Coquet to St Mary's MCZ Fisheries Assessment

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Note: sections of this document have been taken directly from or modified from the MMO Fisheries Assessment Template, Flyde MCZ Fisheries Assessment and West of Walney MCZ Fisheries Assessment.

Marine Protected Area	**Coquet to St Mary's MCZ**
Features	High energy infralittoral rock, High energy circalittoral rock, High Energy Intertidal Rock, Intertidal Coarse Sediment, Intertidal Mixed Sediments Intertidal Mud, Intertidal Sand & Muddy Sand, Intertidal Underboulder Communities, Low Energy Intertidal Rock, Moderate energy Infralittoral Reef Moderate Energy Intertidal Rock, Peat & Clay Exposures, Subtidal Coarse Sediment, Subtidal Mixed Sediments, Subtidal Mud, Subtidal Sand
Gear Type	Towed (demersal) Dredges (towed)
Gear/Feature Interaction Reference	CSMMCZ-221 CSMMCZ-061 CSMMCZ-093 CSMMCZ-223 CSMMCZ-063 CSMMCZ-095 CSMMCZ-219 CSMMCZ-091 CSMMCZ-059 CSMMCZ-053 CSMMCZ-085 CSMMCZ-213 CSMMCZ-054 CSMMCZ-086 CSMMCZ-214 CSMMCZ-051 CSMMCZ-083 CSMMCZ-211 CSMMCZ-052 CSMMCZ-084 CSMMCZ-212 CSMMCZ-060 CSMMCZ-092 CSMMCZ-220 CSMMCZ-217 CSMMCZ-089 CSMMCZ-057 CSMMCZ-062 CSMMCZ-094 CSMMCZ-222 CSMMCZ-218 CSMMCZ-090 CSMMCZ-058 CSMMCZ-064 CSMMCZ-096 CSMMCZ-224 CSMMCZ-056 CSMMCZ-088 CSMMCZ-216 CSMMCZ-055 CSMMCZ-087 CSMMCZ-215 CSMMCZ-050 CSMMCZ-082 CSMMCZ-210 CSMMCZ-049 CSMMCZ-081 CSMMCZ-209

Contents

1. Introduction

1.1 Summary

Table 1 shows a summary of the outcomes of the Coquet to St Mary's MCZ Assessment Subtidal Mud Features and Mobile Gear Assessment. For the purpose of this assessment title mobile gear refers to Towed Demersal gear and Scallop Dredges.

Table 1: Assessment Summary

Features	**Activity/gear**	**Part A outcome**	**Part B outcome**	**In-combination assessment**	**Confidence**
High energy infralittoral rock Moderate energy circalittoral rock Moderate energy infralittoral rock	Heavy otter trawl Light otter trawl Scallop dredging	Capable of affecting (other than insignificantly)	Capable of affecting (other than insignificantly)	No significant risk	L
High energy intertidal rock Intertidal under boulder communities Low energy intertidal rock Moderate energy intertidal rock Intertidal mixed sediments Intertidal mud Intertidal sand and muddy sand Intertidal coarse sediment	Light otter trawl* Scallop dredging* Heavy otter trawl*	Not capable of affecting (other than insignificantly)	N/A	No significant risk	H
Peat and clay exposures (at this time only known to be intertidal)	Light otter trawl* Scallop dredging* Heavy otter trawl*	Not capable of affecting (other than insignificantly)	N/A	No significant risk	M
Subtidal coarse sediment Subtidal mixed sediments Subtidal sand	Light otter trawl Scallop dredging Heavy otter trawl	Capable of affecting (other than insignificantly)	Not capable of affecting (other than insignificantly)	No significant risk	M

Subtidal Mud	Light otter trawl Scallop dredging* Heavy otter trawl*	Capable of affecting (other than insignificantly)	Capable of affecting (other than insignificantly)	No significant risk	H

*Gear/feature interaction does not occur within Coquet to St Mary's MCZ because the activity does not occur or the interaction is incapable of occurring (blue interaction).

1.2 Introduction

Table 2 shows the name and legal status of the site.

Table 2: Site details

Name and legal Status of site(s):	Name of site(s)	Legal status
	Coquet to St Mary's MCZ	MCZ

Coquet to St Mary's Marine Conservation Zone (MCZ) is an inshore site that runs along the southern half of the Northumberland Coast, within the northern North Sea in the north-east of England. The site covers approximately 192 km² of intertidal and subtidal habitats, stretching from Alnmouth in the north to Whitley Bay to the south, and from mean high water out to approximately 7.5km at its seaward-most extent. Coquet to St Mary's MCZ contains a mosaic of sediment and hard substrate benthic habitats, which in turn support a wide range of diverse communities.

The intertidal habitats range from rocky shore platforms and outcrops, to large sandy bays and beaches, each supporting unique communities. Rocky shores support large abundances of red algae, fucoids and kelp, whilst intertidal boulders provides shelter and habitat for a wide variety of crustaceans, molluscs, anemones and encrusting bryozoans. Elsewhere mud and sand flats contain burrowing bivalves and worm communities, whilst amphipods dominate the strandline of sandy beaches. Rare exposures of intertidal peat and clay are found along patches of the coastline, including fossilised tree roots from millions of years ago.

Shallow sloping infralittoral rock platforms also support thriving communities of macroalgae, which in turn support species including hydroids, sponges and anemones. The infralittoral rocky seabed gives way to circalittoral rock, where light penetration is too low to support diverse faunal communities, but instead a large diversity of benthic fauna flourish, including dead man's fingers, hornwrack and sponges. Circalittoral rocky habitats are interspersed between wide areas of subtidal mud, sand and mixed sediments, each of which support their own range of species, including burrowing bivalves, bristle worms, sea pens and urchins. Sandwaves and ripples are formed by underwater currents shaping sediments on the seafloor.

The northern edge of the MCZ abuts with the Berwickshire and North Northumberland Coast SAC, and much of the northern section of the site overlaps with the Northumberland Marine SPA. The site overlaps with the intertidal parts of Coquet Island SPA and St Mary's Island Local Nature Reserve, but does not include the terrestrial parts.

These sites are important for other species too, including marine mammals and seabirds. Grey seals make extensive use of St Mary's Island in the south of the MCZ as a haul out site, whilst the area is also important for white-beaked dolphins and minke whales. The site surrounds Coquet Island SPA, which supports internationally important numbers of terns, including the largest breeding colony of roseate terns in England. These species make extensive use of the MCZ for foraging and other activities.

The conservation objectives for all MCZs are that the features:

(a) so far as already in favourable condition, remain in such condition; and
(b) so far as not already in favourable condition, be brought into such condition, and remain in such condition.

More specific information on how to achieve the conservation objective of an MCZ is provided in the general management approach within the factsheet for each site[1].

This assessment uses an initial screen of fishing activities and designated features, based on the Matrix of fisheries gear types and European marine site protected features[2] (hereafter 'the Matrix') developed as part of Defra's revised approach to the management of commercial fishing in European marine sites (EMS)[3]. The Matrix classifies interactions between EMS features and different fishing activities as red, amber, green or blue.

All interactions classified as 'blue' are screened out of this assessment as there is no pathway for impact. Interactions classified as 'green' are considered low risk but are included in this assessment and when assessing impacts in-combination with other activities. Interactions classified as amber are subject to full assessment. A classification of 'red' indicates that an assessment is not required and the interaction should automatically be addressed through a management measure, however they are included in this assessment.

MCZs are associated with an overlapping but different set of designated features to those associated with EMS. Therefore, for the purposes of the initial screen in this assessment, the designated features have been matched with equivalent EMS features. Where there is no clear match, a precautionary (i.e. more sensitive) EMS feature has been used. This precautionary matching applies only to the initial screen, and not to the later, more detailed assessment.

Table 3 shows the features for which this MCZ has been designated and associated general management approach, while Figure 1 shows the locations of features within the MCZ.

[1] MCZ factsheets are available online: http://publications.naturalengland.org.uk/category/1721481
[2] www.gov.uk/government/publications/fisheries-in-european-marine-sites-matrix
[3] https://www.gov.uk/government/publications/revised-approach-to-the-management-of-commercial-fisheries-in-european-marine-sites-overarching-policy-and-delivery

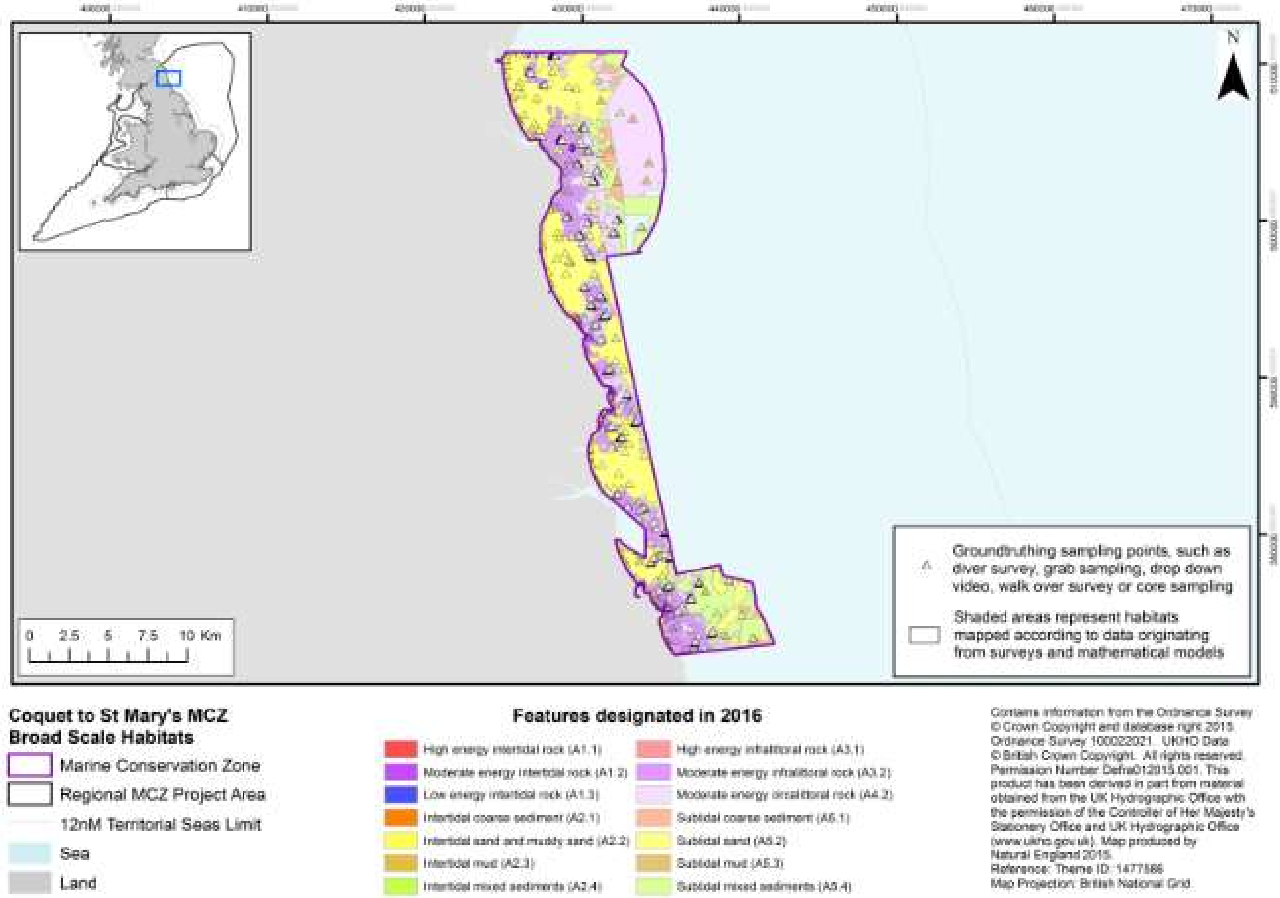


Figure 1. Coquet to St Mary's MCZ Feature Locations

Table 3: Designated features and general management approach

Feature	Fisheries Matrix Sub-feature	General Management Approach
High energy infralittoral rock	Sub-tidal bedrock reef	Maintain in favourable condition
High energy intertidal rock	Intertidal bedrock reef	Maintain in favourable condition
Intertidal coarse sediment	Intertidal gravel and sand	Maintain in favourable condition
Intertidal mixed sediments	Intertidal mixed sediments	Maintain in favourable condition
Intertidal mud	Intertidal mud	Maintain in favourable condition
Intertidal sand and muddy sand	Intertidal mud and sand	Maintain in favourable condition
Intertidal under boulder communities	Intertidal boulder and cobble reef	Maintain in favourable condition
Low energy intertidal rock	Intertidal bedrock reef	Maintain in favourable condition

Moderate energy circalittoral rock	Sub-tidal bedrock reef	Maintain in favourable condition
Moderate energy infralittoral rock	Sub-tidal bedrock reef	Maintain in favourable condition
Moderate energy intertidal rock	Intertidal bedrock reef	Maintain in favourable condition
Peat and clay exposures	N/A	Maintain in favourable condition
Subtidal coarse sediment	Coarse Sediment	Maintain in favourable condition
Subtidal mixed sediments	Subtidal mixed sediments	Maintain in favourable condition
Subtidal mud	Subtidal mud	Maintain in favourable condition
Subtidal sand	Subtidal sand	Maintain in favourable condition

The following features are considered in this assessment.

1.2.1 High energy infralittoral rock

High energy infralittoral rock is located below the low tide water limit, but close enough to the surface for plants and algae to grow. This feature is exposed to the full force of strong tidal currents and waves. As a result, this habitat is often dominated by the hardier and current-loving kelp and red algae. This feature is formed by open bedrock shelves, shallow sloping flat reefs, rocky outcrops, gullies and ledges. Areas of boulders may also occur, but all finer sediments are stripped away by the tide and waves.

Kelp forests thrive in this high energy environment, dominating the infralittoral fringe. Kelp holdfasts provide stability and shelter for a range of species, protecting them against predators, as well as strong tide and waves. Hardy red algae, such as dulse and sea beech, also thrive in this feature, either attaching to the rock or attaching epiphytically to the kelp canopy or stipes. Kelp holdfasts form microhabitats by providing refuge from the high energy environment for a diverse community of fauna, such as chitons, hydroids, sponges and topshells. Common lobster and anemones may shelter within cracks and crevices within the bedrock, whilst the bread crumb sponge and keel worms cover stable rocky areas.

High energy infralittoral rock is found just offshore from Seaton Sluice, running down the coast to surround St Mary's Island (Natural England, 2013). This feature is observed close to the intertidal zone, where the wave action is greatest, and is surrounded by moderate energy infralittoral rock on the seaward side.

The extent of this habitat is estimated to be 21.9 ha

1.2.2 High energy intertidal rock

High energy intertidal rock is subject to the full force of the tide and waves. Very high exposure to the hydrodynamic forces removes all of the fine sediments, such as sand and mud, from the environment, leaving bare rock and large cobbles behind. This feature can form a wide range of different structures, including sloping bedrock, large gullies and crevices, outcrops, ledges, boulders and temporary rock pools at low tide.

The force of the tide and waves results in resilient communities of hardy plants and animals, such as limpets and acorn barnacles. Cracks and crevices in the rock support dahlia anemones, dog whelks and hermit crabs. Mid-shore rock pools, exposed at low tide, may support coralline red algae crusts, sponges, and some areas of ephemeral green macroalgae (Marine Ecological Surveys Limited (MES) and The Marine Biological Association (MBA), 2014). Wracks and red algae, such as false Irish moss, are found on the lower intertidal rock, whilst kelp dominates the infralittoral fringe. The canopy, stipes and holdfasts of oarweed and dabberlocks provides important refuge from the strong tide and waves for a wide range of species, including chitons, hydroids and anemones (Marine Ecological Surveys Limited (MES) and The Marine Biological Association (MBA), 2014).

High energy intertidal rock can be found at Amble, the eastern side of Coquet Island, between Cresswell and Lynemouth and around Newbiggin. This feature is also observed at the coastline between Seaton Sluice and St Mary's Island (Marine Ecological Surveys Limited (MES) and The Marine Biological Association (MBA), 2014), (Natural England, 2013).

The extent of this habitat is estimated to be 52.5 ha.

1.2.3 Intertidal coarse sediment

Coarse intertidal shores are comprised of shingle and gravel, sometimes interspersed with sand and empty shells. Coarse sediment beaches are found on exposed and open shores, where the force of the tide and waves wash away fine sands, silts and muds, leaving the larger material behind. This exposed and highly-mobile environment is often unstable and supports relatively low species diversity, especially during the winter months. However, hardy and resilient communities are able to thrive in this highly mobile and disturbed environment. During summer, the more stable cobbles and shells may be colonised by opportunistic macroalgae and barnacles, whilst amphipods dominate the strandline and seek shelter in decaying seaweed and debris. Harbour crabs and brittlestars may also be found within this feature.

Areas of coarse sediment can be found on beaches at Cambois, Blyth and Amble, as well as between Lynemouth and Cresswell (Marine Ecological Surveys Limited (MES) and The Marine Biological Association (MBA), 2014). A small section of gravel is also observed at Whitley Sands (Marine Ecological Surveys Limited (MES) and The Marine Biological Association (MBA), 2014).

The extent of this habitat is estimated to be 30.9 ha.

1.2.4 Intertidal mixed sediments

Intertidal mixed sediment consist of a range of unsorted gravels, rocks, sands and mud. This feature is found in variable energy environments with changeable exposure to the tide and waves, resulting in the poor sorting of sediments. This allows fine sands and silts to accumulate around larger pebbles and cobbles, creating a diverse mosaic of substrates. As a result, areas of intertidal mixed sediment can support a diverse range of communities, which include polychaete worms, crabs and brittlestars, whilst talitrid amphipods dominate the upper shore and strandline. Opportunistic green macroalgae may attach to the larger and more stable pebbles and cobbles.

Isolated patches of intertidal mixed sediment are observed between St Mary's Island and Seaton Sluice.

The extent of this habitat is estimated to be 4.7 ha.

1.2.5 Intertidal mud

Intertidal mud is formed in very sheltered coastal inlets along the sea shore, where the weak influence of the tide and waves is insufficient to strip away fine sediments, allowing fine sand, silts and clay to accumulate. Intertidal mud is a highly hospitable and nutrient rich environment, which supports a diverse community dominated by bivalves, such as the Baltic tellin, and polychaete worms, such as the lugworm, and other burrowing infauna. This in turn provides important feeding grounds for larger species, such as wading birds, some of which feed exclusively upon burrowing invertebrates within this feature during winter. Opportunistic green macroalgae may form mats on the mud during summer.

Intertidal mudflats are located on the flanks of Seaton Burn (Marine Ecological Surveys Limited (MES) and The Marine Biological Association (MBA), 2014).

The extent of this habitat is estimated to be 2.0 ha.

1.2.6 Intertidal sand and muddy sand

Intertidal sand and muddy sand represents the vast majority of the intertidal sediment within the site, forming wide beaches along the Northumberland coastline. Pure sandy shores are often highly mobile and species poor, often dominated by polychaete and oligochaete worms, ephemeral green macroalgae and amphipod communities which are resilient to the clean, abrasive and mobile environment. Sandhoppers (talitrid amphipods) reside within the strandline on the upper shore, seeking refuge amongst the decomposing seaweed and debris (Marine Ecological Surveys Limited (MES) and The Marine Biological Association (MBA), 2014). Clean intertidal sand can be found at Whitley Sands, Blyth North and South Beaches, and Newbiggin Beach.

Where sandy shores occur in more sheltered locations, muds and silts can accumulate, forming muddy-sand. This allows the features to support a much wider and diverse community, including burrowing infauna such as lugworm, horseshoe worms, and the Baltic tellin. Striped venus clams and polychaete worms burrow within the sediment. Fucoid wracks and red algae grow on the lower shore of muddy-sand beaches, such as at Cresswell (Marine Ecological Surveys Limited (MES) and The Marine Biological Association (MBA), 2014), which also support burrowing bristleworms. Epifauna such as shore crabs and hermit crabs are also found within this feature.

Muddy sandy shores are located at the top of Whitley Sands, Newbiggin Beach, Druridge Bay, Hauxley Beach and Alnmouth Bay (Marine Ecological Surveys Limited (MES) and The Marine Biological Association (MBA), 2014).

The extent of this habitat is estimated to be 500.9 ha.

1.2.7 Intertidal under boulder communities

Intertidal boulders host diverse under-boulder communities as a result of the shelter they provide from the tide and waves. Micro-habitats are created underneath boulders and large rocks, and within crevices and cracks in the rock. These rocks can provide a mosaic of habitats and a refuge for life, with the boulders providing a hard substratum for organisms to attach to, whilst also sheltering biological communities from the sun and waves.

