Document Control

Title	**The Needles MCZ – Part B Fisheries Assessment – Bottom Towed Fishing Gear**
SIFCA Reference	MCZ/03/004
Author	C Smith
Approver	
Owner	Southern IFCA
Template Used	MCZ Assessment Template v1.0

Revision History

Date	Author	Version	Status	Reason	Approver(s)
04/05/2020	C Smith	1.0	Draft		
11/05/2020	C Smith	1.1	Draft	Addition of Natural Disturbance Section	
01/06/2020	C Smith	1.2	Draft		
09/07/2020	C Smith	1.2	Draft	Addition of Annexes	
16/07/2020	C smith	1.3	Draft	Minor amendments	TAC Chair
28/08/2020	C Smith	1.4	Draft	TAC Chair comments addressed	
09/11/2020	C Smith		Final		

This document has been distributed for information and comment to:

Title	Name	Date sent	Comments received
Natural England	Richard Morgan	28 August 2020	16 October 2020 - Approved

Southern Inshore Fisheries and Conservation Authority (IFCA)

Marine Conservation Zone Fisheries Assessment (Part B)

Marine Conservation Zone: The Needles

Feature: High energy infralittoral rock, moderate energy infralittoral rock, moderate energy circalittoral rock

Broad Gear Type: Bottom Towed Fishing Gear

Gear type(s) Assessed: Beam trawl / Light Otter Trawl and Multi-rig trawl

Technical Summary

As part of the MCZ assessment process for the tranche 2 The Needles MCZ, it was identified that trawling (light otter trawl, beam trawl & Multi-rig) and its potential impacts require an in-depth assessment. The level of trawling within the site is considered to be 'very light', with trawling occurring over subtidal sediments on the north fringes of the site twice a year.

The potential pressures likely to be exerted by the activity upon designated features were identified as abrasion, disturbance and penetration of the seabed below and on the surface of the seabed, the removal of non-target species, smothering and siltation rate changes and changes in suspended solids. Scientific literature shows that trawling can lead to the damage, removal and mortality of rocky reef species and communities as well as the dragging of boulders, cobbles, species and biogenic structures. Recovery of rocky reef species can take between 3 and 20 years.

When considering that trawling occurs within The Needles MCZ, in combination with other evidence (scientific literature, feature data, sightings data) it was concluded the activity was likely to pose a significant risk to high energy infralittoral rock, moderate energy infralittoral rock and moderate energy circalittoral rock. As such, it is believed the activity will hinder the achievement of the designated features 'maintain' general management approaches and that it is not compatible with the site's conservation objectives.

Existing management measures are therefore not considered sufficient to ensure that trawling remains consistent with the conservative objectives of the site. Therefore, additional management for bottom towed fishing gear will be introduced which will protect the rock features.

When scientific literature, fishing activity, sightings data and, existing and proposed management is considered, the management of BTFG will be considered sufficient to ensure that trawling will remains consistent with the conservative objectives of the site. Fishing effort will continue to be monitored.

Contents

1 Introduction

1.1 Need for an MCZ assessment

This assessment has been undertaken by Southern IFCA in order to document and determine whether management measures are required to achieve the conservation objectives of The Needles Marine Conservation Zone (MCZ). Southern IFCA has duties under section 154 of the Marine and Coastal Access Act 2009 which states;

154 Protection of marine conservation zones

(1) The authority for an IFC district must seek to ensure that the conservation objectives of any MCZ in the district are furthered.
(2) Nothing in section 153(2) is to affect the performance of the duty imposed by this section.
(3) In this section—
  (a) "MCZ" means a marine conservation zone designated by an order under section 116;
  (b) the reference to the conservation objectives of an MCZ is a reference to the conservation objectives stated for the MCZ under section 117(2)(b).

Section 125 of the 2009 Act also requires that public bodies (which includes the IFCA) exercise its functions in a manner to best further (or, if not possible, least hinder) the conservation objectives for MCZs.

The MCZ assessment process complements Southern IFCA's assessment of commercial fishing activities in European Marine Sites (EMS) – designated to protect habitats and species in line with the EU Habitats Directive and Birds Directive. To bring fisheries in line with other activities, the Department for Environment, Food and Rural Affairs (DEFRA) announced on the 14th August 2012 the revised approach to manage fishing activities within EMSs. This change in approach promotes sustainable fisheries while conserving the marine environment and resources, securing a sustainable future for both.

Habitat and species feature data is continually being added to and updated. In 2020 Southern IFCA received updated habitat data regarding rock features. Therefore, this new data requires MCZ assessments to determine whether or not the conservation measures in place were appropriate to further the conservation objectives of the habitats and species for which the site has been designated (Marine and Coastal Access Act 2009).

This document forms the basis of a Marine Conservation Zone Assessment for the updated rock in The Needles MCZ feature data. The purpose of this document is to assess whether or not in the view of Southern IFCA, the Bottom Towed Fishing Gear activity will have a likely significant effect on the features and sub-features of the MCZ alone, and where appropriate in-combination with other plans or projects. The assessment ensures Southern IFCA meets its responsibilities as a competent authority by ensuring the conservation objectives of the Marine Conservation Zone are furthered with regards to fishing activity.

Southern IFCA have now completed a Part A Assessment of the activities over these features. This indicated that some pressures created by the activities are exerted on the features, and therefore are required to be assessed in a Part B Assessment. Therefore, this document contains the Part B Assessment for rock within The Needles MCZ with the Southern IFCA District.

1.2 Documents reviewed to inform this assessment

- Reference list (Section 9)
- Defra's matrix of fisheries gear types and European Marine Site protected features[1]
- Site map(s) – feature location and extent (Annex 1)
- Natural England's Advice on Operations for The Needles MCZ[2]

[1] https://www.gov.uk/government/publications/fisheries-in-european-marine-sites-matrix
[2] https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UKMCZ0040&SiteName=the%20needles&

- Fishing activity data (map(s), etc) (Annex 3)
- Fisheries Impact Evidence Database (FIED)

2 Information about the MCZ

2.1 Overview and designated features

The Needles MCZ was designated in January 2016 and covers the stretch of Solent adjacent to the northwest side of the Isle of Wight to just south of the Needles, including a series of sheltered bays. The site covers an area of approximately 11 km² and protects a number of rare and fragile habitats including chalk on the seabed, shallow water (infralittoral) rock and soft sediments which support communities of algae, sponges, sea squirts and delicate anemones. The site also protects seagrass beds in both Totland and Colwell Bays, together with rare and threatened species such as the Stalked jellyfish (*Lucernariopsis campanulata*) and Peacock's tail (*Padina pavonica*).

A summary of the site's designated features is provided in Table 1, together with the recommended General Management Approach (GMA) for each feature. The GMA required for a feature in an MCZ will either be for it to be maintained in favourable condition (if it is currently in this state), or for it to be recovered to favourable condition (if it is currently in a damaged state) and then to be maintained in favourable condition.

Table 1. Designated features and General Management Approach

Designated feature	General Management Approach
Moderate energy infralittoral rock	Maintain in favourable condition
High energy infralittoral rock	
Moderate energy circalittoral rock	
Stalked jellyfish (*Lucernariopsis campanulata*)	
Subtidal chalk	Recover to favourable condition
Subtidal coarse sediment	
Subtidal mixed sediments	
Subtidal sand	
Subtidal mud	
Sheltered muddy gravels	
Seagrass beds	
Peacock's tail (*Padina pavonica*)	
Native oyster (*Ostrea edulis)*	

Please refer to Annex 1for site feature maps of broad-scale habitats and features of conservation importance. This feature data comes from the Natural England, 2019 data set given to Southern IFCA, containing a collation of marine habitat and species records that contribute to the designation of marine habitats and features. This corresponds with the feature data on Magic Map which represents Natural England's best available evidence (https://magic.defra.gov.uk/MagicMap.aspx).

2.2 Conservation Objectives

The site's conservation objectives apply to the Marine Conservation Zone and the individual species and/or habitat for which the site has been designated (the "Designated features" listed below).

The conservation objective of each of the zones is that the protected habitats:

1. are maintained in favourable condition if they are already in favourable condition
2. be brought into favourable condition if they are not already in favourable condition

SiteNameDisplay=The%20Needles%20MCZ&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=&NumMarineSeasonality=&HasCA=1

For each protected feature, favourable condition means that, within a zone:

1. its extent is stable or increasing
2. its structure and functions, its quality, and the composition of its characteristic biological communities (including diversity and abundance of species forming part or inhabiting the habitat) are sufficient to ensure that its condition remains healthy and does not deteriorate

Any temporary deterioration in condition is to be disregarded if the habitat is sufficiently healthy and resilient to enable its recovery.

For each species of marine fauna, favourable condition means that the population within a zone is supported in numbers which enable it to thrive, by maintaining:

1. the quality and quantity of its habitat
2. the number, age and sex ratio of its population. Any temporary reduction of numbers of a species is to be disregarded if the population is sufficiently thriving and resilient to enable its recovery.

Any alteration to a feature brought about entirely by natural processes is to be disregarded when determining whether a protected feature is in favourable condition.

3 MCZ assessment process

3.1 Overview of the assessment process

The assessment of commercial fishing activities within the Studland MCZ will be undertaken using a staged process, akin to that proposed by the Marine Management Organisation (MMO)[3], for marine license applications. The assessment process comprises of an initial screening stage to establish whether an activity occurs or is anticipated to occur/has the potential to occur within the site. Activities which are not screened out are subject to a simple 'part A' assessment, akin to the Test of Likely Significant Effect required by article 6(3) of the Habitats Directive. The aim of this assessment is to identify pressures capable of significantly affecting designated features or their related processes. Fishing activities and their associated pressures which are not screened out in the part A assessment and then subject to a more detailed 'part B' assessment, where assessment is undertaken on a gear type basis. A part B assessment is akin to the Appropriate Assessment required by article 6(3) of the Habitats Directive. The aim of this assessment is to determine whether there is a significant risk of the activity hindering the conservation objectives of the MCZ. Within this stage of assessment, 'hinder' is defined as any act that could, either alone or in combination:

- in the case of a conservation objective of 'maintain', increase the likelihood that the current status of a feature would go downwards (e.g. from favourable to degraded) either immediately or in the future (i.e. they would be placed on a downward trend); or

- in the case of a conservation objective of 'recover', decrease the likelihood that the current status of a feature could move upwards (e.g. from degraded to favourable) either immediately or in the future (i.e. they would be placed on a flat or downward trend) (MMO, 2013).

If the part B assessment is unable to conclude that there is no significant risk of an activity hindering the conservation objectives of the MCZ, then the activity may be subject to management and consideration will be given to whether or not the public benefit of the activity outweighs the risk of damage to the environment; and if so, whether the activity is able to deliver measures of equivalent environmental benefit to the damage that is likely to occur to the MCZ.

3 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/410273/Marine_conservation_zones_and_marine_licensing.pdf

3.2 Screening and part A assessment

The aim of the screening stage and part A assessment is to determine whether, under section 125 and 154 of MCAA, fishing activities occurring or those which have the potential to occur within the site are compatible with the conservation objectives of the MCZ.

The screening of commercial fishing activities in The Needles MCZ was undertaken using broad gear type categories. Sightings data collected by the Southern IFCA, together with officers' knowledge, was used to ascertain whether each activity occurs within the site, or has the potential to occur/is anticipated to occur in the foreseeable future. For these occurring/potentially occurring activities, an assessment of pressures upon MCZ designated features was undertaken using Natural England's Advice on Operations for the Feature (using an alternate designated site as the Conservation Advice for the Studland MCZ has not yet been produced.

Activities were screened out for further part B assessment if they satisfied one or more of the following criteria:

1. The activity does not occur within the site, does not have the potential to occur and/or is not anticipated to occur in the foreseeable future.

