Marine Management Organisation

MMO Stage 3 Site Assessment: Farnes East MPA (DRAFT)






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Title: MMO Stage 3 Site Assessment: Farnes East MPA (DRAFT)
Contents

Executive Summary

This assessment analyses the impact of anchored nets and lines, bottom towed gear and traps on the designated features moderate energy circalittoral rock, subtidal coarse sediment, subtidal mixed sediments, subtidal mud, subtidal sand, sea-pen and burrowing megafauna communities, and ocean quahog in Farnes East Marine Protected Area (MPA) to determine whether a significant risk of hindering the conservation objectives of the site can be excluded beyond reasonable scientific doubt. The interaction between bottom towed gear and moderate energy circalittoral rock will not be assessed as this was already considered during Stage 2. The assessment sets out the evidence considered and analyses the quality of that evidence. **The assessment finds that the ongoing use of anchored nets and lines and traps will not result in a significant risk of hindering the achievement of the conservation objectives of the MPA. Management measures will not therefore be implemented for anchored nets and lines and traps for Farnes East MPA. However, there is a significant risk of the ongoing use of bottom towed gear hindering the achievement of the conservation objectives of the MPA. Management measures will therefore be implemented for bottom towed gear. Section 6 contains further details of these measures.**

1 Introduction

This assessment considers whether fishing activities are compatible with the conservation objectives of Farnes East MPA.

This site is designated as a marine conservation zone (MCZ). This assessment uses the best available evidence to review site characteristics and fishing activity and determine if there is a significant risk of fishing activities hindering the conservation objectives of the site. If so, MMO will develop and introduce suitable management measures, such as MMO byelaws. If MMO byelaws are required, then these will be subject to public consultation and will require confirmation from the Secretary of State to come into effect.

2 Site information

2.1 Overview

The following Joint Nature Conservation Committee (JNCC) site information and Department for Environment Food and Rural Affairs (Defra) factsheet were used for background on site geography, designations, features, conservation objectives and general management approaches:

- JNCC Site Information - Farnes East MCZ[1]; and
- Defra Factsheet - Farnes East MCZ[2].

Note: For this site, the Conservation Advice package is being written by JNCC and Natural England. The advice at designation is instead being used.

Farnes East MPA is located in the Northern North Sea, approximately 11 km from the Northumberland coast. The site straddles the 12 nm limit and covers an area of approximately 945 km^2 (**Figure 1**).

[1] JNCC site information – Farnes East MCZ: jncc.gov.uk/our-work/farnes-east-mpa/ (Last accessed 15 February 2024)

[2] Defra factsheet – Farnes East MCZ: assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/492371/mcz-farnes-east-factsheet.pdf (Last accessed 15 February 2024)

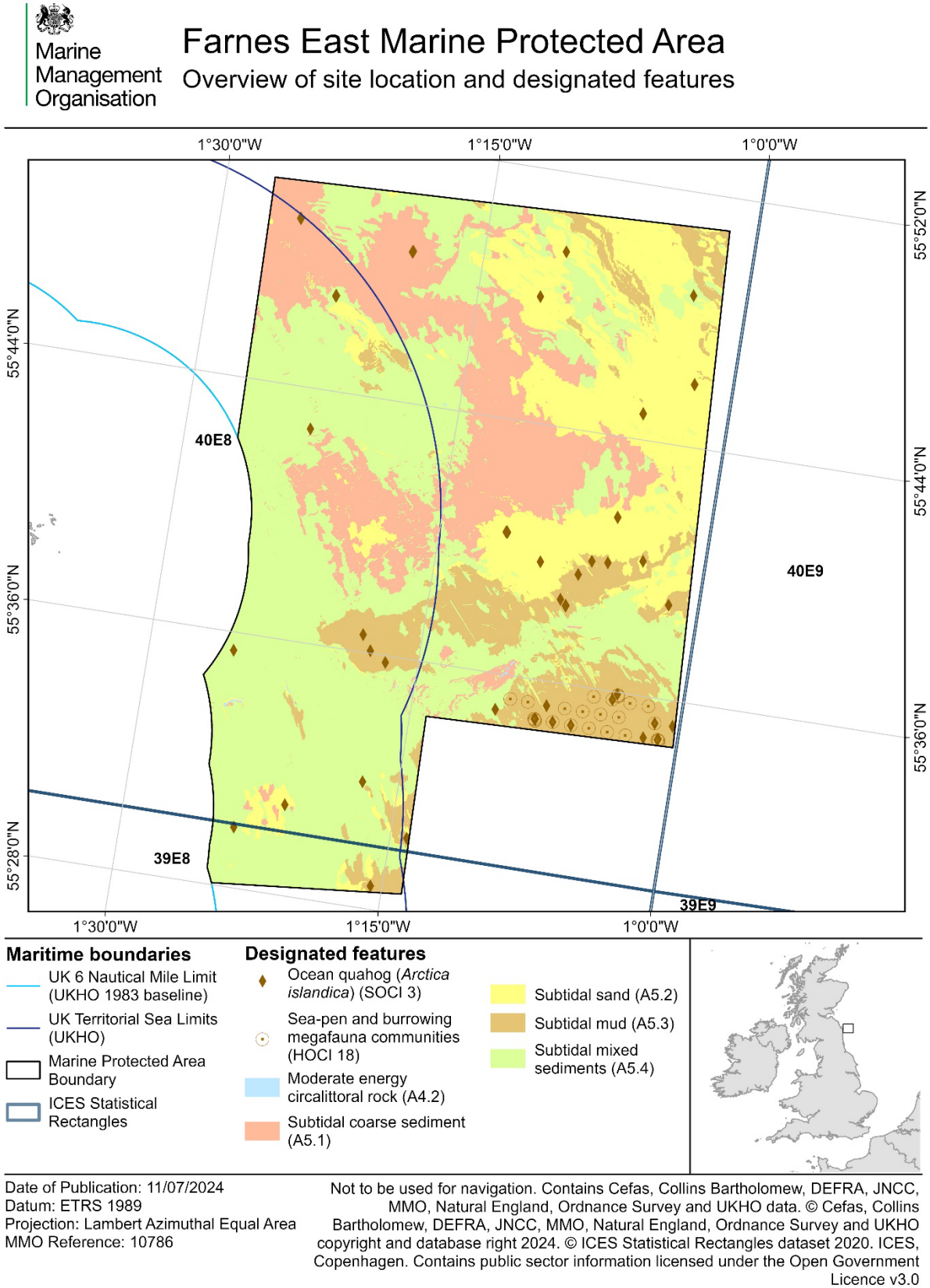

Figure 1: Farnes East MPA location overview.

The designated features and their general management approaches are set out below in **Table 1.**

The seabed in the MPA predominantly consists of subtidal coarse sediment, subtidal mixed sediments and subtidal sand, interspersed with small patches of moderate energy circalittoral rock throughout the site. The shallower areas in the west of the site are dominated by subtidal coarse sediment and subtidal mixed sediments, while the eastern half of the site is dominated by subtidal sand. A section of the Farnes Deep glacial trench occurs within the site boundary and is dominated by subtidal mud. These sedimentary habitats support a broad diversity of species including anemones, particularly *Edwardsia claparedii* and *Cerianthus lloydii*, segmented worms, including *Galathowenia oculata* and sponges. The site also supports ocean quahog *Arctica islandica,* a slow growing bivalve mollusc. This species is listed as Threatened and/or Declining by the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) and is a designated species Feature of Conservation Importance (FOCI) in the site. The moderate energy circalittoral rock in the site supports species of hydroids, bryozoans, and sponges. The subtidal mud habitat supports two species of sea-pen - the slender sea-pen (*Virgularia mirabilis*) and phosphorescent sea-pen (*Pennatula phosphorea*) - and Norway lobster *Nephrops norvegicus.* As a result, as well as being designated for the broad-scale habitat subtidal mud, the habitat feature of conservation importance, sea-pen and burrowing megafauna communities, is also a protected feature of the site.

The general management approaches for the features of Farnes East MPA have been set based on a vulnerability assessment.

Table 1: Designated features and general management approaches.

Designated feature	General management approach
Moderate energy circalittoral rock	Maintain in favourable condition
Subtidal coarse sediment	
Subtidal mixed sediments	
Subtidal sand	
Subtidal mud	Recover to favourable condition
Sea-pen and burrowing megafauna communities	
Ocean quahog *Arctica islandica*	

Natural England and JNCC are currently in the process of developing a conservation advice package for Farnes East MPA. Since there is no package currently available, Natural England and JNCC has advised using two proxy sites from within the same bioregion, North East of Farnes Deep MPA for subtidal sediment features, and South Rigg MPA for moderate energy circalittoral rock and sea-pen and burrowing

megafauna communities (however not for biotope level information). Therefore, the North East of Farnes Deep MPA and South Rigg MPA conservation advice packages have been used to help identify pressures, sensitivities and attributes of relevance to the features within Farnes East MPA.

A proxy package cannot be used as a substitute for condition assessment, nor for attribute target information. MMO has therefore sought advice from Natural England and JNCC when writing this assessment, as well as referring to the vulnerability assessment produced at the time of site designation. More information can be found in Natural England and JNCC's conservation advice and supplementary advice on conservation objectives.

2.2 Scope of this assessment

The scope of this assessment covers fishing activities alone, and relevant activities in combination with fishing. The assessment covers the whole of Farnes East MPA (**Figure 1**).

Bottom towed gear interactions with the moderate energy circalittoral rock feature has not been included in this assessment as it has already been addressed in the MMO Stage 2 assessment of Farnes East MPA. Stage 2 assessed the impacts of fishing using bottom towed gear on rock and rocky and biogenic reef in 13 MPAs and was subsequently prohibited by the MMO Marine Protected Areas Bottom Towed Fishing Gear Byelaw 2023[3].

[3] MMO MPA Bottom Towed Fishing Gear Byelaw 2023: www.gov.uk/government/publications/marine-protected-areas-bottom-towed-fishing-gear-byelaw-2023 (Last accessed 16/02/2024)

3 Part A - Identified pressures on the MPA

Part A of this assessment was carried out in a manner that is consistent with the 'capable of affecting (other than insignificantly)' test required by section 126 of the Marine and Coastal Access Act 2009[4].

Part A assesses the interactions between pressures from fishing gears and the designated features of this site, screening for interactions that require further consideration. Assessment of interactions not screened out in Part A will form Part B of the assessment. For each activity assessed in Part A, there are two possible outcomes for each identified pressure-feature interaction:

1. The pressure-feature interactions **are not** included for assessment in Part B and screened out:
    a. if the feature is not exposed to the pressure, and is not likely to be in the future;
    b. the pressure is not capable of affecting the feature, other than insignificantly; or
    c. if MMO has information that the activity or pressure is not occurring in the site and/or does not need to be considered further.

2. The pressure-feature interactions **are** included for assessment in Part B:
    a. if the feature is exposed to the pressure, or is likely to be in the future;
    b. the pressure is capable of affecting the feature, other than insignificantly;
    c. if it is not possible to determine whether the pressure is capable of affecting the feature, other than insignificantly; or
    d. if MMO has information that the activity or pressure is occurring in the site and/or does need to be considered further.

Consideration of a pressure on a protected feature in an MPA includes consideration of the pressure's exposure to, or effect on, any ecological or geomorphological process on which the conservation of the protected feature is wholly or in part dependent.

3.1 Activities taking place

Table 2 lists all commercial fishing gears included for assessment. All other gears have been screened out of further assessment as they do not take place and are not likely to take place in the future, as there are no vessel monitoring system (VMS) records present within the site linked to these gear codes, nor do they appear in landings data for International Council for the Exploration of the Sea (ICES) statistical rectangles that overlap the site.

[4] For more information: www.legislation.gov.uk/ukpga/2009/23/section/126

To determine fishing activity occurring within the site, the following evidence sources were used:

- VMS data;
- fisheries landings data (logbooks and sales records);
- MMO catch recording project data;
- ICES rectangle level fishing effort data in days (reference: MMO1264);
- swept area ratio (SAR) data.

For more information about the above evidence sources, please see the MPA Fisheries Assessment Methodology document[5], which describes each type of fishing activity evidence and summarises the strengths and limitations of each source.

[5] MPA Fisheries Assessment Methodology document: www.gov.uk/government/publications/stage-3-site-assessments (Last accessed 13 August 2024).

Table 2: Fishing activities covered by this assessment present in VMS and landings data for Farnes East MPA, 2016 to 2021.

Gear type	Gear name	Gear code	Justification
Anchored nets and lines	Trammel net	GTR	Present in under 12 m vessel landings data for ICES statistical rectangles that overlap the site.
	Longline (unspecified)	LL	
	Gill nets (not specified)	GN	
Bottom towed gear	Twin bottom otter trawl	OTT	Present in VMS records and in under 12 m vessel landings data for ICES statistical rectangles that overlap the site.
	Towed dredge	DRB	
	Nephrops trawl	TBN	
	Bottom otter trawl	OTB	
	Mechanised dredge	HMD	Present in VMS data.
	Bottom trawl (unspecified)	TB	
	Beam trawl	TBB	Present in under 12 m vessel landings data for ICES statistical rectangles that overlap the site.
	Otter trawls (unspecified)	OT	
Midwater gear	Midwater otter trawl	OTM	Present in VMS data.
	Hook and line (unspecified)	LX	Present in under 12 m vessel landings data for ICES statistical rectangles that overlap the site.
	Hand-operated pole-and-line	LHP	
	Drift gillnet	GND	
Traps	Pot/Creel	FPO	Present in under 12 m vessel landings data for ICES statistical rectangles that overlap the site.