The underneath of boulders support diverse and vibrant communities. The boulders themselves are encrusted by mussel sprat, limpets, acorn barnacles, sponges, coralline red algae and bryozoans. Other regularly occurring species include winkles, dog whelk, brittlestars and anemones (Marine Ecological Surveys Limited (MES) and The Marine Biological Association (MBA), 2014). Crabs, lobsters and small fish may also reside in cracks within or underneath the boulders, seeking refuge at low tide. Filamentous red algae and fucoids also attach to the more stable boulders, including dulse, sea beech, red rags and toothed wrack. In an intertidal verification survey for the site, 59 out of the 86 species found were recorded within underboulder communities, thereby demonstrating the biological diversity and importance of this habitat (Marine Ecological Surveys Limited (MES) and The Marine Biological Association (MBA), 2014).

Intertidal underboulder communities are found distributed throughout the site, including at St Mary's Island, Blyth beaches, Newbiggin, Lynemouth and Cresswell (Marine Ecological Surveys Limited (MES) and The Marine Biological Association (MBA), 2014).

The extent of this habitat is estimated to be 0.25 ha.

1.2.8 Low energy intertidal rock

Low energy intertidal rock is found on rocky shores sheltered from the full force of the tide and waves. Often in the form of shallow sloping bedrock, with the addition of rocky boulders, cobbles and gullies. When the tide goes out rockpools may form, providing temporary and highly competitive microhabitats. Due to the low energy of the tide and waves, plants and algae are able to anchor on to the rock and grow in this environment. A thin veneer of sand and mud may also accumulate where the tide and waves are weak.

Low energy intertidal rock supports a wide range of plants and algae through zonation of the intertidal area, which in turn provides a wide variety of habitats for animal communities. Spiral wrack, channelled wrack and green algae dominate the upper intertidal, whilst bladder wrack and knotted wrack dominate the mid-shore. Mussels, limpets and acorn-barnacles colonise the bare rock, whilst dog whelk and winkles reside in the cracks and crevices within the rock.

Rock pools within the mid to upper intertidal support coralline red algae crusts, with some areas of ephemeral green algae (Marine Ecological Surveys Limited (MES) and The Marine Biological Association (MBA), 2014). Rockpools also provide habitat for the beadlet anemone, hermit crab, and common starfish. Toothed wrack can be found at the lower shore and infralittoral fringe, and may host the epiphytic sea mat bryozoan (Marine Ecological Surveys Limited (MES) and The Marine Biological Association (MBA), 2014).

Low energy intertidal rock is found interspersed with other rocky habitats across the site, often on the landward side of other rock formations, which help to shelter this feature from the waves and tide. Examples of low energy intertidal rock are found at Newbiggin Beach, Cresswell and around Coquet Island.

The extent of this habitat is estimated to be 57.6 ha.

1.2.9 Moderate energy circalittoral rock

Moderate energy circalittoral rock is located in deep waters, below the level where light can penetrate enough for extensive plant growth. However, where the majority of plant life is unable to survive, faunal turfs and diverse animal communities can be found. This feature consists of open bedrock, shallow sloping reefs, rocky outcrops, gullies and ledges.

Circalittoral boulders, cobbles and bedrock support a wide range of species, which may differ depending on the seabed topography, depth and tidal strength. Regularly occurring species include sponges, dead man's fingers, keel worms, hydroid and hornwrack (Amec, 2011). Faunal turfs of bryozoans, sponges and hydroids coat the bedrock and are grazed by edible urchins. Other common species include edible crabs, lobsters, brittlestars and common starfish.

Moderate energy circalittoral rock is common within the site's deep water habitats, located at the eastern side of the MCZ, offshore from Blyth, Newbiggin, Lynemouth and Cresswell. Additional areas are located offshore from Druridge Bay, Amble and east of Coquet Island. This feature is often overlaid by patches of subtidal mud, which can form a thin veneer over the bedrock (EMODnet, 2016) (Environment Agency (EA) and Cefas, 2014).

The extent of this habitat is estimated to be 6118.0 ha.

1.2.10 Moderate energy infralittoral rock

Moderate energy infralittoral rock lies just below the low tide mark, and is constantly submerged by seawater but close enough to the surface to allow plants and algae to flourish. This feature is formed by open bedrock shelves, shallow sloping flat reefs, rocky outcrops, gullies and ledges. Areas of boulders and cobbles may also occur.

Kelp forests of cuvie, dabberlocks and oarweed dominate the intertidal-infralittoral fringe, which in turn support red seaweeds, such as dulse and red rags. Within and below the kelp canopy, red algae grow epiphytically on the kelp stipes and holdfasts, as well as on the rock face. These include sea belt, pink crustose algae and sea beech (Amec, 2011). The kelp canopy and holdfasts provide stability and shelter for a diverse community of fauna, including the dahlia anemone, winkles, top shells, chitons, hydrozoans and bryozoans, protecting them against the tide and waves. Rock gunnels and common lobster may also shelter within the cracks and crevices of the rock face, whilst urchins graze the faunal and algae turfs which grow on the rocks.

This feature is highly abundant within the MCZ, and is observed offshore from Whitley Bay and St Mary's Island, up to Seaton Sluice (Marine Ecological Surveys Limited (MES) and The Marine Biological Association (MBA), 2014). Moderate energy infralittoral rock is also found off the coast from Blyth North Beach, Newbiggin, Lynemouth and Cresswell. This feature is also present off the coast of Low Hauxley, Amble and Coquet Island (Natural England, 2013) (EMODnet, 2016) (Environment Agency (EA) and Cefas, 2014).

The extent of this habitat is estimated to be 1166.9 ha.

1.2.11 Moderate energy intertidal rock

This feature is moderately exposed to the force of the tide and waves, which is at a sufficient strength to strip the environment of much of the finer sediments, such as sands and silts, which may overlay the bedrock. Moderate energy intertidal rock can form a wide range of different structures which provide a range of habitats. These include sloping bedrock, large gullies and crevices, ledges, boulders and temporary rock pools at low tide.

Moderate energy intertidal rock supports a wide range of biological communities within the site. Exposed rock on the mid to upper shore support acorn barnacles, limpets, tar lichen and filter feeders, whilst the cracks and crevices in the rock face provide refuge for the beadlet anemone, dog whelks, winkles, hermit crabs, edible crabs and rock gunnels. Mid-shore rock pools, exposed at low tide, may support coralline crusts of red algae with some areas of ephemeral green algae (Marine Ecological Surveys Limited (MES) and The Marine Biological Association (MBA), 2014).

Bladderwrack, toothed wrack and red seaweeds, such as pepper dulse, attach to the bedrock at the lower shore, hosting a range of species including topshells and epiphytic bryozoans. Kelps dominate the infralittoral fringe, including cuvie, oarweed and dabberlocks. The stability and shelter of kelp canopies, stipes and holdfasts create microhabitats for a range of species, including crustose sponges, hydroids, anemones and the epiphytic dulse.

Moderate energy intertidal rock is found throughout the rocky shores of this site, including around Hauxley, Coquet Island, and the headlands of Druridge Bay and Blyth.

The extent of this habitat is estimated to be 62.5 ha.

1.2.12 Peat and clay exposures

Peat and clay exposures are rare features which occur when strata of peat and clay breach the surface sediment layers, either in the intertidal or subtidal environment. Exposures can constitute of either peat or clay, or both strata can occur together. The influence of the waves and tide can cause areas of erosion and the mobilisation of fine sediments across the site. As a result, peat and clay exposures can be ephemeral, as the local hydrodynamic regime can cover and uncover this feature in a thin veneer of sediment.

Within the site this feature takes the form of exposed intertidal banks of peat or clay. Pebbles and stones on the surface of this feature may provide a hard and stable attachment point for opportunistic green macroalgae in summer. Along the Amble coastline, fossilised peat tree roots can be observed, having been formed millions of years ago. Peat and clay exposures are vulnerable to damage from anthropogenic activities and has no recoverability due to this feature having been formed millions of years ago (Joint Nature Conservation Committee (JNCC), 2008).

Peat and clay exposures are observed within the intertidal zone near Amble and to the north of Seaton Sluice (Marine Ecological Surveys Limited (MES) and The Marine Biological Association (MBA), 2014). Peat and clay exposures within the MCZ are found close to the shore where the tide and waves strip sediments away from this feature, which is characterised by soft rock and fossilised tree roots. Some ephemeral green and red algae may be found within this feature, including Ulva spp. and false Irish moss, Mastocarpus stellatus. Exposures may also be present ephemerally within the subtidal zone, but no records are currently available (Fitzsimmons et al., 2015). Much less is known about peat and clay exposures when located in deeper waters.

The extent of this habitat is estimated to be 2.7 ha.

1.2.13 Subtidal coarse sediment

Subtidal coarse sediment is a high energy environment consisting of gravel, shingle, shell fragments and coarse sand. This substrate is scoured by strong tidal currents and waves, which strip away fine sediments, such as silts and clay. The regular and extensive movement of coarse sediment causes significant disturbance and abrasion, resulting in a relatively low diversity but specialised community.

The more stable areas of subtidal coarse sediment support dead man’s fingers, tube building worms, hornwrack and hydroids. Hermit crabs, common starfish and brittlestars can be found in abundance on the sea floor, whilst keel worms form tubes on stable rocks, cobbles and shells. Burrowing infauna includes bivalves and the sea potato. Flatfish, such as plaice and dab, hunt over this feature and can submerge themselves within the sediment.

Areas of subtidal coarse sediment are located in the north-eastern section of the site, offshore from the Amble coast, and offshore from Whitley Bay, in the south-eastern corner of the MCZ (Foster-Smith, 1998) (Seasearch, 2013). The confidence in the extent of this feature is low, in the initial site assessment document (SAD) the extent of this feature was reported as 1.00 km^2 with low confidence. A post-survey site report using the findings of a dedicated seabed survey conclude that this feature was identified as present but not included in the updated broad-scale habitat (BSH) map as there was insufficient data to reliably map it (Fitzsimmons et al., 2015).

The extent of this habitat is estimated to be 8.7 ha.

1.2.14 Subtidal mixed sediments

Subtidal mixed sediments are comprised of a mosaic of substratum, ranging from small rocks, cobbles and shingle, to sand, shell fragments, silts and mud. This feature can have a high diversity in substrate types depending upon the environmental conditions. Fine sands and silts will accumulate in lower energy environments, whilst stronger tides and waves can strip these fine sediments away leaving a coarser substrate composition.

The diversity of habitat types within this feature support a wide variety of plant and animal communities, including both infaunal and epifaunal. Bivalves, such as the white furrow shell, and polychaetes burrow into the mixed sediment, whilst dead man's fingers, keel worms and the bryozoan hornwrack attach to the more stable rocks and cobbles. Brittlestars, starfish, hermit crabs and harbour crabs are common mobile epifauna upon tide-swept mixed sediments.

This feature is found in the deeper offshore water in the north of the site, offshore from the Amble coast. Mixed sediment is also located offshore from St Mary's Island and Whitley Bay (EMODnet, 2016) (Environment Agency (EA) and Cefas, 2014). The confidence in the extent of this feature is low, in the initial site assessment document (SAD) the extent of this feature was reported as 2.58 km^2 with low confidence. A post-survey site report using the findings of a dedicated seabed survey conclude that this feature was identified as present but was not included in the updated broad-scale habitat (BSH) map as there was insufficient data to reliably map this (Fitzsimmons et al., 2015).

The extent of this habitat is estimated to be 37.0 ha.

1.2.15 Subtidal mud

Subtidal mud is comprised of very fine sediments which accumulate in sheltered and low energy environments. As a result, subtidal mud is often found in deeper waters where the tidal currents are weaker and are insufficient to mobilise and remove fine mud and silt sediments.

Subtidal mud can be a highly productive environment, supporting a diverse community of burrowing bivalves, including the white furrow shell, the Baltic tellin and the striped venus clam. The sea potato, lugworms, polychaete worms and the economically important Norway lobster also burrow within the muddy sediment. The slender sea-pen is also found within this habitat. The surface of subtidal mud is also used by the flatfish plaice and dab for camouflage and hunting. However, the particular community which subtidal mud supports depends on the softness and cohesiveness of the local sediment.

A large area of subtidal mud is located in the northern offshore area of the MCZ, ranging offshore from the Amble coast down to Druridge Bay. Another area of subtidal mud can be found at the southern end of the MCZ near St Mary's Island. Subtidal mud occupies 29% of the MCZ, the confidence in its extent is medium-high (Fitzsimmons et al., 2015).

The extent of this habitat is estimated to be 4643.1 ha.

1.2.16 Subtidal sand

Subtidal sand is one of the most dominant features across the site, extending out to sea from Northumberland's wide sandy bays. Subtidal sand is highly mobile and is shaped by the waves, currents and tides, forming underwater sandwaves and ripples.

Subtidal sand supports a wide diversity of species, especially further offshore where the stability of the seabed is greater (Amec, 2011). A rich infaunal community includes burrowing polychaete and oligochaete worms, such as bristle worms and catworms. Nematodes and bivalves are common, such as the razor clam, Baltic tellin and the striped venus clam. Hermit crabs, edible crabs, brittlestars and common starfish live on the surface of the sand, whilst flatfish, such as plaice and dab reside and hunt over subtidal sand.

Large areas of subtidal sand can be found extending offshore from the site's sandy beaches. Areas of subtidal sand are found offshore from Alnmouth Bay, Druridge Bay, Cambois, Blyth South Beach and Lynemouth (Environment Agency (EA) and Cefas, 2014) (Fitzsimmons et al., 2015) (EMODnet, 2016).

The extent of this habitat is estimated to be 6422.9 ha.

1.3 Scope of this assessment - fishing activities assessed

The geographic scope of the assessment covers the whole site, and therefore includes all 16 designated features. As the whole site falls within the Northumberland Inshore Fisheries and Conservation District (Figure 2), the assessment and management of fishing activity will be carried out by Northumberland Inshore Fisheries and Conservation Authority (NIFCA).

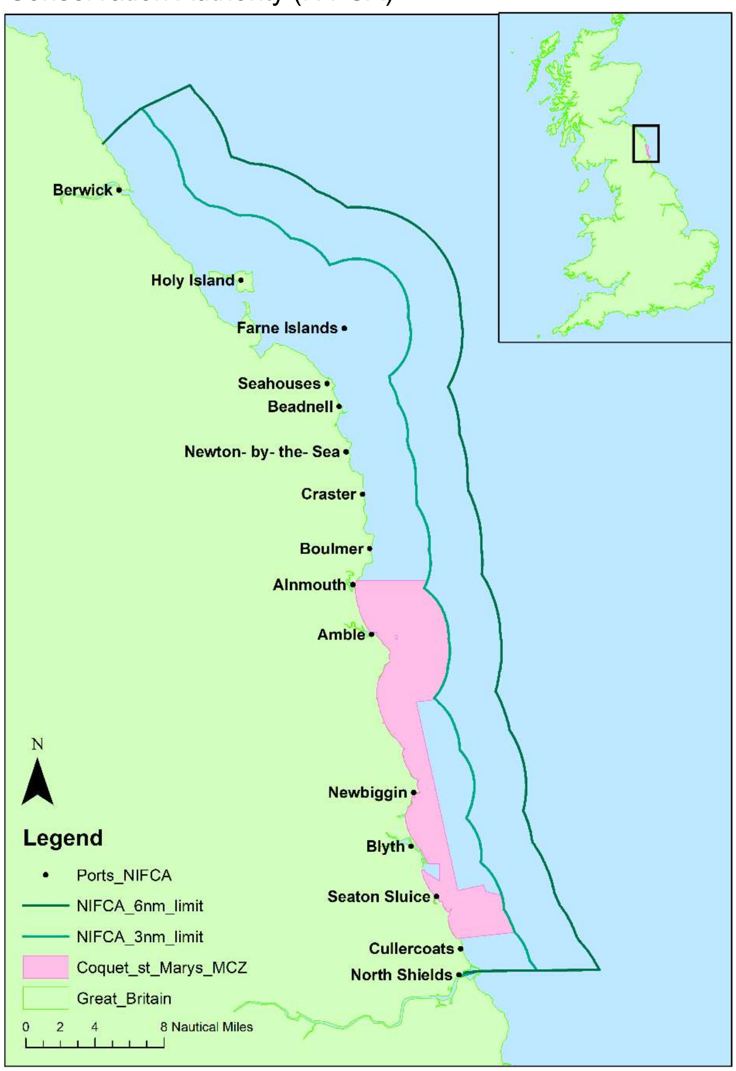


Figure 2. Location of Coquet to St Mary's MCZ in relation to the NIFCA District.

All fishing activity/feature interactions at this site identified as 'red', 'amber' and 'green' in the Matrix of fisheries gear types and European marine site protected features[2] (hereafter 'the Matrix') were considered for inclusion in this assessment. Fishing activity-feature interactions are also assessed if there are in-combination effects with other activities. All non-occurring interactions ('blue' interactions have been screened out at a previous stage.

Appendix 1 shows the fishing activities with amber interactions assessed at this site. The 'Matrix gear type' column shows the categories used in the Matrix. These are matched to the 'aggregated method' categories used in Natural England conservation advice packages.

Commercial and recreational sea fishing have the potential to vary in nature and intensity over time. This assessment considers a particular range of recent and likely future activity based on activity levels and type as identified in section 1.4.3 Fishing gear types used.

To ensure the achievement of the conservation objectives of the site is not hindered should future activity occur outside of this range, activity will be monitored at this site, and this assessment will be reviewed should certain limits be triggered, please see section 7. Review of this assessment.

1.4 Activity description: All occurring activities

1.4.1 Fisheries Access/existing management

UK vessels operate throughout this site. However, as the MCZ is an inshore MCZ (within 0-3nm), no non-UK vessels operate within the boundary of the site.

There are various Northumberland IFCA byelaws[3] that pertain to Coquet to St Mary's MCZ. The byelaws below are therefore relevant to this assessment:

TRAWLING

- Restricted assess: a permit is required to fish using a trawl within the NIFCA district.
- Vessel size restrictions: no vessels over 12m in length can fish in the inner area (0-3nm from shore), no vessel over 18.3m can fish in the outer area (3-6nm).
- Gear restriction: only a single trawl fitted with a single cod end and one pair of otter boards is permitted.
- This byelaw prohibits the use of bottom towed fishing gear within the Coquet to St Mary's MCZ except using specified gear in accordance with an exemption from the Authority.

DREDGING

- A person must not use a dredge for the exploitation of sea fisheries resources within the Northumberland IFCA district and therefore the whole MCZ.
- A relevant fishing vessel transiting through the District must have all dredges onboard, lashed and stowed.

CRUSTACEA CONSERVATION

- Prohibits landing of v-notched or mutilated lobster, and soft or berried (egg bearing) edible crab and lobster, and detached parts of velvet crab, edible crab and lobster.

[2] www.gov.uk/government/publications/fisheries-in-european-marine-sites-matrix
[3] https://www.nifca.gov.uk/byelaws/

MINIMUM SIZES BYELAW

- This byelaw prohibits the removal from the fishery, retention on board, transhipping, landing, transporting, storing, selling, displaying or offering for sale specified marine organisms below specified sizes.

CRUSTACEA AND MOLLUSC PERMITTING AND POT LIMITATION

- Restricted assess: a permit is required to fish within the Northumberland IFCA district and therefore the whole MCZ.
- Pot limitation restricts the number of pots fished per permitted vessel to 800.
- Restricts the number of specified species that can be retained per day dependent on permit type.

MARKING OF FISHING GEAR AND KEEP BOXES

- All static fishing gear should be marked with a marker buoy or dahn that is clearly visible on the surface of the water and marked with the identification of the boat or contact details of the owner.

FIXED ENGINES

- Spatial and seasonal closures for static nets.

1.4.2 Evidence Sources

To determine the levels of fishing activity, the following evidence sources and analyses were used:

- VMS data
- I-VMS data
- NIFCA patrol sightings, recording GPS location of vessel and potting activity.
- NIFCA shore patrol sightings of intertidal activities within two hours of low tide
- Expert opinion from inshore fisheries and conservation officers (IFCOs).
- Information from the fishing industry and stakeholders.

Table 4 summarises the description, strengths and limitations of some of the evidence sources used.

