence practice areas. This is a surface or firing danger area, including for torpedo exercise.

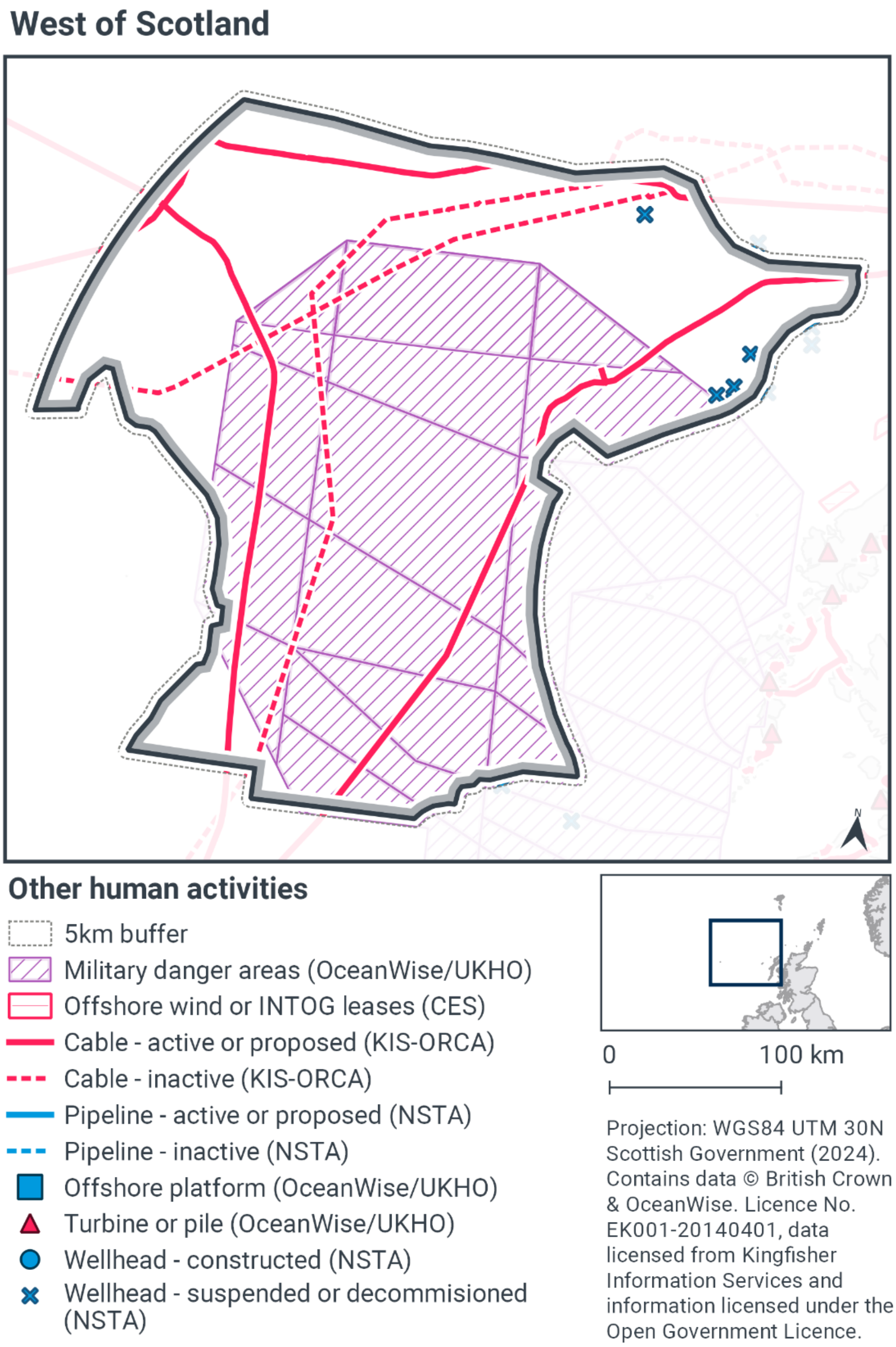

Figure 7. Other offshore activities occurring within or near to the West of Scotland NCMPA derived from OceanWise's Marine Themes Vector data (July 2023 version) and Crown Estate Scotland leases (September 2023 version).

4.4 Potential pressures exerted by fishing and other activities

To identify the specific pressures that the activities exert on the West of Scotland NCMPA features, the JNCC Marine Pressures-Activities Database (PAD) v1.5 2022 was used (Table 7).

Table 7 shows that there are no pressures caused by pelagic activities or telecommunications cables that have the potential for in-combination effects. Table 7 details the pressures exerted by the telecommunication cables activities (Y- pressure exerted, N- pressure not exerted) and the associated risk profile, as taken from the JNCC Pressures Activities Database (PAD) v1.5.

Neither of the activities undertaken within the military dangers area (surface or firing danger area) and the activities of the suspended or decommissioned oil and gas infrastructure (wellheads) were likely to have pressures of concern that could overlap with those exerted by pelagic fishing and to which the protected features of the site is sensitive.

It is only those pressures that are associated with the fishing activities (not assessed in Part B) and the other relevant activities, that have been discussed below. Any pressures that are only associated with the relevant activities, and not the fishing activities, are not within the scope of this assessment.

Table 7: Pressures exerted by pelagic fishing and non-fishing related activities occurring in West of Scotland NCMPA (telecommunications cables). Activity-pressure relationships, and associated risk profile, are taken from the JNCC Pressures-Activities database v1.5. Only the non-fishing pressures that are medium-high risk and are similarly exerted by pelagic fishing with medium-high risk will be assessed further - these are highlighted in red (Y - pressure exerted, N- pressure not exerted).

PAD Pressure	**Fishing activity**	**Telecommunications cables**		
	Pelagic Fishing	**Decommissioning**	**Laying, burial and protection**	**Operation & maintenance**
Above water noise	Y- Low risk	Y- Low risk	Y- Low risk	Y- Low risk
Abrasion/disturbance of the substrate on the surface of the seabed	N	Y - Medium-high	Y - Medium-high	Y - Medium-high
Barrier to species movement	Y- Low risk	N	N	N
Changes in suspended solids (water clarity)	N	Y- Low risk	Y- Low risk	Y- Low risk
Collision ABOVE water with static or moving objects not naturally found in the marine environment (e.g., boats, machinery, and structures)	Y- Low risk	Y- Low risk	Y- Low risk	Y- Low risk
Collision BELOW water with static or moving objects not naturally found in the marine environment (e.g., boats, machinery, and structures)	Y- Low risk	Y- Low risk	Y- Low risk	Y- Low risk
Deoxygenation	Y- Low risk	Y- Low risk	Y- Low risk	N
Habitat structure changes - removal of substratum (extraction)	N	Y- Low risk	N	N

Hydrocarbon & PAH contamination. Includes those priority substances listed in Annex II of Directive 2008/105/EC.	Y- Low risk	Y- Low risk	Y- Low risk	Y- Low risk
Introduction of light	Y- Low risk	Y- Low risk	Y- Low risk	Y- Low risk
Introduction or spread of invasive non-indigenous species (INIS)	Y- Low risk	N	Y- Low risk	Y- Low risk
Litter	Y- Low risk	Y- Low risk	Y- Low risk	Y- Low risk
Nutrient enrichment	N	Y- Low risk	Y- Low risk	N
Organic enrichment	Y- Low risk	N	N	N
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	N	Y - Medium-high	Y- Low risk	Y - Medium-high
Physical change (to another seabed type)	N	Y- Low risk	Y - Medium-high	Y- Low risk
Physical change (to another sediment type)	N	Y- Low risk	Y- Low risk	Y- Low risk
Removal of non-target species	Y - Medium-high	N	N	N
Removal of target species	Y - Medium-high	N	N	N
Smothering and siltation rate changes (Light)	N	N	N	Y- Low risk
Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals). Includes those priority substances listed in Annex	Y- Low risk	Y- Low risk	Y- Low risk	Y- Low risk