3.2 Pressures, features and activities screened out

This section identifies activities or pressures that are **occurring but do not need to be considered** for Farnes East MPA.

The gear types and pressures screened out on this basis are listed below with justification:

- **Midwater gears:** although the use of midwater gears does occur within Farnes East MPA, there is no feasible pathway for gears of this type to interact with benthic designated features as part of normal operation. These gears are not designed to operate on or near the seabed and are deployed entirely within the water column. Therefore, the use of midwater gear within Farnes East MPA is not considered to be capable of affecting the designated

features other than insignificantly and is not considered further within this assessment.

- **Bottom towed gear interactions with the features high and moderate energy circalittoral rock:** Bottom towed gear interactions with circalittoral rock have not been included in this assessment as they have already been addressed in the MMO Stage 2 assessment. Stage 2 assessed the impacts of fishing using bottom towed gears on rock and rocky and biogenic reef in 13 MPAs. and subsequently prohibited such interactions through the MMO Marine Protected Areas Bottom Towed Fishing Gear Byelaw 2023[3].

3.3 Pressures to be taken forward to Part B

The Stage 3 Fishing Gear MPA Impacts Evidence documents detail all pressures created by fishing activity on features of interest. The documents justify which pressures should be taken forward for consideration for each feature. This is documented in Table A1.2 in each of the Impacts Evidence documents:

- Stage 3 Fishing Gear MPA Impacts Evidence Anchored Nets and Lines[6];
- Stage 3 Fishing Gear MPA Impacts Evidence Bottom Towed Gear[7]; and
- Stage 3 Fishing Gear MPA Impacts Evidence Traps[8].

To determine whether a pressure should be taken forward for this particular site, **Table 3** uses the information from the Impacts Evidence documents, alongside site specific information, including sensitivity assessments, risk profiling of pressures from conservation advice packages, and Natural England/JNCC advice to assess the sensitivities of pressures on the designated features of the site.

As previously noted, there is currently no advice on operations available for Farnes East MPA, Natural England and JNCC have therefore advised the use of the conservation advice packages for North East of Farnes Deep MPA and South Rigg MPA, due to the similarity between site features and location within the same bioregion.

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[6] Stage 3 Fishing Gear MPA Impacts Evidence Anchored Nets and Lines www.gov.uk/government/publications/marine-protected-areas-stage-3-impacts-evidence (Last accessed 13 August 2024)

[7] Stage 3 Fishing Gear MPA Impacts Evidence Bottom Towed Gears www.gov.uk/government/publications/marine-protected-areas-stage-3-impacts-evidence (Last accessed 13 August 2024)

[8] Stage 3 Fishing Gear MPA Impacts Evidence Traps www.gov.uk/government/publications/marine-protected-areas-stage-3-impacts-evidence (Last accessed 13 August 2024)

Table 3 details the pressures for each gear type - anchored nets and lines (A), bottom towed gear (B) and traps (T) - to be assessed in Part B, taking into account the pressures screened in and out in **sections 3.1 and 3.2.**

Key	
	Dark blue highlighting indicates that the feature is sensitive to this pressure from the gear type in this site, and that the interaction should be taken forward for consideration.
	Light blue highlighting indicates that feature is sensitive to the pressure in general, but the gear type is unlikely to exert this pressure to an extent where impacts are of concern in the site.
	Grey highlighting indicates that there is insufficient evidence to make sensitivity conclusions, or that a sensitivity assessment has not been made for this feature to this pressure from the gear type.
	If there is no highlighting within a cell, this indicates that the pressure from the gear type is not relevant to the feature, or that the feature is not sensitive to the pressure.

Table 3. Summary of pressures on designated features of Farnes East MPA to be taken forward to Part B.

Potential pressures	Designated features																			
	Moderate energy circalittoral rock		Sea-pen and burrowing megafauna communities			Ocean quahog			Subtidal coarse sediment			Subtidal mixed sediments			Subtidal mud			Subtidal sand		
	A	T	A	B	T	A	B	T	A	B	T	A	B	T	A	B	T	A	B	T
Abrasion or disturbance of the substrate on the surface of the seabed																				
Barrier to species movement																				
Changes in suspended solids (water clarity)																				
Deoxygenation																				
Hydrocarbon and polycyclic aromatic hydrocarbon (PAH) contamination																				
Introduction of light																				
Introduction of microbial pathogens																				
Introduction or spread of invasive non-indigenous species																				
Litter																				
Organic enrichment																				
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion																				
Physical change (to another seabed type)																				
Physical change (to another sediment type)																				
Removal of non-target species																				
Removal of target species																				
Smothering and siltation rate changes (low)																				
Synthetic compound contamination																				
Transition elements and organo-metal contamination																				

4 Part B - Fishing activity assessment

Part B of this assessment was carried out in a manner that is consistent with the 'significant risk of hindering the achievement of the conservation objectives' test required by section 126 of the Marine and Coastal Access Act 2009[4].

Table 3 shows the fishing activities and pressures identified in Part A which have been included for assessment in Part B. The most relevant attributes of the designated features that could be compromised by fishing pressures were identified using the proxy sites used for Farnes East MPA, in this case North East of Farnes Deep MPA and South Rigg MPA and are shown in **Table 4**.

Table 4: Relevant favourable condition targets for identified pressures.

Feature	Target	Relevant pressures
Moderate energy circalittoral rock Subtidal coarse sediment Subtidal mixed sediments Subtidal sand	Maintain	• Abrasion or disturbance of the substrate on the surface of the seabed • Changes in suspended solids (water clarity) • Smothering and siltation rate changes • Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion • Removal of non-target species • Removal of target species
Subtidal mud Sea-pen and burrowing megafauna communities Ocean quahog *Arctica islandica*	Recover	

4.1 Fisheries access and existing management

Non-UK vessels can operate within Farnes East MPA, provided that they have a licence issued by the UK to do so. Nationalities which fished within the MPA from 2016 to 2021 include vessels from the UK, Germany, France and the Netherlands. VMS records indicate that UK vessels are most prevalent.

More information on non-UK vessel access to UK waters can be found on MMO's Single Issuing Authority page[9].

Farnes East MPA is subject to the following relevant legislative catch restrictions that are applicable to fisheries occurring the site:

- Farne Deeps Fishing Restrictions 2021[10]

This legislation has some restrictions on vessels deploying demersal trawls and seines (with the exception of beam trawls) fishing in the Farne Deeps, in relation to gear and mesh size via permit conditions. The whole of Farnes East MPA overlaps the north area of the Farne Deeps area. As such some demersal trawl and seine activity can occur despite this restriction as a result of vessel power and gear configurations.

The MMO Marine Protected Areas Bottom Towed Fishing Gear Byelaw 2023[3] prohibits fishing using bottom towed gears on rock and rocky and biogenic reef in Farnes East MPA.

4.2 Fishing activity summary

Table A1. 1 to Table A1. 7 in **Annex 1** display a detailed breakdown of fishing activity within Farnes East MPA. When discussing weights from landings in this section, figures used are a total of weights from UK and EU member states. Statistics are taken also from the period 2016 to 2020 or 2016 to 2021.

Of the fishing activities screened into Part A of this assessment, VMS data show that the most prevalent gear type operated by over 12 m vessels within the site is dredging, followed by demersal trawling. Landings data show that the most prevalent gears operated by under 12 m vessels within the site are traps – pots/creels.

Anchored nets and lines

The only anchored nets and lines activity in the MPA was from under 12 m vessels, which landed on average 0.04 tonnes per year between 2016 and 2020. Approximately 3 days of total fishing effort were recorded between 2016 and 2021 in ICES rectangles 39E8 and 40E8 in the MPA. Fishing effort days are derived from logbooks and collected at ICES rectangle and then apportioned accordingly. The vast majority of the MPA overlays ICES rectangle 40E8 however the majority of under 12 m vessel activity tends to be within 6 nm, so by apportioning fishing

[9] The UK Single Issuing Authority: www.gov.uk/guidance/united-kingdom-single-issuing-authority-uksia (Last accessed 26 July 2023).
[10] Farne Deeps Fishing Restrictions Legislation: assets.publishing.service.gov.uk/media/665836d30c8f88e868d33371/Cat_A_Licence_Schedule_11_V7_01Jun2024.pdf (Last accessed 05 October 2023)

statistics equally across the ICES rectangles, this may result in an over-estimate of activity within the MPA.

Bottom towed gear

The majority of over 12 m bottom towed gear activity in Farnes East MPA was from dredges (146 and 28 annual average VMS records for towed dredges and mechanised dredges, respectively). In total, dredges landed on average 30.73 tonnes (over 12 m vessels – 30.63 tonnes under 12 m vessels – 0.10 tonnes). Under 12 m vessels using dredges recorded a total of approximately 1.4 days of fishing effort in ICES rectangles 39E8 and 40E8. Mean annual surface and subsurface SAR values for dredge activity for C-squares intersecting Farnes East MPA varied from 0.01 in 2016 to a peak of 0.08 in 2017. From the Stage 3 SAR Dredge (2016 to 2020) WebApp[11] it is visible that dredging intensity illustrated by SAR data, is highest within the 6 to 12 nm section of the site and is at its highest on the western boundary of the MPA, i.e. the 6 nm limit. An SAR value of 1 would mean that on average these C-squares were passed over completely by dredges once every year.

Demersal trawls were the second most prevalent bottom towed gear activity in the MPA, with the majority of over 12 m records being from twin bottom otter trawls (annual average: 57 VMS records) and bottom otter trawls (47 VMS records). Nephrops trawls demonstrated fewer VMS records with an annual average of nine. In total, demersal trawls landed on average 37 tonnes (over 12 m vessels – 25 tonnes, under 12 m vessels – 12 tonnes). Under 12 m vessels using demersal trawls recorded a total of approximately 262 days of fishing effort in ICES rectangles 39E8 and 40E8. Mean annual surface SAR values for demersal trawl activity for C-squares intersecting Farnes East MPA varied from 0.20 to 0.46. Mean annual subsurface SAR values varied from 0.06 in 2016 to a peak of 0.15 in 2019. From Stage 3 SAR Demersal Trawl (2016 to 2020)WebApp[12] it is visible that demersal trawl intensity illustrated by SAR data, is highest on the south-eastern boundary of the site, beyond 12 nm.

No landings or effort data was recorded for demersal seining.

Traps

Trap activity for over 12 m vessels is minimal with an annual average of one VMS record. No landings for vessels over 12 m have been recorded. For vessels under 12 m using pots/creels there was a recorded annual average of 235 tonnes and an

[11] MMO Stage 3 SAR Dredge (2016 to 2020) defra.maps.arcgis.com/apps/dashboards/d4ea330b7bea46b288905a94b6c69d08 (Last accessed 30 August 2024)

[12] MMO Stage 3 SAR Demersal Trawl (2016 to 2020) defra.maps.arcgis.com/apps/dashboards/13a12f1b2251419e94e40ca9a677968a (Last accessed 30 August 2024)

annual average of 761 days of fishing effort in the parts of the MPA overlaying ICES rectangles 39E8 and 40E8. Apportioning landings and fishing effort from under 12 m vessels equally across these ICES rectangles may result in an over-estimate of fishing activity at the MPA level, as under 12 m vessels tend to be more active further inshore.

There is spatial and seasonal variability in potting activity. Lobster is predominantly targeted on hard ground or rock edges closer inshore during the summer. In winter, pots target brown crab primarily over soft or mixed sediment further offshore. (Pers. comms. Northumberland IFCA).

One vessel is known to use Nephrops creels semi-regularly out of Amble harbour, mainly in winter, and two more vessels from Blyth harbour may also use this gear to support their crab and lobster potting. (Pers. comms. MMO).

4.3 Pressures by gear type

The Stage 3 Fishing Gear MPA Impacts Evidence documents for anchored nets and lines[6], bottom towed gear[7] and traps[8] collate and analyse the best available evidence on the impacts of different fishing gears on MPA features. This section summarises the analyses and conclusions of those documents, and considers these alongside site specific information, including the nature and condition of the habitats and species present, the general management approaches for designated features, intensity of fishing activity taking place and exposure to natural disturbance.

As the designated features subtidal coarse sediment, subtidal mixed sediments, subtidal sand, and subtidal mud have similar sensitivities to the pressures identified for different gear types, these features have been considered together. Where there are differences between the features or the potential impacts of different gears within each grouping, this has been highlighted.

In the context of MPA assessment, the pressures removal of target and non-target species refer to any damage, loss, or removal of species defined as a designated feature, or integral to the integrity of a designated feature (for example key structural or influential species). This may occur through intentional or unintentional catch associated with the act of commercial fishing.

