Document Control

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DRAFT South Dorset Marine Conservation Zone MMO Fisheries Assessment

Contents

1. Summary

Table 1 shows a summary of the outcomes of this assessment regarding the impact of fishing activities on site features.

Table 1: Assessment Summary

Feature	Matrix gear type	Part A outcome	Part B outcome	Part C outcome: In-combination assessment
Subtidal coarse sediment **and** Subtidal chalk **and** Moderate energy circalittoral rock **and** High energy circalittoral rock	Beam trawl (whitefish)	Capable of affecting (other than insignificantly)	Significant risk of hindering conservation objectives	N/A
	Beam trawl (shrimp)			
	Beam trawl (pulse/wing)			
	Heavy otter trawl			
	Multi-rig trawl			
	Light otter trawl			
	Pair trawl			
	Towed (demersal)			
	Anchor seine			
	Scottish/fly seine			
	Scallop dredges			
	Mussel, clam and oyster dredges			
	Pump scoop dredges (cockles, clams)			
	Suction dredges (cockles)	Not capable of affecting (other than insignificantly)	N/A	N/A
	Pots/creels (crustacea/gastropods)	Capable of affecting (other than insignificantly)	No significant risk of hindering conservation objectives	No significant risk of hindering conservation objectives
	Cuttle pots			
	Fish traps			
	Gill nets	Not capable of affecting (other than insignificantly)	N/A	N/A
	Trammel nets			
	Entangling nets			

	Drift nets (demersal)			
	Longlines (demersal)			
	Beach seines/ring nets	Not capable of affecting (other than insignificantly)	N/A	N/A
	Shrimp push-nets			
	Fyke and stakenets			
	Bait dragging			
	Commercial diving			
	Crab tiling			
	Bait collection			

2. Introduction

Table 2 shows the name and legal status of the site. Located approximately 17.5 km south of St Alban's Head, South Dorset Marine Conservation Zone (MCZ) lies mainly within the 12 nautical mile limit with a small part extending further offshore. The site covers an area of approximately 193 km^2.

Table 2: Site details

Name of site	Legal status
South Dorset	MCZ

South Dorset MCZ is entirely subtidal, with a depth range of 36 to 52 metres below chart datum. The MCZ is designated for moderate and high energy circalittoral rock, subtidal coarse sediment and subtidal chalk. As outlined in Figure 1, the site is a mosaic of sediment and rocky areas, with dispersed distribution of the features across the site. Subtidal chalk occurs in a mosaic with circalittoral rock habitat, therefore the extent and distribution of rock within the site can be used as a proxy for the extent boundary of the chalk.

Due to reduced light penetration circalittoral rock is characterised by animal dominated species compared to infralittoral rock which is algae dominated. Communities tend to be made up of a variety of species including bryozoans, sponges, ascidians, decapods and worms.

In deeper water such as this, the chalk seabed environment supports biological communities characteristic of reefs. Subtidal chalk habitats are particularly important for marine life and have been known to support rare species of sponge, edible crab and velvet swimming crab. Subtidal chalk habitats are rare, with soft rock that is easily bored and eroded and provides shelter for burrowing piddock and worms.

Once empty, these bore holes provide habitats for a range of crevice-dwelling animals including shellfish, worms and other small invertebrates.

Subtidal coarse sediment can provide a nursery ground for many ecologically and commercially important fish species including sea bass and flat fish such as sole and plaice. The sediment can also support species such as sand eels, which are an important food source for seabirds such as puffin, razorbills and guillemots.

The conservation objectives for all MCZs are that the features:

(a) so far as already in favourable condition, remain in such condition; and

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

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

Table 3 shows the features for which this MCZ has been designated, their associated general management approach, and the European marine site (EMS) features which they have been matched with.

Table 3: Designated features and general management approach

Feature	Matrix sub-feature match	General Management Approach
Subtidal coarse sediment	Coarse sediment (high energy)	Maintain in favourable condition
Subtidal chalk	Intertidal and subtidal chalk reef	Recover to favourable condition
Moderate energy circalittoral rock	Subtidal bedrock reef	Recover to favourable condition
High energy circalittoral rock	Subtidal bedrock reef	Recover to favourable condition

2.1 Subtidal coarse sediment

Coarse sediments include: coarse sand, gravel, pebbles, shingle and cobbles, which are often unstable due to tidal currents and/or wave action. In addition to providing nursery grounds for ecologically and commercially important fish, the sediment can also support species, such as sand eel, which are an important food source for seabirds including puffin, razorbill and guillemot[2]. Current evidence shows subtidal

[1] MCZ factsheets are available online: http://publications.naturalengland.org.uk/category/1721481

[2] Joint Nature Conservation Committee (JNCC). 2014. MCZ Features: Subtidal Coarse Sediment [Online]. Joint Nature Conservation Committee (JNCC). [Accessed Nov-15].

coarse sediment occurring to the east of the site, with a spatial extent of 96.56km^2 (9656 ha) within the site boundary[3,4], which covers approximately 50% of the MCZ[5].

The site experiences strong spring tidal currents which are likely to mobilise sediments creating relatively robust communities in unstable sediments[6]. Current evidence lacks a detailed identification of biological communities, however video observations of coarse sediment, with occasional cobbles and boulders, recorded characterising species that included various anemones, *Actinaria* spp., bryozoans and sponges with brittlestars dominating at three locations [3,4].

2.2 Subtidal chalk

Subtidal chalk is a Habitat of Conservation Interest (HOCI) feature. This site protects the only known subtidal chalk habitat within the south-west region. Subtidal chalk is typically found on the eastern or south-eastern coasts of the UK. Subtidal chalk occurs in a mosaic with circalittoral rock habitat, therefore the extent and distribution of rock within the site can be used as a proxy for the extent boundary of the chalk. Records of subtidal chalk exist across the MCZ and occur in a mosaic with circalittoral rock habitat, mapped throughout the site[5].

Maps of bedrock geology show that Upper Cretaceous chalk is widespread within the MCZ[7] and will comprise part of the circalittoral rock present. Massively bedded Upper Cretaceous chalk typically forms a characteristically smooth seabed[8] which is potentially the case in the eastern, central and southern parts of the MCZ.

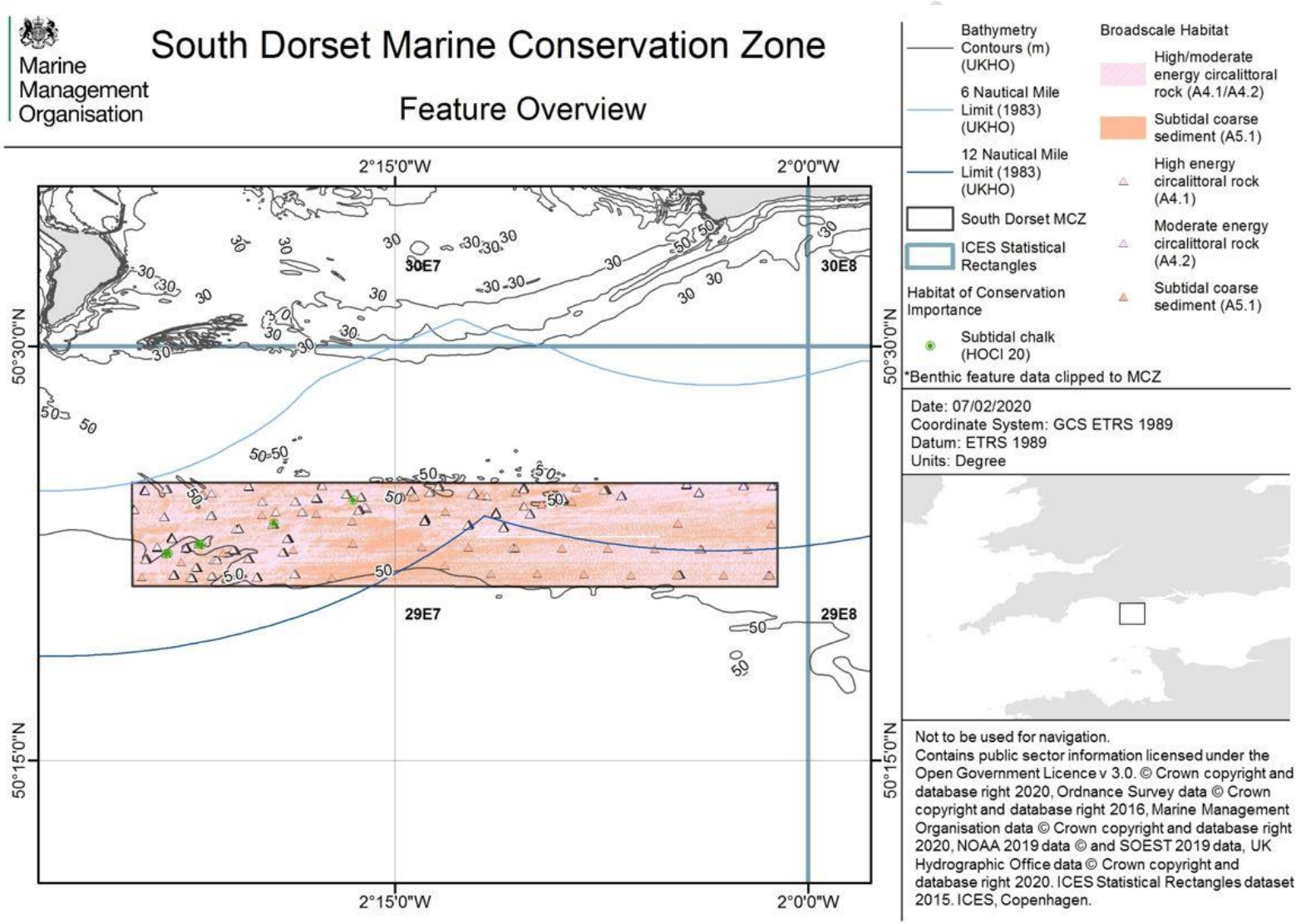
2.3 Moderate and high energy circalittoral rock

Moderate and high energy circalittoral rock habitat includes bedrock and boulders dominated by animal communities. The circalittoral rock within the site consists of a mosaic of high and moderate energy habitats. Along with subtidal chalk, these features are distributed throughout the site.

Current evidence shows the circalittoral rock covers approximately 50% of the MCZ[5], in the form of bedrock ledges with cobbles and boulders. The Cefas survey carried out in 2013 was unable to differentiate the moderate and high energy circalittoral rock from each other as they form a mosaic across the site. The overall spatial extent of circalittoral rock was 98.35km^2 (9835 ha) within the site boundary, although video samples recorded more incidences of high energy circalittoral rock than moderate energy[3,4.]

[3] Downie, A. and Curtis, M. 2014. South Dorset MCZ Post-survey Site Report draft v2.: Department for Environment, Food and Rural Affairs (Defra), the Centre for Environment, Fisheries and Aquaculture Science (Cefas).
[4] Downie, A. and Whomersley, P. 2013. South Dorset rMCZ Survey Report draft v2.: Department for Environment, Food and Rural Affairs (Defra), Natural England, the Centre for Environment, Fisheries and Aquaculture Science (Cefas).
[5]Cefas. 2013. MCZ Verification Survey - South Dorset: Cefas.
[6] UK Hydrographic Office (UKHO) Admiralty Charts.
[7] British Geological Survey (BGS). 1983. Portland. 1:250000, Solid geology., 1:250000. British Geological Survey (BGS), Edinburgh, Scotland.
[8] Collier, J. S., Gupta, S., Potter, G. and Palmer-Felgate, A. 2006. Using bathymetry to identify basin inversion structures on the English Channel shelf. Geology, 34, 1001-1004.

Figure 1: South Dorset MCZ and surrounding area



2.4 Scope of this assessment - fishing activities assessed

The geographic scope of this assessment covers the whole site and therefore includes all four designated features (Figure 1).

Due to the mosaic nature of the features within the site, with dynamic sediments and dispersed distribution of the features, this assessment is focussed on the impacts of fishing on the more sensitive features (subtidal chalk and circalitorral rock).

A revised approach to the management of commercial fisheries in European marine sites[9] was established in 2012 (see Annex 1 for further details). A matrix was developed to aid regulators in assessing whether management measures should be introduced in marine protected areas.[10] Table 4 displays the matrix interactions for the aggregated method fishing activities and designated features. Interactions are considered a 'red risk' where it is clear that the conservation objectives for a feature (or sub-feature) will not be achieved because of its vulnerability to a type of fishing - irrespective of feature condition, level of pressure, or background environmental conditions in all EMSs where that feature occurs[11].

Table 4: Aggregated method fishing activities with amber or red interactions

Feature/Fishing gear type	Coarse sediment (high energy)/ Subtidal coarse sediment	Intertidal and subtidal chalk reef/ Subtidal chalk	Subtidal bedrock reef / High and moderate energy circalittoral rock
Demersal seines			
Demersal trawls			
Dredging			
Traps			

Interactions are considered an 'amber risk' where there is doubt as to whether conservation objectives for a feature (or sub-feature) will be achieved because of its sensitivity to a type of fishing[11].

As demersal seines, demersal trawls and dredging all have red interactions, an assessment is not required and the interaction will automatically be addressed through a management measure. Evidence supporting the 'red risk' categorisation for these gear/feature interactions is set out in footnote[12].

[9] www.gov.uk/government/publications/revised-approach-to-the-management-of-commercial-fisheries-in-european-marine-sites-overarching-policy-and-delivery

[10] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/310814/cefas_matrix_review.pdf

[11] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/310822/matrixbackground.pdf

[12] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/310821/subtidalbedrock.pdf

Due to the mosaic habitat of the site, the management measure which will be considered is to prohibit bottom-towed gear across the whole site and therefore no assessment of bottom towed gear on coarse sediment is required.

Traps have amber and green interactions with the designated features. Interactions classified as ‘green’ are considered low risk, but are included when assessing impacts in-combination with other activities. Interactions classified as amber are subject to full assessment to determine whether management of activity is required to further the site’s conservation objectives. Therefore traps will be taken through to Part B assessment and bottom-towed gears will be automatically be addressed through a management measure.

Table 5 shows the fishing activities classified as having amber interactions with features of this site. The ‘Matrix gear type’ column shows the categories used in the Matrix. These are matched to the ‘aggregated method’ categories used in Natural England/JNCC conservation advice packages.

Commercial sea fishing has the potential to vary in nature and intensity over time. This assessment considers a particular range of recent and likely future activity based on activity levels and type as identified in section 4.

To ensure the achievement of the conservation objectives of the site is not hindered should future activity occur outside of this range, activity will be monitored at this site, and this assessment may be reviewed should activity levels change significantly. See section 8 for more information on ongoing monitoring and control at this site.

Table 5: Fishing activities with amber interactions to be included for assessment if they take place.

Feature	Matrix gear type	Gear Code	Aggregated method
Subtidal coarse sediment **and** Subtidal chalk **and** Moderate energy circalittoral rock **and** High energy circalittoral rock	Suction dredges (cockles)	HMD	Hydraulic dredges
	Pots/creels (crustacea/gastropods)	FPO	Traps
	Cuttle pots		
	Fish traps		
	Gill nets	GNS	Anchored nets/lines
	Trammel nets	GTR	
	Entangling nets	GN	
	Drift nets (demersal)	GND	
	Longlines (demersal)		
	Beach seines/ring nets	SB	Shore-based activities
	Shrimp push-nets	-	
	Fyke and stakenets	FYK/GNF	
	Bait dragging	-	
	Commercial diving	-	
	Crab tiling	-	
	Bait collection	-	

3. Part A Assessment

Table 6 shows the conservation advice package used to inform this assessment.

Table 6: Advice packages used for assessment

Feature	Package	Link
Subtidal coarse sediment **and** Subtidal chalk **and** Moderate energy circalittoral rock	Natural England and Joint Nature Conservation Committee (JNCC) Conservation Advice for Marine Protected Areas South Dorset MCZ - UKMCZ0022	https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UKMCZ0022&SiteName=south%20dorset&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=

and High energy circalittoral rock		

Part A of this assessment was carried out in a manner that is consistent with the 'capable of affecting (other than insignificantly)' test required by section 126(1) (b) of the Marine and Coastal Access Act 2009[13].

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

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

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

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

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

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

3.1 Activities not taking place

Table 7 shows activities which are excluded from further assessment as they do not take place and are not likely to take place in the future.

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

Table 7: Activities not taking place and not likely to take place in the future

Feature	Gear type	Justification
Subtidal coarse sediment **and** Subtidal chalk **and** Moderate energy circalittoral rock **and** High energy circalittoral rock	Hydraulic dredges	Vessel monitoring system (VMS) data were used in order to determine which fishing activities are not taking place in South Dorset MCZ. VMS data shows that this activity does not occur in the site. Fishermap data also revealed little to no fishing activity taking place within the MCZ.
	Anchored nets/lines	
	Shore-based activities	South Dorset MCZ has no shore component and so is not subject to shore-based activities.

3.2 Potential pressures exerted by the activities on the features

For the remaining activities, potential pressures were identified using the Natural England/JNCC conservation advice identified in Table 6 and associated advice on operations tables. All pressures identified other than those categorised as 'not relevant' were included.

Table 8 shows the potential pressures identified for subtidal coarse sediment, subtidal chalk, high and moderate energy circalittoral rock.

Table 8: Potential pressures for gears on subtidal coarse sediment, subtidal chalk, high and moderate energy circalittoral rock

Feature	Aggregated method	Potential pressures
Subtidal coarse sediment **and** Subtidal chalk **and** Moderate energy circalittoral rock **and** High energy circalittoral rock	Traps	Abrasion/disturbance of the substrate on the surface of the seabed
		Removal of non-target species
		Removal of target species
		Barrier to species movement
		Deoxygenation
		Introduction of light
		Introduction or spread of invasive non-indigenous species (INIS)
		Organic enrichment
		Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion

3.3 Significance of effects/impacts

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

Table 9 identifies the pressures from particular gears which are capable of affecting (other than insignificantly) each feature. Where a pressure from a particular gear is identified as not being capable of affecting (other than insignificantly), justification is provided. Features with similar sensitivities have been considered together.

