Department for Environment Food & Rural Affairs

Proposed Fisheries Management Plan for queen scallop in English waters

Supporting document: Evidence Statement

Date: October 2024

Department for Environment, Food and Rural Affairs (Defra) would like to acknowledge the advice, evidence and support that has been provided by the Centre for Environment, Fisheries and Aquaculture Science (Cefas), Joint Nature Conservation Committee (JNCC), Marine Management Organisation (MMO), Natural England (NE), ABP Mer consultants and our stakeholders, throughout the development of this Fisheries Management Plan (FMP).

Contents

Introduction

This Evidence Statement contains evidence on the targeting and landing of queen scallop in English waters, as well as the life history and stock assessment of these species, and environmental considerations. Evidence relating to the objectives of the queen scallop FMP is included within the main FMP.

All of the fisheries data included within this FMP are considered to be accurate at the time of compilation, and represents the best available data at the time of drafting (October 2024). Fisheries data inherently is variable due to retrospective amendments and corrections to reported data meaning revisions of a dataset may differ from another. Issues can sometimes be identified via ongoing data quality and assurance checks and retrospectively amended.

Moreover, the methods used to produce estimates are constantly being assessed, iterated, and improved meaning those figures requiring additional processing may vary slightly compared to other similar datasets depending on the methods in use. Assumptions have been made (e.g. even distribution of landings across ICES rectangles) in order to apportion the data to the FMP area resulting in uncertainty in the absolute landings figures. In addition, fluctuations between years may need to be interpreted with caution due to the uncertainties described above in the data sets.

Over the summer of 2024 an issue with underreporting of landings was identified. This was found to have occurred on a very small scale but over an extended period and at the time of writing steps are being taken to address the problem. Any resultant amendments to the data presented here will be considered in due course.

Overview of the fishery

This FMP applies to queen scallop (Aequipecten opercularis) in English waters only.

Methods

The following information is generated from the MMO and Seafish. MMO UK landings data were extracted from the Sea Fisheries Statistics Annual Publication (UK sea fisheries annual statistics report 2021 - GOV.UK (www.gov.uk). EU landings data were extracted from 2022 DCF Fisheries Dependent Information (FDI) (Fisheries Dependent Information - European Commission (europa.eu)) data call. Data were processed by MMO internal analysis to produce English and UK waters estimates.

This report also includes data collected by Seafish during the Fleet Economic Surveys and is estimated based on the methodology described in the UK Economic Fleet Estimates and Fleet Enquiry Tool (UK Economic Fleet Estimates and Fleet Enquiry Tool - Methodology Report — Seafish) as well as information shared with Seafish as part of Data Collection Framework by MMO. All data has been apportioned to the FMP area and only includes UK vessels other than if stated.

All economic data is collected and estimated by Seafish fleet segments, which group all vessels catching different species using different gears to 33 homogeneous groups. To separate economic values by FMP area and specific species individual vessel level economic performance and employment indicators were partitioned following these steps:

1. Individual vessels landings by rectangle were partitioned to FMP area based on MMO methodology published as part of the UK commercial sea fisheries landings by Exclusive Economic Zone of capture report (UK commercial sea fisheries landings by Exclusive Economic Zone of capture report 2019 - GOV.UK (www.gov.uk)).
2. The FMP stock/species economic dependency for each vessel in the fleet in relevant years was calculated. The calculations are based on associated species and FMP area definition calculated as part of step 1.
3. FMP economic dependency at vessel level is multiplied by each economic variable to obtain GVA (Gross Added Value), operating profit, net profit, and FTE (full time equivalent jobs) by FMP stock/species (assumption: all stocks/species landed by vessel are contributing to the total economic results by the same share as value landed).
4. All results calculated at vessel level are summarised to FMP level.

Commercial fishing methods and geographical location

Distribution within FMP area

Queen scallops are distributed predominantly around Great Britain. Their distribution extends northwards to Shetland, north-eastwards to the southern coast of Scandinavia, and southwards into the Mediterranean.

All scallop species have a highly aggregated spatial distribution within their geographical range (Brand, 2006a), referred to as beds. Some beds are essentially permanent, fairly specific in their location and separated by clearly demarked areas that are unsuitable for scallops, while others vary in their location from year to year, resulting from sporadic settlement or differences in early survival (Andrews et al 2011). The more permanent beds appear to be in areas where oceanographic features ensure a regular larval supply (Sinclair et al., 1985), but temperature, food availability and substrate are also important factors influencing settlement. Not all suitable substrates support high densities of queen scallops (Andrews et al 2011). Aggregations of queen scallops big enough to support commercial fisheries are relatively few in number and widely separated, notably in the western English Channel, Kish Bank, the north Irish Sea, Clyde, Orkney, Shetland, a few locations in the North Sea, the Kattegat and around the Faroes (Brand, 2006a). Of these, the largest and most valuable fisheries have usually been in the north-eastern Irish Sea, around the Isle of Man, though in recent years the fisheries around Faroes and occasionally the western Channel (with landings into France) have produced high landings (Brand, 2006b).

