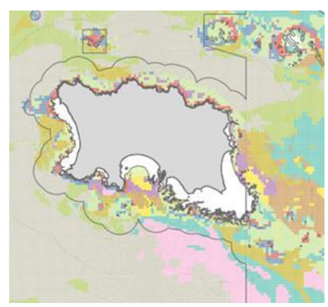
Fisheries Review and Cost Benefit Analysis of Implementing a Static Gear Marine Park in Jersey (Final)

REPORT FOR BLUE MARINE FOUNDATION



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Executive Summary

Commercial fisheries in Jersey play an important role in the daily life and economy of the island, but Jersey's waters also play a significant role for French fisheries. As such, the waters around Jersey are subject to intense activity by several different industries including, but not limited to, fisheries. Currently 6.5% of Jersey's territorial waters (all of the island's key OSPAR habitats such as seagrass and maerl) are protected from mobile fishing gear (principally trawling and dredging), yet this still falls short of the 10% suggested by the Convention on Biological Diversity and several parties, including the Blue Marine Foundation (BLUE)[1], are making the case for further expansion of Jersey's protected marine zone. This may include an ~900km² Marine Park around the island that excludes mobile (demersal and pelagic) fishing gear. A ban of all mobile gear in the zone is proposed by BLUE at this stage, but it is likely that this may be revised to just consider demersal mobile gear.

Before such decisions can be made by the States of Jersey, a sound evidence base to support the objectives of such management measures is required. In general terms, there should be consideration of the scale of economic impacts to fishing businesses versus the potential benefit gained from protecting marine habitats, which in turn provide ecosystem services to Jersey citizens.

This project aims to provide the first step in this process and MacAlister Elliott and Partners (MEP) have been contracted to carry out several tasks to contribute to the evidence base. The overall objective of the project is to assess the opportunities and constraints of implementing a 'low impact' model for Jersey's commercial fisheries, a part of which incorporates a static gear only Marine Park. The definition of a low impact fishery in the UK is still being discussed and defined[2] and in the future may not just be restricted to the static gear fleet. However, for the purposes of this project, MEP have been asked to consider static gear fisheries as 'low impact' fisheries in the cost benefit analysis.

There is a real opportunity for Jersey's fishery to develop a collaborative low-impact fisheries model, working to manage exclusively small-scale, static gear fisheries within sustainable limits, potentially mirroring successful mechanisms and benefits seen in Lyme Bay. The commercial fishery in Jersey may already be considered by some to be primarily a static gear fishery (>100 static gear vessels vs <10 mobile gear), which provides a good basis for implementing a low-impact fisheries model. In addition to this is the potential approaching end to the Bay of Granville Agreement (GBA), a treaty jointly managed between the UK and France which made provision for a large number of French and Jersey vessels to fish in a defined sea area covering Jersey, Normandy and Brittany waters. Following the departure of the UK from the EU, the GBA ceased to apply on 1st January 2021, provided neither party revokes the agreement during the current 90 day cooling off period.

The project comprises several tasks including:

1. Summary of the commercial fisheries in Jersey's waters;
2. Cost benefit analysis of switching to static gear only fisheries within the Marine Park zone;

[1] https://www.bluemarinefoundation.com/projects/jersey/

[2] http://www.ccri.ac.uk/lowimpactfishing/

3. Review of the mechanisms available, and recommendations over how, to deliver a low impact fisheries model for Jersey;
4. A review of options for Jersey eco-labelling for sustainable fisheries added value opportunities

This report provides the results for Tasks 1 and 2. The results for Tasks 3 and 4 are not presented for the following reasons: a) Brexit negotiations regarding the number of French and Jersey fishing permits are still underway which will affect many features of a low impact model (i.e. number of vessels permitted, management regime to be implemented); b) the definition of low impact fisheries has not yet been co-designed or agreed by UK fisheries stakeholders and if options supporting a 'low impact' model in Jersey are to be presented, stakeholder workshops in Jersey will be required to at least define and agree on a set of low impact principles in the Jersey context, and c) stakeholder groups were preoccupied with Brexit negotiations and had limited time or willingness to engage with the project. Nevertheless, desk-based work has been completed for both Tasks 3 and 4, including some virtual consultations relating to Task 4 which will be validated with stakeholder workshops at a later stage by BLUE.

Using data provided by the Government of Jersey and comparative studies in the literature, the minimum total economic cost of implementing the Marine Park is estimated to be around **£7,300**.

The assessment considers: the net loss of income from Jersey mobile fleet (assuming a proportion of mitigation by the mobile fleet either to alternative fishing grounds and/or switching gears); the gain to the Jersey static fleet from additional scallop resources; a reduction in gear conflicts/loss; and the cost to government of enforcing the closure.

It is important to note that the cost presented is considered a minimum impact, as first sale values are utilised in income loss calculations so for the fishing fleet, it represents the loss in immediate first sale income, without considering potential gains and losses in downstream supply chains where value additions occur. Calculating the latter would constitute another study.

When looking at the impact to the fishing fleet as a whole (static and mobile fishers together), the loss of income to the mobile gear sector (£66,200) is offset by the gain in scallops and reduced loss of potting gear (£68,900). Impacts will of course be felt differently by individual businesses. For example, mobile fishers will be less impacted if they can mitigate by moving to alternative fishing grounds, or by diversifying to static gears. Those who are not able to mitigate may qualify for compensation. Compensation costs have not been included in the overall impact assessment as this is also beyond the scope of the project.

The £7,300 represents a direct monetised value deemed from fisheries economic data modelled and provided by the Jersey Government. However, our cost-benefit assessment also incorporates an assessment of Natural Capital (a type of benefit), which is a standard analytical approach to evaluating the role and value of nature to society and thereby to support decision making and to inform policy. The beneficial flows which stem from the Natural Capital stocks are termed 'ecosystem services', and they supply a public need covering economic, social, environmental, cultural, or spiritual benefits. How the value of these goods/benefits is described can be qualitative or quantitative (including monetary). The evidence base to support valuation of the ecosystem services associated with specific marine habitats is unfortunately limited (and limits people's confidence in their application) but where we have been able to find studies that assign monetary value to various ecosystem services, we have calculated this for Jersey's habitats in the Marine Park.

In this assessment we have monetised benefits from carbon sequestration potential, and kelp habitat. As we have not been able to monetise all relevant ecosystem services, and the assessments take very different approaches, the Natural Capital (carbon and kelp) monetised values do not affect the £7,300 obtained during the fisheries data assessment.

The Natural Capital assessment of benefit has concluded that protected marine habitats within the proposed Marine Park could be associated with a monetised value of around **£1.3 million** based on traded carbon values. Other benefits associated with kelp, such as protection of coastlines from erosion, harvesting potential and nursery habitats for commercial species have been valued at around **£5.8 million**. These numbers do not take into consideration a natural capital assessment (with exception of carbon sequestration estimates) of other habitat types (beyond kelp) that would be protected following designation of a Marine Park, including the provision of additional fishery resources beyond scallops. This illustrates that the wider benefits of protecting an area of Jersey's marine environment from the most damaging activities are likely to be considerable over time.

Based on the initial evidence presented, at this stage, it is considered that the environmental, societal and economic benefits of introducing the proposed management outweigh the potential monitoring, administrative and enforcement burden and costs to industry.

TASK 1: REVIEW OF COMMERCIAL FISHERIES IN JERSEY

Task 1 aims to provide an overview of the current commercial (not including recreational) fisheries sector in Jersey waters, which ultimately aims to inform Task 2 – the cost benefit analysis (e.g., identifying important fisheries in the proposed Marine Park which may or may not be affected by its implementation). The time period assessed in Task 1 primarily focuses on the years 2015 - 2020, although historical trends from earlier years have been analysed where relevant. Therefore, this report reflects an overview of commercial fisheries pre-Brexit. Negotiations surrounding the number of French permits to be issued in 2021 were still under review at the time of writing.

The main data sources used in this analysis include: Jersey landings data; Jersey and French spatial distribution of catch and effort; and French vessel catch estimations, all of which were provided by the Marine Resources Department of the Jersey Government (herein referred to as Marine Resources). The latest Marine Resources Annual Report (2019)[3] provides a detailed summary of Jersey's fisheries and marine environment, including commercial shellfish and wetfish landings, fishing effort, landing per unit effort (LPUE), stock information, and overviews of annual research and enforcement. This Task 1 therefore only aims to provides a general overview, selecting the most relevant datasets to guide the cost benefit analysis.

[3] *Gouvèrnément d'Jèrri 2020. Marine Resources Annual Report 2019. Growth, Housing and Environment, Marine Resources Section, Howard Davis Farm, Jersey JE3 5JP.*

Task 1 has four (4) sections including: the methodology; an overview of Jersey and French fishing fleets; trends in landings, catch composition, and fishing effort; and analysis of spatial distribution of Jersey and French catch and effort.

Data and methodology overview

1.1 Landings, catch composition and LPUE

Commercial landings by species and by gear were available via the Jersey Government which covered a timeseries of 2007-2020. The combination of both allows the calculation of Landings Per Unit of Effort (LPUE), a commonly used index for assessing the relative health of commercial fisheries, which considers the effort required to catch a given weight for a species.

LPUE for crab and lobster was calculated using a combined total for creels, D-pots, ink wells and parlour pots, whilst LPUE for whelk was calculated using whelk pots only.

Fishing effort has been presented for bottom otter trawls, tangle nets, longlines, dredgers and parlour pots, which are the main gears operated in Jersey waters. Dredging effort is represented by the number of tows, parlour pot effort is number of pots, longline effort is number of hooks, tangle net effort, and length of foot rope for trawling is in length (m). The Marine Resources Annual Report (2020) provides more detail on other fishing gears.

Reference is made to French vessel catches in Jersey waters between the years of 2015 and 2018, based on an assessment conducted by Ifremer (National Institute for Ocean Science, France) in 2020, but reported on in the Marine Resources Annual Report (2020).

1.1.1 Spatial distribution of fishing activity

GIS modelling by Marine Resources in 2020 provided us with a spatial breakdown (1km^2 grid) of Jersey and French fishing vessel activity including catch (weight), value (£) and effort (hours). The data were calculated based on average yearly values from 2015 - 2019 and aggregated by representative 'indicator' species for eight (8) key metiers. The key metiers are;

- Dredge – clam
- Dive – scallop
- Dredge – scallop
- Benthic nets – crab
- Pots – crustacean (represents lobster)
- Pots – whelk
- Benthic trawl – rays, flat fish
- Pair trawl – fish

A summary of this model was developed and presented by reporting zone (Figure 1) which is referred to in section 4.1 below.

Whilst the model provides a valuable insight into the general levels of activity for Jersey and French vessels within a spatial context, figures are not absolute (i.e. the model is designed to look at relative landings and effort, not to produce economically precise data) and data limitations should be considered when interpreting the results.

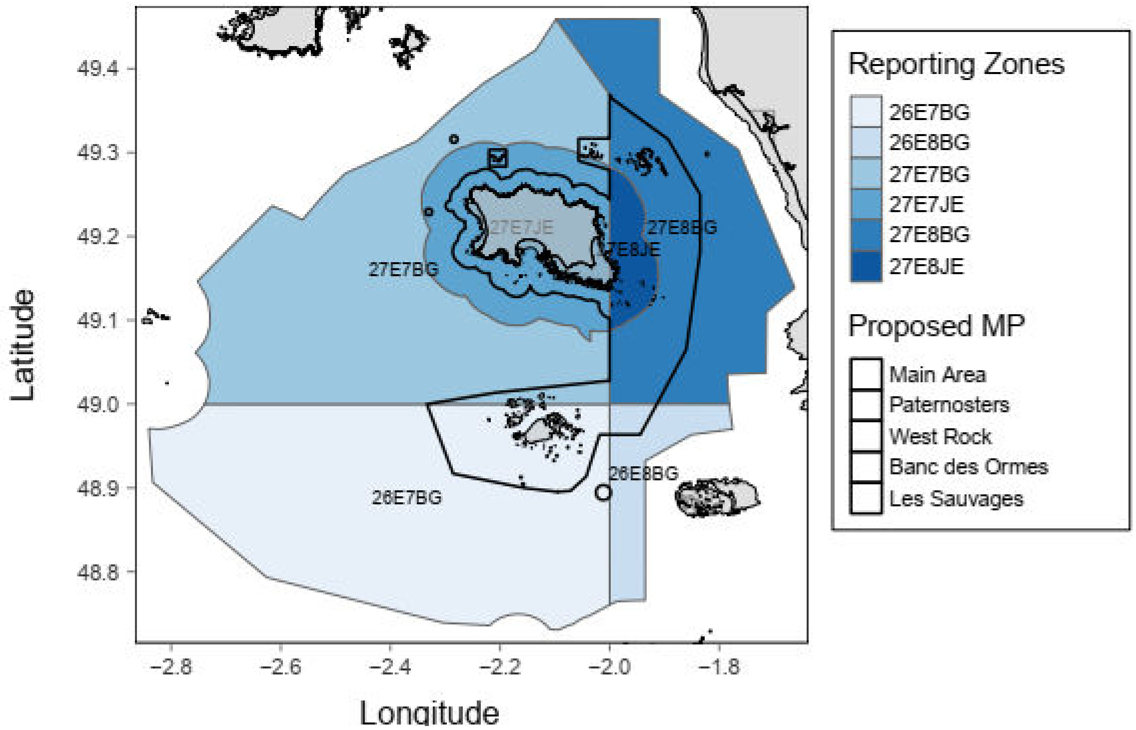

Figure 1: Jersey reporting zones

Table 1: Reporting zone access

Reporting zone	Nationality access
26E7BG	French and Jersey
26E8BG	French and Jersey
27E7BG	French and Jersey
27E7JE	Jersey
27E8BG	French and Jersey
27E8JE	Jersey

Key data considerations and limitations

- Certain species were used to represent main metiers;
  - Lobster was used to represent crustacean potting, as it is the dominating catch proportion but any crab catch (both brown crab and spider crab) caught in the same pots will not be represented. It is likely the results are an under representation of the value of the crab fishery.
  - Spider crab was the representative species for French benthic (tangle) nets. Around 75% of spider crab catch by Jersey vessels is caught via lobster pots[4].
  - Jersey data from the CEFAS annual CEND scientific benthic trawling surveys was used to define representative species for the benthic trawling metier which suggested predominant species included rays, flat fish (sole and turbot), and cuttlefish.
- A combination of VMS, inspection/sightings, and catch and effort data allowed for the distribution of landings/catches throughout Jersey waters for Jersey vessels (the spatial model). Specifically, VMS pings were used for mobile gear and benthic nets, whilst inspection and sighting records used in combination with logbook data formed the basis of static gear spatial elements and density of pots. *Note: few vessels have VMS so this was largely based on inspection/sightings data.*
- French vessel VMS data had previously been analysed by Marine Resources to determine vessel activity (fishing or steaming) based on vessel speed. A key metier was then assigned to each vessel identified as fishing based on sightings/inspection records, and internet searches for vessels which had never been boarded.
- Catch volume and value for French vessels was broadly derived from ICES subrectangle estimates.
- Only dominant metiers (in terms of landed value and volume) were in the model, therefore, there may be some disparity in the metiers presented for Jersey and French vessels.

1.1.2 Habitat data

An existing habitat map of benthic substrates in Jersey waters was developed by Marine Resources and made available for use in this review. The habitat map used in combination with spatial data allowed a coarse inference of the predominant benthic substrates associated with each key metier. This will contribute to recommendations on alternative fishing grounds for those vessels potentially impacted by a new static gear Marine Park.

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[4] *Gouvèrnément d'Jèrri 2020. Marine Resources Annual Report 2019. Growth, Housing and Environment, Marine Resources Section, Howard Davis Farm, Jersey JE3 5JP.*

Jersey fleet profile overview

According to the Marine Resources Annual Report, (2019) there were 130 licenced fishing vessels, of which 88 were entitled to fish for shellfish. The fleet is largely characterised by small scale vessels with 119 vessels of 10m and under in length, whereas only 11 are over 10m in length. This is unsurprising given the predominance of static gears.

An overview of French vessels is not available at the same resolution as Jersey vessels, however, according to an Ifremer report, 59% of the 421 vessels that visited Granville Bay in 2018 had fished in Jersey waters[5].

Table 2 provides an overview of the gears used in 2020, their associated average vessel length and engine power and the numbers of vessels. *Note: As most of the analyses in Task 1 relate to the spatial model data provided to MEP by Marine Resources, we are reliant on the number of vessels that have been estimated for each of these metiers. Numbers of vessels are not absolute, as most vessels use multiple gears, and thus each multi gear vessel is counted more than once.*

Parlour pots are the most dominant gear in use by the fleet (102), although a number of those vessels also deploy creels and whelk or ink-well pots. The average vessel length for potters (all types) ranges from 6.7m to 7.6m, whelk potters being the largest vessels. Vessels using creels have the lowest engine power (average 85.9 Kw), followed by ink-well pot and parlour pot vessels (94 Kw), while vessels targeting whelks appear to be, on average, more powerful (108Kw).

There are fewer mobile/active gear vessels than static/passive gear vessels in the fleet. Vessel activity data suggest that although eight (8) vessels dredge at some point, only one (1) vessel does this exclusively whilst many of the others are multi gear and also use a form of potting. Similarly, five (5) vessels bottom trawl, but three (3) of those vessels also operate a dredger and parlour pots, while one of those operates a pair trawl, and the other vessel interchanges between tangle netting, longlining, dredging, and parlour potting, the latter likely to be the predominant gear type based on number of pots set.

Table 2: Jersey fleet overview based on vessels that fished for 1 day or more in 2020 (note comment about absolute number above)

Gear	Number of vessels which have fished for 1 day or more in 2020	Average vessel length (m)	Average engine power (Kw)
Parlour pot	102	7.1	94.9
Ink-well pot	64	7.1	94.4
Creels	65	6.7	85.9
Whelk pot	37	7.6	108.1
Dredge	8	11.7	146.8
Bottom trawl	5	12.4	172.5
Pair trawl	2	17.7	270.9
Longline	18	7.5	101.9
Tangle net	29	7.4	101
Diving	18	NA	NA

[5] *Ifremer, 2019. Diagnostic elements on the fishing activity of the French fleet in the territorial waters of Jersey*

Overview of commercial landings and effort – key species

1.2 Landings and catch composition

The commercial fishery in Jersey is dominated by lobster (*Homarus gammarus*), and crab (*Cancer pagurus* and *Maja brachydactyla*), followed by whelk (*Buccinum undatum)* and scallop (*Pecten maximus*) in terms of landed weight. From 2008, lobster and brown crab have shown signs of steady decline in total landed weight and landings per unit effort/LPUE (Figure 2 and Figure 3). Whelk landings have been more variable, with a peak in 2018 followed by a steep decline in both landings and LPUE to the second lowest level in the past 10 years in 2020 Figure 4). Spider crab displays an overall more gradual rise in landings and LPUE, although this has fallen slightly in 2020 (Figure 5). Reports from Marine Resources suggest the local spider crab population has been rising in recent years, thought to be the result of milder winters since 2013. Spider crab are very temperature dependent animals.

Wetfish species such as dogfish (various species), bass (*Dicentrarchus labrax*) and mackerel (*Scomber scombrus*) have variable landings over the time series (2008-2020), but largely show a declining trend (Figure 6). In contrast, cuttlefish landings have risen sharply since 2017. Blonde ray (*Raja brachyura*) has been caught in vast quantities since 2012 but landings decreased substantially in 2017, before increasing again in recent years.

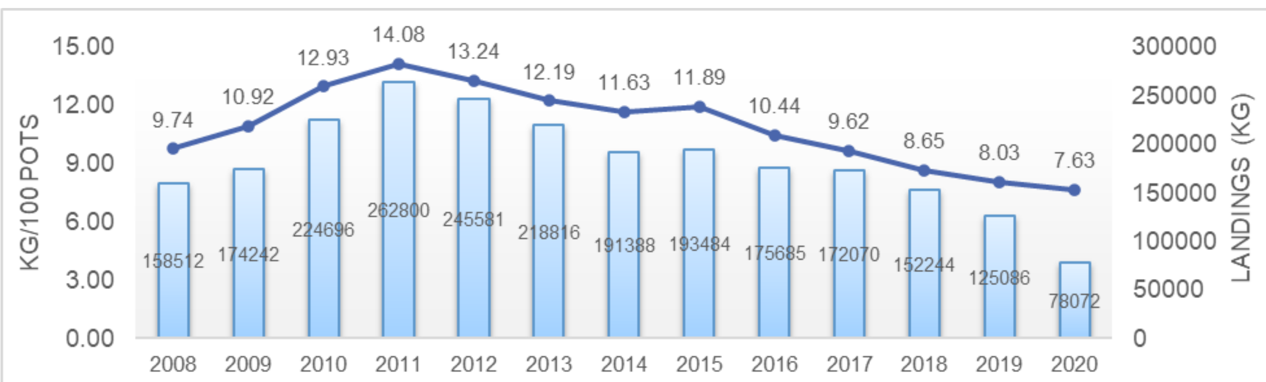

Figure 2: Total lobster landings (kg) and LPUE (Kg/100 pot lifts) 2008-2020. Bars represent total weight, lines represent LPUE.

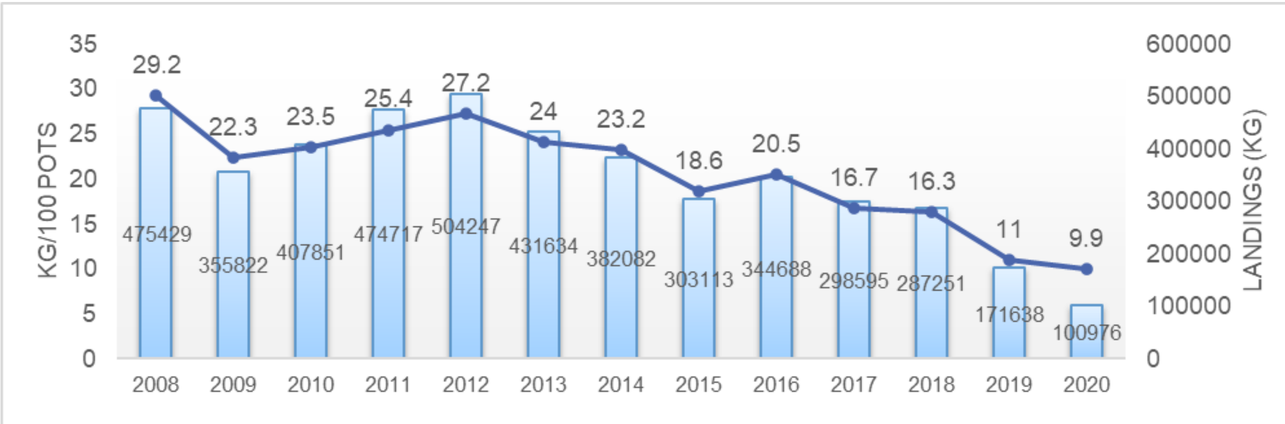

Figure 3: Total brown crab landings (Kg) and LPUE (Kg/100 pot lifts) 2008-2020. Bars represent total weight, lines represent LPUE.

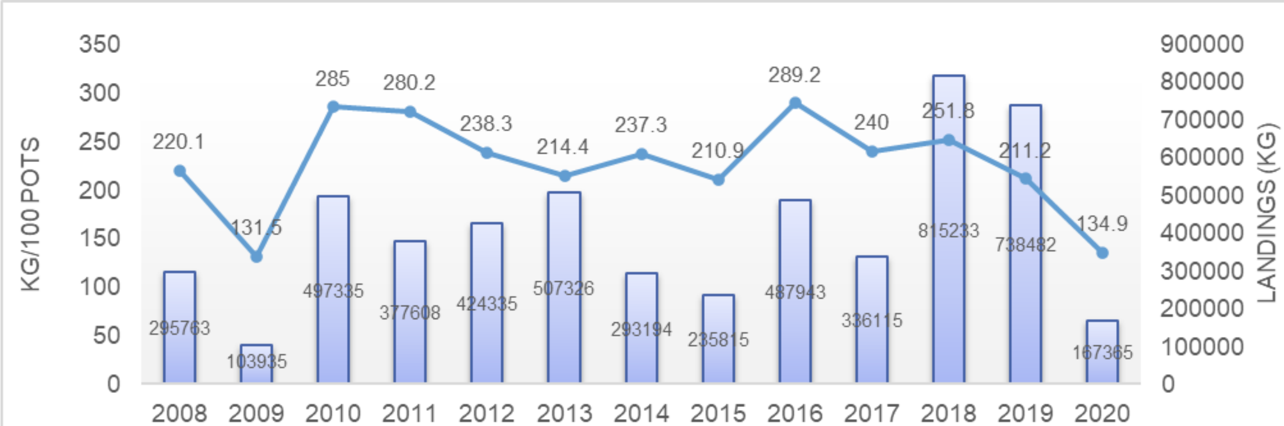

Figure 4: Whelk landings (Kg) and LPUE (Kg/100 pot lifts) 2008-2020. Bars represent total weight, lines represent LPUE.

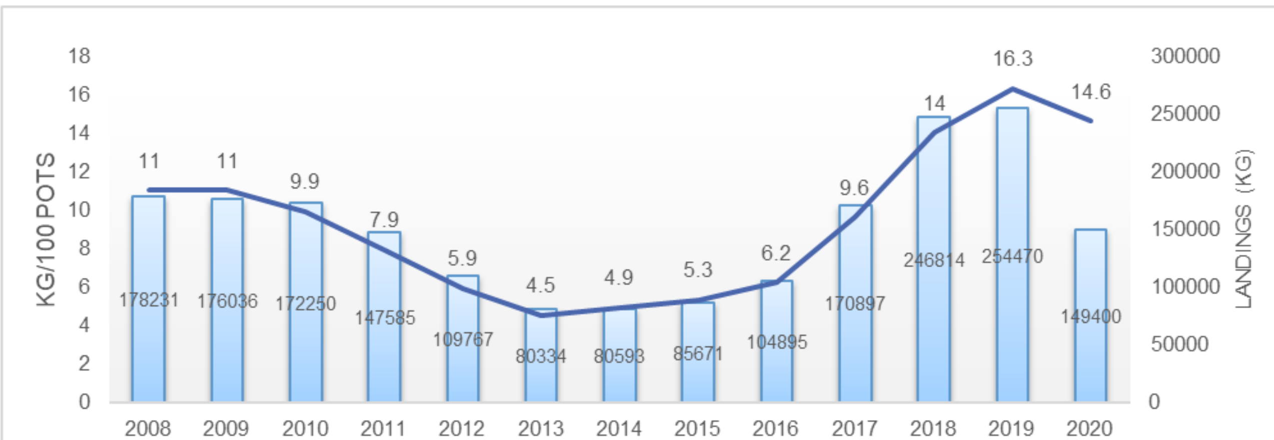

Figure 5: Spider crab landings (Kg) and LPUE (Kg/100 pot lifts) 2008-2020. Bars represent total weight, lines represent LPUE.

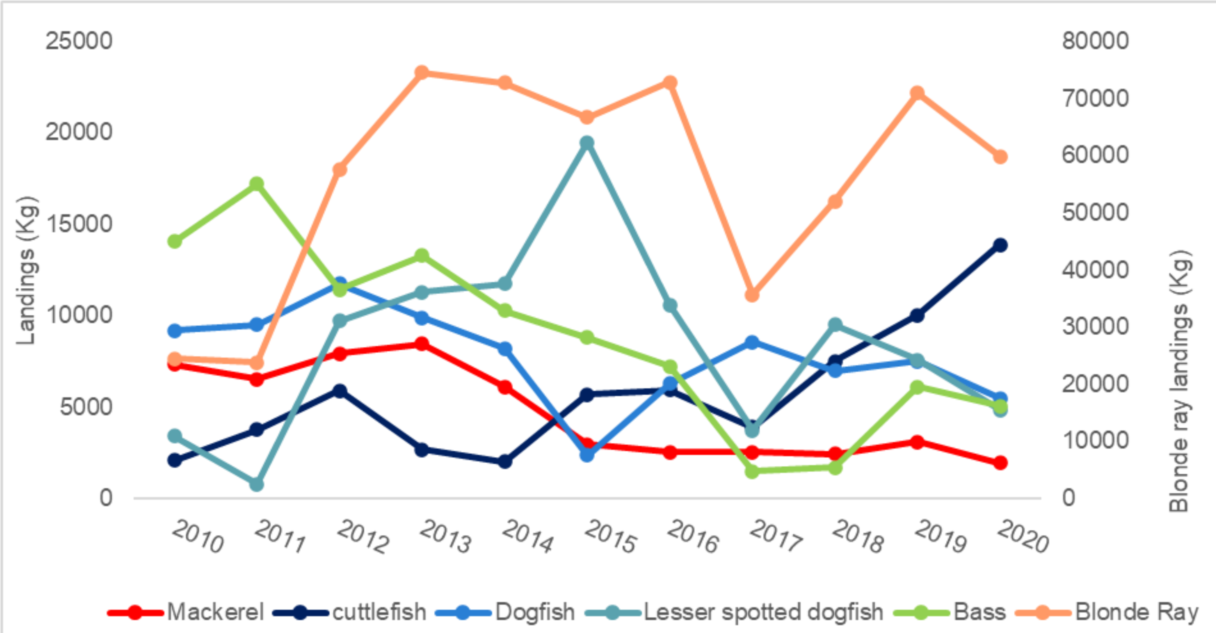

Figure 6: Additional key species landings (Kg) 2008-2020.

1.3 Fishing effort

Trends in fishing effort for the main fishing effort in Jersey waters over the last 10 years are shown below in Figure 7a-e. Bottom otter trawling effort was higher historically and has remained at relatively low levels since 2017. Since 2018, dredging effort data indicates recent rates of decline. Tangle netting effort has progressively declined from higher levels in 2010.

Longlining effort, whilst displaying an overall downward trend in effort since 2010, has risen sharply from a low of 909 hooks/year in 2017 to 13,000 hooks/year in 2020 (Figure 7c), likely due to the opening of the bass fishery. Parlour pots account for more than 80% of fishing effort when targeting crab and lobster[6], and little fluctuation in effort is evident from 2009 to 2017 with number of pots remaining above 1.2 million. This started to fall in 2019 and continued in 2020 with pot numbers dropping to ~760,000 (Figure 7e).

[6] *Gouvèrnément d'Jèrri 2020. Marine Resources Annual Report 2019. Growth, Housing and Environment, Marine Resources Section, Howard Davis Farm, Jersey JE3 5JP.*

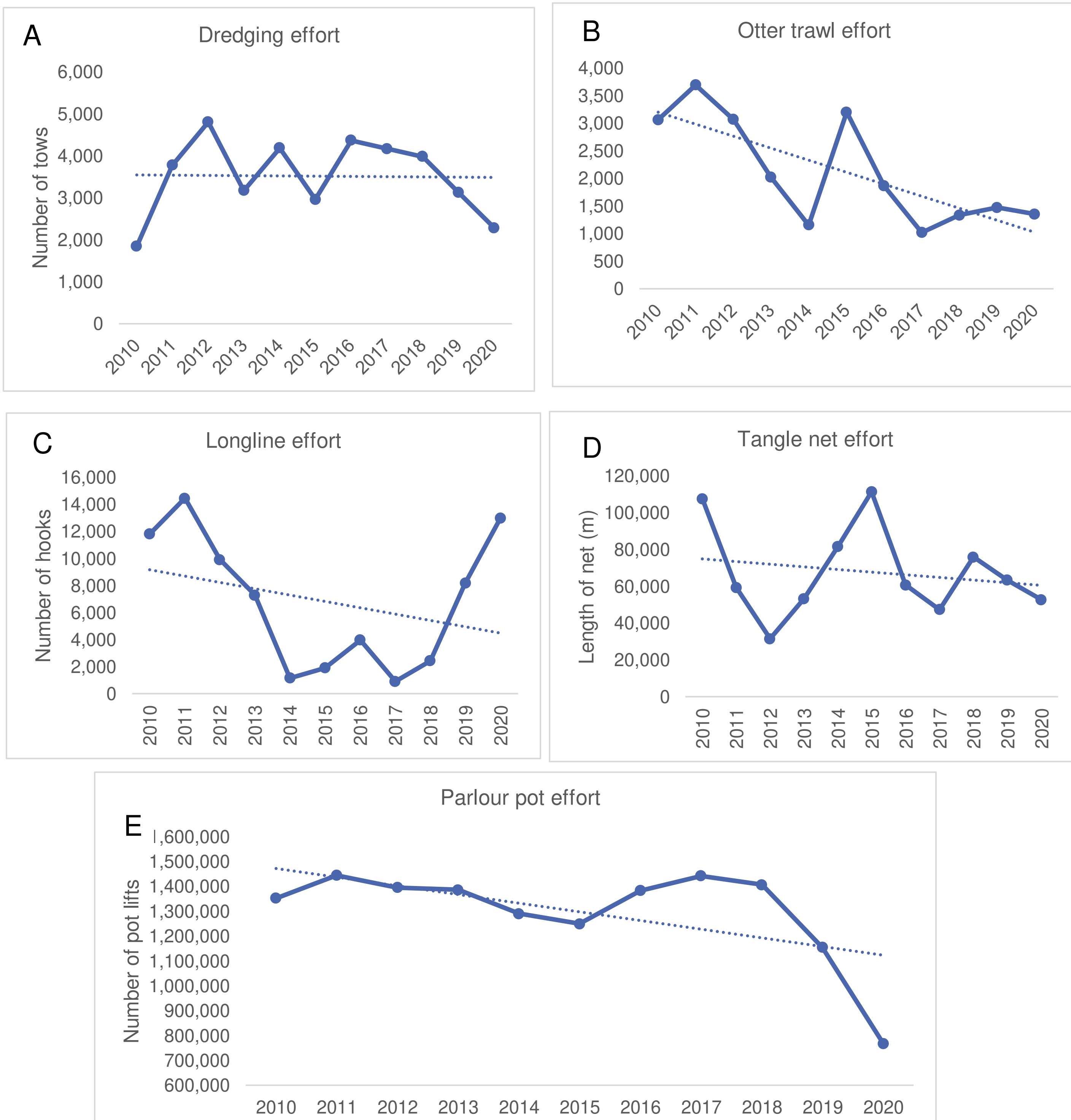

Figure 7: Fishing effort (2010 – 2020) for A) Dredgers, B) Otter trawls, C) Longliners, D) Tangle nets and E) Parlour pots

1.4 Bay of Granville Landings

In 2020, Ifremer assessed catches made by French vessels in Jersey waters between 2015 and 2018. Figures were reported in the Marine Resources Annual Report (2019) and were based on a combination of landing data and additional national datasets. Whilst this provides a useful overview, figures have been estimated.

Whelk, cockle, scallop and spider crab are the dominant targeted species by French fleets, and all appear to have variable landed weight over the timeseries (2015-2018) (Figure 8). Landed volume for scallop has fallen sharply from 900 tonnes in 2015 to 400 tonnes in 2017 and 2018. Spider crab landings peaked in 2017, but as mentioned previously, this species is highly affected by temperature change, which is likely to be a significant influencing factor on variability. Little difference in landed weight is evident between cockle and whelk, although landings peaked in 2015 for whelk, and in 2016 for cockle.

Wetfish species and other crustaceans such as lobster and crab are caught in substantially lower volumes.

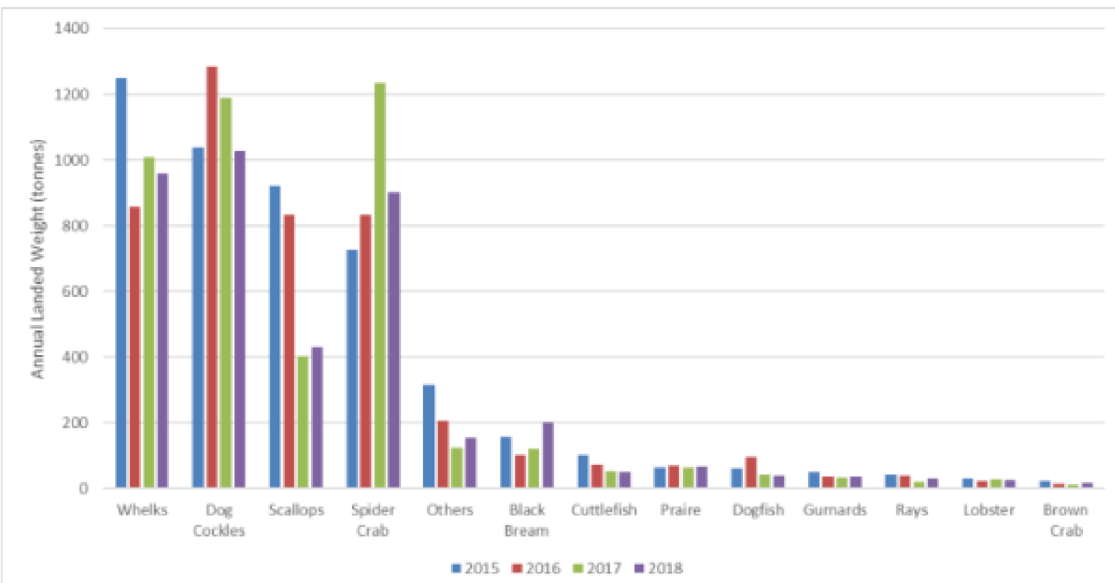

Figure 8: Estimated annual weight (tonnes) of species caught by Normandy and Brittany vessels in Jersey waters between 2015 and 2018. Source: Marine Resources Annual Report 2019.

2. Spatial analysis of Jersey and French vessel activity

As stated above, volume, value and effort data in a spatial context were provided by Marine Resources. Firstly, section 4.1 presents aggregated spatial data by reporting zone, which is collated via logbook records. This provides an overview of the main metiers operating in each reporting zone area (by landed volume and value).

Section 4.2 presents volume and value of landings and fishing effort data on a 1km^2 grid for key metiers, which enables analysis of activity distribution in Jersey's waters and in the proposed Marine Park area. Associated benthic habitats are described.

2.1 Reporting zone summary data

2.1.1 Reporting zone 27E7JE

Reporting zone 27E7JE (Figure 10) lies within the Jersey 3NM zone, allowing only Jersey vessels to fish. All Jersey key metiers included in the data have a presence in this area. Dredged scallop, crustacean potting and whelk potting make up the majority of landed volume. The value for crustacean potting (represented by lobster data) is significantly higher (£1.3 million) than for the other dominant métiers (Figure 9).