Impacts from target and/or non-target removal pressures have been scoped out from this assessment in most cases, as the detail of key structural and influential species is yet to be fully defined and they are assessed more completely within the abrasion and penetration pressures. These pressures may require consideration as a result of any future evidence review, in conjunction with updated conservation advice from JNCC and Natural England. Where separate consideration of these pressures is required, this has been stated, but generally includes the following:

MPAs with certain designated species features or designated features that may contain key commercially targeted species have been highlighted as requiring separate consideration of the removal pressures. This includes MPAs with an active Nephrops fishery, where the habitat sea-pen and burrowing megafauna communities is a designated feature, or where ocean quahog are a designated species feature.

The designated features in this site, sea-pen and burrowing megafauna communities, may be sensitive to removal of target and/or non-target species pressures. Removal of target species in this case is most relevant to Nephrops**,** as part of the burrowing megafauna element of the sea-pen and burrowing megafauna communities feature, commonly targeted using bottom towed gears. As there is Nephrops fishing via bottom towed gear occurring in the site, removal of target species in relation to Nephrops associated with burrowing megafauna will be considered in relation to bottom towed gear. There are also instances of fishing for Nephrops using traps (creels), though this is in limited numbers, with one know vessel working from Amble harbour and a couple from Blyth. Removal of this species is not possible however using anchored nets and lines.

The designated feature in this site, ocean quahog, may be sensitive to removal of non-target species pressures. However, ocean quahog is not considered sensitive to removal pressures via static gear types, as removal of bivalves is highly unlikely through the use of static gear. As such, this feature is more fully assessed within the abrasion and penetration pressures.

Concerns regarding the removal of non-target species pressure in relation to bottom towed gear and ocean quahog, and for removal of target species in relation to bottom towed gear and traps, for sea-pen and burrowing megafauna communities in relation to Nephrops, have as such been addressed in the following sections.

4.3.1 Anchored nets and lines

The relevant pressures on the designated features of Farnes East MPA from anchored nets and lines were identified in **Table 3** and are:

- abrasion or disturbance of the substrate on the surface of the seabed; and
- removal of non-target species; and
- removal of target species (not for sea-pen and burrowing megafauna communities or ocean quahog).

As noted previously, impacts from removal of target and non-target species pressures for anchored nets and lines, are not being considered in detail in this assessment, as they are assessed more completely within the abrasion pressure.

Impacts on these features relating to abrasion or disturbance of the substrate on the surface of the seabed occur primarily during setting and retrieval of nets and the

associated ground lines and anchors, as well as by their movement over the seabed during rough weather.

Moderate energy circalittoral rock

Table A2.1 in **Annex 2** lists the biotopes that may be found within the moderate energy circalittoral rock feature of the site. The relevant sensitivities are available within Natural England's Advice on Operations for North East of Farnes Deep MPA which has been used as a proxy site for Farnes East MPA in the absence of a Conservation Advice Package (as outlined in **Section 2.1**). Biotope sensitivity data was then extracted from MarLIN to outline biotope sensitivity for the relevant pressure.

For the circalittoral rock feature, 18 biotopes were identified as potentially being present at the site, ten were screened out due to low sensitivity, four due to depth, with the remaining four to be considered as per **Table 5**.

Table 5: Moderate energy circalittoral rock biotopes that may be found within Farnes East MPA with medium sensitivity to the abrasion/disturbance of the substrate on the surface of the seabed and have not been excluded due to depth ranges.

Biotope	Sensitivity
Urticina felina and sand-tolerant fauna on sand-scoured or covered circalittoral rock (Tillin and Hiscock, 2016)	Abrasion: Medium
Sabellaria spinulosa encrusted circalittoral rock (Tillin, Marshall, *et al.*, 2023a)	
Sabellaria spinulosa with a bryozoan turf and barnacles on silty turbid circalittoral rock (Tillin, Marshall, *et al.*, 2023b)	
Brittlestars on faunal and algal encrusted exposed to moderately wave-exposed circalittoral rock (De-Bastos *et al.*, 2023a)	

As outlined in **Section 4.2,** there is very limited fishing using anchored nets and lines in the MPA.

As described in section 7.1 of the anchored nets and lines Impacts Evidence document[6], there is the potential for static gear such as anchored nets and lines to cause damage to rocky reefs and sensitive epifauna. Although targeted research on the impacts of netting on reef is extremely limited, there are some literature reviews that state that high levels of netting and associated anchoring can damage reefs and the associated communities through cumulative damage over time.

The potential for impact will depend on the intensity of fishing activity taking place, with increasing activity increasing the likelihood of weights and ropes associated with nets and lines damaging, entangling or removing epifaunal species. A study has shown that rock with erect and branching spp. has high sensitivity to anchored nets and lines at light-heavy fishing intensity. Epifaunal and epifloral communities' recovery following gill netting activity is not well understood, however, as with other gears, the likely impact of nets and lines on rocky reef will vary based on several factors including gear type, fishing intensity, habitat, and environmental variables. Whilst certain studies have categorised rock with erect and branching spp. as having high sensitivity at all levels of static fishing, these were based on expert judgement rather than supported by empirical evidence and the overarching conclusion from the literature available is that rocky reef features are estimated to have low sensitivity to all but heavy levels of fishing intensity from static fishing gear.

Given the low level of anchored nets and lines fishing activity currently occurring within the site, coupled with the small spatial footprint of the gear, no evidence of highly sensitive biotopes being present within these rocky reef habitats, it is unlikely that the ongoing use of anchored nets and lines over moderate energy circalittoral rock will pose a significant risk of hindering the achievement of the conservation objective of Farnes East MPA.

Subtidal coarse sediment; subtidal mixed sediments; subtidal mud; subtidal sand

Table A2. 2 to Table A2. 5 of Annex 2 detail the list of biotopes that may be found within the sediment features of the site and their relevant sensitivities is available within the JNCC Biotope Databases. Biotope sensitivity data was then extracted from MarLIN to outline biotope sensitivity for the relevant pressure. **Table 6** demonstrates the four subtidal mud and two subtidal sand biotopes with medium sensitivity to abrasion and those which have not been excluded due to depth ranges.

Table 6: Subtidal mud and sand biotopes that may be found within Farnes East MPA with medium sensitivity to the abrasion/disturbance of the substrate on the surface of the seabed.

Biotope	Sensitivity
Subtidal mud	
Ampharete falcata turf with *Parvicardium ovale* on cohesive muddy sediment near margins of deep stratified seas (De-Bast and Hill, 2016)	Abrasion: Medium
Levinsenia gracilis and *Heteromastus filifirmis* in offshore circalittoral mud and sandy mud (De-Bastos, 2016a)	

Biotope	Sensitivity
Paramphinome jeffreysii, *Thyasira* spp. and *Amphiura filiformis* offshore circalittoral sandy mud (De-Bastos, 2016c)	
Myrtea spinifera and polychaetes in offshore circalittoral sandy mud (De-Bastos, 2016b)	
Subtidal sand	
Maldanid polychaetes and *Eudorellopsis deformis* in deep circalittoral sand or muddy sand (Ashley, 2016)	Abrasion: Medium
Owenia fusiformis and *Amphiura filiformis* in deep circalittoral sand or muddy sand (De-Bastos, 2023)	

As described in section 9 of the anchored nets and lines Impacts Evidence document[6], anchored nets and lines have been identified as gear types which may have a detrimental effect on sandbank features and MCZ sediment habitats. Overall, available literature suggests that static gears such as anchored nets and lines have a relatively low impact on benthic communities in comparison to towed gears and are likely to be of limited concern to subtidal sediment habitats. Impacts may occur in intensively fished areas, and on epifauna, particularly those susceptible to entanglement or removal by the weights and ropes associated with nets and lines. Abrasion of the seabed is particularly apparent during hauling of gear or the movement of gear along the seabed when subject to strong tides, currents or storm activity. However, interaction of lines and associated anchors with the seabed is likely to be minimal. The literature available considered that subtidal sediments, muds and sands, have no or low sensitivity to all but heavy levels of fishing intensity from static fishing on stable species rich sediments, or those with long-lived bivalves.

Given the low level of anchored nets and lines fishing activity currently occurring within the site, coupled with the small spatial footprint of the gear, no evidence of highly sensitive biotopes being present within these sediment habitats, it is unlikely that the ongoing use of anchored nets and lines over the sediment features will pose a significant risk of hindering the achievement of the conservation objective of Farnes East MPA.

Sea-pen and burrowing megafauna communities

Table 7 demonstrates the three biotopes within the sea-pen and burrowing megafauna communities of Farnes East MPA. Two have medium sensitivity to abrasion whilst one has high sensitivity.

Table 7: Biotopes that may be found within the sea-pen and burrowing megafauna communities of Farnes East MPA with sensitivity to the abrasion / disturbance of the substrate on the surface of the seabed.

Biotope	Sensitivity
Seapens and burrowing megafauna in circalittoral fine mud (Hill *et al.*, 2023)	Abrasion: medium
Burrowing megafauna and *Maxmuelleria lankesteri* in circalittoral mud (Durkin and Tyler-Walters, 2022)	
Seapens, including *Funiculina quadrangularis*, and burrowing megafauna in undisturbed circalittoral fine mud (Tyler-Walters and Watson, 2023)	Abrasion: high

The slender sea-pen has been identified as medium sensitivity to abrasion and physical disturbance. There is limited information available for the phosphorescent sea-pen and its sensitivity to varying pressures. However, this biotope can generally be found in depths ranging from 10 m to 100 m. In addition, the information available outlines that *P. phosphorea* can contract when disturbed and it is also capable of withdrawing into a tube below the mud surface.

Burrowing megafaunas, such as Norwegian lobster (*N. norvegicus*) are generally considered less sensitive to abrasion and penetration impacts than sea-pens due to their motility and ability to move from areas of disturbance. Sea-pens, although able to retract into their burrows and bend in some instances, are fixed and unable to move from potential disturbance episodes. Therefore, this assessment focuses on the most sensitive component of this designated feature, sea-pens.

Research detailing the impacts of abrasion from anchored nets and lines on subtidal mud habitats considered three species of sea-pens and noted that species which cannot retract into the sediment and/or are more rigid are likely to be less tolerant to disturbance caused by potting but no lasting effects on the substrate were observed during the study. Similarly, even if uprooted, some sea-pens are able to reinsert themselves into the sediment. While these studies considered the impact of traps, the ability of sea-pens to flex under weight, reinsert following uprooting and retract into the sediment, will similarly aid in their resilience to demersal nets, lines, and their associated anchors. The potential for impact will be dependent on the intensity of

fishing activity taking place with increasing activity increasing the likelihood of weights and ropes associated with nets and lines damaging, entangling, or removing epifaunal species. Using the evidence regarding traps as a proxy, suggests that anchored nets and lines are unlikely to significantly impact sea-pen and burrowing megafauna communities associated with the site.

Given the low level of anchored nets and lines fishing activity currently occurring within the site, coupled with the small spatial footprint of the gear, it is unlikely that the ongoing use of anchored nets and lines over sea-pen and burrowing megafauna communities will pose a significant risk of hindering the achievement of the conservation objective of Farnes East MPA.

Ocean quahog

A species of conservation importance that is protected in the Farnes East MPA is the ocean quahog. The ocean quahog (*Arctica islandica*, also known as Icelandic cyprine) is a protected feature of the MPA. Ocean quahog generally occur at depths ranging from 4 m to 482 m and are found at extreme low water level but predominately on sublittoral firm sediments including level offshore areas, buried (or part buried) in sand and muddy sand that ranges from fine to coarse grains.

As described in section 6.1 of the of the anchored nets and lines Impacts Evidence document[6], the ocean quahog sis particularly sensitive to pressures exerted by fishing activity as it has a long generation time, low growth rate in adults, variable age and size at maturity, and unpredictable recruitment success. The species has shown to have varying resilience depending on location and amount of mortality. If a population has experienced significant mortality, then a precautionary resistance of ‘very low’ is recorded by MarLIN, as recovery is likely to take more than ten years, or potentially in excess of 25 years. If a population has only suffered some mortality, then the species is assessed as having a resilience of ‘medium’ as recovery may be possible from low levels of continuous recruitment. Furthermore, the recruitment ocean quahog is linked to water temperature, with increasing temperatures being attributed to the cause of low recruitment success in North Sea populations. With increasing warming of oceans, southerly populations of ocean quahog may experience recruitment failure which could result in range contraction of the species and therefore a change in the sensitivity of the species to fishing activity.

There is a lack of literature describing the impacts of anchored nets and lines on ocean quahog. Although these gear types can cause some abrasion of the seabed, given the hard shell of ocean quahog and limited seabed contact of these gears, they are unlikely to significantly impact the species. Additionally, the literature has outlined that no static gears are a ‘major concern’ for subtidal sediments and estimated no or low sensitivity to all but heavy levels of fishing intensity on rich sediments or sand and gravel with long-lived bivalves, such as ocean quahog. An exception would be if these fishing gears are used in high densities in areas where

the associated gear regularly drags across the seabed. With regards to defining high densities of nets and lines, based on the scientific literature and expert judgement, heavy intensity of nets and lines is classed as the densities seen in the heaviest of fisheries, in this case as over 9 pairs of anchors/area (2.5 nm by 2.5 nm) fished daily. Sedimentary habitats containing long–lived bivalves were classed as having medium sensitivity to these high intensities of nets and longlines, and otherwise low sensitivity to lower intensities of nets and lines.