Table 9: Summary of pressures from specific activities on subtidal coarse sediment, subtidal chalk, high and moderate energy circalittoral rock taken to Part B

Potential pressures	**Traps**		
	FPOP	FPOC	FPOF
Abrasion/disturbance of the substrate on the surface of the seabed	Capable of affecting (other than insignificantly) – Abrasion/surface disturbance can be caused by contact between the gear/anchors and the sea bed.		
Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion	Not capable of affecting (other than insignificantly) – Gears are designed to interact with the seabed, but it is considered a low risk pressure when caused by these activities.		
Removal of non-target species	Capable of affecting (other than insignificantly) – Removal of non-target species is likely to affect the presence and/or abundance of typical species found in the designated features.		
Removal of target species	Capable of affecting (other than insignificantly) – Removal of target species is likely to affect the presence and/or abundance of typical species found in the designated features.		
Deoxygenation	Not capable of affecting (other than insignificantly) – These features are sensitive to deoxygenation, but it is considered a low risk pressure when caused by these activities.		
Introduction of light	Not capable of affecting (other than insignificantly) – Introduction of light from fishing activities is unlikely to significantly affect the presence and/or abundance of typical species found in subtidal coarse sediment, subtidal chalk and moderate energy circalittoral rock.		

Introduction or spread of invasive non-indigenous species (INIS)	Not capable of affecting (other than insignificantly) – Ballast water is the principal vector for invasive non-indigenous species[14]. Fishing vessels less than 45m must have permanent ballast and thus this vector is not available[15].
Organic enrichment	Not capable of affecting (other than insignificantly) – Habitat is subject to a degree of wave action or tidal currents suitable enough to make organic enrichment unlikely.
Changes in suspended solids (water clarity)	Not capable of affecting (other than significantly) – Any plumes created by the impact of gear will be small, localised and very short-lived.
Smothering and siltation rate changes (light)	
Physical change (to another seabed type)/ (to another seabed type)	Not capable of affecting (other than insignificantly) – Fishing activities will not change seabed type from sedimentary or soft rock substrata to hard rock or artificial substrata or vice-versa or sediment type by one Folk class.
Introduction of microbial pathogens	Not capable of affecting (other than insignificantly) – South Dorset MCZ is not a shellfish production site.
Barrier to species movement	Not capable of affecting (other than insignificantly) – Fishing activity is unlikely to significantly affect movement of typical species found in subtidal coarse sediment, subtidal chalk and moderate energy circalittoral rock.

FPOP: pots/creels (crustacea/gastropoda); FPOC: cuttle pots; FPOF: fish pots

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

4. Part B Assessment

Part B of this assessment was carried out in a manner that is consistent with the 'significant risk' test required by section 126(2) of the Marine and Coastal Access Act 2009. Table 10 shows the fishing activities and pressures identified in part A which have been included for assessment in part B.

Table 10: Fishing activities and pressures included for part B assessment

Aggregated Method	Fishing gear type	Pressures
Traps	Pots/creels (crustacean/gastropods)	• Abrasion/disturbance of seabed surface substrate • Removal of non-target species • Removal of target species
	Cuttle pots	
	Fish traps	

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

Table 11 shows which targets were identified as important. The impacts of pressures on features were assessed against these targets to determine whether the activities causing the pressures are compatible with the site's conservation objectives (Table 3).

Table 11: Important favourable condition targets for identified pressures

Attribute	Target	Importance /justification
Distribution: presence and spatial distribution of reef communities	Recover the presence and spatial distribution of circalittoral rock communities and subtidal chalk communities; maintain the presence and spatial distribution of subtidal coarse sediment communities.	Important for all pressures identified.
Extent and distribution	Maintain the total extent and spatial distribution of circalittoral rock, subtidal chalk and subtidal coarse sediment, subject to natural variation in sediment veneer.	Identified pressures cannot damage or destroy designated features.
Structure/function: presence and abundance of key structural and influential species	Maintain or recover or restore the abundance of listed species, to enable each of them to be a viable component of the habitat.	Key species not identified therefore cannot be assessed.
Structure: Non-native species and pathogens	Restrict the introduction and spread of non-native species and pathogens, and their impacts.	Excluded in part A assessment.

Structure: physical structure of rocky substrate/sediment composition and distribution	Maintain the surface and structural complexity, and the stability of the reef structure and subtidal chalk/ Maintain the distribution of sediment composition types across the feature.	Pressures do not alter physical structure.
Structure: species composition of component communities	Recover the species composition of component communities.	Important for all pressures identified.
Supporting processes: energy /exposure	Maintain the natural physical energy resulting from waves, tides and other water flows, so that the exposure does not cause alteration to the biotopes, and stability, across the habitat.	Pressures cannot change energy/exposure.
Supporting processes: physico-chemical properties	Maintain the natural physico-chemical properties of the water.	Pressures do not affect physico-chemical properties.
Supporting processes: sedimentation rate	Subtidal coarse sediment: Restrict surface sediment contaminant levels to concentrations where they are not adversely impacting the infauna of the feature Subtidal chalk & moderate energy circalittoral rock: Maintain the natural rate of sediment deposition.	Important. Abrasion/ disturbance of the surface of the seabed may affect sedimentation rate.
Supporting processes: water quality - contaminants	Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status of the Water Framework Directive, avoiding deterioration from existing levels.	Pressures do not affect water quality.
Supporting processes: water quality - dissolved oxygen	Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥ 5.7 mg per litre (at 35 salinity) for 95 % of the year), avoiding deterioration from existing levels.	Pressures do not affect water quality.
Supporting processes: water quality - nutrients	Maintain water quality, specifically mean winter dissolved inorganic nitrogen (DIN) at a concentration equating to High Ecological Status (mean winter DIN is < 12 µM for coastal waters), avoiding deterioration from existing levels.	Pressures do not affect water quality.
Supporting processes: water quality - turbidity	Maintain natural levels of turbidity across the habitat.	Not relevant. Pressures do not affect water quality.

4.1. Activity description: Traps

4.1.1 Existing management

The vast majority of vessels operating in South Dorset MCZ from 2014 to 2018 (Figure 2 to Figure 6) are trawling and dredging vessels, with a small number of midwater otter trawls, pots and one instance of a Danish seine. Vessels which fish within the MCZ include those from the UK, Belgium, France, Ireland, Netherlands

and Norway (Figure 7 to Figure 11). French and UK vessels tend fish most within the MCZ.

South Dorset MCZ is subject to a number of relevant EU byelaws and legislation:

1. The EU lobster and spiny lobster (crawfish) minimum conservation reference size (MCRS) (previously 'minimum landing sizes'), EU Tech Con Regs 1241/2019;
2. 'Berried Lobster and Crawfish prohibition' banning the taking of berried (egg-bearing) and v-notched or mutilated EU lobster and spiny lobster[16]; and
3. The edible crab MCRS, EU Tech Con Regs 1241/2019 (when using pots or creels, a maximum of 1 % by weight of the total catch of edible crabs landed may consist of detached claws. For all other gear types a maximum of 75 kg of detached claws may be landed).

4.1.2 Evidence Sources

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

- vessel monitoring system (VMS) data;
- fisheries landings data (logbooks and sales records);
- Fishermap stakeholder mapping report;
- a Defra commissioned report collating fisheries sightings data from MMO and Inshore Fisheries and Conservation Authority (IFCA) compliance monitoring (reference: MB0117);
- expert opinion from MMO marine officers, inshore fisheries and conservation officers; and
- spatial footprint analysis using Pr-values.

Table 12 summarises the description, strengths and limitations of some of the evidence sources used. For more information about the evidence sources used, please see Annex 1.

[16] http://www.legislation.gov.uk/uksi/2017/899/made

Table 12: Summary of generic confidence associated with fishing activity evidence

Evidence source	Confidence	Description, strengths and limitation
VMS data	High/ Moderate	• Confidence in VMS is high for describing activity relating to larger vessels (>12m). But VMS information was not developed specifically for management of MPAs, and does not describe activity of smaller vessels. • There are assumptions in the processing that speed of 0-6 knots is "fishing speed". • VMS records the location, date, time, speed and course of the vessel. Fishing gear information has to be linked to the VMS data itself by either matching its logbook information where possible, using the fleet register which may not be up to date or local marine officer knowledge of the said vessel.
Fisheries landings data	High/ Moderate	• Landings from all vessels were spatially attributed based on the patterns of fishing observed in vessels of 12m length or over. Therefore it was assumed that under 12m vessels show the same patterns of fishing as those 12m and over. • VMS was introduced and implemented to the UK 12-15m length fleet from 2014. Previously VMS consisted of the 15m length or over fleet. • Data processing takes account of variable reporting rates by using the time between reports to weight each individual report. However, it was assumed that each report (accounting for variable reporting rates) represents an equal amount of landings. • Linking of landings data to VMS data assumed that all reports under 6 knots were assumed to represent fishing activity, and no reports over 6 knots were assumed to be fishing.
Fishermap	Low	• The data were collected in 2012 and are therefore relatively dated. • A condition of the research was that only those interviewees who explicitly gave permission for their data to be shared would have their own mapping represented in the final product shared with third parties. This equated to approximately 50% of responses.
Defra 2015 (MB0117)	Moderate	• Based on recent work to describe fishing activity, but is limited by raw data and other limitations highlighted in the report.
Expert judgement	Low / Moderate	• This depends on the area, and the knowledge of the area from MMO and IFCA staff.
Pr-values	Moderate/High	• Spatial footprint values do not include information for non-VMS vessels. • The methodology used to calculate spatial footprints requires 'matching' of VMS data to specific gear types held on UK or EU fishing fleet registers. This therefore relies on these registers being kept up to date.

4.1.3 VMS and landings data

Traps is a collective term used for structures into which fish or shellfish are guided or enticed through funnels that encourage entry but limit escape. This can include pots, creels, cuttle pots and fish traps.

Within the South Dorset MCZ, a relatively small amount of fishing occurs using pots (Table 13), with the amount of vessels fishing ranging from 9 to 40 between 2014 and 2018. All vessels were of UK nationality, with other member states (OMS) vessels using alternative gear types to fish within the MCZ. Potting vessels tended to fish more on the west side of the MCZ (Figure 2 to Figure 6), with less focus on the south-eastern section of the MCZ, potentially due to the main habitat type in the south-east of the MCZ being subtidal coarse sediment (Figure 1), which lobsters might find a less suitable habitat than rock. A relatively small amount of landings are produced from pots within the MCZ (Table 13), ranging from 0.96-2.78 tonnes per year for UK VMS vessels and 5.05-12.53 tonnes per year for UK non-VMS vessels. The UK non-VMS vessel landings were calculated based on an area-based proportion of the MCZ within the ICES rectangle (4.86%). Expert opinions from IFCA and MMO staff were unable to provide any further information on the site.