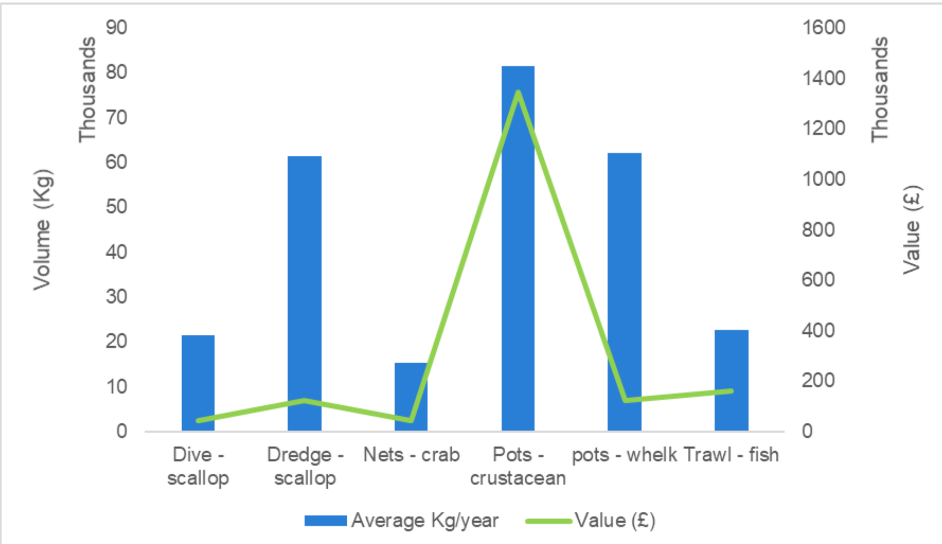

Figure 9: Zone 27E7JE – Jersey vessels landings and value per metier (average 2015-2019)

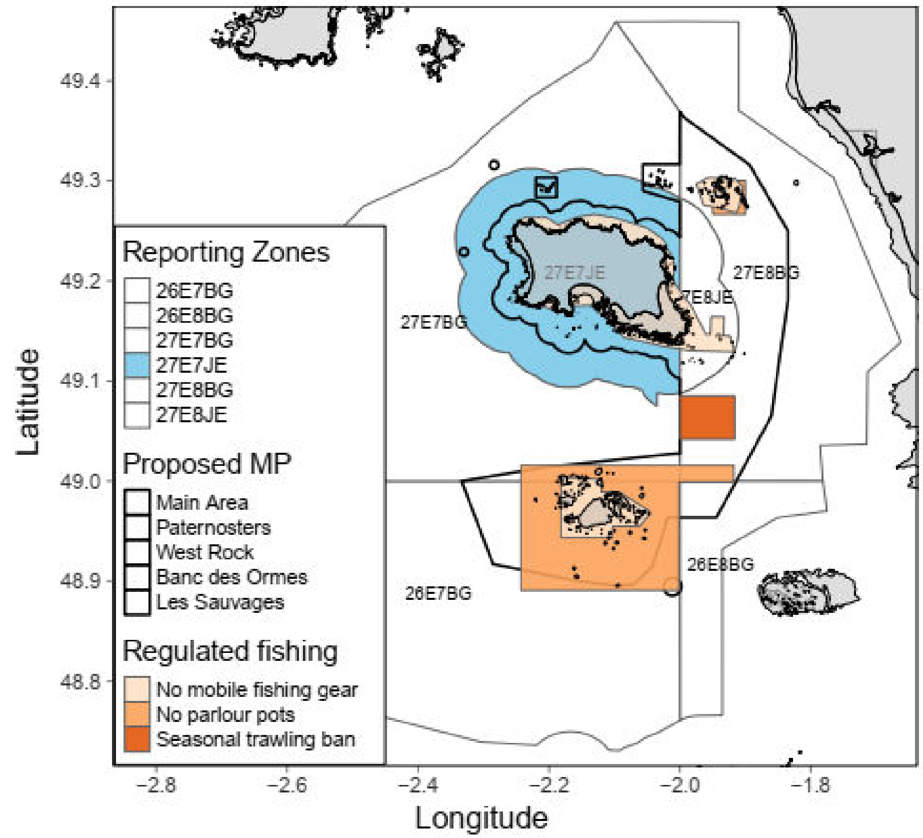

Figure 10: Map highlighting reporting zone 27E7JE (in blue) in addition to existing regulated fishing areas (orange)

Table 3: Summary of data for reporting zone 27E7JE

	Jersey landed weight (Kg) – average (2015-2019)	Jersey landed value (£)	French vessel landing weight (Kg) – average (2015-2019)	French vessel landed value
Dredge - clam	-	-	-	-
Dive - scallop	21,561	43,122	-	-
Dredge - scallop	61,300	122,599	-	-
Nets - crab	15,313	42,876	-	-
Pots - crustaceans	81,452	1,343,965	-	-
Pots - whelk	62,182	124,364	-	-
trawl - fish	22,748	163,786	-	-
Pair trawl - fish	-	-	-	-
Total	264,556	1,840,711		

2.1.2 Reporting zone 27E8JE

As above, reporting zone 27E8JE also falls within Jersey 3NM territorial waters (Figure 12), therefore French vessels are prohibited. Less fishing occurs in this zone in comparison to 27E7JE, although any activity that does take place is largely by whelk potting vessels. Dredging and hand diving for scallop is also present but to a lesser extent than whelk potting (yearly average 17,000Kg, 11,000Kg and 58,000Kg respectively (Figure 11). Limited lobster potting and benthic trawling occur whilst there is no evidence of crab netting.

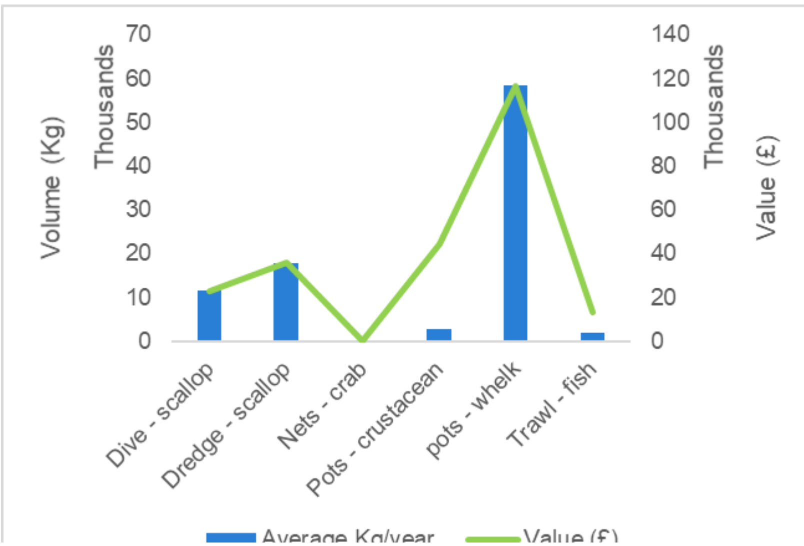

Figure 11: Zone 27E8JE – Jersey vessel landings and value per metier (average 2015-2019)

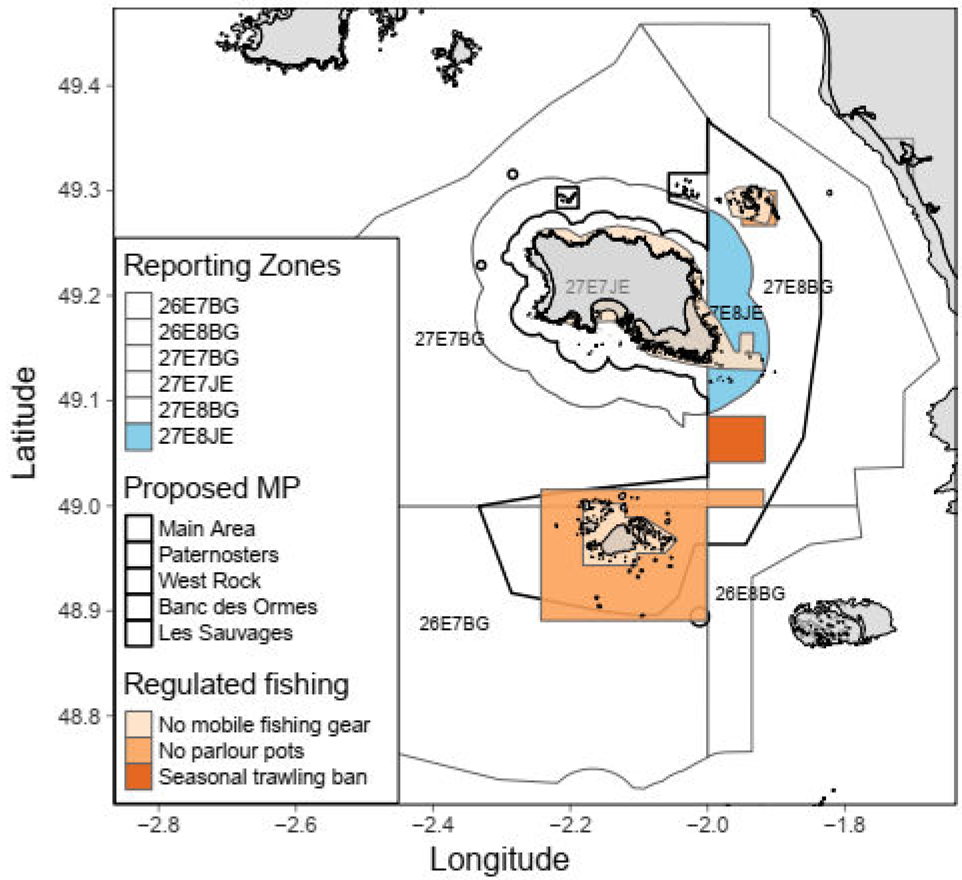

Figure 12: Map highlighting reporting zone 27E8JE (in blue) in addition to existing regulated fishing zones (orange)

Table 4: Summary of data for reporting zone 27E8JE

	Jersey landed weight (Kg) – average (2015-2019)	Jersey landed value (£)	French vessel landed weight – average (2015-2019) (Kg)	French vessel landed value
Dredge - clam	-	-	-	-
Dive - scallop	11,496	22,993	-	-
Dredge - scallop	17,822	35,643	-	-
Nets - crab	240	-	-	-
Pots - crustaceans	2,690	44,392	-	-
Pots - whelk	58,338	116,676	-	-
Trawl - fish	1,808	13,018	-	-
Pair trawl - fish	-	-	-	-
Total	92,395	232,722		

2.1.3 Reporting zone 27E8BG

Reporting zone 27E8BG straddles Jersey and French territorial waters, however, data are only available for Jersey waters. Whelk potting, and scallop diving comprise the majority of landed volume and value by the Jersey fleet (average yearly volumes of 33,000Kg and 20,000Kg) (Figure). French vessels focus largely on whelk potting (800,000Kg) (Figure), although receive a far higher average yearly value for dredged clam than whelk (€1.2 million vs 525,000).

Overall, French vessels have higher volumes and values of landings (by 3,809,163Kg and £3,314,135 respectively) than Jersey vessels in this zone.

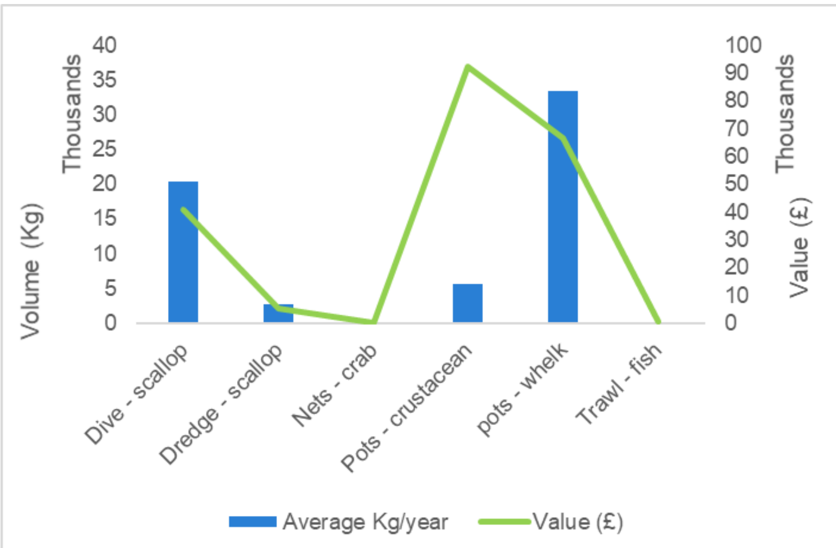

Figure 13: Zone 27E8BG – Jersey vessel landings and value per metier (average 2015-2019)

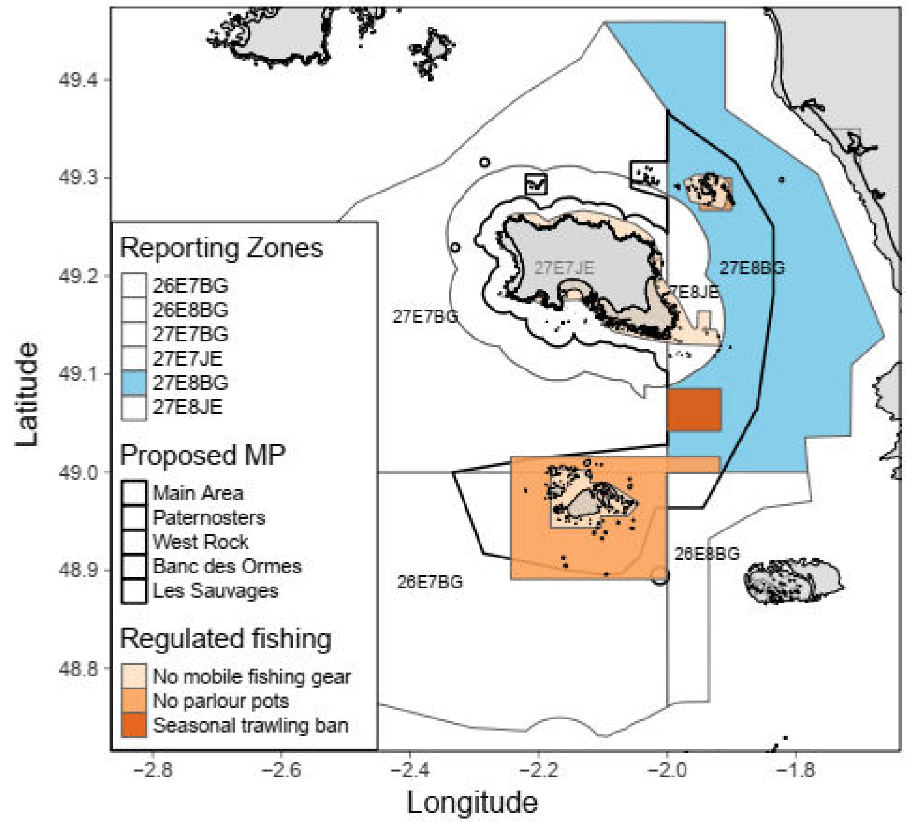

Figure 14 Map highlighting reporting zone 27E8BG (in blue) in addition to existing regulated fishing zones (orange)

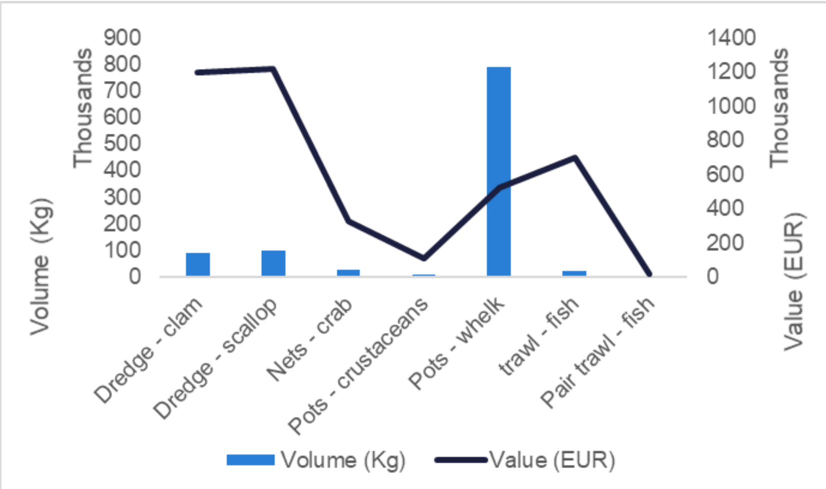

Figure 15: Zone 27E8BG – French vessel landings and value per metier (average 2015-2019)

Table 5: Summary of data for reporting zone 27E8BG

	Jersey landed weight (Kg)– average (2015-2019)	Jersey landed value (£)	French vessel landed weight (Kg)– average (2015-2019)	French vessel landed value (€)	French vessel landed value (£)
Dredge - clam	-	-	88,335	1,195,920	996,600.00
Dive - scallop	20,353	40,705	-	-	-
Dredge - scallop	2,735	5,470	98,025	1,215,510	1,012,925.00
Nets - crab	-	-	25,116	326,830	272,358.33
Pots - crustaceans	5,597	92,354	9,212	108,413	90,344.13
Pots - whelk	33,404	66,808	791,840	524,803	437,335.73
Trawl - fish	100	720	24,656	696,800	580,666.67
Pair trawl - fish	-	-	3,315	15,990	13,325.00
Total	62,188	206,056	1,040,499	4,084,266	3,403,555

2.1.4 Reporting zone 26E8BG

Forming one of the smaller reporting zones and lying to the south east of the island, reporting zone 26E8BG has more French vessel activity then Jersey vessels, in terms of landed volume (French landed 197,789Kg more than Jersey vessels) (Figure 16 and Figure 18).

As with other reporting zones, most Jersey activity is scallop dredging or crustacean potting. Whilst scallops are caught in greater volumes than crustaceans (lobster), crustacea shows a greater yearly average value (£30,000). Dredged scallop and whelk potting by French vessels are landed in the highest volumes whilst dredged scallop, spider crab from tangle nets and benthic trawl fish, predominantly flat fish and rays, receive the highest landed value.

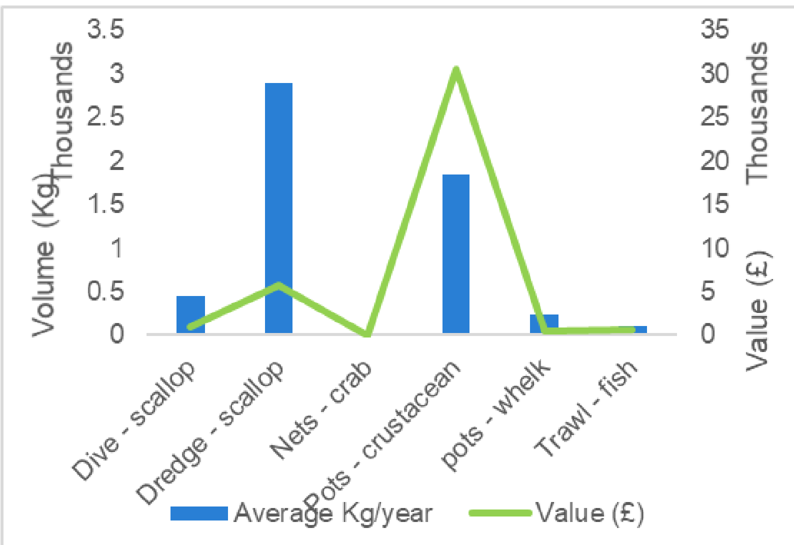

Figure 16: 26E8BG – Jersey vessel landings and value per metier (average 2015-2019)

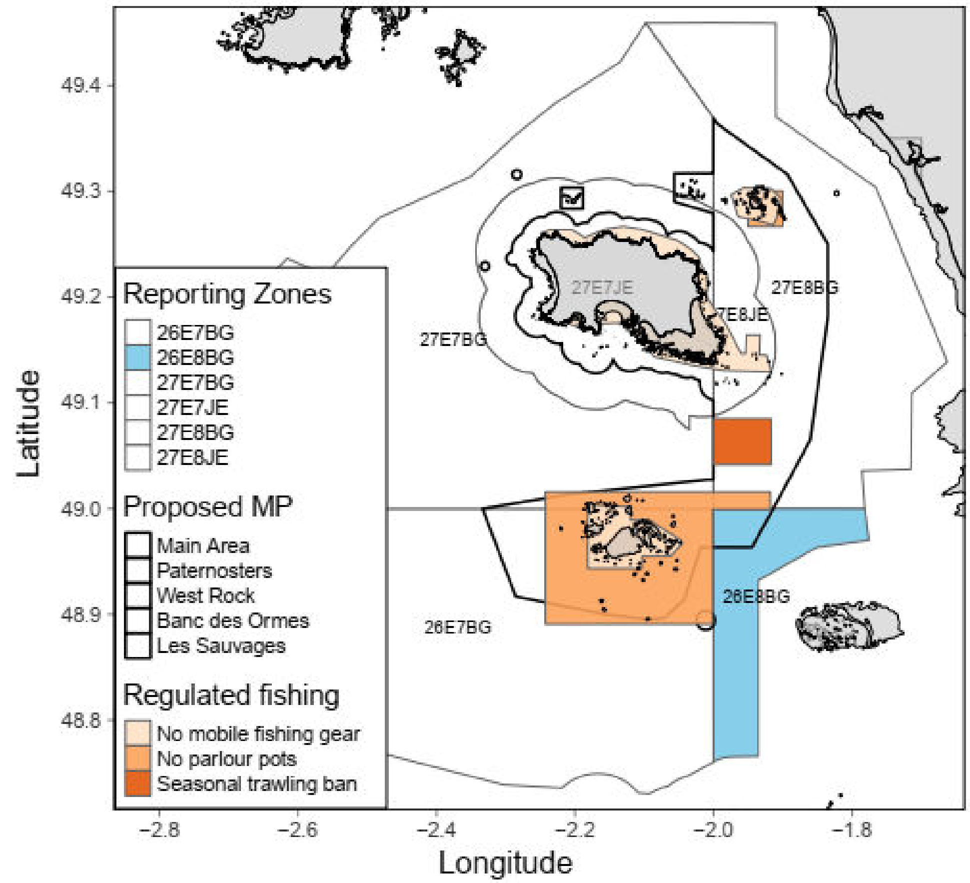

Figure 17: Map highlighting reporting zone 26E8BG (in blue) in addition to existing regulated fishing zones (orange)

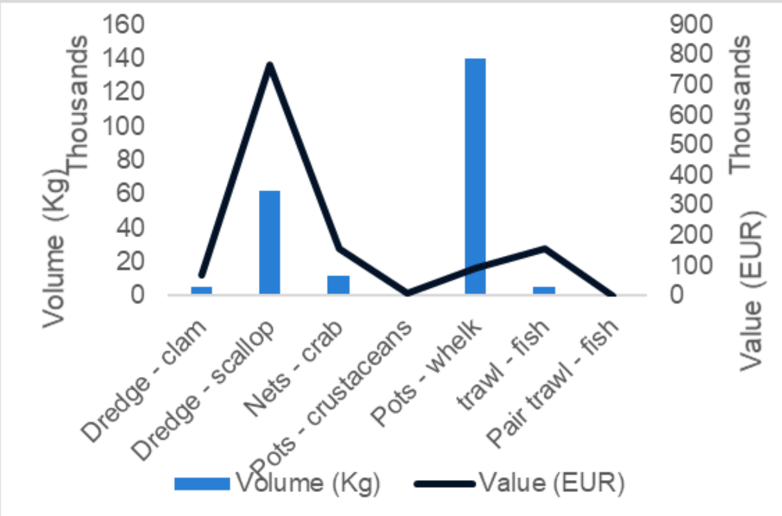

Figure 18: Zone 26E8BG – French vessel landings and value per metier (average 2015-2019)

Table 6: Summary of data for reporting zone 26E8BG

	Jersey landed weight (kg)– average (2015-2019)	**Jersey landed value (£)**	**French vessel landed weight (kg)– average (2015-2019)**	**French vessel landed value (€)**	**French vessel landed value (£)**
Dredge - clam	-	-	5,135	69,520	57,933.33
Dive - scallop	452.20	904.40	-	-	-
Dredge - scallop	2,886.00	5,772.00	61,650	764,460	637,050.00
Nets - crab	-	-	12,012	156,310	130,258.33
Pots - crustaceans	1,847.20	30,478.80	674	7,838	6,531.48
Pots - whelk	244.00	488.00	139,552	92,490	77,075.00
trawl - fish	100.00	720.00	5,474	154,700	128,916.67
Pair trawl - fish	-	-	-	-	
Total	5,529	38,363	224,497	1,245,318	1,037,765

2.1.5 Reporting zone 26E7BG

Reporting zone 26E7BG encompasses more offshore waters and stretches from the south to the south west including Les Minquiers. Fishing restrictions are present in specific areas which prohibit mobile gear and parlour pots.

Activity in this zone is dominated by French vessels where the majority of landed weight is comprised of dredged scallop, spider crab or whelks (Figure 21). Landed value for scallop is by far the greatest with average yearly values around £2.25 million.

The data indicates that Jersey effort is focused on crustacean potting and to a lesser extent, scallop dredging, although overall landings are notably less than French vessels (Jersey landings 163,260Kg, French landings 581,882Kg). The average crustacean pots annual landed value from this zone is far greater for Jersey vessels than French vessels (£400,000 Jersey vessels; 234,000 € for French vessels).

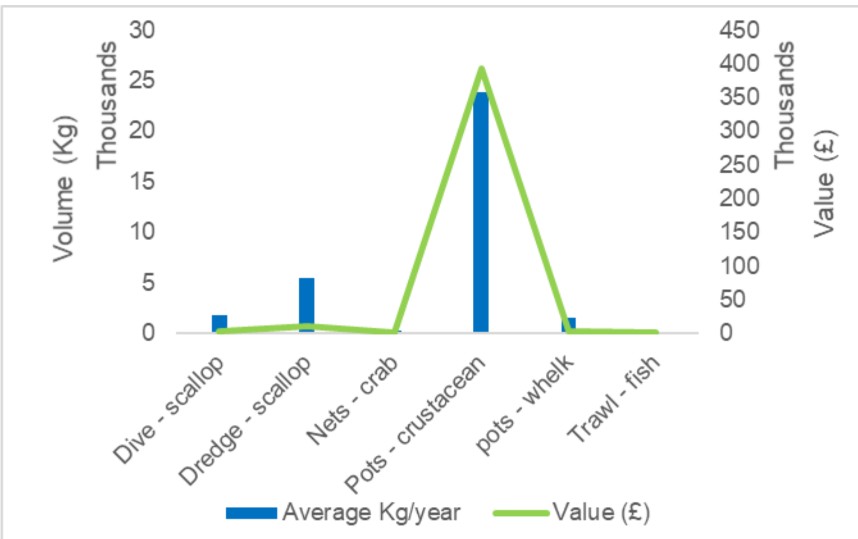

Figure 20: Zone 26E7BG – Jersey vessel landings volume and value (average 2015-2019)

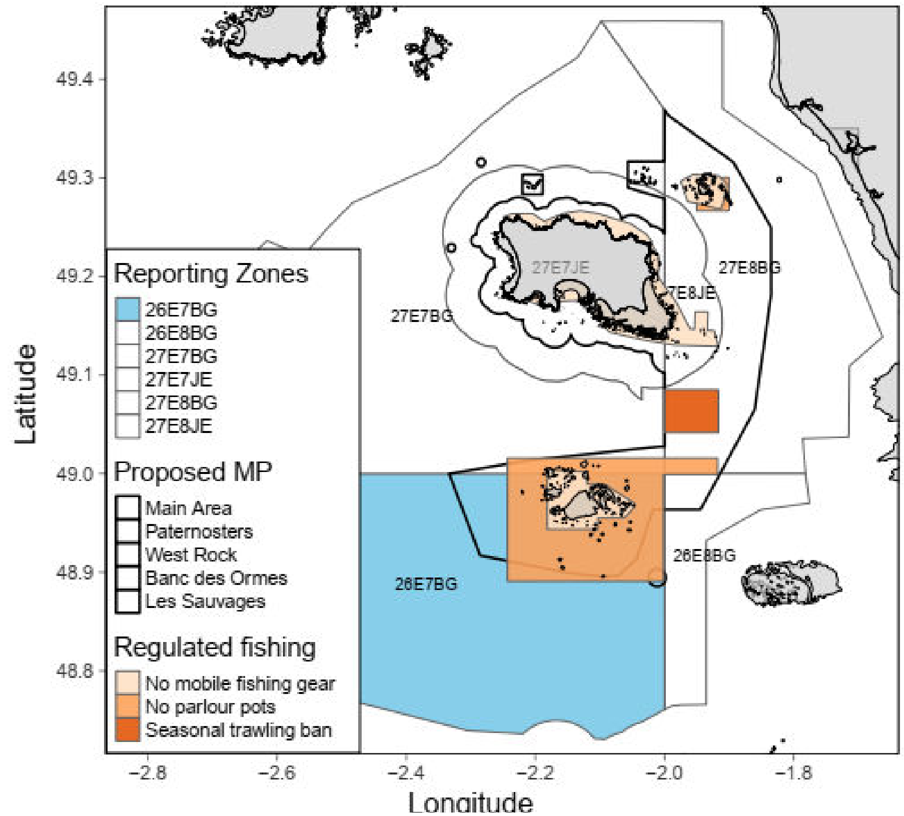

Figure 19: Zone 26E7BG (in blue) in addition to existing regulated fishing zones (orange)

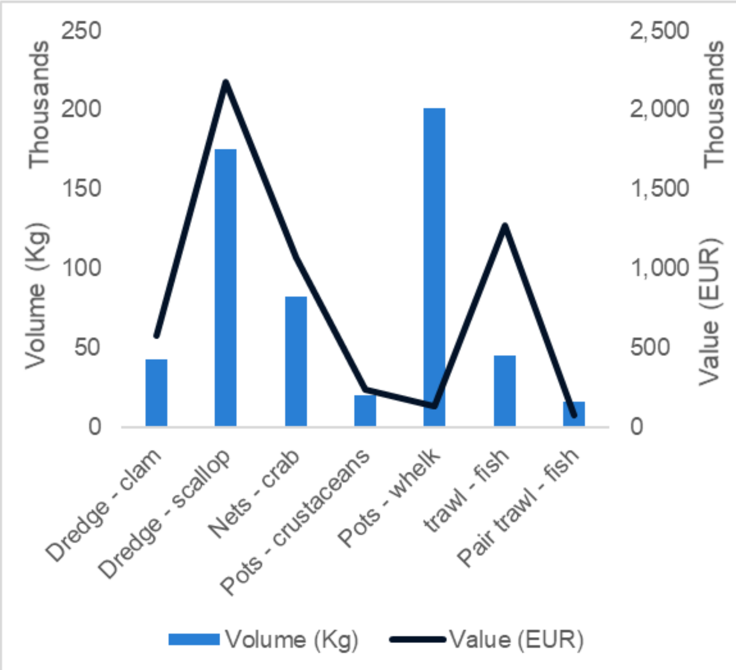

Figure 21: Zone 26E7BG – French vessel landings volume and value per year (average 2015-2019)

Table 7: Summary of data for reporting zone 26E7BG

	Jersey landed weight (Kg)– average (2015-2019)	**Jersey landed value (£)**	**French vessel landed weight (Kg)– average (2015-2019)**	**French vessel landed value (€)**	**French vessel landed value (£)**
Dredge - clam	-	-	42,510	575,520	479,600
Dive - scallop	1,785	3,570	-	-	-
Dredge - scallop	5,558	11,116	175,500	2,176,200	1,813,500
Nets - crab	340	952	82,056	1,067,780	889,817
Pots - crustaceans	23,876	393,951	19,929	234,904	195,754
Pots - whelk	1,610	3,220	200,704	133,019	110,849
Trawl - fish	150	1,080	45,034	1,272,700	1,060,583
Pair trawl - fish	-	-	16,150	77,900	64,917
Total	33,319	413,888	581,883	5,538,024	4,615,020

2.1.6 Reporting zone 27E7BG

One of the largest reporting zone areas and encompassing almost the entirety of the island with the exception of a small area to the east is 27E7BG. Jersey's fishing fleet activity is mostly comprised of whelk potting, scallop dredging and crustacean potting (lobster), with a far smaller proportion represented by benthic trawling or tangle nets for spider crab. Landed value is greatest for lobster potting (~£800,000 yearly average) and whelks (~£600,000 yearly average) (Figure 23).

French vessels' landed volume follows a similar trend to Jersey vessels. However, their average landed value particularly for scallops, benthic fish species and spider crab are considerably higher (€4.5 million, €3 million and €2.5 million, respectively) (Figure 24).

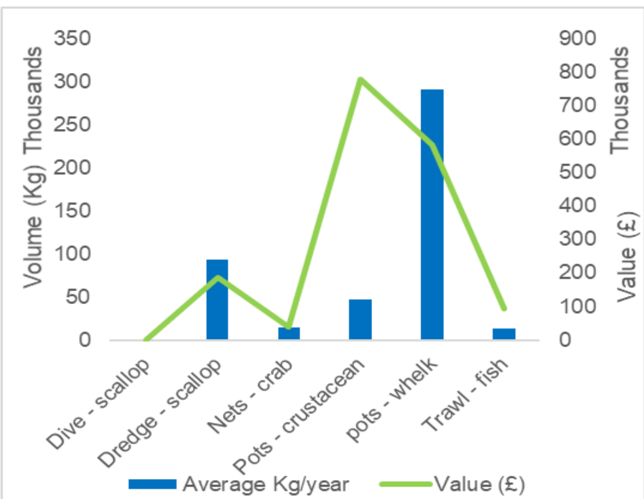

Figure 23: Zone 27E7BG – Jersey vessels landings and value per metier (average 2015-2019)

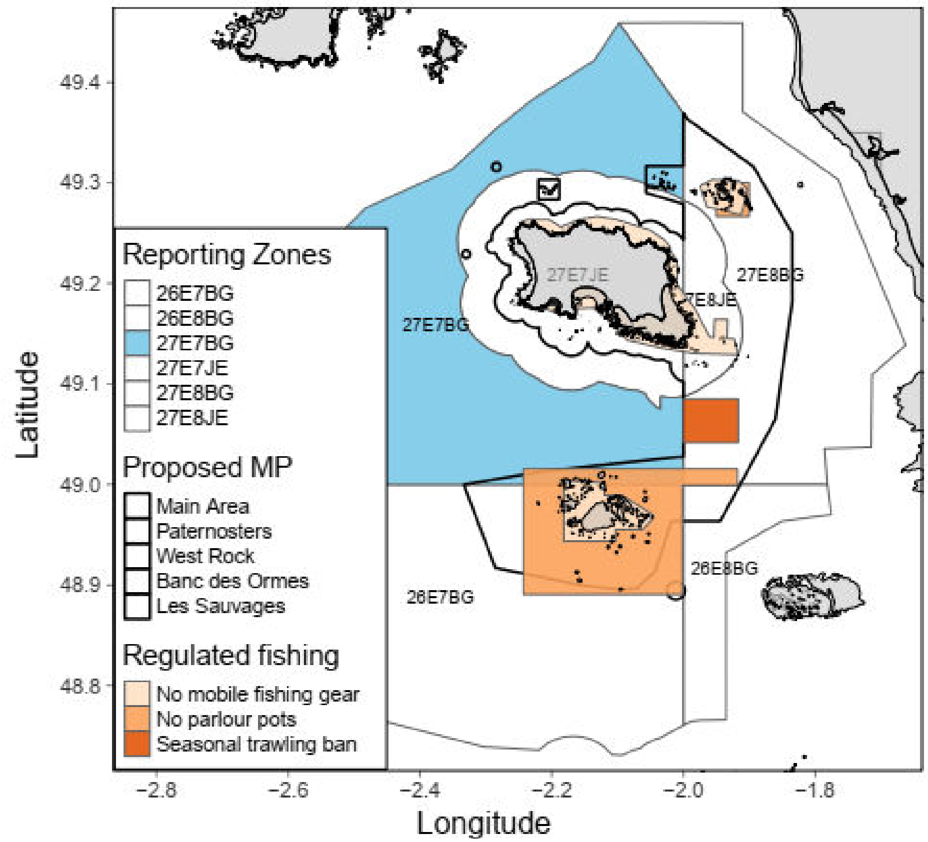

Figure 22: Map highlighting reporting zone 27E7BG (in blue) in addition to existing regulated fishing zones (orange)

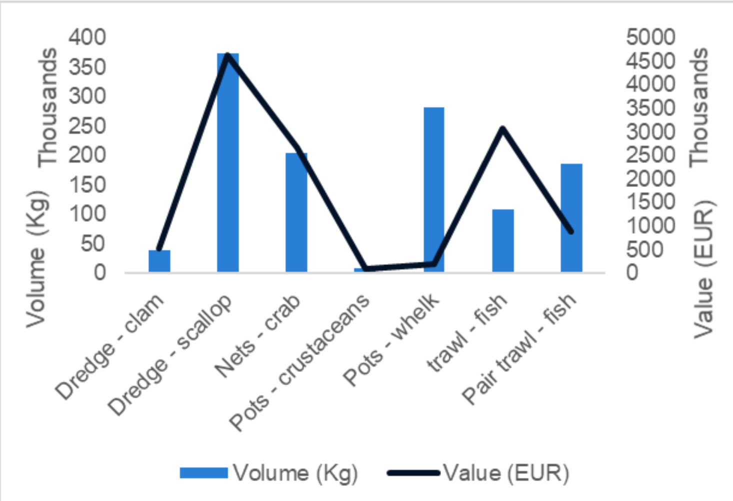

Figure 24: Zone 27E7BG – French vessel landings and value per metier (average 2015-2019)

Table 8: Summary of data for reporting zone 27E7BG

	Jersey landed weight (Kg)– average (2015-2019)	Jersey landed value (£)	French vessel landed weight (Kg)– average (2015-2019)	French vessel landed value (€)	French vessel landed value (£)
Dredge - clam	-	-	39,715	537,680	448,067
Dive - scallop	628	1,257	-	-	-
Dredge - scallop	93,041	186,083	372,825	4,623,030	3,852,525
Nets - crab	14,151	39,622	204,984	2,667,420	2,222,850
Pots - crustaceans	47,149	777,965	9,132	107,326	89,438
Pots - whelk	290,179	580,357	282,240	187,058	155,882
Trawl - fish	13,106	94,360	109,204	3,086,200	2,571,833
Pair trawl - fish	-	-	185,385	894,210	745,175
Total	458,254	1,679,644	1,203,485	12,102,924	10,085,770

2.2 Spatial distribution of fishing effort and benthic habitats

Fishing effort, volume and value for key metiers is presented below the following habitat map. Reference to the Jersey habitat map (Figure 25) will be made to enable broadscale inferences of predominant benthic habitats associated with each key metier. The boundary of the proposed Marine Park is indicated by the black solid line, in a 'J' shape around and to the south of the island.