Table 4: Summary of generic confidence associated with fishing activity evidence (evidence used in this assessment highlighted in yellow)

Evidence source	Confidence	Description, strengths and limitation
VMS data	Low	VMS data were requested from the MMO. Vessels over 12m must be fitted with VMS. VMS sends routine 'pings' to the control centre every 2 hours to track a vessel's course and speed. NIFCA has worked with the MMO to get information for every vessel operating in the district. The data has been filtered for speed (only boats travelling under 4 knots analysed). From this, officers have inferred that no mobile gear fishing activity can be detected in or around the MCZ. However, this can only be **inferred** from these data (see limitations below). The VMS data from the MMO is not fit for purpose in this case. Inferences can be made from the data available, however the infrequency of the tracking 'pings' (every 2 hours per vessel) and the lack of detail about the vessel's activity makes it unsuitable for detecting fishing activity with confidence. Further, information is only available for vessel over 12m, any activity within the MCZ will be carried out by vessels under 12 m (NIFCA Byelaw 1). Data analysed was from 2017 and 2018.
I-VMS	Low - Moderate	I-VMS devices monitor inshore fishing activity by under-12 metre vessels and are more accurate than VMS devices. However, I-VMS data are not available for all <12m vessels who have indicated that they fish within Coquet to St Mary's MCZ. I-VMS tracks vessel activity, location and speed every three minutes. Inferences can be made to differentiate fishing activity as either being paused or steaming to identify speeds and distances at which vessels are likely to be fishing. In this instance trawling was determined to take place if I-VMS points were between 140-310m from each other, and vessel speeds were between 1.5-4.3 knots (nautical miles per hour). NIFCA have moderate confidence in the data for vessels fitted with I-VMS that report trawling in the MCZ via their permit returns. However, gaps lie where vessels do not have I-VMS working, and have not stated they are trawling in the MCZ. One full year of data was analysed from March 2022 to February 2023 to identify vessels potentially fishing within the MCZ.
NIFCA patrol sightings At sea On shore	Moderate	At sea NIFCA officers conduct routine at sea patrols throughout the district. Officers record all vessels sighted and their activity (fishing or steaming). Due to the nature of how this is recorded sightings data is estimated to be accurate to within 100m. NIFCA sightings data has a low sampling effort as it is limited by the number of patrols and the proximity of the patrol vessel to fishing activity On shore

		NIFCA officers conduct routine shore patrols throughout the district. Officers record all sightings of individuals fishing in intertidal areas when two hours either side of low tide. Activities include periwinkle gathering, lobster potting, bait digging and other forms of collection. The location and timing of these is accurate and is now submitted via an app contemporaneously, increasing accuracy from the beginning of 2021. To calculate the proportion of patrols where activities are sighted, sightings of 'No Activity' are also recorded which are likely less accurate or well-represented, though data is checked against patrol locations to account for this. This data is impacted by variables such as patrols targeting commercial fishing locations leading to some areas being underrepresented.
Expert judgement (IFCOs)	Moderate	The NIFCA district is a relatively small area (~1400km^2) and a number of NIFCA officers have been in post for many years. Coquet to St Mary's MCZ is in the south of the district located in close proximity to the NIFCA patrol vessels and the NIFCA office. This results in a higher patrol effort in the south than the north if the district. Broad scale knowledge of fishing activity for this area is therefore very good.
Information from fishing industry and stakeholders	Low - Moderate	NIFCA maintain a good working relationship with the local fishing industry and through which information on fishing activity, extent and intensity can be shared. NIFCA also have the capacity to run consultations in order to get the views of stakeholders on different topics. For example, in 2020 NIFCA sent out a Hand Gathering Call for Information, an open-ended consultation to summarise the thoughts and opinions of stakeholders in relation to bait collection and hand gathering activities throughout the district. From this, NIFCA are able to identify that activity occurs and, with a reasonable degree of confidence, where it occurs but cannot quantify effort due to a lack of available data such as VMS, log books etc.

1.4.3 Fishing gear types used

1.4.3.1 Demersal Trawls (light and heavy otter trawls)

Demersal otter trawls feature a variety of designs and riggings depending on the nature of the ground to be fished and the target species.

Otter trawl rigs consist of netting divided into wings, belly and cod-end. To the sides of the net wings, a pair of otter boards, or trawl doors, open the net horizontally and depress the trawl to the seabed. They also stimulate the fish to swim into the path of the trawl, sometimes through the creation of a sediment cloud. Cables known as bridles and sweeps connect the otter boards to the net wings and these can be from a few meters up to a few hundred meters long. The front of the trawl is framed on the top by a head line, which frequently has floats attached to keep the mouth of the net open, and a ground rope usually constructed of wire. The ground rope will often have associated ground gear attached to it to protect the net from damage and prevent entanglement with the bottom. Ground gear can vary from rock hoppers to bobbins of various dimensions. Tickler chains may also be attached to the net opening, and mechanically stimulate fish through contact with the bottom.

The managing fisheries in MPA gear glossary defines heavy otter trawl gear as any otter trawl that uses any of the following:

- sheet netting of greater than 4 mm twine thickness
- rockhoppers or discs of 200 mm or above diameter
- a chain for the foot/ground line (instead of wire)
- multiple tickler chains

The light otter trawl is defined as a gear which is anything less than the definition of a heavy otter trawl.

1.4.3.2 Dredges (scallop dredge)

Scallop dredges consist of a triangular frame approximately 750mm wide with a toothed bar at the front to penetrate the seabed and flip scallops out of the seabed and into a collecting bag behind it. The bottom of the collecting bag is made of chain links forming a chain mesh (the belly) to reduce damage to the ground. The top of the bag is made of either chain mesh or netting. Several dredges are towed behind a heavy spreading bar on each side of the vessel. The length of the bar and number of dredges is dictated by the power of the vessel and length of the vessel. Within the NIFCA district vessels are not permitted to dredge for Scallops (NIFCA Byelaw 2).

Chapter 2 Part A Assessment

2.1 Introduction

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(1)(b) of the Marine and Coastal Access Act 2009[4].

For each fishing activity, a series of questions were asked:

1. Does the activity take place, or is it likely to take place in the future?
2. What are the potential pressures exerted by the activity on the feature?
3. Are the pressures capable of affecting (other than insignificantly) the protected features of the MCZ?

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

1. The pressure-feature interactions were not included for assessment in Part B if:
    a. the feature is not exposed to the pressure, and is not likely to be in the future; or
    b. the pressures are not capable of affecting (other than insignificantly) the protected features of the MCZ.

2. The pressure-feature interactions were included for assessment in Part B if:
    a. the feature is exposed to the pressure, or is likely to be in the future; and
    b. the pressure is capable of affecting (other than insignificantly) the feature; or
    c. it is not possible to determine whether the pressure is capable of affecting (other than insignificantly) the feature.

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

Table 5 shows the Natural England conservation advice package used to inform this assessment.

Table 5: Advice packages used for assessment

Feature	Package	Link
High energy infralittoral rock High energy intertidal rock Intertidal coarse sediment Intertidal mixed sediments Intertidal mud Intertidal sand and muddy sand Intertidal under boulder communities Low energy intertidal rock Moderate energy circalittoral rock	Natural England Conservation Advice for Marine Protected Areas Coquet to St Mary's MCZ	https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UKMCZ0030&SiteName=coquet&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=

[4] www.legislation.gov.uk/ukpga/2009/23/contents

Moderate energy infralittoral rock Moderate energy intertidal rock Peat and clay exposures Subtidal coarse sediment Subtidal mixed sediments Subtidal mud Subtidal sand		

2.2 Activities not taking place

Table 6 shows activities which are excluded from further assessment as they do not take place and are not likely to take place in the future.

Table 6: Activities not taking place and not likely to take place in the future

Feature	Gear type	Justification
Intertidal mud and sand, Intertidal gravel and sand, Intertidal mixed sediments, Intertidal Underboulder Communities/intertidal boulder and cobble reef, Intertidal Bedrock Reef/High energy intertidal rock, Intertidal Bedrock Reef /Moderate energy Intertidal Rock, Intertidal Bedrock Reef /Low energy intertidal rock, Peat and Clay	Light otter trawl, Heavy Otter trawl	No interaction between activity and features within the Coquet to St Mary's MCZ or the surrounding area/NIFCA district (Mark Southerton, pers. comms. 2021).
Intertidal mud and sand, Intertidal gravel and sand, Intertidal mixed sediments, Intertidal Underboulder Communities/intertidal boulder and cobble reef, Intertidal Bedrock Reef/High energy intertidal rock, Intertidal Bedrock Reef /Moderate energy Intertidal Rock, Intertidal Bedrock Reef /Low energy intertidal rock, Peat and Clay	Gill Nets, Trammel Nets and Entangling Nets	No interaction between activity and features within the Coquet to St Mary's MCZ or the surrounding area/NIFCA district (Mark Southerton, pers. comms. 2021).
Intertidal Underboulder Communities, Intertidal Bedrock Reef/High energy intertidal rock,	Digging with forks	No interaction between features and activity within Coquet to St Mary's MCZ (Mark Southerton, pers. comms. 2021).

Intertidal Bedrock Reef /Moderate energy Intertidal Rock, Intertidal Bedrock Reef /Low energy intertidal rock, Intertidal coarse sediment, Peat and Clay Exposures.		
Subtidal sand (high energy), Subtidal mud, Intertidal mud, Intertidal mud and sand, Intertidal gravel and sand, Intertidal mixed sediments, Subtidal mixed sediments, Coarse sediment (high energy), Intertidal Underboulder Communities/intertidal boulder and cobble reef, Intertidal Bedrock Reef/High energy intertidal rock, Intertidal Bedrock Reef /Moderate energy Intertidal Rock, Intertidal Bedrock Reef /Low energy intertidal rock, High energy infralittoral rock/ Subtidal bedrock reef & Subtidal boulder & cobble reef, Moderate energy infralittoral rock/ Subtidal bedrock reef & Subtidal boulder & cobble reef, High energy circalittoral rock/ Subtidal bedrock reef & Subtidal boulder & cobble reef, Peat and Clay Exposures (Intertidal).	Commercial diving	No current activity (Mark Southerton, pers. comms. 2021).
	Bait dragging	No current activity (Mark Southerton, pers. comms. 2021).
	Crab tiling (Fisheries Aggregation Devices)	No current activity (Mark Southerton, pers. comms. 2021).
	Intertidal handwork (from vessel)	No current activity (Mark Southerton, pers. comms. 2021).
	Trammel netting	No current activity (Mark Southerton, pers. comms. 2021).
	Drift nets	No current activity (Mark Southerton, pers. comms. 2021).
	Beam Trawl (shrimp)	No current activity (Mark Southerton, pers. comms. 2021).
	Beam Trawl (whitefish)	No current activity (Mark Southerton, pers. comms. 2021).
	Beam Trawl (pulse/wing)	No current activity (Mark Southerton, pers. comms. 2021).
	Multi-rig trawls	Regulated activity Multi-rig trawls is prohibited within the NIFCA district (NIFCA Byelaw 1: Trawling). No current activity within the Coquet to St Mary's MCZ or the surrounding area/NIFCA district (Mark Southerton, pers. comms. 2021).
	Pair trawling	Regulated activity pair trawling is prohibited within the NIFCA district (NIFCA Byelaw 1: Trawling). No current activity within the Coquet to St Mary's MCZ or the surrounding area/NIFCA district (Mark Southerton, pers. comms. 2021).
	Anchor Seine	No current activity (Mark Southerton, pers. comms. 2021).
	Scottish/fly seine	No current activity (Mark Southerton, pers. comms. 2021).
	Dredges (towed): - Scallop dredges - Mussels, clams, oysters;	The NIFCA byelaw 'Dredges' 2022 prohibits the use of dredges within the NIFCA District. All gear must be onboard, lashed and stowed when vessels are in the District. There is no evidence of a lack of compliance with this byelaw.
	Dredges (other): - Suction (cockles) - Tractor	No current activity (Mark Southerton, pers. comms. 2021).
	Cuttle pots	No current activity (Mark Southerton, pers. comms. 2021).
	Fish traps	No current activity (Mark Southerton, pers. comms. 2021).
	Seine nets and other: - Beach sine/ring nets - Shrimp push-nets	No current activity (Mark Southerton, pers. comms. 2021).

	- Fyke and stakenets.	
Peat and Clay Exposures (Intertidal).	Pots/creels (crustacea/gastropods)	No interaction between features and activity within Coquet to St Mary's MCZ (NIFCA sightings data) for intertidal peat and clay. Subtidal peat and clay has not been considered in this assessment due to insufficient evidence.

2.3 Potential pressures exerted by the activities on the feature

For the remaining activities, potential pressures were identified using the Natural England conservation advice identified in table 5 and associated advice on operations tables. All pressures identified other than those categorised as 'not relevant' were included.

Tables 7a-c show the potential pressures identified for each feature.

Table 7a: Potential pressures for gears on Subtidal Coarse Sediment and Subtidal Mixed Sediment (pressures capable of effecting other than insignificantly are in bold).

Aggregated method	Potential pressures
Otter trawls (Light otter trawl, Heavy Otter trawl)	**Abrasion/disturbance if the substrate on the surface of the seabed.**
	Changes in suspended solids (water clarity)
	Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion
	Removal of non-target species
	Smothering and siltation rate changes (Light)
	Introduction or spread of invasive non-native species
	Deoxygenation
	Physical change (to another sediment type)
Scallop Dredge	**Abrasion/disturbance if the substrate on the surface of the seabed.**
	Changes in suspended solids (water clarity)
	Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion
	Removal of non-target species
	Smothering and siltation rate changes (Light)
	Introduction or spread of invasive non-native species
	Introduction of microbial pathogens
	Deoxygenation
	Physical change (to another sediment type)

Table 7b: Potential pressures for gears on Subtidal Mud (pressures capable of effecting other than insignificantly are in bold).

Aggregated method	Potential pressures
Otter trawls (Light otter trawl, Heavy Otter trawl)	**Abrasion/disturbance if the substrate on the surface of the seabed**
	Changes in suspended solids (water clarity)
	Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion
	Removal of non-target species
	Smothering and siltation rate changes (Light)
	Introduction or spread of invasive non-native species

	Deoxygenation
	Physical change (to another sediment type)
	Organic enrichment
Scallop Dredge	**Abrasion/disturbance if the substrate on the surface of the seabed**
	Changes in suspended solids (water clarity)
	Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion
	Removal of non-target species
	Smothering and siltation rate changes (Light)
	Introduction or spread of invasive non-native species
	Introduction of microbial pathogens
	Deoxygenation
	Physical change (to another sediment type)
	Organic enrichment

Table 7c: Potential pressures for gears on Subtidal Sand (pressures capable of effecting other than insignificantly are in bold).

Aggregated method	Potential pressures
Otter trawls (Light otter trawl, Heavy Otter trawl)	**Abrasion/disturbance if the substrate on the surface of the seabed**
	Changes in suspended solids (water clarity)
	Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion
	Removal of non-target species
	Smothering and siltation rate changes (Light)
	Introduction or spread of invasive non-native species
	Deoxygenation
	Physical change (to another sediment type)
	Organic enrichment
	Introduction of light
Scallop Dredge	**Abrasion/disturbance if the substrate on the surface of the seabed**
	Changes in suspended solids (water clarity)
	Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion
	Removal of non-target species
	Smothering and siltation rate changes (Light)
	Introduction or spread of invasive non-native species
	Introduction of microbial pathogens
	Deoxygenation
	Introduction of light
	Physical change (to another sediment type)
	Organic enrichment

2.4 Significance of effects/impacts

To determine whether each pressure is capable of affecting (other than insignificantly) the site's feature(s), the sensitivity assessments and risk profiling of pressures from the advice on operations section of the Natural England conservation advice package were used.

Tables 8a-c identify the pressures from particular gears which are capable of affecting (other than insignificantly) each feature. Where a pressure from a particular gear is identified as not being capable of affecting (other than insignificantly), justification is provided (green). Features with similar sensitivities have been considered together. Where a pressure from a particular gear is identified as being capable of affecting a feature, it is highlighted in red and taken to the next stage of assessment.

To ensure the effects of fishing activities in-combination with other activities (including other fishing activities) are fully assessed, the pressures from amber activities which are not capable of affecting (other than insignificantly) the site’s feature(s) but which do interact with the feature(s) are included in the in-combination assessment.

Table 8a: Summary of pressures from specific activities on subtidal coarse sediment and subtidal mixed sediment taken to Part B.

Potential pressures	Demersal Trawl		Dredges	Traps	Static fixed nets		
	Light otter trawls	Heavy otter trawls	Scallop dredge	Pots/creels	Gill net	Entangling net	Trammel net
Abrasion/disturbance if the substrate on the surface of the seabed.	Capable of affecting (other than insignificantly) – Abrasion/surface disturbance can be caused by contact between the gear/anchors and the sea bed.						
Changes in suspended solids (water clarity)	Capable of affecting (other than insignificantly) - This pressure may result from physical disturbance of the sediment, along with hydrodynamic action caused by the passage of towed gear.			Not capable of affecting (other than insignificantly) - Any plumes created by the impact of gear or anchors will be small, localised and very short lived.			
Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion	Capable of affecting (other than insignificantly) - Gears are designed to dig into the seabed.			Not capable of affecting (other than insignificantly) – Gears not designed to penetrate the seabed.			
Removal of non-target species	Capable of affecting (other than insignificantly) – Removal of non-target species by fishing activities will affect the presence and/or population size of the feature.						
Smothering and siltation rate changes (Light)	Capable of affecting (other than insignificantly) - This pressure may result from physical disturbance of the sediment, along with hydrodynamic action caused by the passage of towed gear.			Not capable of affecting (other than insignificantly) – These gears do not create large sediment plumes.			
Introduction or spread of invasive non-native species	Not capable of affecting (other than insignificantly) – Ballast water is the principal vector for invasive non-indigenous species[5]. Fishing vessels less than 45m must have permanent ballast and thus this vector is not available[6].						
Introduction of microbial pathogens	Not capable of affecting (other than insignificantly) – Coquet to St Mary's MCZ is not a shellfish production site.						
Physical change (to another sediment type)	Not capable of affecting (other than insignificantly) – The site is a highly dynamic environment, which results in the natural movement of sediment, it is therefore unlikely that fishing activity would be capable of significantly changing seabed type.						
Deoxygenation	Not capable of affecting (other than insignificantly) – Coquet to St Mary's MCZ is a highly dynamic environment, oxygen levels will be replenished by wave and tidal movements.						

[5] http://qsr2010.ospar.org/media/assessments/p00440_Shipping_Assessment.pdf
[6] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/441098/MGN_501_Combined.pdf

Table 8b: Summary of pressures from specific activities on subtidal mud taken to Part B.

Potential pressures	Demersal Trawl		Dredges	Traps	Static fixed nets		
	Light otter trawls	Heavy otter trawls	Scallop dredge	Pots/creels	Gill net	Entangling net	Trammel net
Abrasion/disturbance if the substrate on the surface of the seabed.	Capable of affecting (other than insignificantly) – Abrasion/surface disturbance can be caused by contact between the gear/anchors and the sea bed.						
Changes in suspended solids (water clarity)	Capable of affecting (other than insignificantly) - This pressure may result from physical disturbance of the sediment, along with hydrodynamic action caused by the passage of towed gear.			Not capable of affecting (other than insignificantly) - Any plumes created by the impact of gear or anchors will be small, localised and very short lived.			
Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion	Capable of affecting (other than insignificantly) - Gears are designed to dig into the seabed.			Not capable of affecting (other than insignificantly) – Gears not designed to penetrate the seabed.			
Removal of non-target species	Capable of affecting (other than insignificantly) – Removal of non-target species by fishing activities will affect the presence and/or population size of the feature.						
Smothering and siltation rate changes (Light)	Capable of affecting (other than insignificantly) - This pressure may result from physical disturbance of the sediment, along with hydrodynamic action caused by the passage of towed gear.			Not capable of affecting (other than insignificantly) – These gears do not create large sediment plumes.			
Introduction or spread of invasive non-native species	Not capable of affecting (other than insignificantly) – Ballast water is the principal vector for invasive non-indigenous species[7]. Fishing vessels less than 45m must have permanent ballast and thus this vector is not available[8].						
Introduction of microbial pathogens	Not capable of affecting (other than insignificantly) – Coquet to St Mary's MCZ is not a shellfish production site.						
Physical change (to another sediment type)	Not capable of affecting (other than insignificantly) – The site is a highly dynamic environment, which results in the natural movement of sediment, it is therefore unlikely that fishing activity would be capable of significantly changing seabed type.						
Deoxygenation	Not capable of affecting (other than insignificantly) – Coquet to St Mary's MCZ is a highly dynamic environment, oxygen levels will be replenished by wave and tidal movements.						

[7] http://qsr2010.ospar.org/media/assessments/p00440_Shipping_Assessment.pdf
[8] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/441098/MGN_501_Combined.pdf

Organic enrichment	Not capable of affecting (other than insignificantly) – Habitat is subject to a degree of wave action or tidal currents suitable enough to make organic enrichment unlikely

Table 8c: Summary of pressures from specific activities on subtidal sand taken to Part B.