II of Directive 2008/105/EC.				
Transition elements & organo-metal (e.g. TBT) contamination. Includes those priority substances listed in Annex II of Directive 2008/105/EC.	Y- Low risk	Y- Low risk	Y- Low risk	Y- Low risk
Underwater noise changes	Y- Low risk	Y- Low risk	Y- Low risk	Y- Low risk
Vibration	N	Y- Low risk	Y- Low risk	Y- Low risk
Visual disturbance	Y- Low risk	Y- Low risk	Y- Low risk	Y- Low risk
Water flow (tidal current) changes, including sediment transport considerations	N	Y- Low risk	Y- Low risk	Y- Low risk

4.5 Part C Conclusion

Scottish Ministers conclude that the remaining fishing activities (pelagic fishing) in-combination with other relevant activities will not hinder the achievement of the conservation objectives for West of Scotland NCMPA.

5. Management Options

5.1 Overview of management options

Management measures are being considered by Scottish Ministers and any decision as to which measures ought to be taken forward will follow upon a statutory public consultation exercise. Any such decision will also be taken in line with the Scottish Ministers obligations in relation to the exercise of their functions..

The socioeconomic impacts and costs of each management option (no additional management, zoned management, and full site exclusion) have been assessed within the Socio-Economic Impact Assessment (SEIA) and Sustainability Appraisal (SA), and are not discussed within this Fisheries Assessment. Nor are other considerations, statutory and non-statutory, which the Scottish Ministers may be required to take into account when assessing whether the imposition of a particular measure is appropriate.

This section assesses the suitability of the management options solely in light of the conservation objectives, biological characteristics of protected features, and current activity levels for West of Scotland NCMPA.

5.2 Assessment of management options

5.2.1 No additional management

The assessment identified that management measures would be required to avoid hindering the achievement of the conservation objectives for the site from mobile demersal gear (demersal trawls and demersal seines) and anchored nets/lines. Thus the option of no management is not considered further.

5.2.2 Zoned management

Scottish Ministers have assessed the available evidence regarding the impact of demersal mobile gears and anchored nets/lines on the protected features, the JNCC Conservation and Management Advice for the site and the JNCC Fisheries Management Options Paper. One management option of full site exclusion, has been identified as suitable for the protected features to further the conservation objectives for West of Scotland NCMPA. Thus, the option of zoned management is not considered further.

5.2.3 Full site exclusion

Full site exclusion would remove/avoid all pressures associated with fishing activities using demersal gears (including mobile and static) across the whole site throughout the year (Figure 8). No prohibition would be considered for pelagic fishing gear, as the need for additional management for this fishing type was not identified during the assessment.

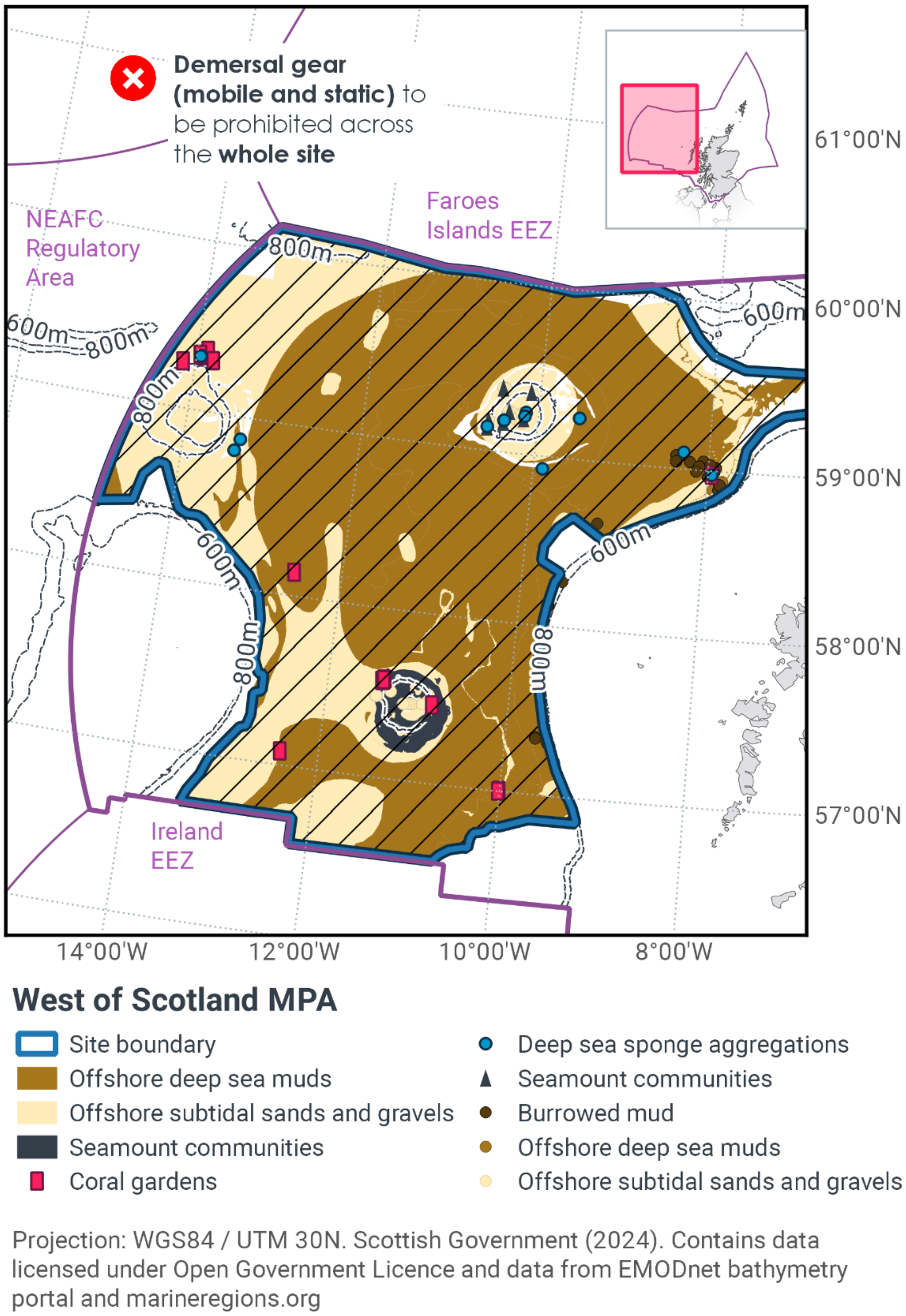

Figure 8. Map showing management measures for West of Scotland NCMPA. Note that the mobile species features are not shown on this map, due to their widespread distribution.