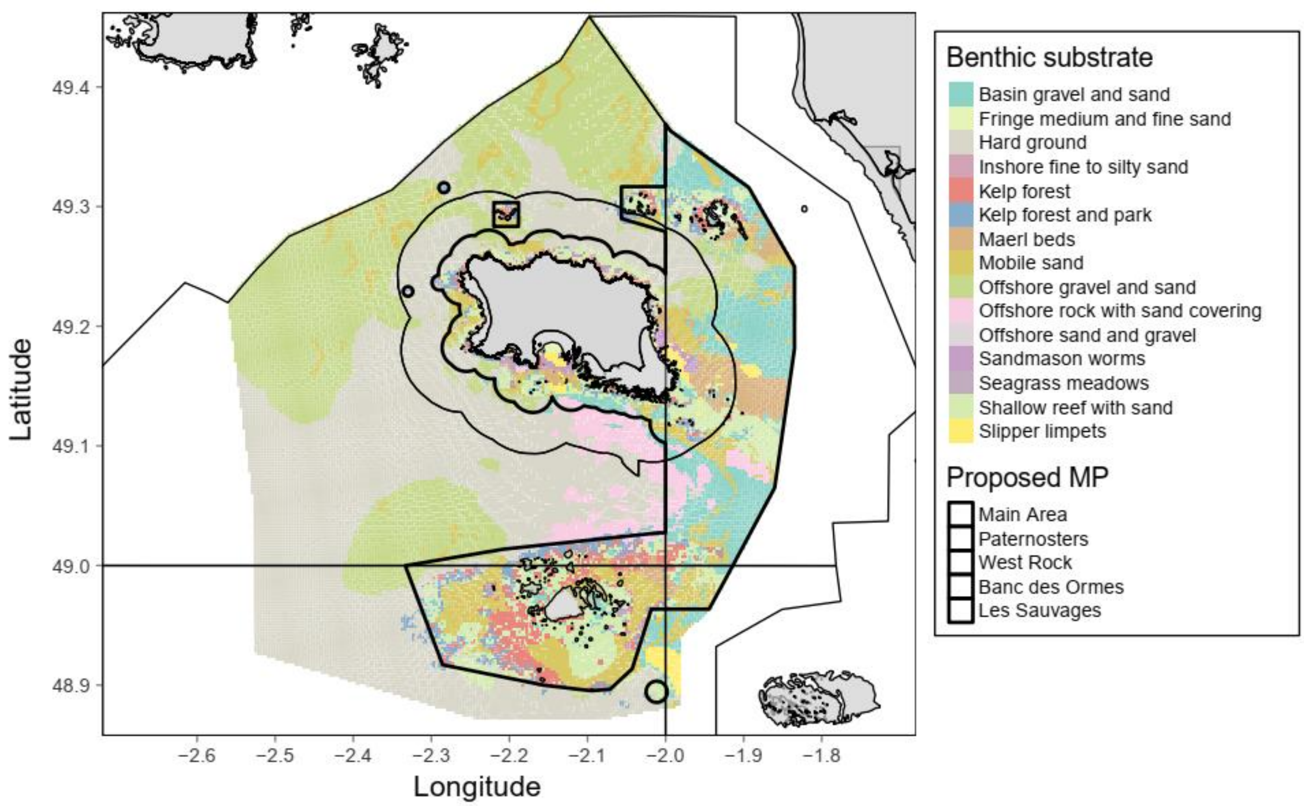

Figure 25: Jersey habitat map (source: Marine Resources)

2.2.1 Dredge - clam

At the time of writing, dredging for clam was only undertaken by French vessels. There is now one Jersey vessel undertaking this activity at a very low level. Data were not available. Effort is concentrated largely to the east of the island (Figure 26) where the benthic substrate is gravel and sand (Figure 25 above). High volumes of activity also appear to the south of the island, near Les Minquiers where habitats constitute shallow reef and mobile sand. Peaks in volume and landed value follow the same geographical distribution as effort where landed volume and value per 1km^2 reaching yearly averages (2015-2019) of 6,000Kg and €80,000 (£69,000) respectively (Annex 3 and 4), although the latter occurs on rare occasions.

A large proportion of metier activity occurs in the potential Marine Park (light blue shading), therefore there will undoubtedly be financial implications to the fishery.

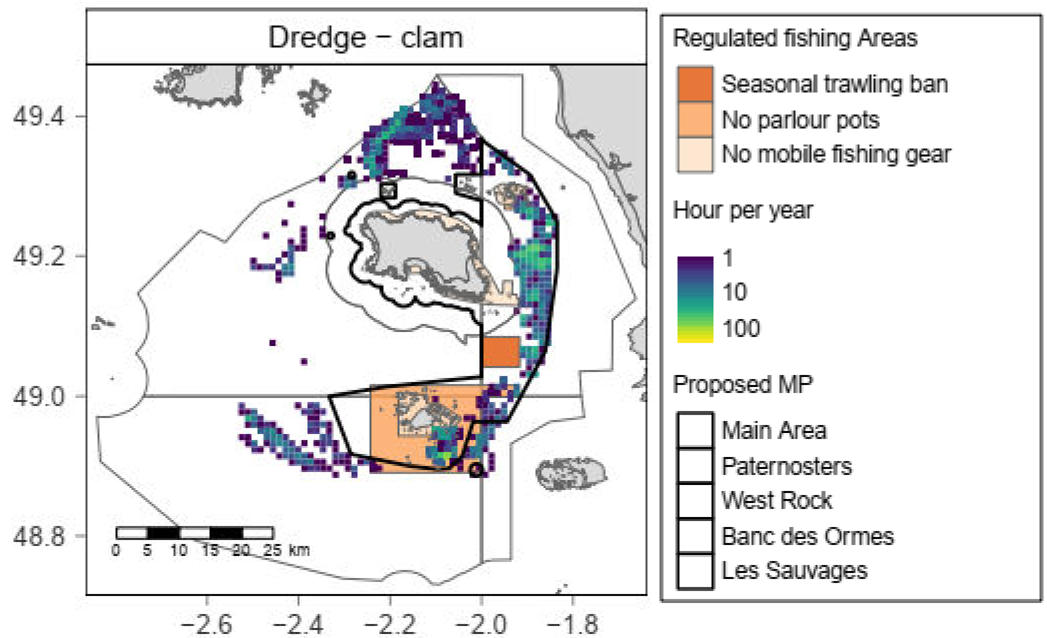

Figure 26: French dredge clam effort log10 (average 2015-2019)

2.2.2 Dredge - scallop

Scallop dredging is an important fishery for both Jersey and France. Spatial distribution maps suggest little overlap occurs between the two fleets (Figure and Figure). Jersey vessels appear to focus more on the inshore zone around St Helier, small areas to the south west, and to the east of the island as well as to the south east of Les Minquiers. Slipper limpets and sandmason worms are common benthic substrates in such areas (Figure 25 above). Jersey vessels fetch up to £7,000 per 1km^2 on average per year (2015-2019) in some of the inshore zones (Annex 1) suggesting a Marine Park closed to such gears would pose some challenges for the fleet, but based on the location of French scallop dredgers, there is suitable habitat offshore.

French vessels fish most intensely south east of Les Minquiers and display similarly high levels of effort offshore. In the offshore regions, benthic substrates are largely a combination of hard ground and offshore gravel and sand, and in the south east corner, there are variable benthic habitats including maerl beds and slipper limpets. Landed volume and value from this area seems to be substantially higher than other regions (€50,000 – 60,000 €(£43,000 – £51,700) value in comparison to ~€10,000 (£8,600)), and significantly higher than Jersey figures (Annex 3 and 4).

Although the number of French fishing licenses permitted to fish in Jersey waters post-Brexit is unknown at this stage, it is likely that whilst there would be some impact of the Marine Park to French scallop dredgers, it may not be as detrimental to them as to other metiers, considering the high fishing effort applied in regions out with the park boundaries.

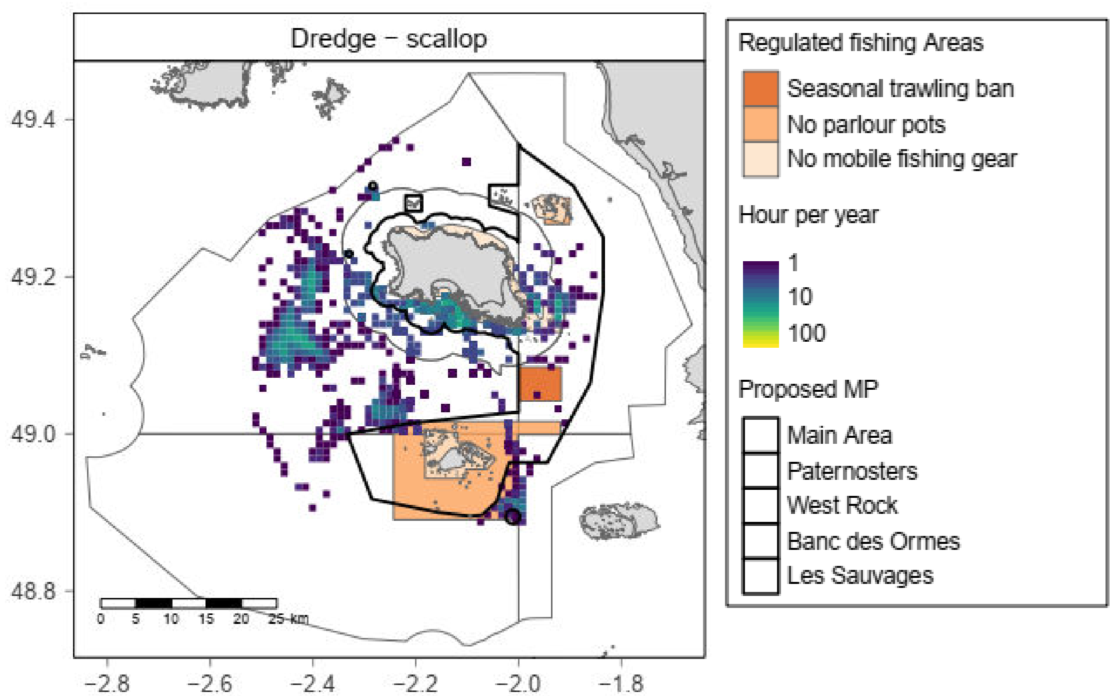

Figure 27: Jersey dredge scallop effort log10 (average 2015-2019)

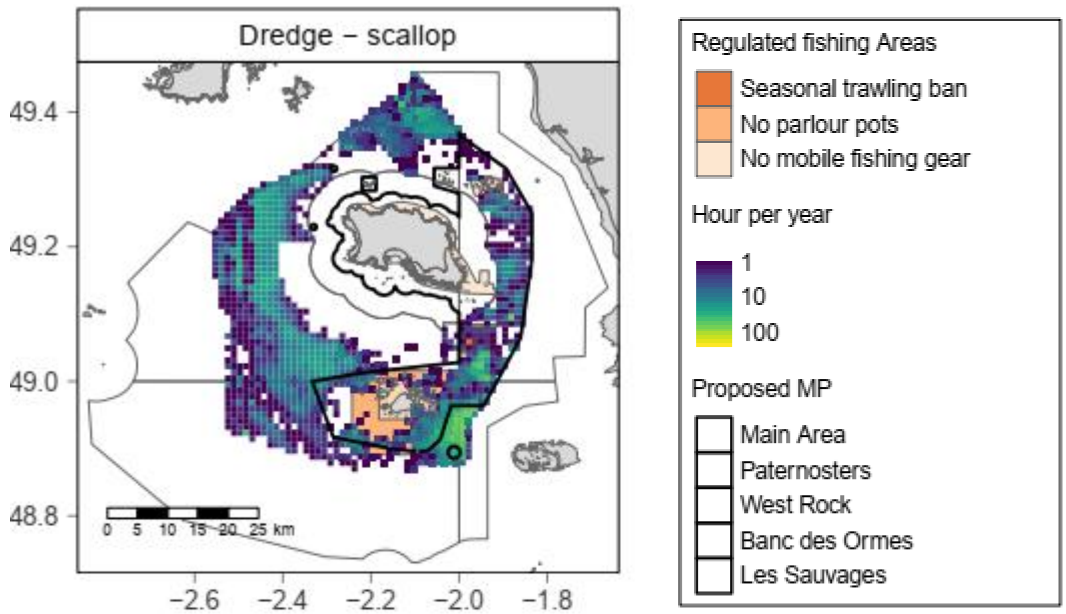

Figure 29: French dredge scallop effort log10 (average 2015-2019)

2.2.3 Nets – spider crab

Data is limited to French netting vessels as there are such few Jersey vessels targeting spider crab via tangle nets. Effort seems to be focused further offshore from Jersey in reporting zone 26E7BG and 27E7BG where activity in this region appears to be most prominent to the north west of Les Minquiers (Figure). Landed volume ranges between 500Kg/year – 2000Kg/year and in few isolated places up to 3,500Kg/year whilst landed value is generally between 10,000 €/year (£8,600) and 30,000 €/year (£25,800) although in some places up to 50,000 €/year (£43,000) (Annex 3 and 4).

There is less benthic biodiversity offshore as much of the benthic substrate is hard ground and offshore gravel and sand, although pockets of kelp forest are present to the south east of Les Minquiers (Figure 25 above).

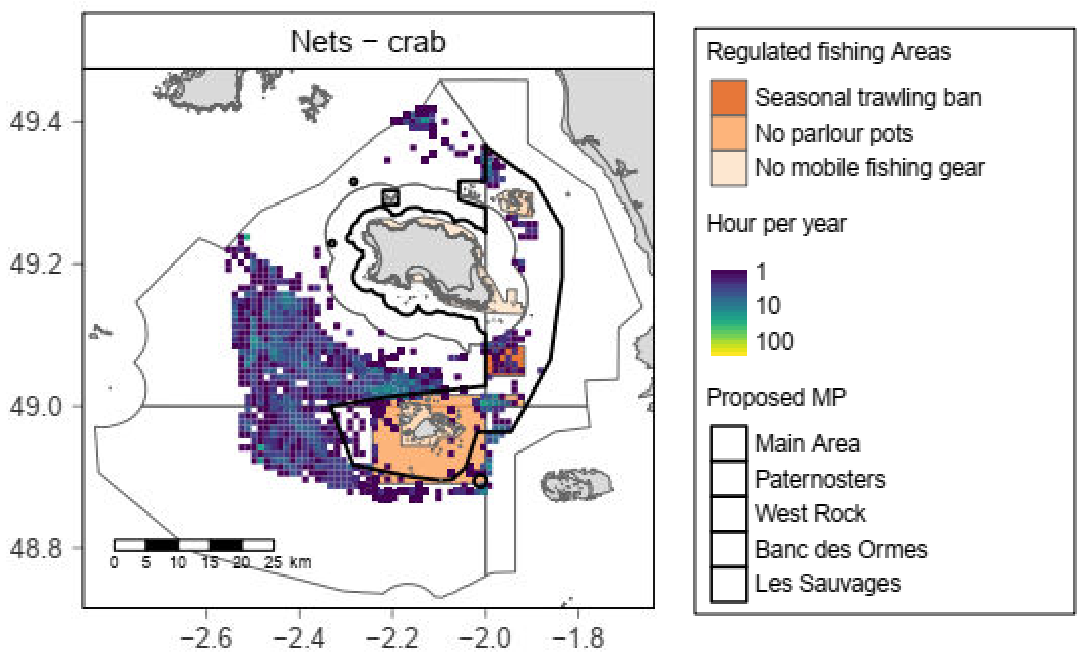

Figure 30: French tangle netting effort log10 (average 2015 – 2019)

2.2.4 Pair Trawl

Similarly to clam dredging and tangle netting, only the French have any substantial pair trawling effort in the region (Figure). However, based on available data, pair trawling does not appear to be as economically important as whelks, where the average maximum value generated in a given 1km^2 square area is €6,000, in comparison to € 20,000 (£17,000) for whelk.

Benthic habitat type diversity is less than inshore areas as the dominant substrate is offshore gravel and sand (Figure 25). Pair trawlers are unlikely to be affected if the proposed Marine Park is implemented, as little activity takes place within the proposed Marine Park area.

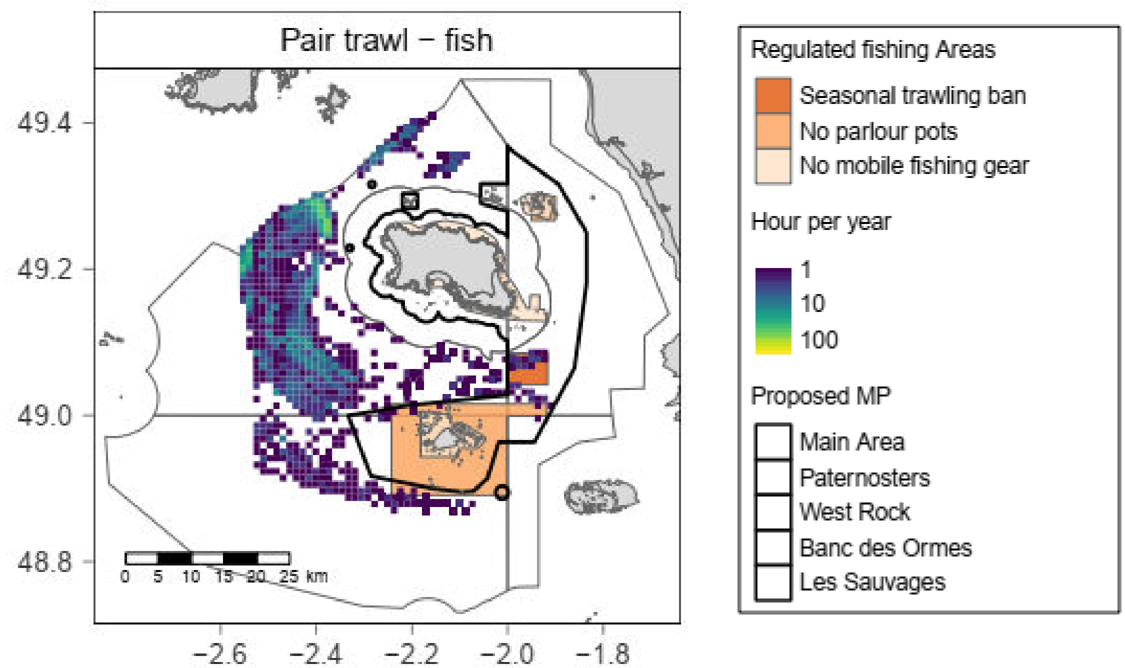

Figure 31: French pair trawl vessel effort log10 (average 2015-2019)

2.2.5 Pots – crustacean (lobster)

Shellfish (lobster and crab) account for 70% of Jersey's financial landed value, and potting is by far the dominant gear in use in Jersey's waters[7]. Potting occurs in all inshore zones around the island (within 3NM), and further south around Les Minquieres (Figure and Figure). Although, similarly to scallop dredgers, a particular effort hotspot for Jersey vessels is between Noirmont point and St Helier where the predominant benthic substrates are slipper limpets and sandmason worms and maerl beds (Figure 25 and Figure).

In those regions where effort is greatest, landed volume and value can be up to 2,500Kg per 1km^2 (Annex 2) on average per year and £45,000 per 1km^2 (Annex 1) on average per year for Jersey vessels.

Whilst there are several French vessels lobster potting, they are far less economically important than for Jersey potting vessels. French vessels generate up to a maximum of €12,000 (£10,300) per 1km^2 (Annex 3) on average per year and land up to a maximum of 1,000 Kg from any 1km^2 on average per year (Annex 4), substantially less than Jersey vessels.

Spatial data suggests potting occurs over benthic areas with high biodiversity. Large areas of kelp forest are present with pockets of maerl bed and mobile sand (Figure 25).

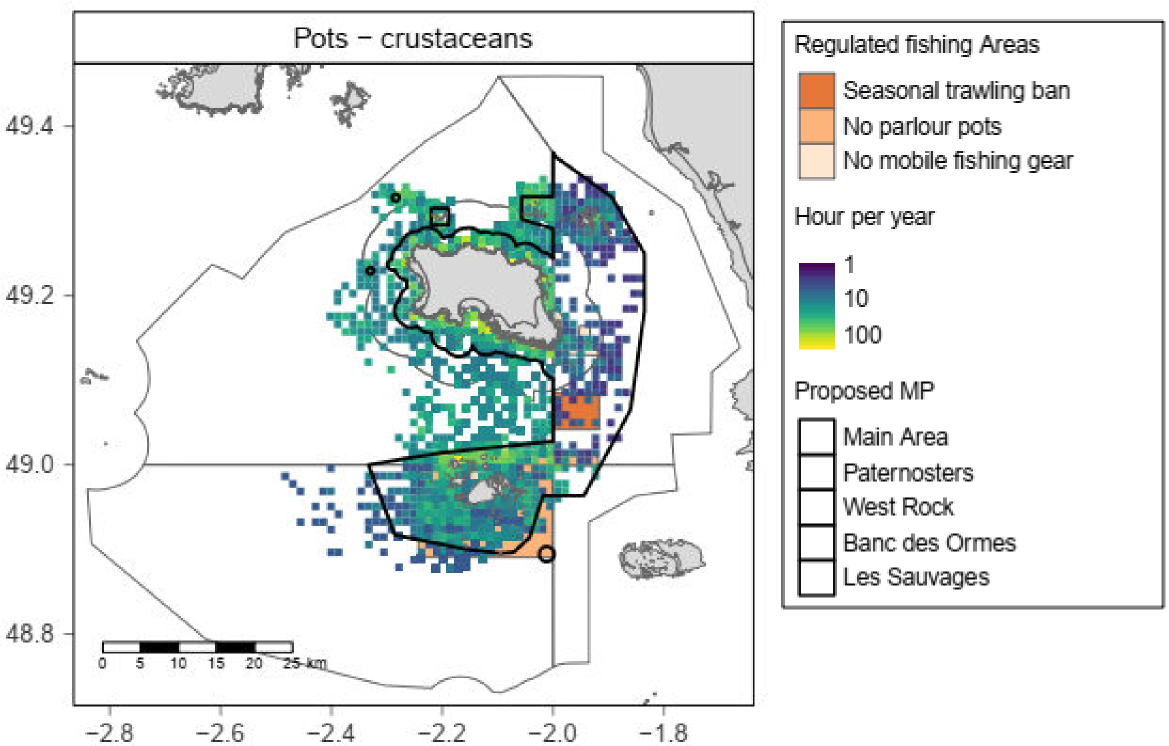

Figure 32: Jersey vessel potting (lobster) effort log10 (average 2015 – 2019)

[7] *Gouvèrnément d'Jèrri 2020. Marine Resources Annual Report 2019. Growth, Housing and Environment, Marine Resources Section, Howard Davis Farm, Jersey JE3 5JP.*

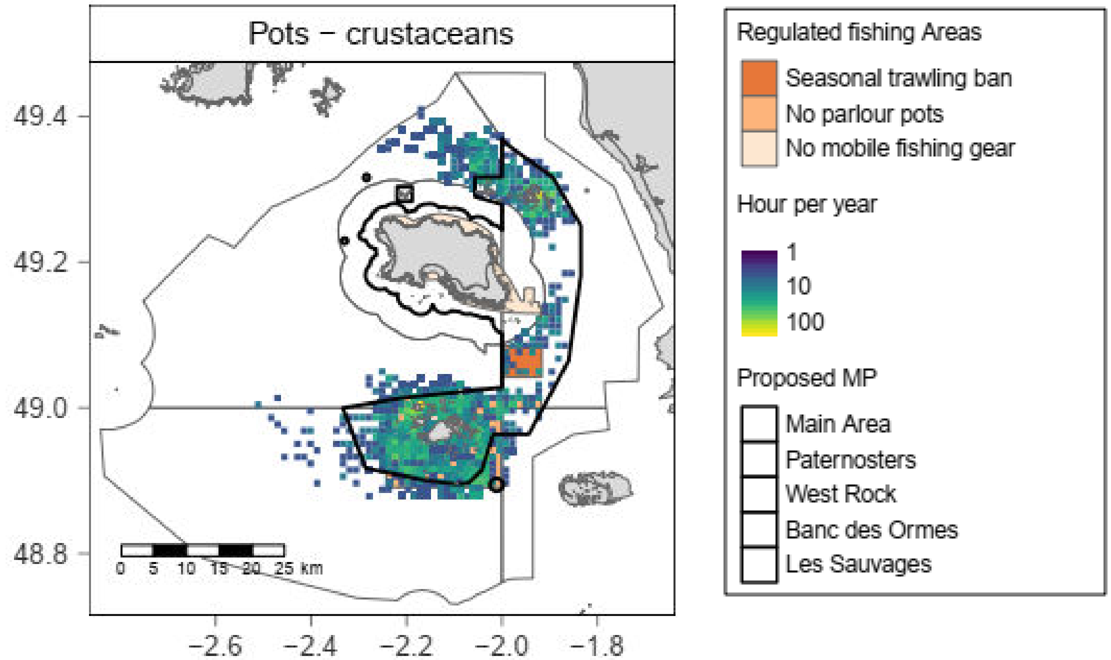

Figure 33: French vessel potting (lobster) effort log10 (average 2015 – 2019)

2.2.6 Hand dived scallop

Data exists only for hand dived scallop by Jersey divers, as this occurs within the 3NM inshore zone. In recent years hand dived scallop LPUE has been approaching the same effort as dredged scallop where the combined annual landings for dredged and hand dived scallop represents around 8% of Jersey's annual fishing economy[8].

The Ecrehous islands to the north east of Jersey appear to receive a high amount of scallop diving effort (Figure), although areas on the south coast and north east coast inshore zone are also popular. Landed volume per 1km^2 square on average per year can be up to 4,000Kg, although most 1km^2 are between 1,000Kg and 2,000Kg (Annex 2). Value per 1km^2 on average per year can range between £1,000 and £8,000 (Annex 1).

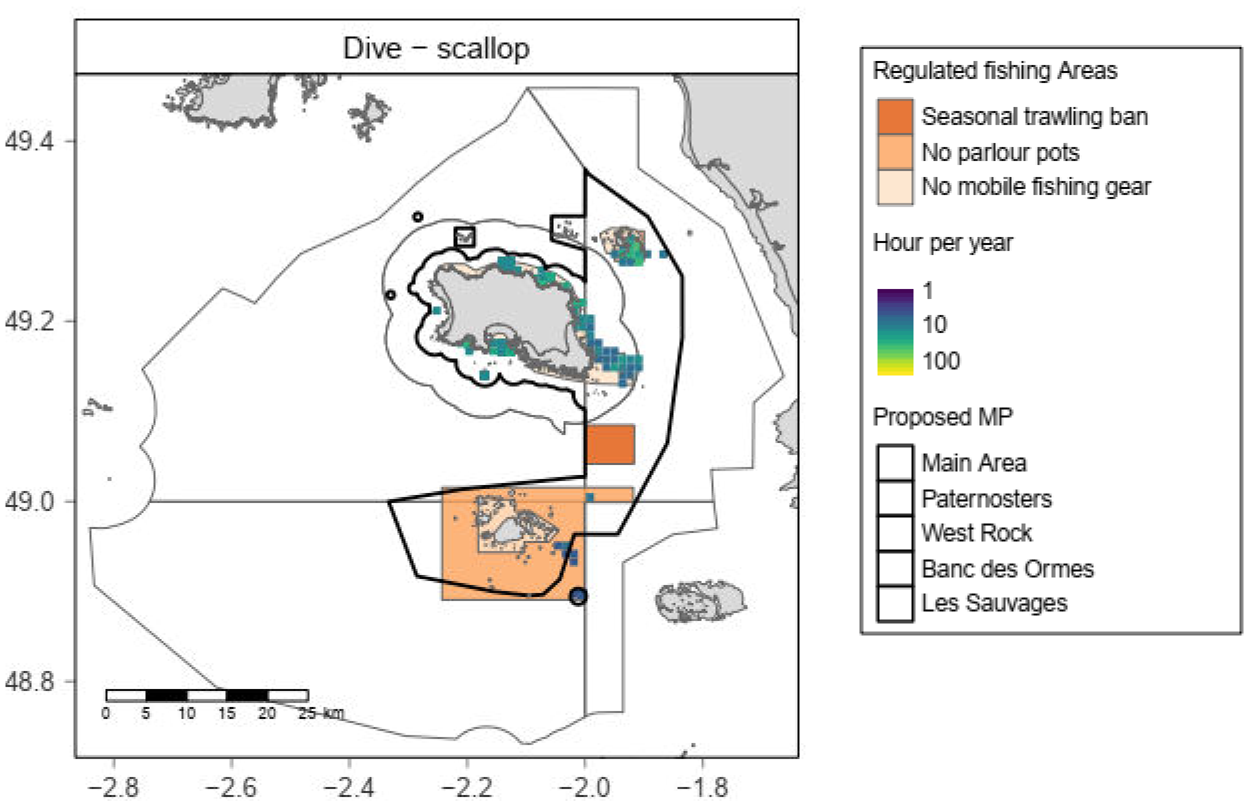

Figure 34: Jersey hand dived scallop effort log10 (Hrs) (average 2015-2019)

[8] *Gouvèrnément d'Jèrri 2020. Marine Resources Annual Report 2019. Growth, Housing and Environment, Marine Resources Section, Howard Davis Farm, Jersey JE3 5JP.*

2.2.7 **Pots – whelk**

Behind lobster potting, whelk places high in economic importance for the Jersey commercial fishing industry, constituting 22% of total landed value when combined with scallop[9].

The majority of whelk potting for both Jersey and French vessels occurs to the north, east and south east of the island, with a particular hotspot about 15km to the south east of La Rocque (Figure and Figure). However, as with French scallop dredging and benthic trawling vessels, an additional hotspot with greater effort is the south east of Les Minquiers (Figure).

Jersey vessels landed value per 1km^2 on average per year ranges between £5,000 and £30,000, although the latter is on rare instances (Annex 1). The equivalent for French vessels is between €5,000 (£4,300) and €20,000 (£17,000) per 1km^2 on average per year (Annex 3).

Benthic habitats vary between slipper limpet, basin gravel and sand, and maerl beds, although basin gravel and sand tends to represent the largest area (Figure 25).

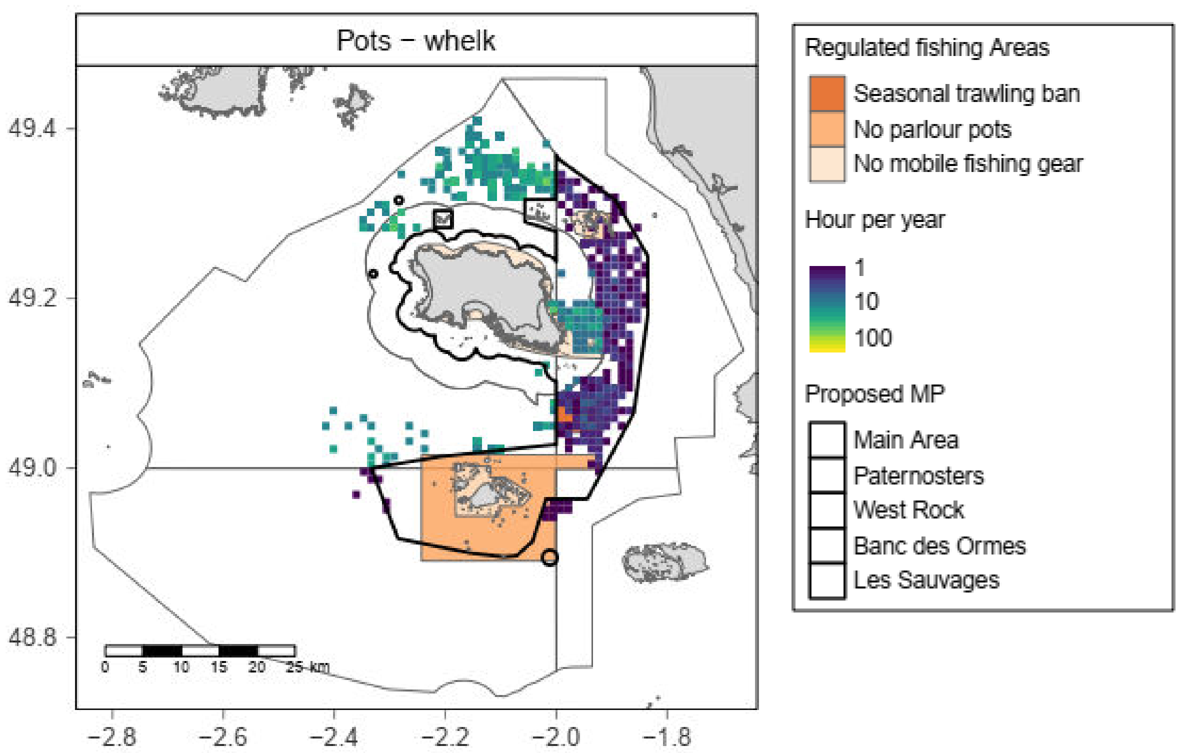

Figure 35: Jersey whelk potting vessel effort log10 (average 2015 - 2019)

[9] *Gouvèrnément d'Jèrri 2020. Marine Resources Annual Report 2019. Growth, Housing and Environment, Marine Resources Section, Howard Davis Farm, Jersey JE3 5JP.*

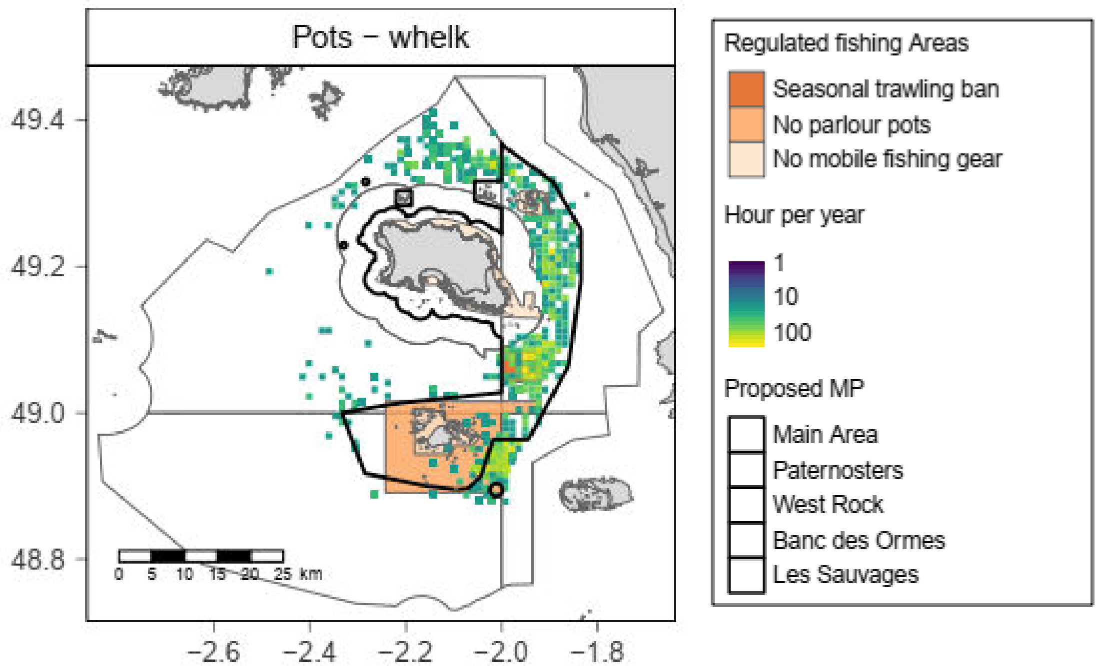

Figure 36: French whelk potting vessel effort log10 (average 2015 - 2019)

2.2.8 Benthic trawl – fish

The Jersey fleet consists of very few trawlers, and their landed volume and value are of less economic importance for the island. Any trawling that does occur tends to be focused on the south, south west and west of the island, although some of this is within the proposed Marine Park area (Figure). Projected landed volume and value from any given 1km2 grid does not exceed 2,500 Kg and £20,000 respectively (Annex 1 and 2).

French vessel trawling effort and distribution is far greater than that of Jersey vessels and occurs around the entire island (Figure). Although most effort takes place outside the Marine Park boundary, one area of note is the south east of Les Minquiers, which appears to receive more activity, and may impact French trawlers in the region should the static gear Marine Park be implemented. Between € 20,000 and € 45,000 (equivalent to £17,200 - £39,000) on average per year could be generated in any 1km^2 in this area.

Trawling offshore occurs predominantly over offshore gravel and sand. However, the hotspot in close proximity to Les Minquiers has more biodiversity with pockets of kelp forest (Figure 25), which would be sensitive to trawling.