Ocean quahog can be damaged by abrasion caused by mobile fishing gear such as beam trawls and otter trawls, however the small footprint of anchored nets and lines on the seabed will likely lead to static gears having relatively low impacts on benthic communities.

Although the ocean quahog has high sensitivity to abrasion pressures, given the low level of anchored nets and lines fishing activity currently occurring within the site, coupled with the small spatial footprint of the gear, it is unlikely that the ongoing use of anchored nets and lines over ocean quahog will pose a significant risk of hindering the achievement of the conservation objective of Farnes East MPA.

Therefore, with regards to the discussion above, **MMO concludes that, at the levels described, the use of anchored nets and lines does not pose a significant risk of hindering the achievement of the conservation objectives of Farnes East MPA.**

4.3.2 Bottom towed gear

The relevant pressures on the designated features of Farnes East MPA from bottom towed gear were identified in **Table 3** and are:

- abrasion or disturbance of the substrate on the surface of the seabed*; and
- penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion*; and
- changes in suspended solids (water clarity)^ (for sediment features only); and
- smothering and siltation rate changes^ (for sediment features only); and
- removal of non-target species; and
- removal of target species (not for ocean quahog).

As noted above, impacts from removal of target and non-target species pressures are not being considered in detail in this assessment, as they are assessed more completely within the abrasion pressure. Removal of target species is considered however, in relation to Nephrops associated with burrowing megafauna communities and targeting of the species via bottom towed gear occurring in the site. Removal of non-target species is also considered in relation to ocean quahog.

Pressures marked with matching superscript symbols (* and ^) have been consolidated in this review to avoid repetition, due to the similar nature of their impacts on habitats.

As outlined in **Section 2.2,** bottom towed gear interactions with the moderate energy circalittoral rock feature have not been included in this assessment as this has already been addressed in the Stage 2 assessment of Farnes East MPA.

Subtidal coarse sediment; subtidal mixed sediments; subtidal mud; subtidal sand

Abrasion or disturbance and penetration of the substrate on the surface of the seabed

The two subtidal sand feature biotopes identified in the anchored nets and lines section as having medium sensitivity to abrasion, have also been identified as having medium sensitivity to penetration (shown in **Table 8**). The subtidal mud feature biotopes identified in in **Table 8** and in the anchored nets and lines section as having medium sensitivity to abrasion, have also been identified as having medium sensitivity to penetration.

Table 8: Subtidal mud and sand biotopes that may be found within Farnes East MPA with medium sensitivity to the abrasion / disturbance and penetration of the substrate on the surface of the seabed.

Biotope	Sensitivity
Subtidal mud	
Ampharete falcata turf with *Parvicardium ovale* on cohesive muddy sediment near margins of deep stratified seas (De-Bastos and Hill, 2016)	Abrasion, penetration: Medium
Levinsenia gracilis and *Heteromastus filifirmis* in offshore circalittoral mud and sandy mud (De-Bastos, 2016a)	
Paramphinome jeffreysii, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud (De-Bastos, 2016c)	
Myrtea spinifera and polychaetes in offshore circalittoral sandy mud (De-Bastos, 2016b)	
Subtidal sand	
Maldanid polychaetes and *Eudorellopsis deformis* in deep circalittoral sand or muddy sand (Ashley, 2016)	Abrasion, penetration: Medium

Biotope	Sensitivity
Owenia fusiformis and *Amphiura filiformis* in deep circalittoral sand or muddy sand (De-Bastos, 2023)	

Given the high levels of demersal trawling concentrated in the south east of the site and dredge activity concentrated in the west and south of the site, it is likely that the sedimentary features of the site are experiencing regular exposure to abrasion and penetration pressures.

As described in section 8.4.1 of the bottom towed gear Impacts Evidence document[7], abrasion and penetration pressures from bottom towed gear can result in both physical and biological impacts on subtidal sediment features. Physical impacts include the creation of furrows and berms in the sediment from the trawl doors associated with bottom otter trawls; and the flattening of bottom features such as ripples and irregular topography by beam trawls and demersal seines. Physical impacts are unlikely, however, to significantly impact the large-scale topography of sediment features. Of more concern are the impacts to the biological structure of sediment habitats. Impacts to biological communities through damage and mortality of flora and fauna via surface and subsurface abrasion and penetration varies based on the levels of fishing activity and intensity. The first pass of bottom towed gear over the seabed also will remove the most sensitive components of the feature. This can lead to long term shifts in biological communities towards smaller, short-lived, opportunistic species that exhibit greater resilience to anthropogenic activity.

Demersal trawls can cause collision, crushing and uprooting as animals encounter or pass under the gear. Initial reductions in biomass, species richness and diversity, as well as changes in community structure are considered likely to be greatest on subtidal coarse sediments compared to subtidal sand. As outlined in section 8.5.1 of the bottom towed gear Impacts Evidence document[7], the first pass of a trawl has the largest initial impact on biomass and production in sediments whereas in areas of high trawling intensity, further increasing trawling intensity can have smaller additional effects on biomass and production (Hiddink *et al.*, 2006). Direct mortality due to otter trawling is considerable but has been found to be lower than that caused by beam trawling for a number of burrowing species, however research has shown that otter trawls remove, on average, around 6% of faunal biomass per pass with the first trawl pass having the most significant impact.

As detailed in section 4.2 of the bottom towed gear Impacts Evidence document[7] During scallop dredging the greatest amount of mortality results in individuals left on the seabed rather than occurring as bycatch. This can lead to shifts in benthic community structure to one dominated by small, encrusting, opportunistic, fast-growing species due to the supplementation of the diet of predators such as starfish or crabs from carrion left in the dredge tracks and the removal of upright species.

This is predominantly related to how long a site had been fished, rather than actual fishing intensity. Stable mixed sediment seabeds (sand and mud mixtures) are dominated by faunal turfs consisting largely of erect hydroids and erect bryozoans, all of which are particularly vulnerable to scallop dredging which can reduce the complexity of benthic habitats by flattening substrates and removing these structurally complex species. These species form emergent structures that provide important settlement substrates for many other species, including scallop spat. The abundance of species within such faunal turfs has been found to be reduced by 56 to 96% by dredging. Lastly, dredging in muddy sediments can cause high mortality and removal rates of benthic macrofauna.

Changes in suspended solids (water clarity) and smothering and siltation rate changes (light)

Table A2. 2 to Table A2. 5 of **Annex 2** detail the list of biotopes that may be found within the sediment features which may be sensitive to the changes in suspended solids (water clarity) and smothering and siltation rate changes pressures. **Table 9** shows the one biotope, in the subtidal mud feature, which was identified as having medium sensitivity to smothering and siltation rate changes pressures.

Table 9: Subtidal mud biotopes that may be found within Farnes East MPA with sensitivity to the abrasion / disturbance and penetration of the substrate on the surface of the seabed, smothering and siltation rate changes (light) and changes in suspended solids (water clarity).

Biotope	Sensitivity
Foraminiferans and *Thyasira* spp. in deep circalittoral soft mud (Tillin and Riley, 2016)	Smothering and siltation rate changes (light): Medium

As described in **section 4.2**, the majority of bottom towed gear activity in the site is being undertaken by vessels deploying dredges and bottom otter trawls. Scallop dredges have been shown to entrain sandy sediments up to 30 m behind the gear. The dredge teeth rake through, loosen, and break up the top layer of sediment. Section 8.4.2 of the bottom towed gear Impacts Evidence document[7] describes a study on sandy sediment grounds in Scotland which demonstrated that the turbulent wake of scallop dredges entrains up to 0.85 kg per metre of plume about 20 m behind the dredge, which is the equivalent of a 1 mm layer of sediment per unit of swept width. This means a typical scallop dredger fishing eight dredges off each side would put about 13.6 kg of sediment into the water column per metre of seabed towed depending on the sediment's particle size distribution and the local hydrography.

Furthermore, research on the effects of sediment suspension by otter trawls used to inform the bottom towed gear Impacts Evidence document demonstrated that activity

over sandy substrates can cause a sediment concentration increase behind the gear of up to 0.43 cm^3 per litre and an estimated 41.3 kg of sediment can be suspended by all otter trawl components (ground gear and trawl doors) per metre. Further research used to inform the Impacts Evidence document on the effects of otter trawling on mud sediments found that a single trawling event by an otter trawl resulted in suspension of approximately 9.5 tonnes of sediment, including tens to hundreds of kilograms of associated particulate elements, per kilometre of track. The sediment plume in the near-bottom water was transported more than 1 km away over the following three to four days and elevated levels of re-suspended fine mud sediment were recorded for up to 5 days after their trawl disturbance event.

As described in section 8.4.2 of the bottom towed gear Impacts Evidence document[7], the degree of suspension and therefore the likely degree of impact varies between gear types and sediment type, however it is likely that the extent of impact will vary in line with the degree of resuspension, the larger the amount of entrainment of sediment, the greater the impact to vulnerable biological communities. More compacted substrates with higher mud fractions generate more sediment resuspension than those which are naturally cleaner. Resuspended sediment and the resulting increase in turbidity may be a risk to organisms that are vulnerable to increased levels of sediment particles in the water column and creates the potential for impacts via smothering. changes in suspended sediment in the water column may have a range of biological effects on different species within the habitat, affecting their ability to feed or breathe. Furthermore, section 8.4.2 of the bottom towed gear Impacts Evidence document[7] describes the impacts on the biological communities of sediment habitats from smothering and siltation as variable depending on the species present. Research used to inform the Impacts Evidence document indicates that sedentary, filter or suspension feeders, such as bivalves, had low resistance to smothering, whereas mobile epifauna appear highly resilient and resistant.

Given the medium sensitivity of one biotope identified within the subtidal mud feature, low resistance to this type of fishing activity and slow recoverability, it is likely that the ongoing use of bottom towed gear over the sediment features will pose a significant risk of hindering the achievement of the conservation objective of Farnes East MPA.

Sea-pen and burrowing megafauna communities

Abrasion or disturbance and penetration of the substrate on the surface of the seabed

As identified in **Table 7**, *V. mirabilis* has moderate sensitivity to abrasion and physical disturbance. As stated on MarLIN, sea-pens retract slowly and are likely to be intolerant of abrasion by trawling for instance, which is likely to break the rachis of *V. mirabilis*. *P. phosphorea* does not have any available information on sensitivity

to different pressures, however, as outlined in **Section 4.3.1**, the species can contract when disturbed and it is also capable of withdrawing into a tube below the mud surface.

Sea-pens, although able to retract into their burrows and bend in some instances, are fixed and unable to move from potential disturbance episodes.

Section 4.2 of the bottom towed gear Impacts Evidence document[7] indicates that these fishing methods have the potential to damage the fragile components of the feature, such as sea-pens which protrude from the seabed, resulting in a change to benthic community structure. Sea-pens are slow growing and particularly sensitive to trawling as the whole animal can be removed from their burrows. Overall, there is limited literature available on the interactions of bottom towed gear with sea-pen and burrowing megafauna communities however, the feature is considered highly vulnerable to disturbance from this fishing method.

Bottom towed gear have the potential to impact sea-pen and burrowing megafauna communities, therefore management of these fishing gears is likely required for this site. Given the resistance of the biotopes identified on the feature is low to this type of fishing activity and recoverability is slow, it is likely that the ongoing use of bottom towed gear over sea-pen and burrowing megafauna communities will pose a significant risk of hindering the achievement of the conservation objective of Farnes East MPA.

Removal of target species

For the sea-pen and burrowing megafauna communities feature, three biotopes were identified as potentially being present at the site in **Table 7**. Two of these biotopes were identified as having medium sensitivity to abrasion and one as having high sensitivity.

Sea-pen and burrowing megafauna communities, including Norwegian lobster (*N. norvegicus)* are generally considered less sensitive to abrasion and penetration impacts than sea-pens due to their motility and ability to move from areas of disturbance. Nephrops are considered to have high recoverability if able to recover fully within five years[13], however the observed SAR values, disturbance events are likely to occur more often than every five years. Given that the Nephrops fishery is also targeting Nephrops specifically, sensitivity is likely to be higher in this situation.

Section 4.2 of the bottom towed gear Impacts Evidence document[7] indicates that these fishing methods have the potential to damage the fragile components of the feature, such as sea-pens which protrude from the seabed, resulting in a change to benthic community structure. Sea-pens are slow growing and particularly sensitive to

[13] For more information: The Marine Life Information Network – Recoverability ranking www.marlin.ac.uk/glossarydefinition/recoverabilityranking.

trawling as the whole animal can be removed from their burrows. Overall, there is limited literature available on the interactions of bottom towed gear with sea-pen and burrowing megafauna communities however, the feature is considered highly vulnerable to disturbance from this fishing method.

Bottom towed gears have the potential to impact sea-pen and burrowing megafauna communities, therefore management of these fishing gears is likely required for this site. The localised are of sea-pen and burrowing megafauna communities in the site, coupled with low resistance of the biotopes identified on the feature to bottom towed gear activity and slow recoverability, it is likely that the ongoing use of this fishing gear at the levels described in this section of the site will pose a significant risk of hindering the achievement of the conservation objective of 'recover to favourable condition' of this feature of Farnes East MPA.