The queen scallop FMP only applies to fishing activity within English waters, which lie within International Council for the Exploration of the Sea (ICES) Divisions 4b (Central North Sea), 4c (Southern North Sea), 7d (Eastern English Channel), 7e (Western English Channel), 7h (Southern Celtic Sea), 7j (Southwest of Ireland), 7g (Northern Celtic Sea), 7f (Bristol Channel), and 7a (Irish Sea). However, due to the sparsity of information on queen scallop fisheries in English waters, and to provide a wider overview, this report also includes data and descriptions of assessments and management measures in other parts of the UK Exclusive Economic Zone (EEZ). The north-eastern Irish Sea is the location of the main queen scallop grounds in English waters, with opportunistic landings also reported in the Western Channel in some years. There are no clear trends in the seasonality of queen scallop landings (Stott et al. 2020). The main queen scallop fishery around Great Britain is located within the Isle of Man Territorial Sea Limit.

Gear types used to catch queen scallops (UK vessels)

Queen scallops in English waters are primarily fished using dredge gear (84%), with the exception of Manx vessels which predominantly use otter trawls (Figure 1). There are also landings from English waters using beam trawl and other mobile gears, but they are so small that they do not register on the figure and are likely a result of bycatch from other fisheries. In Isle of Man (IoM) waters vessels cannot switch gear type during a season, meaning they must decide to prosecute the fishery using trawl or dredge. Landings into IoM are more commonly from trawl gear.

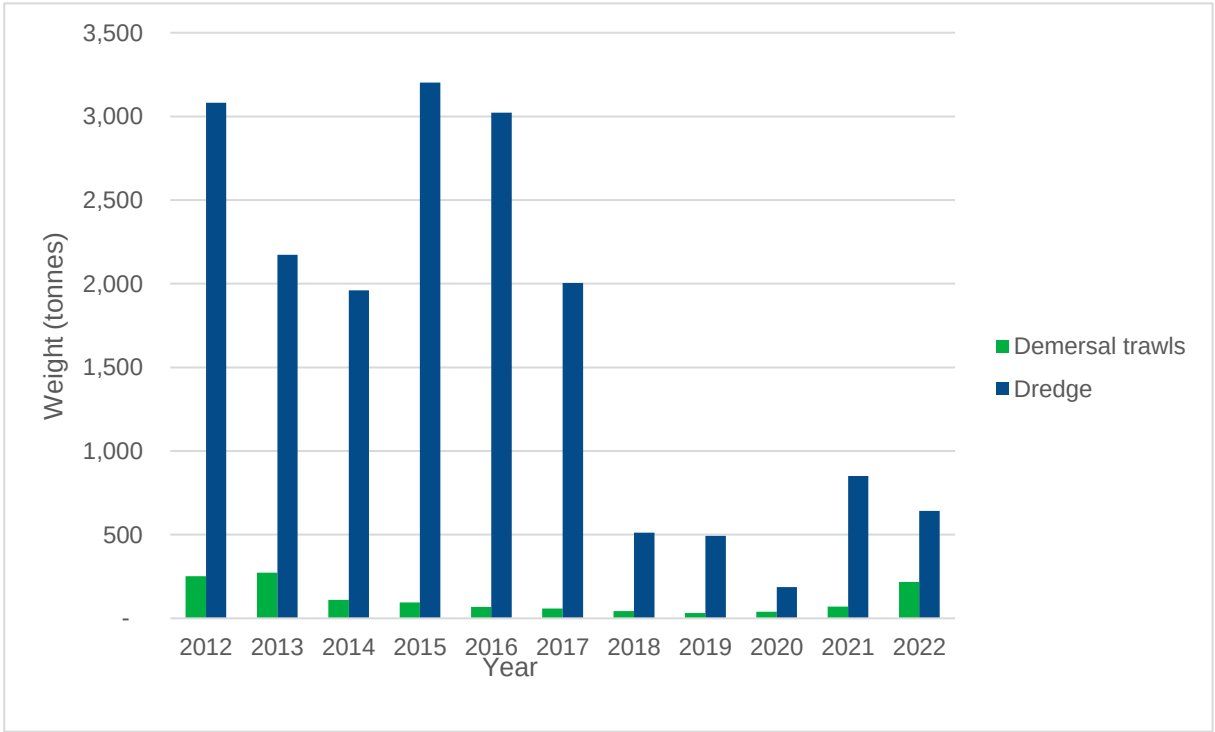

Figure 1: Estimated queen scallop landings from English waters by gear type.