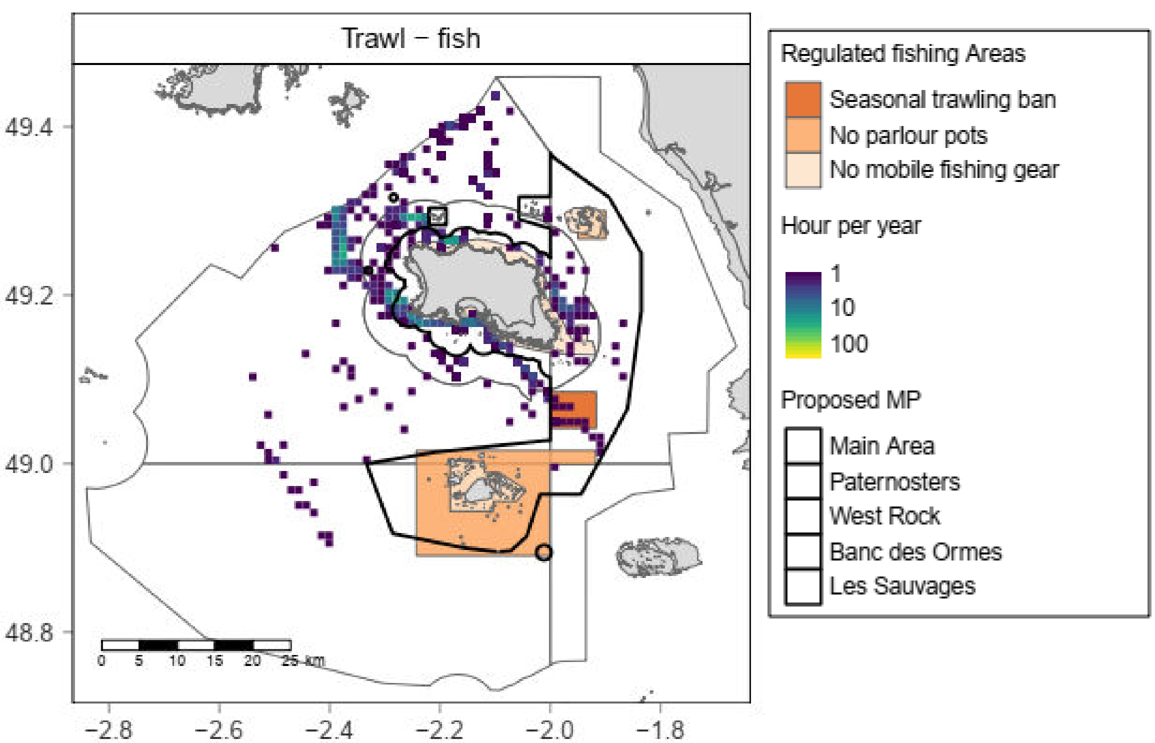

Figure 37: Jersey benthic trawling vessel effort log10 (average 2015-2019)

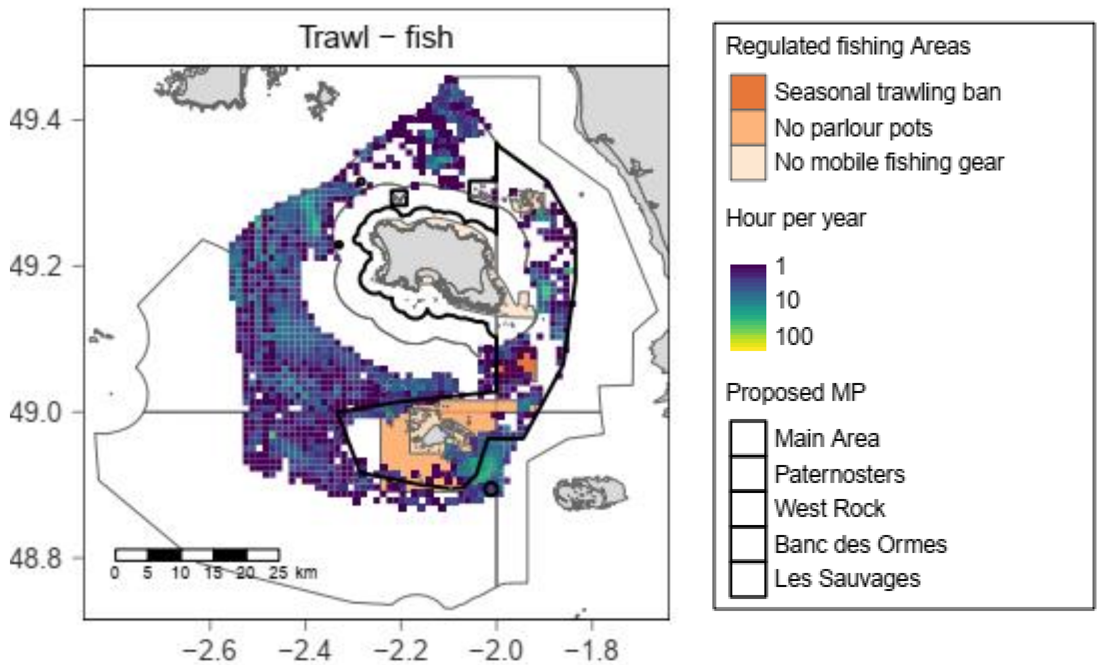

Figure 38: French benthic trawling vessel effortlog10 (average 2015-2019)

2.3 Key metiers summary table

The data in the table below is comprised of a combination of data provided by the Jersey Government and the Marine Resources Annual Report.

Table 9: Summary table of Jersey and French key metiers

Commercial fishery metier	**Commercial landings (based on reporting zones data from Jersey States)**				**Stock status and trends**	**Management measures**	**Other info**
	Kg/year (2015–2019 average)	Value (2015–2019 average)	Largest reporting zone landings	2019 CPUE			
Spider crab (*Maja squinado*) **– nets** **Jersey vessels** *Average length = ~ 7.4* *Engine Power = 101.1 Kw* *No. vessel: 29*	**Jersey Vessels**				Historically Jersey spider crab fishery has been variable due to changes in stock abundance and density. 424% increase in Jersey CPUE since 2013	- Seasonal management measures which prohibit harvest of new shelled spider crab during the autumn months - Prohibited within 200 meters of the shoreline between La Coupe Point to La Rocque harbour and to St Brelade's Bay between 1 April and 15 October - MLS 12cm	- Bay of Granville area produces over half of all European spider crab landings with majority taken by French vessels operating to the south and west of the island using tangle nets - During spring and summer will migrate inshore from deeper waters to shallower waters - Less economically important than lobster - Around 75% of spider crab catch comes from lobster pots
	29 803	£83 450	27E7BG/ 27E7JE	16.3 Kg/100 pots			
	French vessels						
	324 168	€4 218 340 (£3 515 288)	27E7BG	NA			
Benthic trawl – fish **Jersey vessels** *Average length = ~ 12.4m*	**Jersey vessels**					- Mobile gear restricted areas	Only 1 (?) vessel
	37 833	£273 683	27E7B/ 27E7EJ	NA			

Engine Power = 172.5Kw *No. vessel: 5*	**French vessels**						
	184,368	€5 210 400 (£4 342 000)	27E7BG	NA			
Dive – scallop *(Pecten maximus)* **Jersey divers** No. of divers 15	**Jersey vessels**				Suggestion of declining scallop stocks in general, but has not been verified by assessments	- MLS 102mm - Scallop diving is prohibited within a concession area in St Catherine's Bay	Baseline assessments of scallop stocks in 2018 and 2019 were not completed due to bad weather
	56,275	£112,550	27E7JE/ 27E8BG	16, 114 Kg/100 dives			
	French vessels						
	0	€0	NA	NA			
Dredge – Clam (*various species*)	**Jersey vessels**				NA	- Existing mobile gear restricted areas	
	0	£0	NA	NA			
	French vessels						
	175,695	€2,378,640 (£1 982 200)	27E8BG	NA			
Dredge – scallop (*Pecten maximus)* **Jersey vessels** *Average length = ~ 11.7m* *Engine Power = 146.8 Kw* *No. vessel: 8*	**Jersey vessels**				Suggestion of declining scallop stocks in general, but not been verified by assessments	- MLS 102mm - Mobile gear restricted areas	Baseline stock assessments in 2018 and 2019 were not completed due to bad weather
	183,341	£366,682	27E7BG/ 27E7EJ	10,111 Kg/100 tows			
	French vessels						
	708,000	€8,779,200 (£7 316 000)	27E7BG	NA			
Pair Trawl – fish	**Jersey vessels**				NA	NA	NA
	0	£0	0	NA			
	French vessels						

<table>
<tr><td></td><td>204,850</td><td>€988,100
(£853,020)</td><td>27E7BG</td><td>NA</td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">Pots – Crustaceans (lobster)
(Homarus gammarus)

Jersey vessels
Average length =7.1m
Engine power= ~96Kw
No. vessels: 102</td><td colspan="4">Jersey vessels</td><td rowspan="4">According to the latest MSC Jersey lobster fishery surveillance audit, the standardised index of abundance has dipped below the reference point of 0.99, which is triggered the introduction of new management measures[10]</td><td rowspan="4">- Brown crab MLS = 150cm
- All commercial crab and lobster pots must be marked with a valid tag
- Parlour pots restricted use at Les Minquiers and Les Ecrehous
- Pots must have at least 1 escape gap
- Lobster MLS 87mm</td><td rowspan="4">- Jersey lobster MSC certified as part of the Normandy and Jersey cross border fishery
- There is currently no TAC for this fishery
- Caught year-round but have a seasonal peak in summer</td></tr>
<tr><td>Lobster:
163,725

Brown crab*:
251,044</td><td>Lobster:
£2,683,104</td><td>Lobster:
26E7BG/
27E7BG/
27E7JE</td><td>Lobster:
8.03 Kg/100 pots
Brown crab*: 11 Kg/100 pots</td></tr>
<tr><td colspan="4">French vessels</td></tr>
<tr><td>38,946</td><td>€458,480
(£395,802)</td><td>26E7BG</td><td>NA</td></tr>
<tr><td rowspan="3">Pots – Whelk
(Buccinum undatum)

Jersey vessels:
Average length = ~7.6m
Engine power - ~108.1Kw
No. vessel: 37</td><td colspan="4">Jersey vessels</td><td rowspan="3">Stock subject to intense fishing and classed as overfished according to Ifremer</td><td rowspan="3">- MLS 45cm</td><td rowspan="3"></td></tr>
<tr><td>422,436</td><td>£891,912</td><td>26E7BG/
27E7JE/
27E8BG/
27E8JE</td><td>211 Kg/100 pots</td></tr>
<tr><td colspan="4">French vessels</td></tr>
</table>

[10] *Control Union Pesca Ltd, Marine Stewardship Council (MSC) 3rd Surveillance Audit Report, 2020*

	1,414,336	€937,370 (£809,225)	27E8BG	NA			

Note: NA is used to characterise instances where data is unavailable to present French CPUE; and, where either French or Jersey vessels are not utilising a particular gear type but the other (either French or Jersey) is, which subsequently means for those categories there is no comment of stock trend or management measures

Task 1 summary

The purpose of Task 1 is to inform the cost benefit analysis of moving to static gear only fisheries within the proposed Marine Park area of Jersey waters. The data presented have identified the distribution and activity of Jersey and French fishing metiers in Jersey waters.

Jersey mobile gears (bottom trawling for wetfish and scallop dredging) constitute a minor proportion of the fishing activity in Jersey waters, and the majority of fishing activity is potting for crab and lobster. Of the small mobile gear fleet, scallop dredgers are likely to be the most economically impacted due to most of their recent fishing effort being in the proposed Marine Park area. Habitat data and French fishing activity indicate there are suitable alternative fishing grounds further offshore, outside of the Marine Park boundary. Bottom trawling in the Jersey fleet is largely focused outside the boundary of the proposed Marine Park.

The proposed static gear Marine Park is also likely to have economic implications to the French fishery. Available data suggests French scallop dredgers land up to ~3.9 times more than Jersey scallop dredgers within Jersey waters, and their bottom trawl fishery up to 10 times more than that of Jersey's.

There are some caveats in the data which are below discussed in Task 2. Overall, the data provided enables an understanding of both the spatial distribution of volume and value for Jersey and French vessels within Jersey waters, and indicative impacts of a mobile gear closure.

TASK 2: COST BENEFIT ANALYSIS OF IMPLEMENTING A STATIC GEAR MARINE PARK

In an attempt to assess the impact of a static-gear Marine Park, a Cost Benefit Analysis (CBA) employing a natural capital approach has been completed. This approach incorporates both quantitative and qualitative assessments of cost-benefit to the fishing industry, the government, and the ecosystem. The structure of the assessment is a simplified version of the template used by the UK Government when conducting CBA of implementing similar fisheries regulations.

A CBA which employs a natural capital approach, alongside a more traditional economic impact assessment (such as that set out in section 3-5 of Task 2) should be considered essential in the formulation of management strategies that aim to meet complex social, environmental and economic objectives. In doing so, the likely extent and quality of supporting, regulatory, provisioning and cultural ecosystem services can be taken into account and so the goods/benefits provided for society become an inherent feature of future management decision-making processes.

The below CBA assumes the immediate implementation of a static-gear only Marine Park.

In summary, 'cost' is assessed by a combination of the following:

- The gross loss (unmitigated) to the fishing industry of the closure (£/€)
- The net change in income from Jersey active gears assuming mitigation (£)
- The cost to government of enforcing the closure (£)

In summary, 'benefit' is assessed by a combination of the following:

- Additional resources fished by mobile gears available for static gears in the Marine Park (£)
- Increased area available for static gears by avoiding gear conflicts (£)
- Benefits from protecting Natural Capital from mobile gears in the Marine Park (qualitative)

Note: for Natural Capital benefits, although we have been able monetise some ecosystem services (due to available studies providing usable figures), for other ecosystem services we have not, so an overall benefit in £ has not been generated and is purposefully not used to adjust overall 'benefit' figures in the summary tables (Section 7).

This CBA is mainly concerned with the impacts on Jersey vessels because we are aiming to quantify the economic consequences for Jersey. As mentioned above, the implementation of the active/mobile gear closure will also have an impact on the French fishery, and the gross cost of this has been evaluated below for reference. As far as we know at present, however, the economic loss to the French mobile fleet has no economic implications for Jersey, so this cost only intervenes in the analysis relating to Jersey to the extent that it makes additional resources available for static/passive gears, and requires resources for enforcement. There may be additional consequences for Jersey from excluding the French active gear fleet, depending on the legal situation in relation to Brexit, but these issues are not finalised at time of writing (March 2021) and therefore cannot be considered here.

1. Relevant active gear fishing activity in Jersey waters

1.1 Jersey fleet

There are two active gear métiers in the Jersey fleet: **scallop dredging and demersal wetfish trawling** (codend 80-99mm). There are no other types of active gears currently in use by the Jersey fleet. Catch by mid-water pair trawl was negligible in 2017-18 and zero in 2019. According to the effort data, there was some mid-water pair trawling again in 2020, but the catch data only runs to 2019.

It is not appropriate to provide data that identifies individual vessels, but an analysis of effort data allows the active gear fleet to be characterised roughly. Nine (9) vessels had any significant mobile gear activity and were operational during 2020 – of these, eight (8) had scallop dredge activity and five (5) had trawling activity. These vessels can be characterised as follows:

- Three (3) specialist scallop dredgers, of which one was not very active during 2020 (only 2 fishing days) – the two active vessels also do small amounts of potting;
- One (1) specialist trawler;
- Two (2) scallop dredgers who are also active in other métiers (potting, also trawling, netting, longline);
- Three (3) potters who also do some scallop dredging.

These nine (9) vessels vary in size from 9.95m to 18.5m; two are <10m and the rest >10m (similarly, two vessels are >12m, with seven vessels <12m). Excluding the vessel which was inactive in 2020, the number of fishing days per vessel in 2020 ranged from 60-121, average 92.

1.1.1 Jersey fleet: catch

For this analysis we have used data provided by Marine Resources on catch by species and catch by métier, but not catch by species by métier. For scallop dredging we can assume that the entire (landed) catch is made up of scallops (king scallop *Pecten maximus*), since there is no other shellfish dredging conducted by Jersey vessels. Fish trawling, however, targets a mixture of species. Brexit-related modelling by the Jersey Government in 2020 took 'indicator species' for each métier, and for demersal trawl the indicators were flatfish (sole *Solea solea* and turbot *Scophthalmus maximus*) and rays. The main species in the French catch which would be susceptible to demersal trawls are cuttlefish (*Sepia officinalis*), bream (*Spondyliosoma cantharus*), sole and rays. All these species can also be caught by other gears which are actually more commonly used in the area (such as gillnets targeting fish or spider crabs, and cuttlefish targeted by pots). Rays are likely to be a mix of species but *Raja clavata* and *Raja undulata* are probably the most common in the catch (Foucher et al. 2020).

Annual catch by métier for the Jersey fleet for all métiers, as well as fishing days per year, are shown in Table 10: .

Table 10: Jersey annual catch volume (t) and value (£) and annual fishing days by métier (average 2015-19). Value estimated by multiplying catch by price as follows: scallops and whelks: £2/kg, spider crabs: £2.80/kg,

pot crustaceans £16.50/kg, fish £7.20/kg. Data including prices provided by Jersey Marine Resources Section.

Metier	Métier type	Main species in the catch	Average 2015-19	
			Catch (t/yr)	Value (£/yr)
Scallop dredge	Active	King scallop	183	366,683
Demersal trawl (fish)	Active	Sole, turbot, rays; also bream, cuttlefish and others	38.0	273,684
Whelk pots	Static	Whelks	446	891,913
Crustacean pots	Static	Lobster, brown crab, spider crab	163	2,683,105
Scallop dive	Static	King scallop	56.3	112,551
Crab nets	Static	Spider crab, rays	30.0	83,451

1.1.2 Jersey fleet: distribution of effort

The fishing activity by métier by Jersey vessels in the Jersey zone has been plotted based on catch volume by km². The fishing activity for the active métiers (scallop dredging and demersal trawling) is plotted in Figure and Figure . The area proposed to be closed to active gears is indicated on the figures.

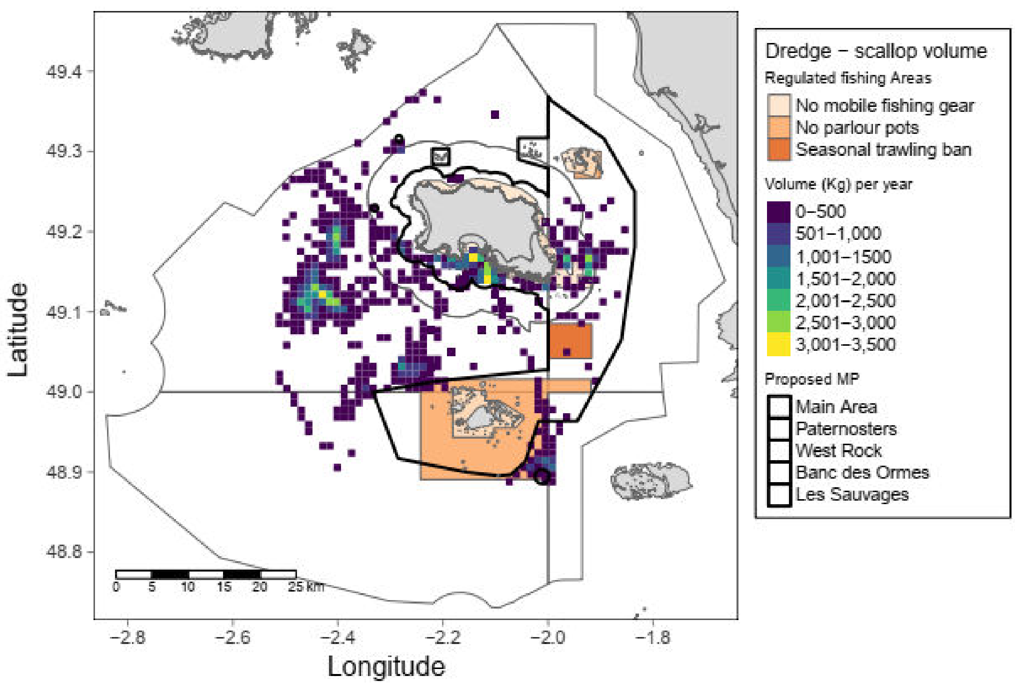

Figure 39: Scallop dredging activity by Jersey vessels in the Jersey zone in terms of catch kg per 1 km² square. Colour coding shows volume of catch in that square. Existing regulatory areas are in orange and proposed mobile gear closures are outlined in black.

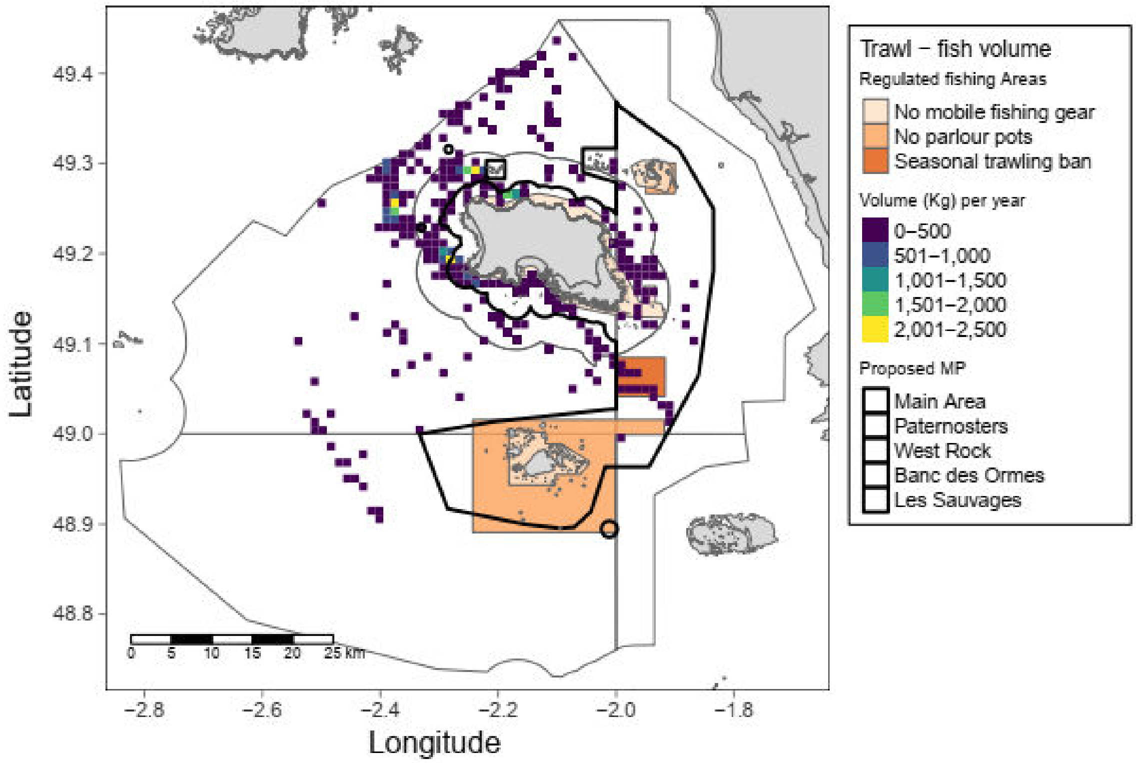

Figure 40: Demersal trawling activity by Jersey vessels in the Jersey zone in terms of catch kg per 1 km^2 square. Colour coding shows volume of catch in that square. Existing regulatory areas are in orange and proposed mobile gear closures are outlined in black.

1.2 French fleet

As noted above, the cost of excluding French active gear vessels from the proposed area is not a cost that is borne by Jersey (as far as we know at present) and therefore has no bearing on the cost/benefit analysis for Jersey, except for i) the availability of the resource formerly taken by these vessels; and ii) the cost of enforcement implied to maintain the closure. Nevertheless, the gross loss to the French fleet has been estimated below (as far as is possible with the data available – see below).

French active gears operating in the Marine Park zone are: scallop dredge, demersal wetfish trawl (single and pair) and clam dredge. French scallop dredgers take 708 t/year scallop (average 2015-19); i.e. ~3.9 times more than the Jersey scallop dredge fleet. The French wetfish trawl fleet takes 184 t/yr (single) and 205 t/yr (pair) (average 2015-19) (~10 times more than the Jersey wetfish trawl fleet). The clam dredge fleet takes 176 t/yr (average 2015-19). For scallops and trawl the available data on the species composition is as described in the section on the Jersey fleet above. The clam dredgers take amande (dog cockle; *Glycymeris glycymeris*) and praire (Venus clam; *Venus verrucosa*).

The French fleet with significant activity in Jersey waters under previous Granville Bay permits is characterised in the 2020 Ifremer report (Foucher et al. 2020). This report divides the fleet into vessels with and without VMS, because of different data sources in each case. In the main, the vessels with VMS are the larger vessels (all vessels >12m must have VMS). Ifremer estimates a total of 247 vessels fishing regularly in Jersey Granville Bay waters (57 vessels with VMS and 190 vessels without), which compares to a total of 364 Granville Bay permits issued to French vessels in 2019 (Gouvèrnément d'Jèrri 2020); presumably some of these permits went unused or little used.

The larger vessels use multiple different gears, but the main gears are all active gears – i.e. they may use various different trawls or dredges, or both types of gear, depending on the season. According to Ifremer (Foucher et al. 2020), 74% of these vessels use scallop dredges, 35% demersal trawls for cuttlefish, 32% demersal trawls for fish and 18% clam dredges. The smaller vessels are made up of 50% of crustacean potters while the other 50% use a range of gears, including active gears: a common pattern for the active gear vessels is fish trawling in the summer and scallop dredging in the winter. The top 12 species taken by the French fleet in Jersey waters, overall, are: edible crab, spider crab, lobster, whelk, scallop, amande, praire, cuttlefish, seabream, bass, sole and rays.

The French catch data available for this analysis are presented in Table 11: . Note that there are some issues with these data which are explained in the next section. The fishing activity for the active métiers (scallop dredging, clam dredging and demersal trawling single and pair) is plotted in Figures 40-43.

Table 11: French annual catch volume (t) and value (€) and annual fishing days by métier (average 2015-19). For more detailed analysis of these data, see below. Note the different currency. Data provided by Jersey Marine Resources Section.

Metier	Métier type	Main species in the catch	Average 2015-19		
			Catch (t/yr)	Value (£/yr)*	Value (€/yr)
Scallop dredge	Active	King scallop	708	7,316,000	8,779,200
Clam dredge	Active	Amande, praire	176	1,982,200	2,378,640
Demersal trawl (single)	Active	Sole, rays, bream, cuttlefish and others	184	4,342,000	5,210,400
Demersal trawl (pair)	Active		205	823,417	988,100
Whelk pots	Static	Whelks	1414	781,142	937,370
Crustacean pots	Static	Lobster, brown crab, spider crab	38.9	382,068	458,481
Scallop dive	Static	King scallop	0	0	0
Crab nets	Static	Spider crab, rays	324	3,515,283	4,218,340

* pounds converted from euros based on average exchange rate during fishing period (2015-19) of £1=€1.20[11]

[11] https://www.ofx.com/en-gb/forex-news/historical-exchange-rates/yearly-average-rates/

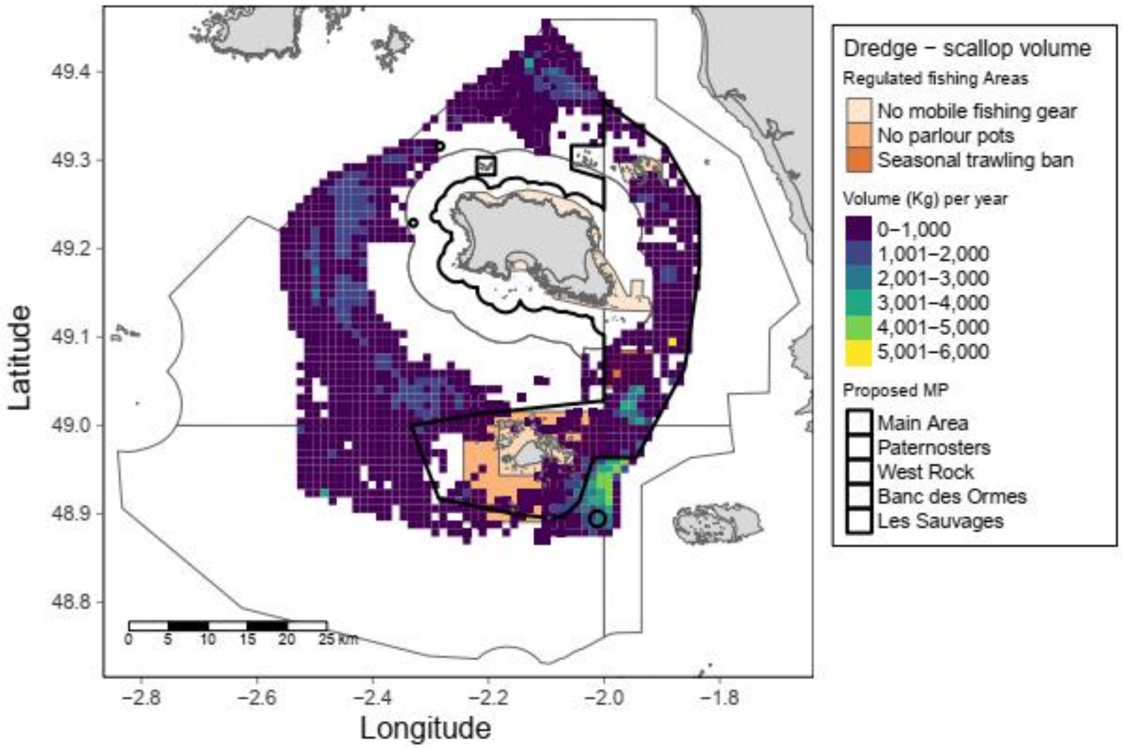

Figure 41: Scallop dredging activity by French vessels in the Jersey zone in terms of catch kg per 1 km² square. Colour coding shows volume of catch in that square. Existing regulatory areas are in orange and proposed mobile gear closures are outlined in black.

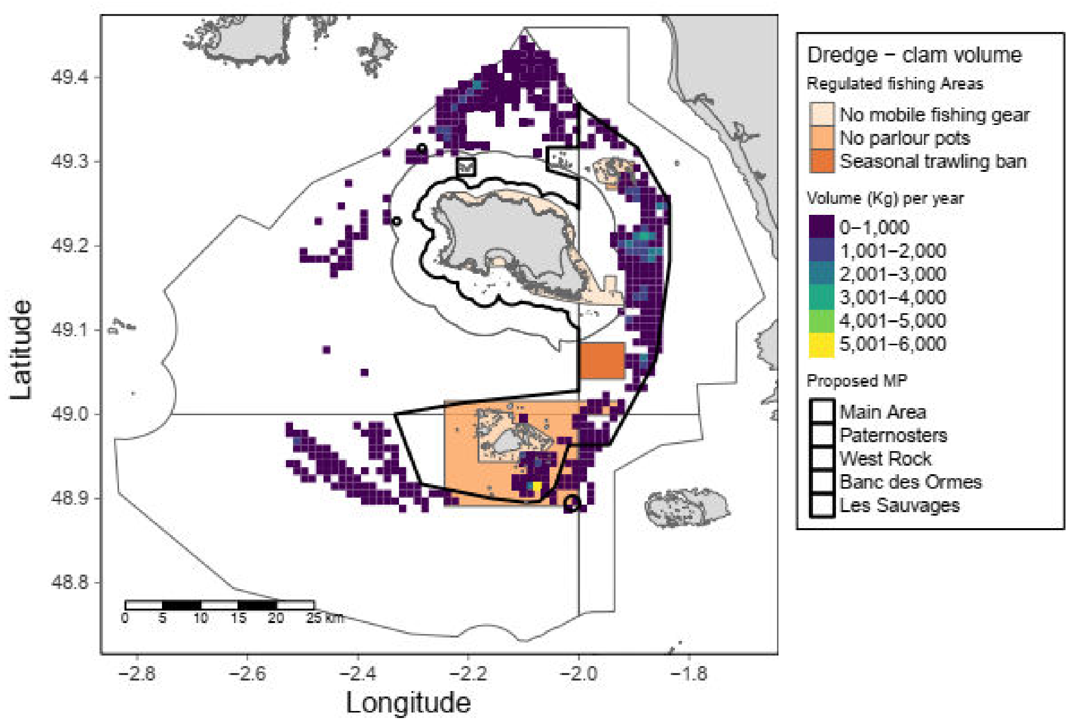

Figure 42: Clam dredging activity by French vessels in the Jersey zone in terms of catch kg per 1 km² square. Colour coding shows volume of catch in that square. Existing regulatory areas are in orange and proposed mobile gear closures are outlined in black.

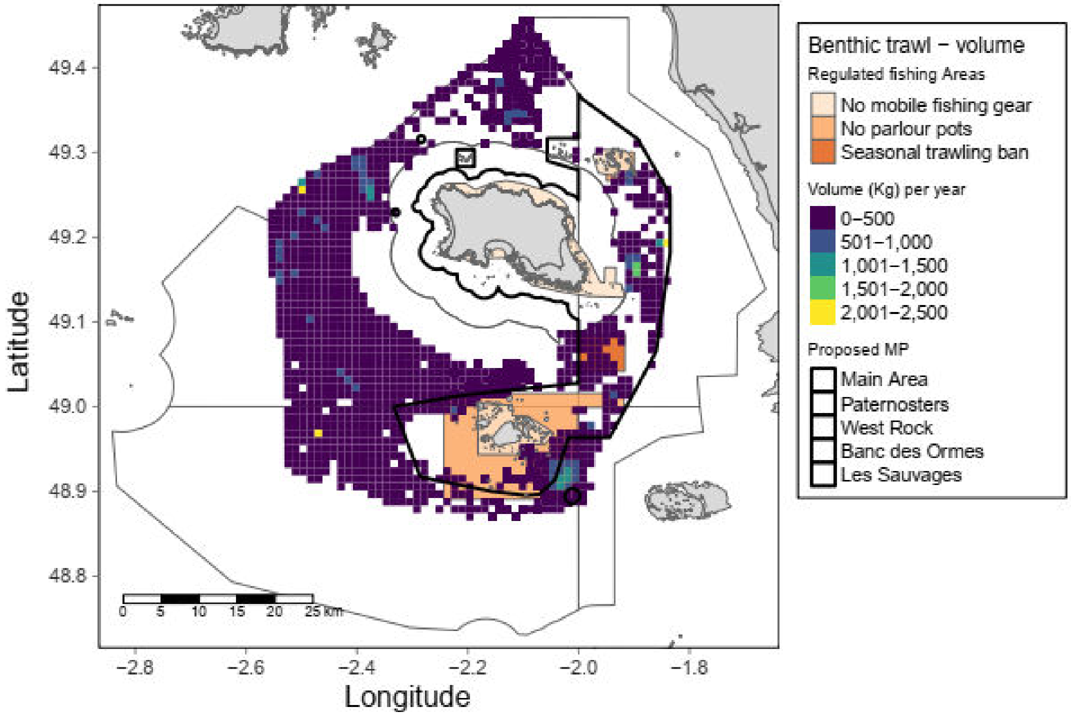

Figure 43: Demersal fish single trawl activity by French vessels in the Jersey zone in terms of catch kg per 1 km² square. Colour coding shows volume of catch in that square. Existing regulatory areas are in orange and proposed mobile gear closures are outlined in black.

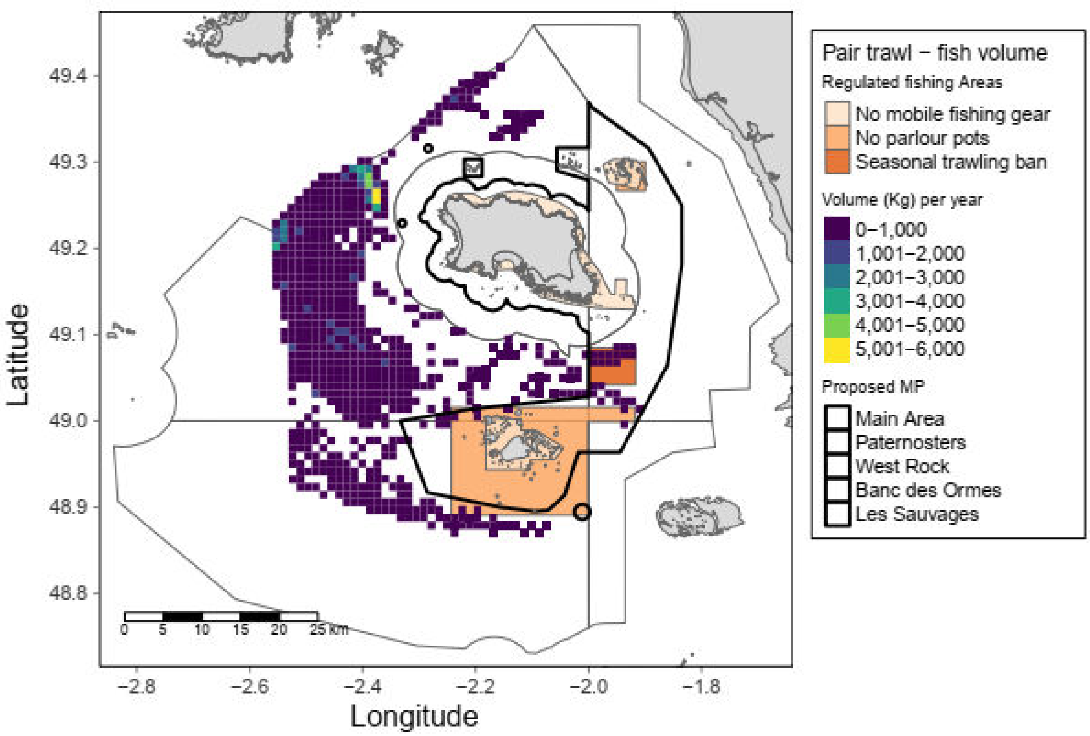

Figure 44: Demersal fish pair trawl activity by French vessels in the Jersey zone in terms of catch kg per 1 km² square. Colour coding shows volume of catch in that square. Existing regulatory areas are in orange and proposed mobile gear closures are outlined in black.

2. Data available for the analysis, and problems

The data provided by Marine Resources for this analysis consisted of catch volume (kg) and value (£ for Jersey, € for France) and effort (fishing days) by métier for 2015-19, averaged over the five years, by statistical rectangle and jurisdiction (summarised in Table 10: and Table 11). In addition to this, spatial data were provided on the distribution of catch within this area by km^2, as per the maps above, as well as data on individual vessels (anonymised) which was used to characterise the mobile gear fleet (see above).

To supplement these data sets, background information is available on both fisheries from the Jersey Marine Resources Annual Report for 2019 (Gouvèrnément d'Jèrri 2020) and the Ifremer report prepared for the French fishery to inform Brexit discussions (Foucher et al. 2020), although in the latter case, the appendices containing the actual data are not publicly available.

In the case of Jersey, value was estimated from catch by multiplication by a price per Kg for the catch. The price was estimated by the Marine Resources Section of the Jersey Government and was clear and transparent. In the case of the data from France, however, the link between volume and value is not clear. It appears that the methodology (value = volume multiplied by a fixed price per Kg) is the same, but the price per Kg obtained from these data is improbably high in the case of most of the metiers (and in all cases different from the Jersey price). The prices used (apparently used in the French case) are given in Table 12 for comparison. The very large inconsistencies are apparent.

Since for the French data it was unclear how volume related to value, for the purpose of estimating French value, we have used two different methods. We either use the French value data directly (i.e. French price) and or alternatively we use the French tonnage multiplied by the Jersey prices.

Table 12. Comparison of the prices used to compute catch value from catch volume for the two datasets. In the case of Jersey, the prices were provided by the Marine Resources Section. In the case of the French data, the prices were back-calculated from the volume and value figures. Note the different currencies.