Ocean quahog

Abrasion and penetration / removal of non-target species

The ocean quahog has been identified as having high sensitivity to both abrasion and penetration pressures particularly as distribution of ocean quahog in Farnes East overlap bottom towed gear activity in the site. As a burrowing species, ocean quahog are highly sensitive to physical habitat loss, and as such, extent and distribution of supporting habitats are important in maintaining the extent and distribution of the species.

As described in section 6.1 of the bottom towed gear Impacts Evidence document[7], there is significant evidence of the impacts of bottom trawling on ocean quahog in the North Sea, with benthic surveys indicating a reduction in distribution of the species between 1902 and 1986 and a reduction in species abundance between 1972 and 1980 and then between 1990 and 1994. Bivalves close to the sediment surface that are buried deep enough to establish stability within the sediment are reported to be more likely to break when they come into contact with otter trawls as they are less likely to be excavated to the surface without damage. However, bivalves that are excavated to the surface by bottom towed gear activity become increasingly exposed to indirect mortality via predation.

As outlined in section 6.3.1 of the bottom towed gear Impacts Evidence document[7], when pulled across the seabed, various parts of a demersal towed gear can cause penetration, abrasion, or disturbance of the seabed surface substrate. Evidence of the impacts of towed gears varies depending on the gear type, particularly gear penetration depth. Ocean quahog are highly sensitive to pressures caused by bottom otter, twin otter and beam trawls. Gear types using tickler chains cause a higher mortality than those without. Ocean quahog caught in beam and otter trawls have a 90 % mortality rate, the highest of all invertebrate species. Ocean quahog live buried in up to 14 cm of sediment with its siphons protruding from the sediment surface, so it can be damaged by the passing of bottom trawl fishing gear. Ocean

quahog is therefore exposed to both the pressures of surface abrasion and penetration of the sediment. In addition, this species is highly sensitive to pressures caused by trawling and dredging. In areas of high trawling intensity, a higher proportion of damaged shells are found relative to areas of low fishing intensity. For example, in a study looking at the catch composition and survival rates of benthic species caught by a beam trawl, it has been estimated that the mortality of ocean quahog caught in beam trawls ranges from 74% to 90%. Furthermore, predation of damaged ocean quahog increases following trawling activity. Thereby illustrating the impact of removal of non-target species pressures.

Additionally, dredges penetrate mud to a similar depth as beam trawls, so it can be assumed that they will affect the same proportion of an ocean quahog population buried in mud (all individuals buried to a depth of around 10 cm will be affected). However, damage and mortality rates in subtidal sand are likely to vary due to differences in how the gear interacts with the seabed and ocean quahog. In sand, dredges penetrate deeper than beam trawls and otter trawl doors, therefore potentially affecting a greater proportion of ocean quahog buried in sand. It has been found that ocean quahog recovery was very slow within the dredge tracks with estimations that it could take decades to see full recovery of the species. Larger ocean quahog are more vulnerable to damage by bottom towed gear, as the ratio of shell thickness to shell size decreases with age, making them more fragile. However, juveniles are also vulnerable to damage by bottom towed gear as they live at shallower depths and are more likely to encounter and be damaged by the gear. Ocean quahog populations in the North Sea are often highly skewed, containing either adults or juveniles as opposed to representatives of both age class. This is likely due to direct mortality through bottom towed gear.

Given the resistance of the biotopes identified on the feature is low to this type of fishing activity and recoverability is slow, it is likely that the ongoing use of bottom towed gear over ocean quahog will pose a significant risk of hindering the achievement of the conservation objective of Farnes East MPA.

Taking into account the high levels of demersal trawling concentrated in the south east of the site and dredging in the west and south of the site, presence of sea-pens and their sensitivity to abrasion in relation to the Nephrops fishery, the evidence available on the sensitivity of the sediment biotopes to abrasion, and the low resistance and slow recoverability of Ocean Quahog, **MMO concludes that, at the activity level described, the use of bottom towed gear does pose a significant risk of hindering the achievement of the conservation objectives of Farnes East MPA.**

4.3.3 Traps

The relevant pressures on the designated features of Farnes East MPA from traps were identified in **Table 3** and are:

- abrasion or disturbance of the substrate on the surface of the seabed; and
- removal of non-target species; and
- removal of target species (not ocean quahog).

As noted previously, impacts from removal of target and non-target species pressures are not being considered in detail in this assessment, as they are assessed more completely within the abrasion pressure.

Impacts on these features relating to abrasion or disturbance of the substrate on the surface of the seabed occur primarily during the setting and retrieval of traps and their associated ropes, weights and anchors, as well as by their movement over the seabed during rough weather.

Moderate energy circalittoral rock

Traps and anchored nets and lines fishing gear exert similar pressures on the biotopes associated with the circalittoral rock features of the site, therefore the biotopes identified in **Table 5** as having medium sensitivity to abrasion in the anchored nets and lines section (**Section 4.3.1**) also apply here for the traps section.

According to VMS data for over 12 m vessels, the use of traps in the site is minimal with 1 VMS count recorded on average annually between 2016 and 2021. No landings for vessels over 12 m have been recorded in the same data reporting period. However, vessels under 12 m using pots/creels were high, landing approximately 235 tonnes on average annually between 2016 and 2020. Average annual fishing effort recorded by UK vessels under 12 m in length using traps between 2016 and 2020 for the area of Farnes East MPA that intersects ICES rectangles 39E8 and 40E8 was 761 days.

Trapping activity by under 12 m vessels has seasonal variability. In summer, pots predominantly target the higher market value species, lobster, which is also more active species in terms of pot catch, at this time of year. Targeting of lobster is usually on hard ground or rock edges closer inshore. In winter, however, the fishery moves further offshore, again perhaps for lobster over rocky ground, but as lobster are less active in this season, pots may also turn to brown crab which can be targeted over a larger range of habitats such as soft or mixed sediment and are more abundant at this time of year. The move offshore is also in relation to reducing damage to gear in poor weather (pers. comms. Northumberland IFCA). Therefore, the use of traps is likely to be occurring primarily outside of the MPA, within 6 nm, particularly in Summer, with any further offshore activity occurring in winter likely to be spread over a larger variety of habitats targeting brown crab and not lobster. As such, the trapping activity is unlikely to be taking place over the areas of moderate energy circalittoral rock scattered across the MPA.

As described in section 7.1 of the traps Impacts Evidence document[8], sensitivity assessments suggest there is the potential for static gear such as traps to cause

damage to rocky reefs and sensitive epifauna. Rock with low-lying fast-growing faunal turf were shown to have medium sensitivity to traps at high fishing intensity. Rock with erect and branching species were shown to have medium sensitivity to traps at moderate-heavy fishing intensity. Certain rocky reef habitats such as those dominated by erect and branching species, fast growing faunal turfs and kelp, are sensitive to high levels of potting activity, but more experimental evidence is required to confirm this. In addition, abundances of erect and potentially fragile species are expected to decline due to physical abrasion from pot fishing, with bare rock and percentage cover of encrusting species increasing.

Therefore, the potential for impact will be dependent on the intensity of fishing activity taking place and the biotopes present within the site. Abrasion impacts from traps may occur during deployment, positioning (via dragging), tidal/current movement and swell, and recovery (via hauling). Direct abrasive contact may occur from the trap itself; the end weight and anchors and indirect impacts may occur from scour, or the rubbing effects caused by the associated trap ropes. Furthermore, the abrasion pressure is unlikely to impact the rocky substrate itself, being more likely to impact the taxa associated with the rocky reef habitats.

The physical footprints of traps are much smaller than mobile gears such as trawls and dredges and it is unlikely that they would land, soak and be hauled, in exactly the same location on successive fishing trips. The majority of literature before 2015 has suggested that traps are unlikely to significantly impact rocky reef biotopes. However, more recent studies suggest that traps will have negative impacts on the biological functions of reef habitats at high spatial and temporal densities. In addition, any loss of reef structure can result in reduced species abundance/richness, biomass, and consequentially ecosystem functioning. Although *Sabellaria* spp. have medium resilience to abrasion, local environmental factors such as current strength and sediment supply may increase impacts felt by traps.

Although sensitive biotopes may occur on the moderate energy circalittoral rock feature, including branching, protruding, and tube forming *Sabellaria* species, the spatial extent of the feature within the site is small with sparse outcrops interspersed amongst the widely distributed subtidal sediment features. Additionally, although apportioned effort days equate to 4,088 days within the area of the site that intersects ICES rectangles 39E8 and 40E8 the level of potting effort that is likely being applied within the small spatial extent of the interspersed outcrops of moderate energy circalittoral rock feature is significantly lower than the effort applied across the whole site.

As mentioned previously, given the seasonal variability in the potting fleet and likelihood that summer activity is more prevalent inshore of 6 nm, outside of the MPA, and the move to a mixed fishery primarily targeting brown crab in the winter, and broader variety of habitats targeted , it is unlikely that the ongoing use of traps over moderate energy circalittoral rock will pose a significant risk of hindering the

achievement of the conservation objective of ‘recover to favourable condition’ of Farnes East MPA.

Subtidal coarse sediment; subtidal mixed sediments; subtidal mud; subtidal sand

Traps and anchored nets and lines fishing gear exert similar pressures on the biotopes associated with the sediment features of the site, therefore the biotopes identified as having medium sensitivity to abrasion in the anchored nets and lines section **(Section 4.3.1)** also apply here for the traps section.

As described in section 9.4 of the traps Impacts Evidence document[8], there is limited primary evidence on the impacts of static gears on sediment habitats. However, available literature suggests that static gears are unlikely to significantly impact the physical structure of the sediment and have a relatively low impact on benthic communities in comparison to towed gears and are likely to be of limited concern to subtidal sand habitats. Impacts to biological communities could become a concern if activity reaches a particularly high level of intensity, or particularly sensitive species are present, as there is the potential for the snagging of gear and subsequent entanglement and damage to fragile epifauna as the level of fishing activity and therefore density level of anchors and ropes increases. Although no primary evidence is available on the impact of traps on subtidal sand specifically, sensitivity assessments indicate that the impact of traps is of limited concern due to the generally high energy environments where subtidal sand occurs and the likely greater impact of natural disturbance in these environments compared to the level of pressure exerted by traps.

Some primary evidence is available for potting impacts on subtidal mud from two experimental studies concerning sea-pens. The studies used sea-pens as an indicator of physical disturbance and found impacts from traps were low with no lasting effects on the muddy substrate. As per other sediment types, sensitivity assessments suggest traps are of limited concern on subtidal muds, due to their limited contact with the seabed. Albeit with the same caveat for potential snagging of gear and subsequent entanglement and damage to fragile epifauna, particularly as the level of fishing activity and therefore density level of traps and associated ropes and anchors increases.

Given the limited evidence on the impacts of static gears on sediment habitats and literature suggesting that static gears are unlikely to significantly impact the physical structure of the sediment, in addition to the low trap activity in the site, and the small footprint associated with this gear type, it is unlikely that the ongoing use of traps over the sediment features will pose a significant risk of hindering the achievement of the conservation objective of Farnes East MPA.

Sea-pen and burrowing megafauna communities

Abrasion / removal of target species

For the sea-pen and burrowing megafauna communities feature, three biotopes were identified as potentially being present at the site in **Table 7**. Two of these biotopes were identified as having medium sensitivity to abrasion and one as having high sensitivity.

Traps and anchored nets and lines fishing gear exert similar pressures on the biotopes associated with the sea-pen and burrowing megafauna communities feature of the site, therefore the biotopes identified as having medium sensitivity to abrasion in the anchored nets and lines section (**Section 4.3.1**) also apply here for the traps section. Burrowing megafaunas, such as Norwegian lobster (*N. norvegicus*) are generally considered less sensitive to abrasion and penetration impacts than sea-pens due to their motility and ability to move from areas of disturbance. Sea-pens, although able to retract into their burrows and bend in some instances, are fixed and unable to move from potential disturbance episodes. Therefore, this assessment focuses on the most sensitive component of this designated feature, sea-pens.

As outlined in section 4.3.1 of the traps Impacts Evidence document[8], there is limited direct evidence of the impacts of static gears such as traps on the physical environment that sea-pen and burrowing megafauna communities inhabit. Research detailing the impacts of abrasion from traps on three species of sea-pens noted that species which cannot retract into the sediment and/or are more rigid are likely to be less tolerant to disturbance caused by potting. Similarly, even if uprooted, some sea-pens are able to reinsert themselves into the sediment. The potential for impact will be dependent on the intensity of fishing activity taking place, with increasing activity increasing the likelihood of weights and ropes associated with traps damaging, entangling, or removing or damaging these species. Although studies have observed no lasting effects, it remains unknown whether they would suffer from potential long-term effects if repeatedly uprooted. However, due to the selectivity of traps for the target species and high probability of survival for any unwanted species caught and discarded. Overall, the available literature suggests that trap fishing is unlikely to significantly impact sea-pen and burrowing megafauna communities.

Given the limited evidence on impacts of static gears such as traps on the physical environment that sea-pen and burrowing megafauna communities inhabit, in addition to the low trap activity in the site, and the small footprint for this gear type, it is unlikely that the ongoing use of traps will pose a significant risk of hindering the achievement of the conservation objective of Farnes East MPA.