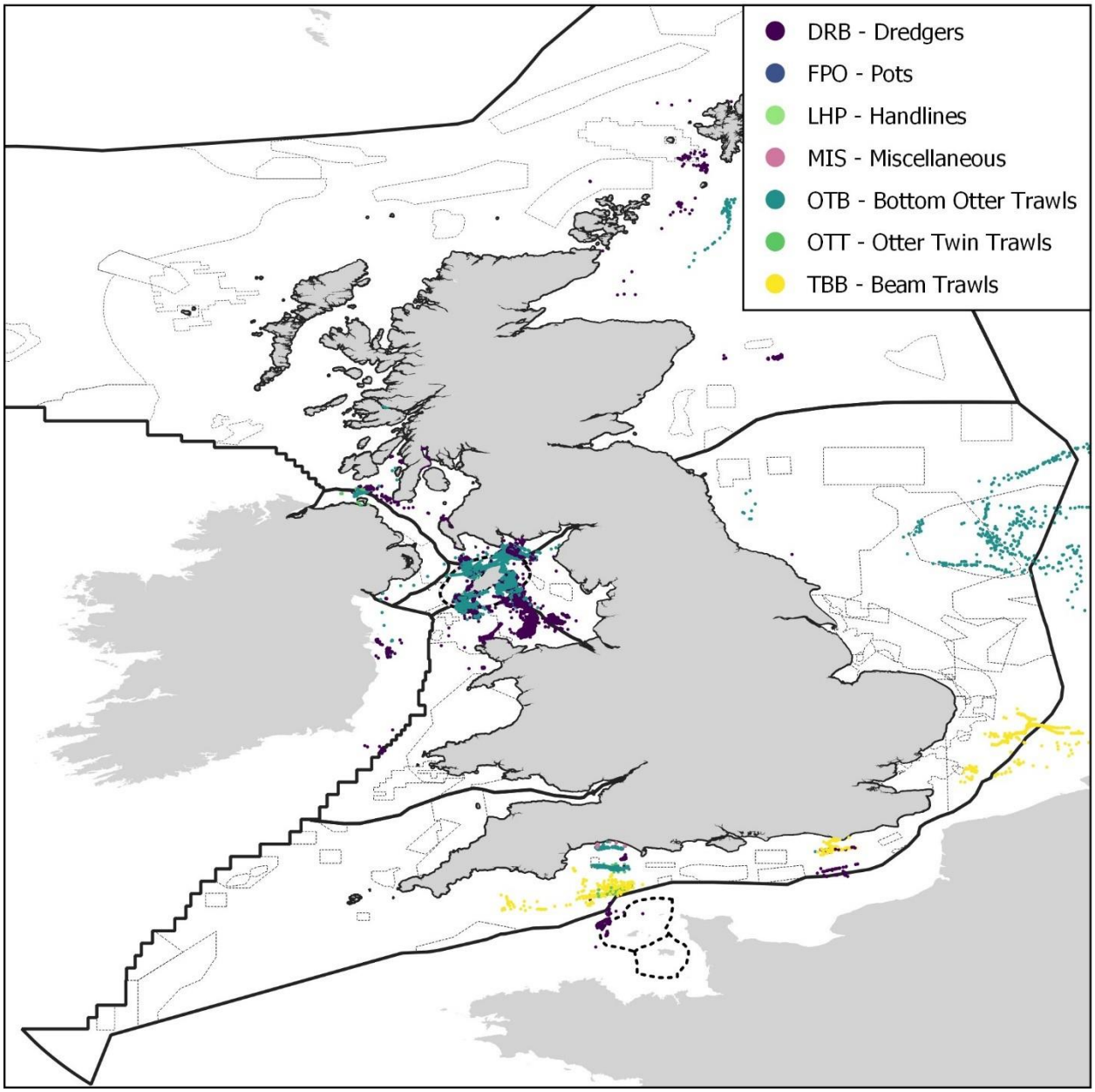

Figure 2: *Queen scallop fishing activity by gear type for the period 2018 to 2022.*

The queen scallop dredges are wider and higher than the traditional Newhaven scallop dredge. This extra height from the seabed enables them to catch the free-swimming queen scallop as they rise up ahead of the dredge (Chapman et al., 1979). Rather than the metal teeth at the front of the dredge the queen scallop dredges rely on a metal grid or a tickler chain at the front of the dredge to disturb the scallops and get them to swim up and into the dredge. They are then retained in a bag made of steel rings of a size to retain the better queen scallops and release most of the smaller ones.

Some of the dredges are now being fitted with a strip of rubber matting across the front of the dredge instead of the metal grid or the tickler chain. This is found to be very effective for catching queen scallop in certain areas. The gear is towed in a similar manner to that of the queen scallop gear with several dredges towed behind a spreading bar with each vessel generally towing two sets of gear, one over each side of the vessel. The number of

dredges towed will depend on the size of vessel (Seafish gear database 2023: Fishing Gear Database | Seafish).

Trawl fishing is based on the principle that queen scallops swim in response to approaching gear. This behaviour is observed at temperatures above 12°C, which means that the trawl fishery is effectively limited to the six-month period between approximately June and November (Marine Scotland 2016). By contrast, dredge fishing can capture scallops all year round (Andrews et al. 2011). Data suggests that the efficiency of trawl gear has been increasing since 2017 based on Landings per Unit Effort (LPUE), but that dredging efficiency peaked in 2020 and the use of dredge gear in 2021 has resulted lower LPUE than in previous years.

Recreational fishing

Recreational fishing, predominantly dive fishing, is managed by the Inshore Fisheries and Conservation Authorities (IFCAs) through issuing of licences and is understood to be minimal in comparison with the trawl and dredge fishery.

Fleet characteristics

Total number of vessels

Since 2012 there has been an average of 63 vessels catching queen scallops in UK waters (Table 1), with an average of 56 of these vessels operating in English waters (Table 2). More than one third of vessels operating in English waters over this period were from Isle of Man (IoM) although this number has declined by 70% since 2012. Vessel numbers for 2021 and 2022 are considered more reliable than the previous period, as zone of capture (whether UK or IoM) has been reported since 2021. This allows each vessel's activity to be assigned to either UK or Isle of Man waters with more confidence.