Metier	Main species in the catch	Jersey price (£/Kg)	French price (€/Kg)
Scallop dredge	king scallop	2	12.40
Clam dredge	amande, praire	2	13.54
Demersal trawl (single)	sole, rays, bream, cuttlefish and others	7.20	28.26
Demersal trawl (pair)		7.20	4.82
Whelk pots	whelks	2	0.66
Crustacean pots	lobster, brown crab, spider crab	16.50	11.60-11.80 (slightly variable)
Scallop dive	king scallop	2	-
Crab nets	spider crab, rays	2.80	13.01

3. Estimate of gross loss from proposed closure (unmitigated)

3.1 Method

The direct gross loss from the proposed closure comes from the exclusion of active gear activity from this area. Leaving aside the possibility of mitigation for the moment, this is estimated by multiplying the total (average annual) value for each active métier by the proportion of fishing effort in that métier taking place in the proposed closure.

The proportion of fishing activity taking place in the proposed closure area is estimated from the map of catch tonnage or value by 1 km^2 (map figures above; data provided by Jersey Government). Since the catch value is estimated by multiplying catch quantity by a fixed price, the spatial plots of volume vs value are identical. The proportion of catch in the proposed closed area is estimated by overlaying the shapefiles of the proposed closure and the fishing activity, converting the km^2 square polygons to spatial points, allowing for weighting of points by the amount of catch in that square, and counting the number of points inside vs outside the proposed closed area.

As noted above in the discussion of data, there are two potential methods of turning these catch data in terms of volume (tonnage) into an estimate of gross loss of catch value, since in both cases value has been estimated from volume multiplied by a fixed price:

- Method 1: total (average annual) value x % loss
- Method 2: total (average annual) volume x % loss x price

Taking the Jersey prices to be correct (since these are transparent and from a known source), these two methods are equivalent for the Jersey data. However, they are not for the French data, since value appears to have been estimated based on prices which vary significantly from the Jersey prices (Table 10).

3.2 Gross loss calculations

The results of the spatial analysis estimate the proportion of the catch in the proposed closed area for each active métier as follows:

- Jersey scallop dredge: 38%
- Jersey demersal fish trawl: 38%
- France scallop dredge: 23%
- France demersal fish trawl: 21%
- France clam dredge: 61%
- France pair trawl: 2%

These proportions have been used to estimate the gross loss of catch by métier (assuming no mitigation) as shown in Table 13.

Table 13: Estimate of gross catch loss from the proposed closure for each active métier, for France and Jersey, based on catch figures provided by the Marine Resources Section and the spatial analysis derived from the maps presented above.

Métier	Jersey (average/yr)			France (average/yr)		
	Catch (t)	Proportion in closure	Catch lost (t)	Catch (t)	Proportion in closure	Catch lost (t)
Scallop dredge	183.3	38 %	69.7	708.0	23 %	162.8
Demersal trawl	38.0	38 %	14.4	184.4	21 %	38.7
Clam dredge			0	175.7	61 %	107.2
Pair trawl			0	204.9	2 %	4.10

Gross lost catch value (average per year per métier) is computed from the data in Table 13, using the two methods described above. The results are presented in Table 14 and Table 15. For Jersey, the gross annual loss is estimated at ~**£243,000**, made up of a loss of £139,000 from the scallop dredge sector and £ 104,000 from the demersal fish trawl sector. To give a rough approximation as to how this breaks down by vessel, the gross loss can be weighted by the amount of trawl and scallop dredge effort for the nine (9) vessels concerned. This shows that the gross loss is significant (>£10,000) for six (6) of the nine (9) vessels (number will be five (5) if one of the scallop dredgers continues to be inactive), but relatively small (<£2,000) for the other three (3).

For France, the loss is harder to estimate due to problems with the data, but appears to be much more significant, in the range **~€ 930,000 - ~€ 4.6 million**, depending on the method used. The biggest part of the loss comes from the scallop dredge sector (€ 0.4-2 million), ahead of the demersal single trawl sector (€ 0.3-1.1 million) and the clam dredge sector (€ 0.2-1.5 million) with a minor loss for the pair trawl sector (€ 20-32 thousand).

Table 14. Jersey: Estimate of gross loss of catch value from active métiers in the Jersey fleet from the proposed closure. Note that because we are using Jersey prices, Method 1 and Method 2 are equivalent. (Small discrepancies due to rounding.) Data provided by the Marine Resources Section.

Jersey métier	Method 1			Method 2		
	Total value (£/yr)	% lost	Value lost (£/yr)	Catch lost (t/yr)	Price (£/t)	Value lost (£/yr)
Scallop dredge	366,682	38 %	139,340	69.7	2	139,340
Demersal trawl	273,684	38 %	104,000	14.4	7.2	104,000
Total			**243,339**			**243,339**

Table 15. France: Estimate of gross loss of catch value from active métiers in the French fleet from the proposed closure. Method 1 and Method 2 give different answers because of the high discrepancies in price per kg. Data provided by the Marine Resources Section. In Method 2, Jersey prices are converted to euros by multiplication by 1.1[12]

French métier	Method 1				Method 2			
	Total value (€/yr)	% lost	Value lost (€/yr)	Value lost (£/yr)	Catch lost (t/yr)	Price (€/t)	Value lost (€/yr)	Value lost (£/yr)
Scallop dredge	8,779,200	23 %	2,019,216	1,835,650	162.8	2.2	358,248	325,680
Demersal trawl	5,210,400	21 %	1,094,184	994,712	38.7	7.92	306,641	278,764
Clam dredge	2,378,640	61 %	1,450,970	1,319,063	107.2	2.2	235,783	214,348
Pair trawl	988,100	2 %	19,762	17,965	4.10	7.92	32,448	29,498
Total			**4,584,132**	**4,167,390**			**933,120**	**848, 290**

Mitigation of losses by Jersey active gear vessels

This analysis assumes that losses to the French fleet have no financial consequences for Jersey, so does not consider these losses further. For the Jersey fleet, we next need to consider how the gross loss estimated above would be mitigated in practice.

The most obvious ways for vessels to mitigate the loss of catch from the proposed closed area is to fish elsewhere. The maps of fishing effort (Figure and Figure) show that there is a clear concentration of scallop dredging to the SW of the island, which would be the obvious zone to absorb the additional effort. Likewise for demersal trawling, there is an important area to the NW. If all the 'lost' effort transferred to these areas outside of the proposed Marine Park, this would be equivalent to 135 days of effort and 70 t of scallops per year, and 22 days and 14 t of fish per year. It is likely that the main vessels impacted by the proposed closure would have no difficulty in being able to fish in these areas, since they are all relatively large by Jersey standards (smallest 9.99m).

However, both Jersey and French scallop vessels may be displaced by the proposed closure to similar areas and if fishing grounds overlap, there may be more competition for resources. Jersey scallop vessels displaced from the Marine Park zone will have at some point fished within the Jersey exclusive zone without competition from French vessels, so this may have an impact on catch rates of the displaced Jersey fleet. There is not enough information on this to quantify impact and moreover, it is unknown how many, if any, 2021 permits will be granted to French scallop boats in Jersey waters outside of the Marine Park zone.

If effort targeting particular stocks concentrates in a smaller area as a result of this change, it will be important to evaluate whether the stocks in these areas can absorb additional effort without damage (this is most likely to be a problem for the scallops because the biomass is not mobile). The overall change in effort by different métiers in Jersey waters outside the exclusive 6-mile

[12] *Note: This is different to the conversion rate used in Table 11 because here we are interested in the current rate at the time of writing (March 2021) while Table 11 relates to values in 2015-19.*

zone is more likely to be strongly influenced by displacement of the French fleet (due to changes to the Granville Bay arrangements more than the proposed active gear closure). This will presumably take a year or two to become apparent. Within the context of overall effort in Granville Bay, the effort of Jersey's active gear fleet in the proposed Marine Park is minor.

Alternatively, vessels can mitigate losses by switching from active to static gears. Of the nine (9) Jersey vessels concerned, all but two (2) also use some static gears, and five (5) of the nine (9) are polyvalent vessels (three (3) of which are mainly potters). The two (2) that use active gears only are i) the inactive scallop dredger and ii) the specialist trawler. It is beyond the scope of this analysis to evaluate the costs involved from switching further towards static gear fishing for the active gear fleet vessels (as this would require primary data from fishers) but we can conclude that it is likely to be possible for most of the vessels, but most likely not for the specialist trawler (which incurs two thirds of the trawling loss).

Overall, the extent to which the mobile métiers can mitigate their losses from the mobile gear exclusion cannot be quantified directly, because it depends mainly on external factors such as the final status of the international fishing agreement to be implemented (GBA/TCA) and French effort around Jersey, as well as fluctuations in quotas and availability of markets (which has been problematic in recent years).

If we assume that the current spatial arrangement of fishing effort is the most efficient available, then most likely the vessels will be able to mitigate the loss somewhat but not fully. If we assume that the existing polyvalent vessels can mitigate 95% of the loss, the specialist scallop dredgers 75% of the loss and the specialist trawler 50% of the loss, the **annual net loss** to the mobile gear sector is estimated to be **£66,200**. Table 16 below shows the workings.

Table 16. Calculation of annual net loss to the mobile gear sector

For each of the 9 Jersey vessels with active gears identified in the data (column H), a proportion of gross loss (cells F2 or F3) was assigned according to its proportion of the total amount of effort reported for that gear (columns I and J). The resulting values are displayed in columns K and L below. The calculations are as follows:

To calculate dredge (column K) values = (F2 / I12) x value in I

To calculate trawl (column L) values = (F3 / J12) x value in J

The total dredge and trawl loss was then summed to get a (notional) total gross loss for that vessel across both active gears (column M).

To get net loss (column O), these total values (column M) were then multiplied by the percentages assumed for mitigation (column N): namely, 50% of that value for the trawler, 25% of the value for the three specialist dredges and 5% for the polyvalent vessels and potters.

Net loss = (total gross loss of active gears / proportion of effort of active gears) x % of mitigation

*O = M * N*

M = K + L

	E	F	G	H	I	J	K	L	M	N	O
1			**Vessels with active gears**		**Vessel's proportion of effort using active gears (from spatial model)**		**Vessel's proportion of gross loss (£) based on effort on active gears**		**Total proportional gross loss (£)**	**Mitigaton adjustment**	**Net loss (£)**
2	Gross loss scallop dredge (£)	139,000			Dredge	Trawl	Dredge	Trawl			
3	Gross loss trawl (£)	104,000	1	Scallop	14,019	418	48,917	1,543	50,459	0.25	12,615
4			2	Scallop	10,807	364	37,709	1,343	39,052	0.25	9,763
5			3	Scallop	7,465		26,048	0	26,048	0.25	6,512
6			4	Polyvalent	3,232	124	11,277	458	11,735	0.05	587
7			5	Polyvalent	3,025	8,633	10,555	31,862	42,417	0.05	2,121
8			6	Potter	506		1,766	0	1,766	0.05	88
9			7	Potter	500		1,745	0	1,745	0.05	87
10			8	Potter	282		984	0	984	0.05	49
11			9	Trawler		18,640	0	68,794	68,794	0.50	34,397
12			Sum		39,836	28,179					66,219

4. Cost of enforcement

The Marine Resources Section, with their vessel the FPV *Norman Le Brocq*, conduct enforcement patrols and make around 500 inspections and boardings per year (Jersey Government, pers. comm.; see Marine Resources Annual Reports for figures). The cost of enforcement is not quantified separately (in terms of a specific enforcement budget) by the Marine Resources Section, because the staff as well as the vessel are used across many different activities, including enforcement but also research and other activities (one trip by the *Norman Le Brocq* may include several different activities). There are a range of factors which could affect enforcement costs for better or worse in the near future. On the one hand, the cost of detaining vessels as well as patrols outside office hours would increase costs. On the other hand, the increasing use of iVMS by both Jersey and French vessels (roll-out to be completed in the near future) and the planned introduction of a buyers and sellers register and catch recording app should make enforcement easier.

Lacking further data, we have assumed a small additional cost associated with additional enforcement in the proposed closure, equating to **£10,000**. This figure is based on discussions with stakeholders, concluding that any increase in costs would be most likely i) small and ii) difficult to quantify; but that some additional cost should be considered a possibility, at least as a precaution.

5. Benefits

5.1 Additional resource available for static gears

Removing the active gears from the proposed closure results in catch being left in the water in that area, as follows:

- 233 t scallops
- 57.2 t fish (flatfish, rays, bream, cuttlefish and other)
- 107 t clams (amande and praire)

This biomass is likely to have beneficial effects for the ecosystem, but leaving that aside, it would also be potentially available to the static gear fishery.

Scallops: Scallops are fished in Jersey by either dredge or diving. Scallop diving accounts for roughly a quarter of the total catch at present (2015-19) but effort has increased rapidly in recent years (Figure), suggesting that there is a strong market for dived scallops. Scallop diving takes place in clearly-defined areas (Figure 46) which overlap with the areas used by dredgers (see Figure and Figure above) suggesting that some benefit may accrue to scallop divers in these areas from improved CPUE. The Marine Resources Section Annual Report for 2019 (Gouvèrnément d'Jèrri, 2020) notes that CPUE is improving for dived scallops, possibly due to divers targeting scallops inside protected areas – and the closure would increase the available area protected from dredging.

An additional 233 t of available catch (across the whole area) is significant compared to an annual catch from the dive fishery of ~56 t (2015-19 average), but this assumes that the scallop dive fishery would be able to expand to the whole of the proposed area. However, there are constraints on the suitability of an area for scallop diving (depth, currents, vessel traffic and other safety factors, as well as available expertise) which makes the potential spatial expansion of this métier difficult to quantify. Nevertheless, it looks as if some benefit to this sector could be expected.

Taking into account that the trend in effort is already upwards, we could assume a 50% increase in the catch of the scallop dive fishery derived from the proposed closure making new areas available with high scallop densities and hence catch rates. This results in an additional 28 t of scallop landings in Jersey, worth **£56,000/yr** at a price of £2/kg.

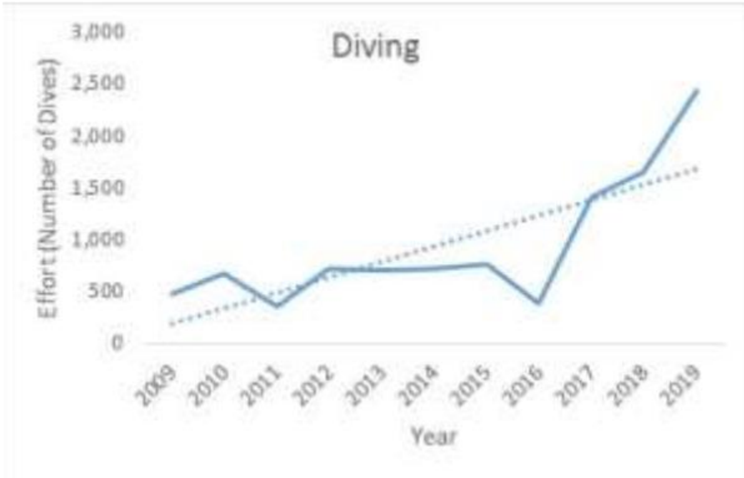

Figure 45: Fishing effort (number of dives per year) in the Jersey scallop dive fishery, 2009-2019. Marine Resources Section Annual Report for 2019 (Gouvèrnément d'Jèrri 2020).

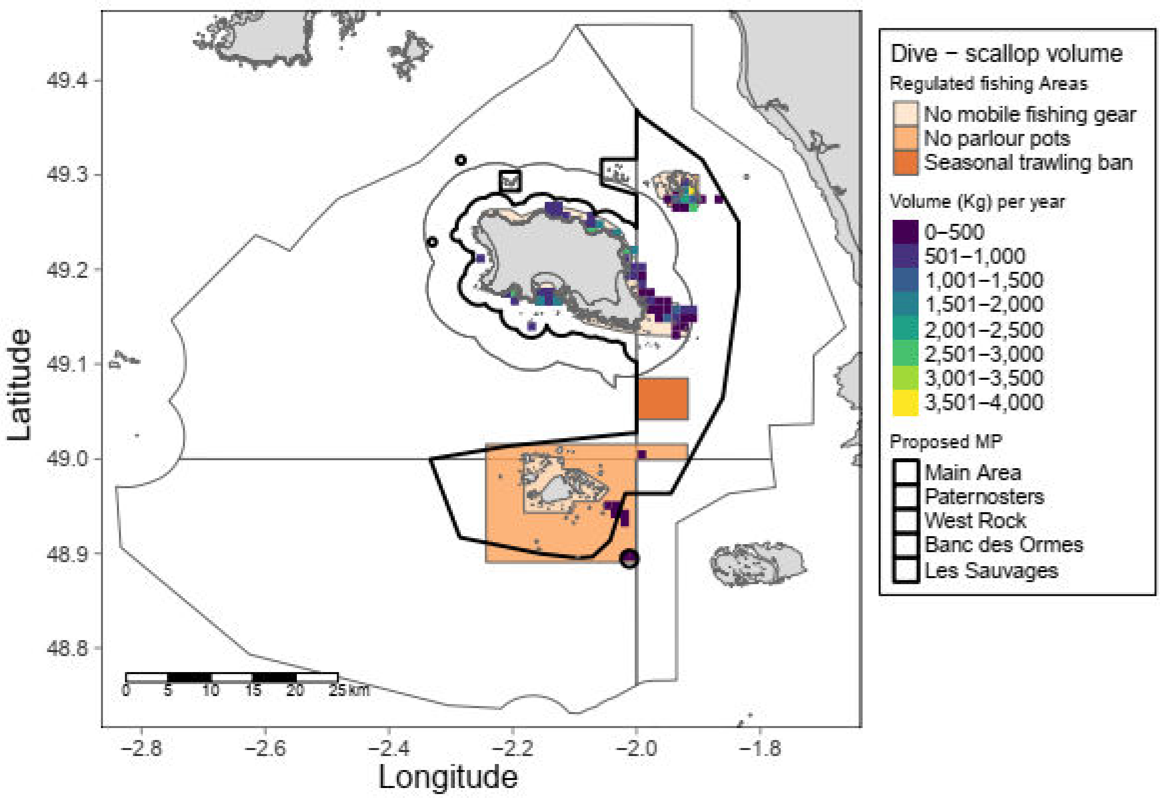

Figure 46: Scallop diving activity in the Jersey zone in terms of catch kg per 1 km² square. Colour coding shows volume of catch in that square. Existing regulatory areas are shaded in orange and the proposed mobile gear closure is outlined in black.

Fish: According to the Marine Resources Annual Report for 2019 (Gouvèrnément d'Jèrri 2020), Jersey's wetfish sector (across all gears) has struggled in recent years due to problems related to catch availability (quotas and stock status) but also external problems such as logistics and markets. Much of the fish catch by Jersey vessels is already taken by static gears (hook and line, nets). The 57 t of additional catch available to these gears might have some benefits but this will depend on the mix of target species specific to each gear and the main constraints on that métier (e.g. catch rates vs markets), and is not likely to be quantifiable, or possibly even detectable.

Clams: Clams are not targeted by any métier in Jersey, so there is no potential gain to existing métiers. As far as we are aware, clams are only fished using active gear – they are infaunal rather than epifaunal like scallops so not easily susceptible to a dive fishery. Therefore, there is not foreseen to be any economic benefit derived from the additional availability of clam biomass. (Ecological benefit is a different question, which is covered in the next section on natural capital.)

5.2 Increased area for static gears: avoiding gear conflicts

The plots of fishing activity by the Jersey potting fleets (crustaceans and whelks; Figure 47 and Figure 48) suggest that pretty much the entire area of the proposed closure is already available to static gear fishing. The areas used by crustaceans potters and whelk potters are complementary and likely result from the presence of suitable habitat – rocky for the crustacean potters targeting mainly lobster, vs sandy for the whelks. There is therefore no evidence from the mapping that static gear fishers are excluded from certain areas by the use of active gears.

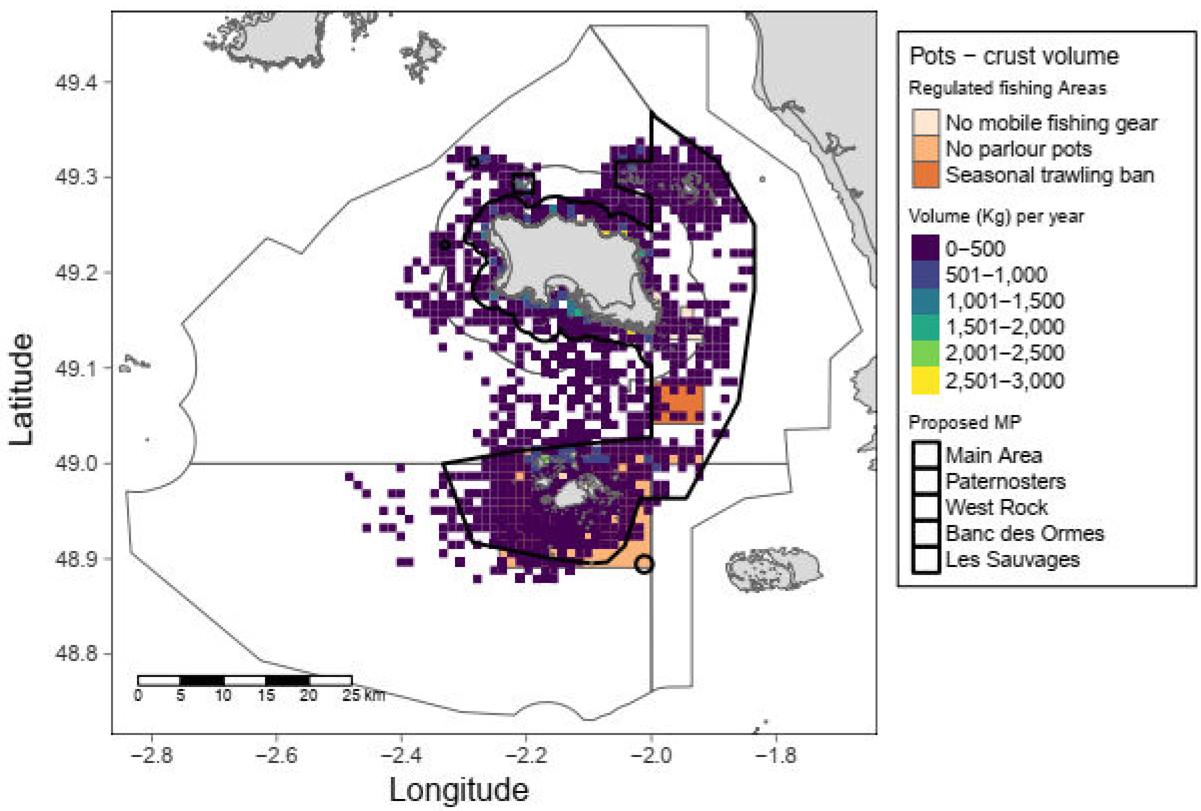

Figure 47: Crustacean potting activity from the Jersey fleet in the Jersey zone in terms of catch kg per 1 km² square. Colour coding shows volume of catch in that square. Existing regulatory areas are in orange shading and proposed mobile gear closures outlined in black.

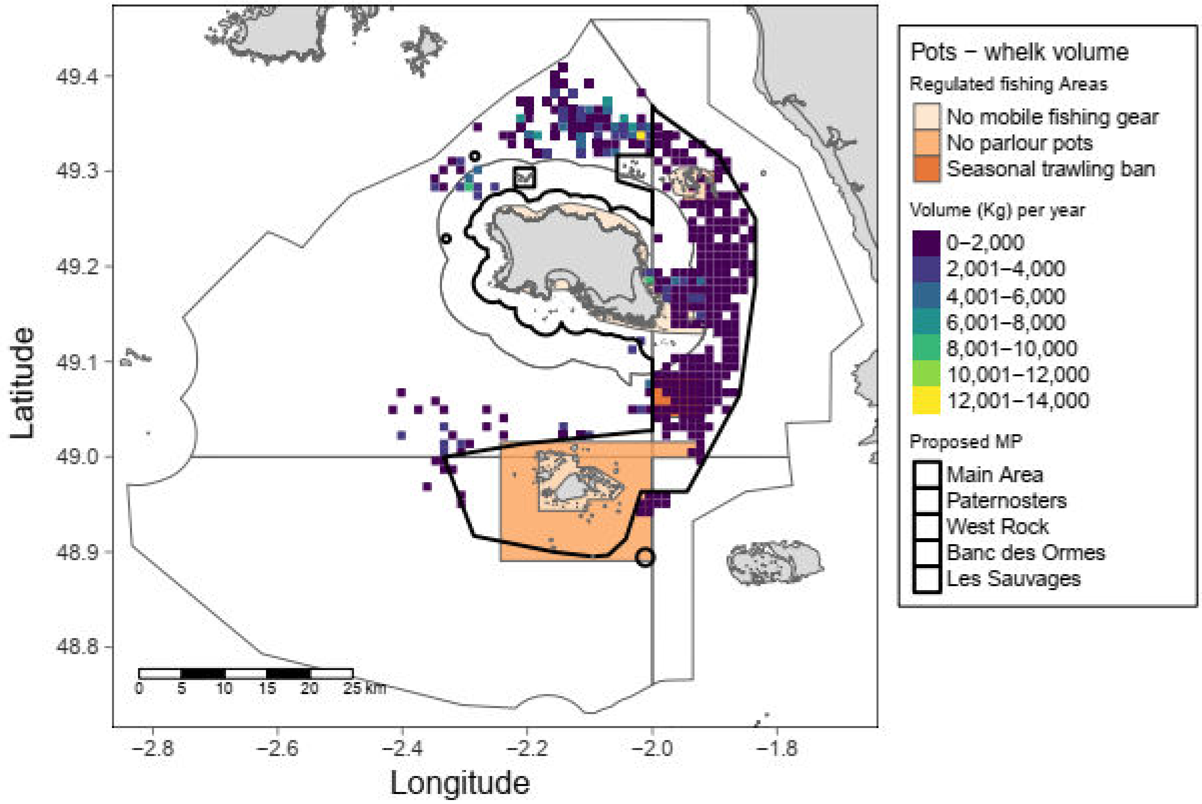

Figure 48: Whelk potting activity from the Jersey fleet in the Jersey zone in terms of catch kg per 1 km^2 square. Colour coding shows volume of catch in that square. Existing regulatory areas are in orange shading and proposed mobile gear closures outlined in black.

It is known that pot fishermen (the largest métier in the area) regularly lose gear to mobile gear vessels. We do not have data on lost pots from Jersey, but the French Granville Bay pot fishery reported that 1.8% of whelk pots were lost in 2019, as well as 232 crustacean pots, mainly to towed gear (Ernst and Addison 2020, Ernst and Sieben 2020). The exclusion of active gear from a larger area will presumably benefit potters (and most likely netters) by reducing costs associated with gear loss, as well as reducing the impact of lost gear on the ecosystem (ghost fishing, entanglement, plastic pollution).

The Jersey Government does not collect data on gear loss, so we have used Normandy figures to extrapolate some indicative values. Jersey and Normandy total landings from the crustacean pot fishery (taking lobster plus brown crab since spiders could also be from the net fishery) are fairly similar (Ernst and Addison 2020) so although Jersey and Normandy fishermen tend to use different types of pots (more inkwell in Normandy, more parlour in Jersey) we have assumed for the sake of argument that 200-250 crustacean pots are lost from the Jersey fleet each year. For whelk pots, the Jersey Government estimates ‘a few thousand’ are in use; taking a figure of 5000 whelk pots; a 1.8% loss rate (same as Normandy) would equate to 90 lost pots per year.

The same spatial analysis was applied to the crustacean and whelk potting plots as to the mobile gear plots (see above) to evaluate the proportion of activity taking place in the proposed closure, but in this case, we also excluded the part of the proposed Marine Park from which mobile gear is already excluded (i.e. gear conflicts are already mitigated). The figures are presented in Table 17. From this we assume that 67% of the loss of crustacean pots and 25% of the loss of whelk pots would be removed by the proposed closure; i.e. there would be a net gain corresponding to the value of 135-165 crustacean pots (we take 150 here as the midpoint value) and 23 whelk pots.

According to https://www.coastalnets.co.uk/crab-lobster-prawn-pots/, crustacean pots cost £85 each (inkwell and parlour pots very similar; excl. VAT) while whelk pots cost £6.50 (excl. VAT). This allows us to calculate the value of the lost pots which are no longer lost, as per Table 18.

Table 17. Spatial analysis of distribution of catch from the crustacean and whelk pot fisheries in Jersey waters (Data from Jersey Government)

Métier	Annual catch from Jersey zone (average 2015-19, t)	Annual catch from proposed MP, excluding current mobile gear closure (average 2015-19, t)	Catch from proposed MP outside mobile gear closure (%)
Crustacean pots	163.7	110.3	67 %
Whelk pots	422.4	106.8	25 %

Table 18. Estimated cost saving from reduction in pots lost due to gear conflicts

Métier	Pots saved as a result of proposed MP	Cost per pot (£)	Total cost saving (£)
Crustacean pots	150	85	12,750
Whelk pots	23	6.5	150
Total			**£ 12,900**

The same analysis might apply to the net fishery, but spatial data for the net fishery is not available. According to the Marine Resources Section, this fishery is minor, and thus it has not been included in this analysis.

5.3 Benefits from protecting Natural Capital in the Marine Park

Natural Capital has become a standard analytical approach to evaluating the role and value of nature to society and thereby to support decision making and to inform policy. The beneficial flows which stem from the Natural Capital stocks are termed 'ecosystem services', and they supply a public need covering economic, social, environmental, cultural, or spiritual benefits. How the value of these goods/benefits is described can be qualitative or quantitative (including monetary)[13]. The evidence base to support valuation of the ecosystem services associated with specific marine habitats is limited. However, whilst uncertainty should be made explicit in decision-making, it should not become a barrier.

A cost-benefit analysis which employs a natural capital approach alongside a more traditional economic impact assessment such as that set out in this report should be considered essential in the formulation of management strategies that aim to meet complex social, environmental and economic objectives. In doing so, the likely extent and quality of supporting, regulatory, provisioning and cultural ecosystem services can be taken into account and so the goods/benefits provided for society become an inherent feature of the management decision-making process (Rees et al. 2012, Potts et al. 2014).

The following natural capital assessment is divided as follows:

1. Overview of Natural Capital – provides an overview of the Natural Capital (NC) approach and frameworks that have been developed to facilitate application of the theoretical concept.
2. Ecosystem Services in the marine environment – this section summarises application of the NC approach to the marine environment, highlighting key limitations due to gaps in the knowledge and evidence base.
3. Summary of evidence - provides a summary of some of the most readily available, and potentially most applicable, information and evidence to inform the evaluation of the potential costs and benefits to the ecosystem services provided by Jersey's marine environment of removal of mobile gear.
4. Assessment of potential benefits of the proposed Marine Park – incorporating four key steps:
    i. Documentation of the range and extent of habitats within Jersey waters and the Marine Park.
    ii. Identification (and monetary valuation, where possible) of the ecosystem services associated with each habitat.
    iii. Assessment of the likely condition of each habitat due to exposure to the physical impacts of bottom towed fishing gear (abrasion and penetration of the substratum).
    iv. Consideration of the potential gains in key ecosystem services due to removal of such fishing activity.
5. Summary and conclusions.

[13] Natural Capital Coalition

5.3.1 Overview of Natural Capital

Definition of Natural Capital (NC)

Full definition of NC[14]

"Natural capital includes certain stocks of the elements of nature that have value to society, such as forests, fisheries, rivers, biodiversity, land and minerals. Natural capital includes both the living and non-living aspects of ecosystems. Stocks of natural capital provide flows of environmental or 'ecosystem' services over time. These services, often in combination with other forms of capital (human, produced and social) produce a wide range of benefits. These include use values that involve interaction with the resource and which can have a market value (minerals, timber, freshwater) or non-market value (such as outdoor recreation, landscape amenity). They also include non-use values, such as the value people place on the existence of particular habitats or species." (p.45)

Summarised definition of NC

NC means thinking of nature as an asset, or natural capital stock, which provides a flow of goods and services that benefit people. Those ecosystem services will vary according to the quantity, quality and location of the natural asset or assets, which in turn are affected by external pressures and management interventions, and may require additional inputs to be delivered[15] (Figure 49).

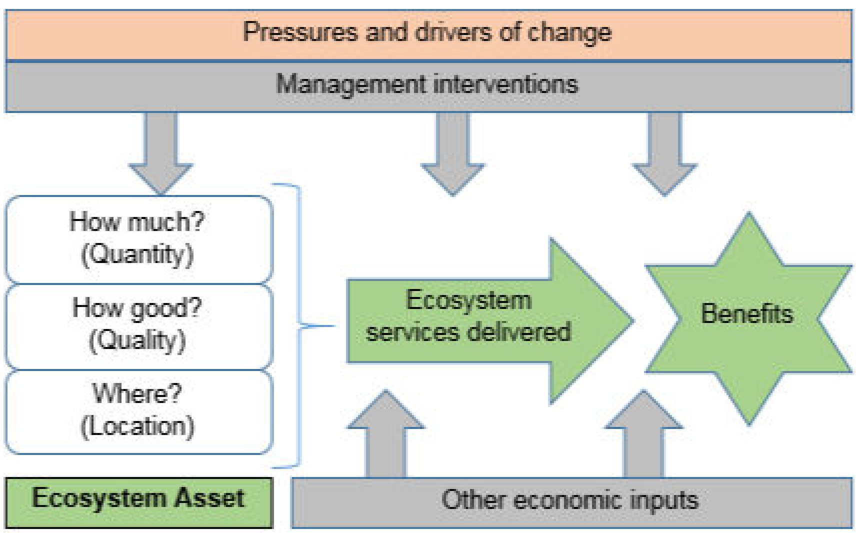

Figure 49: The Natural Capital Framework (source: Natural England)

To put it in simpler terms, natural capital is an economic concept recognising that nature provides benefits and value to people. It considers natural capital (habitats, species, air, soil, water, oceans, minerals and natural processes) as a stock, from which ecosystem services flow, providing benefits and value (Lusardi et al. 2018).

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[14] The Green Book: appraisal and evaluation in central government - GOV.UK (www.gov.uk)

[15] Enabling a Natural Capital Approach: Guidance (March 2020)

Natural Capital Approach

Natural Capital has become a standard analytical approach to evaluating the role and value of nature to society and thereby to support decision making and to inform policy. The NC approach provides a common framework through which scientific, economic and social evidence and factors can be considered when assessing the potential impacts of a decision on natural assets. It therefore enables a more comprehensive cost-benefit analysis and risk assessment process[15].

However, research has shown that the UK, despite the potential and receptive policy landscape, has not yet fully realised the approach in policy and management contexts, especially within the marine environment, where it is especially difficult (Hooper et al. 2019).

Conceptualising Natural Capital

The UK National Ecosystem Assessment (UK NEA)[16] provides a framework which can be used for assessing natural capital, and is based around analyses of the UK's natural environment in terms of the benefits it provides to society and the nation's continuing prosperity. The UK NEA provides an approach to thinking about natural assets through definition of eight (8) key broad habitat types, of which marine habitats is one. The ecological complexity of NC is however perhaps better captured by the Natural Capital Committee, which defines one natural asset type as 'oceans' and includes the interactions between the biotic and abiotic components of oceans[17].

Regardless of how a natural asset is categorised, biodiversity is a core component of NC because it directly affects the resulting services and benefits of the asset, including their resilience to change[15].

Application of the Natural Capital concept – general considerations

Application of the conceptual NC approach can take a variety of forms; there is no single method or model, and it does not always require monetary valuation[15]. However, definition of services and benefits is an important step. Services provided by natural capital which produce a direct outcome have been categorised as per Table 19.

Table 19. Services and benefits provided by natural capital. Source: ENCA Services Databook[18]

Databook category	Description	Examples	Final welfare effects to be valued
Provisioning Services	Tangible outputs that can be obtained from ecosystems that meet human needs	Food, timber, water supply, crops	Production of final goods
Abiotic flows of natural capital	Flows which are not dependent upon functioning ecosystems	Minerals, oil & gas; solar, wind and tidal power	Production of final goods
Regulating services	Ecological processes that regulate and reduce pollution and other adverse effects	Air filtration, water regulation, noise mitigation	Cost savings, reduced damage costs, health benefits, etc.

[16] UK NEA (unep-wcmc.org)

[17] Natural Capital Committee's second state of natural capital report - GOV.UK (www.gov.uk)

[18] Available at: Enabling a Natural Capital Approach - data.gov.uk

Cultural Services	Environmental settings that enable cultural interaction and activity	Settings for recreation, education, tourism	Recreation benefits, education benefits, producer surplus, health benefits etc.
Aggregated/ bundled services	In practice the benefits provided by nature are not easily reducible to specific ecosystem services, or can reflect a bundle of cultural or regulating services. There can be overlap with these categories.	Amenity, biodiversity, landscape, water quality, non-use values	Various use and non-use benefits. In some cases, there may be trade-offs between different types of benefit.

In addition to those set out above are 'supporting services' which do not directly provide outputs. Instead, they are essential for the functioning of provisioning, regulating and cultural services such as soil formation and pollination[19].

Crucially, ecosystem services influence human well-being, amongst many others including: secure and adequate livelihoods, food, shelter, clothing, health, a healthy physical environment, good social relations, security, and protection against natural and human induced disasters (Guerry et al. 2015). The benefits of these services to society are typically (but not always) more measurable or quantifiable. Those benefits are often described as welfare effects and it is changes in these benefits which are the focus of valuation in appraisal (Table 19). Those changes can be both positive where natural capital is enhanced and negative where it is diminished[19]. Figure 50 presents examples of those benefits for provisioning, cultural, regulating and supporting ecosystem services in relation to the marine environment.

It is useful to note here that ecosystem services are the link between ecosystems and things that humans benefit from, not the benefits themselves (Atkins et al. 2013).

A number of approaches have been proposed to evaluate these services, qualitatively and quantitatively (including in monetary terms, where possible, appropriate or desired). An important finding from the application of these approaches has been the need to separate services into intermediate and final categories (Figure 51), with the latter being those that directly provide goods and benefits to human beneficiaries (individually and socially), thereby lending themselves more readily to valuation by economic techniques, for example. Further, by separating the services in such a way the issue of double counting (a feature of the complexity of ecosystem services and the challenge in understanding their multiple interactions) can be avoided as far as possible (Atkins et al. 2013, Fisher & Turner 2008).

Ecosystem service valuation is widely considered to be a tool to improve societal choices through presenting the costs of ecosystem degradation and the benefits of restoration. Understanding the importance of action (or inaction) is a requirement for improved management (Williams & Davies 2019). However, the use of NC and ecosystem services as concepts to communicate society's dependence on nature, and thereby judge the acceptability of a range and variety of human

[19] Enabling a Natural Capital Approach: Guidance (March 2020)

pressures on the environment, remains highly challenging from a practical perspective (Williams & Davies 2019).