2. The activity does occur but the pressure(s) does not significantly affect/ interact with the designated feature(s).

3. The activity does occur but the designated feature(s) is not sensitive to the pressure(s) exerted by the activity.

3.2.1 Screening of commercial fishing activities based on pressure-feature interaction

Fishing activities which were identified as occurring, have the potential to occur and/or are anticipated to occur in the foreseeable future within the site were screened with respect to the potential pressures which they may be exert upon designated features (Part A assessment). This screening exercise was undertaken using Natural England's Advice on Operations (Annex 2) and Supplementary Advice for The Needles MCZ. The Advice on Operations provides a broad scale assessment of the sensitivity of designated features to different activity-derived pressures, using nationally available evidence on their resilience (an ability to recover) and resistance (the level of tolerance) to physical, chemical and biological pressures. The assessments of sensitivity to these pressures are measured against a benchmark. It should be noted that these benchmarks are representative of the likely intensity of a pressure caused by typical activities, and do not represent a threshold of an 'acceptable' intensity of a pressure. It is therefore necessary to consider how the level of fishing intensity observed within the Needles MCZ compares with these benchmarks when screening individual activities.

Due to the broad-scale nature of the sensitivity assessments provided in Natural England's Advice on operations, each pressure is assigned a risk profile based upon the likelihood of the pressure occurring and the magnitude of the impact should that pressure occur. These risk profiles have been used, together with site-specific knowledge, to identify those pressures which could significantly affect designated features.

The Natural England Advice on Operations for the MCZs used is provided in Annex 2. The resultant activity pressure-feature interactions which have been screened in for bottom towed fishing gear for the part B assessment are summarised in Table 2, Table 3 and Table 4 for sensitive designated features. The activity pressure-feature interactions which were screened out in the Part A Assessment are detailed in a standalone document ('Screening and Part A Assessment') for The Needles MCZ.

Table 2. Summary of fishing pressure-feature screening for High energy infralittoral rock and demersal trawls. Please not only pressures screened in for the Part B assessment are presented here.

Potential Pressures	Sensitivity	Considered in Part B Assessment?	Justification	Relevant Attributes (effected by identified pressures)

Abrasion/disturbance of the substrate on the surface of the seabed	S	Y	This gear type is known to cause abrasion and disturbance to the seabed surface. Further investigation is needed on the magnitude of the pressure, including the spatial scale/intensity of the activity.	Distribution: presence and spatial distribution of biological communities; Structure and function: presence and abundance of key structural and influential species; Structure: species composition of component communities; Structure: physical structure of rocky substrate;
Changes in suspended solids (water clarity)	S	Y	This gear is known to cause the resuspension of finer sediments, therefore further assessment is required.	Supporting processes: water quality - turbidity
Removal of non-target species	S	Y	Impacts on the associated community may occur through the removal of larger epifaunal and potentially Infaunal species, whilst smaller organisms are likely to pass through the gear. Abrasion, resulting from contact with the gear, however is likely to disturb smaller species. There is no site-specific information on the communities associated with this feature as it is newly designated. General information on the designated features from the MCZ features catalogue provides a general description. The feature tends to be dominated by dense mats of green and red seaweeds, as well as periwinkles. The post-survey site	Distribution: presence and spatial distribution of biological communities; Structure and function: presence and abundance of key structural and influential species; intertidal rock, Structure: species composition of component communities

			report provides a species list from grab and video samples. Further investigation is needed as to the magnitude of disturbance to associated communities/species.	

Table 3. Summary of fishing pressure-feature screening for Moderate energy infralittoral rock and demersal trawls. Please not only pressures screened in for the Part B assessment are presented here.

Potential Pressures	Sensitivity	Considered in Part B Assessment?	Justification	Relevant Attributes (effected by identified pressures)
Abrasion/disturbance of the substrate on the surface of the seabed	S	Y	This gear type is known to cause abrasion and disturbance to the seabed surface. Further investigation is needed on the magnitude of the pressure, including the spatial scale/intensity of the activity.	Distribution: presence and spatial distribution of biological communities; Structure and function: presence and abundance of key structural and influential species; Structure: species composition of component communities; Structure: physical structure of rocky substrate;
Changes in suspended solids (water clarity)	S	Y	This gear is known to cause the resuspension of finer sediments, therefore further assessment is required.	Supporting processes: water quality - turbidity
Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion	S	Y	This gear type is known to cause abrasion and disturbance to the seabed surface. Further investigation is needed on the magnitude of the pressure, including the spatial scale/intensity of the activity.	Distribution: presence and spatial distribution of biological communities; Structure and function: presence and abundance of key structural and influential species; Structure: species composition of component communities; Structure: physical structure of rocky substrate;

Removal of non-target species	S	Y	Impacts on the associated community may occur through the removal of larger epifaunal and potentially Infaunal species, whilst smaller organisms are likely to pass through the gear. Abrasion, resulting from contact with the gear, however is likely to disturb smaller species. There is no site-specific information on the communities associated with this feature as it is newly designated. General information on the designated features from the MCZ features catalogue provides a general description. The feature tends to be dominated by dense mats of green and red seaweeds, as well as periwinkles. The post-survey site report provides a species list from grab and video samples. Further investigation is needed as to the magnitude of disturbance to associated communities/species.	Distribution: presence and spatial distribution of biological communities; Structure and function: presence and abundance of key structural and influential species; Structure: species composition of component communities
Smothering and siltation rate changes (Light)	S	Y	This gear is known to cause the resuspension of finer sediments, therefore further assessment is required.	Supporting processes: water quality - turbidity; Supporting processes: sedimentation rate

Table 4. Summary of fishing pressure-feature screening for Moderate energy circalittoral rock and demersal trawls. Please not only pressures screened in for the Part B assessment are presented here.

Potential Pressures	Sensitivity	Considered in Part B Assessment?	Justification	Relevant Attributes (effected by identified pressures)
Abrasion/disturbance of the substrate on the surface of the seabed	S	Y	This gear type is known to cause abrasion and disturbance to the seabed surface. Further investigation is needed on the	Distribution: presence and spatial distribution of biological communities; Extent and distribution; Structure and function: presence and abundance of key structural and

			magnitude of the pressure, including the spatial scale/intensity of the activity.	influential species; Structure: species composition of component communities; Structure: physical structure of rocky substrate;
Changes in suspended solids (water clarity)	S	Y	This gear is known to cause the resuspension of finer sediments, therefore further assessment is required.	Supporting processes: water quality - turbidity
Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion	S	Y	This gear type is known to cause abrasion and disturbance to the seabed surface. Further investigation is needed on the magnitude of the pressure, including the spatial scale/intensity of the activity.	Distribution: presence and spatial distribution of biological communities; Extent and distribution; Structure and function: presence and abundance of key structural and influential species; Structure: species composition of component communities; Structure: physical structure of rocky substrate;
Removal of non-target species	S	Y	Impacts on the associated community may occur through the removal of larger epifaunal and potentially Infaunal species, whilst smaller organisms are likely to pass through the gear. Abrasion, resulting from contact with the gear, however is likely to disturb smaller species. There is no site-specific information on the communities associated with this feature as it is newly designated. General information on the designated features from the MCZ features catalogue provides a general description. The feature tends to be dominated by dense mats of green and red seaweeds, as well as periwinkles. The post-	Distribution: presence and spatial distribution of biological communities; Structure and function: presence and abundance of key structural and influential species; Structure: species composition of component communities

			survey site report provides a species list from grab and video samples. Further investigation is needed as to the magnitude of disturbance to associated communities/species.	
Smothering and siltation rate changes (Light)	S	Y	This gear is known to cause the resuspension of finer sediments, therefore further assessment is required.	Supporting processes: water quality - turbidity; Supporting processes: sedimentation rate

4 Part B Assessment

The aim of the part B assessment is for the IFCA to ensure that that there is no significant risk of a fishing activity hindering the conservation objectives of the MCZ; and to confirm that the authority is able to exercise its functions to further the site's conservation objectives.

In order to adequately assess the potential impacts of an activity upon a designated feature, it is necessary to consider the relevant attributes of that feature that may be affected. Attributes are provided in Natural England's Supplementary Advice on Conservation Objectives (SACOs) and represent the ecological characteristics or requirements of the designated species and habitats within a site. These attributes are considered to be those which best describe the site's ecological integrity and which if safeguarded will enable achievement of the Conservation Objectives. Each attribute has an associated target which identifies the desired state to be achieved; and is either quantified or qualified depending on the available evidence.

4.1 Assessment of trawling in the Needles MCZ

4.1.1 Summary of the Fishery

Trawling can take place all year round within the Needles MCZ. The level of activity is however very low with one to two vessels fishing one to two times a year on the fringes of the site using light otter trawls. The activity does not target a specific species. The species caught is dependent on the time of year and catches can include common sole (*Solea solea*) and European plaice (*Pleuronectes platessa*), with a bycatch of bass.

4.1.2 Technical gear specifications

Light otter trawls are used to fish for a number of fish species on the fringes of the Needles MCZ. There is also the potential for a beam trawl and multi-rig trawl to be used within the site, although it is not currently known to occur.

4.1.3 Light otter trawl

An otter trawl comprises of following design (see Figure 1). Two shaped panels of netting are laced together at each side to form an elongated funnel shaped bag (Seafish, 2015). The funnel tapers down to a cod-end where fish are collected (Seafish, 2015). The remaining cut edges of the net and net mouth are strengthened by lacing them to ropes to form 'wings' that are used to drive fish into the net (Seafish, 2015). The upper edge of the rope is referred to as the head line, the lower edge is referred to as the foot rope of fishing line and side ropes are known as wing lines (Seafish, 2015). Floats are attached to the headline to hold the net open and the foot rope is weighted to maintain contact with the seabed and prevent damage to the net (Seafish, 2015). The wings of the net are held open by a pair of trawl doors, also known as otter boards, and are attached to the wings by wires, ropes or chains known as bridles and sweeps (Seafish, 2015). The sweep connects the trawl door to top and bottom bridles which are attached to the headline and footrope of the net, respectively (Seafish, 2015). The choice of material used for the sweeps and bridles depends on the size of

gear and nature of the seabed, with smaller inshore boats using thin wire and combination rope (Seafish, 2015). The trawl doors, which are made of wood or steel are towed through the water at an angle which causes them to spread apart and open the net in a horizontal direction (Seafish, 2015). The trawl doors are attached to the fishing vessel using wires referred to as trawl warps (Seafish, 2015). The trawl doors must be heavy enough to keep the net on the seabed as it is towed (Seafish, 2015). As the trawl doors are towed along the seabed, they generate a sediment cloud which helps to herd fish towards the mouth of the trawl (Seafish, 2015). The bridles and sweeps continue the herding action of the trawl doors as the trail on the seabed and disturb the sediment, creating a sediment cloud (Seafish, 2015). The length of the sweeps and bridles and distance between the two trawl doors is tuned to the target species (Seafish, 2015). Species such as lemon sole and plaice can be herded into the trawl over long distances and so the length of the sweeps is longer (Seafish, 2015).