Table 1: *Estimated total number of vessels that caught any amount of queen scallops in UK waters during relevant years by their home nation. Vessels are allocated to nations based on their ports of administration.*

Vessel nationality	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Isle of Man	26	27	28	26	27	26	26	22	22	21	21
England	24	26	12	8	11	17	13	16	6	5	10
Scotland	17	18	13	12	15	16	13	6	6	4	5

Vessel nationality	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Northern Ireland	13	19	11	15	12	10	7	7	2	3	5
Wales	2	6	2	2	4	3	5	2	4	4	1
Jersey	0	0	0	0	0	1	0	0	0	0	0
Total	82	96	66	63	69	73	64	53	40	37	42

Table 2: *Estimated total number of vessels that caught any amount of queen scallops in English waters during relevant years by their home nation. Vessels are allocated to nations based on their ports of administration. Reporting of zone of capture was introduced in 2021 and allows better allocation of vessels between Isle of Man and UK waters. Prior to 2021 and for English, Scottish, Northern Irish and Welsh waters for all years, allocation is based on a proportional area approach by ICES rectangle.*

Vessel nationality	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Isle of Man	26	27	28	26	27	26	26	22	22	11	8
England	22	26	12	8	10	14	13	15	6	5	10
Scotland	15	18	13	12	15	16	11	6	6	4	5
Northern Ireland	11	15	11	10	11	9	6	7	2	3	5
Wales	2	4	2	1	1	1	1	1	1	0	1
Total	76	90	66	57	64	66	57	51	37	23	29

Since 2012 the total number of vessels landing queen scallops from UK waters has declined from 82 vessels in 2012 to 42 vessels in 2022 (Table 1). Vessels fishing in English waters show a significant decline in 2020 (due to a reduction in the number of English and Northern Irish vessels), and a further reduction in 2021 (due to improved reporting providing a more realistic picture of activity of IoM vessels), to the lowest recorded number of vessels (down to 23) (Table 2). In 2022, English vessels made up

34% of the vessels fishing for queen scallop in English waters, which is an increase of more than 50% since the preceding year. This was the first year that English vessels were the primary nationality landing queen scallops from English waters (Figure 3). Since 2021, catch location has been reported separately for UK and IoM vessels and so the location of fishing activity can be more accurately accounted for, but does skew the numbers pre-2021 to suggest that more IoM vessels have been active in English waters than may be correct.

Figure 4 shows the number of vessels that landed more than one tonne of queen scallops from English waters each year. In 2022 there were 29 vessels that reported landings of queen scallops from English waters, but of these, only 19 vessels landed more than one tonne (Table 3). This further demonstrates the opportunistic nature of the fishery, where there are several vessels actively targeting queen scallops, but most catch it as bycatch or more sporadically. By comparing Figure 3 and Figure 4, it appears that this opportunistic fishery applies more to English vessels than to any other nationality as the total number of vessels is more variable each year and there are only a small number of English vessels landing more than one tonne. This opportunistic approach to fishing queen scallops in English waters was also documented by Stott et al. (2020) and Lawler (2020). The fluctuation in numbers may also be a result of the 'boom and bust' nature of the fishery, in which the biomass naturally fluctuates as a result of queen scallops being a short-lived species and populations heavily reliant on recruitment levels, or as a result of changes in the market demand and value for queen scallops.