Figure 2: 2014 VMS Fishing Activity by gear type in South Dorset MCZ

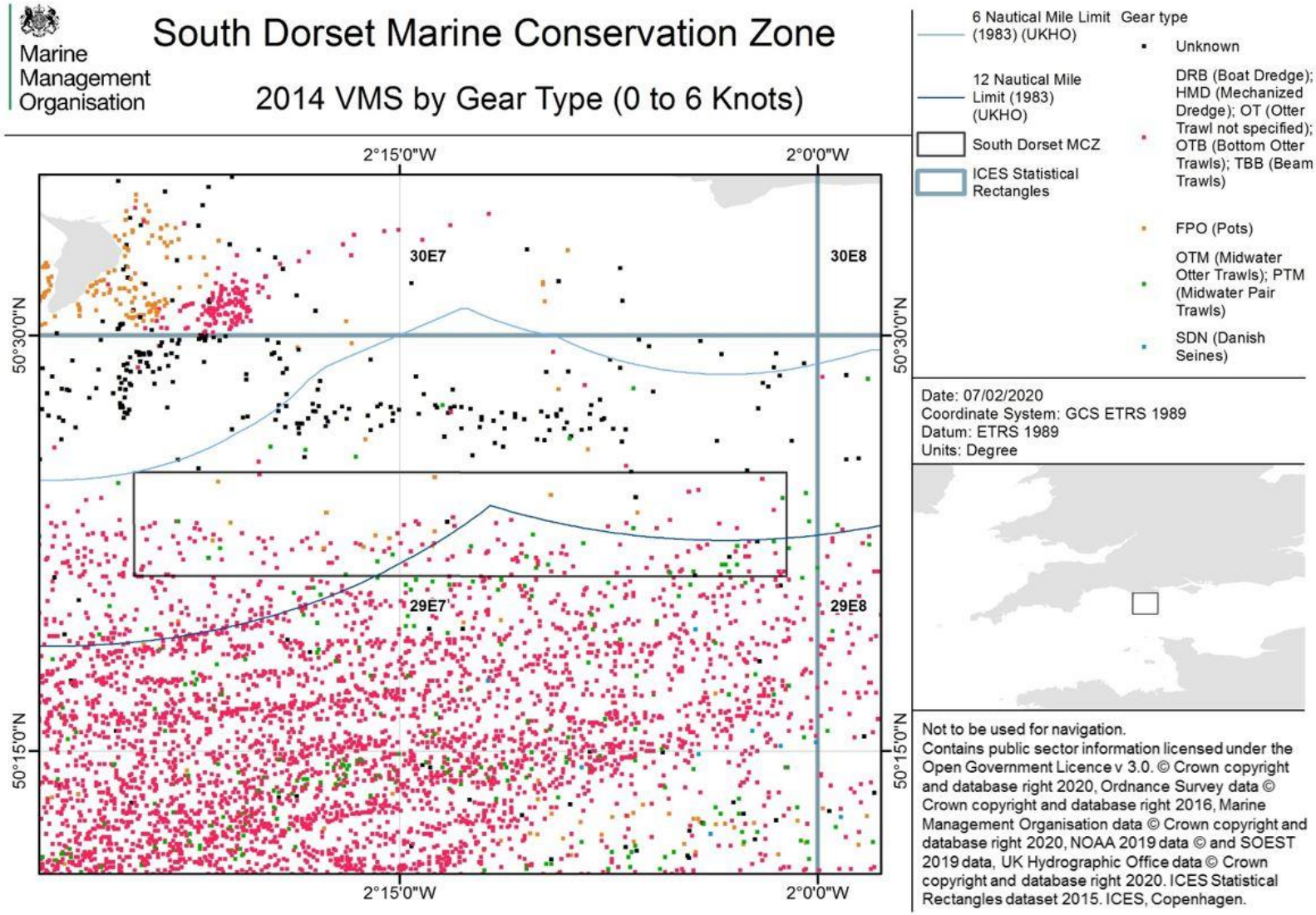


Figure 3: 2015 VMS Fishing Activity by gear type in South Dorset MCZ

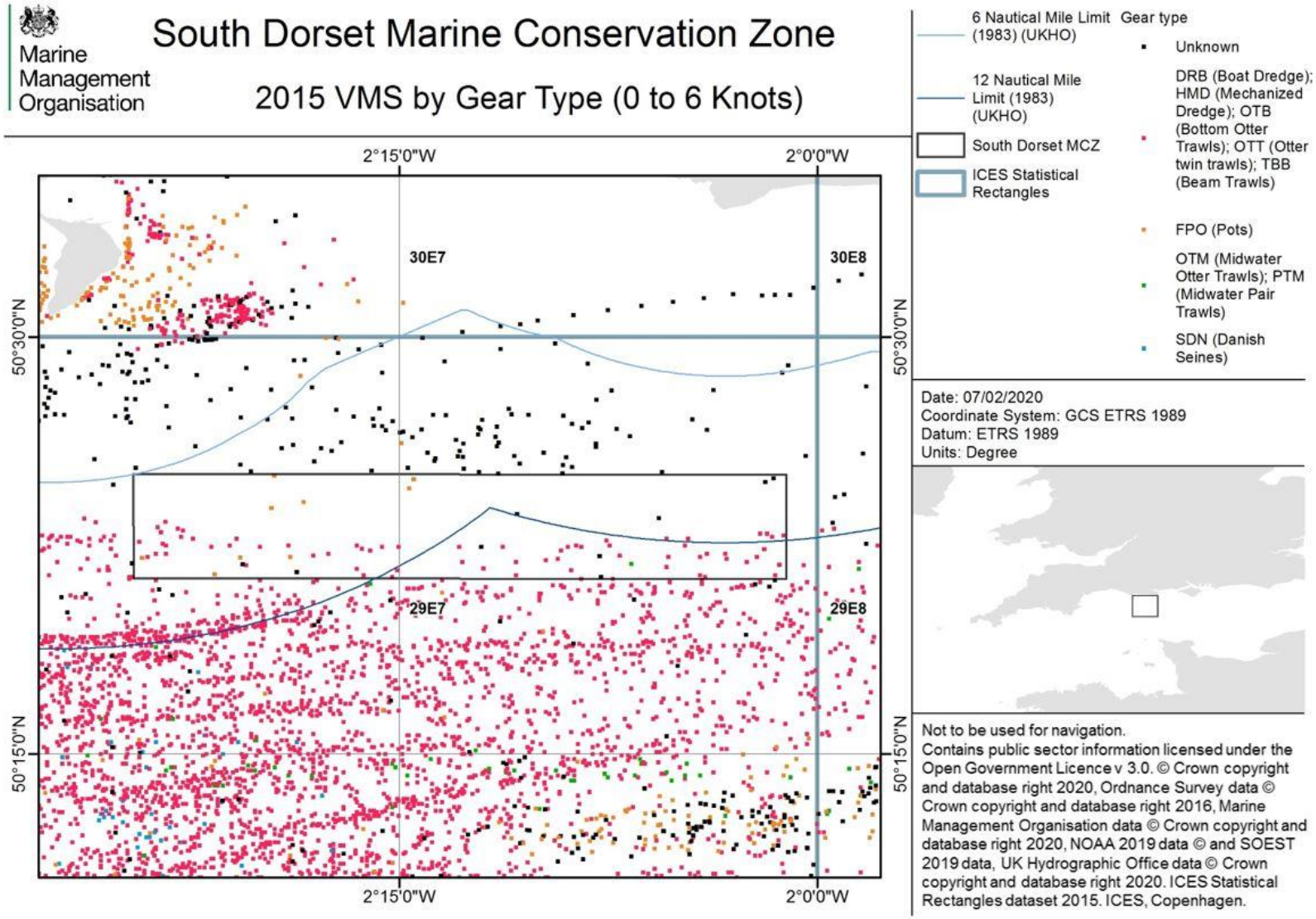


Figure 4: 2016 VMS Fishing Activity by gear type in South Dorset MCZ

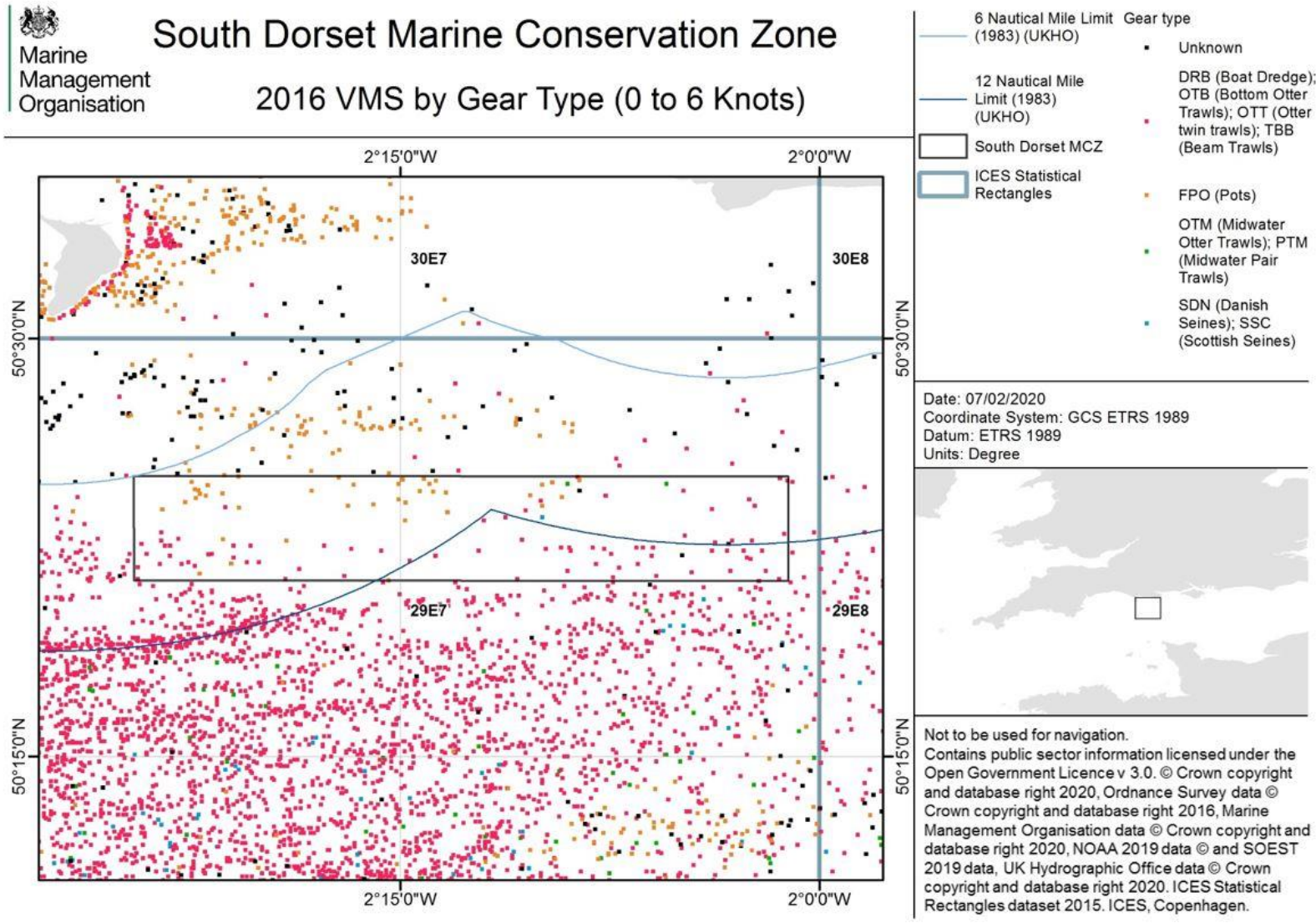


Figure 5: 2017 VMS Fishing Activity by gear type in South Dorset MCZ

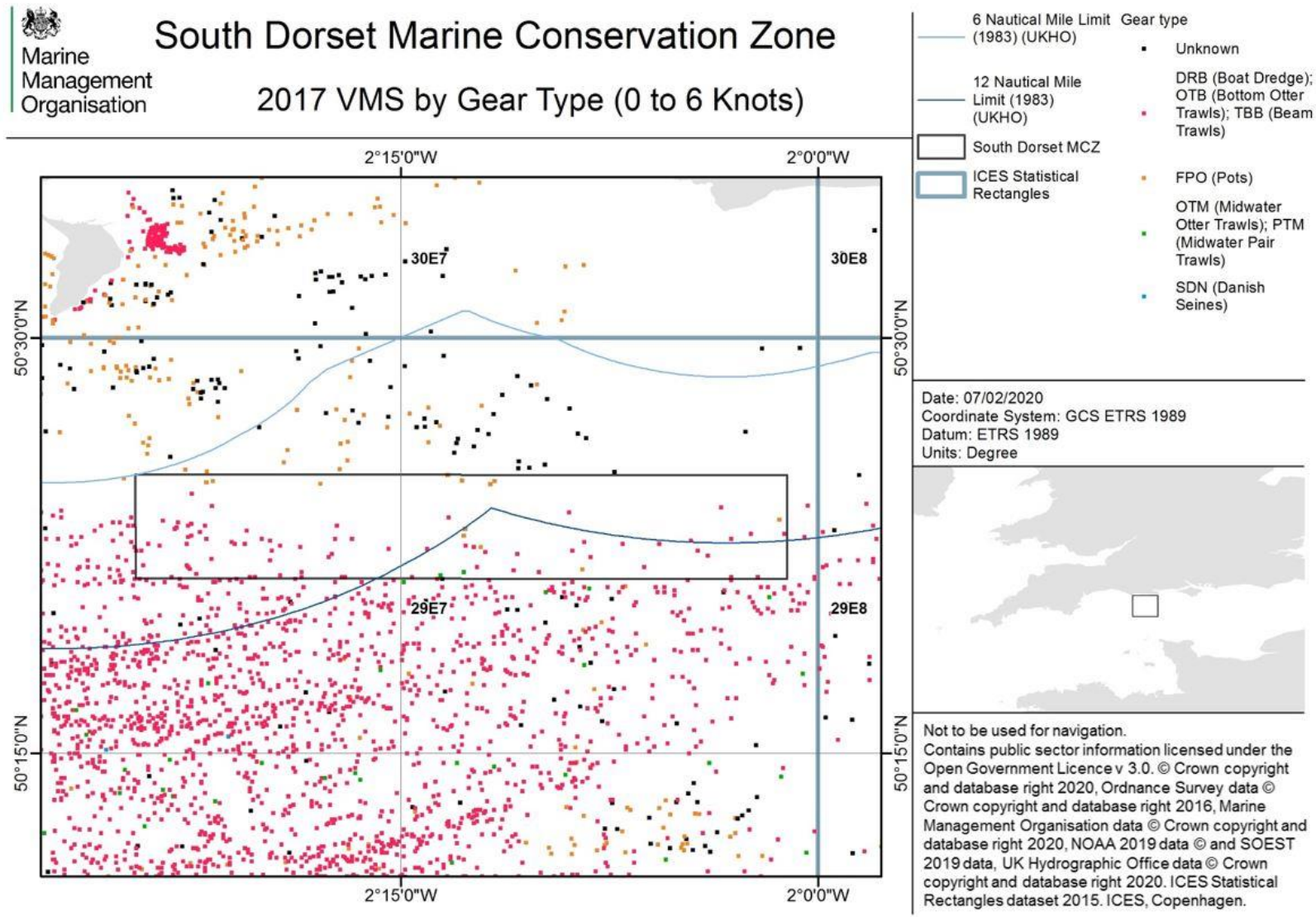


Figure 6: 2018 VMS Fishing Activity by gear type in South Dorset MCZ

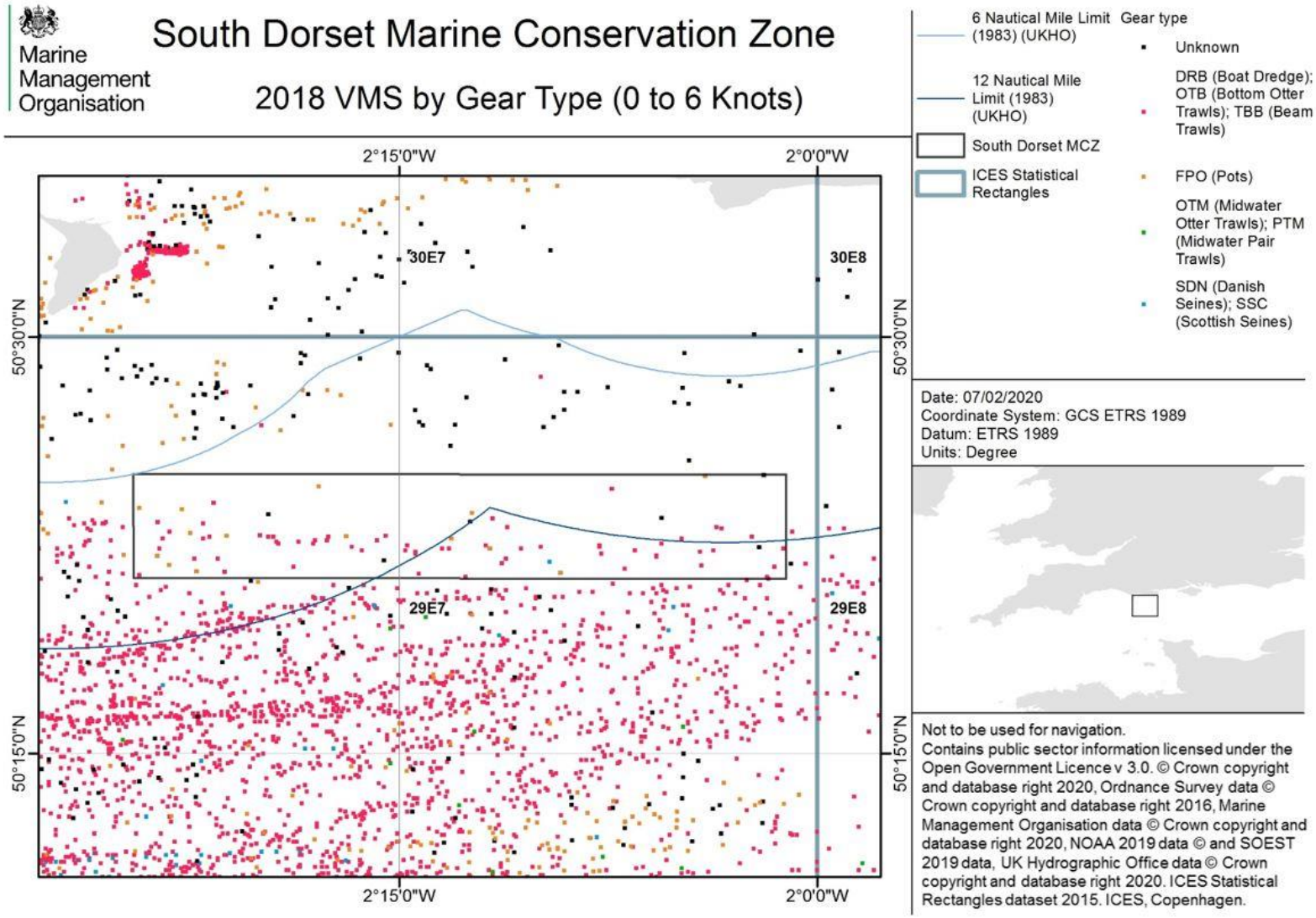


Figure 7: 2014 VMS Fishing Activity by nationality in South Dorset MCZ

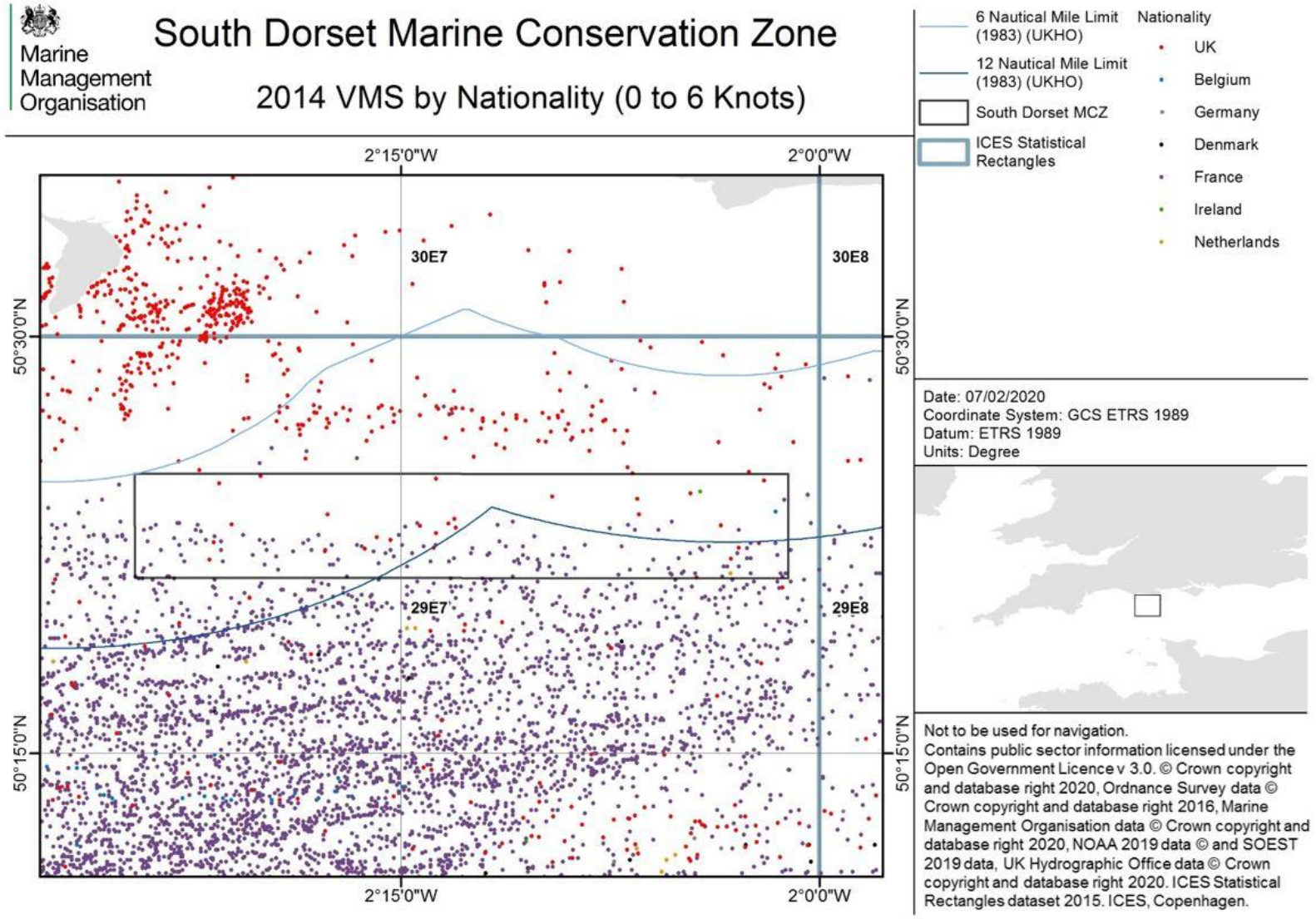


Figure 8: 2015 VMS Fishing Activity by nationality in South Dorset MCZ

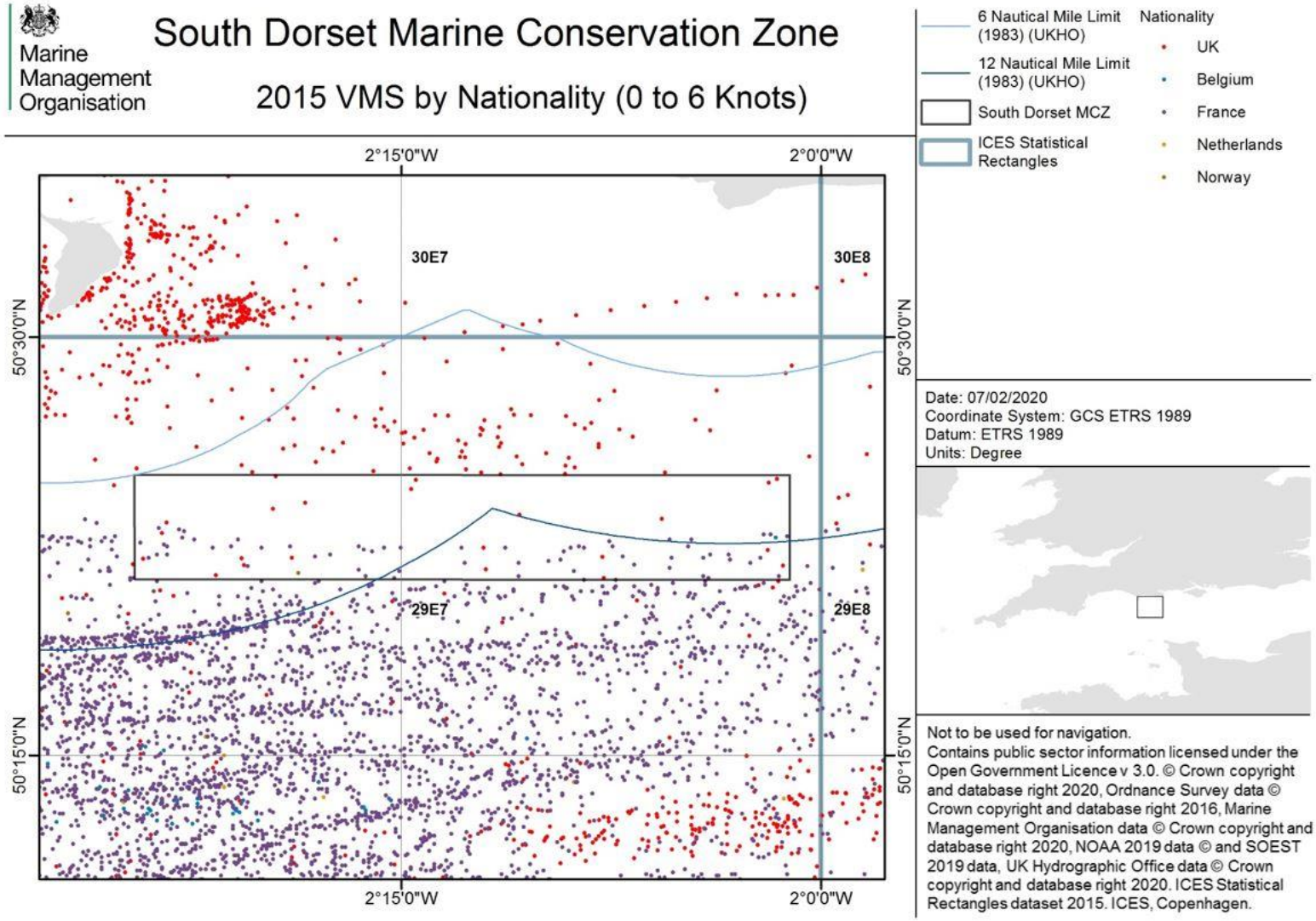


Figure 9: 2016 VMS Fishing Activity by nationality in South Dorset MCZ

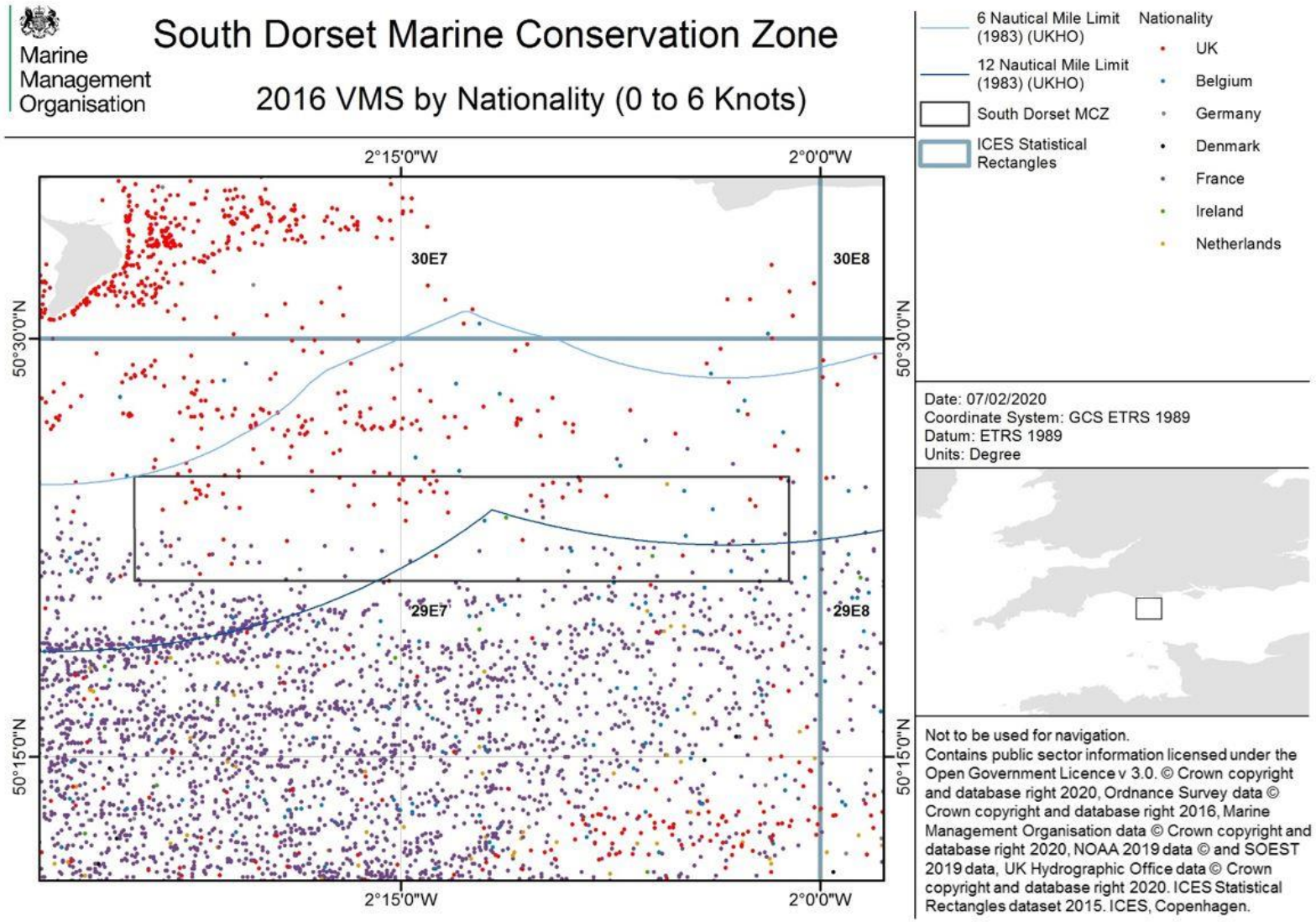


Figure 10: 2017 VMS Fishing Activity by nationality in South Dorset MCZ

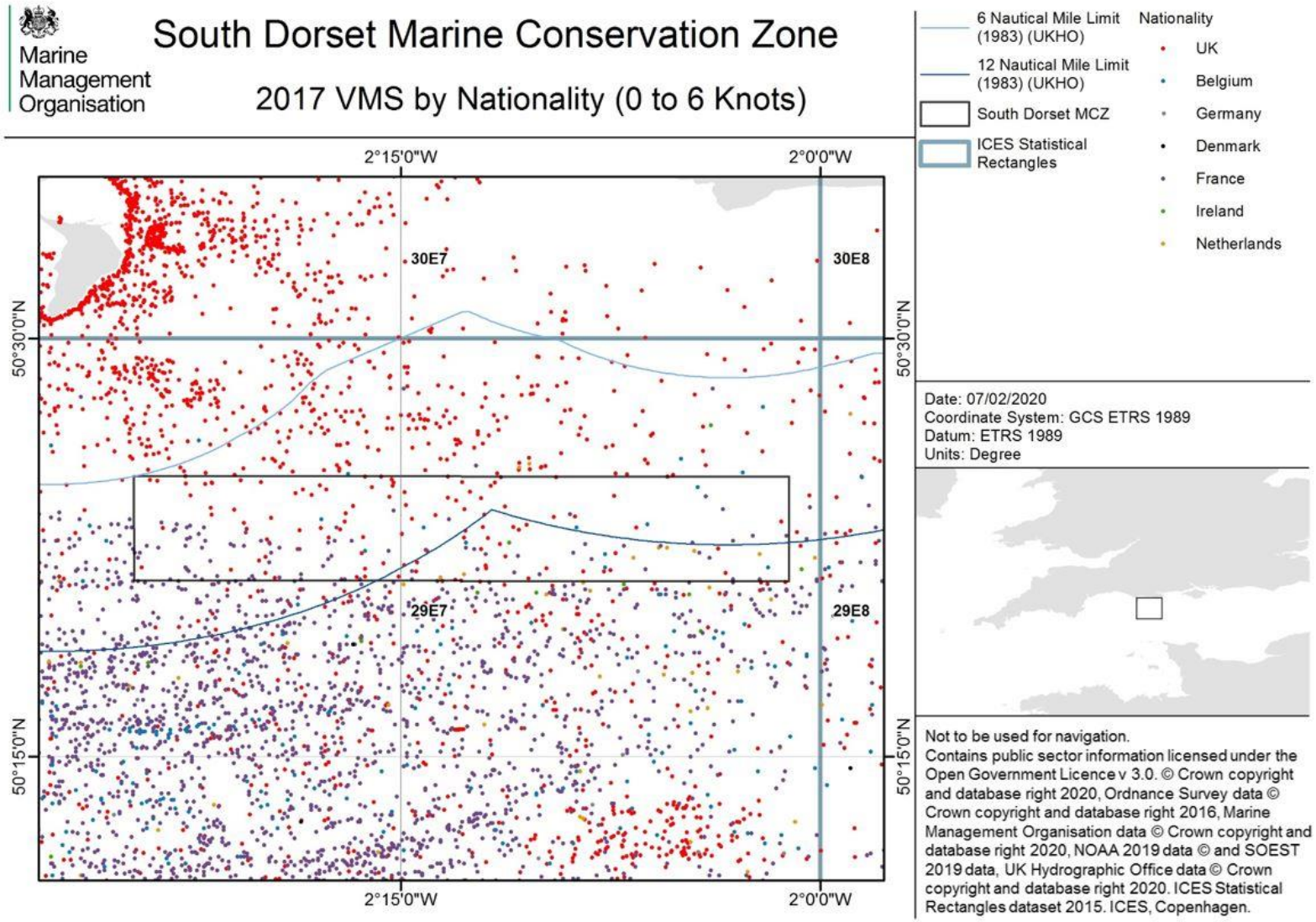


Figure 11: 2018 VMS Fishing Activity by nationality in South Dorset MCZ

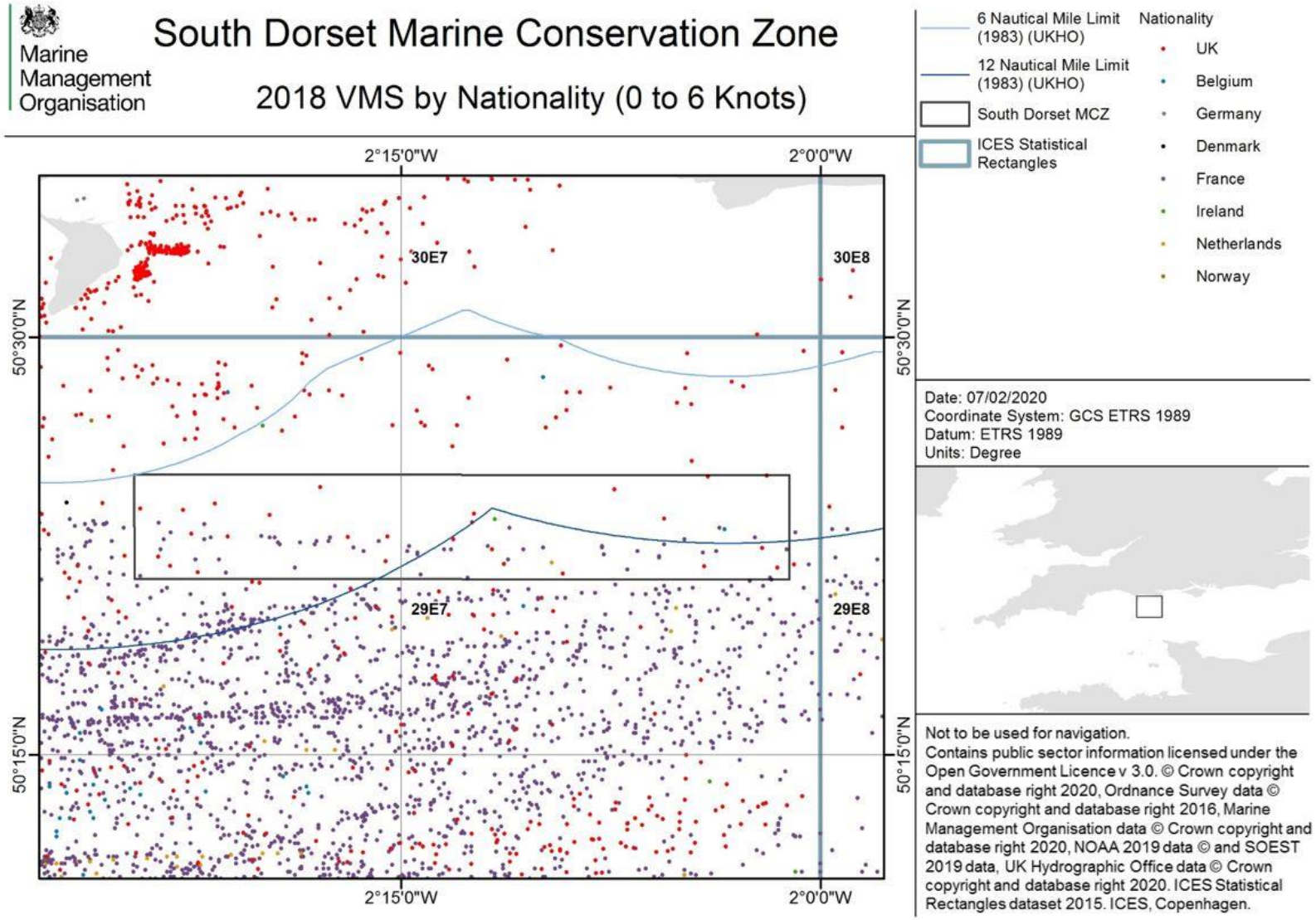