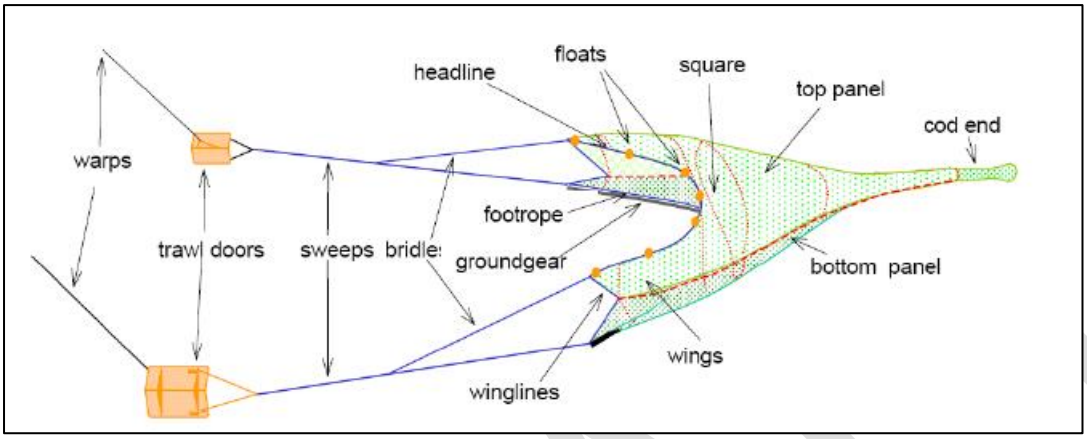


Figure 1. Key components of an otter trawl. Source: www.seafish.org/upload/b2b/file/r_d/BOTTOM%20TRAWL_5a.pdf

The mesh size of the net used varies depending on the type of trawl (Seafish, 2015). In the UK, there has been a move towards an increase in mesh size, particularly in the top panel and wings, in order to improve gear selectivity (Seafish, 2015).

The ground rope will have some form of ground gear attached to protect the netting from damage on the seabed (Seafish, 2015). The ground gear can largely vary. The most basic is where bare fishing line and the netting is laced directly to the rope of combination rope (Seafish, 2015). Chains may also be used and the style of attachment can vary (Seafish, 2015). Ground gear may also include bobbins and rock hoppers which commonly use small and large rubber discs (up to 600 mm) (Seafish, 2015).

The drag of the gear, combined with the floats on the headline, mean the weight of the trawl on the seabed is in the region of 10 to 20% of what it would be in air (Seafish, 2015).

A light otter trawl is one that uses anything less than the definition given for a heavy otter trawl, which include any of the following (MMO, 2014):

- Sheet netting of greater than 4 mm twine thickness
- Rockhoppers or discs of 200 mm or above in diameter
- A chain for the foot/ground line (instead of wire)

Generally, vessels will shoot and haul their gear over the stern of the boat (Seafish, 2015). Restrictions on vessels over 12 metres in length in the Southern IFCA district limits the size of gear that can be used within the district.

There is no typical gear set up used in the Solent and each individual has a different approach (Southern IFCA Committee Member Pers. Comm)[4]. The size and weight of trawl doors used in the Solent varies, however the largest doors likely to be used in the Solent are made of steel and measure approximately 52 x 38 inches, weighing 130 kg each (Southern IFCA Committee Member Pers. Comm). The ground rope used

[4] Information was provided by a Southern IFCA Committee Member who has valuable knowledge and experience of the fishery.

by the vessels ranges between 36 to 60 ft in length and commonly made of 16 mm wire with rubber discs of 4 to 6 inches, spaced 1 inch apart (Southern IFCA Committee Member Pers. Comm). The rubber discs are designed to maintain consistent contact with the seabed. Additional buoyancy may be attached to the ground rope to minimise contact with the seabed (Southern IFCA Committee Member Pers. Comm)**.** The length of the sweeps and bridles is approximately 90 ft (Southern IFCA Committee Member Pers. Comm). Trawls are towed at between 1 and 3.5 knots, depending on the state of the tide. In the Solent, the tow length is dependent on the level of weed and in some areas takes no longer than 10 minutes (Southern IFCA Committee Member Pers. Comm).

4.1.4 Beam trawl

A net is held open by a rigid framework to maintain trawl opening, regardless of towing speed, in addition to supporting the net (Seafish, 2015). The framework consists of a heavy tubular steel beam which is supported by steel beam heads at each end. Each beam head has wide shoes at the base which slide over the seabed (Seafish, 2015). A cone shaped net is towed from the framework, with the head rope attached to the beam and foot rope connected to the base of the shoes (Seafish, 2015). The footrope forms a 'U' shape curve behind the beam as it is towed over the seabed (Seafish, 2015). The beam is towed using a chain bridle which is attached to both shoes and at the centre of the beam; all coming together to form a single trawl warp which leads to the vessel (Seafish, 2015).

There are two types of beam trawl and these are referred to as 'open gear' and 'chain mat gear' (Seafish, 2015). Open gear uses a lighter rig, with a number of chains, known as 'ticklers', which are towed along the seabed across the mouth of the net (Figure 2) (Seafish, 2015). Tickler chains help to disturb fish from a muddy seabed. Open gear is used on clean and soft ground. Chain mat gear on the other hand is used for towing over harder and stonier seabed and if often used by larger vessels (Seafish, 2015). The chain mat gear uses a lattice work of chains which are towed from the back of the beam and attach to the footrope of the net (Figure 3) (Seafish, 2015). Lighter styles of beam, using fewer tickler chains and without a chain mat, are used to target shrimp (Seafish, 2015).

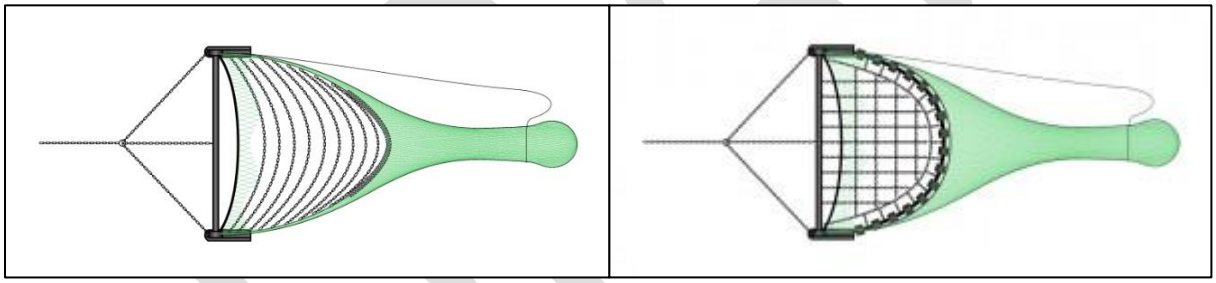


Figure 2. (a) 'Open gear' beam trawl, (b) 'Chain mat gear' beam trawl.

Generally, vessels below 12 metres, like those used in the Southern IFCA district, tow one trawl from the stern of the vessel (Seafish, 2015). The size of the beam towed, and the horsepower of many vessels, can be restricted by the local fishery regulations (Seafish, 2015). The sizes of trawls typically used in the Solent are approximately 3 m in width and weigh 650 kg with a chain matrix. These are not currently used within or on the fringes of the Needles MCZ.

4.1.5 Multi-rig trawl

A multi-rig rig demersal trawl uses a similar set up to a light otter trawl but occurs when two or more smaller trawls are towed side by side, as opposed to one. This makes it possible to fish a wider area without any increase in the drag of the gear. Typically, a multi-rig will be a twin- or triple- rig using two or three nets, respectively, side by side. A variety of configurations are used worldwide to target bottom-living species and the configuration chosen largely depends on the target species (Seafish, 2015). The configuration can vary based a number of components including the number of warps used, the length of the sweeps and bridles and the type of weight used to keep the inner wings of each net open (i.e. skid, trawl doors, chain clump weight, roller clump weight, depressor clump weight) (Seafish, 2015). The outer wings of outside nets are kept open using trawl doors (also known as otter boards), like an otter trawl.

4.1.6 Location, Effort and Scale of Fishing Activities

Light otter trawling takes place subtidally and occurs infrequently (1 to 2 times a year) on the outer northern and western fringes of the site on the edges of the main channel (known as the Needles Channel) in the western Solent. The number of vessels engaged in the activity is limited to 1 to 2 vessels. These vessels operate out of Cowes and Lymington. Both have historically used light otter trawls. One vessel has recently switched to a multi-rig trawl set up however it is not known to have been used within the Needles MCZ.

Based on the information described above; trawling occurs only up to a maximum of four times per year in the Needles MCZ. Hall *et al.* (2008) assessed the sensitivity of marine habitats and species to fishing activities. According to their fishing intensity categories[5] the fishing level in the Needles MCZ is classed as Light – 1-2 times a month during a season in 2.5nm x 2.5nm.

Sightings data displayed in Annex 3 illustrates trawl sightings data from 2009 to 2020. There are no sightings within the Needles MCZ. This is mostly due to the very low level of fishing that occurs within the MCZ, but is also due to the Southern IFCA adopting a risk-based enforcement approach which leads to patrols more often based in other areas of the district.

4.2 Co-location of fishing activity and features under assessment

Maps of the broad-scale habitat types can be found in Annex 1. This map can be used in conjunction with the knowledge of where fishing is known to occur to reveal where fishing activity occurs in relation to the designated features of the site.

Rock features are found throughout the site in Colwell Bay, Totland Bay and around the Needles (Annex 3). Trawling occurs on the fringes of the site over subtidal coarse and mixed sediments. Fishing will aim to avoid rocky areas to prevent snagging of the gear on the seafloor.

4.3 Pressures

4.3.1 Abrasion/disturbance of the substrate on the surface of the seabed/ Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion/ Removal of non-target species

The environmental impacts of bottom towed fishing gear are complex (Boulcott *et al*., 2014). The extent of disturbance depends on a number of factors including substrate type (Kaiser *et al*., 2002), design and weight of the gear (Boulcott & Howell, 2011) performance of the gear over a particular substrate (Caddy, 1973; Currie and Parry, 1999) and the sensitivity of the benthic community (Currie and Parry, 1996; Bergman *et al*., 1998; Collie *et al*., 2000a; Boulcott *et al*., 2014).

In a meta-analysis of 41 bottom towed impact control studies, only 3 were found to look at reef features, and these focused on biogenic reefs (Hiddink *et al.,* 2020). The meta-analysis revealed that effects of bottom towed gears were strongest on coarse sediments and biogenic structures. Additionally, those effects were worse for impacts caused by dredges rather than trawls (Hiddink *et al.,* 2020). Whole community biomass and numbers were found to be strongly negatively affected by bottom towed gear in benthic habitats and were determined to be the best indicators (Hinddink *et al.,* 2020). However, biomass of individual taxa was not found to be significantly affected (Hiddink *et al.,* 2020).

Dredges

Very few studies have been carried out of the impacts of bottom towed fishing gear over rocky reef habitat. A meta-analysis of 39 fishing impact studies revealed dredging had a more negative impact than trawling (Collie *et al*., 2000b). Potential effects include reductions in habitat structural complexity and subsequent habitat homogenisation, reduction in biodiversity, removal of erect epifaunal species and large sessile species some of which are likely to large, fragile and long-lived and physical damage to fragile structures (Sewell and Hiscock, 2005). Such impacts are caused through direct contact with the seabed.

[5] Heavy – Daily in 2.5 nm x 2.5 nm, Moderate – 1 to 2 times a week in 2.5 nm x 2.5 nm, Light – 1 to 2 times a month during a season in 2.5 nm x 2.5 nm, Single pass – Single pass of fishing activity in a year overall

Cranfield *et al.,* (2003) studied the effect of oyster dredges in the Foveaux Strait, New Zealand, on bryozoan biogenic reefs. Side scan surveys revealed that dredging over the reefs completely removed the biogenic structure and, on the fringes, had damaged the framework structure (Cranfield *et al.,* 2003). The removal of the biogenic structures had exposed associated sediments which were then transported down current, however this sediment supply stopped when dredging ceased due to a lack of oyster stock (Cranfield *et al.,* 2003).