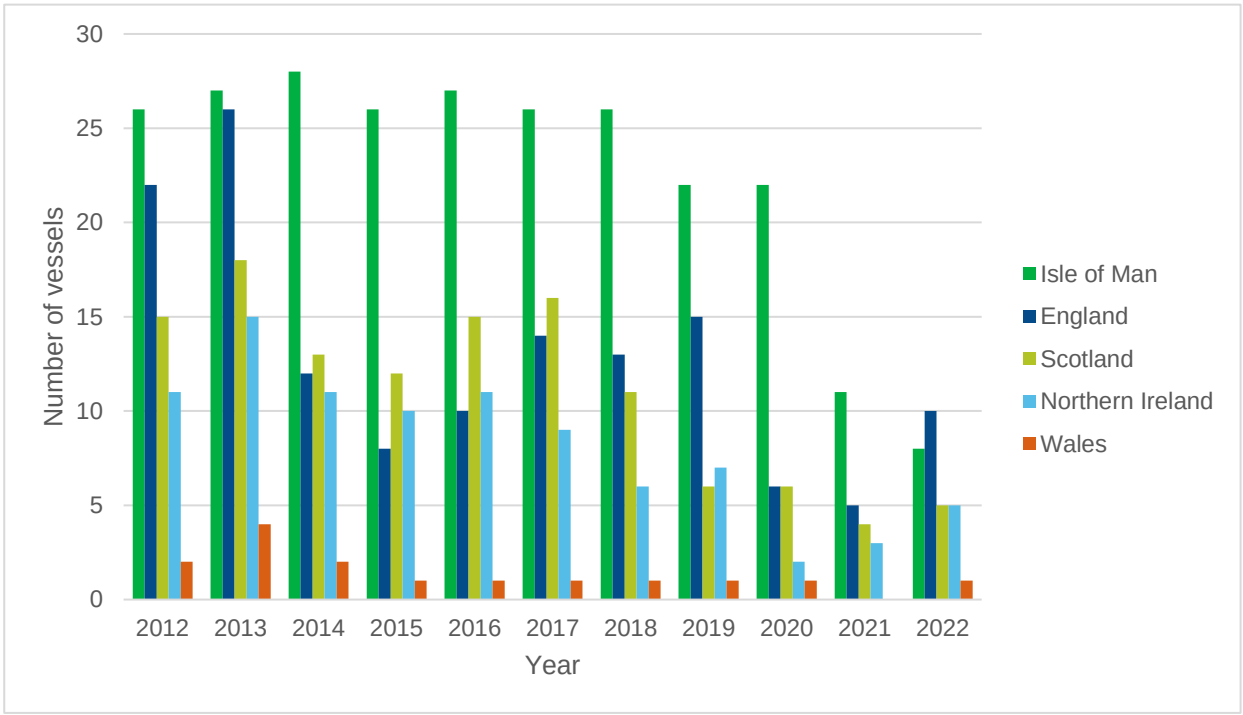

Figure 3: Estimated total number of UK and Crown Dependency vessels involved in the queen scallop fishery in English waters between 2012 to 2022.

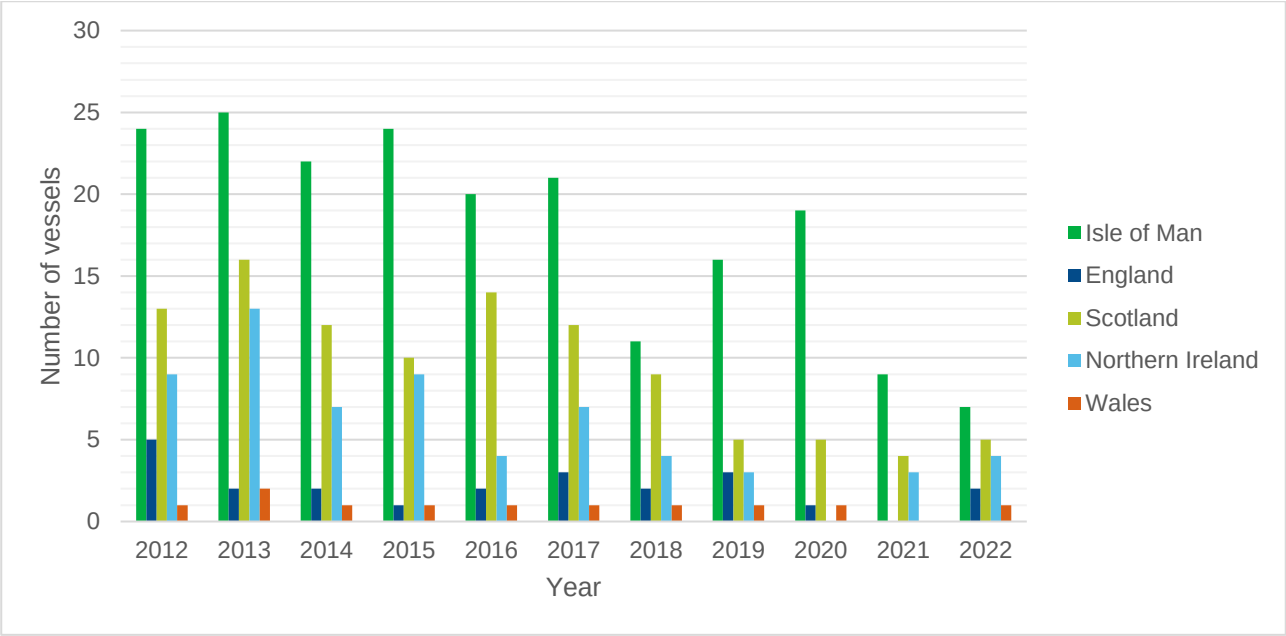

Figure 4: Estimated number of UK and Crown Dependency vessels involved in the queen scallop fishery in English waters by home nation of registry between 2012 to 2022, (>1 tonne per annum cut off used).

Table 3: Estimated number of UK and Crown Dependency vessels involved in the queen scallop fishery in English waters by home nation (port of registry) in 2022 (total number and number landing >1 tonne per annum).

	Isle of Man	England	Scotland	Northern Ireland	Wales	Total
Vessels landing any queen scallops in 2022	8	10	5	5	1	29
Vessels landing >1 tonne of queen scallops in 2022	7	2	5	4	1	19

Landings

Total landings (volume and value)

Over the period 2012 to 2022, the value and volume of the queen scallop fishery peaked in 2013, and this combined with a high market value led to an increase of vessels in the fishery. By 2014, the stock size had reduced, leading to a decrease in landings. The low point for both volume and value of landings for the fishery across the UK as well as

specifically in English waters was in 2020, which is likely to be a reflection of Covid-19 restrictions, however, landings volume and value have been relatively low over the period 2018 to 2022 compared to previous years. In 2022 UK queen scallop landings was 2,979 tonnes, 865 tonnes caught in English waters by UK vessels (29%). In 2022 the value of the UK queen scallop fishery was £1,832,012; £533,954 landed from English waters (Table 4).