Table 13: The amount of vessel VMS reports, vessel nationality, landings of UK VMS and non-VMS vessels for pots gear type

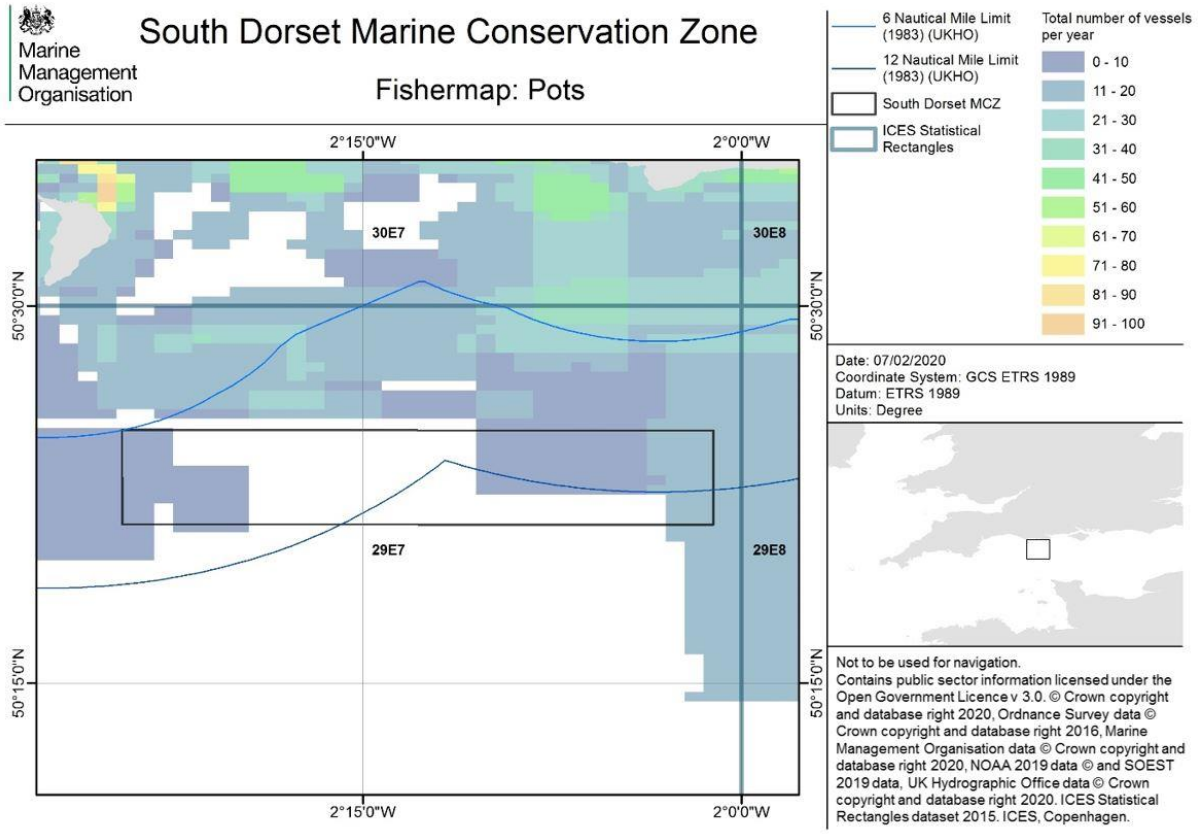
Year	Vessel Nationality	Number of vessel VMS reports at fishing speed	Landings of UK VMS vessels (tonnes)	Estimated landings of UK non-VMS vessels (tonnes)
2014	UK	13	2.78	6.84
2015	UK	9	1.52	7.16
2016	UK	40	3.55	5.05
2017	UK	12	0.96	5.79
2018	UK	14	1.49	12.53

4.1.4 Fishermap

In 2012 the Fishermap project aimed to map the activities of the commercial fishing fleet. Interviews were conducted with ~1000 skippers of the under 15 m fishing fleet. Of those interviewed, 594 gave their permission for their data to be shared with third parties. Fishermap data represents the number of fishers that indicated they fish within the site boundary over a year's fishing activity (collected from a series of monthly totals of vessel numbers per grid cell) using a particular gear type (des Clers et al., 2008; des Clers, 2010).

Fishermap data in the area demonstrates few (up to 20 vessels per year) to no fishing using pots took place within the MCZ (Figure 12). This supports the VMS data, where an average of 18 vessels fished within the MCZ across the five years (2014-2018).