Removing all pressures associated with demersal mobile and static gears across the whole site would support the recovery of Burrowed mud, Coral gardens, Cold-water coral reefs, Deep-sea sponge aggregations, Offshore deep-sea muds, Offshore sands and gravels and Seamount communities to favourable condition such that their extent is stable or increasing and their structures and functions, quality, and the composition of their characteristic biological communities are such as to ensure that they are in a condition which is healthy and not deteriorating. In addition, it would aid the conservation of Blue Ling and recover the Leafscale Gulper shark, Gulper shark, Orange roughy, Portuguese dogfish and Round-nose grenadier to favourable condition, such that the population is maintained in numbers which enable it to thrive.

The full exclusion would remove the impact of demersal trawls, demersal seines and anchored nets/lines from all areas of the site and is most likely to contribute to furthering the conservation objectives of the site and give a higher probability of restoring the Offshore sands and gravels, Burrowed mud, offshore deep-sea muds, Leafscale gulper shark, Gulper shark, Portuguese dogfish, Roundnose grenadier and Orange roughy features to favourable condition, and maintaining the Blue ling feature in favourable condition.

Full site year-round exclusion of demersal mobile and static gear would contribute to the ecological coherence of both the Scottish MPA Network and the broader OSPAR MPA Network.

Given the available evidence, Scottish Ministers consider that full site exclusion would not hinder the achievement of the conservation objectives for the West of Scotland NCMPA, rather it would further those objectives.

5.3 Management options conclusion

Scottish Ministers consider that adopting no additional management measures and zoned management measures for mobile demersal fishing (including demersal trawls and demersal seines) and demersal static fishing (anchored nets/lines) would, or might, hinder the achievement of the conservation objectives for West of Scotland NCMPA. Scottish Ministers consider that the full site exclusion option for demersal mobile and static fishing, outlined above, would further the conservation objectives for the site.

At current activity levels, fishing using pelagic gears is not considered to pose a risk to achieving the conservation objectives, and no additional management is currently required for this activity.

The decision on which management option is to be taken forward will be taken in the light of all relevant duties incumbent upon the Scottish Ministers in relation to the exercise of their functions and following upon a statutory public consultation exercise in which views on the options under consideration are invited.

6. Monitoring and review

Scottish Ministers will review this assessment as required. A review of this assessment may be in response to updated conservation advice; updated advice on the condition of the feature; new information on the sensitivity of the feature to pressures arising from activities within the site; or information on changes in fishing activity within the site.

To coordinate the collection and analysis of information regarding activity levels a monitoring and control plan may be developed for this site. Although management measures for static gear are not currently proposed for this site, should activity levels increase, or monitoring showed evidence of detrimental effects, management measures may need to be reassessed.

7. Conclusion

In regard to best available evidence, Scottish Ministers conclude that, provided appropriate management measures for fishing activities as identified above are implemented, any remaining fishing activities would not hinder the conservation objectives of this Nature Conservation Marine Protected Area.

8. References

Adey, J.M., 2007. Aspects of the sustainability of creel fishing for Norway lobster, *Nephrops norvegicus* (L.), on the west coast of Scotland (PhD Thesis). University of Glasgow.

Althaus, F., Williams, A., Schlacher, T.A., Kloser, R.J., Green, M.A., Barker, B.A., Bax, N.J., Brodie, P., Schlacher-Hoenlinger, M.A., 2009. Impacts of bottom trawling on deep-coral ecosystems of seamounts are long-lasting. *Mar. Ecol. Prog. Ser.,* **397**, 279–294. https://doi.org/10.3354/meps08248

Baker, K., Devine, J., Haedrich, R., 2009. Deep-sea fishes in Canada's Atlantic: population declines and predicted recovery times. *Environ. Biol. Fishes,* **85**, 79–88. https://doi.org/10.1007/s10641-009-9465-8

Ball, B.J., Fox, G., Munday, B.W., 2000. Long- and short-term consequences of a *Nephrops* trawl fishery on the benthos and environment of the Irish Sea. *ICES J. Mar. Sci.*, **57**, 1315–1320. https://doi.org/10.1006/jmsc.2000.0924

Bensch, A., Gianni, M., Gréboval, D., Sanders, J., Hjort, A., 2009. Worldwide review of bottom fisheries in the high seas.

Bergmann, M.J.N., Van Santbrink, J.W., 2000. Fishing mortality and populations of megafauna in sandy sediments. In: Kaiser, M.J., de Groot, S.J. (Eds.). *Effects of Fishing on Non-Target Species and Habitats.* Blackwell, Oxford.

Black, K.E., Smeaton, C., Turrell, W.R., Austin, W.E., 2022. Assessing the potential vulnerability of sedimentary carbon stores to bottom trawling disturbance within the UK EEZ. Frontiers in Marine Science, 9, p.892892.

Branch, T.A., 2001. A review of orange roughy *Hoplostethus atlanticus* fisheries, estimation methods, biology and stock structure. *South Afr. J. Mar. Sci.,* **23**, 181–203. https://doi.org/10.2989/025776101784529006

Brooks, E.J., Brooks, A.M.L., Williams, S., Jordan, L.K.B., Abercrombie, D., Chapman, D.D., Howey-Jordan, L.A., Grubbs, R.D., 2015. First description of deep-water elasmobranch assemblages in the Exuma Sound, The Bahamas. *Deep Sea Res. Part II Top. Stud. Oceanogr.*, Biology of Deep-Water Chondrichthyans **115**, 81–91. https://doi.org/10.1016/j.dsr2.2015.01.015

Buhl-Mortensen, L., Aglen, A., Breen, M., Buhl-Mortensen, P., Ervik, A., Husa, V., Løkkeborg, S., Røttingen, I., Stockhausen, H.H., 2013. Impacts of fisheries and aquaculture on sediments and benthic fauna: suggestions for new management approaches, Fisken og Havet. Havforskningsinstituttet Institute of Marine Research.

Buhl-Mortensen, L., Ellingsen, K.E., Buhl-Mortensen, P., Skaar, K.L., Gonzalez-Mirelis, G., 2016. Trawling disturbance on megabenthos and sediment in the Barents Sea: chronic effects on density, diversity, and composition. *ICES J. Mar. Sci.,* **73**, i98–i114. https://doi.org/10.1093/icesjms/fsv200

Buhl-Mortensen, P., 2017. Coral reefs in the Southern Barents Sea: habitat description and the effects of bottom fishing. *Mar. Biol. Res*. **13**, 1–14. https://doi.org/10.1080/17451000.2017.1331040

Clark, M., 2006. Biology of exploited deepwater sharks west of Ireland and Scotland in Deep Sea 2003: Conference on the Governance and Management of Deep-sea Fisheries. Part 2: Conference poster papers and workshop papers, in: Shotton, R. (Ed.), FAO Fisheries Proceedings (FAO), *Deep Sea 2003: Conference on the Governance and Management of Deep-Sea Fisheries*, Queenstown (New Zealand), 1-5 Dec 2003. FAO.

Clark, M.R., Althaus, F., Schlacher, T.A., Williams, A., Bowden, D.A., Rowden, A.A., 2016. The impacts of deep-sea fisheries on benthic communities: a review. *ICES J. Mar. Sci.,* **73**, i51–i69. https://doi.org/10.1093/icesjms/fsv123

Clark, M.R., Anderson, O.F., Francis, R.C., Tracey, D.M., 2000. The effects of commercial exploitation on orange roughy (*Hoplostethus atlanticus*) from the continental slope of the Chatham Rise, New Zealand, from 1979 to 1997. *Fish. Res.,* **45**, 217–238.