Ocean quahog

Traps and anchored nets and lines fishing gear exert similar pressures on the ocean quahog feature, therefore the narrative in the anchored nets and lines section also applies here for the traps section. As outlined in section 6 of the traps Impacts

Evidence document[8], there is a lack of literature describing the sensitivity of the species to impacts associated with the use of traps. Moreover, the use of traps can cause some abrasion of the seabed but given the hard shell of ocean quahog and limited seabed contact of these gears, they are unlikely to significantly impact the species. Additionally, traps are not known to target ocean quahog in UK waters and there is no evidence of individuals being caught as bycatch by traps.

Although the number of fishing effort days is particularly high in ICES rectangle 40E8, given the hard shell of the species, it is unlikely that the ongoing use of traps over ocean quahog will pose a significant risk of hindering the achievement of Farnes East MPA.

Therefore, with regards to the discussion above, **MMO concludes that, at the activity levels described, the use of traps does not pose a significant risk of hindering the achievement of the conservation objectives of Farnes East MPA.**

4.4 Part B conclusion

The assessment of anchored nets and lines, and traps on designated features of Farnes East MPA has concluded that the ongoing use of anchored nets and lines, and traps will not result in a significant risk of hindering the achievement of the conservation objectives of the MPA. Management measures will therefore not be implemented for anchored nets and lines, and traps for Farnes East MPA.

The assessment of bottom towed gear on subtidal sand, subtidal mud, subtidal mixed sediments, and ocean quahog features of Farnes East MPA has concluded that the ongoing use of bottom towed gear will result in a significant risk of hindering the achievement of the conservation objectives of the MPA. Management measures will therefore be implemented for bottom towed gear for Farnes East MPA.

Section 6 contains further details of these measures.

5 Part C - In-combination assessment

This section assesses the impacts of fishing activities in-combination with relevant activities taking place. This includes the following:

- fishing interactions assessed in Part B but which were not considered, alone, to pose a significant risk of hindering the achievement of the conservation objectives; and
- other activities: such as marine development infrastructure plans or projects that occur in the MPA.

ArcGIS software has been used to check relevant activities that occur within, or adjacent to, the assessed site where there could be a pathway for impact. To determine relevant activities to be included in this part of the assessment, a distance of 5 km was selected as suitable to capture any potential way in which the activity could impact the benthic features of the site in-combination effects of the fishing activities assessed.

A 5 km buffer was therefore applied to the site boundary to identify relevant activities. This assessment considers the in-combination impacts of marine licensable activities that are ongoing or upcoming, with the same medium to high-risk pressure impact pathways as permitted fishing activity. As the models were run using ArcGIS in August 2023, any licences that ended before this date were screened out of the assessment.

The North Sea Transition Authority (NSTA) is responsible for regulating the oil, gas and carbon storage industries, and as such these activities fall outside of MMO's marine licensing remit. Oil, gas and carbon storage industry activities are not currently considered in this draft assessment, as information on the potential pressures exerted by associated activities is currently under review. Following formal consultation, relevant oil, gas and carbon storage industry activities that could impact the site in-combination with the effects of assessed fishing activities will be included before finalising this assessment, alongside marine licence applications submitted after August 2023.

There may be historic and/or operational submarine cables within this MPA, these cables are already in-situ and are unlikely to have any residual abrasion/removal pressure in-combination with the assessed fishing activity. Any abrasion/removal pressure from submarine cable operation and maintenance activity will be temporary with limited seabed impacts and is therefore unlikely to have significant in-combination effects with assessed fishing.

Bottom towed gears were identified in Part B as requiring management to avoid posing a significant risk of hindering achievement of the conservation objectives of the MPA. Anchored nets and lines, and traps, are the only remaining fishing activities

occurring within Farnes East MPA that interact with the seabed. In-combination effects of these fishing activities as well as these activities in-combination with other relevant activities will be assessed in this section.

In accordance with the methodology detailed above, ArcGIS identified four projects, within the 5 km buffer applied. **Table 10** shows this activity and the relevant category from the JNCC Pressures-Activities Database (PAD)[14].

Table 10: summary of marine licensable activities and associated PAD categories.

Marine licence case reference number[15]	PAD Category	Description
MLA/2022/00231	Power cable: Laying, burial and protection; Power cable: Operation and maintenance	Scotland to England Green Link 1 / Eastern Link 1 'marine scheme' overlaps the south-western corner of the MPA, 26 km cable corridor approx. **Possible in-combination effects.**
MLA/2023/00177	Physical Sampling	Morven offshore wind farm (OWF) export cable corridor, geotechnical and benthic survey. Overlaps the Eastern third of the MPA, however no sampling is proposed to be undertaken within the MPA boundary itself. **No direct or indirect pressure pathway for impact and therefore, no in-**

[14] JNCC Pressures-Activities Database (PAD): hub.jncc.gov.uk/assets/97447f16-9f38-49ff-a3af-56d437fd1951)

[15] Details on the marine licence activities can be viewed on the public register of marine licence applications and decisions, searching by the marine licence case reference numbers: Marine case management system - Public register - MCMS (marinemanagement.org.uk) URL: marinelicensing.marinemanagement.org.uk/mmofox5/fox/live/MMO_PUBLIC_REGISTER (Last accessed 27 August 2024)

Marine licence case reference number[15]	PAD Category	Description
		combination effects possible.
MLA/2022/00273	Power cable: Laying, burial and protection; Power cable: Operation and maintenance	Eastern Green Link 2 - Marine Scheme. The works are nearly 5 km from the MPA boundary**. No direct or indirect pressure pathway for impact and therefore, no in-combination effects possible.**
MLA/2023/00334	Power cable: Laying, burial and protection; Power cable: Operation and maintenance	Berwick Bank Cambois Connection marine scheme. Cable installation/laying & protection is 0.7 km (at nearest point) from the MPA boundary. **No direct or indirect pressure pathway for impact and therefore, no in-combination effects possible.**

The PAD and **Table 3** from **section 3.3**, was used to identify medium-high risk pressures exerted by fishing and non-fishing activities to identify those which require in-combination assessment (**Table 11**).

Table 11 summarises the pressures exerted by fishing and non-fishing activities and identifies those exerted by both (Y: pressure exerted). Activity-pressure interactions are highlighted dark blue to illustrate an in-combination effect. Only fishing activity with no proposed or current fisheries management in place are considered.

Table 11: Pressures exerted by fishing and non-fishing activities.

	Non-fishing activities	Fishing activities	
Potential pressures	**Power cable: laying, burial and protection; Power cable: Operation and maintenance**	**Anchored nets and lines**	**Traps**
Abrasion or disturbance of the substrate on the surface of the seabed	Y	Y	Y
Removal of non-target species		Y	Y
Removal of target species		Y	Y

5.1 In-combination pressure sections

Fisheries vs fisheries in-combination pressures will be considered in this section. The pressures exerted by the non-fishing activity will also be considered in-combination with the anchored nets and lines and traps fishing pressures.

5.2 Fishing vs Fishing in-combination pressures

5.2.1 Abrasion and disturbance of the substrate on the surface of the seabed and removal of target and non-target species

As noted in Part B (**Section 4.3.1** nets and lines and **4.3.3** traps), impacts from the removal of target and non-target species pressure, in relation to anchored nets and lines, and traps, is not being considered in detail in this assessment. In-combination impacts from the removal of target and non-target species pressures are more fully assessed under the pressure abrasion, as the detail of key structural and influential species is yet to be fully defined. Therefore, the removal pressures are not considered further in this in-combination assessment. The pressures may require further consideration as future evidence becomes available, in conjunction with updated conservation advice from JNCC and Natural England.

The annual average VMS records for over 12 m vessels within the MPA totalled one count (traps). For under 12 m vessels, between 2016 and 2021, the annual average fishing effort estimated to have been derived from the MPA via traps and anchored nets and lines was 762 days (761.29 days for traps, 0.46 days for anchored nets and lines, **Annex 1**, calculated from **Table A1. 7**). For the same period (2016-2021), the total fishing effort (under 12s) estimated to have been derived from the MPA were 4,571 days (4,567.74 days for traps, 2.77 days for anchored nets and lines **(Section 4.2**). The fishing effort data is further supported by the estimated live weight landings for under 12 m vessels that equal an annual average of 235.04 tonnes, 235 tonnes

for traps and 0.04 tonnes for anchored nets and lines, between 2016 and 2020 (**Section 4.2**).

The combined impacts from anchored nets and lines and traps could potentially increase the risk of negative effects from the pressure abrasion and disturbance of the substrate on the surface of the seabed. However, due to the annual average anchored nets and lines effort being low (0.46 days) and seasonal spatial separation of gear effort by target fishery on different features in the MPA being prevalent (pers. comms., Northumberland IFCA), any in-combination impact is considered insignificant.

Under 12 m trap activity is known to target lobster more extensively within the 6 nm limit on rocky habitat, or rock edges during the summer. In winter, trap effort tends to be further offshore, targeting lobster on rocky ground and brown crab on softer sedimentary habitat with lower sensitivity to abrasion (**Section 4.3.3**) (pers. comms. Northumberland IFCA 2024). Given a large proportion of the under 12 m trap effort may be more extensive within the 6 nm limit during summer and is spatially separated on different habitat types during winter in the MPA, the low effort (0.46 days) of anchored nets and lines in-combination with traps is considered insignificant. Therefore, while potting effort is relatively high, having considered the spatial separation of the trap effort occurring in the MPA, the in-combination impacts from abrasion and disturbance of the substrate, resulting from the combined traps and low anchored nets and lines effort, it has been concluded that there is no significant risk that the conservation objectives of the site are being hindered.

Therefore, MMO concludes that the combined pressures from anchored nets and lines and traps will not result in a significant risk of hindering the achievement of the conservation objectives for Farnes East MPA at the levels described.

5.3 Fishing vs non-fishing activities in-combination pressures

5.3.1 Abrasion and disturbance of the substrate on the surface of the seabed

The designated features of the Farnes East MPA are sensitive to physical damage through surface abrasion and disturbance of the substrate from anchored nets and lines and traps during gear deployment, movement of the gear on the seabed due to tidal movements and storm activity, and as the gear is dragged along the seabed during retrieval.

The Green Link 1 / Eastern Link 1 (MLA/2022/00231) licence will cause abrasion or disturbance of the seabed and overlaps the subtidal sediments present in the south-western corner of the MPA, as such there is potential for in-combination effects regarding the abrasion pressure along the 26 km cable corridor (approx.). As detailed in **section 4.3.1** and **4.3.3**, at current activity levels anchored nets and lines

and traps are not considered to be causing significant in-combination impacts via the pressure abrasion and disturbance. It is possible that activities linked to the marine scheme, in-combination with anchored nets and lines and traps may increase the potential for the abrasion pressure to have negative cumulative effects on the designated features of the MPA. However, the applicant has provided information to confirm that the scheme has been designed to minimise interaction with designated features and does not overlap known locations of the most sensitive features; sea-pen and burrowing megafauna and ocean quahog. Reef was identified in the marine installation corridor (moderate energy circalittoral rock) but in very small, localised patches. The majority (89%) of the corridor is characterised by mixed sediments, with the remainder by a mosaic of coarse and mixed sediments.

With the limited spatial extent of the activities, temporary nature of works (cable laying/burial scheduled for two years, of which only 26 km is within the MCZ) and the minimal spatial overlap with fishing due to trap effort being more extensive inshore and rocky ground in the summer, with limited overlap on sediments in the winter when targeting brown crab, it is unlikely there would be a significant in-combination risk. Furthermore, there are no highly sensitive biotopes present within the sediment features (**Section 4.3.1** and **4.3.3**). Therefore, the scale of the in-combination impacts from abrasion and disturbance of the substrate on the surface of the seabed between anchored nets and lines and traps and non-fishing activity is considered insignificant.

Therefore, MMO concludes that the combined pressures from anchored nets and lines and traps and other relevant activities will not result in a significant risk of hindering the achievement of the conservation objectives for Farnes East MPA.

5.4 Part C conclusion

MMO concludes that different fishing gear types in combination, and fishing in-combination with other relevant activities will not result in a significant risk of hindering the achievement of the site conservation objectives of Farnes East MPA.

Further management measures will not therefore be implemented for fishing activities currently occurring within the MPA.

6 Conclusion and proposed management

Part A of this assessment concluded that anchored nets and lines, bottom towed gear, and traps, alone, are likely to have a significant effect on the designated features of Farnes East MPA.

Part B of this assessment concluded that, at the activity levels described, use of bottom towed gear may cause a significant risk of hindering the achievement of the conservation objectives of the MPA as a result of the impacts of abrasion or disturbance, penetration and smothering, siltation rate and suspended solid changes whilst anchored nets and lines, and traps will not.

Part C of this assessment concluded that, at the activity levels described, use of anchored nets and lines and traps, in combination with each other and with other relevant activities, will not result in a significant risk of hindering the achievement of the conservation objectives of the MPA.

To ensure that fishing activities do not result in a significant risk of hindering the achievement of the conservation objectives of the MPA, MMO will implement a byelaw to prohibit the use of bottom towed gear throughout Farnes East MPA.