Figure 12: Fishermap data for pots in South Dorset MCZ

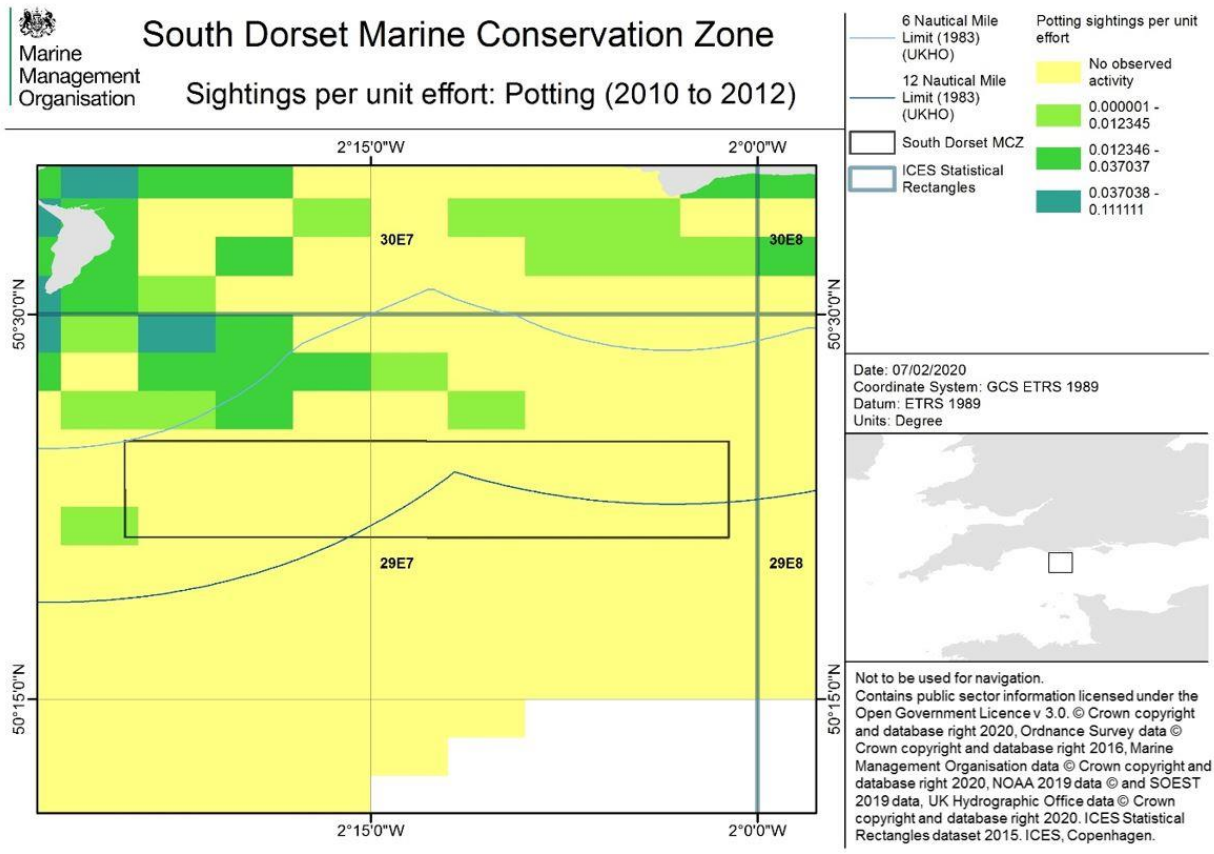


4.1.5 Fisheries sightings data

Fisheries sightings data are based on a Defra commissioned project (Vanstaen & Breen 2014) to collate sightings data from MMO, IFCA and Navy surveillance from 2010-2012 inclusive and create a gridded geographic data layer of sightings per unit effort (SPUE = number of sightings / surveillance effort).

Fisheries sightings data for pots demonstrates that no activity was observed across the majority of the MCZ, with a small (0.000001 -0.01 sightings per unit of effort) amount of sightings in the south west portion of the MCZ (Figure 13). It is likely that although little fishing activity using pots took place within the MCZ, based on the other sources of evidence, it is likely to be higher than the fisheries sightings data suggest, due to the nature of the sightings data being limited to when patrolling vessels were in the area.

Figure 13: Fisheries sightings data for potting



4.1.6 Spatial footprint analysis using Pr-values

Analysis was undertaken of the total spatial footprint of fishing gear used each year. The total spatial footprint of a particular gear group was then compared to the total area of the feature, producing a ratio (Pr). A Pr-value of less than 1 means that the total spatial footprint of the gear in a given year was smaller than the total area of the feature. A Pr-value of more than one means that the total spatial footprint of the gear in a given year was greater than the total area of the feature. The spatial footprint analysis used in this assessment is based on a report commissioned by Defra's Impact Evidence Group on the feasibility of using a spatial footprint method in

appropriate assessments[17] (report reference: MMO1108). It should be noted that Pr-values are derived from VMS data, and therefore only capture vessels with VMS.

Analysis was undertaken of the total spatial footprint of pots fishing gear used each year. This total gear footprint was divided by the total area of the feature, in this instance the whole of the MCZ due to the mosaic arrangement of the protected features, producing the Pr-value which was also calculated as a percentage. Estimates of the Pr-values for the pots fishing gear at this site are displayed in Table 14. The assumptions used when calculating footprints are displayed in Annex 2Annex 2 - Assumptions used to calculate spatial footprint (Pr-values).

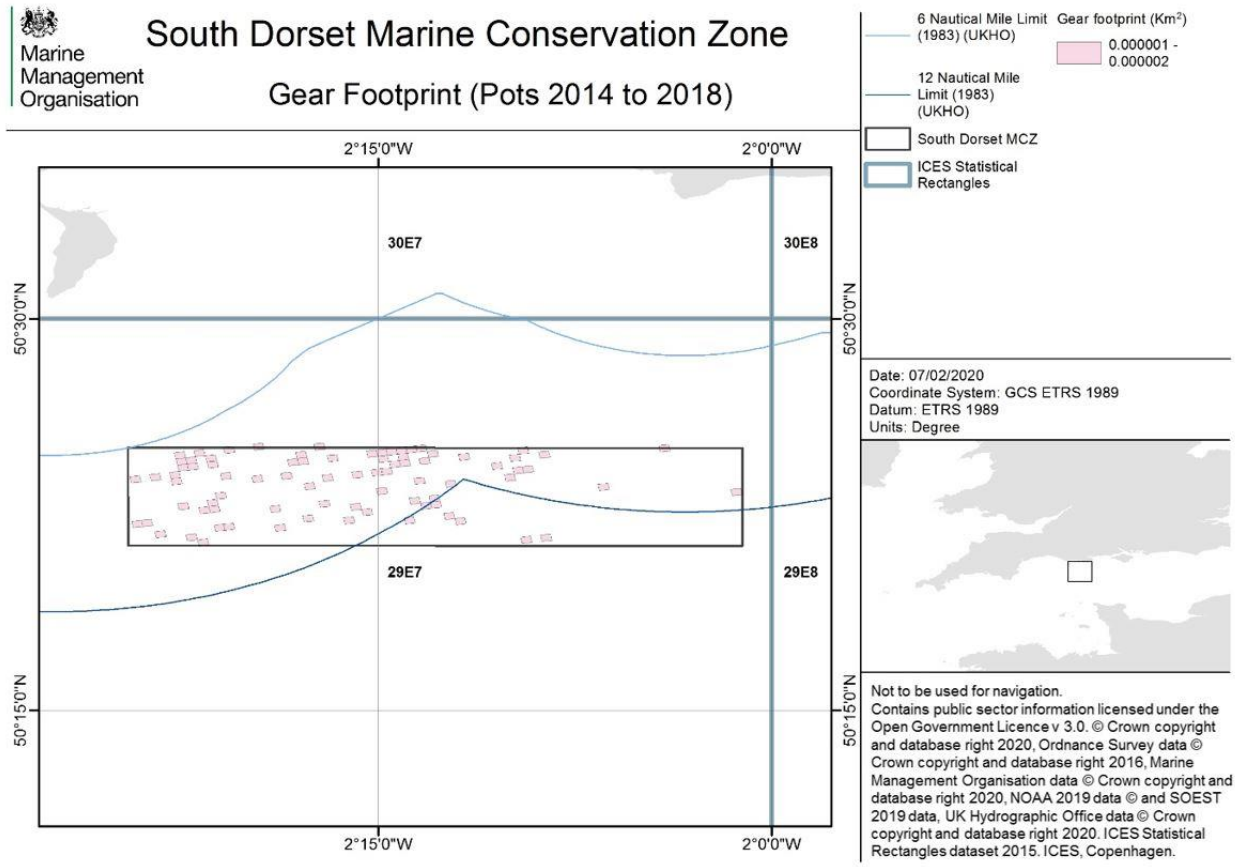
Table 14: Pr-values for pots from 2014-2018

Year	Total VMS report area (km^2)	Total gear footprint (km^2)	Pr-value	Pr-value %
2014	2.63	1.05 e^{-5}	5.46e^{-8}	5.46 e^{-6}
2015	1.82	7.29 e^{-6}	3.78e^{-8}	3.78 e^{-6}
2016	8.1	3.16 e^{-5}	1.64 e^{-7}	1.63 e^{-5}
2017	2.43	9.72 e^{-6}	5.04 e^{-8}	5.04 e^{-6}
2018	2.84	1.13 e^{-5}	5.88 e^{-8}	5.88 e^{-6}

The total VMS report area calculates the sum of unique cell areas (0.2025km^2) where VMS reports occur. This peaked in 2016 at 8.1km^2 and was lowest in 2015 at 1.82km^2, also following the trend of vessels fishing in the area (40 vessel VMS reports in 2016 and 9 in 2015). Due to the relatively small footprint of pots on the seabed and the little fishing activity occurring within the site, the total gear footprint, which is the total area impacted by fishing gear, is very low (7.29 e^{-6} to 3.16 e^{-5} km^2). This small impact is also shown across the site (Figure 14), with summed gear footprint across the years (2014 to 2018) ranging from 1e^{-6} to 2e^{-6} km^2. The Pr-values, which is the total extent of the MPA (193 km^2) impacted by pots, are also very small (3.78e^{-8} to 1.64 e^{-7}).

[17] http://randd.defra.gov.uk/Document.aspx?Document=12955_MMO1108SpatialFootprintAnalysisReport-FINAL.pdf, MARG Ltd in association with Envision Mapping Ltd, 2015

Figure 14: Total Pr-values of pots from 2014-2018



4.1.7 Summary

Data from VMS, Fishermap, fisheries sightings and Pr-values demonstrates that a relatively small level of potting occurred within the MCZ. However, there is still an interaction between traps fishing activity occurring and designated features of the South Dorset MCZ. The sections below begin to explore the pressure that pots exerts on the South Dorset designated features.

For pressures where potential impacts to features are of a similar nature, those pressures have been consolidated to avoid repetition during this stage of the assessment. For each subsequent pressure, new information regarding the potential effects of that pressure could have on the feature has been discussed.

4.2 Abrasion and disturbance of seabed surface substrate

4.2.1 Impact of potting on abrasion and disturbance of the seabed

One aspect of the potential impacts on features from potting and the associated lines and anchors is through surface abrasion and disturbance during deployment of pots (or creels, or traps); and movement on the benthos.

The protected features in the South Dorset MCZ are high energy circalittoral rock, moderate energy circalittoral rock, subtidal chalk, and subtidal coarse sediment. Tilin *et al*. (2010) created a non-quantitative sensitivity assessment that classified high and moderate energy and circalittoral rock as having a medium to high sensitivity to surface abrasion and subtidal course sediment as having a low to medium sensitivity. Subtidal chalk was classified as having a low sensitivity to surface

abrasion, and OSPAR (2009) identified that the removal or over harvesting of shellfish species can impact littoral chalk communities, though the scale of the threat was assessed to be low.

The use of pots or creels is generally considered far less damaging to benthic communities than the use of mobile gears (Sewell & Hiscock, 2005), with benthic community biomass and species richness being significantly greater in static gear only sites compared to bottom-towed gear sites (Blyth *et al*., 2004). Circalittoral faunal turf and chalk boring communities may be only lightly damaged by potting (Hartnoll, 1998; Tillin *et al*., 2010). However, there is still the potential for static gear to cause damage to reefs and sensitive epifauna at high, medium and even low levels of potting, particularly to vertical rock faces and associated communities (Roberts et al., 2010; Eno et al., 2013; Rees *et al*., 2019), and rock habitats with erect and branching species (Hall *et al*., 2008).

The most damage is likely to occur during gear setting and retrieval, when gear weights and anchors are hauled over the seabed (JNCC & NE, 2011). Damage to the benthos can also occur while the gear is soaking, due to tides, currents, and storm activity (Eno *et al*., 2001; Roberts *et al*., 2010). When monitoring individual pot movement over a 23 day period, Stephenson *et al.* (2015) found a mean area of seabed disturbed of 85.8m^2 per pot. However, the average soaking time for pots is estimated to be 24-48 hours (Seafish, 2015) and therefore commercial potting may do less damage, although pots may be kept in the water for longer during bad weather. Anchor weights on pot fleets are used to prevent gear dragging in dynamic areas (Coleman *et al*., 2013), but when deployed incorrectly the pots can move on the seabed during strong tides and large swells (Eno *et al*., 2001; Stephenson *et al*., 2015). This can be especially damaging to soft substrates such as chalk reefs, with evidence of one pot scraping 200mm of chalk relief from the reef surface (Spray and Watson, 2011). Further, in Flamborough Head EMS higher abundance of benthic taxa was identified inside the 'no take zone' (NTZ) compared to the fished site, which in comparison also had a higher percentage of bare substrate (7.2%) (Young *et al*. 2013).

There is mixed evidence on the impact of potting on rocky reef habitats. Fragile sponge and anthozoan communities are classified as having a high sensitivity to surface abrasion (Tillin *et al.,* 2010). For example, there is evidence of detachment of reef fauna due to potting, including bryozoans such as Ross coral (*Pentapora foliacea*) which can be found within the South Dorset MCZ, as well as ascidians (Ascidiacea) and sponges (Porifera) (Eno *et al*. 2001). JNCC and Natural England (2011), advised that the impacts of weights and anchors associated with static gear and hauling of gear can damage some species within fragile sponge and anthozoan communities on subtidal rocky habitats, but that other species appear to be resilient to individual fishing operations, concluding the sensitivity of these species to low intensity potting is low.

Some epifauna may have high resilience to abrasive impacts due to high colonisation rates (such as *Nemertesia ramosa*), repairing abilities (such as *Amphiura filiformis*) and robust, hard or protected bodies such as barnacles (Tilin *et al.* 2014). Further, some studies have shown that potting had no impact on species abundance and community composition. For example, Coleman *et al.* (2013) found the abundance of sessile species (including porifera, cnidarian, bryozoan and chordata) were not affected by potting, and Stephenson (2016) found that the

species richness and composition of rocky reef biotopes were not impacted by commercial potting pressure. This was supported by a review from Roberts *et al*. (2010) where limited impacts were shown where potting only accounts for a small footprint of the seabed. Stephenson (2015) found no evidence of change in species abundance or community composition (dominated by faunal and algal crusts) with experimental intensive potting(three pots within a 10 x 10 m area), however it was acknowledged that the potting did not replicate the likely more damaging commercial practices (10-30 pots in a fleet dragged along the benthos).

Recently however, Rees *et al.* (2019) found after three years of potting, at various densities, sessile reef species showed significant reductions in abundance, with Ross coral being particularly sensitive, displaying a significant negative response to even low potting densities (5-10 pots per 500 m^2). Further, Lewis *et al*. (2009) found lobster trap movement paths caused reductions in the cover of sessile fauna (including corals and sponges) compared to control sites of 45% to 31%, 51% to 41%, and 41% to 35% at 4m, 8m, and 12m depths respectively. Therefore a variation in the severity of impacts to faunal assemblages by potting may be found across different waters depths, with water depths ranging from 4m (Lewis *et al*., 2009) to 31m (Rees *et al*., 2019). This may be due to pots in shallower water moving greater distances than those anchored in deeper water due to increased wave action (Lewis *et al.* (2009). Other factors may also influence the amount of damage caused. For example, unbuoyed pots caused substantially less disturbance than buoyed traps, suggesting it is the drag on the buoy lines, not on the pot itself, which causes the pot to move. This may also imply that pots lost at sea will not do as much damage to the seabed as actively fished pot fleets.

4.2.2 Pressure conclusion

Overall, empirical studies generally found no detrimental impacts of potting on the abundance of species studied (Eno *et al*., 2001; Haynes *et al.,* 2014); assemblages of sessile epifauna (Coleman *et al*., 2013); nor biodiversity aspects of faunal-algal crust habitat (Stephenson *et al*., 2015).

However, particularly sensitive species may still be damaged from potting. For example, temperate reefs may be impacted during trap fishing, with delicate species such as Ross coral more likely to be harmed. Further, a sensitivity assessment suggested similar fishing impacts on chalk reefs to other rocky reef habitats (emergent fauna at risk of being removed), but the softness of chalk means that that the actual chalk structure is at high risk from abrasion from pots and other fishing gear being dragged over it (Roberts *et al.* 2010).

It must be noted that the majority of studies focused on shallow water impacts (less than 30m depth). However, water depths in South Dorset MCZ range from 36 to 52m, where limited research is available. Lewis *et al.,* (2009) indicated that traps move less and therefore cause less abrasion at greater water depths, consequently the Roberts *et al*. 2010 review may assume a greater impact compared to potting occurring in the MCZ. Shallow water studies may also show comparatively less loss of species abundance or richness since shallower waters are often subject to harsher environmental conditions than deeper waters, including increased wave and tidal action (Birkett *et al.,* 1998; Connor *et al.,* 2004). Studies in deeper water, where the conditions are less extreme, may show a greater difference in the biotopes of fished versus non-fished communities. Within the South Dorset MCZ fishing effort from pots

is low, with the amount of vessels fishing ranging from 9 to 40 between 2014 and 2018. Therefore there is currently little interaction occurring between potting activity and the designated features and risk of abrasion and disturbance will be limited.

With regards to the discussion above and the assessed activity levels**, the MMO conclude that this pressure associated with traps is compatible with the conservation objectives of the site.**

4.3 Removal of non-target species

4.3.1 Impact of traps on incidental catch

Static gear such as pots can remove non-target species which could impact community composition. Incidental catch also includes non-targeted catch such as undersized target species. Pots are one of the most commonly lost or abandoned types of fishing gear (Macfadyen *et al*., 2009), and can also continue to catch target and non-target species when lost (ghost-fishing) (Brown & Macfadyen, 2007).