In Lyme Bay, within the southern IFCA district king scallops are typically harvested using mechanical dredges in the past over rocky, boulder and coble reef habitats (Munro & Baldock, 2012). The introduction of a statutory closed area provided the opportunity to measure the effects of scallop dredging over rocky habitats. Three types of area were studied – areas which had been voluntarily closed to fishing before the statutory closure, areas newly closed as a part of the statutory closure, and areas which were open to fishing. In open areas there were significantly fewer taxa when compared to both closed and newly closed areas. In particular the number of branching sponges and cover of sponge crusts were significantly lower in areas open to scallop dredging (Munro & Baldock, 2012). The assemblage composition was also significantly different between open and closed areas (Munro & Baldock, 2012). Open sites were characterised by hydroids, polychaetes and barnacles, whilst the closed sites contained sponges as an important component (Munro & Baldock, 2012).

Trawling

Otter trawl fishing gear has contact with the seabed through ground rope, chains and bobbins, sweeps, doors and any chaffing mats or parts of the net bag (Jones, 1992). Otter door marks are often the most recognisable and commonly observed effects of otter trawls on the seabed (Caddy, 1973; Friedlander *et al*., 1999; Grieve *et al*., 2014). Bridles or sweeps, the cables that connect the trawl doors to the trawl net, can snag on boulders or other obstructions over rough ground (Grieve *et al*., 2014). This contact with the seabed disturbs the benthos and relocates stones and boulders (Gislason 1994).

A number of studies have reported impacts of otter trawling in areas of reef and where corals are present. In an area of mixed substrata at 50 to 100 m depth in north-western Australia, Moran and Stephenson (2000) reported, on each tow of an otter trawl (dimensions unknown), a 15.5% reduction in benthic organisms that stood higher than 20 cm off the seabed, comprised mainly of gorgonians, sponges and soft corals. Van Dolah *et al*. (1987) reported significant decreases in the density of barrel sponges and damage to finger sponges, vase sponges, whip corals, fan corals, stock corals and stony tree corals after a single pass with an otter trawl in a hard-bottom sponge and coral community at 20 m in Grays Reef, Georgia. The otter trawl used had a 40/54 fly net,12.2-m headrope,16.5-m footrope with 30 cm rubber rollers and 15-cm rubber discs and 1.8 x 1.2 m China V-doors. Recovery was reported to occur within one year (Van Dolah *et al*.,1987).

Deep-water trawling has had a clear and significant impact on deep-water coral reefs (200-1300m) and other organisms, including *Lophelia*, in the North Atlantic since the 1980s (Sewell and Hiscock, 2005; Malecha & Heifetz, 2017). Halls-Spencer *et al*. (2002) analysed commercial otter trawl catches taken from the West Ireland continental shelf break and West Norway and reported large amounts of coral bycatch in 5 out of 229 trawls, including pieces up to 1 m^2. ROV video observation revealed sparse living coral, coral rubble and track marks in trawled area. The otter trawls used in the fishery are fitted with rockhopper gear and 900-kilogram trawl doors. A similar study, looking at the same corals in the same area, documented that trawling had caused complete destruction of reef structures, removal and displacement of reefs by the otter boards and trawl nets (Fossa et al., 2002).

The intensity of trawling activity plays a key role in the severity of the effect to reef habitats. Kędra *et al.* (2017) found that high intensity trawled areas had considerably lower taxonomic richness, species numbers and significant differences in epifaunal abundance and biomass. Hydrozoans, bryozoans and annelids were particularly negatively affected; however, gastropods were found only in trawled areas (Kędra *et al.,* 2017). Sponges occurred five times less frequently in trawled areas (Kędra *et al.,* 2017).

Malecha & Heifetz (2017) revisited an experimentally trawled site, ~200m depth, in the Gulf of Alaska, 13 years after the experimental original study. Thirteen years after the trawling average density of large sponges

was more than 30% lower and incidence of sponge damage was 59% higher in trawled transects compared to reference areas, indicating the long-term effects of trawl damage to fragile species.

Unfortunately, due to the lack of similarity between areas and habitats in which trawling has been shown to cause adverse effects and those found in the Southern IFCA district, many of the studies examined are of limited relevance.

4.3.2 Changes in suspended solids/ Smothering and siltation rate changes

The resuspension of fine sediments takes place as fishing gear is towed along the seafloor (Johnson *et al*., 2002). Larger sand particles are redeposited near the dredge whilst measurable amounts of fine silt and clay particles remain in suspension and are potentially transported away by currents (Godcharles, 1971; Tuck *et al*., 2000). The effects of sediment resuspension include increased turbidity and thus a reduction in light, burial of benthic biota, smothering of adjacent areas including potential spawning areas, and negative effects on the feeding and metabolic rates of organisms (Johnson *et al*., 2002). These effects are site-specific and depend on grain size, sediment type, water depth, hydrological conditions, sensitivity of fauna, currents, tides and water mass properties (Coen, 1995).

Where gear is towed over rocky habitat the impact of this will be significantly reduced due to the low or non-existence level of sediment present within the sea habitats. However, if gear is towed between reef areas in coarse and mixed sediment the suspension of sediment is likely.

Dale *et al.,* (2011) used a particle tracking model to determine the effect of a vessel towing eight dredges on either side in a water current of 0.1m per second. The model suggested that the majority of all sediment size classes suspended settles within 100 meters of the dredge (Dale *et al.,* 2011). Of the suspended sand and larger particles, only 10m from the dredge all but 3.6% of these particles will have settled (Dale *et al.,* 2011). However, of the fraction of silt that makes up the sediment, 92.5% persists in the water column 100m away from the dredge site (Dale *et al.,* 2011). The total sediment accumulation immediately outside the dredge is just 1.6mm, and, after 1 hour, just 8,2% of the suspended silt remains in suspension at 315m away from the dredge which is comparable to low natural suspended sediment levels (Dale *et al.,* 2011).

For a 48-minute dredge tow, in combination with tidal period, in the far field (where the sediment has been carried by the current away from the dredge site) the maximum suspended concentration is 0.24g per m cubed, with a maximum settled thickness of 0.0012mm (Dale *et al.,* 2011). If sediment hotspots from multiple vessels coincided it would take more than 15 tows for silt concentrations to match low natural levels, and more than 200 tows for the levels to equal that seen during stormy conditions (Dale *et al.,* 2011). The model therefore suggests that reefs in the area are only at risk if they are within 10m of the dredge site, and that those which lay further afield will not be significantly affected by changes in turbidity, siltation or smothering rates beyond natural levels (Dale *et al.,* 2011).

The resuspension of sediment can impact upon benthic communities through smothering, burial and increased turbidity. These effects may extend to organisms living a distance away from the fished area (Kyte & Chew, 1975). If high levels of sediment are resuspended and exposure to such events is regular, impacts may be severe (Mercaldo-Allen & Goldberg, 2011). Increased turbidity can inhibit respiratory and feeding functions of benthic organisms, in addition to causing hypoxia or anoxia (Morgan & Chuenpagdee, 2003). Sediment resuspension can jeopardise the survival of bivalves and fish as a result of clogged gills and inhibition of burrowing activity (Dorsey & Pederson, 1998). Small organisms and immobile species are particularly vulnerable to smothering (Manning, 1957). A redistribution of finer sediment can also hinder the settlement of organisms if hard surfaces are smothered (Tarnowski, 2006). The severity of such impacts is largely determined by sediment type, the level of sediment burden and the tolerance of organisms which is largely related to their biology (i.e. size, relationship to substrate, life history, mobility) (Coen, 1995).

4.3.3 Natural disturbance

Communities that exist in areas of high natural disturbance rates are likely to have characteristics that provide resilience to additional disturbance (Hiddink *et al*., 2006a). Any vulnerable species would be unable to exist within conditions of frequent disturbance (Hiddink *et al*., 2006a). The impact of bottom towed fishing gear (such as trawling and scallop dredging is therefore expected to be higher in areas that experience low levels

of natural disturbance and lower at locations of high levels of natural disturbance (Hiddink *et al*., 2006a). Despite the significance between benthic community responses to bottom towed gears disturbance and levels of natural disturbance, the relationship remains unquantified (Hiddink *et al*., 2006a). There can often be a failure to detect the effect of experimental fishing disturbance in areas exposed to high levels of natural disturbance (Thrush & Dayton, 2002). Whilst it may be appropriate to equate effects of natural disturbance to some effects of trawling disturbance, it is not always the case. Fishing can involve a higher intensity of disturbance, although this is dependent on frequency and extent (Thrush & Dayton, 2002). Bottom towed gear effects small-sized organisms through sediment perturbations, which is comparable to that of natural disturbance, whereas its impacts on larger-bodied organisms will be through physical contact with fishing gear (Bergman & van Santbrink, 2000). The relatively low impact on benthic communities inhabiting mobile sediments might therefore only apply to small-bodied animals (Bergman & van Santbrink, 2000).

The Solent, including the Needles, is a dynamic area with strong tidal flows in the Needles mid-Channel reaching up to 4.5 knots on a spring tide and 2.9 knots at the Needles Lighthouse[6]. Bolam *et al*. (2014) modelled natural seabed disturbance as part of a study looking at the sensitivity of microbenthic second production to trawling in the English sector of the greater North Sea. Natural seabed disturbance was represented by tidal bed stress and kinetic energy at the seabed. Maps showing the probability of natural forces disturbing the seabed to 1 and 4 cm for a range of frequencies (once, 10 times, and 17 times were also created. These maps cover the Solent (Figure 3 & Figure 4), although the resolution is low as the area covered includes the North Sea and western English Channel. These maps however do demonstrate that the Solent, particularly the western Solent, including the Needles MCZ, is subject to relatively high levels of natural disturbance. Annual tidal bed stress ranges from 1.0-2.5 NM^2 in the western part of the Needles MCZ and 2.5-7.5 NM^2 in eastern part of the site. Kinetic energy at the seabed ranges from moderate to high within the site. The probability of natural forces disturbing the seabed to 1 cm reach the highest probability (0.81-1.00) at most frequencies, a high probability (0.61-0.8) at >4cm >10 days per year, and moderate probability (0.41-0.6) at >4cm >17 days a year.

[6] Information and diagrams on the tidal streams experienced in the western Solent can be found at http://www.visitmyharbour.com/articles/3188/hourly-tidal-streams-west-solent-area-np337