Potential pressures	Demersal Trawl		Dredges	Traps	Static fixed nets		
	Light otter trawls	Heavy otter trawls	Scallop dredge	Pots/creels	Gill net	Entangling net	Trammel net
Abrasion/disturbance if the substrate on the surface of the seabed.	Capable of affecting (other than insignificantly) – Abrasion/surface disturbance can be caused by contact between the gear/anchors and the sea bed.						
Changes in suspended solids (water clarity)	Capable of affecting (other than insignificantly) - This pressure may result from physical disturbance of the sediment, along with hydrodynamic action caused by the passage of towed gear.			Not capable of affecting (other than insignificantly) - Any plumes created by the impact of gear or anchors will be small, localised and very short lived.			
Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion	Capable of affecting (other than insignificantly) - Gears are designed to dig into the seabed.			Not capable of affecting (other than insignificantly) – Gears not designed to penetrate the seabed.			
Removal of non-target species	Capable of affecting (other than insignificantly) – Removal of non-target species by fishing activities will affect the presence and/or population size of the feature.						
Smothering and siltation rate changes (Light)	Capable of affecting (other than insignificantly) - This pressure may result from physical disturbance of the sediment, along with hydrodynamic action caused by the passage of towed gear.			Not capable of affecting (other than insignificantly) – These gears do not create large sediment plumes.			
Introduction or spread of invasive non-native species	Not capable of affecting (other than insignificantly) – Ballast water is the principal vector for invasive non-indigenous species[9]. Fishing vessels less than 45m must have permanent ballast and thus this vector is not available[10].						
Introduction of microbial pathogens	Not capable of affecting (other than insignificantly) – Coquet to St Mary's MCZ is not a shellfish production site.						
Physical change (to another sediment type)	Not capable of affecting (other than insignificantly) – The site is a highly dynamic environment, which results in the natural movement of sediment, it is therefore unlikely that fishing activity would be capable of significantly changing seabed type.						

[9] http://qsr2010.ospar.org/media/assessments/p00440_Shipping_Assessment.pdf
[10] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/441098/MGN_501_Combined.pdf

Deoxygenation	Not capable of affecting (other than insignificantly) – Coquet to St Mary's MCZ is a highly dynamic environment, oxygen levels will be replenished by wave and tidal movements.
Organic enrichment	Not capable of affecting (other than insignificantly) – Habitat is subject to a degree of wave action or tidal currents suitable enough to make organic enrichment unlikely
Introduction of light	Not capable of affecting (other than insignificantly) – Introduction of light from fishing activities is unlikely to significantly affect the feature.

Chapter 3 Part B Assessment

3.1 Demersal trawls

Subtidal Coarse Sediment, Subtidal Mixed Sediments, Subtidal Mud, Subtidal Sand

Part B of this assessment was carried out in a manner that is consistent with the ‘significant risk’ test required by section 126(2) of the Marine and Coastal Access Act 2009.

Tables 9 shows the fishing activities and pressures included for assessment in part B.

This chapter is the assessment for the interaction between mobile fishing gears (demersal trawls and towed dredges) and subtidal soft sediment features (subtidal coarse sediment, subtidal mixed sediments, subtidal mud, and subtidal sand).

Table 9: Fishing activities and pressures included for part B assessment for Subtidal coarse sediment and Subtidal mixed sediments, Subtidal mud, and Subtidal sand.

Natural England Aggregated Method	Fishing gear type	Pressures
Demersal trawl	Light otter trawl Heavy otter trawl	• Abrasion/disturbance of the substrate on the surface of the seabed • Changes in suspended solids (water clarity) • Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion • Removal of non-target species • Removal of target species • Smothering and siltation rate changes (Light)

The important targets for favourable condition were identified within Natural England’s conservation advice supplementary advice tables. ‘Important’ in this context means only those targets relating to attributes that will most efficiently and directly help to define condition. These attributes should be clearly capable of identifying a change in condition.

Tables 10 shows which targets were identified as important. The impacts of pressures on features were assessed against these targets to determine whether the activities causing the pressures are compatible with the site’s conservation objectives.

Table 10: Relevant attributes and targets for identified pressures to Subtidal coarse sediment and Subtidal mixed sediments, Subtidal mud, and Subtidal sand features.

Potential pressures	Advice on Operations	Considered in Part B assessment?	Relevant attributes (that could be impacted by identified pressures)	Target
Abrasion/disturbance of the substrate on the surface of the seabed	S	Y	- Distribution: presence and spatial distribution of biological communities - Structure: species composition of component communities	Maintain
Changes in suspended solids (water clarity)	S	Y	- Distribution: presence and spatial distribution of biological communities - Structure: species composition of component communities - Supporting processes: water quality - turbidity	Maintain

Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion	S	Y	- Distribution: presence and spatial distribution of biological communities - Structure: species composition of component communities	Maintain
Removal of non-target species	S	Y	- Distribution: presence and spatial distribution of biological communities - Structure: species composition of component communities	Maintain
Removal of target species	S	Y	- Distribution: presence and spatial distribution of biological communities - Structure: species composition of component communities	Maintain
Smothering and siltation rate changes (Light)	S	Y	- Distribution: presence and spatial distribution of biological communities - Structure: species composition of component communities - Supporting processes: water quality - turbidity	Maintain

3.2 Fishing gear types used

3.2.1 Demersal Trawls (light and heavy otter trawls)

A bottom trawl is constructed like a cone-shaped net that is towed (by one or two boats) on the bottom. They are designed to catch species above the seabed but have components which remain in contact with the seabed during the fishing activity (Lokkeborg, 2005). Parts of the gear such as ropes, chains, sole plates and teeth come into contact with the sea floor to keep the trawl mouth open but may not remain in continuous contact. Other components such as the trawl doors must penetrate the sediment for the duration of the fishing activity (Lokkeborg, 2005).

Three categories of bottom trawls can be distinguished based on how their horizontal opening is maintained: demersal otter trawls, demersal pair trawls and beam trawls. This assessment concerns the first of the three: **demersal light otter trawls**. Pair trawls and beam trawls do not operate within the NIFCA district, due to equipment restrictions in the NIFCA Trawling byelaw, and have therefore been screened out at an earlier stage in the assessment process.

Demersal otter trawls feature a variety of designs and riggings depending on the nature of the ground to be fished and the target species.

Otter trawl rigs consist of netting divided into wings, belly and cod-end. To the sides of the net wings, a pair of otter boards, or trawl doors, open the net horizontally and depress the trawl to the seabed. They also stimulate the fish to swim into the path of the trawl, sometimes through the creation of a sediment cloud. Cables known as bridles and sweeps connect the otter boards to the net wings and these can be from a few meters up to a few hundred meters long. The front of the trawl is framed on the top by a headline, which frequently has floats attached to keep the mouth of the net open, and a ground rope usually constructed of wire. The ground rope will often have associated ground gear attached to it to protect the net from damage and prevent entanglement with the bottom. Ground gear can vary from rock hoppers to bobbins of various dimensions. Tickler chains may also be attached to the net opening, and mechanically stimulate fish through contact with the bottom.

The managing fisheries in MPA gear glossary defines heavy otter trawl gear as any otter trawl that uses any of the following:

- sheet netting of greater than 4 mm twine thickness
- rockhoppers or discs of 200 mm or above diameter
- a chain for the foot/ground line (instead of wire)
- multiple tickler chains

The light otter trawl is defined as a gear which is anything less than the definition of a heavy otter trawl.

3.3 Fishing activity levels in Coquet to St Mary's MCZ

3.3.1 Demersal trawls (light otter trawls)

The local fishery targeting *Nephrops* on subtidal mud takes place mainly outside of the Coquet to St Mary's MCZ boundary between 3-25 miles offshore with best catches being seen during the autumn and winter months. When the fishery is at its height it also attracts a large number of visiting trawlers from Scotland, Northern Ireland and other English ports. The majority of the visiting trawlers are larger and more powerful than the local boats, and this enables them to work further offshore in most weather conditions. In the summer months a number of smaller under 10 metre boats from North Shields, Blyth and Amble move up to the Firth of Forth to target the summer prawns (*Nephrops*), normally working daylight and darkness throughout the week and coming home at weekends. The remaining under 10 metre boats and the larger local trawlers tend to work further offshore (beyond 6 nm) in the summer when the weather is usually finer, targeting both white fish and prawns (A. Browne, NIFCA, November 2018, pers. comms.).

In the last 10 years, the trawl fleet has become ever more reliant on the local prawn (*Nephrops norvegicus*) fishery, which is now the fleet's principal fishery. Anecdotal evidence indicates that the decline in the use of demersal light otter trawls within the NIFCA district is due to various factors, but predominantly the introduction of Total Allowable Catches and quotas in 1983, which drove many towards potting for shellfish. Locally, the cessation of dumping sewage sludge at sea around 20 years ago, particularly off the River Tyne and Blyth, is indirectly attributed to a decline in local cod (*Gadhus* morhua) stocks, which used the dumping grounds for feeding. There was a relatively small fishery targeting flatfish (mainly plaice) within sandy bays in Coquet to St Mary's MCZ. This was predominantly Druridge Bay and Cambois Bay. There is one permit holder who has said they trawl in the bays in Coquet to St Mary's MCZ. However, they have submitted no activity returns since the activity returns system was set up for the MCZ in 2021.

Much of the NIFCA district is designated as the Farne Deeps ground. This is defined as ICES rectangles 38E8, 38E9, 39E9, 40E8 and 40E9. Here, there are different regulations on mesh sizes and a quota. Mesh sizes of the trawls are dependent on their target species, for the UK sizes are specified under Council Regulation (EC) No 2019/1241 of 25 July 2019 for the conservation of fishery resources through technical measures for the protection of juveniles of marine organisms. Annex 1 of the Council Regulation states the minimum mesh sizes for towed gears, applicable to our district, with 80 mm used for *Nephrops*. Within the Farne Deeps the mesh size has been increased to 90 mm. NIFCA also have a Minimum Sizes byelaw[11] that sets out minimum sizes for species commonly caught in the NIFCA district, including *Nephrops* in line with the sizes in the Council Regulation.

[11] https://nifca.gov.uk/byelaws/

3.3.2 Demersal trawls (heavy otter trawls)

In 2021, NIFCA updated the trawling byelaw to prohibit all mobile gear in Coquet to St Mary's MCZ except for light otter trawl gear to protect the reef feature (NIFCA MCZ Assessment: CSMMCZ FA 002). In a slight variation from the definition in section 3.2.1, for the purpose of the byelaw light otter trawl gear is defined as:

> a single trawl fitted with a single cod-end and one pair of otter boards rigged for fine ground fishing using either:
> (i) grass rope with lead rings;
> (ii) light single chain ground gear, with a chain link diameter of less than or equal to 10 millimetres; or
> (iii) rubber leg ground gear with rubber discs less than 70 millimetres in diameter.

The byelaw also requires anyone who fishes using a trawl in Coquet to St Mary's to have an exemption from NIFCA in addition to a trawl permit. All exemption holders must fill in monthly returns forms specifically for Coquet to St Mary's MCZ.

The change to this byelaw prohibits heavy otter trawl gear and scallop dredging gear from being used in the site. Since this change came into force in 2021, NIFCA is not aware of any infringements to this byelaw. **Therefore, NIFCA can say with moderate-high confidence that heavy otter trawl activity will not occur in this site.**

3.3.3 Trawling activity in Coquet to St Mary's MCZ

The main data sources used to generate this information were:

- iVMS data - this is available for some boats in the NIFCA District and has been analysed where available. It is important to note that iVMS is not yet a requirement for all boats and therefore these data are not available for all vessels who have indicated that they fish within Coquet to St Mary's MCZ. Of the data analysed three vessels have iVMS data showing trawling activity in the MCZ.
- NIFCA permit returns and Coquet to St Mary's MCZ exemption returns.

It was not possible to use VMS data for the purpose of this assessment as information is only available for vessels over 12m, any activity within the MCZ will be carried out by vessels under 12 m (NIFCA Byelaw 1).

To trawl within the NIFCA district, fishers must have a valid permit. In 2022, 46 vessels had a permit to trawl in the NIFCA district. To trawl within Coquet to St Mary's MCZ, fishers must also obtain an 'exemption' from Northumberland IFCA. Of the 46 vessels who held a trawl permit in 2022, 22 also held an exemption to trawl in Coquet to St Mary's MCZ. Out of those 22, 7 submitted returns to say that they had fished within the MCZ. In 2021, NIFCA changed the permit requirements to include the need for a permit if trawling in the entire NIFCA district (0-6 nm area). Prior to this change, a permit was only required for those trawling in the 0-3nm area of the NIFCA district. This may account for the increase in permit holders from 2020 to 2022 (Table 11).

Table 11 The number of vessels with a NIFCA Byelaw 1 Trawling permit from 2016-2022 and the number of permit holders with an exemption to fish in Coquet to St Mary's MCZ (this requirement was introduced in 2021, no data exists pre-2021).

Year	Number of permit holders	Number of exemption holders
2016	34	-
2017	32	-
2018	25	-
2019	34	-
2020	38	-
2021	43	11
2022	46	22

The majority of permit holders do not fish within Coquet to St Mary's MCZ as the main trawl grounds within the 0-3 nm area were removed from the MCZ before designation during the stakeholder consultation process (Net Gain, 2013) (Figure 3). Within the boundary of the MCZ, the majority of trawling activity within the site occurs on the mud feature in the north east of the site around Coquet Island targeting prawns. Vessels tow in specific areas in order to avoid known obstacles on the seabed such as rock, boulders, wrecks and static fishing gear. As such, tows are not conducted over all of the subtidal mud area but follow distinct tracks (Figure 4).

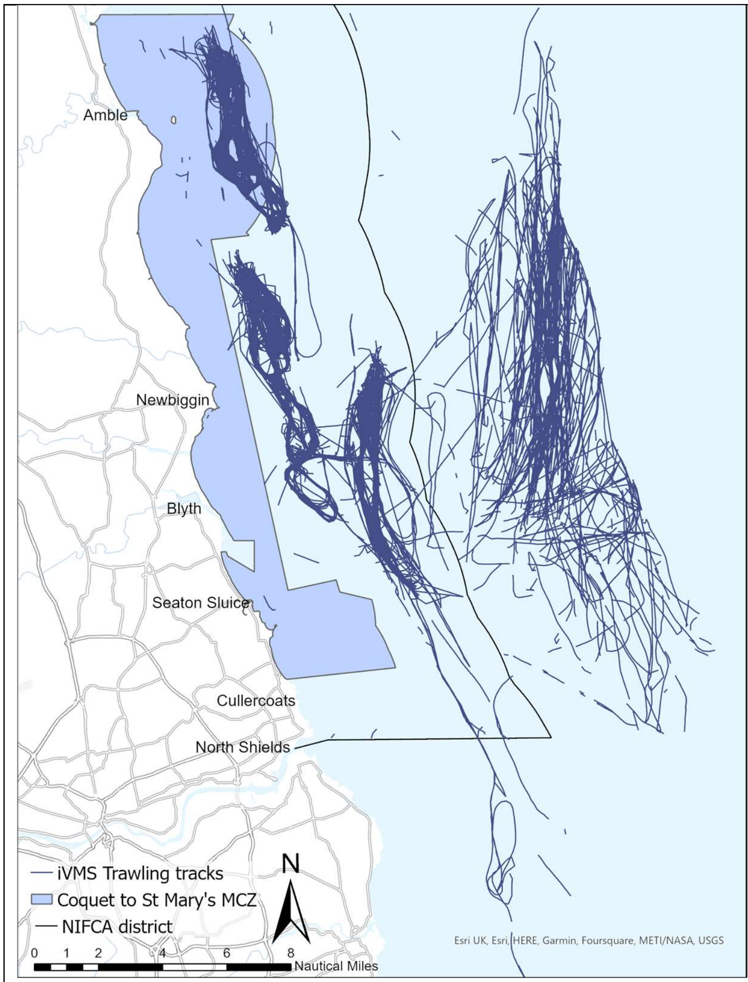


Figure 3. iVMS tracks of fishing activity from the six vessels identified as trawling within the MCZ from trawling permit returns (March 2022- Feb 2023).

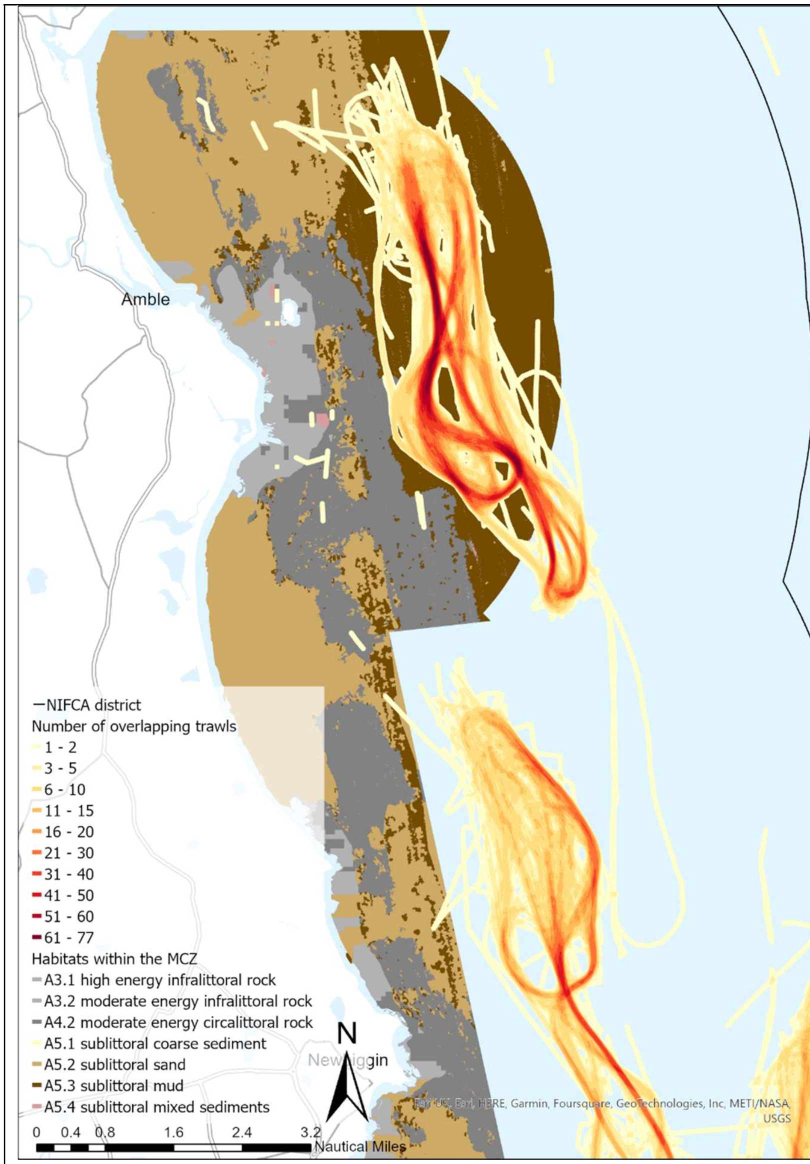


Figure 4. Overall footprint of six vessels trawling with number of overlapping trawls showing distinct tracks, from iVMS data. Habitat types within Coquet to St Mary's MCZ are shown.

A condition of holding an exemption to fish in Coquet to St Mary's MCZ is that fishers must fill in monthly catch returns forms detailing the number of days they have fished inside the MCZ, the average number of tows per day that fall within the MCZ, and the number of hours fished each day inside the MCZ. For this assessment, returns from 2022 only have been used as this is the first full year for which data is available.

Twenty-two vessels held an exemption to fish in 2022, although only seven indicated some fishing activity within the MCZ (through NIFCA trawl returns) out of which four vessels submitted monthly catch returns reporting trawling activity in the site (Table 12). It is mandatory to fill in a monthly trawl return if you have a NIFCA trawl permit, within which there is a box to tick if you have fished within the MCZ however it is not mandatory to supply this information through this return. It is mandatory to fill in an exemption return if you have an exemption to fish within the MCZ. If you have an exemption but have not fished in the site you are still required to submit a nil return. Therefore, the exemption returns are a more reliable source of information than the standard trawl return information and have been used for analysis in this assessment.