Figure 5 shows the decrease in queen scallop landing volume in English waters since 2012. The lower landings in 2014 may be a result of cumulative increased effort in the fishery in previous year, leading to increased pressure on the biomass. This coincides with the loss of the Marine Stewardship Council (MSC) certification for IoM queen scallops based on concerns for the stock biomass as a result of increased fishing pressure (Andrews et al. 2014). The lower landings since 2014 has partially compensated for by the higher prices (Figure 6). In 2012, when there was a peak in queen scallop landings, the price per tonne was £380, but by 2018 landings were a sixth of the 2012 volumes but the price per tonne was four times higher (Figure 7).

Table 4: Estimated landings of queen scallops by liveweight (tonnes) and value (£) from UK and Crown Dependency vessels in English waters between 2012 to 2022.

Metric	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Volume (tonnes)	3350	2447	2070	3298	3090	2063	555	528	226	920	865
Value (GBP)	1,273,926	1,054,188	916,343	1,729,360	2,139,116	1,574,970	669,425	621,514	194,179	598,485	533,954

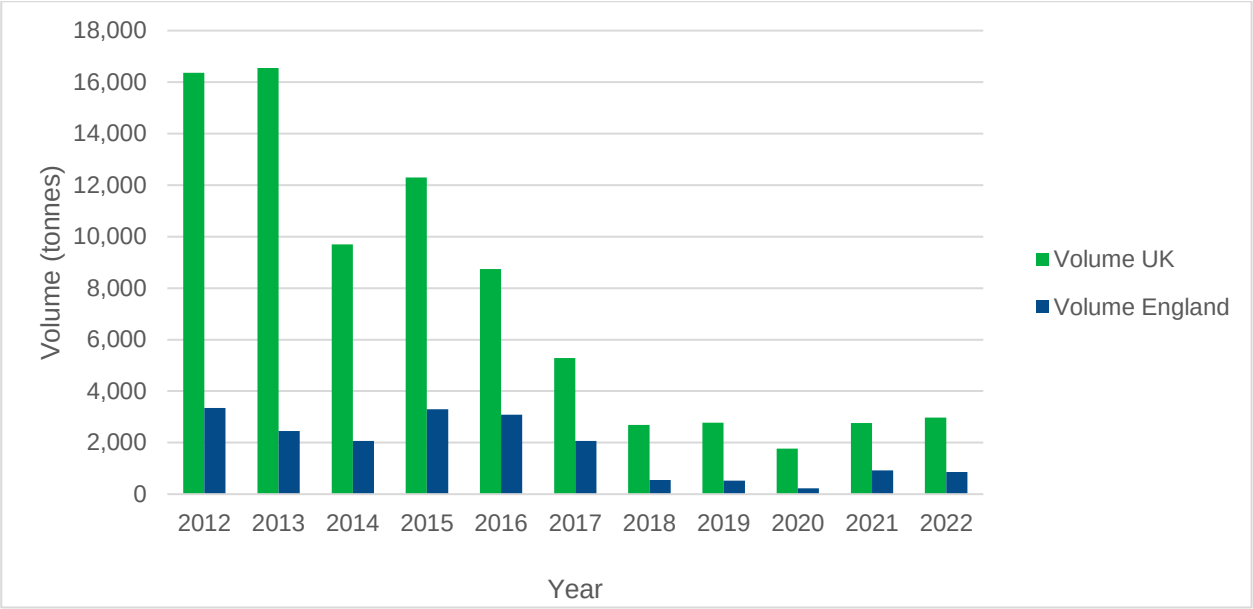

Figure 5: Estimated queen scallop landings by live weight for all UK vessels fishing in UK (green) and fishing only in English waters (blue).

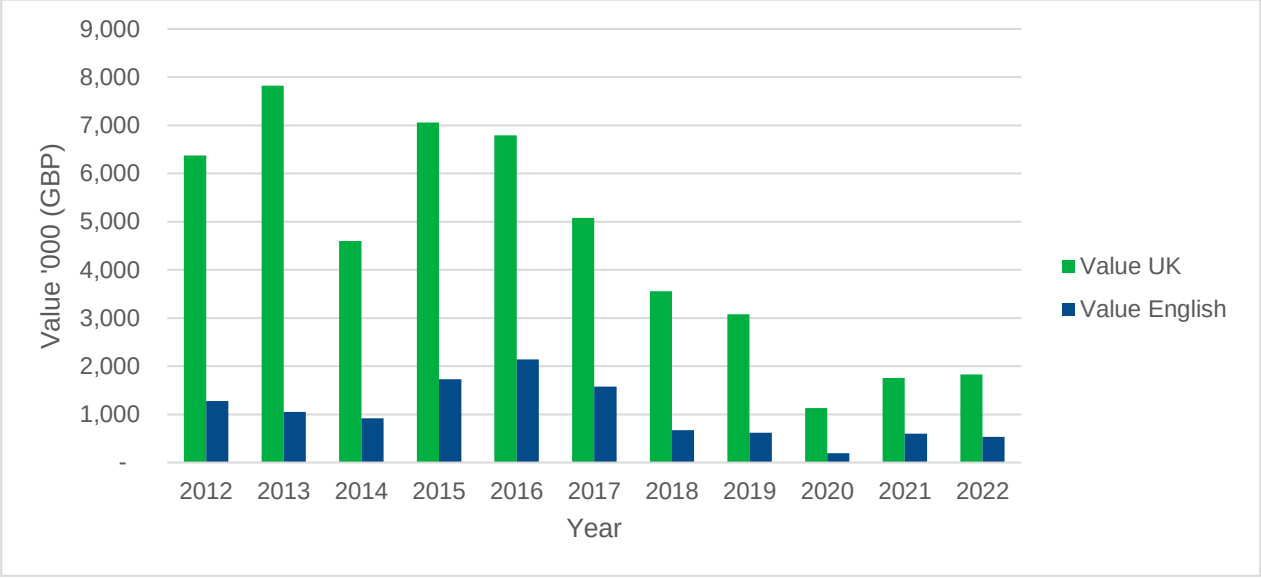

Figure 6: Estimated queen scallop landings by value for all UK vessels fishing in UK (green) and fishing only in English waters (blue).