The mortality of incidental catch in pots (or creels) is generally considered low due to the selectivity for the target species and high probability of survival for any unwanted species caught and returned (Suuronen *et al*., 2012). Potting can however catch undersized and berried crabs and lobsters which could have implications for future populations.

4.3.2 Impact of traps on the damage to sensitive epifauna

The movement of pots along the seabed can damage and remove sensitive or delicate species (see section 4.2.1). Benthic communities can be directly impacted by potting gear in a number of ways, including being directly struck by a pot or end-weight during deployment, through the entanglement or removal with moving pots or ropes under the influence of tidal currents or waves and through retrieval of pots which may lead to lateral dragging of the gear as it is being lifted (Coleman *et al*. 2013).

For South Dorset MCZ, the presence of potentially sensitive, non-target species,slow growing or branching epifauna such as Ross coral (Defra, 2014) associated with the reef feature are of potential concern for impacts from static gear.

Species that grow taller and branching could be at more risk from potting (Hall *et al*., 2008), with Coleman *et al.* (2013) finding that *Cliona celata* (a sponge species that grows close to the substrate surface), increased in commercially potted areas compared to the NTZ, whereas *Raspalia ramosa* (a tall and branching sponge species) reduced in abundance in the commercially potted area. Other studies found evidence of potting resulting in possible damage to branching epifauna, especially on vertical rock faces (Roberts *et al*., 2010; Eno *et al*., 2013; Rees *et al*., 2019) and Rees *et al*., (2019) found that high levels of potting can significantly reduce abundance of sessile reef species with Ross coral appearing particularly sensitive with significant reductions in abundance even at low potting densities.

Coleman *et al.* (2013) examined sessile epifauna in circalittoral reef habitats over a four year period following the designation of a (NTZ at Lundy Island in 2003. The study concluded no detectable effects of potting for lobster and crabs on the benthic assemblage. However, physical differences such as wave exposure between the NTZ and control locations are likely to complicate the detection of any changes in assemblage.

Stephenson *et al*. (2015) investigated the long-term impacts of potting on benthic biotopes in the Berwickshire and North Northumberland Coast EMS and found that between 2002/3 to 2011 biotope richness and composition was similar between years and transects, with only slight variations. Further, results suggested that biotopes most likely to be impacted by fishing pressure were deeper, faunal and algal crusts. Overall, it was concluded that there was little evidence of change in species composition or species richness of biotopes between years and it was not fully possible to investigate the role of fishing pressure in relation to community change.

As referenced in section 4.2.1, the literature review by Walmsley *et al*. (2015) found limited sources of primary evidence specifically addressing the physical impact of potting, with studies reporting no or limited significant impacts from potting on subtidal bedrock reef or subtidal boulder and cobble reef. Particular evidence gaps were identified include those which relate to certain habitats (specifically maerl, seagrass, mussel beds, subtidal mixed sediments) and pot types (i.e. whelk pots and cuttle traps). Overall, the review of evidence found that most sub-features are unlikely to be of significant concern, particularly at existing potting intensity levels and limited impacts are likely to be undetectable against natural variability and disturbance. This conclusion may be drawn due to a paucity of long term studies. Babcock *et al*., (2010) found that detection of fishing impacts in marine reserves took 5.13 ± 1.9 years for target species, and 13.1 ± 2.1 years for non-target species, so there is an evidence gap in current literature for long term potting impact studies.

4.3.3 Pressure conclusion

The available evidence that suggests that mortality to non-target species by bycatch is low, particularly when using escape gaps.

Fragile species and biotopes (reefs and faunal and algal crusts) may be more at risk to damage and removal by trap fishing, but the majority of the benthos in cited studies shows no loss in species richness or abundance, and no change in community composition. Sensitive sponge and bryozoan species need to be taken into account in management decisions, and further long term studies of potting impacts on the benthic ecosystems need to be undertaken to fully understand how pots and traps can affect different biotopes.

With regards to the discussion above and the assessed activity levels**, the MMO conclude that this pressure associated with traps is compatible with the conservation objectives of the site.**

4.4 Removal of target species

4.4.1 Impact of traps on the removal of target species

Potting results in the removal of target species which play a role in maintaining habitat diversity within the reef ecosystem. The main target species for potting in the area surrounding the South Dorset MCZ are edible crab (C*ancer pagurus*), spider crab (*Maja squinado*), whelks (*Buccinum undatum*) and European lobster (*Homarus gammarus*). These species are subject to minimum conservation size legislation, making it illegal for them to be landed if they are below a certain size (see section 4.3.1 Impact of traps on incidental catch). This legislation is in place to try to maintain a healthy stock size of sexually mature individuals. But removal of these species could impact the productivity and community composition of the reef feature. Literature on the ecological effects of selective extraction of target species is limited,

however the following studies give some indication as to the ecological impacts of removing target species through potting.

Removing lobsters, one of the top predators in shallow water rocky habitats, may lead to ecosystem destabilization through changes in food web dynamics (Eno *et al*. 2001). However, Wootton *et al*. (2015) suggest that since *H. gammarus* population expand rapidly at the expense of other species when freed from commercial exploitation, lowered lobster populations may therefore increase biodiversity and maintain ecosystem function, although this has not been confirmed in empirical studies.

Similar prey preferences have been found for edible crab and other co-existing crab species indicating niche-competition (Mascaró and Seed, 2001; Silva *et al*. 2008). Therefore, removal of edible crab through the targeted potting fishery could increase the abundance of co-existing crab species due to reduced competition with edible crab. However, Griffin *et al*. (2008) found a wider variation in prey exploitation by common UK crab species, suggesting that replacing a species with conspecifics in an ecosystem would reduce the breadth of resources exploited, increasing competition and depressing the rate of resource acquisition.

Silva *et al*. (2014) reported intertidal migrations of different sublittoral crab species, indicating that the different species could be interchangeable in terms of ecosystem function (such as predation), and that fished areas could be easily repopulated. Wootton *et al*. (2015) suggest that the 50-60 species of brachyuran crabs in the UK all belong to a large functional group due to their similar diets and behaviour, and so a reduction of *C. pagurus* in the marine environment is unlikely to negatively impact ecosystem function and stability. There is, however, a potential concern for removal of large edible crabs from subtidal ecosystems at the same time as lobsters, when both constitute apex predators whose ecological function may not be able to be performed by smaller crustaceans.

The Centre for Environment, Fisheries and Aquaculture Science (Cefas) conduct regular stock assessments for fisheries. For edible crab, the most recent stock assessment (based on 2016 data)[18] reported that the status of the stock in the Western English Channel is approaching the level associated with maximum sustainable yield (MSY). Exploitation levels are close to the levels required to produce MSY. The status of the stock has not changed since the last assessment in 2014 (Cefas 2017a).

For European lobster, the most recent stock assessment (based on 2016 data) reported that the status of the stock in the Southeast and South Coast is low, with biomass for both sexes just around the minimum reference point limit. However biomass has increased since the previous assessment in 2014. The exploitation level is high, being just under the maximum reference point limit, and fishing pressure is particularly high around the MCRS (Cefas 2017b).

The minimum reference point is the point at which fisheries operating beyond this level are considered to carry higher risk to the production of future generations.

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18 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/722904/Cefas_Crab_Stock_Assessment_2017.pdf

Exploitation (fishing) below this level indicates that the population is sustainable, although will not provide maximum long term fisheries yields.

The Cefas stock assessments are based on a large spatial scale, and do not necessarily indicate the status of local populations at a smaller area, such as South Dorset MCZ. However, lobster and particularly edible crab are mobile species with relatively large scale larval dispersal, meaning that local populations within a region are to some degree linked.

There is little empirical evidence for how whelk potting could impact the South Dorset MCZ, or even how it impacts the marine environment as a whole. Historically it has been a small artisanal fishery, but rising demand from Asian markets has seen the global landings of whelks rise from 7000 t yr^{-1} to over 35,000 t yr^{-1} between 1990 and 2014 (FAO, 2017a). European waters are the principal area of fishing for this species (FAO, 2017a), and therefore understanding how the increasing fishing effort will impact the marine environment is imperative. Whelks can be susceptible to recruitment overfishing (Shrives *et al*. 2015) due to their relatively sedentary lifestyles and the lack of inward migration of other whelk populations into a fished area (Hancock, 1963). Wootton *et al*. (2015) suggest that reduced whelk populations would not impact ecosystem functioning, as there are numerous other species that can fill their scavenging ecological niche.

A similar paucity in scientific literature exists for the spider crab potting fishery. Seen as a bycatch in nets set for crawfish until recent decades, the stock has been not long been deliberately exploited. The fishery is not as large as the more commercially demanded edible crab and lobster and spider crab is not among the most highly targeted crustaceans, but fishing effort can increase when stocks of more valuable species like lobsters decline. This can cause CPUE to sharply decline when fishing effort increases (Fahy, 2001). The FAO reports that 364 tonnes were landed in the UK in 2017, with annual landings declining since the peak in the 1990s (FAO, 2017b).

4.4.2 Pressure conclusion

Crab and lobster stocks in the general area around the MCZ are not being over exploited, though lobster exploitation levels are high, being just under the maximum reference point limit.

There is little empirical evidence for the effects of removing pot-targeted species, with most literature being speculation based on ecological knowledge of the species. The general consensus is that due to niche-overlap in crustacean species, the removal of edible crabs and other fished crabs will not impact ecological functioning. However, there is a concern that as a top predator in subtidal environments, the removal of lobsters could cause a trophic cascade. This could result in changes to the distribution of biological communities. Within the South Dorset MCZ fishing effort from pots is low, therefore the risk of removing target species and the potential consequences from this is low.

With regards to the discussion above and the assessed activity levels**, the MMO conclude that this pressure associated with traps is compatible with the conservation objectives of the site.**

4.5. Part B conclusion

The main impacts of potting on the designated features are abrasion and disturbance of the seabed, removal of target species and removal of non-target species including incidental catch and damage to sensitive epifauna and mobile fauna.

Potting is generally considered a low impact fishing gear, particularly in comparison to trawling and dredging. The available evidence suggests that generally, potting has no detrimental impacts on abundance or biodiversity of benthic sessile species, although sensitive species such as Ross coral may still be damaged by potting. Mortality to non-target species by bycatch is low although there is potential for marine mammals in the area to be at risk from entanglement. The crab and lobster stocks are being fished at sustainable levels, although there is less evidence available on the sustainability of the whelk and spider crab industries.

Fishing effort from pots within the site is low, with the amount of vessels fishing ranging from 9 to 40 between 2014 and 2018. The total gear footprint of pots (7.29 e^{-6} to 3.16 e^{-5} km^2) and Pr-values (3.78e^{-8} to 1.64 e^{-7} km^2) are very small, indicating that there is little interaction with pots on the designated features of the MCZ. As fishing effort within the site is low, the impact of the assessed pressures on the designated features will also be low, and with the current effort potting is compatible with the conservation objectives (Table 15).

As such the **MMO concludes that alone, provided the levels or nature of trap activity do not depart from recently observed levels, there is not a significant risk of the fishing activities hindering the achievement of the conservation objectives stated for the designated features within the South Dorset MCZ.**

Table 15: South Dorset MCZ part B pressure assessment summary.

Pressures	**Favourable condition target**	**Aggregated method**	**Compatible with the conservation objectives?**
Abrasion/ disturbance of seabed surface substrate; Removal of non-target species; Removal of target species	Recover the presence and spatial distribution of circalittoral rock communities and subtidal chalk communities; maintain the presence and spatial distribution of subtidal coarse sediment communities; Recover the species composition of component communities; Subtidal coarse sediment: Restrict surface sediment contaminant levels to concentrations where they are not adversely impacting the infauna of the feature Subtidal chalk & moderate energy circalittoral rock: Maintain the natural rate of sediment deposition.	Traps	Yes

5. Part C Assessment

5.1. In-combination assessment

This section assesses the effects of activities considered as compatible with the conservation objectives of South Dorset MCZ in combination with other relevant activities taking place which includes the following**:**

- fishing activity/pressure combinations which were excluded in Part A of this assessment as having no likely significant effect (see Table 7);
- fishing interactions assessed in Part B but not resulting in adverse effect;
- fishing activities with interactions at the site identified as being in green status in the Matrix; and
- plans and projects (see Table 16).

The MMO SPIRIT (SPatial InfoRmatIon Toolkit) system was used to check regulated and unregulated activities that occur within, or adjacent to, the assessed site where there could be a pathway for disturbance. To determine plans and projects to be included in this part of the assessment, a distance of 5 km was selected as suitable to capture any potential source receptor pathways which could impact the site in combination with effects of the fishing activities assessed. A 5 km buffer was therefore applied to the site boundary to identify any activities including other fishing activities, marine works licensed by MMO, and recreational activities within the assessed site.

Other fishing activities occurring in South Dorset MCZ are bottom-towed gears which will be automatically be addressed through a management measure. Therefore there is no current requirement to assess other fishing activities in combination.

5.2. Pressures exerted by fishing and plans or projects

In accordance with the methodology detailed above, the SPIRIT system identified nine military practise areas which include firing danger area, surface danger area, practice and exercise area (surface fleet) and submarine exercise area. No recreational activities or marine works were identified.

To identify the specific pressures that the military practise areas exert on the South Dorset MCZ designated features, the MMO used the Royal Navy's environmental assessment of military activities at sea[19] because military activities are not covered by the Natural England/JNCC conservation advice.

A list of pressures has been collated and only those pressures that are relevant to both the fishing activities and the project/plans have been discussed below. Pressures from plans/projects that are not associated with the fishing activities are not within the scope of this assessment. From these considerations, Table 16 details the pressures exerted by military practice areas and traps.

[19] http://archive.jncc.gov.uk/pdf/011113_MOD_SNCB_SOI_final.pdf

Table 16: Pressures exerted by military practise areas and traps occurring in South Dorset MCZ. Non fishing pressures similarly exerted by traps require further assessment and are highlighted in red.

Pressure	Military submarine/ surface exercise & practice areas	Traps
Abrasion/disturbance of the substrate on the surface of the seabed	Y	Y
Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion	Y	N
Removal of non-target species	N	Y
Removal of target species	N	Y
Deoxygenation	N	N
Introduction of light	N	N
Introduction or spread of invasive non-indigenous species (INIS)	N	N
Organic enrichment	N	N
Changes in suspended solids (water clarity)	N	N
Smothering and siltation rate changes (light)	N	N
Physical change (to another seabed type)/ (to another seabed type)	N	N
Introduction of microbial pathogens	N	N
Barrier to species movement	N	N

5.2.1. Abrasion and disturbance of the substrate on the surface of the seabed

The designated features of South Dorset MCZ are sensitive to physical damage through surface abrasion from pots during deployment, movement of gear on the benthos due to strong tidal current and storm activity; and as the gear is dragged along the seafloor during retrieval.

Military activities which might cause abrasion or disturbance of the seabed are outlined in Table 17. As military operations will take into consideration protected areas and the potential impacts on the marine environment when planning these activities it may be of very low likelihood that these activities would occur within the MCZ. The impacts of these activities are also likely to be localised, for example detonations may create a 5m wide crater, up to 1m deep.

Table 17: Activities which may occur in military practise areas [20]

Activity	Activity description	Potential impact to environment
Fast inshore attack craft (FIAC)	FIAC are operated by UK special forces. In addition to their own training they will often be used to simulate terrorist or piratical water bourn attacks on surface vessels. Their activity will involve very high speed manoeuvres and possibly blank munitions firings.	Surface (and water column/sea bed in very shallow waters) - minor noise and physical disturbance. All FIAC operations will take due account of protected areas, especially where high speed manoeuvres and gunfire could disturb benthic or sea mammal communities.
Demolition of unexploded ordnance (DUO)	Underwater or shoreline EOD activity - MCM or EOD Teams. This will always take place in established and closely controlled Ministry of Defence (MOD) ranges unless it is the operational destruction of live ordnance which cannot be moved.	Air & Water Column - noise & physical disturbance. In all circumstances explosions will be controlled in accordance with JNCC protocols in BRd 5063 'Clearance Diving Operations – Ch.3 Section 9: Protection of Marine Mammals and the Environment when using explosives, February 2010'.
Explosives trials (ET)	Underwater or shoreline explosives trials. All new or modified naval weapons systems have to be tested before accepted for service. Trial planning will conform to the considerations set out above for managing activities involving explosions. Such trials will only take place if licensed by the Naval Authority Explosives (NAEXP).	Air & Water Column - Noise & physical disturbance. All explosive operations will be conducted in accordance with the JNCC protocols set out in BRd 5063 and will be strictly controlled within MOD established ranges.

As detailed in section 4.2 Abrasion and disturbance of seabed surface substrate, at current activity levels pots are not considered to be causing significant pressure through abrasion and disturbance. While it is possible that activities within military practise areas in combination with potting may increase the potential for this pressure to have negative effects, the likelihood and frequency of activities occurring is very low.

The MMO conclude that this pressure associated with traps, in combination with the plans/projects/activities occurring in the site are compatible with the conservation objectives of the site.

[20] http://archive.jncc.gov.uk/pdf/011113_MOD_SNCB_SOI_final.pdf

5.3 Part C conclusion (fishing in-combination with relevant activities)

MMO concludes, taking into account the introduction of management areas for bottom towed fishing gear outlined in section 6, that fishing activities in combination with other relevant activities are not adversely affecting the designated features of the South Dorset MCZ and are compatible with the conservation objectives of the site.

6. Assessment result

6.1 Fishing alone

The MMO consider that there is a pathway for disturbance from bottom-towed gear, and the impacts alone are of significant risk to hinder the conservation objectives of the site.

The MMO consider that there is not a pathway for disturbance from traps, and therefore trap fishing alone are not of significant risk to hinder the conservation objectives of the site.

6.2 In-combination

As with the assessment of fishing alone, this section assumes that management for bottom towed gear will be introduced. When the pressures from trap fishing activities were combined and considered alongside pressures from the potential non fishing activities taking, none were identified which likely result in a negative impact on the designated features. Therefore the MMO concludes that the trap fishing activities assessed, in-combination with other known activities, are not causing a significant risk to hinder the conservation objectives of the site.

7. Management options

Option 1: No fisheries restrictions. Introduce a monitoring and control plan within the site.