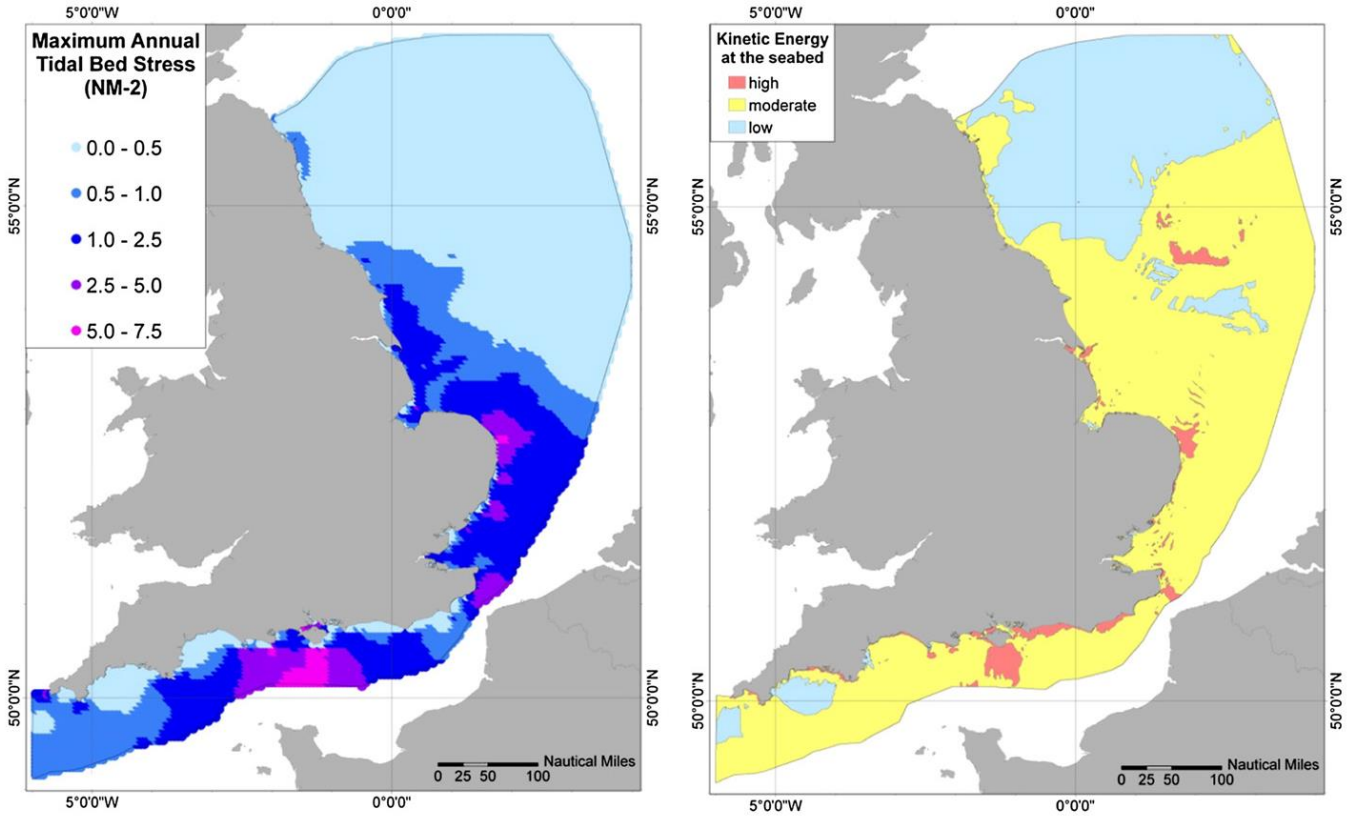


Figure 3. Maps of modelled natural disturbance of the seabed, represented by tidal bed stress (left) and kinetic energy (right). Source: Bolam *et al*., 2014

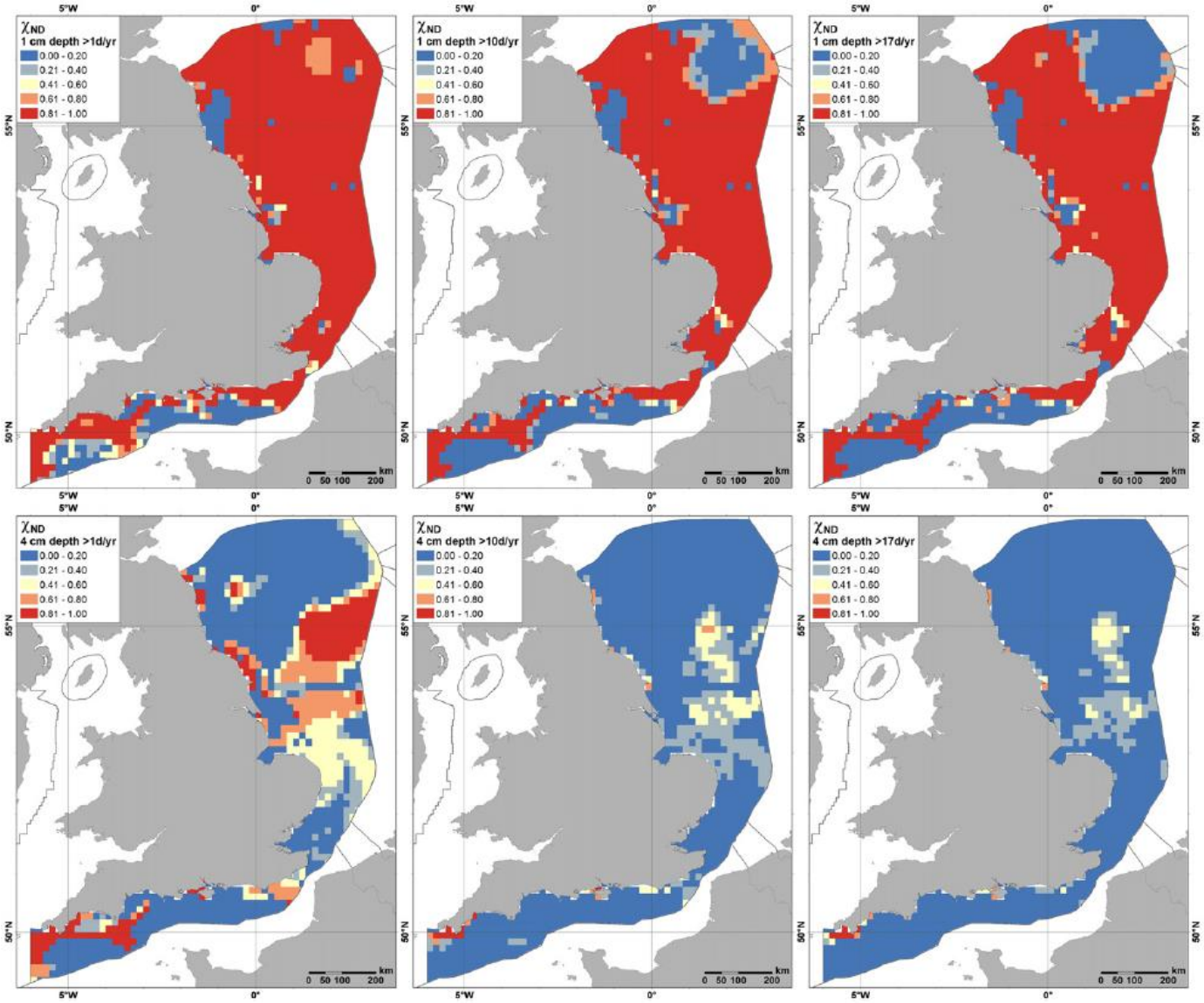


Figure 4. Maps of the modelled probability that natural forces disturb the seabed to different depths of 1 and 4 cm for a range of frequencies per year (once, 10 and 17 times). Source: Bolam *et al*., 2014

In the context of MPA management, it is important to qualify which changes occur to naturally dynamic communities as a result of natural variability within the environment, as opposed to that resulting from anthropogenic pressures (Goodchild *et al*., 2015). The reason being that the conservation objectives of a site are 'subject to natural change (Goodchild *et al*., 2015). It can therefore prove difficult in ascertaining if the conservation objective of a site is being compromised by anthropogenic pressures if the MPA feature is also subject to natural variability (Goodchild *et al*., 2015). Potential changes caused by towed fishing gear could be masked by the impacts of natural sediment movements which maintain the benthic community in a state of successional flux (Løkkeborg, 2005; Goodchild *et al*., 2015). A recent study attempted to analyse existing data to study effects of towed fishing gears on mobile sediments against a background of natural variability, however, it concluded the results of the study were of little direct value in terms of MPA management (Goodchild *et al*., 2015)

4.3.4 Sensitivity

A number of recent studies have endeavoured to map the sensitivity of habitats to different pressures (Tillin *et al*., 2010) and fishing activities (Hall *et al*., 2008).

Tillin *et al*. (2010) developed a pressure-feature sensitivity matrix, which in effect is a risk assessment of the compatibility of specific pressure levels and different features of marine protected areas. The approach used considered the resistance (tolerance) and resilience (recovery) of a feature in order to assess its sensitivity

to relevant pressures (Tillin *et al*., 2010). Where features have been identified as moderately or highly sensitive to benchmark pressure levels, management measures may be needed to support achievement of conservation objectives in situations where activities are likely to exert comparable levels of pressure (Tillin *et al*., 2010). In the context of this assessment, the relevant pressures likely to be exerted are surface abrasion, shallow abrasion/penetration and penetration and/or disturbance of the substrate below the surface of the seabed. Sensitivity to all pressures is considered high for Pink sea-fans, with medium confidence in these assessments (Table 5).

Hall *et al*. 2008 aimed to assess the sensitivity of benthic habitats to fishing activities. A matrix approach was used, composed of fishing activities and marine habitat types and for each fishing activity sensitivity was scored for four levels of activity (Hall *et al*., 2008). The matrix was completed using a mixture of scientific literature and expert judgement (Hall *et al*., 2008). The type of fishing activity chosen was 'beam trawls and scallop dredges' and 'light demersal trawls and seines' as they best encompassed the fishing activities under consideration. The majority towed bottom gears where considered unlikely to be deployed in these habitat types and as such were not assessed for heavy to light gear intensities. Rock with erect and branching species appears to be slightly less sensitive to a single pass of the heavier gear types than very slow growing erect and branching species (Table 6). On the other hand, the assessment for the lighter gear type revealed a high sensitivity for both habitat types to a single pass, which may be inaccurate when considering against the sensitivity assigned for heavier gear types.

Table 5. Sensitivity of features to pressures identified by Tillin et al. (2010). Confidence of sensitivity assessment is included in brackets.

	Pressure			
Feature	**Surface abrasion: damage to seabed surface features**	**Shallow abrasion/penetration: damage to seabed surface and penetration**	**Penetration and/or disturbance of the substrate below the surface of the seabed**	**Siltation rate changes (low)**
Moderate energy circalittoral rock	Medium (low)	Medium (low)	Medium (low)	Not sensitive to medium (loW)
High energy infralittoral rock	Medium (low)	Medium (low)	Medium to High (Low)	Not sensitive (loW)
Moderate energy infralittoral rock	Medium (low)	Medium (low)	Medium to high (low)	Not sensitive (low)

Table 6. Sensitivity of relevant features to different intensities (high, medium, low, single pass) of static gear (fishing activities which anchor to the seabed) as identified by Hall *et al*. (2008).

Habitat Type	**Gear Type**	**Gear Intensity***			
		Heavy	Moderate	Light	Single pass
Erect and branching spp. very slow growing	**Beam trawls and scallop dredges**				High
	Light demersal trawls and seines				High
	Demersal trawls				High
Rock with low-lying fast-growing faunal turf	**Beam trawls and scallop dredges**				Low
	Light demersal trawls and seines				Medium
	Demersal trawls				Low
Rock with erect and branching species	**Beam trawls and scallop dredges**				Medium
	Light demersal trawls and seines				High
	Demersal trawls				Medium
*Gear activity levels are defined as follows; Heavy – Daily in 2.5 nm x 2.5 nm, Moderate – 1 to 2 times a week in 2.5 nm x 2.5 nm Light – 1 to 2 times a month during a season in 2.5 nm x 2.5 nm, Single pass – Single pass of fishing activity in a year overall					

4.3.5 Recovery

Since the introduction of a statutory closed area in Lyme Bay it has provided the opportunity to study the recovery of rocky reef habitats and species from the effects of scallop dredging. Three years after the gear was prohibited, overall sessile reef associated species (RAS) were significantly greater within the Marine Protected Area compared to before and still open controls (Sheehan *et al.,* 2013). The mean abundance of RAS increased by 158%. Analysis of the assemblage compositions revealed that before the closure open to fishing and MPA sites were similar to one another, however after three years before and after sites assemblage composition were significantly different. Four species (ross coral, sea squirt (*P. mammillata)*, dead man's fingers and branching sponges) significantly increased in abundance from before the MPA to the after the MPA relative to open to fishing controls (Sheehan *et al.,* 2013). These species were found in coarse, cobbled and boulder sediment areas between those areas of solid bedrock, showing that the exclusion of bottom towed fishing gear not only enables the reef itself to recover, but also enables reef associated species to thrive in areas between reef structures (Sheehan *et al.,* 2013).

A longer-term study of the Lyme Bay reefs found that species recovery within these sites showed that recovery is linked to life history characteristics (Kaiser *et al.,* 2018). Species with high dispersal rates and less specific habitat requirement such as soft corals (dead men's fingers) and king scallops recovered within 3 years, whilst longer lived ross corals, white sea squirts and pink sea fans increased in abundance but had not fully recovered after 10 years (Kaiser *et al.,* 2018). Kaiser *et al.,* predicted that these species could take 17 to 20 years to recover fully from the damage of scallop dredging (Kaiser *et al.,* 2018).