Clark, M.R., Rowden, A.A., Schlacher, T., Williams, A., Consalvey, M., Stocks, K.I., Rogers, A.D., O'Hara, T.D., White, M., Shank, T.M., Hall-Spencer, J.M., 2010. The Ecology of Seamounts: Structure, Function, and Human Impacts. *Annu. Rev. Mar. Sci.*, **2**, 253–278. https://doi.org/10.1146/annurev-marine-120308-081109

Clark, M.R., Tittensor, D.P., 2010. An index to assess the risk to stony corals from bottom trawling on seamounts. *Mar. Ecol.,* **31**, 200–211.

Clarke, M., Connolly, P., Bracken, J., 2005. Age estimation of the exploited shark Centrophorus squamosus from the continental slopes of the Rockall Trough and Porcupine Bank. *J. Fish Biol.*, **60**, 501–514. https://doi.org/10.1111/j.1095-8649.2002.tb01679.x

Clarke, M., Connolly, P.L., Bracken, J.J., 2001a. Aspects of reproduction of the deep water sharks *Centroscymnus coelolepis* and *Centrophorus squamosus* from west of Ireland and Scotland. *J. Mar. Biol. Assoc. UK*, **81**, 1019–1029. https://doi.org/10.1017/S0025315401005008

Clarke, M., Hareide, N., Hoey, S., 2001b. Deepwater longline survey of the slopes of Porcupine Bank and Porcupine Seabight. *Fish. Leafl. No.186*.

Cohen, D., Inda, I., Iwamoto, T., Scialabba, N., 1990. Food and Agricultural Organisation of the United Nations Species Catalogue. *FAO Fish. Synop. 25*, **10**, 442.

Collie, J.S., Hermsen, J., Valentine, P., Almeida, F., 2005. Effects of fishing on gravel habitats: assessment and recovery of benthic megafauna on Georges Bank. In: Barnes, P.W., Thomas, J.P. (Eds.). *Benthic Habitats and the Effects of Fishing, American Fisheries Society Symposium 41*. Bethesda, Maryland, pp. 325–343.

Cyr, H.A., 2018. The Impacts of Longlines on Deep Sea Sponges in the Azores. Universidade dos Açores.

Dahl, M.P., Pereyra, R.T., Lundälv, T., André, C., 2012. Fine-scale spatial genetic structure and clonal distribution of the cold-water coral *Lophelia pertusa*. *Coral Reefs,* **31**, 1135–1148. https://doi.org/10.1007/s00338-012-0937-5

de Moura Neves, B., Edinger, E., Hayes, V.W., Devine, B., Wheeland, L., Layne, G., 2018. Size metrics, longevity, and growth rates in *Umbellula encrinus* (Cnidaria: *Pennatulacea*) from the eastern Canadian Arctic. *Arct. Sci.,* 1–28. https://doi.org/10.1139/as-2018-0009

Devine, J., Haedrich, R., 2008. Population trends and status of two exploited Northwest Atlantic grenadiers, *Coryphaenoides rupestris* and *Macrourus berglax.*

Devine, J.A., Baker, K.D., Haedrich, R.L., 2006. Deep-sea fishes qualify as endangered. *Nature*, **439**, 29–29. https://doi.org/10.1038/439029a

Dias, V., Oliveira, F., Boavida, J., Serrão, E.A., Gonçalves, J.M.S., Coelho, M.A.G., 2020. High Coral Bycatch in Bottom-Set Gillnet Coastal Fisheries Reveals Rich Coral Habitats in Southern Portugal. *Front. Mar. Sci.,* **7**. https://doi.org/10.3389/fmars.2020.603438

Dinwoodie, K., 2021a. Pheronema carpenteri field on Atlantic mid bathyal mud. In: Tyler-Walters, H., Hiscock, K. (Eds.). *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Marine Biological Association of the United Kingdom, Plymouth.

Dinwoodie, K., 2021b. Pheronema carpenteri field on Atlantic lower bathyal mud, in: Tyler-Walters, H., Hiscock, K. (Eds.). *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Marine Biological Association of the United Kingdom, Plymouth.

Dransfeld, L., Gerritsen, H.D., Hareide, N.R., Lorance, P., 2013. Assessing the risk of vulnerable species exposure to deepwater trawl fisheries: the case of orange roughy *Hoplostethus atlanticus* to the west of Ireland and Britain. *Aquat. Living Resour.*, **26**, 307–318. https://doi.org/10.1051/alr/2013066

Durán Muñoz, P., Murillo, F.J., Sayago-Gil, M., Serrano, A., Laporta, M., Otero, I., Gómez, C., 2011. Effects of deep-sea bottom longlining on the Hatton Bank fish communities and benthic ecosystem, north-east Atlantic. *J. Mar. Biol. Assoc. UK.,* **91**, 939–952. https://doi.org/10.1017/S0025315410001773

Durán Muñoz, P., Sayago-Gil, M., Patrocinio, T., González-Porto, M., Murillo, F.J., Sacau, M., González, E., Fernández, G., Gago, A., 2012. Distribution patterns of deep-sea fish and benthic invertebrates from trawlable grounds of the Hatton Bank, north-east Atlantic: effects of deep-sea bottom trawling. *J. Mar. Biol. Assoc. UK.,* **92**, 1509–1524. https://doi.org/10.1017/S002531541200015X

Edinger, E., Sherwood, O., 2009. Taphonomy of Gorgonian and Antipatharian Corals in Atlantic Canada: Experimental decay rates and field observations. *Can. Tech. Rep. Fish. Aquat. Sci. No 2830.*

Eleftheriou, A., Robertson, M.R., 1992. The effects of experimental scallop dredging on the fauna and physical environment of a shallow sandy community. Neth. J. Sea Res., *Proceedings of the 26th European Marine Biology Symposium Biological Effects of Disturbances on Estuarine and Coastal Marine Environments*, **30**, 289–299. https://doi.org/10.1016/0077-7579(92)90067-O

Eno, C., S Macdonald, D., A M Kinnear, J., Chris Amos, S., J Chapman, C., Clark, R., St, F., D Bunker, P., Munro, C., C Macdonald, N., S Chapman, C., R A, B., D Munro, P., 2001. Effects of crustacean traps on benthic fauna. *ICES J. Mar. Sci. – ICES J. Mar. Sci.* Aberd. AB9 8DB, **58**, 11–20. https://doi.org/10.1006/jmsc.2000.0984

Epstein, G., Middelburg, J.J., Hawkins, J.P., Norris, C.R., Roberts, C.M., 2022. The impact of mobile demersal fishing on carbon storage in seabed sediments. Global Change Biology, 28(9), pp.2875-2894.

Fang, J.K.H., Rooks, C.A., Krogness, C.M., Kutti, T., Hoffmann, F., Bannister, R.J., 2018. Impact of particulate sediment, bentonite and barite (oil-drilling waste) on net fluxes of oxygen and nitrogen in Arctic-boreal sponges. *Environ. Pollut.,* **238**, 948–958. https://doi.org/10.1016/j.envpol.2017.11.092

Favaro, B., Rutherford, D.T., Duff, S.D., Côté, I.M., 2010. Bycatch of rockfish and other species in British Columbia spot prawn traps: Preliminary assessment using research traps. Fish. Res., **102**, 199–206. https://doi.org/10.1016/j.fishres.2009.11.013

FeAST, 2013. Feature Activity Sensitivity Tool (FeAST) (online).