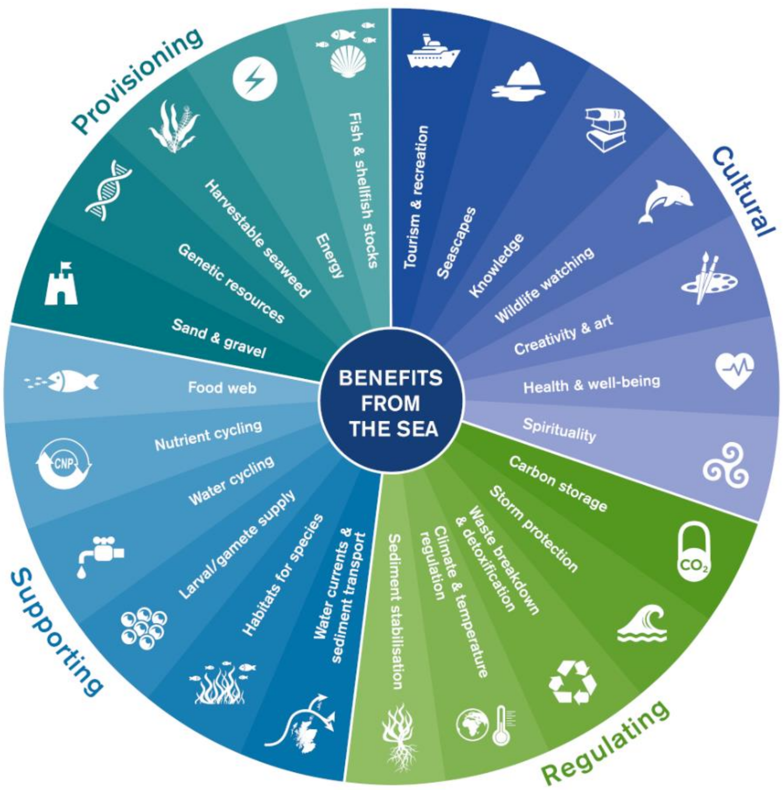

Figure 50: Examples of benefits potentially derived from the four main categories of natural capital services in relation to the marine environment. Source: NatureScot[20]

5.3.2 Ecosystem services in the marine environment

Coastal and marine ecosystems provide an enormous range of services that are integral for the functioning of society (Figure 51), including for example carbon sequestration and contribution to commercial fisheries productivity (through provision of juvenile habitat) by salt marshes and seagrass (Turner et al. 2014). However, the services provided by the marine environment – and the offshore component in particular – are less well studied and documented, both in terms of function and value, relative to terrestrial ecosystems (Atkins et al. 2013). Improvements in the evidence-base are developing, in part due to legislative and policy requirements for delivery of an Ecosystem Approach to the management of the marine environment (such as the EU Marine Strategy Framework Directive), which depends upon an understanding of the linkages between services, ecosystem functioning and biodiversity (Atkins et al. 2013).

[20] https://www.nature.scot/scotlands-biodiversity/scottish-biodiversity-strategy/ecosystem-approach/ecosystem-services-natures-benefits

There are a range of frameworks that describe, connect and illustrate the ecosystem service concept with that shown in Figure 51 presenting a conceptual model of coastal and marine ecosystem services, taken from the UK NEA (Turner et al. 2014) .

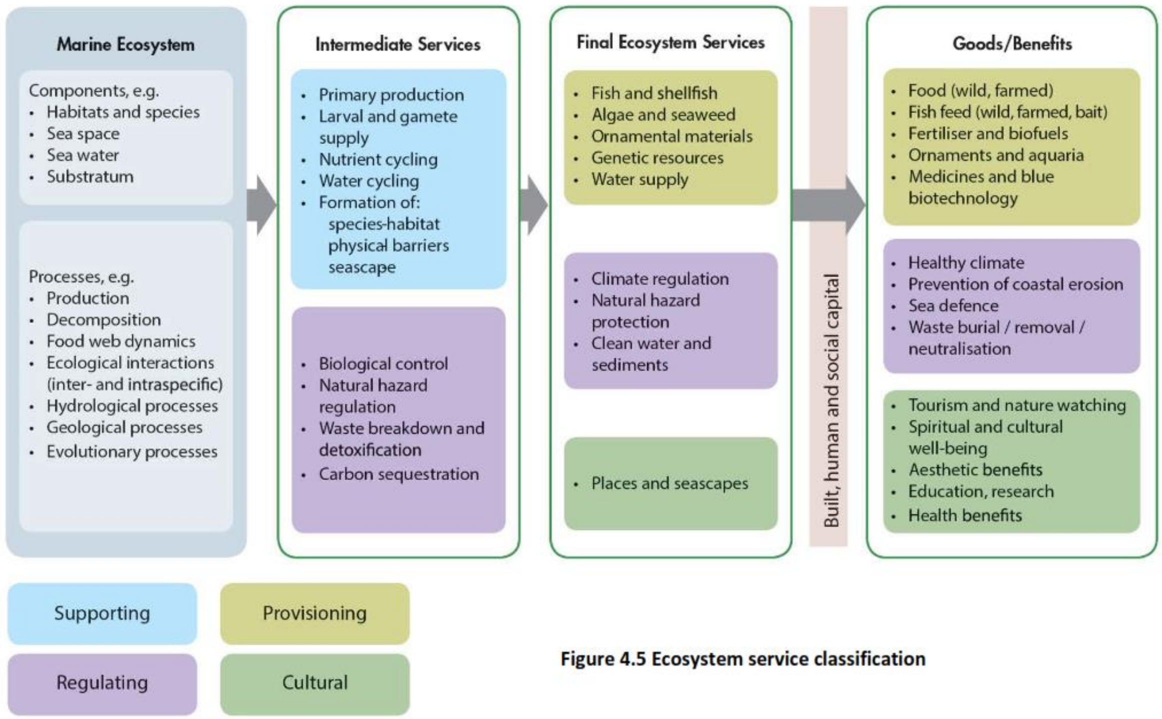

Figure 51: A conceptual model of coastal and marine ecosystem services and their classification. Source: Turner et al. (2014)

Evaluation of marine ecosystem services

Much of the theory and practice associated with ecosystem services / natural capital has been developed for terrestrial systems. The application of the proposed methods therefore has limitations in the marine environment due to both greater gaps in the knowledge base and the diversity and productivity of coastal and marine ecosystems, which are interconnected in complex and dynamic ways, thereby complicating efforts to operationalize ecosystem services (Atkins et al. 2013). A key challenge remains in coastal and marine research to understand and quantify the influence of biodiversity on different classes of ecosystem functions and the provision of (final) services. Such information is important for informing decision-making over biodiversity protection and management, for example via marine protected areas (MPAs) (Atkins et al. 2013). MPAs are recognised as being the mechanism through which marine ecosystem services may be conserved to benefit human well-being. Planning and decision-making can therefore be supported by the quantification and valuation of ecosystem services (Rees et al. 2012)[Error! Bookmark not defined.].

The classification and where possible, valuation of ecosystem services associated with MPAs enables both the services provided by marine ecosystems in general to be highlighted, along with those that can potentially be enhanced or supported by MPA processes to be identified. This includes local-scale provisioning services (i.e. marine resources such as fisheries) to large-scale and longer-term processes that support human welfare (e.g. carbon sequestration)**Error! Bookmark not defined.** (Potts et al. 2014). Such information should ultimately inform societal debate over management of activities in MPAs by extending the assessment of costs and benefits beyond those which are the most evident or measurable (such as loss or gain of fisheries yields or tourism). The rationale for such a decision-making process is that protection of features of MPAs will have positive effects on the delivery of ecosystem services, and thereby welfare benefits for society, as the condition (ecological functioning) of the features are able to improve or be maintained through appropriate management of human pressures (Potts et al. 2014). However, such holistic approaches to cost-benefit analyses remain limited by the availability of data and knowledge, particularly for specific habitats.

In general, economic valuation of marine ecosystem services relies upon both market and non-market techniques (and therefore interdisciplinary skills and knowledge). This is recognition of the applicability of market prices to the value of some marine ecosystem services (such as commercial fish species), but the absence or unsuitability of them for others, for which non-market techniques must be employed. This for example might include valuation based on revealed preferences (e.g. travel cost[21] or hedonic pricing[22]) or stated preferences (e.g. contingent valuation[23] or choice experiment[24] methods) (Atkins et al. 2013). A longer list of potential economic valuation techniques and their potential use in the marine environment is provided in Atkins et al. 2013, although their application to coastal / intertidal rather than subtidal marine ecosystem services is more evident and intuitive, exacerbated by the prevalence of case studies on habitats such as salt marshes as opposed to subtidal rocky reefs, for example.

Primary valuation evidence for coastal and marine ecosystem services is still very limited, but where it is available it is typically relatively generic (e.g. not site – or potentially habitat type – specific and moreover most often not derived from UK studies) and focused on key provisioning and regulating services such as fisheries, carbon storage and coastal defences, as well as cultural services in the form of recreation and tourism (Atkins et al. 2013).

Where primary data on marine ecosystem services are not available, a qualitative assessment for each ecosystem service might be undertaken based on the existing evidence drawn from the

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[21] Described as the cost incurred in reaching a recreation site as a proxy for the value of recreation.

Expenses differ between sites (or for the same site over time) with different environmental attributes. For example, the costs borne by visitors to bird watching sites may be interpreted as the minimum value they attached to that site (taken from Atkins et al. 2013).

[22] Described as deriving an implicit price for an environmental good from analysis of goods for which markets exist and which incorporate particular environmental characteristics. For example, house prices are determined by the characteristics of the houses, including environmental features such as their proximity to marine leisure facilities (taken from Atkins et al. 2013).

[23] Described as construction of a hypothetical market by direct surveying of a sample of individuals and aggregation to encompass the relevant population. Problems of potential bias. For example, the public might be asked to value a hypothetical environmental improvement, such as increased biodiversity (taken from Atkins et al. 2013).

[24] Described as a discrete choice model which assumes the respondent has perfect discrimination capability. Uses experiments to reveal factors that influence choice. For example, can be used to investigate preference trade-offs involving security of water supply and biodiversity (taken from Atkins et al. 2013).

literature and databases, and on expert judgement, including that obtained through stakeholder consultation (Atkins et al. 2013).

5.3.3 Summary of evidence to support an evaluation of Jersey's marine ecosystem services

The aim of this section is to provide a summary of some of the most readily available, and potentially most applicable, information and evidence to inform the following evaluation of the potential costs and benefits to the ecosystem services provided by Jersey's marine environment of removal of mobile gear. Inevitably, there are gaps and weaknesses in this evidence base which are considered in the assessment, as far as possible. The scarcity of primary valuation studies for UK coastal and in particular marine ecosystem services means that the majority of the evidence base supports a non-monetised assessment of the goods and benefits associated with the proposed Marine Park. The following types of evidence are considered below:

- Information on the relative importance of different marine habitats and species in providing ecosystem services and goods/benefits
- Economic (monetised) valuations of marine ecosystem services (namely evidence associated with kelp beds of West Sussex and blue carbon estimates for Jersey's marine habitats)
- Studies of ecosystem services associated with specific marine habitats (non-monetised)
- Evidence to inform qualitative assessment of the impact of fisheries management on marine ecosystem services

Relative importance of marine habitats and species in providing ecosystem services and goods/benefits

As part of the NERC-funded Valuing Nature Network (VNN) project (2012-2013) on coastal ecosystem services two matrices (Annex 5) were developed that identify specific ecosystem services from UK protected habitats and species. The matrices were subjected to internal and external peer review through an expert based process. The shading of each cell within the matrices represents an indication of the relative importance of each feature in providing the respective ecosystem service (darker being more important, lighter less important, no highlighting indicates knowledge gap). Some features are more important than others in providing a particular service and therefore scores should be interpreted relative to all the features. The number within each cell relates to the level of confidence in the evidence[25].

Potts et al. (2014) explains that the matrices focus on intermediate services and goods/benefits as a separate scoring of final ecosystem services was deemed unnecessary and would also reduce the clarity and manageability of the matrix. The rationale for this approach, which was based upon the conceptual framework in Figure 51, was that the final services directly link to goods/benefits through complementary capital, and therefore their direct contributions are

[25] Where there was scientific, UK-relevant, peer-reviewed evidence establishing a link between a feature and a service, the level of confidence was rated 3. A confidence level of 2 indicated support from non-peer reviewed grey literature or overseas literature that was not specific to either the UK context or the particular species (e.g. a closely related species) in question. Where the evidence was based on expert opinion then this was given a confidence rating of 1 (Potts et al. 2014).

captured through the inclusion of goods/benefits, which also avoids the potential for double counting.

Economic assessments of marine ecosystem services

The *UK NEA Follow-on report* on 'Coastal and marine ecosystem services: principles and practice' (Turner et al. 2014) provides a literature review of primary valuation studies (published between 2000 and 2013) of coastal and marine ecosystem services of relevance to the UK (e.g. where monetary values are assigned to specific goods/benefits). Approaches to the review, as well as the identified limitations associated with the evidence, are described in detail in the report and not repeated here. Instead, the summary tables of evidence and estimated values are provided in Annex 5. Table 20 summarises the number of UK studies reviewed by the authors for each combination of habitat and ecosystem service, highlighting the paucity of evidence to support monetised assessments, particularly for subtidal habitats. The report also summarises the number of international studies for each combination and suggests that for benefit transfer to the UK using international studies, studies from North- and West-Europe could be applied with the necessary caution, then studies from South-and East-Europe with more caution, followed by Australian and North-American studies with further increased caution, and studies from elsewhere should probably not be applied due to large differences in cultural, economic and ecological differences. Just four North- and West-Europe studies were reviewed which provided values for habitat/goods&benefit combinations for which no UK primary evidence was available at the time of the report's production (Turner et al. 2014).

Table 20. Overview of the number of UK studies published between 2000 and 2013 for each combination of habitat and ecosystem service. Source: Turner et al. (2014)

The numbers refer to the number of studies that provide at least one value for the ecosystem service in a particular habitat type since 2000. Yellow indicates services for which one to four studies are available, and green indicates that five or more studies are available for a service in a habitat type. The recreation study by Sen *et al.* (2013) and the hedonic pricing study by Mourato *et al.* (2010) are not included in this overview because they cannot be assigned to habitats. The study by Mangi *et al.* (2011) is excluded because the study does not provide sufficient information to convert the value estimates into 2012 prices for annual flows.

	Pro-ducts	Sea defence	Erosion preven-tion	Healthy climate	Tourism and nature watching	Education research	Aesthetic: property	Spiritual/ aesthetic: wild species, seascapes
Dunes	0	2	0	1	1	0	0	1
Beaches	0	1	1	0	4	0	0	0
Cliffs,small isl.	0	0	0	0	1	0	0	0
Machair	0	0	0	0	0	0	0	0
Lagoons	0	0	0	0	0	0	0	0
Marshes	1	4	0	4	1	0	0	1
Mudflats	0	2	0	2	1	0	0	0
Inter. wetland	0	0	0	0	0	0	0	1
Seagrass beds	0	0	0	0	0	0	0	0
Kelp forest	0	0	0	0	0	0	0	0
Estuaries	0	0	0	0	0	0	0	0
Coral reefs	0	0	0	0	0	0	0	0
Rocky bottom	0	0	0	0	0	0	0	0
Coastal shelf	3	0	0	1	5	0	0	2
Open ocean	0	0	0	0	0	0	0	0

The subjects covered by the 25 primary UK valuation studies (as of 2013) were:

• fisheries values from the coastal shelf/EEZ and salt marshes;
• sea defence benefits provided by dunes, shingle beaches, salt marshes and mudflats;
• prevention of coastal erosion related losses by shingle beaches;
• ‘healthy’ climate benefits provided by salt marshes, mudflats, dunes, seagrasses, kelp forests and the coastal shelf;
• recreational values by salt marshes, mudflats, beaches, dunes, small islands and coastal areas; and
• spiritual and cultural wellbeing and aesthetic benefits of wild species and seascapes for saltmarshes, and generic non-use values for wetlands and the coastal shelf.

More recently, an evaluation of the ecosystem benefits of kelp bed recovery off West Sussex has been completed by the New Economics Foundation (NEF). The study involved development of a model incorporating economic valuation of seven ecosystem services, using secondary data (e.g. data from studies of kelp beds outside the UK and Europe and/or comparable habitats such as seagrass) to estimate unit area valuations for these services (Williams & Davies 2019). The resulting estimates for scenarios involving differing levels of kelp bed recovery are presented in the paper. Table 21 shows the estimated values should the kelp bed be restored to 1987 levels, when the extent of the beds was around 2800% greater than the present day. The estimated ecosystem services value of over £3.6 million per year is significantly higher than that estimated for the current kelp beds: £79,000 per year (Table 22).

Table 21. Ecosystem services valuation of kelp beds off West Sussex, if they returned to 1987 levels. Source: (Williams & Davies 2019).

	Value per km2 (£)	Area by kelp bed density (%)				Value of areas of kelp bed density (£)				Total value (£)
		Low	Medium	High	Very High	Low	Medium	High	Very High	
Fishery resources	£2,066	60%	20%	10%	10%	£54,864	£36,576	£27,432	£36,576	£155,447
Harvesting e.g. materials (alginates) for pharmaceutical and industrial use	£10,288	60%	20%	10%	10%	£-	£-	£-	£182,095	£182,095
Water quality maintenance	£5,703	60%	20%	10%	10%	151,419	£100,946	£75,709	£100,946	£429,020
Protection of coastlines from storm surges waves/ reduction in shoreline erosion	£17,870	60%	20%	10%	10%	474,446	316,297	£237,223	£316,297	£1,344,264
Carbon sequestration	£9,046	60%	20%	10%	10%	240,176	£160,117	£120,088	£160,117	£680,498
Nursery habitats for commercial fish species	£7,099	60%	20%	10%	10%	188,473	£125,649	£94,237	£125,649	£534,008
Tourism and recreation	£4,058	60%	20%	10%	10%	£107,743	£71,829	£53,872	£71,829	£305,273
						Total ecosystem services value				**£3,630,605**

Table 22. Value per annum for kelp ecosystem services by ecosystem service type, for the 3 kelp bed extent scenarios included in the model. Source: (Williams & Davies 2019).

	Provisioning services	Regulating services	Supporting services	Cultural services	Total ecosystem services
Current scenario	£3,569	£56,333	£12,260	£7,008	**£79,170**
% total	5%	71%	15%	9%	
1987 past extent	£337,542	£2,453,782	£534,008	£305,273	**£3,630,605**
% total	9%	68%	15%	8%	
Hypothetical maximum scenario	£276,575	£2,247,058	£489,019	£279,555	**£3,243,886**
% total	7%	69%	15%	9%	

However, whilst the concept of value is central to the natural capital approach, it has been acknowledged that a focus on the monetary valuation of the natural capital approach may be less appropriate for marine areas in the absence of a sufficient number of primary or even secondary monetary assessments[26].

Ecosystem services associated with specific marine habitats (of relevance)

Assessments of the types of ecosystem services associated with marine habitats and species are inevitably more numerous than those which attempt to assign a monetary value to those services. For example, Potts et al. (2014) describe the ecosystem services associated with the species and habitats protected by five UK MPAs in non-monetary terms, highlighting that ecosystem service provision will vary across spatial scales and across configurations of habitats, species and local management arrangements, and thereby that even without valuation of those services, it is clear that different mixes of features can lead to different service flows from areas designated under the same or equivalent conservation legislation.

The Government of Jersey have shared a draft report assessing Jersey's blue carbon resources with MEP. The report remains unpublished and subject to independent review and is therefore used with caution here. This blue carbon assessment has generated values for potential sequestered carbon for Jersey's offshore marine habitats adapting the methodology used by Scottish National Heritage (SNH), which used an area-based approach to estimate the blue carbon potential of defined benthic habitat. Assessments were achieved by extracting data from GIS models relating to the classification, properties and extents of benthic habitats and datasets relating to the biomass and production of organic and inorganic carbon and various sedimentary properties, including the approximate rate of sedimentation (Government of Jersey, *in prep.*).

As stated in the report "*The annual weight of carbon that can accumulate in habitats is of particular interest to climate scientists as the permanent sequestration (i.e. removal) of carbon from the natural environment means that it is unavailable to form atmospheric carbon dioxide. Defining and preserving the carbon sequestration potential of natural environments is therefore a key process in the reduction of atmospheric greenhouse gases such as carbon dioxide. Within Jersey*

[26] Department for Environment, Food and Rural Affairs, Plymouth Marine Laboratory, University of Plymouth, University of St Andrews and Sweep. 2019. The Natural Capital Approach: What it is, and how does it fit into decision-making for coastal and marine areas

waters it is only sedimentary habitats that can sequester carbon as in areas of bedrock, boulders and cobble there is no means of removing and preserving the remains of plants and animals from the natural environment through burial. Even within sedimentary habitats, it is only those with a high sedimentary accumulation rate that will be most effective as material buried in mobile or semipermanent sedimentary habitats is liable to be uncovered and remobilised back into the marine environment" (Government of Jersey, *in prep*.).

The dominance of individual sedimentary habitats is reflected in the sequestration weights given below in Table 23. Also stated in the report: "*These specific habitats that have a combination of high biodiversity (and therefore production) and a high sediment accumulation rate that have the largest capacity for carbon storage. Much of this sequestration potential will be in the form of carbonate production from animals and calcareous algae via new growth for shells, bones and thalli. Some of Jersey's marine habitats, such as seagrasses, are already internationally recognised for their sequestration potential. However, the relative area is small (3 km^2 for seagrass) and so, while effective, their relative sequestration contribution is small. Other key habitats, such a maerl, are known to have a high sequestration potential and can cover large areas of seabed but, even so, they are not presently recognised for the purposes of international carbon budgeting"*. The annual weight of carbon sequestered annually in Jersey's waters is estimated at 161,783 or 175,246 tonnes depending on which biomass figures are used (Government of Jersey, *in prep*.).

These data (Table 23), alongside the latest UK Government current traded carbon values[27], are used in the following assessment to estimate values (£/tCO2e) of carbon sequestered by habitats in Jersey waters and the proposed Marine Park.

There are however a number of reasons why this evidence should be used with caution. This includes that some of the data are old (50+ years) or only taken from specific areas and so may not be current and/or more widely representative. Further, the results only relate to benthic derived carbon (i.e. animals and plants living on or in the seabed). The contribution from planktonic organisms (which may be considerable) has not yet been factored into the modelling and "*it is therefore likely that these figures represent an underestimate of the true situation"*. Field and laboratory work would therefore be required to provide more detailed information in relation to the Marine Park (Government of Jersey 2020).

[27] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/794188/2018-short-term-traded-carbon-values-for-modelling-purposes.pdf

Table 23. Estimated weight of carbon (tonnes) sequestered annually in Jersey offshore waters in JNCC benthic habitats. The two sets of values relate to biomass figures derived from different resources. Source: Government of Jersey (in prep.)[i]

JNCC Biotope	Description	Sequestered (LH)	Sequestered (Ret)
IR.HIR.Ksed	Offshore rock with sand	643	825
IR.HIR.Ksed.XKScrR	Shallow reef with sand	2,644	3,174
IR.MIR.KR.Lhyp	Kelp forest	0	0
IR.MIR.KR.Lhyp.Pk	Kelp park	0	0
CR.HCR.Xfa	Hard ground	0	0
SS.SCS.ICS.MoeVen	Basin gravel/sand	21,619	23,322
SS.SCS.ICS.Glap	Offshore gravel/sand	46,212	48,279
SS.SCS.ICS.Slan	Sandmason worms	1,463	1,987
SS.SCS.CCS.PomB	Hard ground	0	0
SS.SCS.CCS.MedLumVen	Basin gravel/sand	21,333	21,956
SS.SCS.CCS.Blan	Offshore gravel/sand	22,285	23,853
SS.Ssa.IfiSa	Fringe medium & fine sand	255	339
SS.Ssa.IfiSa.ImoSa	Mobile gravel sand	11,885	14,391
SS.Ssa.ImuSa	Inshore fine to silty sand	28	26
SS.SMx.Imx.CreAsAn	Slipper limpets	2,785	3,395
SS.SMx.Omx.PoVen	Basin gravel/sand	19,439	21,038
SS.SMp.Mrl	Maerl beds	10,659	12,081
SS.SMp.SSgr.Zmar	Seagrass beds	533	580
TOTAL		**161,783**	**175,246**

Qualitative assessment of the impact of fisheries management on marine ecosystem services

An essential component of the natural capital approach is that it does not just aim to maintain the flow of those ecosystem services and benefits that are most important to society now. Rather, equal importance is given to ensuring that the underlying natural capital assets (species, habitats and ecological processes) are not allowed to degrade in order to ensure that we can continue to enjoy the full range of possible services and benefits into the future[26].

Evidence linking management of habitats and the ecosystem services they provide is available and can be used to inform a qualitative assessment of the potential impacts of a comparable management intervention on a comparable habitat[28]. A number of studies have described the effects of the exclusion of certain fishing activities or all fishing effort from a spatial area, either explicitly linking the observed response to a directional change or change in magnitude of an ecosystem service or providing information that potentially enables such an inference to be made, with the necessary caution over resulting confidence levels. A review of such evidence in relation to limitation of demersal fishing on marine habitats is provided by the 'Managing Ecosystem Services Evidence Review' (MESER) tool[29], the outcome of which is summarised in Figure 52.

[28] *With appropriate acknowledgement of sources/levels of uncertainty, given the need for evidence extrapolation*

[29] https://meser.simomics.com

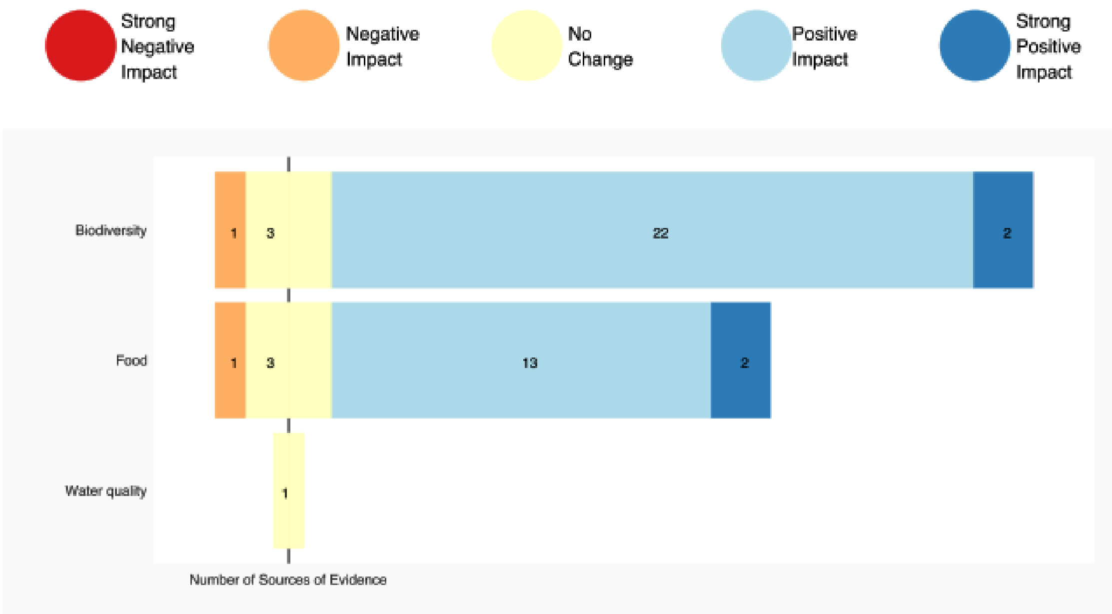

Figure 52: Visual summary of the reviewed evidence from scientific literature on the effect of limited demersal trawling on ecosystem services, provided by a specific habitat. An overview of the quantity of evidence, the magnitude and the direction of the observed effect is shown. Source: https://meser.simomics.com

MESER factsheets[30], created in 2014 during the original review, provide a descriptive summary of the published peer-reviewed literature available at the time in relation to the implementation of mobile gear exclusion (or no-take zones – evidence not included below due to more limited applicability to the proposed Marine Park). Such evidence includes:

- Countryside Commission for Wales (CCW) reported that the restriction of mobile fishing gears within the Skomer Marine Nature Reserve resulted in increased abundance of the local King scallop (*Pecten maximus*) population by 'at least four-fold and perhaps more than eight-fold' over the first 20 years of its designation (CCW Press Release, 20 April 2010). The site is also recognised as providing several services associated with tourism/wildlife watching (including recreational diving and angling), with increases in participation over time (Lock et al. 2013).
- The exclusion of towed demersal fishing gear from Lyme Bay MPA resulted in increases in species richness and total abundance within three years, including a range of economically important species. Further, the protected reef was found to extend beyond the normal expected boundaries showing that 'reef' species assemblages could extend into areas mapped as sediment (Sheehan et al 2013a), resulting in increased biodiversity within the site, which had a spillover effect into adjacent fished areas (Sheehan et al 2014b).
- Ongoing monitoring of the recovery of the Lyme Bay reef has shown that, in addition to an increase in the structural fauna of the reef and subsequent increase in 'habitat provision'

[30] http://publications.naturalengland.org.uk/publication/5890643062685696?category=7004

the densities of scallops within the area showed an expected increase which is likely to have spill over effects. An evaluation was carried out to assess the impacts of the closure in socio-economic terms. The report focused on direct services and showed that landings data of all gear types (static gear is still used in the closed area) increased following the closure implying the loss of access to fishing grounds in the closed area has been compensated for by the remaining fishing grounds (Attrill et al. 2011, Mangi et al. 2011).

- The positive effects for ecosystem services of the Lyme Bay MPA also extend to recreation and tourism, with higher diversity of activities supported by the MPA and therefore improved monetary valuation of those services (Rees et al. 2010).
- Voluntary agreements, such as the Inshore Potting Agreement (IPA) off Devon and Cornwall, have been found to result in significantly higher species richness and biomass of benthic communities, where static gear only was permitted (Blyth et al. 2004).
- Exclusion of mobile gear from a 2km^2 scallop ground off the Isle of Man resulted in increased abundance and size of scallops in the area (Bradshaw et al. 2001).

5.3.4 Assessment of potential benefits of the proposed Marine Park

The approach taken to assessment of the natural capital benefits associated with the proposed Marine Park is based upon the natural capital asset register developed for the North Devon Marine Pioneer (NDMP) (Rees et al. 2019). The key steps involve:

1. **Documenting the range and extent of habitats within Jersey waters and the Marine Park**. This task is completed based on data provided by the Government of Jersey (Government of Jersey 2020) Table 24).

2. **Identifying (and valuing, where possible) the ecosystem services associated with each habitat**. Information for this task is largely taken from Annex 5 (Potts et al. 2014). Due to the evidence limitations discussed in the previous section, we do not attempt to assign a monetary value to the ecosystem services associated with each habitat, with the following two exceptions[31] (see previous section for details of these evidence sources):

   (i) Carbon storage (Regulating Service) as we can incorporate the work undertaken by the Government of Jersey[i] and apply the method used by Rees et al. (2019) to estimate the cost avoided of mitigating equivalent emissions to the carbon sequestered by habitats.

   (ii) Ecosystem services associated with kelp beds, based on extrapolation of the values developed for kelp beds of West Sussex (Williams & Davies 2019).

   Note: clearly the review of fishing activity above and the economic impact assessment provided as part of this report indirectly inform a quantitative review of the provision of food (fisheries resources) by Jersey's waters and the proposed Marine Park more specifically.

[31] A future iteration of this study could also include estimates for Food (Provisioning Service) because of the work done by Samantha Blampied as part of her PhD thesis. Whilst the data were not received in time to inform this report, our understanding is that the work involves using habitat usage to determine habitat value for each of the five key shellfish species (lobster, brown crab, spider crab, scallop and whelk). Using the literature, a table which has information about which habitats each species uses at different life stages has been created. The landings value (estimated from primary sales to vendors) have been equally spilt across the habitats used, giving a £ per habitat for each species. That value is then divided by the area in km^2 to give a £ per km^2. This method was used partly because spatial fishing data is not available for the whole fleet but also because such data does not take into account the importance of nursery/spawning habitats. Those estimated values would clearly be informative for an assessment of the natural capital benefits associated with the proposed Marine Park.

However, to avoid repetition, and because those assessments are not habitat specific, the findings are deliberately not repeated here.

3. **Assessing the likely condition of each habitat**. In the absence of direct evidence of condition of the habitats, vulnerability is used as a proxy of condition, where vulnerability is the product of the habitat's sensitivity to pressures and exposure of the habitat to those pressures. Such an assessment would ideally consider the full range of pressures and associated activities which exert those pressures, but that is beyond the scope of this work. Therefore, the assessment has focused on the main pressures caused by the activities of interest, bottom towed gear including dredging and bottom otter trawl, namely (i) abrasion and (ii) penetration or disturbance of the substratum subsurface, and to the potential exposure of the habitat to that activity / pressures. At present this is necessarily done at a very basic level, by visually comparing the habitat map (Figure 53) to the effort plots presented above. Exposure is manually assessed as Low (L), Moderate (M) or High (H) based on the approximate proportion of the habitat present within the Marine Park zone, which appears to be exposed to towed gear (clam and scallop dredging, benthic trawling) activity (average of 2015-2019). A more robust, quantitative assessment of exposure may be possible but further consideration of the data and project's resources would first be required.

   Another notable limitation to this approach is that other activities to which the habitats may be exposed, including static fishing gear, cause abrasion (and other pressures to which the habitat may be sensitive). Moreover, demersal fishing gear also exerts other pressures which are likely to affect the condition of the habitats and associated species, such as disturbance of the substratum, removal of non-target species, changes in suspended solids[32]. However, for the purposes of this assessment, it was felt that a simplified approach was justified.

   Sensitivity information by EUNIS habitat was extracted from the Marine Evidence-based Sensitivity Assessment (MarESA) database by biotope. MarESA compiles sensitivity information through a detailed literature review process of available evidence on the effects of pressures arising from human activities on marine habitats. The assessments assign scores for habitat sensitivity as a combination of resistance and resilience to particular pressures. The scores allocated are: Not Sensitive, Low, Medium, High and Not relevant[33]. Where a sensitivity assessment was not available for a specific biotope listed as present in Jersey's waters, the closest available was used. This may mean some assessments are more precautionary e.g. if the assessed biotope features species with higher sensitivity than the listed parent biotope.

4. **Consider the potential gains in ecosystem services**. This part of the assessment draws on information presented in the previous section (and otherwise) to make predictions over the potential impacts of removal of bottom towed gear in relation to the natural capital assets of the proposed Marine Park.

It is important to note there are various sources and degrees of uncertainty associated with the data and evidence sources used in this assessment (e.g. extent and distribution of habitat data

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32 JNCC's Marine Pressures-Activities Database

33 https://www.marlin.ac.uk/sensitivity/sensitivity_rationale

and assigned EUNIS codes, attribution of ecosystem services including their relative importance, sensitivity analyses, exposure to fishing activity, sole consideration of abrasion, vulnerability assessment as a proxy for condition, etc). To help quantify that uncertainty, Potts et al. (2014) provide a simple scoring of evidence for habitat and ecosystem services links and in the MarESA assessments, three different measures of certainty summarise the evidence base contributing to each habitat's sensitivity score per pressure. Combining these data therefore compounds these uncertainties and this unavoidable limitation needs to be taken into account when interpreting and applying the resulting assessment of the natural capital benefits associated with the proposed Marine Park.

Step 1. Range and extent of habitats within Jersey waters and the Marine Park

Table 24 presents the documented biotopes in Jersey waters and their associated spatial extent both across Jersey waters and within the proposed Marine Park boundary (Government of Jersey 2020). The equivalent EUNIS codes have also been assigned to each habitat type (Tillin et al. 2020).

Whilst across Jersey waters, hard ground and offshore gravel and sand are the dominant biotope types, within the proposed Marine Park, shallow reef with sand, mobile sand, basin gravel/sand, maerl beds and kelp forest characterize the marine landscape (Figure 53).