The combined number of days the four vessels reported fishing within the MCZ totalled 166 days, with an average of 41.5 days per vessel.

iVMS evidence

The addition of iVMS data through 2022 and 2023 adds detail to the information provided through permit returns and can be used to corroborate this evidence. Of the seven vessels potentially fishing within the MCZ (from NIFCA Trawl permit returns), two vessels had iVMS for the full year (one of which was the main vessel fishing within the MCZ), four had iVMS since June 2022 and all vessels have data available since October 2022. One full year was analysed from March 2022 to February 2023 for all available iVMS data for the seven vessels, so the estimates from iVMS of fishing trips and hours are likely slightly underestimated and cannot be compared directly with permit returns data (Table 12). Other trawling vessels were also checked, through available iVMS data, to ensure no trawling occurred inside the MCZ which was not reported in permit returns.

Tracks of fishing activity were obtained from iVMS data (see Appendix 2 for methods). iVMS identified 111 fishing trips within the MCZ, with an average of 20.6 days per vessel per year within the MCZ. Only three vessels were identified as actively fishing within the MCZ from iVMS data, accounting for 81%, 47% and 3% of their total effort, respectively. The cumulative area ground trawled within the MCZ was 273km^2, including overlapping trawls (Figure 4), while the overall footprint was 22.8km^2 or 11.7% of the total area of the MCZ.

Table 12. Fishing activity within the MCZ, from permit returns and iVMS evidence from seven vessels. Permit returns were for the full year in 2022, while iVMS data was from March 2022 - February 2023 using all available data in that time.

	Fishing activity (permit returns)	**Fishing activity (iVMS)**
No. of vessels fishing in MCZ	7 (Trawl permit returns) 4 (Exemption returns)	3
Cumulative no. of fishing trips	166	111
Average no. of tows per day	3	-
Cumulative number of hours fished per year	1069	835
Hours per month (average)	89	-

3.3.4 Bottom-towed gear extent on subtidal soft sediment features

Light otter trawling within the MCZ takes place predominantly on subtidal mud in the northern section of the site near Coquet Island (Figure 3). Trawling within the site targets muddy habitat where the target species, *Nephrops*, burrow. 44.25% of subtidal mud is trawled at least once within the year, based on iVMS evidence, while the amount of trawling on other soft sediment features is negligible (Table 13). For subtidal mud, the cumulative area of ground trawled is 267.9km^2 compared to the actual footprint of 20.5km^2. Most of the trawls occur in set patterns so some areas are heavily impacted while others are only trawled once or twice per year.

Table 13. Coquet to St Mary's subtidal soft sediment feature attributes with estimates of trawling activity over each habitat taken from iVMS data from February 2022-March 2023 showing cumulative area of ground trawled over each habitat by overlapping trawls, overall trawling footprint, and percentage of each habitat which is impacted within the MCZ by total gear width, sweeps (70% of gear width) and trawl doors (2.6%). Available iVMS data was used from March 2022- February 2023 for the seven vessels identified as potentially trawling within the MCZ from the permit returns data (see Appendix 2 for methods).

Eunis habitat classification	Total habitat area within MCZ (km^2)	Cumulative area of overlapping trawls (km^2)	Trawling footprint (km^2)	% of habitat impacted by all gear components*	% of habitat impacted by sweeps	% of habitat impacted by trawl doors
Sublittoral coarse sediment	0.0862	0.107	0.007	8.35% (6.94%)	5.84%	0.22%
Sublittoral sand	64.168	2.000	1.298	2.02% (0.47%)	1.42%	0.05%
Sublittoral mud	46.416	267.922	20.539	44.25% (37.04%)	30.97%	1.15%
Sublittoral mixed sediments	0.370	0.126	0.014	3.81% (2.98%)	2.67%	0.10%
Total MCZ	**195.47**	**273.02**	**22.841**	**11.69% (9.16%)**	**8.18%**	**0.30%**

*Percentages in brackets are percentage of habitat impacted by more than one overlapping trawl, to reduce the false detections of trawling from iVMS data.

Trawling using otter trawl gear has been found to have limited impacts to sandy, coarse and mixed sediment habitats, which are less physically stable than subtidal mud (Kaiser, 2006) (Collie, 2000), more resistant to impacts and quicker to recover through wave action (Krost et al., 1990).

Therefore, NIFCA concludes with moderate-high confidence that light otter trawling on sublittoral coarse sediment, sublittoral mixed sediment and sublittoral sand will not hinder the achievement of the conservation objectives stated for this site.

Sections 3.4, 3.5 and 3.6 will therefore focus on assessing impacts to the subtidal mud feature.

A study took place between 2018 and 2020 to assess the impacts of trawling on benthic communities in inshore waters of the northeast coast of England and to compare the responses of various monitoring techniques to trawl disturbance (Tinlin-McKenzie, 2020). The study mapped trawling pressure using NIFCA sightings data to generate four pressure categories: none, low, moderate, and high. Grab surveys were carried out in each of the pressure categories with the contents analysed for macrofaunal abundance, biomass, taxonomic richness, and diversity; and, meiofaunal taxonomic richness, family richness, and family diversity. Sediment Profile Imagery (SPI) was taken to look at Benthic Habitat Quality and the Organism Sediment Index. Results of this study are discussed in relation to the assessment of the pressures in section 3.4 and 3.5.

3.4 [Pressure 1] Abrasion/disturbance of seabed surface substrate and Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion

All gear types

Abrasion and disturbance is generally related to the direct and physical effects of bottom towed fishing gear. Such effects include the scraping and ploughing of the substrate, scouring and flattening of the seabed, sediment resuspension and changes in the vertical redistribution of sediment layers (Roberts *et al*. 2010). The impacts of abrasion and disturbance depends on a number of factors including substrate type (Kaiser *et al*., 2002), design and weight of the gear (Boulcott & Howell, 2011), and the sensitivity and resilience of the benthic community (Currie and Parry, 1996; Collie *et al*., 2000; Boulcott *et al*., 2014).

Penetration into sediment by towed demersal gear can alter sedimentary characteristics and structure in subtidal sand and muddy sand habitats (Jones, 1992; Gubbay & Knapman, 1999; Ball *et al*. 2000; Roberts *et al*. 2010). Sediment structure may change through the resuspension of sediment, nutrients and contaminants and relocation of stones and boulders (ICES, 1992; Gubbay & Knapman, 1999). Trawling can increase the fraction of fine sediment on superficial layers of the seabed (Queirós *et al*. 2006). As fine material is suspended, it can be washed away from the surface layers (Gubbay & Knapman, 1999). Trimmer *et al*. (2005) reported significant correlations between fishing intensity and sediment silt content (Queirós *et al*. 2006).

Otter trawls

Trawling has been found to have little impact on sediment grain size both in a sheltered muddy sea loch (Tuck et al, 1998) and an area of sandy habitat on the Grand Banks in Newfoundland (Schwinghamer et al., 1998). Lindholm et al. (2013) compared changes to the attributes of the seabed in Estero Bay, California. They analysed any changes in grain size from experimental otter trawling (using a 33 foot small footrope trawl net) over coarse silt/fine sand at a depth of 160-170 m. Grain size did not differ between post- and pre-trawl samples, however there was a slight increase in the silt content and a 2% decrease fine sand. The study found that there was no quantifiable sedimentary difference between trawled and non-trawled areas. However, Nilsson and Rosenberg (2003) used Sediment Profile Images (SPIs) to estimate the physical impacts of experimental trawling in muddy sediments. This study used a shrimp otter trawl with a head rope length of 10 m, otter boards measuring 90 x 140 cm and weighing 125 kg each and ground rope of 14 m, with 20 kg of lead weight distributed across its length in the Gullmarfjord (Nilsson & Rosenberg, 2003). A crude estimate of the scale of disturbance was made from the images, with an estimated depth of the trawl tracks at approximately 10 cm, and width between 30 and 60 cm. Forty-three percent of the images in trawl area had signs of physical disturbance (Nilsson & Rosenberg, 2003).

Otter trawl fishing gear has contact with the seabed through the ground gear (ground rope, chains and bobbins), sweeps, doors and any chaffing mats or parts of the net bag (Jones, 1992; Figure 5). The gear used to make up otter trawls can vary in size and weight, and therefore in their impacts on the seabed. The depth of furrows depends on the weight of the board, the angle of attack, towing speed, and the nature of the substrate, being greatest in soft mud (Jones, 1992; Løkkeborg, 2005). The passage of the doors also creates sediment mounds known as berms (Gilkinson *et al*. 1998; Johnson *et al*. 2002). Otter doors have been found to have the greatest impact creating furrows that can be 0.2-2m wide and up to 30 cm deep in mud (Jones, 1992; Thrush & Dayton, 2002; Lucchetti & Sala, 2012) though a typical *Nephrops* trawl door penetrates 7.43cm in mud (Eigaard et al., 2016). Marks on the seabed caused by other parts of the gear are faint when compared with those caused by trawl doors on mud (Løkkeborg *et al*. 2005).

Though they have the deepest seabed penetration, trawl doors have the smallest width of contact, only 2.6% of the total gear width for *Nephrops* otter trawls (Eigaard et al., 2016). The overall fishing footprint of the doors is 1.15% of subtidal mud habitat within the MCZ (Table 13). Ground gear typically covers 29% of the width while sweeps cover the majority, around 70% of total gear width (Eigaard et al., 2016). The footprint from sweeps covered 30% of the subtidal mud feature in the site (Table 13). Ground gear and sweeps do not penetrate as deeply (0.41cm and 2.59cm respectively in mud), though cover a much greater area than doors. The light ground gear specified in the NIFCA Trawl byelaw is likely to have even less of an impact, with the ‘cookies’ used by the main vessel fishing in the MCZ ranked in Eigaard et al (2016) as only having ‘subsurface’ impacts (<2cm penetration).

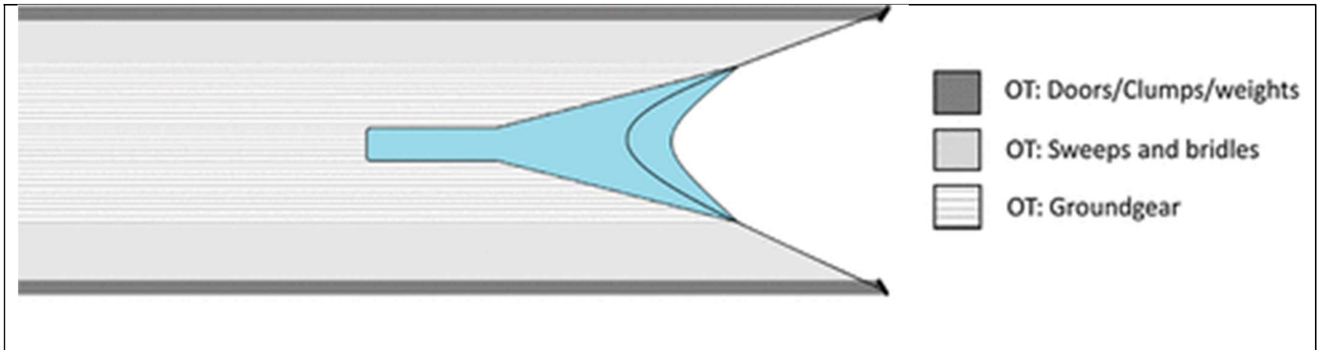


Figure 5. Gear footprint of different gear components for a single otter trawl (from Eigaard et al., 2016).

The recovery of subtidal habitats from disturbance caused by trawling varies based on sediment type, trawling intensity, and current and wave action. Humborstad et al., (2004) showed that highly intensive trawling over a sandy/gravel bottom caused a decrease in sediment hardness with an increase in surface roughness, whereas moderate trawling did not cause such changes in the property of the sediment. Therefore, the intensity of trawling activity also has an effect on the bottom topography. Comparisons of areas of heavy and lighter activity show that, while trawling activity creates furrows which increases surface roughness, trawling activity over a prolonged period can lower surface roughness by smoothing any structures created through natural causes (Kaiser et al., 2002). It is unknown whether the initial man-made features, such as tracks and trenches, compensate for any smoothing caused by the gear (Johnson, 2002). Heavily trawled areas have more exposed sediment and shell fragments with fewer mounds and flocculent organic matter than lightly trawled areas (Engel and Kvitek, 1998). Rate of recovery appears to be most rapid in habitats which are less physically stable, however more intensely fished habitats (even those fished in excess of three times per year) are likely to be in a permanently altered state (Collie, et al., 2000). Subtidal mud is a relatively stable habitat and so recovery rates are likely to be slower that sandy or coarse habitats.

Persistence of marks depends on current and wave action; in high energy environments recovery can occur within days, in lower energy environments recovery could take months or years (Lokkeborg, 2005). Humborstad et al., (2004) attributed no change to sediment post trawling, under moderate trawling intensity, to the survey area being exposed to strong currents. In a sheltered Scottish sea loch, with little current or tidal movement, disturbance from trawl gear was documented for up to 18 months (Tuck, et al., 1998). Much of Coquet to St Mary’s MCZ is exposed to moderate-high energy conditions and strong tidal streams suggesting habitats and communities are more robust and less sensitive to external pressures. Recovery time is likely to be shorter than in a sheltered loch environment, however this is unknown.

Local research into the impacts of trawling pressure on habitat quality was assessed using SPI methods across a trawling pressure gradient (Tinlin McKenzie, 2020). They found that Benthic Habitat Quality scores significantly reduced with increased trawling pressure, but with a high threshold for changes with the drop in scores occurring only in the highest-pressure category. However, scores were variable between sites and the sediment characteristics have been found to be a key factor in differences in BHQ scores. Penetration was greater in trawled sites suggesting that contact of gear with the sediment may have broken up the surface layers, or the presence of a finer top layer from the settlement post-resuspension.

Otter boards cause the greatest abrasion / penetration disturbance, however they cover the smallest area (Table 13). Though they penetrate less deeply, the sweeps will cause abrasion pressure over a greater area.

The intensity of fishing pressure on the mud habitat within the site suggests that in highly trawled areas NIFCA cannot conclude no significant impacts from light otter trawling, although the extent of abrasion and disturbance pressure is unknown. Although the site is in a highly dynamic area, the nature of mud habitat means it is likely to be relatively stable and therefore while recovery may be faster than in more sheltered areas where some studies occurred, e.g. sea lochs, impacts from this gear pressure may persist but this is unknown.

There are promising developments in gear development, which would mean otter trawl doors and sweeps were lifted off the seabed entirely, which would effectively eliminate this pressure. NIFCA are investigating the potential of gear trials in this area.

3.5 [Pressure 2] Removal of non-target species and Removal of Target Species

Removal of non-target species

Trawling activity has many impacts on the marine environment and is well known to modify community structures (Jennings et al., 2001). Benthic communities can be affected directly through physical damage from contact with a trawl (Bergman and van Santbrink, 2000; Johnson, 2002) or indirectly through exposure or burial, which can provide food for predatory species (Ramsay et al., 1998). The recovery and ability to adapt is dependent on life history, habitat type, physical characteristics and amount of natural disturbance (Coen, 1995; Kaiser, 1998; Auster and Langton, 1999).

Many examples of impacts of otter trawling on soft subtidal sediment exist in scientific literature through multiple studies in different areas of the world. This literature has been reviewed to inform this assessment. However, impacts will be different based on site specific variables such as hydrodynamics, sediment characteristics, biotic factors (Kaiser, 2006), and target and non-target species. A local study was carried out from 2018-2020, which took an ecosystem-based approach to assess macrofauna, meiofauna, and sediment characteristics for muddy sediment across a trawling pressure gradient (Tinlin-McKenzie, 2020). While results from other studies are useful for context; the local study provides information relevant to Coquet to St Mary's MCZ.

Vulnerability of organisms to fishing activity depends on its physical characteristics (hard or soft bodied), its mobility (mobile or sessile) and its habitat (infaunal or epifaunal) (Mercaldo-Allen and Goldberg, 2011). Larger bodied, slow moving, fragile organisms are most vulnerable (Kaiser and Spencer, 1996). The effects of trawling can have different impacts upon organisms with different methods of feeding; otter trawling had the greatest impact on suspension feeders in mud and sand habitats (Kaiser et al., 2006). Some organisms, such as suspension feeding bivalves, are heavily impacted by burial that is associated with trawling activity and are unable to escape burial of more than 5 cm (Tuck et al., 1998). Bivalves buried in the scour path were displaced to berms with 58-70% of displaced individuals exposed on the surface. However, only 5% showed physical damage to shells. Some burrowing species of sedentary bivalves may not be affected by trawl doors as they bury in sediment to depths greater than the penetration depth of the trawl doors (Bergman and van Santbrink, 2000). Opportunistic feeders such as oligochaetes and nematodes were seen to increase year-on-year in highly trawled areas (see Kaiser et al., 2006).

In local research, macrofaunal abundance and biomass were not affected by trawling pressure (Tinlin-McKenzie, 2020), despite being a common pattern in other studies (Hiddink, 2006a; Hinz, 2009). Many of the studies describing impacts are experimental where samples are collected shortly after a trawling event when initial mortality events are most evident. Results here could indicate that sites have begun to recover. Experimental trawling, with a commercial otter trawl (dimensions unknown), over a muddy substrate at a depth of 30 to 40 m off the Catalan coast in Spain reported a similar percentage abundance of most major taxa between fished (polychaetes, 51.5%; crustaceans, 10.9%; molluscs, 34.7%; other taxa, 2.9%) and unfished (polychaetes, 48.9%; crustaceans, 11.3%; molluscs, 36.1%; other taxa, 3.7%) sites (Sanchez *et al*., 2000). Analysis of species richness and diversity indicated that the infaunal community did not alter during the first 102 hours following a single sweep. The number of individuals and taxa were significantly greater after 150 hours in an area subject to a single sweep, although no effect was detected after 72 hours in an area subject to a double sweep.

In a meta-analysis of experimental fishing impact studies, conducted by Kaiser *et al*. (2006), the mean initial response of deposit and suspension feeding fauna to trawl disturbance (up to 7 days afterwards) was analysed in gravel, sand and muddy habitats. Otter trawling generally had the least negative impact on functional groups of biota, when compared to beam trawling and scallop dredging. Otter trawls produced a significant, negative, short-term effect on muddy habitats, but interestingly there was also a longer-term positive effect on the response variables (either individual taxa abundance, number of individuals or total number of species reported) (Kaiser et al., 2006).

Conversely, other studies have suggested that the initial impacts of otter-trawl gear on muddy habitats are relatively modest, however cumulative long-term disturbance can lead to significant changes in benthic communities (Hinz *et al*., 2009). Hinz *et al*. (2009) investigated the biological consequences of long-term chronic disturbance caused by the otter trawl *Nephrops norvegicus* (Norway lobster) fishery along a gradient of fishing intensity over a muddy fishing ground in the northeastern Irish Sea. Trawling intensity and its spatial distribution was estimated using overflight data and log book records of hours spent fishing. The study reported reductions in infaunal abundance of 72% from the lowest trawling effort recorded (1.3 times trawled/year) to the highest (18.2 times trawled/year). Over the same range of trawl intensities, infaunal biomass was reduced by 77% and species richness decreased by 40%, whilst epifaunal abundance was reduced by 81% and epifaunal species richness decreased by 18%.

Hiddink *et al*. (2006a) conducted an assessment of large-scale impacts of a bottom trawl fishery on benthic production, biomass and species richness in the North Sea. Model development allowed for the effects of habitat parameters on the dynamics of benthic communities and to predict the effects of trawling on species richness. Data used to validate the model was collected from 33 sampling stations in four areas of soft sediment in the North Sea subject to different levels of trawling intensity. The model predicted that benthic community biomass was reduced by 56% and production by 21%. However, this model excluded areas within 12nm of the shore, where this MCZ is located, due to the current inconsistency of VMS data from these areas.

Shifts in benthic community structures have been observed from a community dominated by higher biomass species to one dominated by more species of lower biomass (Collie et al., 2000). Sixteen months after trawling activity there was a significant difference in infaunal species richness where polychaetes increased but bivalves decreased (Tuck et al., 1998). Life history stages play a large role in the ability of a species to adapt to changes in sediment and turbidity. Shorter life history stages with high levels of recruitment are able to repopulate an area post disturbance (Churchill, 1989; Schratzberger et al., 2002). Levin (1984) described the rapid recolonization of polychaetes with shorter larval stages and post-larval movements. They exhibited small scale dispersal to disturbed patches of trawling ground, and colonised, resulting in high densities of infauna. Prolonged trawling has reduced the abundance of fragile large-bodied organisms and increased the abundance of opportunists (Ball et al., 2000). More fragile and slow recruiting animals are the most sensitive to trawling disturbance, with fast growing species with good recruitment the least susceptible (MacDonald et al., 1996). This resulted in an increase in small polychaetes but created stable communities with fewer species. These effects were recorded in an area where fishing was restricted for parts of the year (Ball et al., 2000). This follows the predicted change of anthropogenically disturbed communities towards r-strategists (such as polychaetes) and away from k-strategists (such as molluscs) (Jones, 1992).