Foden, J., Rogers, S., Jones, A., 2010. Recovery of UK seabed habitats from benthic fishing and aggregate extraction—towards a cumulative impact assessment. *Mar. Ecol. Prog. Ser.,* **411**, 259–270. https://doi.org/10.3354/meps08662

Fosså, J.H., Mortensen, P.B., Furevik, D.M., 2002. The deep-water coral *Lophelia pertusa* in Norwegian waters: distribution and fishery impacts. *Hydrobiologia*, **471**, 1–12. https://doi.org/10.1023/A:1016504430684

Fox, A.D., Henry, L.-A., Corne, D.W., Roberts, J.M., 2016. Sensitivity of marine protected area network connectivity to atmospheric variability. *Open Sci.,* **3**, 160494. https://doi.org/10.1098/rsos.160494

Freese, J.L., 2001. Trawl-induced Damage to Sponges Observed From a Research *Submersible. Mar. Fish. Rev.*, **63**, 7–13.

Freese, L., Auster, P.J., Heifetz, J., Wing, B.L., 1999. Effects of trawling on seafloor habitat and associated invertebrate taxa in the Gulf of Alaska. *Mar. Ecol. Prog. Ser.,* **182**, 119–126.

Freitas, M., Costa, L., Delgado, J., Jimenez, S., Timoteo, V., Vasconcelos, J., González Pérez, J.A., 2018. Deep-sea sharks as by-catch of an experimental fishing survey for black scabbardfishes (*Aphanopus* spp.) off the Canary Islands (NE Atlantic). *Sci. Mar.* ISSN 0214-8358 V 82 P 151-154. https://doi.org/10.3989/scimar.04793.03A

Garrard, S.M., Perry, F., Tyler-Walters, H., 2020. Atlantic upper bathyal live [*Lophelia pertusa*] reef (biogenic structure). In: Tyler-Walters, H., Hiscock, K. (Eds.). *Marine Life Information Network: Biology and Sensitivity Key Information Reviews (Online)*. Marine Biological Association of the United Kingdom, Plymouth, UK.

Girard, M., Du Buit, M.-H., 1999. Reproductive biology of two deep-water sharks from the British Isles, *Centroscymnus coelolepis* and *Centrophorus squamosus* (Chondrichthyes: Squalidae). *J. Mar. Biol. Assoc. UK.,* **79**, 923–931. https://doi.org/10.1017/S002531549800109X

Goode, S.L., Rowden, A.A., Bowden, D.A., Clark, M.R., 2020. Resilience of seamount benthic communities to trawling disturbance. *Mar. Environ. Res. 161*, 105086. https://doi.org/10.1016/j.marenvres.2020.105086

Gordon, J.D., 2003. Fish and fisheries in the SEA7 area. Scott. Assoc. Mar. Sci. Res. Serv. Ltd. Rep. Dep. Trade Ind.

Gordon, J.D.M., Duncan, J. a. R., 1987. Aspects of the biology of *Hoplostethus atlanticus* and *H. mediterraneus* (Pisces: *Berycomorphi*) from the slopes of the rockall Trough and the Porcupine Sea Bight (north-eastern Atlantic). *J. Mar. Biol. Assoc. UK.,* **67**, 119–133. https://doi.org/10.1017/S0025315400026400

Gordon, J.D.M., Swan, S.C., 1997. Thc distribution and abundance of deep-water sharks on the continental slope to the west of the British Isles, *ICES CM 1997/BB:ll Theme Session Biology and Behaviour (I).*

Grehan, A.J., Unnithan, V., Roy, K.O., Opderbecke, J., 2005. Fishing impacts on Irish deepwater coral reefs: Making a case for coral conservation. *Am. Fish. Soc. Symp. 41*, 819.

Haedrich, R.L., 1974. Pelagic capture of the epibenthic rattail *Coryphaenoides rupestris*. *Deep Sea Res. Oceanogr. Abstr. 21*, 977–979. https://doi.org/10.1016/0011-7471(74)90030-8

Hall-Spencer, J., Allain, V., Fosså, J.H., 2002. Trawling damage to Northeast Atlantic ancient coral reefs. *Proc. R. Soc. B Biol. Sci.*, **269**, 507–511. https://doi.org/10.1098/rspb.2001.1910

Hareide, N.R., Garnes, G., Rihan, D., Mulligan, M., Tyndall, P., Clark, M., Connolly, P., Misund, R., McMullen, P., Furevik, D., Humborstad, O.B., Høydal, K., Blasdale, T., 2017. A preliminary Investigation on Shelf Edge and Deepwater Fixed Net Fisheries to the West and North of Great Britain, Ireland, around Rockall and Hatton Bank.

Hareide, N.-R., Garnes, G., Rihan, D., Mulligan, M., Tyndall, P., Clarke, M., Connolly, P., Misund, R., McMullen, P., Furevik, D., 2005. A Preliminary Investigation on Shelf Edge and Deepwater Fixed Net Fisheries to the West and North of Great Britain, Ireland, around Rockall and Hatton Bank. *ICES CM.*

Hiddink, J., Jennings, S., Kaiser, M., Queiros, A., Duplisea, D.E., Piet, G., 2006. Cumulative Impacts of Seabed Trawl Disturbance on Benthic Biomass, Production, and Species Richness in Different Habitats. *Can. J. Fish. Aquat. Sci.*, 63 2006 4 63. https://doi.org/10.1139/f05-266

Hixon, M.A., Tissot, B.N., 2007. Comparison of trawled vs untrawled mud seafloor assemblages of fishes and macroinvertebrates at Coquille Bank, Oregon. *J. Exp. Mar. Biol. Ecol.*, **344**, 23–34. https://doi.org/10.1016/j.jembe.2006.12.026

Howell, K., Huvenne, V., Piechaud, N., Robert, K., Ross, R., 2014. Analysis of biological data from the JC060 survey of areas of conservation interest in deep waters off north and west Scotland.

Huvenne, V.A.I., Bett, B.J., Masson, D.G., Le Bas, T.P., Wheeler, A.J., 2016. Effectiveness of a deep-sea cold-water coral Marine Protected Area, following eight years of fisheries closure | Elsevier Enhanced Reader. *Biol. Conserv.*, **200**, 60–69. https://doi.org/10.1016/j.biocon.2016.05.030

ICES, 2020a. Orange roughy (*Hoplostethus atlanticus*) in subareas 1-10, 12 and 14 (the Northeast Atlantic and adjacent waters). https://doi.org/10.17895/ICES.ADVICE.5767

ICES, 2020b. 2020 Report Working Group on Bycatch of Protected Species. https://doi.org/10.17895/ICES.PUB.7471

ICES, 2020c. ICES Fisheries Overviews. Section 13.2 Oceanic Northeast Atlantic ecoregion. [Online]. http://ices.dk/sites/pub/Publication%20Reports/Advice/2020/2020/FisheriesOverviews_ONAE_2020.pdf [Accessed October 2021].

ICES, 2019a. Stock Annex: Orange roughy (*Hoplostethus atlanticus*) in subareas 1-10, 12 and 14 (the Northeast Atlantic and adjacent waters).

ICES, 2019b. ICES Fisheries Overviews. Section 12.2 Norwegian Sea ecoregion, ICES Fisheries Overview.

ICES, 2019c. ICES Fisheries Overview. Section 11.2 Icelandic Waters ecoregion, ICES Fisheries Overview.

ICES, 2018. Blue ling (*Molva dypterygia*) in subareas 6–7 and Division 5.b (Celtic Seas, English Channel, and Faroes grounds). *ICES Advice on fishing opportunities, catch, and effort.* Celtic Seas and Faroes ecoregions.