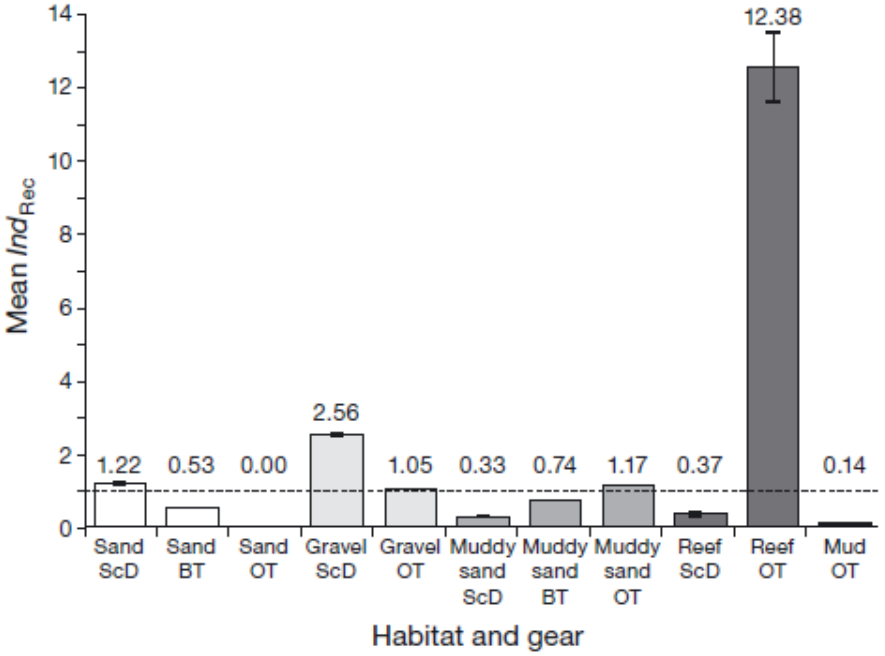
Foden *et al*. (2010) investigated recovery of different sediment types based on the spatial and temporal distribution of benthic fishing. Vessel monitoring system data (2006 to 2007) was used to estimate the distribution and intensity of scallop dredging, beam trawling and otter trawling in UK marine waters. This data was then linked to habitat in a geographic information system. Recovery periods for different habitats were estimated based on existing scientific literature for gear types and fishing intensity (Table 10), with recovery rates generally increasing with sediment hardness. It was estimated that based on mean annual trawl frequencies that 80% of bottom-fished areas were able to recover completely before repeat trawling. In 19% percentage bottom-fished areas however, the frequency of scallop dredging in sand and gravel and otter trawling in muddy sand and reef habitats occurred at frequencies that prevented full habitat recovery. At average fishing intensities (for each gear type), sand and mud habitats were able to recover fully, whilst gravel, muddy sand and reef habitats were fished at frequencies in excess of the estimated recovery period (shown in Figure 5 where the mean index of recovery exceeds 1).

Table 7 Recovery rates (days) of different habitats for different fishing gear types. ND: No Data. Source: Foden et al., 2010.

Gear Type	Reef
Beam trawl	ND
Otter trawl	2922[a]
Scallop dredge	1175[a]

[a] Kaiser *et al.,* 2006

Figure 5 Mean index of recovery (Ind_{Rec}) for gear-habitat combinations using fishing intensity data derived from Vessel Monitoring Systems in 2007. At Ind_{Rec} Rec = 1, the recovery period is equal to fishing frequency (horizontal dashed line), at Ind_{Rec} <1 fishing frequency is less than the predicted recovery period and at Ind_{Rec} fishing frequency exceeds the recovery period. BT: Beam Trawl, OT: Otter Trawl and ScD: Scallop Dredge. Source: Foden et al., 2010.



Physical disturbance from chronic trawling occurs over large spatial scales and it may be expected that recovery rates will be slower than those assumed from experimental studies (Hinz *et al*., 2009). Recovery at small experimental scales is likely to simply be immigration, which is a form of recovery that is unlikely in large and repeatedly trawled areas (Jennings *et al*., 2001). The recovery of chronically disturbed benthic communities on fishing grounds will be largely dependent on recruitment and population growth, rather than on immigration from adjacent untrawled areas (Hiddink *et al*., 2006b). The importance of larval recruitment for the recolonization of a disturbed area increases with the size of the disturbed area (Smith & Brumsickle, 1989; Foden *et al*., 2010). The time of year when disturbance takes place may also influence the mode of recovery and recovery rate of the affected community (Foden *et al*., 2010). The recruitment supply of larvae and adult infauna will vary at different times of year and in relation to the physical characteristics at a specific location (Foden *et al*., 2010). The hydrodynamic regime will influence the rate of recolonization by influencing the deposition of infaunal adults and larval stages (Foden *et al*., 2010).

Population recovery rates are known to be species specific (Roberts *et al*., 2010). Long-lived bivalves will undoubtedly take longer to recovery from disturbance than other species (Roberts *et al*., 2010). Megafaunal species such as molluscs and shrimp over 10 mm in size, especially sessile species, are more vulnerable to impacts of fishing gear than macrofaunal species as a result of their slower growth and therefore are likely to have long recovery periods (Roberts *et al*., 2010). Short-lived and small benthic organisms on the other hand have rapid generation times, high fecundities and therefore excellent recolonization capacities (Coen, 1995). For example, slow-growing large biomass biota such as sponges and soft corals are estimated to take up to 8 years, whilst biota with short life-spans such as polychaetes are estimated to take less than a year (Kaiser *et al*., 2006).

4.4 Existing management measures

All Bottom Towed Gears:

- **Bottom Towed Fishing Gear** byelaw 2016 – prohibits bottom towed fishing gear over sensitive features including reef features and seagrass within the District, closing most of the site to these activities.

- **Vessels Used in Fishing** byelaw – prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear and restricted to carry less static gear.

Trawling:

- Southern IFCAs **Minimum Fish Sizes** Byelaw prohibits the taking of fish under the specified size (Black Seabream, Brill, Dab, Conger Eel, Flounder, Red Mullet, Shad, Turbot, Witch Flounder).
- A separate Minimum Size Southern IFCA byelaw exists for Skates and Rays and this states that no person shall take any ray that measures less than 40 cm between the extreme tips of the wings or any wing which measures less than 20 cm in its maximum dimension and which is detached from the body of a skate or ray.
- Other regulations include minimum sizes, mesh sizes and catch composition as dictated by European legislation. European minimum sizes, listed under Technical Conservation Regulation 1241/2019 and Bass Emergency Measures 2020/123 specify the minimum size for bass is 42 cm

4.5 Table 8. Assessment of trawling on high energy infralittoral rock, moderate energy infralittoral rock and moderate energy circalittoral rock in the Needles MCZ.

Feature	Attribute	Target	Potential pressure(s) and Associated Impacts	Likelihood of Impacts Occurring/Level of Exposure to Pressure	Current mitigation measures
High energy infralittoral rock; Moderate energy infralittoral rock; moderate energy circalittoral rock	Distribution: presence and spatial distribution of biological communities	Not available	Abrasion/disturbance of the substrate on the surface of the seabed and penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion, and removal of non-target species were identified as potential pressures. Bottom towed fishing gear directly impacts on rock habitats through physical passage of fishing gear over the seabed. The otter doors, chains and net bag found on trawl gear and the teeth and dredge on a shellfish dredge scrape the surface and can lead to the damage and removal of erect, branching and soft epifaunal species. Recovery of these species will take years and is dependent upon the life history characteristics of the species, with some predicted to require 20 years to recover.	Demersal trawling is known to occur in the Solent, and on the fringes of the Needles MCZ. There are no recent sightings within the site. Historic sightings show that trawling has occurred in the most northern section of the site over subtidal sediments. Rocky reef habitats support a wide range of fauna including algae, hard corals, soft corals, hydrozoans, sea squirts, sponges, crustaceans, echinoderms, fish and many more. In addition, they can support nationally rare species such as the pink sea fan and sunset cup coral. Scientific literature has indicated that dredging and trawling can have significant negative effects on the presence, diversity and abundance of many reef associated species. Additionally, trawling will drag boulders, cobles, species and biogenic structures across the seafloor. The intensity of the activity is linked to the severity of the affects. Recovery of reef associated species in Lyme Bay, Dorset is between 3 and 20 years depending on the life history characteristics of the species. Hall *et al.,* (2008) assessed the sensitivity of reef habitats to all bottom towed fishing gear types for a single pass to be medium to high. Trawling takes place on the fringes of the site over subtidal sediments. The habitats and associated communities are highly sensitive to these types of fishing gear and have a long recovery period. If fishing were to occur over the habitats it could lead to	**Bottom Towed Fishing Gear** byelaw 2016 – prohibits bottom towed fishing gear over sensitive features including reefs within the District, closing most of these habitats to these activities **Vessels Used in Fishing** byelaw – prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear and restricted to carry less static gear.
	Structure and function: presence and abundance of key structural and influential species	Not available			
	Structure: species composition of component communities	Not available			

				significant damage and changes to the communities associated with the feature which would take many years to recover. Therefore, it is believed that trawling will pose a significant risk to the rock features within the Needles MCZ.	
	Structure: physical structure of rocky substrate	Not available	Physical impacts on the seabed from trawling and dredging include scraping and ploughing, creation of depressions, trenches, scouring and flattening of the seabed, and dragging of large boulders/rock features. Studies on the effects of otter trawling in variable habitats have revealed trawling can lead to the removal of biogenic structures, moved or overturn stones and boulders, smooth the seafloor and exposed sediment/shell fragments.	Addressed above	Addressed Above
	Supporting Process sedimentation rate	Not available	Smothering and siltation rate changes (Light) and Changes in suspended solids (water clarity) were identified as potential pressures. The resuspension of sediment can impact upon benthic communities through smothering, burial and increased turbidity. These effects may extend to organisms living a distance away from the fished area. The timescale for recovery after trawling disturbance largely depends on sediment type, associated fauna and rate of natural disturbance, and variation in recovery arises from characteristics specific to the site. Generally	Demersal trawling is known to occur in the Solent, and on the fringes of the Needles MCZ. There are no recent sightings within the site. Historic sightings show that trawling has occurred in the most northern section of the site over subtidal sediments. Rocky reef habitats support a wide range of fauna including algae, hard corals, soft corals, hydrozoans, sea squirts, sponges, crustaceans, echinoderms, fish and many more. In addition, they can support nationally rare species such as the pink sea fan and sunset cup coral. Scientific literature has indicated that dredging and trawling may resuspend sediment which can lead to changes in smothering and siltation rate. This can negatively affect communities through smothering, burial	Addressed above.
	Supporting processes water quality - turbidity	Not available			

			speaking, locations subject to high levels of natural disturbance, the associated fauna are likely to be adapted to withstand and recover from disturbance.	and restriction of respiratory or feeding processes. The timescale for recovery for these processes however varies considerably depending on the scale of the impact. Dale *et al.,* (2011) used a model to track suspended sediment from a boat towing 8 dredges on either side. The model suggested that reefs in the area are only at risk if they are within 10m of the dredge site, and that those which lay further afield will not be significantly affected by changes in turbidity, siltation or smothering rates beyond natural levels (Dale *et al.,* 2011). Tillin *et al.,* (2010) completed a sensitivity assessment of rock habitats to siltation rate changes. He found that high energy infralittoral rock and moderate energy infralittoral rock were not sensitive to this pressure. Moderate energy circalittoral rock was not sensitive to medium sensitivity to this pressure. The site is located on the west corner of the Isle of Wight where strong tidal flows are frequent and energy at the seabed in high. The features themselves are high - moderate energy indicating that they are exposed to strong to moderate wave action and the water does not lie still. Therefore, resuspended sediment would be unlikely to settle over the feature. Trawling in is known to occur on the fringes of the site over subtidal sediment. The habitat is not sensitive to medium sensitivity to this pressure as it is high energy and therefore particles are unlikely to settle over the	

				feature. Additionally, activity levels are very low with only two vessels able to take part in the fishery Therefore, it is believed that bottom towed fishing gears will not significantly affect the turbidity, smothering and siltation rates of the rock features in the Needles MCZ.	