Similar to the differing conclusion in studies into the impacts of otter trawling on subtidal mud targeting *Nephrops*, the impacts of trawling activity on epifauna in wider literature are mixed, with no long term effects having been reported in the North Sea (Jennings et al., 2001), in Scottish sea lochs (Tuck et al., 1998) or in Hong Kong harbours (Thrush and Dayton, 2002). Scavenging organisms have been recorded feeding in a recently fished area. Ramsay et al. (1998) found the density of hermit crabs increased significantly in a recently fished area with no change in a non-fished control area. Diver observations also recorded starfish *Asterias rubens*, hermit crab *Pagurus bernhardus* brittle stars *Ophiura ophiura* and whelks *Buccinum undatum* feeding on damaged organisms in trawl paths. In other areas surveyed, the number of scavenging organisms decreased. Therefore, the response of species to fishing activity varies between communities.

Direct damage to biota from trawl gear had been recorded a number of times with larger individuals showing higher direct mortality than smaller individuals (Lindeboom and de Groot, 1998; Bergman and van Santbrink, 2000). Kenchington et al. (2001) simulated trawling disturbance in a test tank to understand biological damage caused to bivalves buried in and around an otter trawl path. A full-scale trawl door model was used to perform a scour test in a simulated environment designed to represent the sea bed found in the Grand Banks, Newfoundland. Bergman and van Santbrink (2000) assessed damage caused by a single passage of commercial beam and otter trawls on macrofauna and megafauna. In macrofauna (including gastropods, starfish and small crustacea) mortality occurred in 5-40% of initial densities. This increased to 20-65% for bivalves. This mortality was attributed to direct damage from contact with the trawl gear. They found the heavy (by NIFCA definition) otter trawl and a 4m beam trawl fisheries caused similar annual mortalities.

In a *Nephrops* fishery in the Clyde Sea, a large amount of invertebrate discards are produced. Bergmann and Moore (2001) assessed the post trawling mortality of echinoderms, looking at injury from fishing activity and exposure on deck. Mortality was 0-31% with injured individuals having a long-term mortality of 22-96%. Common bycatch species in demersal trawl fisheries include demersal fish and invertebrates.

The conclusion of much of the research into the impacts of otter trawling on mud on associated communities (both target and non-target species) is mixed, although many experimental trawling impacts studies describe shifts in benthic communities. The local study investigating the impact of this interaction concluded that significant impacts of trawling pressure were observed on macrofauna and meiofauna richness, diversity and community composition. However, high intensity fishing sites still maintained abundant benthic communities and so it is unclear whether the fishery currently effects site condition or breaches the conservation objectives in MPAs (Tinlin-McKenzie, 2020).

In light of the uncertainty around the impacts of otter trawling at this site, NIFCA have used the Benthic Impacts Tool (BIT). The BIT is a decision support tool developed by Bangor University in collaboration with the JNCC (Hiddink et al., 2017) and aims to aid in quantifying the impact of bottom towed fishing activity on sedimentary habitats, in terms of depletion of the benthic community (i.e. removal of both target and non-target species). The tool quantifies both depletion and recovery and therefore provides a better indication that just depletion rates. More information on tool inputs and outputs are in Appendix 3.

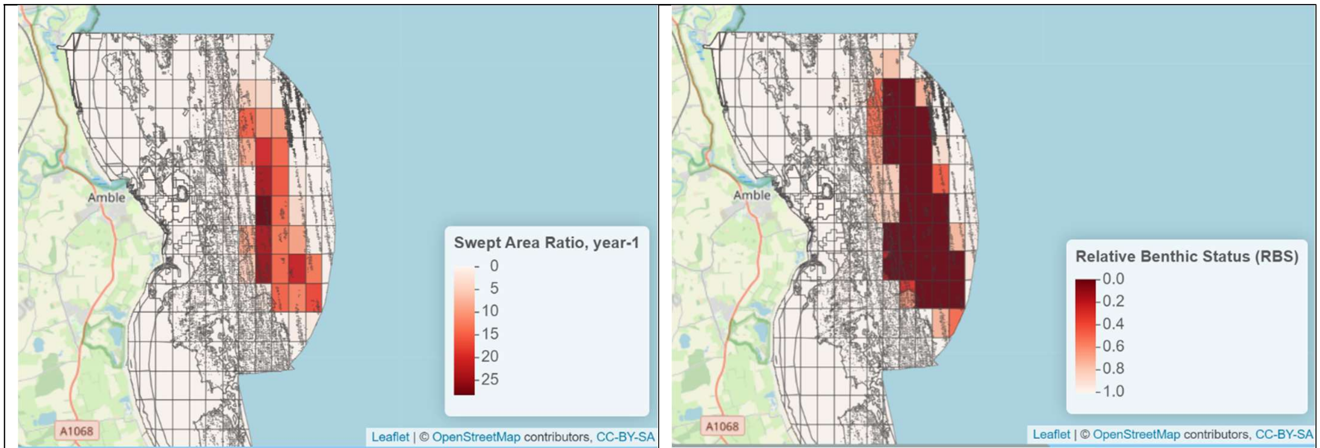
Otter trawling has a general depletion rate of 6% i.e. 6% of the biota is removed per pass. However, there are differences in depletion rates with different habitats, subtidal mud has a higher depletion rate (10% per pass) as gear penetrates deeper, assuming an average penetration depth of 2.08cm from all otter trawl gear components (Stzostek at al., 2022). Assuming no recovery, the tool quantifies the proportion of the benthic community remaining after an increasing number of trawl passes (Table 14). This shows that approximately half (44.25%) of the mud habitat within the site has experience less than one trawl, with a decreasing proportion of the mud habitat experiencing increasing trawl pressure. Table 14 suggests that even at a relatively low number of trawl passes (>7 passes) approximately half of the benthic community will be removed. However, only 22.1% of the mud habitat within the site was trawled more than 7 times in the year.

Table 14 Proportion of benthic community remaining after increasing number of trawling passes (assuming no recovery), and proportion of subtidal mud feature impacted.

	>1 trawl	>3 trawls	>7 trawls	>13 trawls	>21 trawls	>28 trawls	>43 trawls
Proportion of benthic community remaining	0.9	0.73	0.48	0.25	0.10	0.05	0.01
Proportion of subtidal mud impacted	44.25%	30.12%	22.10%	14.99%	9.49%	6.37%	2.25%

Fishing effort data from iVMS and a habitat map of Coquet to St Mary's MCZ were input into the tool and aggregated to a 0.1 decimal degree resolution. The tool calculated Swept Area Ratio, the number of times an area is swept by fishing gear per year (e.g. 0.5 means on average half the cell is swept once per year) showing the highest impacted cell area was swept 25 times per year (Figure 6a). The tool calculated Relative Benthic Status (RBS) which indicates what proportion of the benthos has been removed by trawling, where a value of 1 means there has been no depletion and a value of 0 means a grid cell has been totally depleted. Figure 6b shows a high proportion of the area trawled has RBS values of 0 and is therefore highly depleted. It should be noted that since the data is aggregated to a grid, and trawling tends to follow very specific patterns (Figure 4), not all the areas within each grid cell will be highly impacted.

The average RBS of mud habitats in the MCZ was 0.55, with roughly the same proportion of the habitat highly impacted as not impacted (Appendix 3 Figure 6b). All other habitats ranged from RBS values of 0.9-1 (virtually unimpacted).



a **b**

Figure 6. Benthic Impacts Tool outputs for trawling activity within Coquet to St Mary's MCZ. a) Swept Area Ratio of fishing gear per year; b) Relative Benthic Status of the benthic environment.

Although difficult to assign impact from otter trawling pressure to the subtidal mud feature in Coquet to St Mary's MCZ from the results of scientific studies alone, the BIT suggests that approximately half of the mud feature in the site is in a highly depleted state. **Therefore, NIFCA cannot conclude that the impact of light otter trawling on non-target species will not hinder the achievement of the conservation objectives for the subtidal mud feature of this site.**

Removal of target species

The main target species for this fishery is *Nephrops*, they live in burrows in muddy habitat and so this habitat is the focus of the fishery. The fishery occurs at time most effective for catching *Nephrops* which is at dawn or dusk when *Nephrops* are active and out of their burrows.

The fishery within Coquet to St Mary's MCZ is within the Farne Deeps functional unit and so is subject to the management measures for the Farne Deeps unit (MMO, 2021). This unit is also managed through a quota and Cefas carry out annual *Nephrops* burrow counts in the Farne Deeps functional unit. Although this survey does not cover the area of Coquet to St Mary's MCZ, it gives an indication of the overall health of the population in the Farne Deeps.

ICES provided advice on the Farne Deeps fishery (Functional Unit 6) in October 2023 alongside explanatory information (ICES,2023). This report identifies that the Farne Deeps stock size is above the MSY $B_{trigger}$. This means the biomass/ stock size is above the level which triggers measures to maintain/rebuild the stock to MSY (Maximum Sustainable Yield). However, the fishing pressure on the stock is above that which would give Maximum Sustainable Yield. ICES suggest that management measures should be in smaller functional units (i.e at the Farnes Deep level) rather than the larger ICES sub-area at which catch limits are set, as this contains multiple functional units. As mentioned above the MMO introduced management measures for the Farnes Deep (FU6) specifically in 2016 and ICES considers the MMO management plan for the Farnes Deep to be precautionary (ICES, 2023).

As described in section 3.3.3, the fishery in the NIFCA district is managed through a permit, which has a condition that permit holders must supply information on their catch and the number of days fished monthly. This can be used to monitor catch and effort levels in the district. For vessels fishing in Coquet to St Mary's MCZ, a proxy for landings per unit effort was developed from the information in the permit returns (Figure 7), with the quantity of prawns landed divided by the number of days fished per month. This has fluctuated between 2020 and 2022 (years data available). The decrease in 2020 could be explained by changes in fishing practices, as due to Covid-19 the market for *Nephrops* closed. Fishers changed the way they sold catch, with *Nephrops* caught to order for local door-to-door sales. This meant fewer *Nephrops* were required, and so more selective fishing practices were employed (Local fishermen, pers. comms, 2023). As markets reopened, LPUE increased (Figure 7A). This suggests the fishing pressure inshore is not depleting the inshore *Nephrops* to the point where catches are decreasing. However, this inference is made with only three years of data, a longer time-series of data is required to have more confidence in this conclusion.

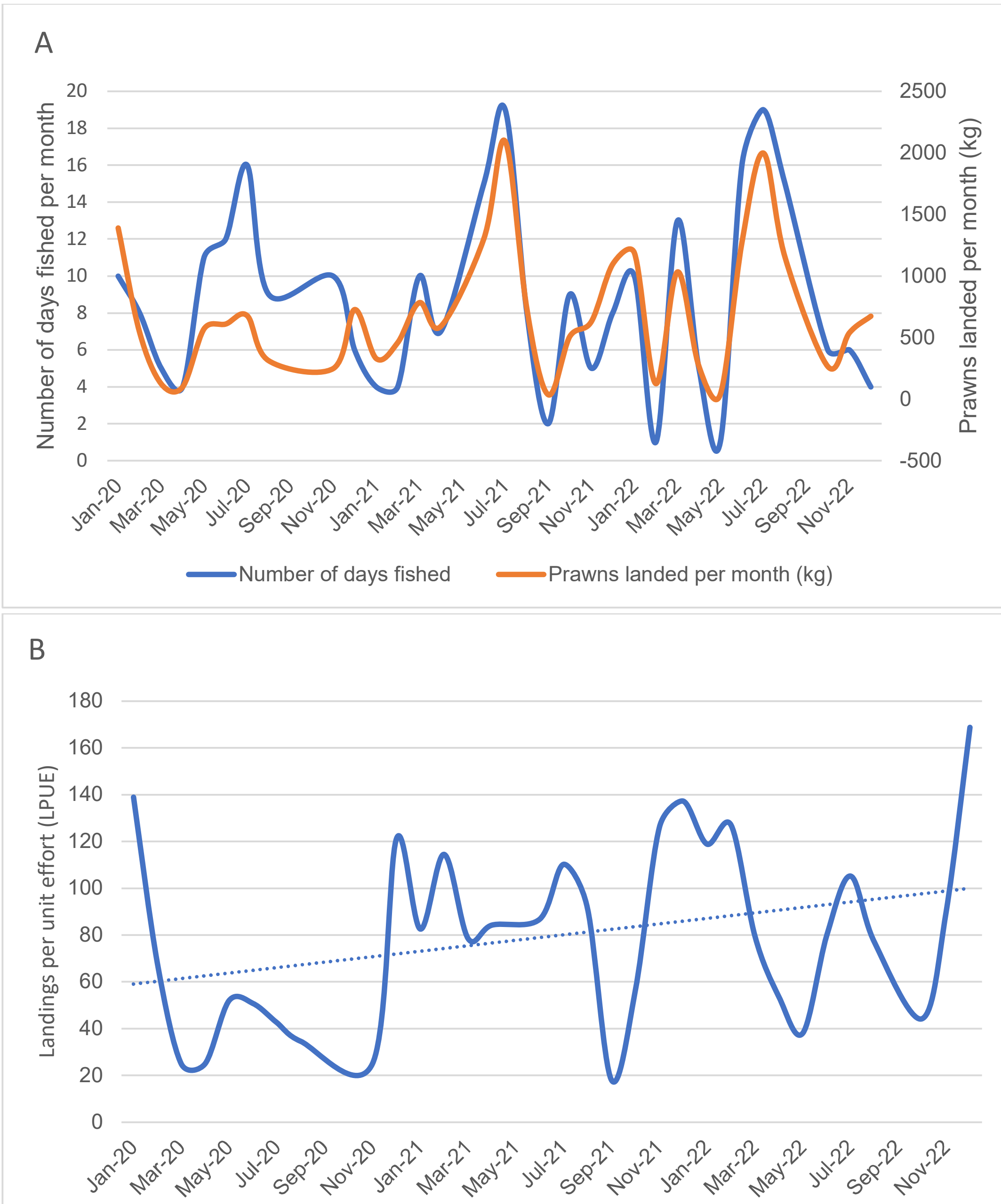


Figure 7 A The average number of days fished and the landings of Nephrops (kg) B Quantity of Nephrops (kg) landed per days fished from 2020-2022, both taken from NIFCA permit returns for vessels fishing within Coquet to St Mary's MCZ.

Due to the management measures implemented by the MMO, annual monitoring of the catch data by ICES and estimated LPUE from NIFCA permit returns (2020-22) NIFCA conclude with moderate confidence that the impact of light otter trawling on target species will not hinder the conservation objectives of the subtidal mud feature in CSM MCZ.

3.6 [Pressure 3] Smothering and siltation changes (Light) and Changes in suspended solids (water quality).

Towed gears will generate a plume of suspended sediment as the gear is pulled across the seabed. The amount of material brought into suspension is dependent on the gear being used and the makeup of the seabed (O'Neill and Summerbell, 2011). Heavy components of the gear, such as the doors of an otter trawl will penetrate in the seabed and create a furrow by pushing aside the sediment and causing sediment to be entrained into the water column (Schwinghamer et al., 1996; Depestele et al., 2016; O'Neill and Ivanovic, 2016).

The effects of sediment resuspension from fishing activity are widespread and include burial of benthic organisms, reduction of light for photosynthesis, smothering of spawning areas, releasing contaminants, exposing anoxic layers and affects to the metabolism of organisms (Duplisea et al., 2001; Johnson, 2002). Sediment resuspension occurs from direct contact from fishing gear (Kaiser et al., 2002). Organisms that inhabit unconsolidated sediment should be adapted to periodic sediment resuspension and smothering (Kaiser et al., 2002). Responses of organisms in sandy habitats are usually less negative than in other habitats (Collie et al., 2000).

The type of gear affects the amount of sediment resuspension and hence the magnitude of the effects on biota. An otter trawl moves superficial sediment but causes little change to organic matter profiles (Mayer et al., 1991). Any movement of sediment can result in the burial of organic matter which can cause shifts in community food chains (Mayer et al., 1991). Quantity and length of resuspension depends on grain size and how compact sediment is on the seabed, as resuspension is higher in fine sand than coarse sand (Johnson, 2002).

Within sheltered areas, anthropogenic resuspension of sediment can be larger than natural mechanisms. Schoellhamer (1996) found that sediment in a shallow estuary was resuspended through fishing activity more frequently than disturbance through natural causes such as tidal currents. Churchill, 1989 found that coarse sand was penetrated to a shallower depth with an otter board than fine sand or mud. Resuspended sediment in Middle Atlantic Bight study site was found to come from inshore areas and moved due to storms causing resettlement further offshore. Only with the most intense fishing activity was sediment resuspension attributed to fishing activity in this area. In areas of currents and tides, resuspended sediment duration is short and effects of sediment redeposition are not permanent; conversely in areas with little water movement sediment resuspension by gear could persist for longer (Jones, 1992).

Bottom trawls will mobilise sediment in the wake of the gear (De Madron et al., 2005; Lucchetti and Sala, 2012). O'Neill and Summerbell (2011) quantified the amount of mobilised sediment in the wake of an otter trawl on different substrate types. They found that the amount of sedimentation depended on the hydrodynamic drag of the gear and substrate type. The greater the drag and the finer the sediment, the greater the amount of sand remobilised. The study shows that gear with rockhoppers creates more hydrodynamic drag and therefore produces around 4 times the amount of suspended sediment in muddy sand than that of gear with small rubber discs only (19.1 kg m^{-1} and 5.9 kg m^{-1}), respectively.

Szotek et al. (2017) developed a tool to quantify habitat impacts (including seabed penetration depth and benthic community depletion) for a range of bottom towed gears. Otter trawl gear (without rockhoppers) was found not to penetrate the seabed as deep as other gears, which reduced its hydrodynamic drag and therefore amount of sediment particles entrained into the water column (Szotek et al., 2017; O'Neill and Summerbell, 2011)., Szotek et al. (2017) found that penetration depth of otter trawl gear was lowest on subtidal mud, again reducing the hydrodynamic drag and the amount of sediment resuspension. Given the hydrodynamics of the area, there are high levels of natural redistribution of sediment in the inshore area off the Northeast England coast (Stephenson, 2016). The gear used in the site does not have rockhoppers attached, with relatively light gear used on the ground ropes, which based on the results of Szotek *et al* (2017) may result in less resuspension of sediment in comparison to heavier gear. However, there have been no local studies.

NIFCA concludes with low-moderate confidence that light otter trawling will not hinder the achievement of the conservation objectives for this site through smothering and siltation changes or changes in suspended solids.

3.7 Pressures conclusion

There may be a risk that bottom towed gear could hinder the conservation objectives of the site through abrasion and disturbance and removal of non-target species.

Table 15 Summary of pressures assessment

Pressure	Interest feature	Favourable condition target	Activity	Compatible with conservation objectives?	Confidence
Abrasion and disturbance And Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion	Subtidal coarse sediment And Subtidal mixed sediments And Subtidal sand.	Maintain the presence and spatial distribution of soft sediment communities.	Light otter trawl	Y	Moderate-High
		Maintain the total extent and spatial distribution of subtidal coarse sediment.		Y	
		Maintain OR Recover OR Restore the abundance of listed species*, to enable each of them to be a viable component of the habitat.		Y	
		Maintain the species composition of component communities.		Y	
Removal of non-target species And Removal of target species	Subtidal coarse sediment And Subtidal mixed sediments And Subtidal sand.	Maintain the presence and spatial distribution of soft sediment communities.	Light otter trawl	Y	Moderate-High
		Maintain OR Recover OR Restore the abundance of listed species*, to enable each of them to be a viable component of the habitat.		Y	
		Maintain the species composition of component communities.		Y	
Smothering and siltation changes (Light)	Subtidal coarse sediment	Maintain the presence and spatial distribution of soft sediment communities.	Light otter trawl	Y	Moderate

And Changes in suspended solids (water quality).	And Subtidal mixed sediments And Subtidal sand.	Maintain the species composition of component communities.		Y	
		Maintain the distribution of sediment composition types across the feature.		Y	
		Maintain water quality at mean winter dissolved inorganic nitrogen levels		Y	
		Maintain natural levels of turbidity		Y	
Abrasion and disturbance And Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion	Subtidal mud	Maintain the presence and spatial distribution of subtidal mud communities.	Light otter trawl	N	Low-Moderate
		Maintain the total extent and spatial distribution of subtidal mud		Y	
		Maintain OR Recover OR Restore the abundance of listed species*, to enable each of them to be a viable component of the habitat.		N	
		Maintain the species composition of component communities.		N	
Removal of non-target species	Subtidal mud	Maintain the presence and spatial distribution of subtidal mud communities.	Light otter trawl	N	Low-Moderate
		Maintain OR Recover OR Restore the abundance of listed species*, to enable each of them to be a viable component of the habitat.		N	
		Maintain the species composition of component communities.		N	
Removal of target species	Subtidal mud	Maintain the presence and spatial distribution of subtidal mud communities.	Light otter trawl	Y	Moderate
		Maintain OR Recover OR Restore the abundance of listed species*, to enable each of them to be a viable component of the habitat.		Y	
		Maintain the species composition of component communities.		Y	
Smothering and siltation changes (Light) And	Subtidal mud	Maintain the presence and spatial distribution of soft sediment communities.	Light otter trawl	Y	Low-Moderate
		Maintain the species composition of component communities.		Y	

Changes in suspended solids (water quality).		Maintain the distribution of sediment composition types across the feature.		Y	
		Maintain water quality at mean winter dissolved inorganic nitrogen levels		Y	
		Maintain natural levels of turbidity		Y	

3.8 Fisheries management measures

Risk to the site's conservation objectives from light otter trawling through abrasion and disturbance and the removal of non-target species cannot be ruled out. Therefore, NIFCA must introduce fisheries management measures such that activity occurs in line with the conservation objectives of the feature.