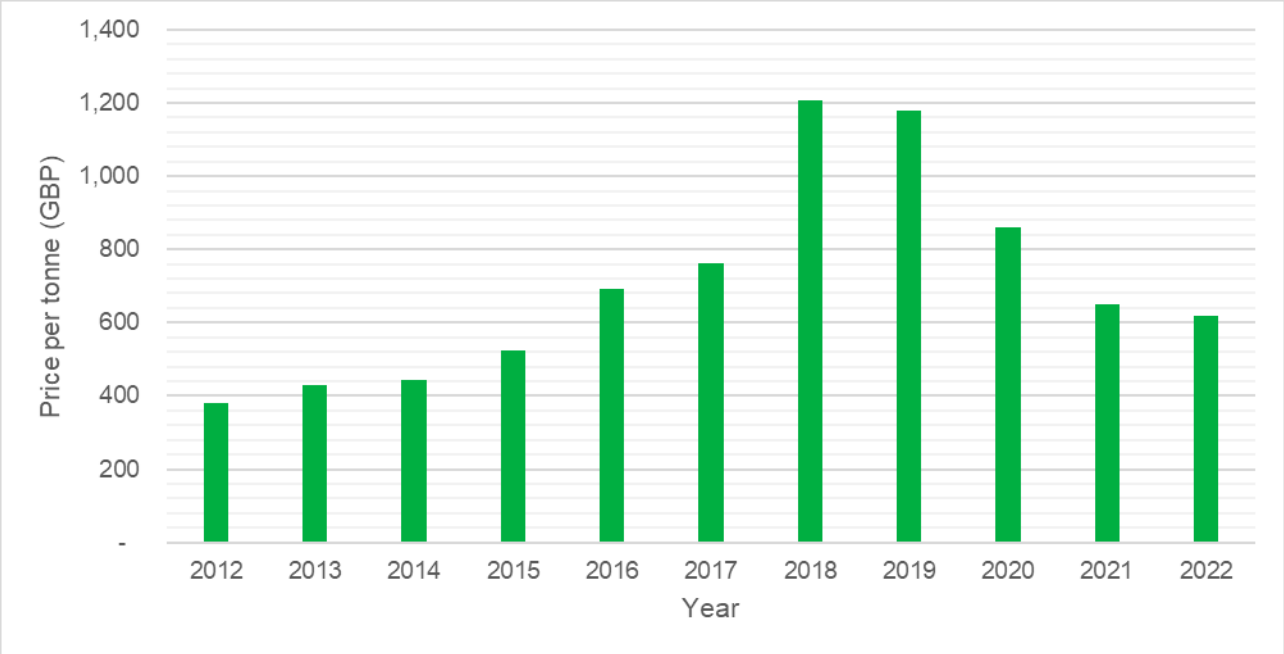

Figure 7: *Estimated price per tonne of queen scallops for UK vessels fishing in English waters between 2012 and 2022.*

Landings by vessel nationality

MMO data (Figure 8) indicates that the majority of the queen scallop landings from English waters are taken by Scottish vessels, emphasising the importance of these vessels for the overall fishery. While landings have been declining overall, the impact this has had on individual nations is not proportional and has seen much more variation over time. It may be that vessels are also fishing other queen scallop areas or that the often-opportunistic nature of the fishery masks any real trends in landings by nationality.