4.6 Site Condition

A condition assessment has not yet been completed by Natural England for the Needles MCZ. Additionally, this site is not underpinned by another MPA and therefore, no condition assessment of areas within the site are available.

5 Proposed mitigation measures

In recognition of the potential pressures of bottom towed fishing gear upon designated features and their supporting habitats, Southern IFCA recognises that management measures will need to be put in place to protect sensitive; High energy infralittoral rock, Moderate energy infralittoral rock and Moderate energy circalittoral rock features from the effects of all forms of bottom towed fishing gears. This is due to the result of this MCZ assessment which has found that bottom towed fishing gears are likely to pose a significant risk to the rock features of the Needles MCZ.

Based on the findings of the assessment, the Authority is therefore required to develop management that will provide protection to the rock features within the site from the relevant fishing gears. Spatial closures, based on the most up to date data for the location of rock features, will be introduced and incorporated into appropriate management following best practice[7]. This will involve consultation with the local community and the consideration of formal advice from the Authorities Statutory Nature Conservation Body Natural England. Existing closures will be considered against the updated data to determine the most appropriate course of action to protect the features and ensure Southern IFCA meets its responsibilities afforded by the Marine and Coastal Access Act 2009.

6 Conclusion

In order to conclude whether types of bottom towed fishing gear (trawling) pose a significant risk, it is necessary to assess whether the impacts of the activities will hinder the achievement of the general management approach of the designated feature (high energy infralittoral rock, moderate energy infralittoral rock and moderate energy circalittoral rock) of maintain at favourable condition' and the sites conservation objectives, namely:

"The conservation objective of each of the zones is that the protected habitats:

1. are maintained in favourable condition if they are already in favourable condition
2. be brought into favourable condition if they are not already in favourable condition

For each protected feature, favourable condition means that, within a zone:

1. its extent is stable or increasing
2. its structure and functions, its quality, and the composition of its characteristic biological communities (including diversity and abundance of species forming part or inhabiting the habitat) are sufficient to ensure that its condition remains healthy and does not deteriorate

Any temporary deterioration in condition is to be disregarded if the habitat is sufficiently healthy and resilient to enable its recovery.

Having reviewed a wide range of evidence, including scientific literature, IFCO knowledge, habitat feature mapping, it has been concluded that bottom towed fishing gear activity as it is currently managed is likely to pose a significant risk to high and moderate energy infralittoral rock and high energy circalittoral rock within the Needles MCZ.

The review of the research into the impacts of bottom towed fishing gear on subtidal rock habitats reported the habitat to have medium to high sensitivity to a single pass. It was determined that the potential for fishing activity to occur over or in close proximity to the features of the site could prevent the ability of subtidal rock

[7] http://www.association-ifca.org.uk/Upload/About/ifca-byelaw-guidance.pdf

habitats to attain their ‘maintain’ general management approach. In summary, this was based upon the following evidence:

- IFCO knowledge indicates that trawling occurs on the fringes of the site over subtidal sediment at a very low intensity.
- Sightings data shows historic trawl sightings in the north of the site and outside in the Solent.
- A review of scientific literature demonstrated that bottom towed fishing gear at any intensity can lead to the direct removal, damage and mortality of the associate’s species and communities found on rock habitats. Trawling can drag boulders, cobbles, species and biogenic structures.
- Sensitivity of rock habitats to pressures associated with trawls is medium to high.
- Rock associated species can take 3 to 20 years to recover.

It is therefore recognised that the activities have the potential to pose a significant risk upon the rock feature attributes:

- Distribution: presence and spatial distribution of biological communities
- Structure and function: presence and abundance of key structural and influential species
- Structure: species composition of component communities
- Structure: physical structure of rocky substrate

In recognition that the feature will be at risk from BTFG activity, additional management measures are required to ensure the MCZs conservation objective can be furthered. The location, timing, duration and intensity of bottom towed fishing gear within the site will be influenced by new management measures being developed, which will protect the sensitive feature (high and moderate energy infralittoral rock, moderate energy circalittoral rock), by prohibiting all BTFG activities over the feature. This is to support the general management approach of the features discussed at a favourable condition.

When the above evidence, fishing activity levels, current and, proposed management measures are considered it has been concluded that bottom towed fishing gear will not pose a significant risk to the achievement of sites conservation objectives to ‘maintain high energy infralittoral rock, moderate energy infralittoral rock and moderate energy circalittoral rock at favourable condition. Southern IFCA must seek to ensure that the conservation objectives of any MCZ in the district are furthered.

7 References

Bergman, M.J. N., Ball, B., Bijleveld, C., Craeymeersch, J. A.,Munday, B. W., Rumohr, H., & van Santbrink, J.W. 1998. Direct mortality due to trawling. In the Effects of Different Types of Fisheries on the North Sea and Irish Sea Benthic Ecosystems, NIOZ-Rapport 1998–1, RIVO-DLO Report C003/98, pp. 167–184. Ed. by J. H. Lindeboom, and S. J. de Groot. Netherlands Institute for Sea Research, Texel, Netherlands.

Bergman, M.J.N. & van Santbrink, J.W. 2000. Mortality in megafaunal benthic populations caused by trawl fisheries on the Dutch continental shelf in the North Sea in 1994. *ICES J. Mar. Sci*., 57, 1321-1331.

Bolam, S.G., Coggan, R.C., Eggleton, J., Diesing, M., Stephens, D. 2014. Sensitivity of microbenthic secondary production to trawling in the English sector of the Greater North Sea: A biological tarsit approach. Journal of sea research. 85: 162-177.

Boulcott, P., and Howell, T. R.W. 2011. The impact of scallop dredging on rocky-reef substrata. *Fish. Res*., 110, 415–420.

Boulcott, P., Millar, C.P. & Fryer, R.J. 2014. Impact of scallop dredging on benthic epifauna in a mixed-substrate habitat. *ICES J. Mar. Sci*., 71, 4, 834-844.

Brown, C.J., Eaton, R.A. & Thorp, C.H. 2001. Effects of chromated copper arsenate (CCA) wood preservative on early fouling community formation. *Marine Pollution Bulletin*, **42**, 1103-1113.

Caddy, J.F. 1973. Underwater observations on tracks of dredges and trawls and some effects of dredging in a scallop ground. *J. Fish. Res. Board. Can*., 30,173–180.

Coen, L.D. 1995. A review of the potential impacts of mechanical harvesting on subtidal and intertidal shellfish resources. SCDNR-MRRI, 46 pp.

Coen, L.D. 1995. A review of the potential impacts of mechanical harvesting on subtidal and intertidal shellfish resources. SCDNR-MRRI, 46 pp.

Collie, J. S., Escanero, G. A., and Valentine, P. C. 2000a. Photographic evaluation of the impacts of bottom fishing on benthic epifauna. *ICES J. Mar. Sci*., 57, 987–1001.

Collie, J.S., Hall, S.J., Kaiser, M.J. & Poiner, I.R. 2000b. A quantitative analysis of fishing impacts on shelf-sea benthos. *J. Anim. Ecol*., 69, 785-798.

Cranfield, H.J., Manighetti, B., Michael, K.P, Hill, A. 2003. Effects of oyster dredging on the distribution of bryozoan biogenic reefs and associated sediments in Foveaux Strait, southern New Zealand. Continental Shelf Research. 23: 1337-1357.

Currie, D. R., & Parry, G.D. 1996. Effects of scallop dredging on a soft sediment community: a large-scale experimental study. *Mar. Ecol. Prog. Ser*., 134: 131–150.

Dale, A.C. Boullcott, P., Sherwin, T.J. 2011. Sedimentation patterns caused by scallop dredging in a physically dynamic environment. Marine Pollution Bulletin. 62:2433-2441

Dorsey, E.M., ad Pederson, J. 1998. Effects of Fishing Gear on the Sea Floor of New England. Conservation Law Foundation. Available at: http://nsgl.gso.uri.edu/mit/mitw97003/effects_of_fishing_gear.htm

Duval, D.M., 1963. The biology of *Petricola pholadiformis* Lamarck (Lammellibranchiata: Petricolidae). *Proceedings of the Malacological Society*, **35**, 89-100.Foden, J., Rogers, S.I. & Jones, A.P. 2010. Recovery of UK seabed habitats from benthic fishing and aggregate extraction – towards a cumulative impact assessment. *Mar. Ecol. Prog. Ser*., **411**, 259-270.

Foden, J., Rogers, S.I., Jones, A.P. Recovery of UK seabed habitats from benthic fishing and aggregate extraction – towards a cumulative impact assessment. Marine Ecological Progress Series. 411:259-270

Fossa, J.H., Mortensen, P.B. & Furevik, D.M., 2002. The deep-water coral *Lophelia pertusa* in Norwegian waters: distribution and fishery impacts. *Hydrobiologia,* **471**, 1-12.

Friedlander, A.M., Boehlert, G.W., Field, M.E., Mason, J.E., Gardner, J.V. & Dartnell, P. 1999 Sidescan-sonar mapping of benthic trawl marks on the shelf and slope off Eureka, California. *Fish. Bull*., 97, 786–801.

Gislason, H., 1994. Ecosystem effects of fishing activities in the North Sea. *Marine Pollution Bulletin,* **29**, 520-527.

Godcharles, M.F. 1971. A study of the effects of a commercial hydraulic clam dredge on benthic communities in estuarine areas. Fla. Dep. Nat. Resour. Mar. Res. Lab. Tech. Ser. 64. 51 pp.

Goodchild, R., Brutto, D., Snaith, E., Frost, N., Kaiser, M. & Salmon, P. 2015. Analysis of existing data to study effects of towed fishing gears on mobile sediments against a background of natural variability. Funded by Department for Environment, Food and Rural Affairs (Defra). 65 pp.

Grieve, C., Brady, D.C. & Polet, H. 2014. Best practices for managing, measuring and mitigating the benthic impacts of fishing – Part 1. Marine Stewardship Council Science Series, 2, 18 – 88.

Hall, K., Paramor, O.A.L., Robinson, L.A., Winrow-Giffin, A., Frid, C.L.J., Eno, N.C., Dernie, K.M., Sharp, R.A.M., Wyn, G.C. & Ramsay, K. 2008. Mapping the sensitivity of benthic habitats to fishing in Welsh Waters: development of a protocol. CCW (Policy Research) Report No: 8/12. 85 pp.

Hall-Spencer, J., V. Allain, and J.H. Fossa. 2002. Trawling damage to Northeast Atlantic ancient coral reefs. *Proc. R. Soc. Lond*. B., 269, 507-511.

Hiddink JG, Kaiser MJ, Sciberras M, et al. Selection of indicators for assessing and managing the impacts of bottom trawling on seabed habitats. *J Appl Ecol*. 2020;00:1–11.
Hiddink, J.G., Jennings, S., Kaiser, M.J., Queirós, A.M., Duplisea, D.E. and Piet, G.J., 2006. Cumulative impacts of seabed trawl disturbance on benthic biomass, production and species richness in different habitats. *Can. J. Fish. Aquat. Sci*., 63, 4, 721-736.

Johnson, K.A. 2002. A review of national and international literature on the effects of fishing on benthic habitats. NOAA Tech. Memo. NMFS-F/SPO-57. 72 pp.