Figure 2 shows the proposed management area in line with the conclusions set out above.

The boundaries of the proposed management area include an appropriate buffer zone to prevent direct damaging physical interactions between fishing activities and the designated features to be protected. The rationale for determining buffer size can be found in in Annex 2 of the Stage 3 MPA Site Assessment Methodology document[5].

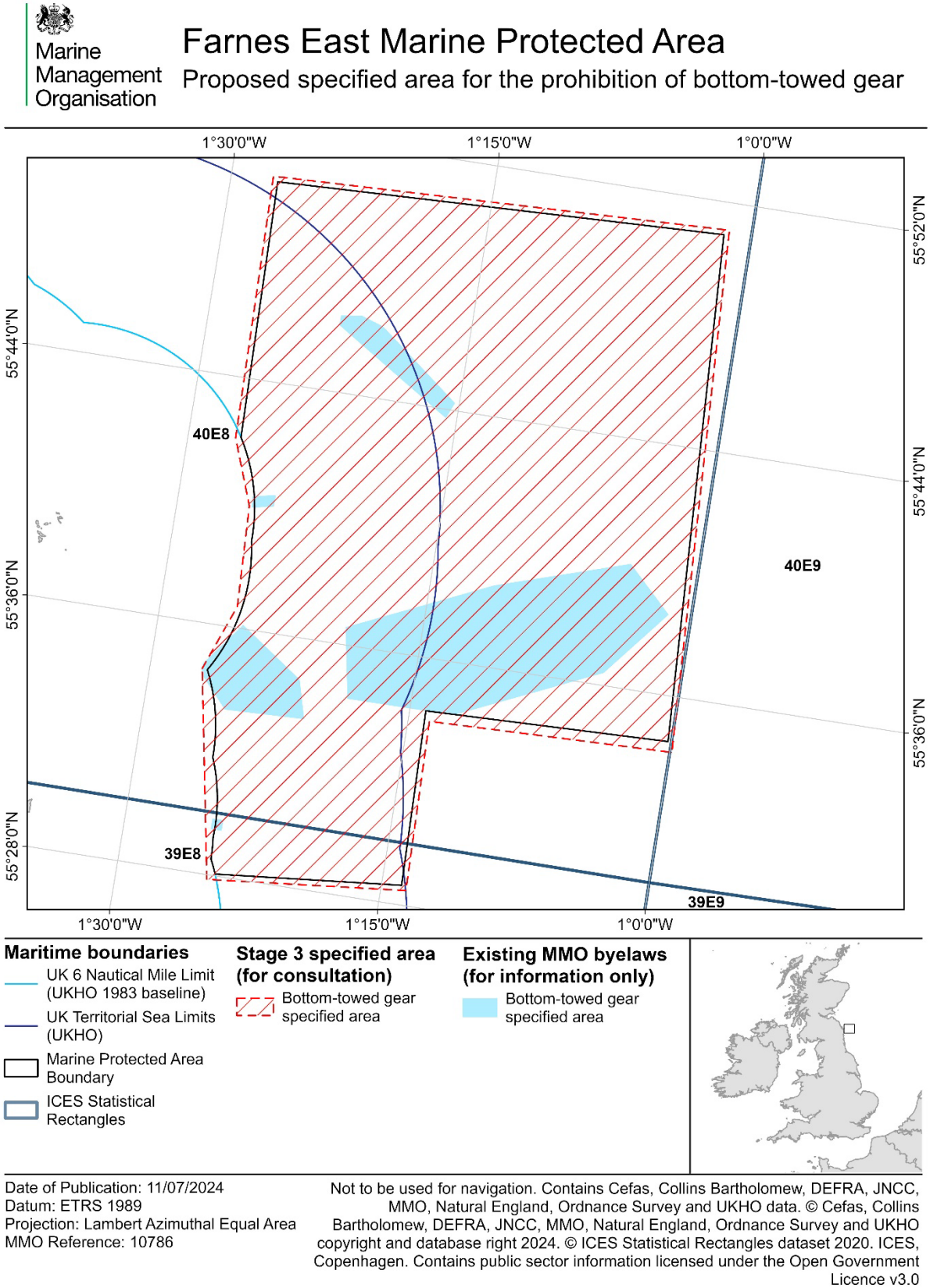

Figure 2: Map of proposed management.

7 Review of this assessment

MMO will review this assessment every five years, or earlier if significant new information is received. Such information could include:

- updated conservation advice; and
- updated advice on the condition of the site's feature(s); and
- significant increase in activity levels.

To coordinate the collection and analysis of information regarding activity levels, and to ensure that any required management is implemented in a timely manner, a monitoring and control plan will be implemented for this site. This plan will be developed in line with MMO's Monitoring and Control Plan framework.

References

Ashley, M. (2016) ‘Maldanid polychaetes and Eudorellopsis deformis in offshore circalittoral sand or muddy sand’, in Tyler-Walters, H. (ed.) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/1105.

De-Bastos, E. (2016a) ‘Levinsenia gracilis and Heteromastus filiformis in offshore circalittoral mud and sandy mud’, in Tyler-Walters, H. and Hiscock, K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/1108.

De-Bastos, E. (2016b) ‘Myrtea spinifera and polychaetes in offshore circalittoral sandy mud’, in Tyler-Walters, H. (ed.) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/1110.

De-Bastos, E. (2016c) ‘Paramphinome jeffreysii, Thyasira spp. and Amphiura filiformis in offshore circalittoral sandy mud’, in Tyler-Walters, H. and Hiscock, K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/1109.

De-Bastos, E. (2023) ‘Owenia fusiformis and Amphiura filiformis in offshore circalittoral sand or muddy sand’, in Tyler-Walters, H. (ed.) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/381.

De-Bastos, E. and Hill, J. (2016) ‘Ampharete falcata turf with Parvicardium ovale on cohesive muddy sediment near margins of deep stratified seas’, in Tyler-Walters, H. and Hiscock, K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/75.

De-Bastos, E.S.R., Hill, J.M., Lloyd, K.A. and Watson, A. (2023a) ‘Brittlestars on faunal and algal encrusted exposed to moderately wave-exposed circalittoral rock’, in Tyler-Walters, H. (ed.) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/1059.

De-Bastos, E.S.R., Hill, J.M., Lloyd, K.A. and Watson, A. (2023b) ‘Polydora sp. tubes on moderately exposed sublittoral soft rock’, in Tyler-Walters, H. and Hiscock, K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/247.

Durkin, O.C. and Tyler-Walters, H. (2022) ‘Burrowing megafauna and Maxmuelleria lankesteri in circalittoral mud’, in Tyler-Walters, H. (ed.) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/387.

Hiddink, J.G., Jennings, S., Kaiser, M.J., Queirós, A.M., Duplisea, D.E. and Piet, G.J. (2006) ‘Cumulative impacts of seabed trawl disturbance on benthic biomass, production, and species richness in different habitats’, *Canadian Journal of Fisheries and Aquatic Sciences*, 63(4), pp. 721–736.

Hill, J.M., Tyler-Walters, H., Garrard, S.L. and Watson, A. (2023) ‘Seapens and burrowing megafauna in circalittoral fine mud’, in Tyler-Walters, H. and Hiscock, K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/131.

Readman, J.A.J., Lloyd, K.A. and Watson, A. (2023) ‘Bryozoan turf and erect sponges on tide-swept circalittoral rock’, in Tyler-Walters, H. (ed.) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/9.

Tillin, H.M. (2016) ‘Hiatella-bored vertical sublittoral limestone rock’, in Tyler-Walters, H. and Hiscock, K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/362.

Tillin, H.M., Gibb, N., Garrard, S.L., Lloyd, K.A. and Watson, A. (2023) ‘Circalittoral Sabellaria reefs (on rock)’, in Tyler-Walters, H. (ed.) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/225.

Tillin, H.M. and Hiscock, K. (2016) ‘Urticina felina and sand-tolerant fauna on sand-scoured or covered circalittoral rock’, in Tyler-Walters, H. and Hiscock, K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/290.

Tillin, H.M., Marshall, C.E., Gibb, N., Lloyd, K.A. and Watson, A. (2023a) ‘Sabellaria spinulosa encrusted circalittoral rock’, in Tyler-Walters, H. and Hiscock, K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/1169.

Tillin, H.M., Marshall, C.E., Gibb, N., Lloyd, K.A. and Watson, A. (2023b) ‘Sabellaria spinulosa with a bryozoan turf and barnacles on silty turbid circalittoral rock’, in Tyler-Walters, H. and Hiscock, K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/1171.

Tillin, H.M. and Riley, K. (2016) ‘Foraminiferans and Thyasira sp. in deep circalittoral fine mud’, in Tyler-Walters, H. and Hiscock, K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/215.

Tillin, H.M. and Watson, A. (2023a) ‘Glycera lapidum, Thyasira spp. and Amythasides macroglossus in offshore gravelly sand’, in Tyler-Walters, H. (ed.) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/1136.

Tillin, H.M. and Watson, A. (2023b) ‘Polychaete-rich deep Venus community in offshore gravelly muddy sand’, in Tyler-Walters, H. (ed.) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/1117.

Tyler-Walters, H. and Watson, A. (2023) ‘Seapens, including Funiculina quadrangularis, and burrowing megafauna in undisturbed circalittoral fine mud’, in

Tyler-Walters, H. (ed.) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/habitats/detail/239/.

Tyler-Walters, Harvey and and Sabatini, M. (2017) 'Icelandic cyprine: Arctica islandica', in Tyler-Walters, H. and Hiscock, K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Plymouth. Available at: www.marlin.ac.uk/species/detail/1519.

Annex 1: Fishing activity data

Table A1. 1: VMS record count per nation group (UK and EU Member State) and proportional activity (%), per gear, per gear group, per year (2016 to 2020), totals and annual average (2016 to 2020).

			2016		2017		2018		2019		2020		2021		Total (2016 to 2021)		Annual average (2016 to 2021)
Gear group	**Gear code**	**Nation group**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**
Demersal trawl	OTB	UK	33	100	57	100	39	100	109	100	20	100	2200	100	280	100	47
	OTB Total		**33**	**27**	**57**	**41**	**39**	**53**	**109**	**47**	**20**	**36**	**2200**	**44**	**280**	**42**	**47**
	OTT	EU Member State	0	0	15	24	2	6	0	0	6	17	0	0	23	7	4
	OTT	UK	78	100	47	76	30	94	106	100	29	83	2800	100	318	93	53
	OTT Total		**78**	**64**	**62**	**45**	**32**	**43**	**106**	**45**	**35**	**63**	**2800**	**56**	**341**	**51**	**57**
	TB	UK	0	0	0	0	0	0	0	0	1	100	0	0	1	100	0
	TB Total		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**2**	**0**	**0**	**1**	**0**	**0**
	TBN	UK	10	100	19	100	3	100	19	100	0	0	0	0	51	100	9
	TBN Total		**10**	**8**	**19**	**14**	**3**	**4**	**19**	**8**	**0**	**0**	**0**	**0**	**51**	**8**	**9**
Demersal trawl Total			**121**	**85**	**138**	**15**	**74**	**38**	**234**	**62**	**56**	**77**	**5000**	**21**	**673**	**35**	**112**
Dredge	DRB	UK	20	100	681	100	34	100	141	100	2	100	0	0	878	100	146
	DRB Total		**20**	**100**	**681**	**89**	**34**	**29**	**141**	**100**	**2**	**100**	**0**	**0**	**878**	**84**	**146**
	HMD	UK	0	0	81	100	85	100	0	0	0	0	0	0	166	100	28
	HMD Total		**0**	**0**	**81**	**11**	**85**	**71**	**0**	**0**	**0**	**0**	**0**	**0**	**166**	**16**	**28**
Dredge Total			**20**	**14**	**762**	**85**	**119**	**62**	**141**	**37**	**2**	**3**	**0**	**0**	**1044**	**54**	**174**
Midwater Trawl	OTM	EU Member State	1	100	0	0	0	0	2	100	15	100	0	0	18	100	3
	OTM Total		**1**	**100**	**0**	**0**	**0**	**0**	**2**	**100**	**15**	**100**	**0**	**0**	**18**	**100**	**3**
Midwater Trawl Total			**1**	**1**	**0**	**0**	**0**	**0**	**2**	**1**	**15**	**21**	**0**	**0**	**18**	**1**	**3**
Traps	FPO	EU Member State	0	0	0	0	0	0	0	0	0	0	3	100	3	100	1
	FPO Total		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**100**	**3**	**100**	**1**
Traps Total			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**1**	**3**	**0**	**1**
Unknown	NK	UK	0	0	0	0	0	0	0	0	0	0	189	100	189	100	32
	NK Total		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**189**	**100**	**189**	**100**	**32**

			2016		2017		2018		2019		2020		2021		Total (2016 to 2021)		Annual average (2016 to 2021)
Gear group	Gear code	Nation group	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count
Unknown Total			0	0	0	0	0	0	0	0	0	0	189	78	189	10	32
Grand Total			142	0	900	1	193	0	377	1	73	0	242	0	1927	0	321

Table A1. 2: UK live weight landings tonnage (t) estimates by gear from vessels over 12 m in length in the MMO section of Farnes East MPA (2016 to 2020).