ICES, 2010. Impacts of human activities on cold water corals and sponge aggregations. Special request advice June 2010. Section 1.5.5.6, in: *Report of the ICES Advisory Committee, 2010., Report of the ICES Advisory Committee, 2010.* ICES, Copenhagen.

ICES, 2007. Report of the Working Group on Deep-water Ecology (WGDEC), 26-28 February 2007.

ICES WGEF, 2020. Working Group of Elasmobranch Fisheries Report 2020. Section 03 - Portuguese dogfish and Leafscale gulper shark (*ICES Scientific Report No. 2:77*). ICES.

ICES WGEF, 2019, 2019. WGEF Report 2019: Section 03 - Deep-water sharks; Leafscale gulper shark and Portuguese dogfish in the Northeast Atlantic (subareas 4–14) (*ICES Scientific Report No.1:25*).

Jennings, S., Kaiser, M.J., 1998. The effects of fishing on marine ecosystems. Adv. Mar. Biol., **34**, 201–352.

Jones, D., Gates, A., Lausen, B., 2012. Recovery of deep-water megafaunal assemblages from hydrocarbon drilling disturbance in the Faroe−Shetland Channel. *Mar. Ecol. Prog. Ser.*, **461**, 71–82. https://doi.org/10.3354/meps09827

Jones, E., Beare, D., Dobby, H., Trinkler, N., Burns, F., Peach, K., Blasdale, T., 2005a. The potential impact of commercial fishing activity on the ecology of deepwater chondrichthyans from the west of Scotland, in: *ICES 2005/Theme Session N ICES CM 2005/N:16.* ICES.

Jones, E., Beare, D., Dobby, H., Trinkler, N., Burns, F., Peach, K., Blasdale, T., Jones, E., 2005b. The potential impact of commercial fishing activity on the ecology of deepwater chondrichthyans from the west of Scotland, *ICES 2005/Theme Session N ICES CM 2005/N:16.*

Jørgensen, O.A., 1995. A Comparison of Deep Water Trawl and Long-Line Research Fishing in the Davis Strait, in: Hopper, A.G. (Ed.). *Deep-Water Fisheries of the North Atlantic Oceanic Slope*, NATO ASI Series. Springer Netherlands, Dordrecht, pp. 235–250. https://doi.org/10.1007/978-94-015-8414-2_8

Jørgensen, O.A., Bastardie, F., Eigaard, O.R., 2014. Impact of deep-sea fishery for Greenland halibut (*Reinhardtius hippoglossoides*) on non-commercial fish species off West Greenland. *ICES J. Mar. Sci*., **71**, 845–852. https://doi.org/10.1093/icesjms/fst191

Kaiser, M.J., Clarke, K.R., Hinz, H., Austen, M.C., Somerfield, P.J., Karakassis, I., 2006. Global analysis of response and recovery of benthic biota to fishing. *Mar. Ecol. Prog. Ser.*, **311**, 1–14.

Kaiser, M.J., Spencer, B.E., 1996. =The Effects of Beam-Trawl Disturbance on Infaunal Communities in Different Habitats. *J. Anim. Ecol*., **65**, 348–358. https://doi.org/10.2307/5881

Kędra, M., Renaud, P.E., Andrade, H., 2017. Epibenthic diversity and productivity on a heavily trawled Barents Sea bank (Tromsøflaket). *Oceanologia*, **59**, 93–101. https://doi.org/10.1016/j.oceano.2016.12.001

Kelly, C., Connolly, P., Clarke, M., 1998. The deep water fisheries of the Rockall Trough; some insights gleaned from Irish survey data. *CM-Int. Counc. Explor. Sea 900.*

Kenchington, E.L., Murillo, F.J., Cogswell, A., Lirette, C., 2011. Development of Encounter Protocols and Assessment of Significant Adverse Impact by Bottom Trawling for Sponge Grounds and Sea Pen Fields in the NAFO Regulatory Area

(SCWG on the Ecosystem Approach to Fisheries Management No. N6005), *NAFO SCR Doc. 11/75*. Northwest Atlantic Fisheries Organization.

Kinnear, J.A.M., Barkel, P.J., Mojsiewicz, W.R., Chapman, C.J., Holbrow, A.J., Barnes, C., Greathead, C.F.F., 1996. Effects of *Nephrops* Creels on the environment (*Fisheries Research Services Report No. 2/96*). Scottish Office Agriculture, Environment and Fisheries Department.

Kulka, D.W., Themelis, D.E., Halliday, R.G., 2001. Distribution and Biology of Orange Roughy (*Hoplostethus atlanticus* Collett 1889) in the Northwest Atlantic. *Sci. Counc. Meet. - Sept. 2001 Serial No. N4471.* NAFO SCR Doc. 01/84.

Kyne, P., Simpfendorfer, C., 2007. A collation and summarization of available data on deepwater chondrichthyans: Biodiversity, life history and fisheries. Collat. Summ. Available *Data Deep. Chondrichthyans Biodivers. Life Hist. Fish.*

Large, P.A., Diez, G., Drewery, J., Laurans, M., Pilling, G.M., Reid, D.G., Reinert, J., South, A.B., Vinnichenko, V.I., 2010. Spatial and temporal distribution of spawning aggregations of blue ling (*Molva dypterygia*) west and northwest of the British Isles. *ICES J. Mar. Sci.*, **67**, 494–501. https://doi.org/10.1093/icesjms/fsp264

Last, E.K., Ferguson, M., Baron-Cohen, L., Robson, L.M., 2020a. Kophobelemnon field on Atlantic mid bathyal mud. In: Tyler-Walters, H., Hiscock, K. (Eds.). *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Marine Biological Association of the United Kingdom, Plymouth.

Last, E.K., Ferguson, M., Baron-Cohen, L., Robson, L.M., 2020b. Kophobelemnon field on Atlantic upper bathyal mud. In: Tyler-Walters, H., Hiscock, K. (Eds.). *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Marine Biological Association of the United Kingdom, Plymouth.

Last, E.K., Ferguson, M., Serpetti, N., Narayanaswamy, B.E., Hughes, D.J., 2019a. *Geodia* and other massive sponges on Atlanto-Arctic upper bathyal coarse sediment. In: Tyler-Walters, H., Hiscock, K. (Eds.). *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Marine Biological Association of the United Kingdom, Plymouth.

Last, E.K., Ferguson, M., Serpetti, N., Narayanaswamy, B.E., Hughes, D.J., 2019b. *Geodia* and other massive sponges on Atlanto-Arctic upper bathyal mixed sediment, in: Tyler-Walters, H., Hiscock, K. (Eds.), Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Marine Biological Association of the United Kingdom, Plymouth.

Lorance, P., 2020. Stock Annex: Blue ling (*Molva dypterygia*) in subareas 6-7 and Division 5. b (Celtic Seas, English Channel, and Faroes grounds).