To do so, NIFCA have explored the following options:

1. **Do nothing**

Maintain the current management in the site as it is. This option would not address the conclusions of this assessment.

2. **Suite of measures introduced through permit conditions to the trawling byelaw**

- A cap on the number of permits issued.
- A cap on the number of hours fished per year.
- Spatial restrictions to protect areas where evidence shows more sensitive species and habitats are present.

This option takes an adaptive management approach to work with the fishing industry to support small scale inshore fishing while managing activity in the site in relation to NIFCAs duty towards MCZs.

3. **Prohibition of light otter trawling (and therefore all mobile gear in the site)**

This would completely remove bottom towed gear fishing from the site and the eliminate the otter trawling pressure on the mud feature in CSM MCZ.

NIFCA have a duty under the Marine and Coastal Access Act (2011) to ensure that the conservation objectives of MCZs are met and furthered. The mud feature has a maintain conservation objective, although this does not mean 'do nothing' therefore, we must consider option 2 or 3 for the management of light otter trawling over subtidal mud in the MCZ. Considering the uncertainty in the conclusions of this assessment, NIFCA can take a precautionary approach to prohibit light otter trawling within the site (Option 3) however, this may not be proportionate if NIFCA's duties in relation MCZs are being fulfilled under the adaptive management approach set out in option 2.

Under option 2, activity in the site will be restricted but will be permitted to continue under strict conditions therefore NIFCA will develop and implement a monitoring and control plan to closely monitor activity levels and extent within the site and further understand the impact of the activity in relation to the conservation objectives of the subtidal mud feature. It is important to note that there is limited information available on the condition of the feature when the site was designated and limited information on the current condition of the site which makes decisions on management and the development of a management plan in relation the furthering the conservation objectives difficult.

3.9 Part B conclusion (fishing alone)

The use of light otter gear on subtidal coarse sediment, subtidal mixed sediment, and subtidal sand will not hinder the conservation objectives of the features of the MCZ. NIFCA concludes that the fishing activities assessed on these habitats, alone, will not pose a significant risk to the conservation objectives of Coquet to St Mary's MCZ (moderate-high confidence).

The impacts of the use of light otter trawl gear on subtidal mud features in terms of abrasion and disturbance, penetration, and removal of non-target species is uncertain however NIFCA cannot rule out significant impacts due to the evidence that is available through local studies and use of the BIT. NIFCA will develop a management plan for further management in this site (option 2 in section 3.8). This is alongside a gear trial project to test the use of semi pelagic otter doors gear which keeps the doors and part of the sweeps off the ground during fishing to reduce any impacts of the gear on the seabed. The results of the gear trial will be fed into the management plan to understand whether restrictions on the level of trawling activity in the site, and lower impact gear are effective measures to manage the site in line with the conservation objectives.

The current Coquet to St Mary's trawling monitoring and control plan has been expanded to include a total number of hours fished per year to assist this assessment and management plan. This will ensure ongoing and timely assessment of the effectiveness of the proposed management measures which will feed into future management discussions.

4. In-combination Assessment

Potential risks of in-combination effects have been considered in Table 15 listing other fisheries, current and possible plans and projects and other activities within the site.

In summary, mobile gear within Coquet to St Mary's MCZ is not deemed to have a likely significant effect on intertidal rock features, subtidal rock features or subtidal sediment features in combination with other plans/projects.

Table 15. In-combination assessment of mobile gear with other plans and projects within and around Coquet to St Mary's MCZ, occurring on intertidal and subtidal habitats.

Fishing Activity			
Activity	**Description**	**Potential Pressure**	**Assessment**
Potting on subtidal rock and at lower levels on intertidal rock and subtidal sediment	Potting for European lobster (*Homarus gammarus)* and brown crab (*Cancer pagurus)* is the principle fishery within the NIFCA district. Most fishers in the district use parlour pots of various sizes and pots are typically worked in fleets of 10-40, dependant on the size of the vessel. Potting occurs predominantly in and around rocky habitat for lobster and brown crab, with some potting on subtidal mud for *Nephrops* and brown crab.	In 2023 NIFCA have issued 85 Commercial Shellfish Permits to fishers, compared to 93 in 2022, 108 in 2021 and 98 in 2020. The total number of pot hauls in Sectors 1-4 (corresponding with CSM MCZ) was 754,95 in 2022, compared to 961,778 in 2021 and 909,762 in 2020. Pots are limited to 800 per shellfish permit and the fishery is governed by multiple IFCA byelaws. In the NIFCA district recreational potting also occurs and numbers are monitored through a permit system. A permit allows fishers to use 5 pots, which must be fitted with escape gaps. In 2023 (so far) 268 recreational permits have been issued.	Trawling does not usually co-occur with potting activity in the MCZ. Mobile gear is targeted on subtidal muddy and sandy ground, where potting levels are very low. Potting is primarily targeted on and around rocky ground, with some activity on subtidal mud for *Nephrops* (Figure 8). In addition, potters avoid setting gear where mobile fishers operate, as gear loss is expensive. NIFCA does not consider that a significant interaction is likely to occur between these two activities, increasing pressure on the protected features of the MCZ (high confidence).
Fixed nets on subtidal ground	Fixed nets (gill nets and trammel nets) are anchored to the seabed, with a floating headline and used to target white fish (cod) and flatfish in the NIFCA District. These nets will be set on firmer ground, likely near wrecks for cod, but on sandy ground for flatfish. Only one vessel is though to set tangle nets, this is outside of CSM MCZ. Fixed netting is managed by the Fixed Engines Byelaw which NIFCA is currently looking to update.	Fixed nets are anchored on the seabed and have the potential to cause impacts to features through both 'abrasion' and the removal of target and non-target species. This activity occurs at a very low level across the NIFCA District and in the MCZ. NIFCA are currently aware of one vessel from Amble which very occasionally sets gill nets in the MCZ area. On NIFCA shellfish permit returns data only 4-5 vessels have reported setting nets in the District each year (2020-22).	Due to the very low levels of this activity NIFCA can say with high confidence that fixed netting activity 'in-combination' with mobile gear will not increase pressures on the protected features in CSM MCZ.

Hand work (access from land) in the intertidal	Hand work encompasses a wide variety of fishing methods, including; angling, periwinkle collection, hand gathering of mussels/bait, 'cleeking' and crab tiling. These activities occur across the NIFCA district and since 2016 NIFCA officers have been collecting information on shore-based activity two hours either side of low tide, including 'no activity'.	The main pressure from shore-based activities is the removal of target species. Any interaction with potting will be from the additional removal of shellfish by 'cleeking' for lobsters at low tide. Shellfish can be considered component species of the intertidal and sub-tidal rocky habitats protected in the MCZ.	Hand work from land does not spatially overlap with mobile fishing in CSM MCZ, nor are these activities targeting the same species. Therefore, NIFCA can conclude with high confidence that mobile fishing activity 'in-combination' with hand work from land will not increase pressures on the protected features in CSM MCZ.
Digging with forks in the intertidal	Digging with forks entails collecting worms from the intertidal at low tide, primarily lugworms and ragworms. This activity occurs in estuaries across the NIFCA district and since 2016 NIFCA officers have been collecting information on shore-based activity two hours either side of low tide.	Bait digging activity has a seasonal aspect and SPUE is highest from September-January. Digging with forks could cause pressure to intertidal sediment habitats in the MCZ through penetration of the substrate and the removal of target species.	There will be no spatial overlap between bait digging and mobile fishing gear, nor are these activities targeting the same species. NIFCA can therefore conclude with high confidence that mobile fishing activity and bait digging will not 'in-combination' increase pressures on the bird features of the SPA.

Projects and Plans

Activity	Description		Assessment
Mine water discharge	Abandoned mines are one of the biggest sources of water pollution by metals. There is a mine water treatment scheme at Lynemouth and groundwater upwellings have occurred at Hauxley/Hadston as well as water pumped from a mine, discharged through an existing outfall at Hauxley.	Sediments and invertebrate communities could be negatively impacted by mine water discharges. This could occur where mine water is not treated before release into the marine environment. In the majority of cases significant mine water outflow is identified and treated by the Coal Authority.	Appropriate licence conditions/monitoring has been incorporated to mitigate any impacts.

Active Marine Licences

Project number	Brief description	Assessment
MLA/2023/00158	Hydrophone deployment for monitoring cetaceans	All marine licence applications are assessed to ensure appropriate licence conditions/monitoring are in place. These assessments must consider impacts to Marine Protected Areas, with an aim to
MLA/2023/00017	Deployment of cetacean acoustic monitoring equipment	

MLA/2023/00094	Bore hole back-filling	preferably avoid, then minimise and mitigate impacts to the protected features. NIFCA are consulted on all relevant marine applications, as are Natural England.
MLA/2020/00458	Construction of telecommunications pipeline	
MLA/2019/00109	Maintenance of Newbiggin coastal wave buoy	
MLA/2019/00319	Laying of sub-sea cable	
MLA/2012/00122	Blyth windfarm (construction of 15 turbines). Work is set to continue after the installation of the initial five.	

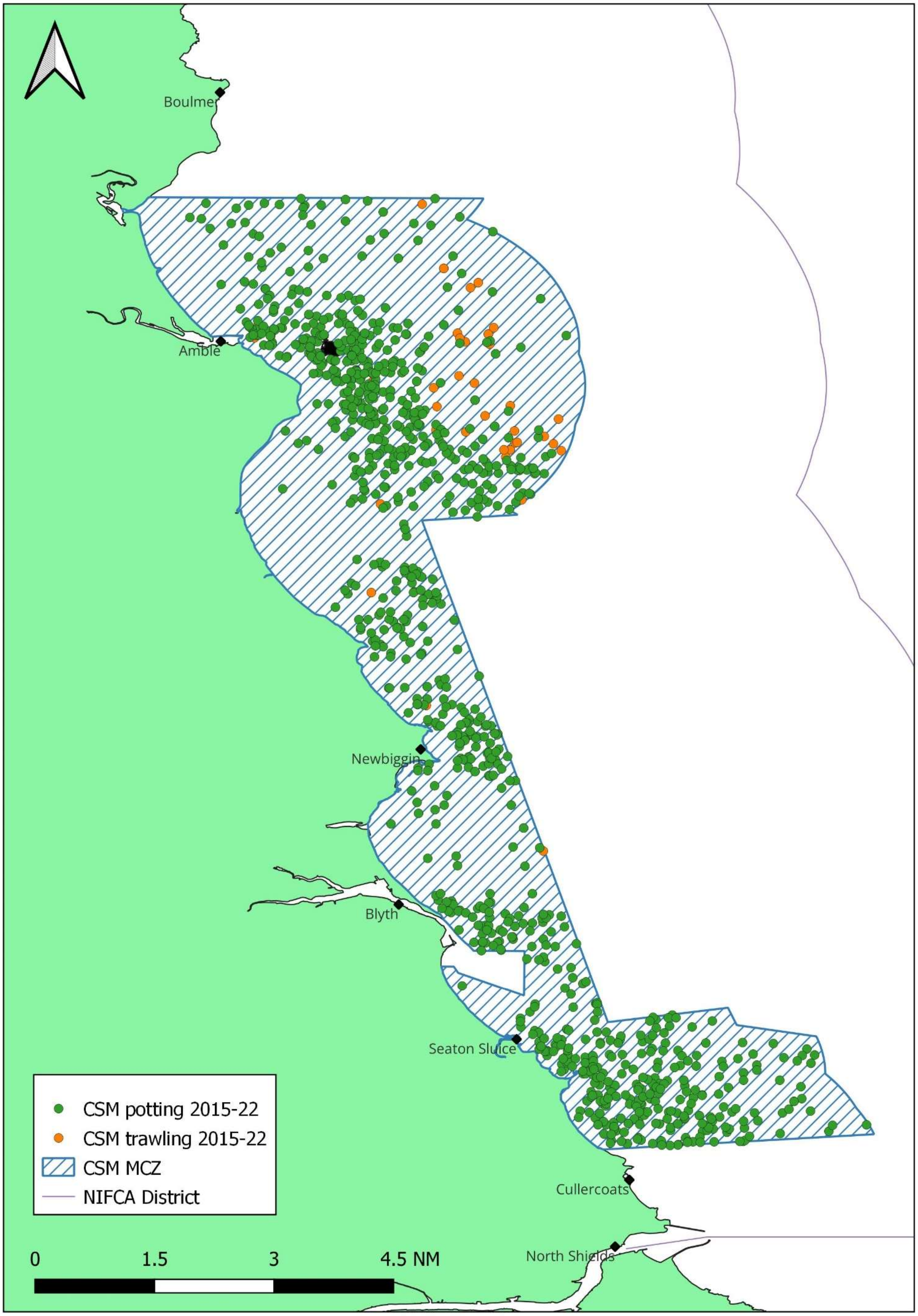


Figure 8 NIFCA at-sea sightings data from patrol vessels for potting and trawling (2015-22)

Chapter 5 Conclusion

5.1 Assessment Result for Demersal trawls

5.1.1 Fishing alone

NIFCA consider that there is a pathway for impacts on the MCZ through abrasion and disturbance, and removal of non-target species from light otter trawl gear on subtidal mud (see Chapter 3.4). Light otter trawl gear moving along the bottom, alone, is sufficient to affect (other than insignificantly) some features of the site. Namely, subtidal mud.

5.1.2 In-combination

As with the assessment of fishing alone in chapter 3.4 and the in-combination assessment in chapter 4 this section assumes that management for bottom towed gear will be introduced. NIFCA consider that whilst there is a pathway for disturbance, this is not sufficient to affect (other than insignificantly) the features of the site from the following in-combination factors:

- All fishing gear on all pressures combined
- All fishing gear on all pressures combined in combination with existing licenced activities within the site.

5.2 Proposed Management

Option 1: Nothing is required.

Option 2: Suite of measures introduced through permit conditions to the trawling byelaw

Option 3: Prohibition of light otter trawling (and therefore all mobile gear in the site)

NIFCA has ascertained that, due to the significant risk to the site's conservation objectives from fishing with gears that trawl or dredge the seabed, current management is insufficient to protect Coquet to St Mary's MCZ as such management measures will be required to restrict the level of activity in the site.

As such, the implementation of Option 2 will be required to best further the conservation objectives of the site. Therefore, the following management measure will be introduced through NIFCA Trawling byelaw and the implementation of a management plan:

- A cap on the number of permits issued.
- A cap on the number of hours fished per year.
- Spatial restrictions to protect areas where evidence shows more sensitive species are present.

This decision has been made in accordance with the Marine Policy Statement (MPS). Specifically:

Section 2.6:

2.6.1.1 Marine plan authorities should be mindful that, consistent with the high-level marine objectives, the UK aims to ensure:

- A halting and, if possible, a reversal of biodiversity loss with species and habitats operating as a part of healthy, functioning ecosystems

2.6.1.6 Many individual wildlife species receive statutory protection under a range of legislative provisions. Other species and habitats have been identified as being of principal importance for the conservation of biodiversity in the UK and thereby requiring conservation action or are subject to recommended conservation actions by an appropriate international organisation. Priority marine features are being defined in the seas around Scotland. The marine plan authority should ensure that development does not result in a significant adverse effect on the conservation of habitats or the populations of species of conservation concern and that wildlife species and habitats enjoying statutory protection are protected from the adverse effects of development in accordance with applicable legislation.

3.8.8 Fishing can have negative environmental impacts. As well as over-exploitation of commercial fish stocks, this can include threats to vulnerable or rare species, including by-catch, and can cause extensive damage or destruction to habitats and the historic environment. Such impacts can often be associated with particular gear types and the intensity of fishing activity. Interactions between fishing activity and marine developments and their consequent impacts on fish stocks and the environment are complex and need to be considered. It should also be recognised that many fishing activities are compatible with other sea users.

5.3 Review of Assessment

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 put in place in 2025.

The monitoring and control plan will closely monitor activity levels and extent within the site to further understand the impact of the activity in relation to the conservation objectives of the subtidal mud features and assess the effectiveness of any management. As part of the monitoring and control plan process a number of triggers with thresholds will be set and if evidence collected shows a threshold is reached a full reassessment will be carried out. It should be noted that at the point of designation, information on the condition of this feature was limited. The current condition of the site is poorly evidenced and consequently, complicates the development of management and monitoring and control plans aimed at furthering the conservation objectives of the site.

NIFCA will effectively review this assessment continuously throughout the year through the monitoring and control plan. Information that will trigger a full review of the assessment, in addition to any triggers put in place through the plan could include:

- updated conservation advice;
- updated advice on the condition of the feature;
- significant change in activity levels.

5.4 Conclusion

NIFCA have had regard to best available evidence and through consultation with relevant advisors and the public, conclude that bottom towed fishing activities are not compatible with the conservation objectives and General Management Approach of this marine protected area with fishing effort at the current level. This will be addressed through the introduction of management measure discussed in section 5.2.

Has Natural England been formally consulted on this document (and do they agree)?	**Yes.**

Date of document completion/signature:	**02/12/2024 (Catherine L Scott & Pete Welby)**

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Appendix 1: Fishing activities with amber interactions to be included for assessment if they take place:

Features	Matrix Gear Type	Natural England Aggregated Method
High energy intertidal rock	Beam trawl (whitefish) Beam trawl (shrimp) Beam trawl (pulse/wing) Heavy otter trawl Multi-rig trawls Light otter trawl Pair trawl Anchor seine Scottish/fly seine	Towed (demersal)
	Scallops Mussels, clams, oysters	Dredges (towed)
Intertidal coarse sediment	Beam trawl (whitefish) Beam trawl (shrimp) Beam trawl (pulse/wing) Heavy otter trawl Multi-rig trawls Light otter trawl Pair trawl Anchor seine Scottish/fly seine	Towed (demersal)
	Scallops Mussels, clams, oysters Pump scoop (cockles, clams)	Dredges (towed)
Intertidal mixed sediments	Beam trawl (whitefish) Beam trawl (shrimp) Beam trawl (pulse/wing) Heavy otter trawl Multi-rig trawls Light otter trawl Pair trawl Anchor seine Scottish/fly seine	Towed (demersal)
	Scallops Mussels, clams, oysters Pump scoop (cockles, clams)	Dredges (towed)

Intertidal mud	Beam trawl (whitefish) Beam trawl (shrimp) Beam trawl (pulse/wing) Heavy otter trawl Multi-rig trawls Light otter trawl Pair trawl Anchor seine Scottish/fly seine	Towed (demersal)
	Scallops Mussels, clams, oysters Pump scoop (cockles, clams)	Dredges (towed)
Intertidal sand and muddy sand	Beam trawl (whitefish) Beam trawl (shrimp) Beam trawl (pulse/wing) Heavy otter trawl Multi-rig trawls Light otter trawl Pair trawl Anchor seine Scottish/fly seine	Towed (demersal)
	Scallops Mussels, clams, oysters Pump scoop (cockles, clams)	Dredges (towed)
Intertidal under boulder communities	Beam trawl (whitefish) Beam trawl (shrimp) Beam trawl (pulse/wing) Heavy otter trawl Multi-rig trawls Light otter trawl Pair trawl Anchor seine Scottish/fly seine	Towed (demersal)
	Scallops Mussels, clams, oysters Pump scoop (cockles, clams)	Dredges (towed)
Low energy intertidal rock	Beam trawl (whitefish) Beam trawl (shrimp) Beam trawl (pulse/wing) Heavy otter trawl Multi-rig trawls Light otter trawl Pair trawl Anchor seine Scottish/fly seine	Towed (demersal)
	Scallops Mussels, clams, oysters Pump scoop (cockles, clams)	Dredges (towed)

Moderate energy circalittoral rock	Beam trawl (whitefish) Beam trawl (shrimp) Beam trawl (pulse/wing) Heavy otter trawl Multi-rig trawls Light otter trawl Pair trawl Anchor seine Scottish/fly seine	Towed (demersal)
	Scallops Mussels, clams, oysters Pump scoop (cockles, clams)	Dredges (towed)
Moderate energy intertidal rock	Beam trawl (whitefish) Beam trawl (shrimp) Beam trawl (pulse/wing) Heavy otter trawl Multi-rig trawls Light otter trawl Pair trawl Anchor seine Scottish/fly seine	Towed (demersal)
	Scallops Mussels, clams, oysters Pump scoop (cockles, clams)	Dredges (towed)
Subtidal coarse sediment	Beam trawl (whitefish)	Towed (demersal)
	Beam trawl (shrimp)	
	Beam trawl (pulse/wing)	
	Heavy otter trawl	
	Multi-rig trawls	
	Light otter trawl	
	Pair trawl	
	Anchor seine	
	Scottish/fly seine	
	Scallops	Dredges (towed)
	Mussels, clams, oysters	
	Pump scoop (cockles, clams)	
	Suction (cockles)	Dredges (other)
Subtidal mixed sediments	Beam trawl (whitefish) Beam trawl (shrimp) Beam trawl (pulse/wing) Heavy otter trawl Multi-rig trawls Light otter trawl Pair trawl Anchor seine Scottish/fly seine	Towed (demersal)
	Scallops Mussels, clams, oysters Pump scoop (cockles, clams)	Dredges (towed)

Subtidal mud	Beam trawl (whitefish) Beam trawl (shrimp) Beam trawl (pulse/wing) Heavy otter trawl Multi-rig trawls Light otter trawl Pair trawl Anchor seine Scottish/fly seine	Towed (demersal)
	Scallops Mussels, clams, oysters Pump scoop (cockles, clams)	Dredges (towed)
Subtidal sand	Beam trawl (whitefish)	Towed (demersal)
	Beam trawl (shrimp)	
	Beam trawl (pulse/wing)	
	Heavy otter trawl	
	Multi-rig trawls	
	Light otter trawl	
	Pair trawl	
	Anchor seine	
	Scottish/fly seine	
	Scallops Mussels, clams, oysters Pump scoop (cockles, clams)	Dredges (towed)

Appendix 2: iVMS analysis

Inshore Vessel Monitoring Systems (iVMS) is in the implementation process for the inshore fleet nationally. The systems track vessel activity and record vessel location and speed every three minutes.