Option 2: Reduce/limit pressures. Due to the potential impacts of bottom towed gears on the more stable sub features of the site, zoned management will be introduced to ensure the achievement of the conservation objectives.

Option 3: Remove/avoid pressures (site closures). Prohibit bottom contacting towed gears in all areas of the site.

At this time, the MMO does not believe that management option 1 is sufficient to protect South Dorset MCZ due to the significant risk to the site's conservation objectives from fishing with gears that are towed over the seabed.

The introduction of any management measures will be subject to a separate process, including appropriate levels of consultation.

South Dorset MCZ lies within the South Marine Plan Area. The South Marine Plans[21] were adopted in 2018. The decision in this assessment will be compliant and made in accordance with relevant policies. Consideration of policies will be detailed in the Regulatory Triage Assessment which will accompany the proposed management.

8. Review of this assessment

MMO will review this assessment every five years or earlier if significant new information is received.

Such information could include:

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

To coordinate the collection and analysis of information regarding activity levels, and to ensure that any required management is implemented in a timely manner, a monitoring and control plan will be implemented for this site.

Monitoring of activity levels will occur through a combination of surface surveillance and ongoing monitoring of VMS and landings data. Should activity levels increase significantly or in a manner that could affect the site features, this will trigger further investigation into the level and distribution of the activity, including consultation with Natural England and JNCC regarding current site condition. Any subsequent evidence gathered would be used to assess the need for further management measures.

Monitoring will be recorded through annual MPA reporting. South Dorset MCZ is categorised as Tier 2 which means an individual report is produced by the MMO's Marine Conservation Team for this site annually between March and May. The report includes VMS data for fishing activity over the reporting period and a 5-year period as well as information on inspected/observed activities, intelligence and non-compliant activity (if applicable). Coastal questionnaires are completed by local MMO officers regarding any changes in activity within the site. This will act as an early warning system for potential negative impacts on the site. If the report determines that a change in fishing activity is a risk to the conservation objectives of the site, an assessment of the site will be triggered regardless of whether a review is due. An increase in activity above that identified in this assessment, will initiate discussion with Natural England/JNCC following the annual MPA report.

Possible management measures include an MMO emergency byelaw, which can be implemented immediately for up to 12 months, or a (non-emergency) MMO byelaw which would be subject to public consultation before implementation.

An overview of the monitoring and control process is illustrated in Annex 3.

[21] https://www.gov.uk/government/collections/south-marine-plans

9. Conclusion

MMO have had regard to best available evidence and through consultation with relevant advisors and the public, conclude that, provided that appropriate management measures for fishing activities identified above are implemented, fishing activities at levels similar to the years analysed are compatible with the conservation objectives and general management approach of this marine protected area.

10. References

Babcock, R.C., Shears, N.T., Alcala, A.C., Barrett, N.S., Edgar, G.J., Lafferty, K.D., Mcclanahan, T.R. and Russ, G.R., 2010. Decadal trends in marine reserves reveal differential rates of change in direct and indirect effects. *Proceedings of the National Academy of Sciences*, 107(43), pp.18256-18261.

Birkett, D.A., Maggs, C.A., Dring, M.J., Boaden, P.J.S. and Seed, R., 1998. Infralittoral reef biotopes with kelp species. *Vol VII An Overview of Dynamic and Sensitivity Characteristics for Conservation Management of Marine SACs*, 174.

Blyth, R.E., Kaiser, M.J., Edwards-Jones, G.A., and Hart, P.J., 2004. Implications of a zoned fishery management system for marine benthic communities. *Journal of Applied Ecology*, 41(5), pp.951-961.

Brown, J. and Macfadyen, G., 2007. Ghost fishing in European waters: Impacts and management responses. *Marine Policy*, 31(4), pp.488-504.

Bullimore, B.A., Newman, P.B., Kaiser, M.J., Gilbert, S.E. and Lock, K.M., 2001. A study of catches in a fleet of" ghost-fishing" pots. *Fishery Bulletin*, 99(2), pp.247-247.

Cefas (2017)a. Edible crab (Cancer pagurus) Stock Status Report 2017. 29 August 2017.

Cefas (2017)b. Lobster (Homarus gammarus). Stock Status Report 2017. 29 August 2017.

Coleman, R.A., Hoskin, M.G., von Carlshausen, E., Davis, C.M. 2013. Using a no-take zone to assess the impacts of fishing: Sessile epifauna appear insensitive to environmental disturbances from commercial potting. *Journal of Experimental Marine Biology and Ecology*, 440: 100-107.

Connor, D., Allen, J.H., golding, N., Howell, K.L., Lieberknecht, L.M., Northen, K.O. and Reker, J.B. 2004. The Marine Habitat Classification for Britain and Ireland Version 04.05, Report to the JNCC, Peterborough ISBN 1 861 07561 8.

DEFRA. 2014. South Dorset MCZ Post-survey Site Report. (Version 2). Retrieved from http://randd.defra.gov.uk/Document.aspx?Document=12855_SouthDorsetrMCZ_SummarySiteReport_V2.pdf.

Eno, N.C., Frid, D.L.J., Hall, K., Ramsay, K., Sharp, R.A.M., Brazier, D.P., Hearn, S., Dernie, K.M., Robinson, K.A., Paramore, O.A.L., Robinson, L.A. 2013. Assessing the

sensitivity of habitats to fishing: from seabed maps to sensitivity maps. *Journal of Fish Biology*. 83(4), pp.826-846.

Eno, N.C., MacDonald, D.S., Kinnear, J.A.M., Amos, S.C., Chapman, C.J., Clark, R.A., Bunker, F.St.P.D., Munro, C. 2001. Effects of crustacean traps on benthic fauna. *ICES Journal of Marine Science*, 58: 11-2.

Fahy, E. 2001. The Maharees spider crab Maja squinado fishery in 2000. Marine Institute.

FAO. 2017a. Species Fact Sheets: Buccinum undatum. Retrieved 28/11/2019 from http://www.fao.org/fishery/species/2659/en.

FAO. 2017b. Global Capture Production 1950-2017. Retrieved 29/11/2019 from http://www.fao.org/figis/servlet/TabSelector.

Galparsoro, I., Borja, Á., Bald, J., Liria, P. and Chust, G. 2009. Predicting suitable habitat for the European lobster (Homarus gammarus), on the Basque continental shelf (Bay of Biscay), using Ecological-Niche Factor Analysis. *Ecological Modelling*. 220(4), pp. 556-567.

Griffin, J,, De La Haye, K., Hawkins, S., Thompson, R., Jenkins, S. 2008. Predator diversity and ecosytem functioning: density modifies the effect of resource partitioning. *Ecology*, 89: 298–305.

Hall, K., Paramour, 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, Countryside Council for Wales (CCW), Bangor, 85 pp.

D.A. Hancock. Marking experiments with the commercial whelk (Buccinum undatum), 4, ICNAF Special Publication (1963), pp. 176-187.

Hartnoll RG (1998) Circalittoral faunal turf biotopes: An overview of dynamics and sensitivity characteristics for conservation management of marine SACs. Scottish Association of Marine Sciences (UK Marine SAC Project), Oban, Scotland.

Haynes T, Bell J, Saunders G, Irving R, Williams J, Bell G (2014) Marine Strategy Framework Directive Shallow Sublittoral Rock Indicators for Fragile Sponge and Anthozoan Assemblages Part 1: Developing Proposals for Potential Indicators. JNCC Report No. 524, Nature Bureau and Environment Systems Ltd. for JNCC, JNCC Peterborough.

HISCOCK K. 1983. Water movement. In: R. EARLL & D.G. ERWIN eds. *Sublittoral ecology. The ecology of shallow sublittoral benthos* Oxford Clarendon Press. pp. 58-96.

JNCC, 2003. Atlas of Cetacean distribution in north-west European waters. Accessed online 10/01/2020. Available here: http://archive.jncc.gov.uk/PDF/CetaceansAtlas_web.pdf

Joint Nature Conservation Committee and Natural England, (2011) Advice from the Joint Nature Conservation Committee and Natural England with regard to fisheries impacts on Marine Conservation Zone habitat features.

Johnson, A., Salvador, G., Kenney, J., Robbins, J., Kraus, S., Landry, S. and Clapham, P., 2005. Fishing gear involved in entanglements of right and humpback whales. Marine Mammal Science, 21(4), pp.635-645.

Lewis, C.F., Slade, S.L., Maxwell, K.E. & Matthews, T.R. 2009. Lobster trap impact on coral reefs: effects of wind-driven trap movement. New Zealand Journal of Marine and Freshwater Research, 43, 1, 271–282.

Macfadyen, G., Huntington, T. and Cappell, R., 2009. Abandoned, lost or otherwise discarded fishing gear (No. 523). Food and Agriculture Organization of the United Nations (FAO).

Mascaró M, Seed R (2001) Foraging behaviour of juvenile Carcinus maenas and Cancer pagurus Marine Biology, 139: 1135–1145.

McFee, W.E., Burdett, L.G. and Beddia, L.A., 2006. A pilot study to determine the movements of buoy line used in the crab pot fishery to assess bottlenose dolphin entanglement.

Northridge, S., Cargill, A., Coram, A., Mandleberg, L., Calderan, S. and Reid, R., 2010. Entanglement of minke whales in Scottish waters: an investigation into occurrence, causes and mitigation. *Contract Report. Final Report to Scottish Government CR/2007/49*.

Öndes, F., Kaiser, M.J. and Murray, L.G., 2018. Fish and invertebrate by-catch in the crab pot fishery in the Isle of Man, Irish Sea. *Journal of the Marine Biological Association of the United Kingdom*, *98*(8), pp.2099-2111.

OSPAR, 2009. Background Document for Littoral Chalk Communities. Accessed on 03/01/2020. Retrieved from: https://www.ospar.org/documents?v=7192

Pantin, J.R., Murray, L.G., Cambiè, G., Le Vay, L. and Kaiser, M.J., 2015. Escape Gap Study in Cardigan Bay: consequences of using lobster escape gaps. Fisheries and Conservation Science.

Rees A, Sheehan E.V, Attrill M.J (2019) The Lyme Bay experimental potting study: A collaborative programme to assess the ecological effects of increasing potting density in the Lyme Bay Marine Protected Area. A report to the Blue Marine Foundation and Defra, by research staff at the Marine Institute at the University of Plymouth.

Roberts, C., Smith, C., Tillin, H. Tyler-Walters, H. (2010). Review of existing approaches to evaluate marine habitat vulnerability to commercial fishing activities.

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.

Shester, G.G. and Micheli, F., 2011. Conservation challenges for small-scale fisheries: Bycatch and habitat impacts of traps and gillnets. Biological Conservation, 144(5), pp.1673-1681.

J.P. Shrives, S.E. Pickup, G.M. MorelWhelk (Buccinum undatum L.) stocks around the Island of Jersey, Channel Islands: reassessment and implications for sustainable management. Fish. Res., 167 (2015), pp. 236-242.

Silva ACF, Boaventura DM, Thompson RC, and Hawkins SJ (2014) Spatial and temporal patterns of subtidal and intertidal crabs excursions. Journal of Sea Research, 85: 343–348.

Silva ACF, Hawkins SJ, Boaventura DM, Thompson RC (2008) Predation by small mobile aquatic predators regulates populations of the intertidal limpet Patella vulgata. Journal of Experimental Marine Biology and Ecology, 367: 259–265.

Spray, R. and Watson, D., 2011. North Norfolk's Chalk Reef. *A report on marine surveys conducted by Seasearch East*.

Stephenson F, Fitzsimmons C, Polunin NVC, Mill AC, Scott CL (2015) Assessing Long-Term Benthic Impacts Of Potting In Northumberland. Report to Natural England.

Stephenson, F., 2016. Shellfisheries, seabed habitats and interactions in Northumberland (Doctoral dissertation, Newcastle University).

Suuronen P, Chopin F, Glass C, Lokkeborg S, Matsushita Y, Queirolo D, Rihan D (2012) Low impact and fuel efficient fishing—Looking beyond the horizon. Fisheries Research, 119–120: 135–146.

Tillin HM, Hull SC, Tyler-Walters H (2010) Development of a sensitivity Matrix (pressures-MCZ/MPA features). Report to the Department of Environment, Food and Rural Affairs from ABPMer, Southampton and the Marine Life Information Network (MarLIN) Plymouth:Marine Biological Association of the UK. Defra Contract No. MB12 Task 3A, Report No. 22.

Tillin, H.M. and Tyler-Walters, H., 2014. Assessing the sensitivity of subtidal sedimentary habitats to pressures associated with marine activities. Phase 1 Report: Rationale and proposed ecological groupings for Level 5 biotopes against which sensitivity assessments would be best undertaken.

Walmsley SF, Bowles A, Eno NC, West N (2015) Evidence for Management of Potting Impacts on Designated Features. Report prepared for Defra's Marine Biodiversity Impact Evidence Group by ABP Marine Environmental Research Ltd, Eno Consulting and Centre for Environment, Fisheries and Aquaculture Science. Reference: MMO1086.

Wilson, E. 2008. Homarus gammarus Common lobster. 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 27-11-2019]. Available from: https://www.marlin.ac.uk/species/detail/1171

Wootton, E., Clegg, T., Woo, J. & Woolmer, A. 2015. Ecosystem niche review for species caught by commercial potting. 2015. Salacia-Marine Marine Ecological Consultancy. 119 pp.

Young, T. E. 2013. Assessing the impact of potting on chalk reef communities in the Flamborough Head European Marine Site. Report to the North Eastern Inshore Fisheries and Conservation Authority. MSc Thesis. Newcastle University. 74 pp.

Annex 1 - MMO methodology

The need for assessment

In 2012, the Department for Environment, Food and Rural Affairs (Defra) announced a revised approach to the management of commercial fisheries in European marine sites (EMS)[22]. The objective of this revised approach is to ensure that all existing and potential commercial fishing activities are managed in accordance with the provisions of Article 6 of the Habitats Directive[23]. The revised approach was extended to include management of commercial fisheries in marine conservation zones (MCZ) in 2014[24].

This approach was being implemented using an evidence based, risk-prioritised, and phased basis. Risk prioritisation is informed by using a matrix of the generic sensitivity of the sub-features of EMS to a suite of fishing activities. These activity/sub-feature interactions have been categorised according to specific definitions, as red, amber, green or blue[25].

Activity/sub-feature interactions identified within the matrix as amber required a site-level assessment to determine whether management of activity is required to conserve site features. Activity/sub-feature interactions identified within the matrix as green also require a site level assessment if there are “in combination effects” with other plans or projects.

Site-level assessments are carried out in a manner consistent with the requirements of Article 6(3) of the Habitats Directive for EMS and the requirements of section 126 of the Marine and Coastal Access Act 2009 for MCZ. For EMS the assessments will determine whether, in light of the sites conservation objectives, fishing activities are having an adverse effect on the integrity of the site. For MCZ the assessments will determine whether there is a significant risk of fishing activities hindering the conservation objectives of the site.

Assessment process

The fisheries assessments have three stages:

Part A: A coarse assessment using generic sensitivity information to identify which fishing activities can be discounted from further assessment (Part B) as they are not taking place or not a significant concern.

[22] www.gov.uk/government/publications/revised-approach-to-the-management-of-commercial-fisheries-in-european-marine-sites-overarching-policy-and-delivery
[23] Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora
[24] The MMO responsibilities in relation to management of MCZs are laid out in Sections 125 to 133 of the Marine and Coastal Access Act 2009
[25]Managing Fisheries in MPAs matrix: www.gov.uk/government/publications/fisheries-in-european-marine-sites-matrix

Part B: An in-depth analysis to assess the effects of remaining pressures on the features of the site

Part C: An in-combination assessment between all fishing and non-fishing activities occurring.

Sources of evidence

Evidence used in the assessments falls into two broad categories:

1. Fishing activity information. This includes patterns, intensity, and trends of fishing activities and types of gear used.
2. Ecological information, in particular the location, condition and sensitivity of designated features.

Fishing activity information

VMS data

VMS data are derived from positional information reported by UK and Other Member States (OMS) vessels carrying the EU mandated vessel monitoring system (VMS). Since 2015 all commercial fishing vessels of 12 metres and over in length have been required to report their position, course and speed at regular intervals using VMS. Prior to 2015 this requirement applied to commercial fishing vessels of 15 metres and over.

VMS data were analysed in ArcGIS. VMS reports not associated with fishing activity were removed. These included reports with speeds greater than 6 knots (indicating non-fishing) and reports from vessels known to be performing guard ship duties for marine developments.

For UK vessels gear type and landings were assigned to VMS data by matching each report to gear types recorded in relevant landings declarations, logbooks and the Community Fishing Fleet Register.

For OMS vessels only gear types are assigned to the VMS data as individual vessel landings are not available.

Landings data

Landings data are recorded at International Council for the Exploration of the Sea (ICES) statistical rectangle[26] level through landings declarations and logbooks.

In areas where a high proportion of landings came from vessels with VMS, landings data from vessels with VMS were linked to VMS-derived location reports to provide spatial estimates of where landings were derived from within an ICES rectangle (see VMS data above).

For vessels that do not require VMS (<12 m in length) or OMS vessels where landings are not assigned to VMS reports (see VMS data above), landings from within specified areas (e.g. MPA's or area of feature) are estimated using the

[26] ICES statistical rectangles are part of a widely used grid system for North Eastern Atlantic waters. For more information see: www.ices.dk/marine-data/maps/Pages/ICES-statistical-rectangles.aspx

proportion of VMS reports (for VMS vessels) or the relative size of the MPA/Feature area compared to the sea area of the containing ICES rectangle(s).

Landings data are analysed to determine quantities of landings by gear group and vessel size group.

Spatial footprint analysis

See Annex 3 for how spatial footprint analysis using Pr-values were calculated.

Vessel Sightings data

Sighting information is recorded into the Monitoring Control and Surveillance System (MCSS). It is collected by various bodies such as MMO coastal staff, IFCAs, Navy patrols and other relevant agencies and contains the following:

1. Date and time of sighting
2. Reporting body
3. Vessel name, ID, gear type
4. Approximate location of vessel
5. Approximate speed of vessel
6. Whether the vessel is: Laid/tied up, steaming or fishing.