Major, R.N., Taylor, D.I., Connor, S., Connor, G., Jeffs, A.G., 2017. Factors affecting bycatch in a developing New Zealand scampi potting fishery. *Fish. Res.*, **186**, 55–64. https://doi.org/10.1016/j.fishres.2016.08.005

Malecha, P., Heifetz, J., 2017. Long-term effects of bottom trawling on large sponges in the Gulf of Alaska. *Cont. Shelf Res.,* **150**, 18–26. https://doi.org/10.1016/j.csr.2017.09.003

Malecha, P., Stone, R., 2009. Response of the sea whip *Halipteris willemoesi* to simulated trawl disturbance and its vulnerability to subsequent predation. *Mar. Ecol. Prog. Ser.* - MAR ECOL-PROGR SER **388**, 197–206. https://doi.org/10.3354/meps08145

Martín, J., Puig, P., Masqué, P., Palanques, A., Sánchez-Gómez, A., 2014. Impact of Bottom Trawling on Deep-Sea Sediment Properties along the Flanks of a Submarine Canyon. *PLOS ONE*, **9**, e104536. https://doi.org/10.1371/journal.pone.0104536

Mauchline, J., Gordon, J.D., 1991. Oceanic pelagic prey of benthopelagic fish in the benthic boundary layer of a marginal oceanic region. *Mar. Ecol. Prog. Ser.* Oldendorf, **74**, 109–115.

Mauchline, J., Gordon, J.D.M., 1984. Diets and bathymetric distributions of the macrourid fish of the Rockall Trough, northeastern Atlantic Ocean. *SpringerLink. Mar. Biol*., **81**, 107–121.

Merrit, N.R., Badcock, J., Ehrich, S., Hulley, P.A., 1986. Preliminary observations on the near-bottom ichthyofauna of the Rockall Trough: a contemporaneous investigation using commercialsized midwater and demersal trawls to 100m depth. *Proc. R. Soc. Edinb. Sect. B Biol. Sci.,* **88**, 312–314. https://doi.org/10.1017/S0269727000014895

Minto, C., Nolan, C.P., 2006. Fecundity and Maturity of Orange Roughy (*Hoplostethus atlanticus* Collett 1889) on the Porcupine Bank, Northeast Atlantic. *Environ. Biol. Fishes*, **77**, 39–50. https://doi.org/10.1007/s10641-006-9053-0

Morrison, K.M., Meyer, H.K., Roberts, E.M., Rapp, H.T., Colaço, A., Pham, C.K., 2020. The First Cut Is the Deepest: Trawl Effects on a Deep-Sea Sponge Ground Are Pronounced Four Years on. *Front. Mar. Sci.*, **7**. https://doi.org/10.3389/fmars.2020.605281

Mortensen, P.B., Buhl-Mortensen, L., Gordon, Donald. C, Fader, Gordon.B.J, McKeown, David. L, Fenton, Derek. G, 2005. Effects of Fisheries on Deepwater Gorgonian Corals in the Northeast Channel, Nova Scotia (*No. 41*), American Fisheries Society Symposium. Canada.

Moura, T., Fernandes, A., Figueiredo, I., Alpoim, R., Azevedo, M., 2018. Management of deep-water sharks' by-catch in the Portuguese anglerfish fishery: from EU regulations to practice. *Mar. Policy*, **90**, 55–67. https://doi.org/10.1016/j.marpol.2018.01.006

Moura, T., Jones, E., Clarke, M.W., Cotton, C.F., Crozier, P., Daley, R.K., Diez, G., Dobby, H., Dyb, J.E., Fossen, I., Irvine, S.B., Jakobsdottir, K., López-Abellán, L.J., Lorance, P., Pascual-Alayón, P., Severino, R.B., Figueiredo, I., 2014. Large-scale distribution of three deep-water squaloid sharks: Integrating data on sex, maturity and environment. *Fish. Res.* **157**, 47–61. https://doi.org/10.1016/j.fishres.2014.03.019

Mytilineou, C., Smith, C.J., Anastasopoulou, A., Papadopoulou, K.N., Christidis, G., Bekas, P., Kavadas, S., Dokos, J., 2014. New cold-water coral occurrences in the Eastern Ionian Sea: Results from experimental long line fishing. *Deep Sea Res. Part II Top. Stud. Oceanogr., Biology and Geology of Deep-Sea Coral Ecosystems:*

Proceedings of the Fifth International Symposium on Deep Sea Corals, **99**, 146–157. https://doi.org/10.1016/j.dsr2.2013.07.007

OSPAR, 2010a. Background Document for Deep-sea sponge aggregations. *Publication number: 491/2010.*

OSPAR, 2010b. Background Document for Coral gardens. Biodiversity Series. *Publication Number: 486/2010.*

OSPAR, 2010c. Background Document for Gulper shark. Biodiversity Series. *Publication Number: 472/2010.*

OSPAR, 2010d. Background Document for Portuguese dogfish. Biodiversity Series. *Publication Number: 469/2010.*

OSPAR, 2010e. Background Document for Leafscale gulper shark. Biodiversity Series. *Publication Number: 473/2010.*

OSPAR, 2010f. OPSAR QSR 2010: Species: Portuguese Dogfish (OSPAR Threatened and/or Declining Species and Habitats Implementation Report). OSPAR Commission.

Parker, S.J., Bowden, D.A., 2010. Identifying taxonomic groups vulnerable to bottom longline fishing gear in the Ross Sea region. *CCAMLR Sci.* **17**, 105–127.

Pawlowski, L., Lorance, P., 2014. Stock Annex: Roundnose grenadier (*Coryphaenoides rupestris*) in subareas 6-7, and in Divisions 5.b and 12.b (Celtic Seas and the English Channel, Faroes grounds, and western Hatton Bank). ICES Stock Annex.

Pham, C.K., Diogo, H., Menezes, G., Porteiro, F., Braga-Henriques, A., Vandeperre, F., Morato, T., 2014. Deep-water longline fishing has reduced impact on Vulnerable Marine *Ecosystems. Sci. Rep. 4,* 4837. https://doi.org/10.1038/srep04837

Pham, C.K., Murillo, F.J., Lirette, C., Maldonado, M., Colaço, A., Ottaviani, D., Kenchington, E., 2019. Removal of deep-sea sponges by bottom trawling in the Flemish Cap area: conservation, ecology and economic assessment. *Sci. Rep. 9*, 15843. https://doi.org/10.1038/s41598-019-52250-1

Pires, D., Castro, C., Silva, J., 2009. Reproductive biology of the deep-sea pennatulacean *Anthoptilum murrayi* (Cnidaria, Octocorallia). *Mar. Ecol. Prog. Ser*., **397**, 103–112. https://doi.org/10.3354/meps08322

Priede, I.G., 2019. Deep-sea Fishes Literature Review. *JNCC Rep. No 619*.

Pusceddu, A., Bianchelli, S., Martín, J., Puig, P., Palanques, A., Masqué, P., Danovaro, R., 2014. Chronic and intensive bottom trawling impairs deep-sea biodiversity and ecosystem functioning. *Proc. Natl. Acad. Sci*., **111**, 8861–8866. https://doi.org/10.1073/pnas.1405454111

Ramalho, S.P., Lins, L., Bueno-Pardo, J., Cordova, E.A., Amisi, J.M., Lampadariou, N., Vanreusel, A., Cunha, M.R., 2017. Deep-Sea Mega-Epibenthic Assemblages from the SW Portuguese Margin (NE Atlantic) Subjected to Bottom-Trawling Fisheries. *Front. Mar. Sci.,* **4**. https://doi.org/10.3389/fmars.2017.00350

Rihan, D., Muligan, M., Mhara, B.I., 2005. Irish Gillnet Retrieval Survey for Lost Gear MFV India Rose Rockall & Porcupine Bank August 8th – September 3rd 2005.