Jones, J.B. 1992. Environmental impact of trawling on the seabed: a review. *New Zeal. J. Mar. Freshwat. Res*., 26, 59-67.

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

Kaiser, M.J., Collie, J.S., Hall, S.J., Jennings, S. & Poiner, I.R. 2002. Modification of marine habitats by trawling activities: prognosis and solutions. *Fish and Fisheries*, 3, 1-24.

Kaiser, M.J., Hormbrey, S., Booth, J.R., Hinz, H., Hiddink, J.G. 2018. Recovery linked to life history of sessile epifauna following exclusion of towed mobile fishing gear. Journal of Applied Ecology. 00:1-11
Kędra, M., Renaud, P.E., Andrade, H. 2017. Epibenthic diversity and productivity on a heavily trawled Barents Sea bank (Tromsøflaket). Oceanologica. 59:93-101.

Knight, J.H., 1984. *Studies on the biology and biochemistry of* Pholas dactylus *L.*. , PhD thesis. London, University of London.

Kyte, M.A. & Chew, K.K. 1975. A review of the hydraulic escalator shellfish harvester and its known effects in relation to the soft-shell clam, *Mya arenaria*. Seattle (WA) Washington Sea Grant Program, University of Washington. 32 pp.

Løkkeborg, S. 2005. Impacts of trawling and scallop dredging on benthic habitats and communities. FAO Fisheries Technical Paper 472. Food and Agriculture Organisation of the United Nations. 69 pp.

Malecha, P. & & Heifetz, J. 2017. Long-term effects of bottom trawling on large sponges in the gulf of Alaska. *Continental shelf research.* **150:** 18-26

Manning, J.H. 1957. The Maryland softshell clam industry and its effects on tidewater resources. Md. Dep. Res. Educ. Resour. Study Rep. **11:** 25 pp.

Mercaldo-Allen, R. & Goldberg, R. 2011. Review of the Ecological Effects of Dredging in the Cultivation and Harvest of Molluscan Shellfish. NOAA Technical Memorandum NMFS-NE-220. 84 pp.

Micu, D., 2007. Recent records of Pholas dactylus (Bivalvia: Myoida: Pholadidae) from the Romanian Black Sea, with considerations on its habitat and proposed IUCN regional status. Acta Zoologica Bulgarica, 59, 267-273.MMO. 2014. Fishing gear glossary for the matrix (by gear type). Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/314315/gearglossary_gear.pdf [Accessed 2016, 19th September].

Morgan, L.E. & Chuenpagdee, R. 2003. *Shifting gears: Addressing the collateral impacts of fishing methods in US waters*. PEW Science Series. Washing D.C., Island Press.

Munro, C. D. and Baldock, B.M., 2012. *Lyme Bay Closed Area: measuring recovery of benthic species in cobble reef habitats - analysis of data collected by SCUBA divers September 2008, August 2009 and July 2010*. A Marine Bio-images report. Marine Bio-images, Exeter, Devon, UK.

Pinn, E.H., Richardson, C.A., Thompson, R.C. & Hawkins, S.J., 2005. Burrow morphology, biometry, age and growth of piddocks (Mollusca: Bivalvia: Pholadidae) on the south coast of England. Marine Biology, 147(4), 943-953.

Richter, W. & Sarnthein, M., 1976. Molluscan colonization of different sediments on submerged platforms in the Western Baltic Sea. In *Biology of benthic organsisms* (ed. B.F. Keegan, P.Ó. Céidigh & P.J.S. Boaden), pp. 531-539. Oxford: Pergamon Press.Seafish. 2015. Basic fishing methods. A comprehensive guide to commercial fishing methods. August 2015. 104 pp.

Sewell, J. & Hiscock, K. 2005. Effects of fishing within UK European Marine Sites: guidance for nature conservation agencies. Report to the Countryside Council for Wales, English Nature and Scottish Natural Heritage from the Marine Biological Association. Plymouth: Marine Biological Association. CCW Contract FC 73-03-214A. 195 pp.

Sheehan, E.V., Cousens, S.L., Nancollas, S.J., Stauss, C., Royle, J., Attrill, M.J. 2013. Drawing Lines at the sand: evidence for functional vs. visual reef boundaries in temperate Marine Protected Areas. Marine Pollution Bulletin.

Tarnowski, M. 2006. A literature review of the ecological effects of hydraulic escalator dredging. *Fish. Tech. Rep. Ser.* **48**: 30

Thrush, S.F. & Dayton, P.K. 2002. Disturbance to marine benthic habitats by trawling and dredging: implications for marine biodiversity. *Annu. Rev. Ecol. Syst*., 33, 449-473.

Tillin, H.M. & Hill, J.M., 2016. Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 14-01-2020]. Available from: https://www.marlin.ac.uk/habitat/detail/152

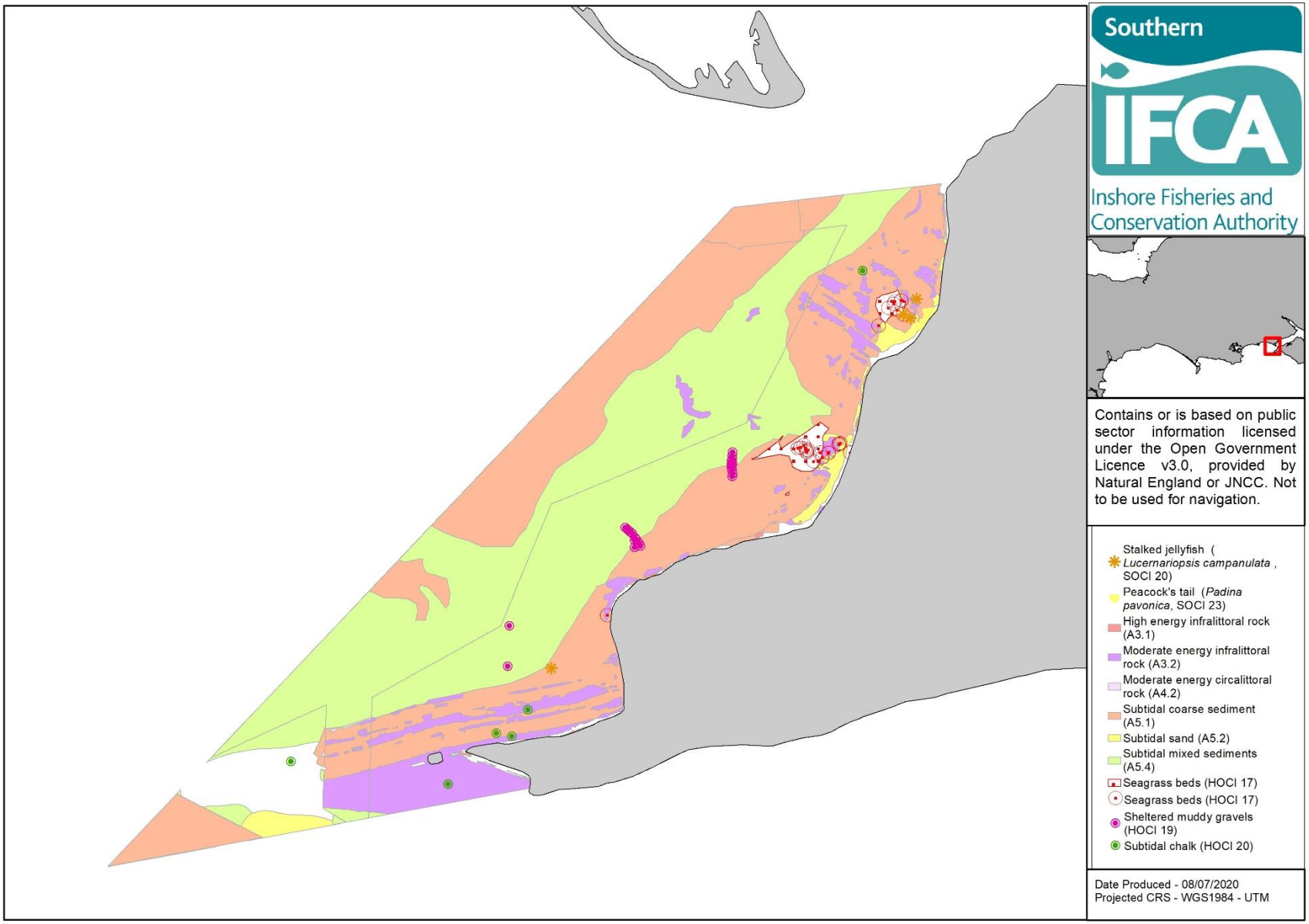
Tillin, H.M., Hull, S.C. & Tyler-Walters, H. 2010. Development of a Sensitivity Matrix (pressures-MCZ/MPA features). Report to the Department of Environment, Food and Rural Affairs (DEFRA) from ABPMer, Southampton and the Marine Life Information Network (MarLIN) Plymouth: Marine Biological Association of the UK. Defra Contract No. MB0102 Task 3A, Report No. 22. 947 pp.

Tillin, H.M., Mainwaring, K., & Garrard, S. L. 2016. [Mytilus edulis] beds on sublittoral sediment. In Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 21-04-2020]. Available from: https://www.marlin.ac.uk/habitat/detail/36

Tuck, I.D., Bailey, N., Harding, M., Sangster, G., Howell, T., Graham, N. & Breen, M. 2000. The impact of water jet dredging for razor clams, *Ensis* sp., in a shallow sandy subtidal environment. *J. Sea Res*., **43**, 65-81.

Van Dolah, R. F., Wendt, P. H. & Levisen, M. V., 1991. A study of the effects of shrimp trawling on benthic communities in two South Carolina sounds. *Fish. Res*., 12, 2, 139-156.

Annex 1. Broadscale habitat and species map for the Needles Marine Conservation Zone.



Annex 2. Advice on operations for commercial trawling activity in the Needles MCZ

Pressure Name	Habitat										Species		
	High energy infralittoral rock	Moderate energy infralittoral rock	Seagrass beds	Sheltered muddy gravels	Subtidal chalk	Subtidal coarse sediment	Subtidal mixed sediments	Subtidal mud	Subtidal sand	Moderate energy circalittoral rock	Native oyster	Peacock's tail	Stalked jellyfish (Calvadosia campanulata)
Abrasion/disturbance of the substrate on the surface of the seabed	S	S	S	S	S	S	S	S	S	S	S	S	S
Changes in suspended solids (water clarity)	S	S	S	S	S	S	S	S	S	S	S	NS	S
Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion		S	S	S	S	S	S	S	S	S	S		S
Removal of non-target species	S	S	S	S	S	S	S	S	S	S	S	S	S
Smothering and siltation rate changes (Light)	NS	S	S	S	S	IE	S	S	S	S	S	S	S
Deoxygenation	IE	S	NS	S	IE	S	S	S	S	S	NS	NS	IE
Hydrocarbon & PAH contamination	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Introduction of light	S	S	S	IE	S	IE	IE	NS	S	IE	NS	NS	IE
Introduction or spread of invasive non-indigenous species (INIS)	S	S	S	S	S	IE	S	S	S	S	S	IE	IE
Litter	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nutrient enrichment	S	NS	S	NS	NS	NS	NS	NS	NS	NS	NS	NS	S

Organic enrichment	S	S	S	S	NS	S	S	S	S	S	IE	NS	S
Physical change (to another seabed type)	S	S		S						S	S	S	S
Physical change (to another sediment type)			S		S	S	S	S	S		NS		S
Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Transition elements & organo-metal (e.g. TBT) contamination	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Underwater noise changes							NS	NS	NS	NS			
Visual disturbance		NS			NS		NS	NS	NS	NS			

Annex 3. Fishing activity maps using trawl sightings data from 2009 -2020 in the Needles MCZ.