One full year of iVMS data was analysed from March 2022 to February 2023 for all available iVMS data for the seven vessels identified as potentially fishing within the MCZ from permit returns and officer knowledge. iVMS data were downloaded from Themis and data cleaned in R. To minimise the number of data points, points detected as being 'in port' were excluded (see Figure 8).

To identify parameters needed to differentiate fishing activity from vessels either being paused, or steaming, a selection of iVMS data was inspected in ArcGIS. Points were selected which were obviously fishing/steaming/paused, and both their distances from consecutive points and vessel speed were plotted to identify speeds and distances at which vessels were very likely fishing (Figure 7). Trawling was determined to take place in this fishery where iVMS points were between 140-310m from each other, and vessel speeds were between 1.5-4.3 knots (nautical miles per hour).

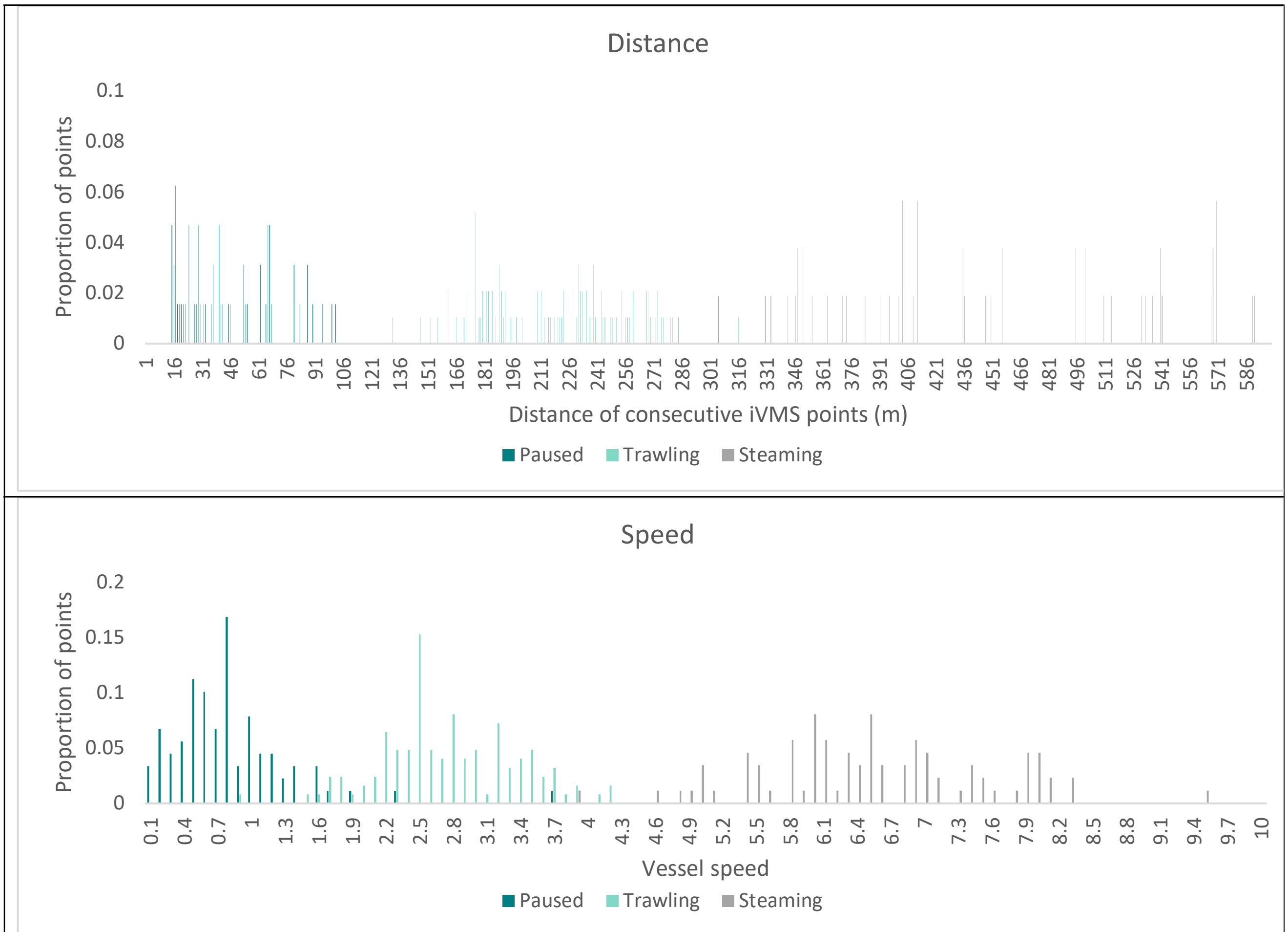


Figure 7 Selection of iVMS points manually identified as either paused, trawling or steaming, and their a) distance from consecutive points and b) speed at which the vessel was travelling at that time.

In R, clusters of similar points were grouped by vessel, date and time to identify potential fishing trips. Points were filtered by distance of consecutive points from each other, and then vessel speed, based on the values above. Only points identified as fishing were then used to create tracks of vessel fishing activity.

The number of fishing trips to the MCZ was also calculated per month, and number of hours fished within the MCZ. The number of fishing trips was calculated as opposed to days fished, as in the summer fishing mainly occurs overnight and a single trip spans two days.

To calculate the area of ground covered by the trawling gear, a total width of trawling tows between the two otter boards of 45m was used, based on information from fishers and Seafish:

Example calculations based on one fishing vessel measurements:
20 (distance in inches between towing strops) x 75 (length of warp shot in fathoms = 137m)
Divided by 12 to give the door spread in feet
+ 10% to allow for divergence in the warps
=137.5 feet or 42m

In ArcGIS, trawling tracks using the 45m buffer were overlaid with habitat information within the MCZ to calculate the area of ground covered by trawling for each habitat.

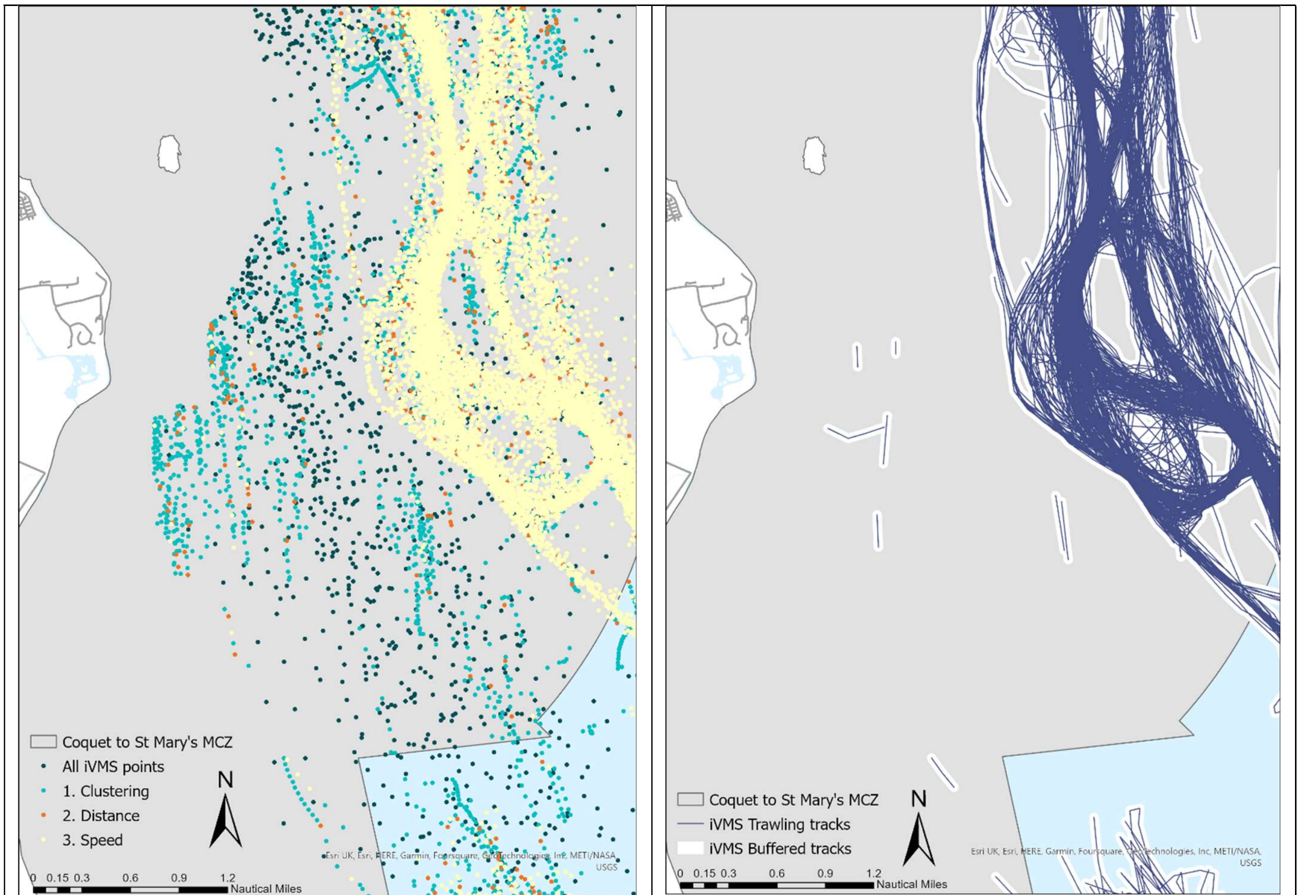


Figure 8. Illustration of methods used to analyse iVMS data. **a)** Filtering iVMS points to identify where fishing activity occurs, by 1. clustering, 2. a distance from consecutive points of between 140-310m, and 3. vessel speeds of between 1.5-4.3 knots. **b)** Tracks created from points identified as fishing, and buffered using the width of trawling tows to calculate area of ground covered.

Appendix 3: Benthic Impacts Tool

For more information on the BIT see User Manual, available at:
https://hub.jncc.gov.uk/assets/101bb59f-55ce-4195-9710-6ff9abe4c8dd

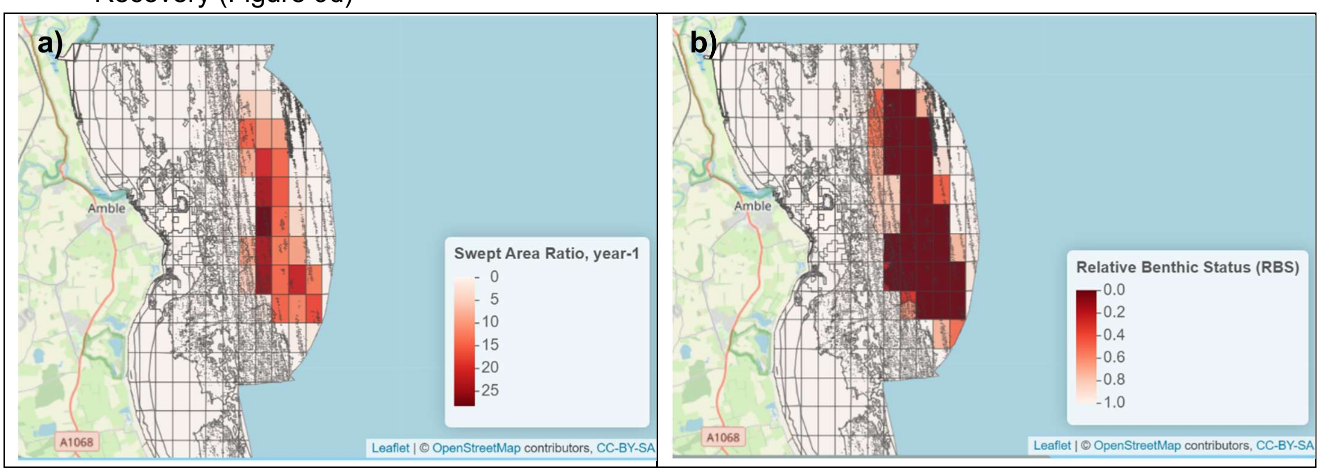
Tool inputs:
Fishing effort data

- iVMS data as obtained above for one year, as fishing tracks buffered by trawl door width
- The sum of buffered fishing tracks was aggregated to a 0.1 decimal degree grid to use as the total area of gear swept per grid cell
- Grid cell size of 0.1 decimal degrees used in the BIT

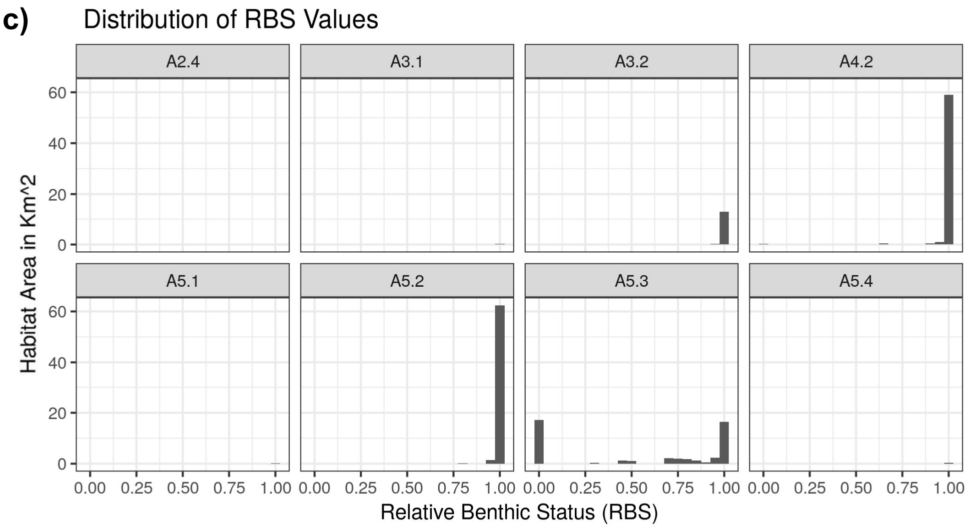
Assessment area: Coquet to St Mary's MCZ
EUNIS habitat map within the figureMCZ

Tool outputs

- Swept Area Ratio SAR (Figure 9a)
- Default depletion rates for Otter Trawls used:
  - Depletion rate of 0.11 for gravel assigned to EUNIS habitat sublittoral mixed sediments
  - Depletion rate of 0.12 for mud assigned to EUNIS habitat sublittoral mud
  - Depletion rate of 0.05 for sand assigned to EUNIS habitat sublittoral sand
  - All other habitat types assigned standard depletion rate of 0.06
- Default recovery rate of 0.42 used
- Relative Benthic Status (Figure 9b and c; Table 16)
- Recovery (Figure 9d)



c)



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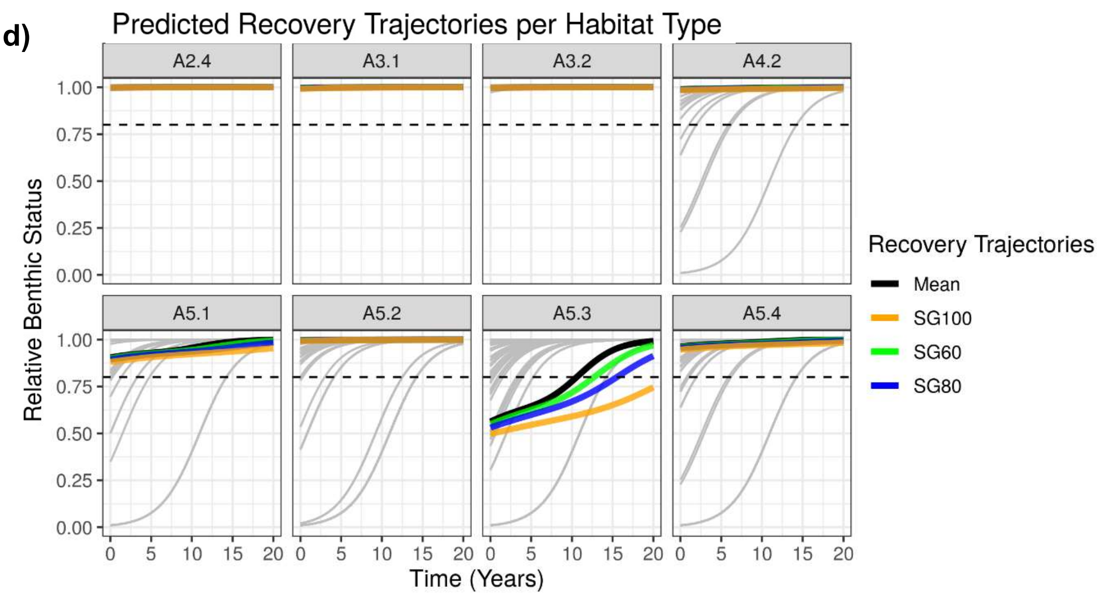

Figure 9. Benthic Impacts Tool outputs for trawling activity within Coquet to St Mary's MCZ. **a)** Swept Area Ratio of fishing gear per year; **b)** Relative Benthic Status of the benthic environment; **c)** distribution of RBS values within each habitat type, by habitat area (A5.3 is subtidal mud); and **d)** predicted recovery trajectories per habitat type. Grey lines illustrate the recovery trajectory for biomass in each individual grid cell. The black line indicates the mean recovery trajectory of all species biomass together across each habitat. The dashed line indicates an RBS of 0.8, or 80% carrying capacity. Each indicative MSC score relates to uncertainty in the recovery trajectory - to score SG100, there must be high certainty that the species biomass would recover to 80% within 20 years.

Table 16. RBS values per habitat type, with subtidal mud highlighted.

Habitat Type	Mean RBS Score	Total Area of Habitat Type (km^2)
A1	0.998938829	0.05725
A1.1	0.999728745	0.618954
A1.2	0.999719743	0.675755
A1.3	0.999429017	0.580806
A1.4	0.999458194	0.422606

A2.1	1	0.30859
A2.2	0.999998792	7.117944
A2.3	1	0.019087
A2.4	0.999184341	0.04684
A3.1	0.995959347	0.21921
A3.2	0.99884098	13.16482
A4.2	0.989121328	61.16591
A5.1	0.90371846	0.08615
A5.2	0.996048721	64.16691
A5.3	0.559137952	46.41629
A5.4	0.961386414	0.369431