Table 24. The JNCC biotopes identified in Jersey waters and their extent, with equivalent EUNIS Level 3, 4 or 5 code (Tillin et al. 2020). Source: Government of Jersey (2020)

Biotope	Description	EUNIS code	Extent – Jersey waters (km^2)	Extent – Proposed Marine Park (km^2)	% within Proposed Marine Park
IR.HIR.Ksed	Offshore rock with sand	A3.1	86.9	35	40.3%
IR.HIR.KSed.XKScrR	Shallow reef with sand	A3.1	188.2	182.5	97.0%
IR.MIR.KR.Lhyp	Kelp forest	A3.214	74.3	74.1	99.7%
IR.MIR.KR.Lhyp.Pk	Kelp park	A3.2142	55.8	48.8	87.5%
CR.HCR.Xfa	Hard ground	A4.13	422.1	40.7	9.6%
SS.SCS.ICS.MoeVen	Basin gravel/sand	A5.133	57.2	53.2	93.0%
SS.SCS.ICS.Glap	Offshore gravel/sand	A5.135	293.7	44.6	15.2%
SS.SCS.ICS.Slan	Sandmason worms	A5.137	14.8	14.8	100.0%
SS.SCS.CCS.PomB	Hard ground	A5.141	474.5	52.5	11.1%
SS.SCS.CCS.MedLumVen	Basin gravel/sand	A5.142	90.1	39	43.3%
SS.SCS.CCS.Blan	Offshore gravel/sand	A5.145	276.5	1.5	0.5%
SS.Ssa.IfiSa	Fringe medium and fine sand	A5.23	4.3	4.3	100.0%
SS.Ssa.IfiSa.ImoSa	Mobile sand	A5.231	199.9	146.6	73.3%
SS.Ssa.ImuSa	Inshore fine to silty sand	A5.24	0.4	0.4	100.0%
SS.SMx.Imx.CreAsAn	Slipper limpets	A5.431	19.3	18.2	94.3%
SS.SMx.Omx.PoVen	Basin gravel/sand	A5.451	43.7	42.1	96.3%
SS.SMp.Mrl	Maerl beds	A5.51	58.7	56.2	95.7%
SS.SMp.SSgr.Zmar	Seagrass meadows	A5.5331	3.4	3.4	100.0%

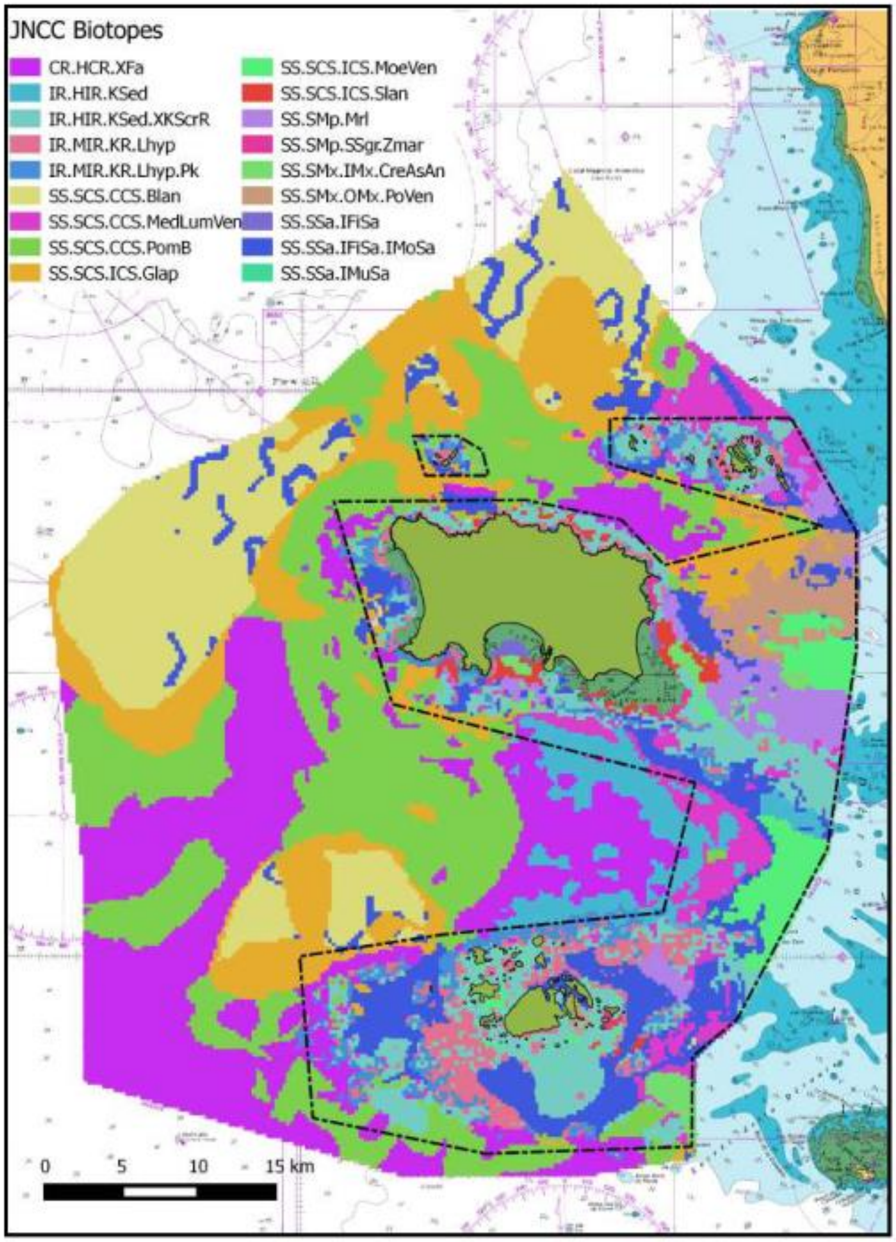

Figure 53: Biotope map for Jersey waters, with proposed MPA boundary shown. Source: Government of Jersey. *See* Table 24 *for habitat and biotope description.*

Step 2. Identifying the ecosystem services associated with each habitat

The intermediate ecosystem services and good/benefits potentially associated with each habitat that has been mapped within the proposed Marine Park were identified based on Potts et al. (2014) (Annex 5; Table 25). The habitats making the largest relative contribution to the ecosystem services provided by Jersey's marine environment are kelp, seagrass, and subtidal rock/reef (offshore rock with sand/shallow reef with sand). In addition, maerl plays a critical role in the formation of species habitat (Supporting Service) and the subtidal sand and gravel habitats provide fish feed through Provisioning Services[34].

The five most important[35] services and goods/benefits associated with Jersey's marine habitats are focused on for the remainder of the report:

- Primary production (Supporting Service)
- Larval/gamete supply (Supporting Service)
- Nutrient cycling (Supporting Service)
- Formation of species habitat (Supporting Service)
- Food (Provisioning Service)

In addition, Healthy climate (Carbon sequestration – Regulating Service) is further assessed considering the more recent evidence base for this ecosystem good/benefit. For kelp, the ecosystem services considered in Williams & Davies (2019) are assessed.

[34] Note these habitats are identified as being important in relation to other habitats; factors determining the actual scale of services that could be derived from each habitat in Jersey waters are not taking into account, for example spatial area (extent) or condition (quality) of the habitat.

[35] Based on the sum of their relative importance across all habitats (scored as 3 = significant contribution, 2 = moderate contribution, 1 = low contribution, 0 = no or negligible ESP or not assessed) and the confidence in evidence across all habitats (as per scoring presented in Table 25)

Table 25. The relative importance of marine habitats in Jersey waters in providing intermediate ecosystem services and good/benefits. The closest EUNIS code/level for which ecosystem services information was provided by Potts et al. (2014) is assigned to each habitat – for many an exact match was not available.

Habitat Description	EUNIS code	EUNIS code associated with ecosystem service(s)	Intermediate Services											Goods/Benefits													
			Supporting Services							Regulating Services				From Provisioning Services					From Regulating Services					From Cultural Services			
			Primary production	Larval / gamete Supply	Nutrient cycling	Water cycling	Formation of species habitat	Formation of physical barriers	Formation of seascape	Biological control	Natural hazard regulation	Regulation of water & sediment quality	Carbon sequestration	Food	Fish feed	Fertiliser	Ornaments (inc. aquaria)	Medicine & blue biotechnology	Healthy climate	Prevention of coastal erosion	Sea defence	Clean water and sediments	Imobilisation of pollutants	Tourism / nature watching	Spiritual / cultural wellbeing	Aesthetic benefits	Education
Offshore rock with sand Shallow reef with sand	A3.1 A3.1	A3.1: High energy infralittoral rock	2	2			2	1			1			3						1	1			1	1		1
Kelp forest Kelp park	A3.214 A3.2142	A3.126, A3.213: Tidal swept algal communities (L. hyperborea)	1	1	1		1	1	1	1	1	1	1	1		1		1	1	1	1	1	1	1	1	1	1
Hard ground	A4.13	A4.1: High energy circalittoral rock	2	2			2	1			1			1						1	1			1	1		1
Basin gravel/sand	A5.133	A5.133: Shallow tide-swept coarse sands with burrowing bivalves (Morella sp.)			1		1					1		1								1			1		1
Offshore gravel/sand Sandmson worms	A5.135 A5.137	A5.13: Subtidal sands and gravels	1	1	1		2					1		2	3							1		1	1		1
Hard ground Basin gravel/sand Offshore gravel/sand	A5.141 A5.142 A5.145	A5.1: Subtidal coarse sediment	3	3	3		3				3	1		2	3					3	3	3	1		1		1
Fringe medium & fine sand Mobile sand Inshore fine to silty sand	A5.23 A5.231 A5.24	A5.2: Subtidal sand	3	3	3		3				3	1		2	3					3	3	3	1		1		1
Slipper limpets Basin gravel/sand	A5.431 A5.451	A5.4: Subtidal mixed sediments	3	3	3		3				3	1		2	3					3	3	3	3		1		1
Maerl beds	A5.51	A5.51: Maerl beds	3	1	1		3	1	1	1				3		1	1							1	1	1	1
Seagrass beds	A5.5331	A5.53: Seagrass beds	2	1	2		3	1	1	2	1	2	2	3		2	2	1	2	2	2	2	2	2	1	2	1

Scale of ecosystem service supplied relative to other features		Confidence in evidence	
#	Significant contribution	3	UK-related, peer-reviewed literature
#	Moderate contribution	2	Grey or overseas literature
#	Low contribution	1	Expert opinion
#	No or negligible ESP		Not assessed
	Not assessed		

Monetary valuation of specific ecosystem services

Recent and directly applicable evidence available to support a monetary valuation in relation to the ecosystem services of carbon sequestration and food provision, as well as for a range of goods/benefits associated with kelp, are available and utilized in the following section.

Carbon sequestration / Healthy climate – Regulating Service

An average of the estimated weight of carbon (tonnes) sequestered annually in Jersey offshore waters in JNCC benthic habitats (based on two different biomass figures) (Table 23) was first used to calculate the annual sequestration per km^2 of each habitat. Those estimates (t/C/km2/yr) were then applied to the extent of each habitat within the proposed Marine Park. Traded carbon values provide an assessment of the cost avoided of mitigating equivalent emissions to the carbon sequestered by habitats. The latest central estimate for 2021 (£14.56/tCO2e)[36] was then applied to calculate the value of carbon sequestered annually for each habitat and in total, both across Jersey waters and within the Marine Park (Table 26).

The resulting estimate of more than 86,000 tonnes of carbon sequestered per year by the marine habitats within the proposed Marine Park is associated with a value of nearly £1.3 million based on traded carbon values (Table 26). This does not take into account potential increases in biotope extent as a result of protection within the Marine Park.

Table 26. Estimated value of carbon sequestered by marine habitats within Jersey waters and within the proposed Marine Park only, based on carbon sequestration values estimated by Government of Jersey (in prep.) and UK Government traded carbon values. Biotope descriptions are provided Table 24 above.

JNCC Biotope	Based on extent of habitat across Jersey waters					Marine Park		Value of carbon sequestered (£) - Jersey waters	Value of carbon sequestered (£) - Marine Park
	Sequestered (LH) (t/C/yr)	Sequestered (Ret) (t/C/yr)	Average sequestered (t/C/yr)	Extent (km2)	Average sequestered (t/C/km2/yr)	Extent – Proposed Marine Park (km^2)	Average sequestered (t/C/yr)		
IR.HIR.Ksed	643	825	734	86.9	8	35	296	10,687	4,304
IR.HIR.KSed.XKScrR	2,644	3,174	2909	188.2	15	182.5	2,821	42,355	41,072
IR.MIR.KR.Lhyp	0	0	0	74.3	0	74.1	0	0	0
IR.MIR.KR.Lhyp.Pk	0	0	0	55.8	0	48.8	0	0	0
CR.HCR.Xfa	0	0	0	422.1	0	40.7	0	0	0
SS.SCS.ICS.MoeVen	21,619	23,322	22470.5	57.2	393	53.2	20,899	327,170	304,291
SS.SCS.ICS.Glap	46,212	48,279	47245.5	293.7	161	44.6	7,174	687,894	104,461
SS.SCS.ICS.Slan	1,463	1,987	1725	14.8	117	14.8	1,725	25,116	25,116
SS.SCS.CCS.PomB	0	0	0	474.5	0	52.5	0	0	0
SS.SCS.CCS.MedLumVen	21,333	21,956	21644.5	90.1	240	39	9,369	315,144	136,411
SS.SCS.CCS.Blan	22,285	23,853	23069	276.5	83	1.5	125	335,885	1,822
SS.SSa.IFiSa	255	339	297	4.3	69	4.3	297	4,324	4,324
SS.SSa.IFiSa.IMoSa	11,885	14,391	13138	199.9	66	146.6	9,635	191,289	140,285
SS.SSa.IMuSa	28	26	27	0.4	68	0.4	27	393	393
SS.SMx.IMx.CreAsAn	2,785	3,395	3090	19.3	160	18.2	2,914	44,990	42,426
SS.SMx.OMx.PoVen	19,439	21,038	20238.5	43.7	463	42.1	19,498	294,673	283,884
SS.SMp.Mrl	10,659	12,081	11370	58.7	194	56.2	10,886	165,547	158,497
SS.SMp.SSgr.Zmar	533	580	556.5	3.4	164	3.4	557	8,103	8,103
Total	**161,783**	**175,246**	**168,515**				**86,222**	**2,453,571**	**1,255,389**

Ecosystem Services provided by kelp

Based on the work by Williams & Davies (2019) (see Table 21), the following values of the kelp habitat[37] present within the Marine Park for 7 specific ecosystem services[38] are estimated in Table 27, resulting in a total predicted value of approximately £7 million. Kelp's provision of storm surge or erosion protection for the coastline, followed by harvesting potential and carbon sequestration, are associated with the highest estimated values.

Williams & Davies (2019) valued the West Sussex kelp bed at £9046 per km^2 based on carbon sequestration estimates for kelp in Falkland Island waters (Bayley et al. 2017). The Government of Jersey's assessment of blue carbon resources in Jersey waters concluded that "*habitats such*

[36] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/794188/2018-short-term-traded-carbon-values-for-modelling-purposes.pdf

[37] *For the purposes of this exercise, it was necessary to assume that the estimated ecosystem services and their values provided by kelp forest and kelp park are the same.*

[38] *The estimated value of fishery resources per km2 is taken from Table 13, however it could potentially be updated with that estimated within Blampied (PhD thesis, in prep.) if available.*

as kelp forests will be a major source of carbon production and standing stock (through seaweed growth) but, due to a lack of accumulating sediment, are unlikely to able to sequester much of this". Whilst the extrapolation of precise values from the Falkland Islands to the UK and Channel Islands could be questioned, the reason for these potentially differing views on kelp's contribution to a healthy climate requires further investigation. However, a brief literature review suggests the Government of Jersey's conclusions are better supported. For example, Smale et al. (2013) state:

"The fraction of carbon fixed by kelps that is effectively removed from the atmosphere over decadal to century timescales is as yet poorly understood. The process of incorporation into longer term stores of carbon may depend on the export of particulate kelp detritus from coastal habitats into sediment in deeper water or the export of recalcitrant dissolved carbon into deep ocean water, but the potential for such storage (and thereby influence on the carbon budget) is not inconsiderable."

Table 27. Estimated value of ecosystem services associated with kelp habitats within the proposed Marine Park, based on values per km² provided in Table 21 (Williams & Davies 2019)

Biotope	Description	Extent – Jersey waters (km^2)	Extent – Proposed Marine Park (km^2)	Fishery resources	Harvesting e.g. materials (alginates for pharmaceutical and industrial use)	Water quality maintenance	Protection of coastlines from storm surges /reduction in coastline erosion	Carbon sequestation	Nursery habitats for commercial fish species	Tourism and recretaion	Total (£)
IR.MIR.KR .Lhyp	Kelp forest	74.3	74.1	153,091	762,341	422,592	1,324,167	670,309	526,036	300,698	4,159,233
IR.MIR.KR .Lhyp.Pk	Kelp park	55.8	48.8	100,821	502,054	278,306	872,056	441,445	346,431	198,030	2,739,144
Total		130.1	122.9	253,911	1,264,395	700,899	2,196,223	1,111,753	872,467	498,728	6,898,377

Step 3. Assessing the likely condition of each habitat

Using vulnerability as a proxy of condition, the full range of potential outcomes (good, moderate, poor) are likely to be present across the habitats within the proposed Marine Park, based on their sensitivity to abrasion and penetration and exposure to those pressures through clam dredging (French vessels), scallop dredging (primarily French vessels, some Jersey boats), and to a lesser extent bottom trawling. Vulnerability (sensitivity x exposure) is determined according to the tables below (Figure 54). For the purposes of this assessment, the blue and green cells are considered as good condition (low vulnerability), yellow cells as moderate condition (moderate vulnerability) and brown and red cells as poor condition (high vulnerability).

Sensitivity	Exposure			
	None	Low	Moderate	High
NS	None	None	None	None
L	None	Low	Low	Moderate
M	None	Low	Moderate	High
H	None	Moderate	High	Very High

⇒

Sensitivity	Exposure			
	None	Low	Moderate	High
NS	Good	Good	Good	Good
L	Good			↓
M	Good			↓
H	Good	→	→	

Figure 54: Combination matrix for impacts due to habitat's sensitivity and pressure exposure and inferred likely condition due to vulnerability to impacts caused by key pressures (abrasion, penetration) associated with demersal towed fishing activity within the proposed Marine Park. Source: Rees et al. (2019)

As stated above, the exposure assessment (and therefore estimation of likely condition) has low confidence associated with it due to it currently being based on a visual comparison of the habitat map (Figure 53) and fishing activity plots provided above. A more robust assessment could potentially be undertaken in a more detailed and extended study.

The results of the assessment indicate that the condition of several habitats within the proposed Marine Park may be being adversely affected by exposure to clam dredging and scallop dredging in particular, with the most significant concerns associated with maerl beds and mixed sediment basin gravel and sand (Table 28). As a result, the goods/benefits of the ecosystem services associated with these habitats and their associated flora and fauna (Table 25) may be being suppressed.

Table 28. Sensitivity assessment, estimated relative exposure to bottom towed fishing gear within the proposed Marine Park boundary and resulting likely condition of each biotope.

Biotope	Description	EUNIS code	Sensitivity to abrasion / penetration	Potential Exposure to pressures in Marine Park (L/M/H)	Likely condition (vulnerability assessment)
IR.HIR.Ksed	Offshore rock with sand	A3.1	Medium / Not Relevant (based on IR.HIR.KSed. XKScrR)	M	Moderate
IR.HIR.Ksed.XKScrR	Shallow reef with sand	A3.1	Medium / Not Relevant	M	Moderate
IR.MIR.KR.Lhyp	Kelp forest	A3.214	Medium / Not Relevant	M	Moderate
IR.MIR.KR.Lhyp.Pk	Kelp park	A3.214 2	Medium / Not Relevant	M	Moderate
CR.HCR.Xfa	Hard ground	A4.13	Medium / Not Relevant (based on CR.HCR.Xfa. ByErSp)	L	Good
SS.SCS.ICS.MoeVen	Basin gravel/sand	A5.133	Low / Low	H	Moderate
SS.SCS.ICS.Glap	Offshore gravel/sand	A5.135	Low / Low	L	Good

SS.SCS.ICS.Slan	Sandmason worms	A5.137	Not Sensitive / Not Sensitive	M	Good
SS.SCS.CCS.PomB	Hard ground	A5.141	Low / Low	L	Good
SS.SCS.CCS.MedLumVen	Basin gravel/sand	A5.142	Low / Low	H	Moderate
SS.SCS.CCS.Blan	Offshore gravel/sand	A5.145	Low / Medium	L	Good
SS.Ssa.IfiSa	Fringe medium & fine sand	A5.23	Low / Low (based on SS.Ssa.IfiSa.ImoSa)	M	Good
SS.Ssa.IfiSa.ImoSa	Mobile gravel sand	A5.231	Low / Low	M	Good
SS.Ssa.ImuSa	Inshore fine to silty sand	A5.24	Not Sensitive / Low (based on SS.Ssa.ImuSa.ArelSa)	M	Good
SS.SMx.Imx.CreAsAn	Slipper limpets	A5.431	Low / Low	L	Good
SS.SMx.Omx.PoVen	Basin gravel/sand	A5.451	Medium / Medium (based on SS.SMx.CMx.FluHyd)	H	Poor
SS.SMp.Mrl	Maerl beds	A5.51	High / High	M	Poor
SS.SMp.SSgr.Zmar	Seagrass beds	A5.5331	Medium / High	L	Moderate

Step 4. Consider the potential gains in Ecosystem Services

Bringing together the estimations and assessments above, the following combinations of habitats and ecosystem services are further considered in relation to the potential gains that may arise from removal of bottom towed fishing gear activity within the Marine Park. The assessment focuses on those habitats which are most likely being adversely affected by the activities (because of exposure to the physical pressures, abrasion and penetration) and the top five ecosystem services previously selected (Table 29). The assumption inherent in this assessment is that removal of any interaction between these habitats and bottom towed fishing gear within the Marine Park will enable the habitats to recover and thereby strengthen their ecosystem services contribution and so the benefits provided to society from these natural capital assets. An obvious potential weakness in this assumption is therefore that no other factors or activities are adversely affecting the condition of the biotopes. Further, the uncertainties associated with the vulnerability assessment that has been used to inform likely condition have been previously discussed.

Nevertheless, the following points summarise some of the processes through which potential benefits may arise by protection of these (and indeed other) marine habitats within the proposed Marine Park from the damage caused by bottom towed fishing gear:

- The habitats support food production that benefit food provision (fisheries) at both a local and regional scale, for example (Rees et al. 2019, Williams & Davies 2019, Smale et al. 2013, Kamenos et al. 2004):

    - Habitats that provide structure, complexity, and niches provide shelter and food resources for fish and shellfish.
    - Reefs, including the biogenic reef maerl, seagrass and kelp communities provide shelter and prey resources for:
        - juvenile stages of commercially targeted fishes (including cod)
        - crustaceans
        - molluscs and
        - invertebrates (including queen scallops).
    - Sediment habitats are also a significant provider of food resources for fish.
- Maerl habitats provide brood-stock areas for bivalves and act as traps for organic material. For example:
    - Maerl beds can enhance the recruitment of juvenile scallops. Juvenile queen scallops (*Aequipecten opercularis*) are attracted to pristine live maerl by a series of chemical and physical cues and it is likely that the higher post-settlement recruitment (settlement out of the water column and recruitment to the adult population) to pristine live maerl, compared to gravel and rock substrata, is attributable to this stimulus (Kamenos et al. 2004).
    - Maerl beds act as active traps for sestonic particles (particulate matter suspended in the water column comprising of organic and/or inorganic material) and are sites of high organic matter remineralization (Martin et al. 2006, Fletcher et al. 2012).
- Kelps are hugely important primary producers (both locally and via export of detritus to nearby habitats), including high levels of nutrient uptake, photosynthesis and growth.
    - Kelp may conservatively account for at least 45% of primary production in UK coastal waters, and 12% of marine production in the entire UK EEZ.
    - Kelp detritus is particularly important as a spatial subsidy of energy into low-productivity habitats.
        - The most visible example of this is the deposition of kelp wrack into sandy beach habitats, where it provides a principal food source for rich and abundant microbial and faunal assemblages (Smale et al. 2013 and references therein).
- Habitat-forming species or “engineers”, such as kelps, seagrass and maerl, exert control over entire communities by modifying the environment and resources available to other organisms (Fletcher et al. 2012). For example:
    - Kelps alter light, sediments, physical scour, and water flow for proximal organisms while providing structural habitat for a wide range of species.
        - Within the UK alone, more than 1800 species of flora and fauna have been recorded from kelp-dominated habitats (MNCR, unpubl. data).
        - As habitat formers, a single kelp directly provides three distinct primary habitats; the holdfast, the stipe, and the lamina. In addition, epiphytes (primarily attached to the stipe) provide a secondary habitat for colonization (Smale et al. 2013 and references therein).

Table 29. Biotopes within the proposed Marine Park which are likely to be in sub-optimal condition based on their sensitivity to abrasion and penetration of the subsurface, caused by bottom towed fishing gear to which they may be exposed. The relative importance of those biotopes for 5 key ecosystem services provided by marine habitats in Jersey's waters is shown. Source: Potts et al. (2014)

Biotope	Description	Extent – Proposed Marine Park (km²)	Likely condition	Intermediate Services				Goods/Benefits
				Supporting Services				From Provisioning Services
				Primary production	Larval / gamete Supply	Nutrient cycling	Formation of species habitat	Food
IR.HIR.Ksed	Offshore rock with sand	35	Moderate	2	2		2	3
IR.HIR.Ksed.XKScrR	Shallow reef with sand	182.5	Moderate					
IR.MIR.KR.Lhyp	Kelp forest	74.1	Moderate	1	1	1	1	1
IR.MIR.KR.Lhyp.Pk	Kelp park	48.8	Moderate					
SS.SCS.ICS.MoeVen	Basin gravel/sand	53.2	Moderate			1	1	1
SS.SCS.CCS.MedLumVen	Basin gravel/sand	39	Moderate	3	3	3	3	2
SS.SMx.Omx.PoVen	Basin gravel/sand	42.1	Poor	3	3	3	3	2
SS.SMp.Mrl	Maerl beds	56.2	Poor	3	1	1	3	3
SS.SMp.SSgr.Zmar	Seagrass beds	3.4	Moderate	2	1	2	3	3

Scale of ecosystem service supplied relative to other features	
#	Significant contribution
#	Moderate contribution
#	Low contribution
#	No or negligible ESP
	Not assessed

Confidence in evidence	
3	UK-related, peer-reviewed literature
2	Grey or overseas literature
1	Expert opinion
	Not assessed

5.3.5 Natural Capital conclusions

Balancing short-term economic costs to industry versus long-term gains in biodiversity and natural habitat restoration is to a large extent incommensurable, but management decisions need to take account of the full range of costs and benefits and acknowledge they are not evenly felt, understood, or valued across society (Williams & Davies 2019). Paucity of primary evidence means that a quantitative, or even qualitative in some cases, assessment of the full extent of benefits arising from ecosystem services and the impacts of managing activities which may limit or even enhance those services is extremely challenging. However, whilst uncertainty should be made explicit in decision-making, it should not become a barrier. While the data on identifying and evaluating ecosystem service flows is incomplete, the concept is important in understanding our relationship to coastal systems and the benefits of conservation and protection (Potts et al. 2014). An important factor in using an ecosystem approach to management is to use evaluation as part of a transparent, objective framework to inform management decisions (Williams & Davies 2019). For that reason, a cost-benefit analysis which employs a natural capital approach alongside a more traditional economic impact assessment such as that set out in this report should be considered essential in the formulation of management strategies that aim to meet complex social, environmental and economic objectives. In doing so, the likely extent and quality of supporting, regulatory, provisioning and cultural ecosystem services can be taken into account and so the goods/benefits provided for society become an inherent feature of the MPA designation and management process (Rees et al. 2012).

This assessment has identified specific opportunities for strengthening the ecosystem services provided by marine habitats within the proposed Marine Park, and thereby the goods and benefits that flow from those services, through removal of the damaging effects of bottom towed fishing gear. Notably, the most sensitive habitats to physical damage – kelp, maerl, reefs and seagrass – are rich natural capital assets in Jersey's waters and therefore their protection is likely to result in disproportionate benefits for Jersey's marine environment and society, particularly through their provision of supporting services such as primary production and nutrient cycling, larval and gamete supply and formation of species habitat and thereby their resulting contribution to wild food production – both for other marine species and for human consumption.

Whilst monetised valuation of the ecosystem services associated with Jersey's marine environment is severely limited due to extensive evidence gaps, estimates relating to annual carbon sequestration suggest that marine habitats within the proposed marine park could be associated with a value of nearly £1.3 million based on traded carbon values (Table 26). Further, specific goods and benefits associated with kelp alone (without quantitative consideration of ecosystem services provided by other habitats) have been valued at around £5.8 million[39] (Table 27) based on estimates applied to kelp beds off West Sussex. Even though confidence in these specific values may be limited, they illustrate that the wider benefits of protecting an area of Jersey's marine environment from the most damaging activities are likely to be considerable.

[39] *Excluding estimates for carbon sequestration due to the high uncertainty associated with those values and assumptions.*

6. Summary of cost benefit analysis

Table 30. Summary of economic (monetised) impact to Jersey mobile fishing fleet and Jersey Government

Code	Detail	Minimum estimated cost / gain to Jersey over a year
a	**Gross loss of income (unmitigated) from Jersey active gears** *[French vessels gross loss of income estimated between €933,120 and €4,584,132. Assumed cost to Jersey £0]*	£ 243,339 COST
b	**Net loss (assuming mitigation) in income from Jersey active gears** For each of the 9 Jersey vessels with active gears identified in the data, a proportion of gross loss (row a: £139,000 for dredge and £104,000 for trawl) was assigned according to its proportion of the total amount of effort reported for that gear. The total dredge and trawl loss was then summed to get a (notional) total gross loss for that vessel across both active gears. To get net loss, these total values were then multiplied by the percentages assumed for mitigation: namely, 50% of that value for the trawler, 25% of the value for the three specialist dredges and 5% for the polyvalent vessels and potters. See Task 2, section 4 above for more details and supporting data table. *Calculation:* *Net loss = (total gross loss of active gears / proportion of effort of active gears) x % of mitigation*	£ 66,200 COST
c	Minimum economic benefit to Jersey static fleet from additional scallop resources	£ 56,000 GAIN
d	Economic benefit to Jersey static fleet from reduction in gear conflicts	£ 12,900 GAIN
e	Minimum cost of enforcement of static gear Marine Park	£ 10,000 COST
	Minimum overall economic cost/gain to Jersey *Calculation = (b + e) - (c + d)* *See second paragraph under this table for further explanation.*	**£ 7,300 COST**

Table 30 above represents the minimum economic (monetised) impact of implementing the Marine Park. It is important that the cost presented is considered a *minimum* impact, as first sale values are utilised in income loss calculations, so for the fishing fleet, it represents the loss in immediate first sale income, without considering potential gains and losses in downstream supply chains where value additions occur. When looking at the impact to the fishing fleet as a whole (static and mobile fishers together), the loss of income to the mobile gear sector (£66,200) is offset by the gain in scallops and reduced loss of potting gear (£76,200). Impacts will of course be felt differently by individual businesses. For example, mobile fishers will be less impacted if they can mitigate by moving to alternative fishing grounds, or by diversifying to other static gears.

The Natural Capital assessment of benefit has concluded that protected marine habitats within the proposed Marine Park could be associated with a monetised value of around **£1.3 million** based on traded carbon values. Other benefits associated with kelp, such as protection of coastlines from erosion, harvesting potential, and nursery habitats for commercial species have been valued at around **£5.8 million**. These numbers do not take into consideration a natural capital assessment (with exception of carbon sequestration estimates) of other habitat types (beyond kelp) that would be protected following designation of a Marine Park, including the provision of additional fishery resources beyond scallops.

Nevertheless, the NC values illustrate that the wider economic benefits of protecting an area of Jersey's marine environment from the most damaging activities are likely to be considerable over time.

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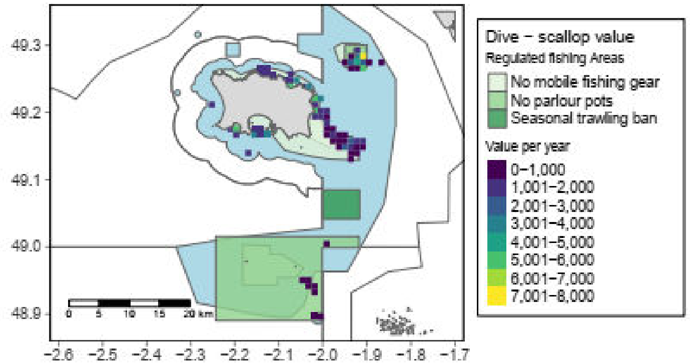
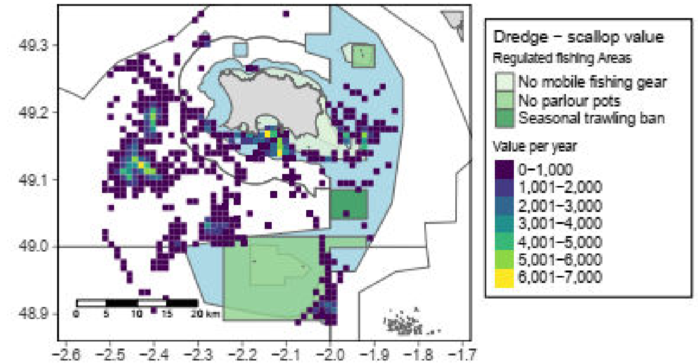
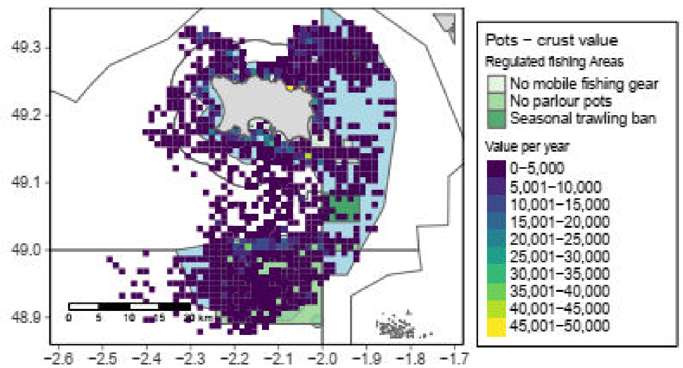
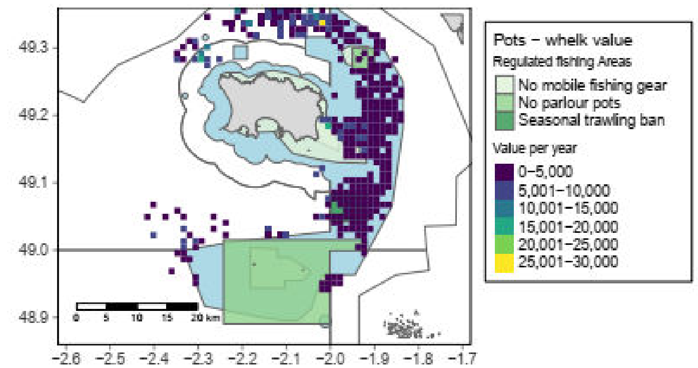
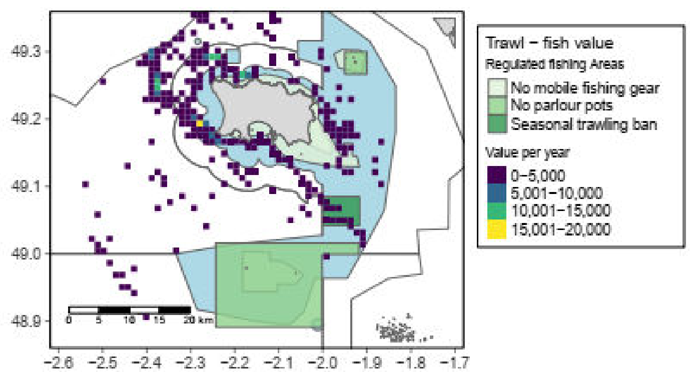
Annex 1. Jersey key metiers average (2015 – 2019) value (£)



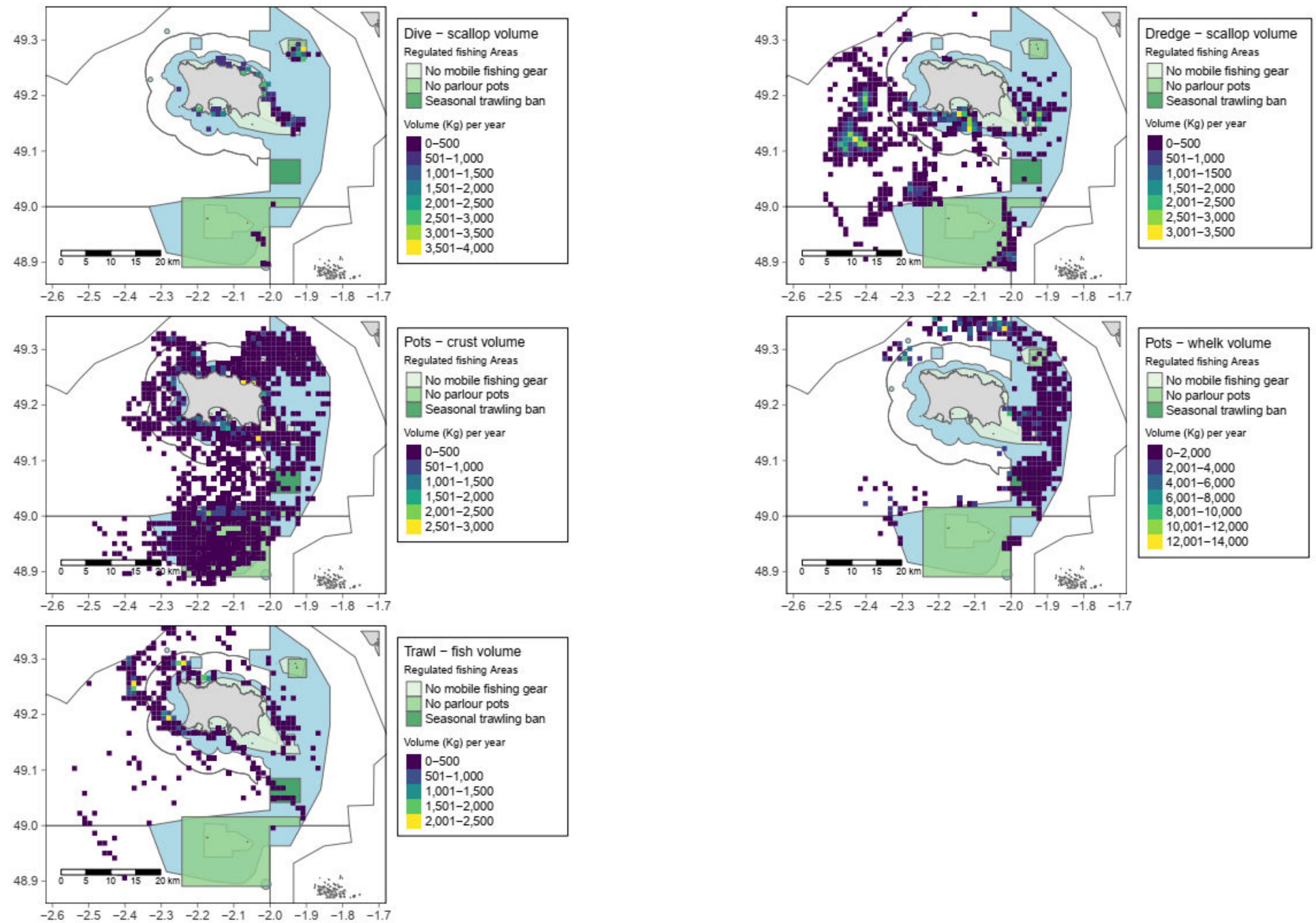






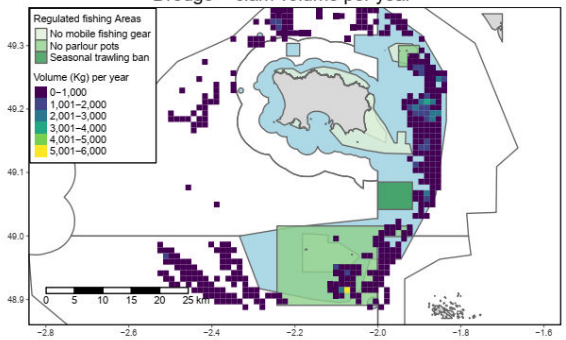


Annex 2. Jersey key metiers average (2015 – 2019) volume (Kg)