SPUE Fisheries sightings data

Sightings data between 2010 and 2012 were collated and analysed to produce Sightings Per Unit Effort figures for a Defra commissioned Cefas project published in 2014 to better understand trends in inshore fisheries[27].

These data were displayed as national layers of sightings (of certain fishing activities - trawling, potting, netting etc) per unit effort.

MMO and IFCA expert opinion on fishing activity

MMO marine officers and IFCA inshore fisheries and conservation officers provided information on fishing activity within MPAs. Information included number and size of vessels fishing, target species, type and amount of fishing gear used and seasonal trends in activity. Confidence levels were provided alongside expert opinion and estimates were provided where exact numbers were not known.

Fishing Industry Information

Where possible and achievable, information from the fishing industry regarding current fishing locations, intensity and gear types has been used to build the evidence base for the assessment.

Fishermap data

Source: 2012 Marine Conservation Zone Project Stakmap Commercial Fishing under 15m vessels lines summary by month.

In 2012 the Fishermap project conducted interviews with almost 1000 skippers of the under 15 m fishing fleet, with the aim of mapping the activities of the commercial

[27] http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=1&ProjectID=18126

fishing fleet. Of those interviewed, 594 gave their permission for their data to be shared with third parties.

The data was presented as a year's activity, collected from a series of monthly totals of vessel visits, per grid cell.

Summary data is provided as a series of monthly totals of vessel visits per grid cell.

Fishermap data and expert opinion is used to calculate numbers of under 15m vessels operating in a given site.

Ecological information

The fisheries assessments use the conservation advice packages produced by Natural England and the Joint Nature Conservation Committee. These provide information on the features of the site, their area and conditions. The packages also contain advice on operations and supplementary advice documents which allow the assessment of which pressure/gear combinations a feature may be sensitive too.

For some assessments, further ecological information has also been provided by Natural England. This information is available in the relevant assessments.

Sensitivity and vulnerability

The following definitions of sensitivity and vulnerability are used in MMO assessments.

Sensitivity is defined as:

a measure of tolerance (or intolerance) to changes in environmental conditions.[28]

Vulnerability is defined as:

a combination of the sensitivity of a feature to a particular pressure/activity, and its exposure to that pressure/activity.

[28] Tilin *et al* 2010, Roberts *et al* 2010

Annex 2 - Assumptions used to calculate spatial footprint (Pr-values)

1. Pr-value background

1.1. Introduction

The MMO are required to assess the impacts of all fisheries on designated features and habitats within marine protected areas (MPAs) in English waters.

The application of a "footprint" approach has been promoted by previous authors (such as Jennings *et al.*, 2012[29]) as a method to quantify fishing pressure within an area of interest (AOI) such as a 'fishing impact equation' where:

$$Fishing\ footprint\ (Pr) = \frac{Fishing\ effort\ within\ AOI * Area\ fished\ by\ indiviual\ vessel\ in\ 1\ day}{Total\ area\ of\ MPA/feature}$$

Generating a "fishing footprint value" (Pr) aims to define the level of pressure for a single average day of effort for a reference vessel or fisher (land-based) within a fleet, taking into account the gear used. This value could be multiplied by the number of vessels or fishers to give the total pressure for a particular gear over a specific time period e.g. a calendar year.

This aims to inform assessments concerning the level of impact that is acceptable for maintaining integrity of the site or feature. This approach can also be used to help define the spatial extent of the fisheries activities (in relation to feature size) or simply identify where interactions exist with features (which may in itself signify adverse effect and warrant management measures). The equation can also be used to model "worst case" scenarios to help define upper limits of potential impact, which can be refined to more realistic levels with local expert judgement.

However the factors involved in calculating the area of interaction and level of impact can be complex depending on the range of vessels, fishing effort and gear types used in the area, temporal or spatial patterns of activity within the fishery, the frequency of impacts and resilience of the habitats concerned, and any cumulative impacts of different types of gear. The incorporation of these factors will need to be considered when calculating the equation, along with the availability and robustness of data to provide such information for current and future assessments.

In order to calculate the fishing pressure effectively for each gear, a clear understanding of the three parameters that define the fishing pressure must be obtained.

1.1.1. Fishing effort

In order to calculate fishing effort there are two specific variables that must be defined for each gear type:

- **Effort** (the number of effort units for a particular gear type) and
- **Area of interaction** (the area of contact from a unit of gear)

[29] Jennings, S., Lee, J., Hiddink, J.G., 2012. Assessing fishery footprints and the trade-offs between landings value, habitat sensitivity, and fishing impacts to inform marine spatial planning and an ecosystem approach. ICES J. Mar. Sci. 69, 1053–1063. doi:10.1093/icesjms/fss050

A source of effort data is vessel monitoring system (VMS) data as this represents high quality independent data that can be linked to logbook data for UK vessels to verify and merge catch and effort datasets. Area of interaction is defined as the actual impact of the individual gear type based on the proportion of gear in contact with the bottom and this information can be sourced from scientific literature and/or interviews (see section 3.1 for further details).

1.1.2. Area of interest

The area of interest (AOI) could be defined as the MPA itself or designated features within a specific MPA. Data sources on the distribution and extent of designated features could be obtained from statutory nature conservation bodies (SNCBs) such as Natural England and the Joint Nature Conservation Committee (JNCC).

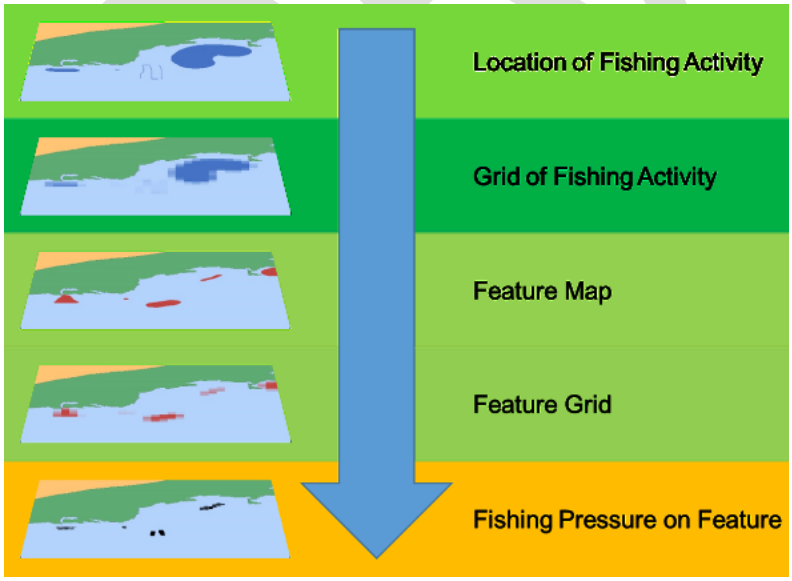
1.2. Developing the equation further

In order to determine the level of impact of fishing activity on designated features, the sensitivity of the feature should be incorporated into the proposed fisheries footprint calculation to help determine the extent to which the interaction is likely to cause an adverse effect. The sensitivity of the feature may be influenced by the time of recovery of a feature, the level of natural disturbance, cumulative impacts etc. This was identified through the fisheries European Marine Site (EMS) matrix and further scientific literature reviews.

Fishing effort also varies in terms of both the spatial and temporal distribution, potentially leading to clustering and non-uniform distribution of fishing effort across a single feature. Therefore gaining an understanding of intensity of fishing on a feature would be useful in identifying potential cumulative impacts.

To incorporate clumping or non-uniform distribution of fishing effort a geospatial system was developed (Figure 15).

Figure 15: An example of input layers and stages for geospatial calculations



Spatial and temporal data was obtained in the form of VMS data to map fishing activity (effort). Area of interaction with the seabed from different gears was calculated using scientific literature and interviews with informed individuals. Feature

maps of designated features within MPAs were obtained from SNCBs. From this the following can be calculated for the different gear types:

- Single VMS report gear footprint (m^2): This calculates the gear fishing footprint equivalent to a single VMS report across a cell area (0.2025km^2) over a 2hr time frame.
- Total VMS report area (km^2): This calculates the sum of unique cell areas (0.2025km^2) where VMS reports occur.
- Total gear footprint (km^2): This is the total area impacted by fishing gear. This is calculated by multiplying the total number of VMS reports by cell area (0.2025km^2) and the single VMS report gear footprint.
- Pr-value: Total extent of AOI impacted by gear (as a ratio). This is calculated by dividing total gear footprint by the AOI.
- Pr-value percentage (%): Percentage of AOI impacted by gear.

2. Analysis

2.1. Single VMS report gear footprint

The types of gear currently included in the gear calculators which calculates the single VMS report gear footprint are described in Table 18.

Table 18: A description of gear and the gear code used

IFISH Code	Gear	Brief Description
DRB	Boat dredges	Two types; one that is dragged along sea bed, another that is like a benthic scoop that penetrates the sea bottom. Targets mussels, clams, scallops, crab etc.
FPO	Pots	Cages/baskets made from various materials and come in various sizes. Mainly set on the bottom, sometimes designed for mid-water use. Pots target fish, crustaceans and cephalopods.
GN/GNS	Gillnets (not specified) /Set gillnets (anchored)	A gillnet is a wall of netting that hangs in the water column. Set gillnets are anchored in the sea bed and held down by the heavy rope line. They can be either vertical (with a float line) or flat (without a float line). Targets coastal species.
HMD	Mechanized dredges	Hydraulic dredges dig and wash out mussels from the sea bed. It is considered a harvesting machine when the same gear collects the mussels and hauls them on board.
OTB	Otter trawls - bottom	Dragged along bottom and has an extended top panel to stop fish escaping upwards. Targets bottom and demersal species.
OTT	Otter twin trawls	Two identical trawls fixed together to increase the fishing area. Two otter boards to hold mouths open, one at each far end. The connection between the two trawls is a rope which joins the connection between the two pulling. Usually targets shrimp.

TBB	Beam trawls	Mouth of trawl is permanently held open by a beam with guides/skids attached. This disturbs bottom fish which rise up and get caught.
TBN	Nephrops trawls	Adapted to be selective for Nephrops with mall holed mesh. Some have devices to allow the inevitable larger by-catch to escape.

Each gear type has a gear calculator which calculates the gear fishing footprint for a cell area over a 2 hour time frame. A cell is 450m by 450m (20250m^2) or 0.2025km^2, 2 hours was chosen as it is the maximum time allowed between VMS reports. This is calculated as 0.083 or one twelfth of a day.

The calculation is as follows for trawls or dredge gears:

$$Single\ VMS\ report\ = \frac{\text{Total width of gear (m)} * \text{Total length hauled per day (m)}}{\text{Area of cell size } (20250 m^2)} * \text{2hr period } (0.083)$$

The calculation is as follows for nets & lines, pots & traps, hand-gathering or single position gears:

$$Single\ VMS\ report\ = \frac{\text{Area of impact from one unit of gear } (m^2) * \text{No.of operations in one day}}{\text{Area of cell size } (20250 m^2)} * \text{2hr period } (0.083)$$

This gives an estimate of the area (in m^2) impacted by gear from a single VMS report based on the different fishing gears (Table 19). However this does assume the same size gear and amount of operations/hauls occurs for each gear type regardless of other variables (e.g. boat length, engine power, bylaws in place etc). See section 3.1 for assumptions made about the gear calculations.

Table 19: Estimate of different gears fishing footprint across a cell area for a two hour period.

Gear	Single VMS report gear fishing footprint over cell area (m^2)
TBB	1.336195
OTT	0.559954
DRB	0.437237
OTB	0.282455
OT	0.282455
HMD	0.057756
TBN	0.034159
GNS	0.001787
GN	0.001787
FPO	0.000004

2.2. Pr-value model

The pr-value model requires several datasets as inputs including:

- Annual UK VMS data for >12m vessels

- Annual Non-UK VMS data >12m vessels
- Single VMS report gear footprint calculations
- MPA sites and designated feature data

Assumptions about the datasets are included in Section 3.

The pr-value model has the following steps:

1. The UK and non-UK VMS data is clipped to the area of interest (MPA site or designated feature within site)
2. VMS reports which are denoted as 'fishing' are chosen (vessels travelling between >0 and <6 knots)
3. VMS reports from the same vessels which are less than 2 hours apart (7080 seconds exactly, see Section 3.4 for explanation) are excluded
4. The processed VMS data (VMS reports= fishing & ≥ 2 hours) is joined to the gear calculations data
5. A grid is created across the area of interest, with cell sizes of 450m by 450m
6. The grid and processed VMS data are joined together.
7. Gear not included in the current gear calculators is excluded.
8. The cell area is calculated as 0.2025km^2 for each cell.
9. Total gear footprint is calculated by multiplying single VMS report gear footprint by the cell area (0.2025km^2). This is then multiplied by the number of VMS reports per gear type.
10. The VMS report area and total gear footprint is summed by gear type
11. A summary table is created which includes:

- AOI field (km^2)
- AOI name (text)
- Total VMS report area (km^2): Sum of unique cell areas (0.2025km^2) where VMS reports occur.
- Total gear footprint (km^2): Total area impacted by fishing gear.
  $\text{Total no. of fishing VMS reports} * \text{cell area (0.2025)} * \text{single VMS report gear footprint}$
- Pr-value: Total extent of AOI impacted by gear. $\frac{Total\ gear\ footprint}{AOI}$
- Pr-value percentage (%): Percentage of AOI impacted by gear.
  $\frac{Total\ gear\ footprint}{AOI} * 100$

3. Pr-value Assumptions

3.1 Gear Calculators

A cell is 450m by 450m or 0.2025 km^2. Two hours was chosen as it is the maximum time allowed between VMS reports. These were chosen so that a beam trawler (the largest swept area) will have covered the whole cell in 2hrs.

Current gear calculations are based on the following defaults:

Boat dredges (DRB):

- Based on one vessel with two tow bars each carrying eight dredges of 75cm.Trawl wheels/skids not added as no data on size could be found. Data from:

https://www.researchgate.net/publication/269629387_Review_of_habitat_dependent_impacts_of_mobile_and_static_fishing_gears_that_interact_with_the_sea_bed.

- No information on number of hauls and length found. Assumption made that a 12 hour shift is undertaken with 6 hauls. Haul speed assumed to be similar to other bottom towed gear.

Pots (FPO):

- Data taken from Annexes to: "Feasibility study on applying a spatial footprint approach to quantifying fishing pressure".
- Based on a pot 500cm by 700m and hauling 30 pots per day.

Gillnets/ Set Gillnets (GN/GNS):

- Based on a vessel shooting 10 tiers each 132m. Each tier has 2 anchors at 2 x 0.5m. Foot rope 3m wide drag. Info derived from seafish report on a workshop on the physical effects of fishing activities on Dogger Bank and Annexes to: Feasibility study on applying a spatial footprint approach to quantifying fishing pressure.
- 5.5 nets hauled per day. Info derived from seafish report on a workshop on the physical effects of fishing activities on Dogger Bank and MMO coastal.

Mechanised dredges (HMD):

- Based on 1 cage with a total width of 74". Data from http://spo.nmfs.noaa.gov/mfr444/mfr4441.pdf
- Haul duration 10.12 hours. Data from http://www.seafish.org/media/Publications/SR348.pdf
- Haul speed 4 knots. Data from http://www.seafish.org/media/Publications/SR348.pdf

Otter trawls/ Otter trawls – bottom (OT/OTB):

- Based on a vessel with one 12m trawl with two 1.2m x 0.65m otter boards and with 60 % ground rope interaction. Information derived from seafish report on a workshop on the physical effects of fishing activities on Dogger Bank.
- Haul duration 4 hours, from an MMO officer.
- Haul speed 4 knots, from an MMO officer.

Otter twin trawls (OTT):

- Based on a vessel with two 12m trawls with two 1.2m x 0.65m otter boards and with 60 % ground rope interaction and 1 clump of 0.6m. Information derived from seafish report on a workshop on the physical effects of fishing activities on Dogger Bank and Annexes to: Feasibility study on applying a spatial footprint approach to quantifying fishing pressure.
- Haul duration 4 hours, from an MMO officer.
- Haul speed 4 knots, from an MMO officer.

Beam trawls (TBB):

- Based on a vessel with two 12m trawls, four 720mm shoes and 2 tickler chains with 60% interaction with the sea bed. Information derived from seafish report on a workshop on the physical effects of fishing activities on Dogger Bank and Annexes to: Feasibility study on applying a spatial footprint approach to quantifying fishing pressure.
- Haul duration 4 hours. Information derived from seafish report on a workshop on the physical effects of fishing activities on Dogger Bank and MMO coastal.
- Haul speed 4 knots. Information derived from seafish report on a workshop on the physical effects of fishing activities on Dogger Bank and MMO coastal.

Nephrops trawls (TBN):

- Based on a vessel with two 3.5m beam trawls, 4 x 0.2 feet and 60% ground rope interaction. Information derived from Annexes to: Feasibility study on applying a spatial footprint approach to quantifying fishing pressure.
- Haul duration 2 hours. Information derived from Annexes to: Feasibility study on applying a spatial footprint approach to quantifying fishing pressure.
- Haul speed 1.5 knots. Information derived from Annexes to: Feasibility study on applying a spatial footprint approach to quantifying fishing pressure.

3.2. VMS data assumptions

It has been assumed that:

- Non-UK VMS data is accurate although only presented to 3 decimal degrees for latitude and longitude.
- UK data is complete or null gear codes are processed and corrected.
- 'Fishing' VMS reports are vessels travelling between 0-6kts.
- VMS data is only available for >12m vessels.

3.3. MPA sites and designated features assumptions

It has been assumed that:

- The data used for the outline of the MPAs is accurate, although there may be very minor inaccuracies due to differences in projection.
- Designated features areas are up to date and complete.

3.4. Pr-value assumptions

It has been assumed that:

- The model does not have false fishing VMS reports such as vessels moving between 0-6kts but not fishing.
- VMS reports from the same vessels which are less than 2 hours apart (7080 seconds to allow for a grace period) are duplicated and therefore are removed.
- All gear is included in the gear calculators to be used in the model. Gear not included in the gear calculators are removed.

Annex 3 - Monitoring and Control Process

Figure 16: Monitoring and control process