Gear group	Gear code	2016	2017	2018	2019	2020	Total (2016 to 2020)	Average (2016 to 2020)
Demersal trawl	OT	0	0	0	0	0	0	0
Demersal trawl	OTB	3.77	11.90	7.26	33.10	5.95	61.98	12.40
Demersal trawl	OTT	8.81	9.23	6.32	20.88	6.54	51.77	10.35
Demersal trawl	TB	0	0	0	0	0.18	0.18	0.04
Demersal trawl	TBN	1.80	3.85	0.41	4.29	0	10.35	2.07
Demersal trawl Total		**14.37**	**24.98**	**13.99**	**58.27**	**12.67**	**124.29**	**24.86**
Dredge	DRB	1.94	110.76	4.84	18.91	0.24	136.70	27.34
Dredge	HMD	0	8.30	8.13	0	0	16.43	3.29
Dredge Total		**1.94**	**119.06**	**12.98**	**18.91**	**0.24**	**153.13**	**30.63**
Grand Total		**16.31**	**144.04**	**26.97**	**77.19**	**12.91**	**277.42**	**55.48**

Table A1. 3: EU27 live weight landings tonnage (t) estimates by gear from vessels over 12 m in length in the MMO section of Farnes East MPA (2016 to 2020).

Gear group	Gear code	2016	2017	2018	2019	2020	Total (2016-2020)	Average (2016-2020)
Midwater Trawl	OTM	0	0	0	108.82	70.83	179.65	35.93
Midwater Trawl Total		**0**	**0**	**0**	**108.82**	**70.83**	**179.65**	**35.93**
Grand Total		**0**	**0**	**0**	**108.82**	**70.83**	**179.65**	**35.93**

Table A1. 4: Percentage of each ICES rectangle intersected by the MMO section of Farnes East MPA.

ICES rectangle	Percentage overlap (%)
39E8	1.84
40E8	29.61

Table A1. 5: UK live weight landings tonnage (t) estimates by gear from vessels under 12 m in length for the MMO section of Farnes East MPA (2016 to 2020).

Gear group	Gear code	2016	2017	2018	2019	2020	Total (2016-2020)	Average (2016-2020)
Anchored Net/Line	GEN	0	0	0	0	0	0	0
Anchored Net/Line	GN	0	<0.01	<0.01	0	0	<0.01	<0.01
Anchored Net/Line	GTR	0.01	<0.01	0	0	<0.01	0.01	<0.01
Anchored Net/Line	LL	0.14	0.02	0	0	<0.01	0.16	0.03
Anchored Net/Line Total		**0.15**	**0.02**	<0.01	**0.00**	**0.01**	**0.18**	**0.04**
Demersal trawl	OT	0.85	0.05	0	0	0	0.90	0.18
Demersal trawl	OTB	<0.01	3.60	8.93	7.31	3.12	22.96	4.59
Demersal trawl	OTT	0.47	0.003	0	0	0	0.48	0.10
Demersal trawl	TBB	0	0.15	0.01	0	0	0.16	0.03
Demersal trawl	TBN	9.01	13.37	6.11	5.29	3.50	37.29	7.46
Demersal trawl Total		**10.34**	**17.17**	**15.05**	**12.61**	**6.62**	**61.79**	**12.36**
Dredge	DRB	0.03	0.04	0	0.07	0.34	0.48	0.10
Dredge Total		**0.03**	**0.04**	**0**	**0.07**	**0.34**	**0.48**	**0.10**
Midwater - Gill Drift	GND	0.03	0.02	0	0	<0.01	0.05	0.01
Midwater - Gill Drift Total		**0.03**	**0.02**	**0**	**0**	<0.01	**0.05**	**0.01**
Midwater Hook/Lines	LHP	0.55	0.12	<0.01	0	0.02	0.70	0.14
Midwater Hook/Lines	LX	0	0.07	0.13	0.44	0.28	0.92	0.18

Gear group	Gear code	2016	2017	2018	2019	2020	Total (2016-2020)	Average (2016-2020)
Midwater Hook/Lines Total		**0.55**	**0.19**	**0.14**	**0.44**	**0.30**	**1.62**	**0.32**
Traps	FPO	253.90	291.88	227.81	234.53	165.70	1173.81	234.76
Traps Total		**253.90**	**291.88**	**227.81**	**234.53**	**165.70**	**1173.81**	**234.76**
Grand Total		**265.01**	**309.32**	**243.00**	**247.65**	**172.97**	**1237.95**	**247.59**

Table A1. 6: Mean annual surface and subsurface SAR values for C-squares intersecting the MMO section of Farnes East MPA (2016 to 2020).

Gear group	SAR category	2016	2017	2018	2019	2020
Demersal Seines	Surface	<0.01	0	0	0	0
	Subsurface	0	0	0	0	0
Dredges	Surface	0.01	0.08	0.02	0.02	<0.01
	Subsurface	0.01	0.08	0.02	0.02	<0.01
Demersal Trawls	Surface	0.20	0.24	0.20	0.46	0.16
	Subsurface	0.06	0.07	0.06	0.15	0.05
Bottom Towed Gear	Surface	0.21	0.33	0.22	0.48	0.16
	Subsurface	0.07	0.16	0.08	0.17	0.05

Table A1. 7: Fishing effort (days) recorded by UK vessels under 12 m in length, separated by gear type for the area of Farnes East MPA that intersects the marine portion of ICES rectangles 39E8 and 40E8 (2016 to 2021). ICES rectangle level data has been apportioned to the MPA based on the percentage area of the ICES rectangle that intersects the MPA (see Table A1. 4)

Gear group	Fishing effort (days at sea)							
	2016	2017	2018	2019	2020	2021	Total (2016 to 2021)	Annual average (2016 to 2021)
Demersal trawl	38.92	36.87	50.23	46.76	31.80	57.22	261.81	43.63
Dredge	0.50	0	0	0.22	0.52	0.15	1.38	0.23
Bottom towed gear total	**39.42**	**36.87**	**50.23**	**46.98**	**32.32**	**57.37**	**263.19**	**43.87**
Midwater gill drift	0.43	0.35	0	0	0.05	0.06	0.88	0.15
Midwater hooks and lines	2.27	1.32	1.21	2.74	0.80	0.62	8.95	1.49
Midwater gear total	**2.70**	**1.67**	**1.21**	**2.74**	**0.84**	**0.67**	**9.83**	**1.64**
Traps	801.48	779.67	799.96	827.69	659.75	699.19	4,567.74	761.29
Anchored nets and lines	1.18	0.82	0.02	0	0.51	0.26	2.77	0.46
Static gear total	**802.65**	**780.49**	**799.98**	**827.69**	**660.25**	**699.45**	**4,570.51**	**761.75**
MPA total	**844.78**	**819.03**	**851.42**	**877.41**	**693.41**	**757.49**	**4,843.53**	**807.26**

Annex 2: Biotope information

Table A2. 1: Moderate energy circalittoral rock biotopes that may be found within Farnes East MPA with sensitivity to the abrasion/disturbance and penetration of the substrate on the surface of the seabed.

Biotope	Sensitivity	Justification
Bryozoan turf and erect sponges on tide-swept circalittoral rock (Readman, Lloyd and Watson, 2023)	Abrasion: Medium Penetration: Not relevant	Excluded due to depth range.
Urticina felina and sand-tolerant fauna on sand-scoured or covered circalittoral rock (Tillin and Hiscock, 2016)	Abrasion: Medium Penetration: Not relevant	Included as within depth range.
Sabellaria reefs on circalittoral rock (Tillin, Gibb, *et al.*, 2023)	Abrasion: Medium Penetration: Medium	Excluded due to depth range.
Sabellaria spinulosa encrusted circalittoral rock (Tillin, Marshall, *et al.*, 2023a)	Abrasion: Medium Penetration: Medium	Included as within depth range.
Sabellaria spinulosa with a bryozoan turf and barnacles on silty turbid circalittoral rock (Tillin, Marshall, *et al.*, 2023b)	Abrasion: Medium Penetration: Medium	Included as within depth range.
Polydora sp. tubes on moderately exposed sublittoral soft rock (De-Bastos *et al.*, 2023b)	Abrasion: Medium Penetration: Medium	Excluded due to depth range.
Hiatella-bored vertical sublittoral limestone rock (Tillin, 2016)	Abrasion: Medium Penetration: High	Excluded due to depth range.
Brittlestars on faunal and algal encrusted exposed to moderately wave-exposed circalittoral rock (De-Bastos *et al.*, 2023a)	Abrasion: Medium Penetration: Not relevant	Included as within depth range.

Table A2. 2: Subtidal coarse sediment biotopes that may be found within Farnes East MPA with sensitivity to the abrasion / disturbance and penetration of the substrate on the surface of the seabed, smothering and siltation rate changes (light) and changes in suspended solids (water clarity).

Biotope	Sensitivity
Glycera lapidum, Thyasira spp. and *Amythasides macroglossus* in offshore gravelly sand (Tillin and Watson, 2023a)	Abrasion: Low Penetration: Low Smothering and siltation rate changes (light): Low Changes in suspended solids (water clarity): Not sensitive

Table A2. 3: Subtidal mixed sediments biotopes that may be found within Farnes East MPA with sensitivity to the abrasion / disturbance and penetration of the substrate on the surface of the seabed, smothering and siltation rate changes (light) and changes in suspended solids (water clarity).

Biotope	Sensitivity
Polychaete-rich deep Venus community in offshore mixed sediments (Tillin and Watson, 2023b)	Abrasion: Low Penetration: Low Smothering and siltation rate changes (light): Low Changes in suspended solids (water clarity): Low

Table A2. 4: Subtidal mud biotopes that may be found within Farnes East MPA with sensitivity to the abrasion / disturbance and penetration of the substrate on the surface of the seabed, smothering and siltation rate changes (light) and changes in suspended solids (water clarity).

Biotope	Sensitivity
Ampharete falcata turf with *Parvicardium ovale* on cohesive muddy sediment near margins of deep stratified seas (De-Bastos and Hill, 2016)	Abrasion: Medium Penetration: Medium Smothering and siltation rate changes (light): Low Changes in suspended solids (water clarity): Not sensitive
Foraminiferans and *Thyasira* spp. in deep circalittoral soft mud (Tillin and Riley, 2016)	Abrasion: Low Penetration: Low Smothering and siltation rate changes (light): Medium Changes in suspended solids (water clarity): Not sensitive
Levinsenia gracilis and *Heteromastus filifirmis* in offshore circalittoral mud and sandy mud (De-Bastos, 2016a)	Abrasion: Medium Penetration: Medium Smothering and siltation rate changes (light): Not sensitive Changes in suspended solids (water clarity): Not sensitive
Paramphinome jeffreysii, *Thyasira* spp. and *Amphiura filiformis* in offshore circalittoral sandy mud (De-Bastos, 2016c)	Abrasion: Medium Penetration: Medium Smothering and siltation rate changes (light): Not sensitive Changes in suspended solids (water clarity): Not sensitive
Myrtea spinifera and polychaetes in offshore circalittoral sandy mud (De-Bastos, 2016b)	Abrasion: Medium Penetration: Medium Smothering and siltation rate changes (light): Not sensitive Changes in suspended solids (water clarity): Not sensitive

Table A2. 5: Subtidal sand biotopes that may be found within Farnes East MPA with sensitivity to the abrasion / disturbance and penetration of the substrate on the surface of the seabed, smothering and siltation rate changes (light) and changes in suspended solids (water clarity).

Biotope	Sensitivity
Maldanid polychaetes and *Eudorellopsis deformis* in deep circalittoral sand or muddy sand (Ashley, 2016)	Abrasion: Medium Penetration: Medium Smothering and siltation rate changes (light): Not sensitive Changes in suspended solids (water clarity): Not sensitive
Owenia fusiformis and *Amphiura filiformis* in deep circalittoral sand or muddy sand (De-Bastos, 2023)	Abrasion: Medium Penetration: Medium Smothering and siltation rate changes (light): Low Changes in suspended solids (water clarity): Not sensitive

Table A2. 6: Sea-pen and burrowing megafauna communities biotopes that may be found within Farnes East MPA with sensitivity to the abrasion and physical disturbance, smothering and increase in suspended sediment.

Biotope	Sensitivity
Seapens and burrowing megafauna in circalittoral fine mud (Hill *et al.*, 2023)	Abrasion: medium Penetration: high
Burrowing megafauna and *Maxmuelleria lankesteri* in circalittoral mud (Durkin and Tyler-Walters, 2022)	
Seapens, including *Funiculina quadrangularis*, and burrowing megafauna in undisturbed circalittoral fine mud (Tyler-Walters and Watson, 2023)	Abrasion, penetration: high

Table A2. 7: Ocean quahog biotopes that may be found within Farnes East MPA with sensitivity to the abrasion / disturbance and penetration of the substrate on the surface of the seabed, smothering and siltation rate changes (light) and changes in suspended solids (water clarity).

Biotope	Sensitivity
Icelandic cyprine (*Arctica islandica)* (Tyler-Walters and Sabatini, 2017)	Abrasion: High Penetration: High Smothering and siltation rate changes (light): Not sensitive Changes in suspended solids (water clarity): Not sensitive