Roberts, J.M., Davies, A.J., Henry, L.A., Dodds, L.A., Duineveld, G.C.A., Lavaleye, M.S.S., Maier, C., Soest, R.W.M. van, Bergman, M.J.N., Hühnerbach, V., Huvenne, V. a. I., Sinclair, D.J., Watmough, T., Long, D., Green, S.L., Haren, H. van, 2009. Mingulay reef complex: an interdisciplinary study of cold-water coral habitat, hydrography and biodiversity. *Mar. Ecol. Prog. Ser.*, **397**, 139–151. https://doi.org/10.3354/meps08112

Rodríguez-Cabello, C., González-Pola, C., Sánchez, F., 2016. Migration and diving behavior of Centrophorus squamosus in the NE Atlantic. Combining electronic tagging and Argo hydrography to infer deep ocean trajectories. *Deep Sea Res. Part Oceanogr. Res. Pap.* **115**, 48–62. https://doi.org/10.1016/j.dsr.2016.05.009

Rodríguez-Cabello, C., Sánchez, F., 2017. Catch and post-release mortalities of deep-water sharks caught by bottom longlines in the Cantabrian Sea (NE Atlantic). *J. Sea Res., Changing Ecosystems in the Bay of Biscay: Natural and Anthropogenic Effects*, **130**, 248–255. https://doi.org/10.1016/j.seares.2017.04.004

Rodríguez-Cabello, C., Sánchez, F., 2014. Is *Centrophorus squamosus* a highly migratory deep-water shark? *Deep Sea Res. Part Oceanogr. Res. Pap.*, **92**, 1–10. https://doi.org/10.1016/j.dsr.2014.06.005

Rogers, A.D., 1999. The Biology of Lophelia pertusa (Linnaeus 1758) and Other Deep-Water Reef-Forming Corals and Impacts from Human Activities. *Int. Rev. Hydrobiol.,* **84**, 315–406. https://doi.org/10.1002/iroh.199900032

Sampaio, Í., Braga-Henriques, A., Pham, C., Ocaña, O., de Matos, V., Morato, T., Porteiro, F.M., 2012. Cold-water corals landed by bottom longline fisheries in the Azores (north-eastern Atlantic). *J. Mar. Biol. Assoc. UK.*, **92**, 1547–1555. https://doi.org/10.1017/S0025315412000045

Shephard, S., Trueman, C., Rickaby, R., Rogan, E., 2007. Juvenile life history of NE Atlantic orange roughy from otolith stable isotopes.

Shester, G.G., Micheli, F., 2011. Conservation challenges for small-scale fisheries: Bycatch and habitat impacts of traps and gillnets. *Biol. Conserv.*, **144**, 1673–1681. https://doi.org/10.1016/j.biocon.2011.02.023

Simpson, M., Miri, C., Mercer, J., Bailey, J., Power, D., Themelis, D., Treble, M., 2011. Recovery potential assessment of Roundnose Grenadier (*Coryphaenoides rupestris* Gunnerus, 1765) in Northwest Atlantic Waters. *DFO Can. Sci. Advis. Sec. Res. Doc.* 2011.

STECF, 2006. Deep-sea Gillnet Fisheries (Commission Staff Working Paper), *Report of the Scientific Technical and Economic Committee for Fisheries (STECF).* Commission of the European Communities.

Stone, R.P., Masuda, M.M., Karinen, J.F., 2015. Assessing the ecological importance of red tree coral thickets in the eastern Gulf of Alaska. *ICES J. Mar. Sci.,* **72**, 900–915. https://doi.org/10.1093/icesjms/fsu190

Talwar, B., Brooks, E., Mandelman, J., Grubbs, R.D., 2017. Stress, post-release mortality, and recovery of commonly discarded deep-sea sharks caught on longlines. *Mar. Ecol. Prog. Ser.,* **582**. https://doi.org/10.3354/meps12334

Tillin, H.M., Hull, S.C., Tyler-Walters, H., 2010. Development of a sensitivity matrix (pressures-MCZ/MPA features).

Troffe, P.M., Levings, C., Beth) E. Piercey, G., Keong, V., 2005. Fishing gear effects and ecology of the sea whip (*Halipteris willemoesi* (Cnidaria: Octocorallia: Pennatulacea)) in British Columbia, Canada: Preliminary observations. *Aquat. Conserv. Mar. Freshw. Ecosyst.*, **15**, 523–533. https://doi.org/10.1002/aqc.685

Tuck, I.D., Hall, S.J., Robertson, M.R., Armstrong, E., Basford, D.J., 1998. Effects of physical trawling disturbance in a previously unfished sheltered Scottish sea loch. *Mar. Ecol. Prog. Ser.*, **162**, 227–242.

Tyler-Walters, H., Rogers, S.I., Marshall, C.E., Hiscock, K., 2009. A method to assess the sensitivity of sedimentary communities to fishing activities. *Aquat. Conserv. Mar. Freshw. Ecosyst.,* **19**, 285–300. https://doi.org/10.1002/aqc.965

Vea Salvanes, A.G., 1986. *Preliminary report from a study of species composition, size composition and distribution of the fish in a fjord of western Norway based on regularly conducted experimental fishing and catch statistics during one year* (ICES Demersal Fish Committee).

Veiga, N., Moura, T., Figueiredo, I., 2013. Spatial overlap between the leafscale gulper shark and the black scabbardfish off Portugal. *Aquat. Living Resour.*, **26**, 343–353. https://doi.org/10.1051/alr/2013070

Viera, R.P., Bett, B.J., Jones, D.O.B., Durden, J.M., Morris, K.J., Cunha, M.R., Trueman, C.N., Ruhl, H.A., 2020. Deep-sea sponge aggregations (Pheronema carpenteri) in the Porcupine Seabight. *Prog. Oceanogr.*, **183**, 102189.

Wareham, V.E., Edinger, E.N., 2007. Distribution of deep-sea corals in the Newfoundland and Labrador region, Northwest Atlantic Ocean. *Bull. Mar. Sci.*, **81**, 289–313.

Williams, A., Schlacher, T.A., Rowden, A.A., Althaus, F., Clark, M.R., Bowden, D.A., Stewart, R., Bax, N.J., Consalvey, M., Kloser, R.J., 2010. Seamount megabenthic assemblages fail to recover from trawling impacts: Trawling impacts. *Mar. Ecol.,* **31**, 183–199. https://doi.org/10.1111/j.1439-0485.2010.00385.x

Wilson, D.T., Pattterson, H.M., Summerson, R., Hobsbawn, P.I., 2009. Information to support management options for upper-slope gulper sharks (including Harrisson's dogfish and southern dogfish). *Final Report to the Fisheries Research and Development Corporation Project No. No. 2008/65*. Bureau of Rural Sciences, Canberra, Australia.

Yoklavich, M.M., Laidig, T.E., Graiff, K., Elizabeth Clarke, M., Whitmire, C.E., 2018. Incidence of disturbance and damage to deep-sea corals and sponges in areas of high trawl bycatch near the California and Oregon border. *Deep Sea Res. Part II Top. Stud. Oceanogr., Results of Telepresence-Enabled Oceanographic Exploration,* **150**, 156–163. https://doi.org/10.1016/j.dsr2.2017.08.005

This publication is available at **www.gov.scot**

Any enquiries regarding this publication should be sent to us at

The Scottish Government
St Andrew's House
Edinburgh
EH1 3DG

ISBN: 978-1-83601-517-8 (web only)

Published by The Scottish Government, August 2024

Produced for The Scottish Government by APS Group Scotland, 21 Tennant Street, Edinburgh EH6 5NA
PPDAS1481078 (08/24)