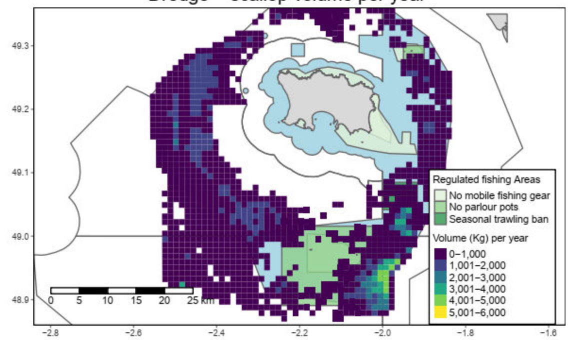


Annex 3. French vessel key metiers average landed volume (Kg) 2015-2019

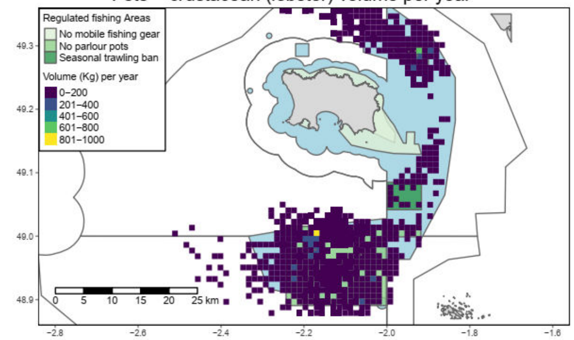
Dredge – clam volume per year



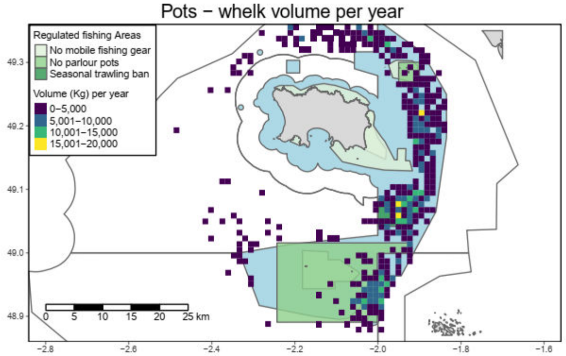
Dredge – scallop volume per year



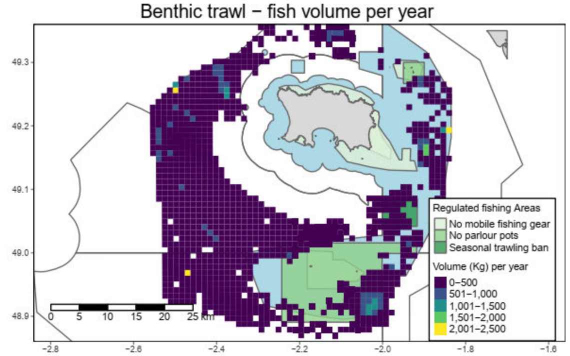
Pots – crustacean (lobster) volume per year



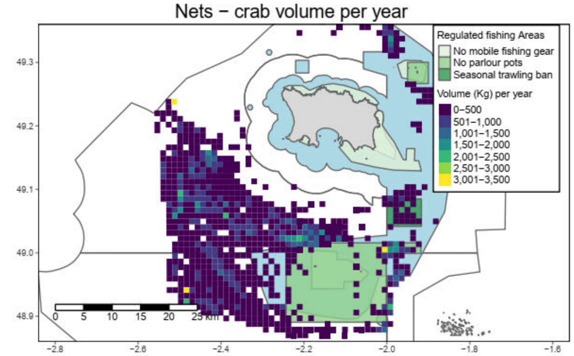
Pots – whelk volume per year



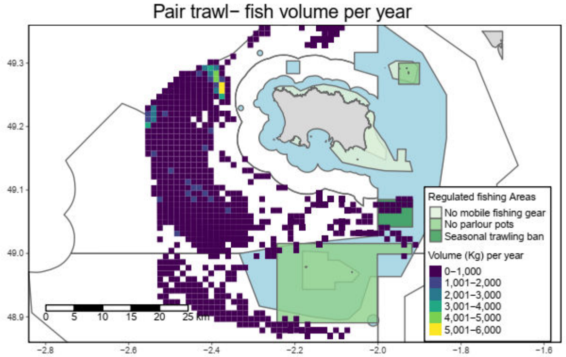
Benthic trawl – fish volume per year



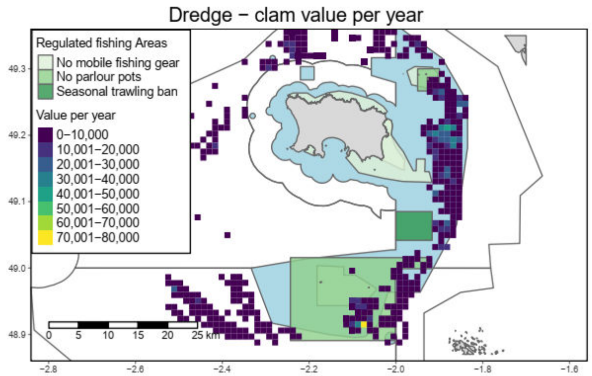
Nets – crab volume per year

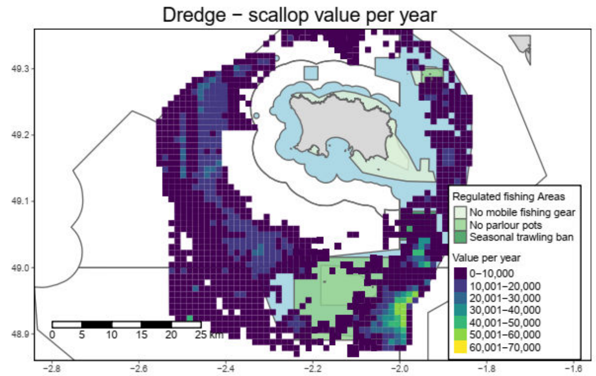


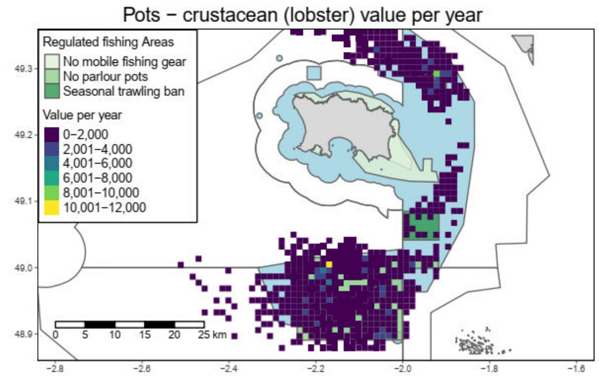
Pair trawl– fish volume per year

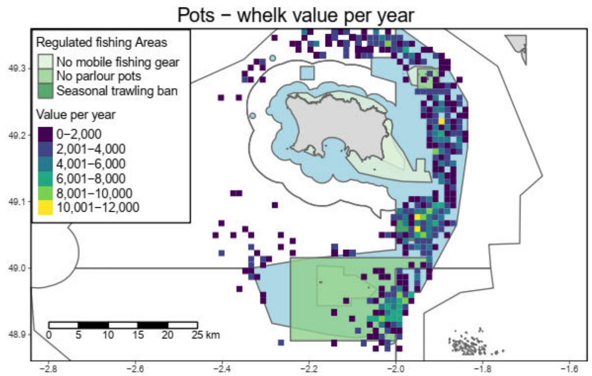


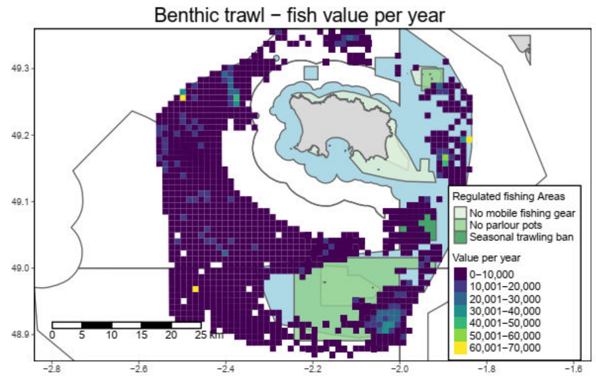
Annex 4. French vessel key metiers average value (€) 2015 - 2019

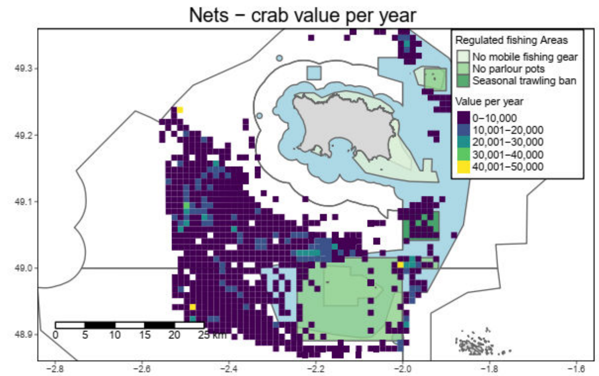


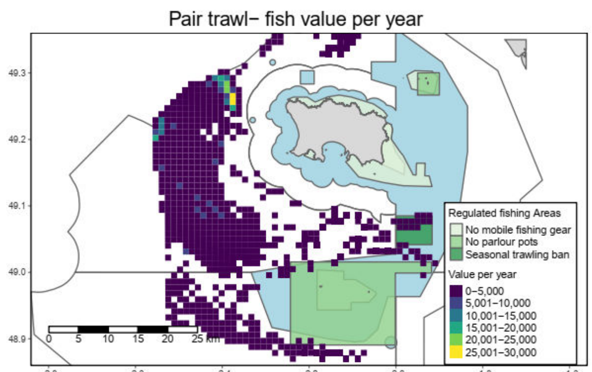












Annex 5. Relative importance of marine habitats (first matrix) and species (second matrix) in providing ecosystem services and goods/benefits. Source: Potts et al. (2014)

Feature Type[1]	EUNIS code (Note: Eunis codes were identified using the JNCC EUNIS translation matrix. Some habitats do not have a direct relationship to the EUNIS code and this column should only be used as a guide.)	Feature	Intermediate services											Goods/Benefits													
			Supporting services							Regulating services				from Provisioning services					from Regulating services					from Cultural services			
			Primary production	Larval / Gamete supply	Nutrient cycling	Water cycling	Formation of species habitat	Formation of physical barriers	Formation of seascape	Biological control	Natural hazard regulation	Regulation of water & sediment quality	Carbon sequestration	Food	Fish feed	Fertiliser	Ornaments (incl. aquaria)	Medicine & blue biotechnology	Healthy climate	Prevention of coastal erosion	Sea defence	Clean water and sediments	Immobilisation of pollutants	Tourism / Nature watching	Spiritual / Cultural wellbeing	Aesthetic benefits	Education
Broad Scale Habitat																											
E,W	A1.1	High energy intertidal rock	3	2	3		2	1	1		1		2	3					2	1	1			1	1	1	1
E,W	A1.2	Moderate energy intertidal rock	3	2	3		2	1			1		2	3					2	1	1			1	1	1	1
E,W	A1.3	Low energy intertidal rock	3	2	3		2	1			1		2	3					2	1	1			1	1	1	1
E,W	A2.1	Intertidal coarse sediment	1	3	1		3	1	1		3			1						3	3			1	1	1	1
E,W	A2.2	Intertidal sand and muddy sand	3	3	3		3	1	3		3		2	1					2	3	3			1	1	3	1
E,EU	A2.4	Intertidal mixed sediments	3	3	3		3	1	1		3		2	1					2	3	3			1	1	1	1
E,W	A2.3	Intertidal mud	3	3	3		1		1		3	3	3	3					3	3	3	3	3	1	1	1	1
E	A2.5	Coastal saltmarshes and saline reedbeds	2	3	3		3	3	3		3	3	3	3		3			3	3	3	3	3	3	1	3	1
E,EU,W	A2.6	Intertidal sediments dominated by aquatic angiosperms	2		3		2	1	1		1	3	1	3		3			1	1	1	1	1	1	1		1
E,EU,W	A2.7	Intertidal biogenic reefs	1	1	2		3		1		2	1	1	2					1	2	2	2	2	1	1		1
E,W	A3.1	High energy infralittoral rock*	2	2			2	1			1			3						1	1			1	1		1
E,W	A3.2	Moderate energy infralittoral rock*	2	2			2	1			1			3						1	1			1	1		1
E,W	A3.3	Low energy infralittoral rock*	2	2			2	1			1									1	1			1	1		1
E,W	A4.1	High energy circalittoral rock**	2	2			2	1			1			1						1	1			1	1		1
E,W	A4.2	Moderate energy circalittoral rock**	2	2			2	1			1			1						1	1			1	1		1
E,W	A4.3	Low energy circalittoral rock**	2	2			2	1			1			1						1	1			1	1		1
E,W	A5.1	Subtidal coarse sediment	3	3	3		3				3	1		2	3					3	3	3	1		1		1
S	A5.1, A5.2	Offshore subtidal sands and gravels	1	1	1		1	1		1	1	1		1	3	1	1	1	1	1	1	1	1	1	1		1
E,W	A5.2	Subtidal sand	3	3	3		3				3	1		2	3					3	3	3	1		1		1
E,W	A5.3	Subtidal mud	3	3	3		3				3	1		2	3					3	3	3	3		1		1
E,EU,W	A5.4	Subtidal mixed sediments	3	3	3		3				3	1		2	3					3	3	3	3		1		1
W	A5.4, A5.3	Subtidal mixed muddy sediments	3	3	3		3				3	1		2	3					3	3	3	3		1		1
E,EU,W	A5.5	Subtidal macrophyte-dominated sediment	3	2	2		2				1	2	2	3		3			2	1	1	2	2	1	1		1
E,EU,W	A5.6	Subtidal biogenic reefs	1	2	3		2				3	3	1	3			1		1	2	2	3	1	1	1		1
S	A7.4, A7.7	Salinity fronts	1	1	1		1	1		1	1	1	1	1		1	1	1	1	1	1	1	2	1	1		1
S	Various	Low or variable salinity habitats	1	1	1		1	1	1	1	1	1		1		1	1	1	1	1	1	1	1	1	1	1	3
EU	X02	Saline lagoons		3	3		3		1					1										1	1		1
Habitats																											
E	A1.32	Estuarine rocky habitats	1	1			2		1		1			1						1	1			1	1	1	1
E,W	A1.2142, A3.2112	Intertidal under boulder communities	1	1			2				1			2						1	1			1	1	1	1
E	A1.127, A1.223, A4.231	Peat and clay exposures		1			2																	1	1		1
S	A1.325	Sea loch egg wrack beds	1	1	1		1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1		1
E	A1.441, B3.114, B3.115	Littoral chalk communities	1	1			3																	1	1		1
EU	A1.44	Submerged or partially submerged sea caves					1		1															1	1		1
E,S,W	A2.2, A2.7, A5.6	Blue Mussel beds	1	1	1		1	1	1	1	1	3	1	2		2	1	1	1	1	1	1	1	1	1		1
E,W	A2.71	Honeycomb worm *Sabellaria alveolata* reef		1	1		3	1		1	2	1	1	1					1	1	1	1	1	1	1		1
S	A3.126, A3.213	Tide-swept algal communities (Laminaria hyperborea, Halidrys siliquosa)	1	1	1		1	1	1	1	1	1	1	1		1		1	1	1	1	1	1	1	1	1	1
S	A3.126, A3.213, A1.15	Tide-swept algal communities	1	1	1		1	1	1	1	1	1	1	1		1		1	1	1	1	1	1	1	1	1	1
E,W	A4.12, A4.12	Fragile sponge&anthozoan communities on subtidal rocky habitats		1			3			1				3									1	3	1		1
W	A4.131, A4.2122	Subtidal rock with Ross 'coral' Pentapora foliacea		1			2			1				1									1	3	1		1
S	A4.133, A4.211	Northern sea fan and sponge communities					1		1														1			1	
E	A4.22	Ross worm *Sabellaria spinulosa* reefs		1	1		3	1		1	1	1	1	1					1	1	1	1	1	1	1		1
E	A4.23	Subtidal chalk		1			2																	1	1	1	1
E	A5.12, A5.13	Subtidal sands and gravels	1	1	1		2					1		2	3							1		1	1		1
S	A5.133	Shallow tide-swept coarse sands with burrowing bivalves (Morella sp.)			1		1					1		1								1			1		1
E,S	A5.361	Sea-pen and burrowing megafauna communities	1	1	2		3	1	1	1	1	1	1	2		1	1	1	1	1	1	1	1	1	1	1	1
S	A5.371	Inshore deep mud with burrowing heart urchins	3	3	3		3				3	1		2						3	3	3	3		1		1
W	A5.371	Mud habitats in deep water	3	3	3		3				3	1		2	3					3	3	3	3		1		1
E,W	A5.43, A2.41, A2.42	Sheltered muddy gravels		1	1		2					1	1	2					1			1		1	1		1
E,S	A5.434	Flame/ File shell beds	1	1	3		3		1	1	3		1	3					1	1	1		1	1	1	1	1
E,S,W	A5.435	Native Oyster *Ostrea edulis* beds		1	1		1		1	1	1	1	1	3					1	1	1	1	1	1	1	1	1
All	A5.51	Maerl beds	3	1	1		3	1	1	1				3		1	1							1	1	1	1
S	A5.5112	Maerl or coarse shell gravel with burrowing sea cucumbers	3	1	1		3	1	1	1				3		1	1							1	1		1
S	A5.52	Kelp and seaweed communities on sublittoral sediment	1	1	1		1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1
All	A5.53, A5.545, A2.61	Seagrass beds	2	1	2		3	1	1	2	1	2	2	3		2	2	1	2	2	2	2	2	2	1	2	1
E,S,W	A5.62	Horse mussel (*Modiolus modiolus*) beds	1	1	1		3	1	1	1	1	1	1	1		1	1	3	1	1	1	1	1	1	1	1	1
E	A5.63	Cold-water coral reefs		1	1		2	3					1	1					1					1	1	2	1
EU	A5.71	Submarine structures made by leaking gases			1		3							1				1							1		1
E,S	A6.61	Coral Gardens	1	1	1		3	1	1	1	1	1	1	1		1	3	1	1	1	1	1		1	1	1	1
S	A6.75	Carbonate mound communities	1	1	1		1	1		1	1	1	1	1		1	1	1	1	1	1	1		1	1		1
E,W	Various	Tide-swept channels		1			1																	1	1		1
W	Various	Sediment habitats with long lived bivalves			2		1	1		1		1		1								1	1	1	1		1
E	N/A	Areas of high planktonic primary productivity	3	1	3		1	1		1	1		2	2	3				2	1	1	1	1	1	1		1

Scale of ecosystem service supplied relative to other features

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Confidence in evidence

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- 1 Expert opinion
- Not assessed

Feature type†

- S Scottish MPA search feature
- E English MCZ feature
- W Welsh HP MCZ feature
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Feature Type †	Species Names	Scientific Name	Intermediate Services											Goods/Benefits													
			Supporting services							Regulating services				from Provisioning services					from Regulating services					from Cultural services			
			Primary production	Larval / Gamete supply	Nutrient cycling	Water cycling	Formation of species habitat	Formation of physical barriers	Formation of seascape	Biological control	Natural hazard regulation	Regulation of water & sediment quality	Carbon sequestration	Food	Fish feed	Fertiliser	Ornaments (incl. aquaria)	Medicines & blue biotechnology	Healthy climate	Prevention of coastal erosion	Sea defence	Clean water and sediments	Immobilisation of pollutants	Tourism / Nature watching	Spiritual / Cultural wellbeing	Aesthetic benefits	Education
Low or limited mobility species																											
E, W	Peacock's tail	*Padina pavonica*	2		1		2							1		1		1									1
E, W	Burgundy maerl paint	*Cruoria cruoriaeformis*	1	1	1		1	1		1				1		1	1							1	1		1
E, W	Grateloup's little-lobed weed	*Grateloupia montagnei*	1	1	1		1	1		1				1		1	1							1	1		1
E, W	Coral maerl	*Lithothamnion corallioides*	3	1	1		3	1	1					3		1	1								1		1
E, W	Common maerl	*Phymatolithon calcareum*	3	1	1		3	1	1					3		1	1								1		1
W	Bearded red seaweed	*Anotrichium barbatum*	1											1											1		1
E	Tentacled lagoon-worm	*Alkmaria romijni*	1											1											1		1
E	Lagoon sandworm	*Armandia cirrhosa*	1											1											1		1
E	Giant goby	*Gobius cobitis*	1											2										1			1
E	Couch's goby	*Gobius couchi*	1											3										1			1
E	Long snouted seahorse	*Hippocampus guttulatus*	1	3					1					2			1	1						1	3		3
E	Short snouted seahorse	*Hippocampus hippocampus*	1	3					1					2			1	1						1	3		3
E	Trembling sea mat	*Victorella pavida*	1											1											1		1
S, W	Burrowing sea anemone aggregations	*Arachnanthus sarsi*	1		1		1	1						1										1	1		1
E	Sea-fan anemone	*Amphianthus dohrnii*	1				1		1					1											1		1
E,W	Pink sea-fan	*Eunicella verrucosa*	1				1		1					1										1	1		3
E,W	Kaleidoscope jellyfish	*Haliclystus auricula*	1											1													1
E	Sunset cup coral	*Leptopsammia pruvoti*	1				2		1					1										3			1
E,W	Stalked jellyfish	*Lucernariopsis campanulata*	1											1													1
E	St. John's jellyfish	*Lucernariopsis cruxmelitensis*	1											1													1
E	Starlet sea anemone	*Nematostella vectensis*	1											1													2
E	Lagoon sand shrimp	*Gammarus insensibilis*	1											1													1
E	Gooseneck barnacle	*Pollicipes pollicipes*	1				3		1					3										1			1
E, S	Spiny lobster	*Palinurus elephas*	1	1	1		1	1	1					3		1	1	1	1	1		1		1	1	1	1
E, S, W	Ocean quahog	*Arctica islandica*	1						1		1			3										1	1		1
E, S, W	Fan mussel	*Atrina pectinata*	1				1		1					1			1					1		1	1		1
E	Defolin's lagoon snail	*Caecum armoricum*	1											1											1		1
E, W	Native oyster	*Ostrea edulis*	1		1		1		1	1	1	1	1	3					1	1	1	1	1	1	1		1
E	Sea snail	*Paludinella littorina*	1											1													1
E	Lagoon sea slug	*Tenellia adspersa*	1						1					1													1
W	Smooth venus clam	*Callista chione*	1											1				2							1		2
S	Heart cockle aggregations	*Glossus humanus*	1											1										1	1		1
S	Northern feather star aggregations on mixed substrata	*Leptometra celtica*	1						1					1										1	1		1
Highly mobile species																											
EU	Allis shad	*Alosa alosa*	1	3	3									1										1			1
EU	Twaite shad	*Alosa fallax*	1	3	3									1										1			1
EU	Atlantic salmon	*Salmo salar*	1	3	3									3										3	1	2	1
EU	Sea lamprey	*Petromyzon marinus*	1	3					1	2				2										1			1
EU	River lamprey	*Lampetra fluviatilis*	1	3						2				2										1			1
E	Smelt	*Osmerus eperlanus*	1	3										3			3							3	1		1
E	European eel	*Anguilla anguilla*	1	3	1		2							3			3							1	1	1	1
S	Blue ling	*Molva dypterygia*	1	1	1		1	1						1		1	1	1	1	1		1		1	1	1	1
S	Orange roughy	*Hoplostethus atlanticus*	1											2										1	1		1
S	Sandeels		1											1	3									1	1	1	1
E	Undulate ray	*Raja undulata*	1											1													1
S	Basking shark	*Cetorhinus maximus*	1	1	1		1	1	1					1		1	1	1	1	1		1		1	1	2	1
S	Common skate	*Dipturus batis*	1	1	1		1		1					3										1	1	1	1
EU	Grey seal	*Halichoerus grypus*	1						1															3		2	3
EU	Common seal	*Phoca vitulina*	1						1															3		2	3
EU, S	Bottlenose dolphin	*Tursiops truncatus*	1	1	1		1	1	1	1	1	1		1		1	1	1	1	1		1		3	3	3	1
EU, S	Harbour porpoise	*Phocoena phocoena*	1	1	1		1	1	1	1	1	1		1		1	1	1	1	1		1		3	3	3	1
S	Minke whale	*Balaenoptera acutorostrata*	1	1	1		1	1	1	1	1	1		1		1	1	1	1	1		1		2	1	1	1
S	Risso's dolphin	*Grampus griseus*	1	1	1		1	1	1	1	1	1		1		1	1	1	1	1		1		1	1	1	1
S	White-beaked dolphin	*Lagenorhynchus albirostris*	1	1	1		1	1	1	1	1	1		1		1	1	1	1	1		1		1	1	1	1
EU	Otter	*Lutra lutra*	1						1															3	3	1	3
S	Black guillemot	*Cepphus grylle*	1	1	1		1	1	1					1		1	1	1	1	1		1		1	1	1	1

Scale of ecosystem service supplied relative to other features

- # Significant contribution
- # Moderate contribution
- # Low contribution
- # No or negligible ESP
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Confidence in evidence

- 3 UK-related, peer-reviewed literature
- 2 Grey or overseas literature
- 1 Expert opinion
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Feature type †

- S Scottish MPA search feature
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Annex 6. Overview of UK valuation studies published between 2000 and 2013 in peer-reviewed literature. Source: Turner et al. 2014.

Ecosystem service	Habitat	Case study and reference	Valuation method	Value as reported in study (£/yr)	Value in 2012 prices (£/yr unless stated otherwise)
Products: Fisheries (nursery)	Salt marshes	contribution to commercial fishing of Blackwater realignment (Luisetti *et al.*, 2011)	Market prices	7.43-11.55/ha (2007) (after 5 years)	8.27-12.86/ha (after 5 years)
Products: Fisheries	UK coast/ open sea	Cod fisheries in North Sea (Crilly & Esteban, 2013)	Gross value	12M in 3 years (2006-2008)	4.4M
		Fisheries and (shell)fish farming (Austen *et al.*, 2010 ; Beaumont *et al.*, 2010)	Gross value	Fisheries: 596M (2010) Fish farms: 327M (2007) Shellfish farms: 23M (2007)	Fisheries: 619M Fish farms: 364M Shellfish farms: 26M
Healthy climate	Dunes	(Beaumont *et al.*, 2010)	Abatement costs (DECC)	32–242/ha (2010)	33-251/ha
	Salt marsh & mudflats	(Andrews *et al.*, 2006)	SCC	12/ha (2004-05)	14/ha
		(Shepherd *et al.*, 2007)	SCC	11-45/ha (2004-05)	13-53/ha
	Salt marshes	(Luisetti *et al.*, 2011)	Various prices (4-230/tC)	1-770/ha (2007)	1-865/ha
		(Beaumont *et al.*, 2010)	Abatement costs (DECC)	61–622/ha (2010)	63-646/ha
	Sea grasses	(Luisetti *et al.*, 2013a)	Various prices: DECC (54), (SCC (3.33-233/tC))	-	103/ha (6.36-445/ha)
	Coastal shelf	(Beaumont *et al.*, 2010)	Abatement costs (DECC)	6.74 billion	Total: 7 billion (+/-50%)
Coastal erosion prevention	Shingle bank (beach)	Recreational values of freshwater marshes protected by shingle bank (Bateman *et al.*, 2001)	TC CV	TC: 50/hh/visit (2000) CV: 1.58-62.08/hh (2000)	TC: 66/hh/visit CV: 2-81/hh

Ecosystem service	Habitat	Case study and reference	Valuation method	Value as reported in study (£/yr)	Value in 2012 prices (£/yr unless stated otherwise)
Sea defence	Dunes	(Beaumont *et al.*, 2010)	Replacement costs	England: 174-520M (2010); Wales: 54Bn (2010)	England: 181- 540M; Wales: 56Bn
		(Van der Meulen *et al.*, 2008)	Management costs	285- 1800 €/ha (2001)	309-1949/ha
	Shingle beaches	(Beaumont *et al.*, 2010)	Replacement costs	England: 0.79Bn (2010)	England: 0.82Bn
	Salt marshes and mudflats	(Andrews *et al.*, 2006)	Cost based (replacement/ avoided)	Capital costs: 878,159/km; opportunity costs: 2282-2,576/ha; savings on investments (one off): 668,441/km; maintenance costs savings: 3,170-3,560/km	Capital costs: 1,033,420/km; opportunity costs: 2,685-3,031/ha; savings on investments (one off): 786,623/km; maintenance costs savings: 3,730-4,189/km
		(Shepherd *et al.*, 2007)	Cost based (avoided costs)	maintenance costs savings: 4,206/km; (5,546->1,340)	maintenance costs savings: 4,950/km; (6,527->1,577)
	Salt marshes	(Beaumont *et al.*, 2010)	Net replacement costs Replacement costs	England: 2.17Bn (2010) 1,500-3,500/m wall (1994) 2,600-4,600/m wall (1994) 3.7-6.6Bn (1994)	England: 2.25Bn; 2,225-5,191/m wall; 3,856-6,822/m wall 5.5-9.7 Bn
Tourism and nature watching	All	Coastal recreation (Sen *et al.*, in press)	Meta-analysis	3.96/trip (2011) England: 38 M	4/trip England: 39M
	Beaches	Norfolk EC Bathing Water Directive (Georgiou *et al.*, 2000)	CV	35.73/hh (1997)	49/hh
		Norfolk beach replenishment (Bateman *et al.*, 2001)	CV	25.84 - 31.62/hh (local – holiday) Total: 741,517 (2000)	34-41/hh (local – holiday) Total: 971,640
		Coastal water quality in Scotland (Hanley *et al.*, 2003)	TC, Contingent behaviour	0.48/trip (5.81/pp/yr) (1999); Total 1.25M	0.63/trip (7.66/pp) Total: 1.65M
		Beach protection (Christie & Gibbons, 2011)	CE	Beach safety: 33.4/hh (2006); Surfing conditions: 14.5/hh (2006)	Beach safety: 38/hh; Surfing conditions: 16.5/hh
	Cliffs, small islands	Lundy Island Marine Nature Reserve (Chae *et al.*, 2012)	TC	359-574/trip (2005)	420- 672/trip
	Salt marshes	Blackwater managed realignment (Luisetti *et al.*, 2011)	CE	Total for case study area: 4,429-8,348 (2006) Access: 4.31/hh (2006) Area (ln (ha)): 1.11/hh (2006)	Total for case study area: 5,041-9,501 Access: 4.91/hh Access (ln(ha)): 1.36/hh
	Coastal shelf	Seal conservation in England (Bosetti & Pearce, 2003)	CV	8-9/view (seal conservation) (2000)	10-12/view
		Whale-tourism in West-Scotland (Parsons *et al.*, 2003)	Gross value	Whale-tourism: 1.77 M (2000); Total: 6 M (2000)	Whale-tourism: 2.3 M Total: 7.9 M
		Sea angling in England (Lawrence, 2005)	CE	Per day-trip: 5.60-12.45 (2004)	Per day-trip: 6.72-14.93
		Lyme Bay, England (Rees *et al.*, 2010)	Gross value	18.3M (angling, diving, wildlife watching: 13.7, 1, 3.5) (2008)	19.8M (angling, diving, wildlife watching: 14.8; 1.1; 3.8 M)
		Biodiversity related recreation in Wales (Ruiz Frau *et al.*, 2012)	Gross value (financial revenues)	Diving: 7.8M; kayaking: 2.5M; boating: 13.4M (2008); seabird watching: 3.7M (2009)	Diving: 8.4M; kayaking: 2.7M; boating: 14.5M; seabird watching: 3.9M
Spiritual and cultural wellbeing and aesthetic benefits of wild species and seascapes	Salt marshes	Blackwater managed realignment (Luisetti *et al.*, 2011)	CE	Additional bird species: 1.84–3.57/hh (2006)	Additional bird species: 2.09-4.06/hh
	Intertidal wetlands	Otter and bird protection (Birol & Cox, 2007)	CE	Otter hold creation: 31.6/pp; Protecting birds: 1.2/pp	Otter hold creation: 37.19/pp; Protection birds: 1.41/pp
	Coastal shelf	MPAs in the UK (McVittie & Moran, 2010)	CE	Halting loss of biodiversity and ES: England: 69/hh; Wales: 107/hh, Scotland: 21/hh, NI: 34/hh (2008) Increasing biodiversity: England: 69/hh, Wales: 61/hh, Scotland: 24/hh, NI: 38/hh (2008).	Halting loss of biodiversity and ES: England: 75/hh; Wales: 116/hh; Scotland: 23/hh, NI: 37/hh. Increasing biodiversity: England: 75/hh, Wales: 66/hh, Scotland: 26/hh, NI: 41/hh.
		Marine species conservation (Ressurreicao *et al.*, 2011; 2012)	CE		Mammals: 43-49/hh; Birds: 39-44/hh; Fish 38-43/hh; Invertebrates: 36-41/hh; Algae: 46-53/hh. All one-off payments.
		Seal conservation in England (Bosetti & Pearce, 2003)	CV	Non-use: 526,000 (2000)	Total: 689,239

Note: M: million.

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	Shingle beaches	(Beaumont *et al.*, 2010)	Replacement costs	England: 0.79Bn (2010)	England: 0.82Bn
	Salt marshes and mudflats	(Andrews *et al.*, 2006)	Cost based (replacement/ avoided)	Capital costs: 878,159/km; opportunity costs: 2282-2,576/ha; savings on investments (one off): 668,441/km; maintenance costs savings: 3,170-3,560/km	Capital costs: 1,033,420/km; opportunity costs: 2,685-3,031/ha; savings on investments (one off): 786,623/km; maintenance costs savings: 3,730-4,189/km
		(Shepherd *et al.*, 2007)	Cost based (avoided costs)	maintenance costs savings: 4,206/km; (5,546->1,340)	maintenance costs savings: 4,950/km; (6,527->1,577)
	Salt marshes	(Beaumont *et al.*, 2010)	Net replacement costs Replacement costs	England: 2.17Bn (2010) 1,500-3,500/m wall (1994) 2,600-4,600/m wall (1994) 3.7-6.6Bn (1994)	England: 2.25Bn; 2,225-5,191/m wall; 3,856-6,822/m wall 5.5-9.7 Bn
Tourism and nature watching	All	Coastal recreation (Sen *et al.*, in press)	Meta-analysis	3.96/trip (2011) England: 38 M	4/trip England: 39M
	Beaches	Norfolk EC Bathing Water Directive (Georgiou *et al.*, 2000)	CV	35.73/hh (1997)	49/hh
		Norfolk beach replenishment (Bateman *et al.*, 2001)	CV	25.84 - 31.62/hh (local – holiday) Total: 741,517 (2000)	34-41/hh (local – holiday) Total: 971,640
		Coastal water quality in Scotland (Hanley *et al.*, 2003)	TC, Contingent behaviour	0.48/trip (5.81/pp/yr) (1999); Total 1.25M	0.63/trip (7.66/pp) Total: 1.65M
		Beach protection (Christie	CE	Beach safety: 33.4/hh	Beach safety: 38/hh;

Ecosystem service	Habitat	Case study and reference	Valuation method	Value as reported in study (£/yr)	Value in 2012 prices (£/yr unless stated otherwise)
		& Gibbons, 2011)		(2006); Surfing conditions: 14.5/hh (2006)	Surfing conditions: 16.5/hh
	Cliffs, small islands	Lundy Island Marine Nature Reserve (Chae *et al.*, 2012)	TC	359-574/trip (2005)	420- 672/trip
	Salt marshes	Blackwater managed realignment (Luisetti *et al.*, 2011)	CE	Total for case study area: 4,429-8,348 (2006) Access: 4.31/hh (2006) Area (ln (ha)): 1.11/hh (2006)	Total for case study area: 5,041-9,501 Access: 4.91/hh Access (ln(ha)): 1.36/hh
	Coastal shelf	Seal conservation in England (Bosetti & Pearce, 2003)	CV	8-9/view (seal conservation) (2000)	10-12/view
		Whale-tourism in West-Scotland (Parsons *et al.*, 2003)	Gross value	Whale-tourism: 1.77 M (2000); Total: 6 M (2000)	Whale-tourism: 2.3 M Total: 7.9 M
		Sea angling in England (Lawrence, 2005)	CE	Per day-trip: 5.60-12.45 (2004)	Per day-trip: 6.72-14.93
		Lyme Bay, England (Rees *et al.*, 2010)	Gross value	18.3M (angling, diving, wildlife watching: 13.7, 1, 3.5) (2008)	19.8M (angling, diving, wildlife watching: 14.8; 1.1; 3.8 M)
		Biodiversity related recreation in Wales (Ruiz Frau *et al.*, 2012)	Gross value (financial revenues)	Diving: 7.8M; kayaking: 2.5M; boating: 13.4M (2008); seabird watching: 3.7M (2009)	Diving: 8.4M; kayaking: 2.7M; boating: 14.5M; seabird watching: 3.9M

Ecosystem service	Habitat	Case study and reference	Valuation method	Value as reported in study (£/yr)	Value in 2012 prices (£/yr unless stated otherwise)
Spiritual and cultural wellbeing and aesthetic benefits of wild species and seascapes	Salt marshes	Blackwater managed realignment (Luisetti *et al.*, 2011)	CE	Additional bird species: 1.84–3.57/hh (2006)	Additional bird species: 2.09-4.06/hh
	Intertidal wetlands	Otter and bird protection (Birol & Cox, 2007)	CE	Otter hold creation: 31.6/pp; Protecting birds: 1.2/pp	Otter hold creation: 37.19/pp; Protection birds: 1.41/pp
	Coastal shelf	MPAs in the UK (McVittie & Moran, 2010)	CE	Halting loss of biodiversity and ES: England: 69/hh; Wales: 107/hh, Scotland: 21/hh, NI: 34/hh (2008) Increasing biodiversity: England: 69/hh, Wales: 61/hh, Scotland: 24/hh, NI: 38/hh (2008).	Halting loss of biodiversity and ES: England: 75/hh; Wales: 116/hh; Scotland: 23/hh, NI: 37/hh. Increasing biodiversity: England: 75/hh, Wales: 66/hh, Scotland: 26/hh, NI: 41/hh.
		Marine species conservation (Ressurreicao *et al.*, 2011; 2012)	CE		Mammals: 43-49/hh; Birds: 39-44/hh; Fish 38-43/hh; Invertebrates: 36-41/hh; Algae: 46-53/hh. All one-off payments.
		Seal conservation in England (Bosetti & Pearce, 2003)	CV	Non-use: 526,000 (2000)	Total: 689,239

Note: M: million.