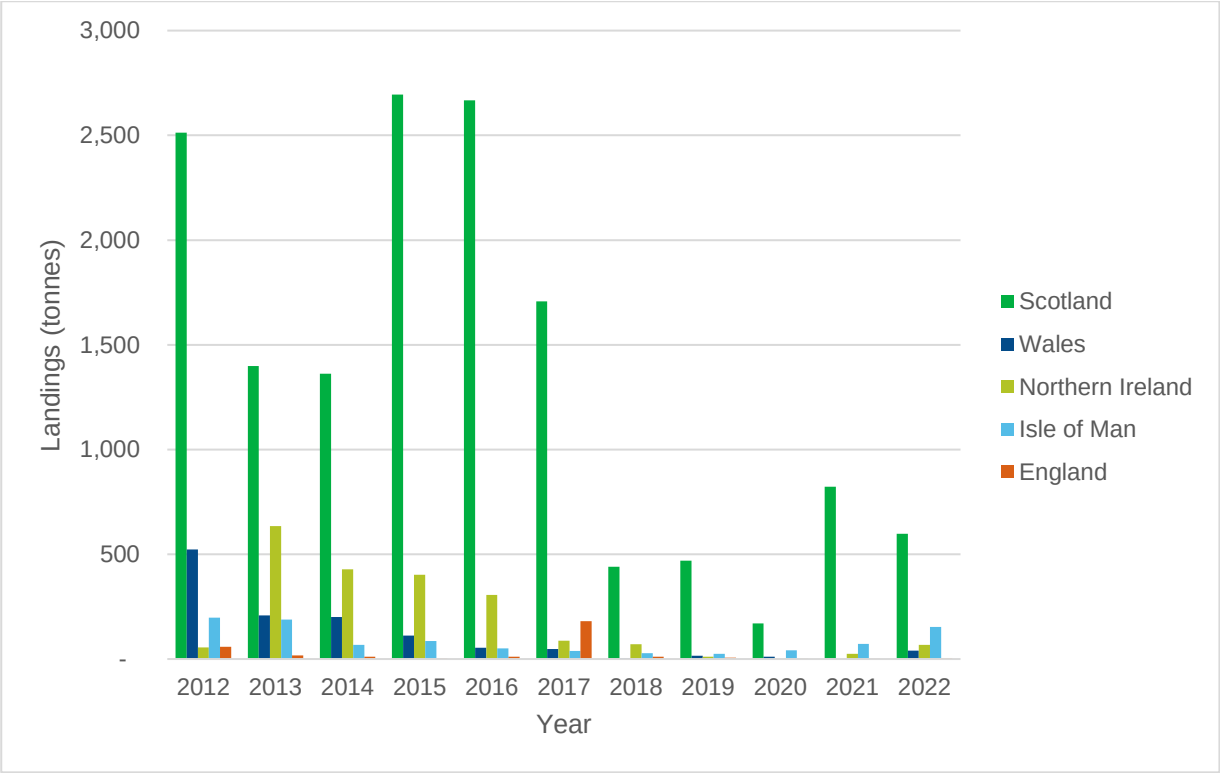

Figure 8: Estimated queen scallop landings by live weight from English waters by UK and Crown Dependency vessels proportioned out by nationality since 2012.

Landings by EU vessels

On average, landings of queen scallops by EU vessels make up 15% of the total landings from English waters. EU vessel activity shows a similar pattern to UK vessels, decreasing significantly since 2012, although for EU vessels the lowest historic landings were recorded in 2015 (Figure 9). There was a peak in landings from EU vessels in 2019, which coincides with some of the lowest historic landings for UK vessels. This may be a result of altered fishing activity in anticipation of the UK leaving the EU and the impact that new legislation may have for vessels without a historic track record. This also coincides with an increase in value of landings of queen scallop by EU vessels (Figure 10). In 2020 there were Covid-19 restrictions in place limiting EU vessels' activity which may account for the small decrease in landings that year. The data setting out estimated landings of queen scallops by liveweight (tonnes) and value (£) from EU vessels in English waters between 2016 to 2021 is summarised in Table 5.

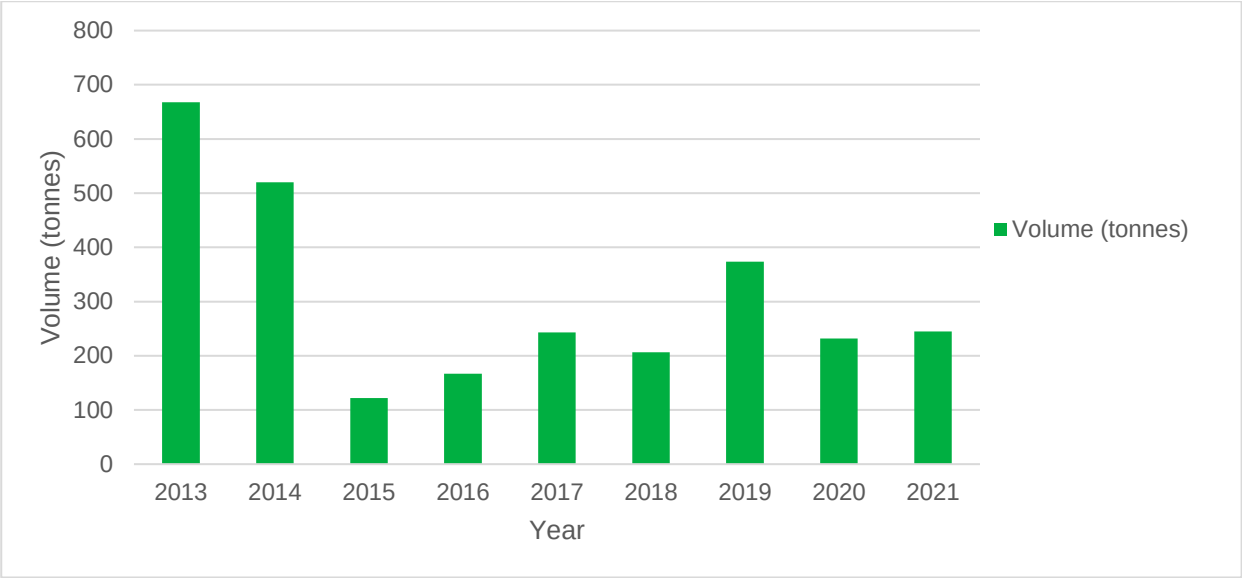

Figure 9: Estimated volume (tonnes, liveweight) of queen scallop landings from English waters by EU-27 vessels between 2013 and 2021.

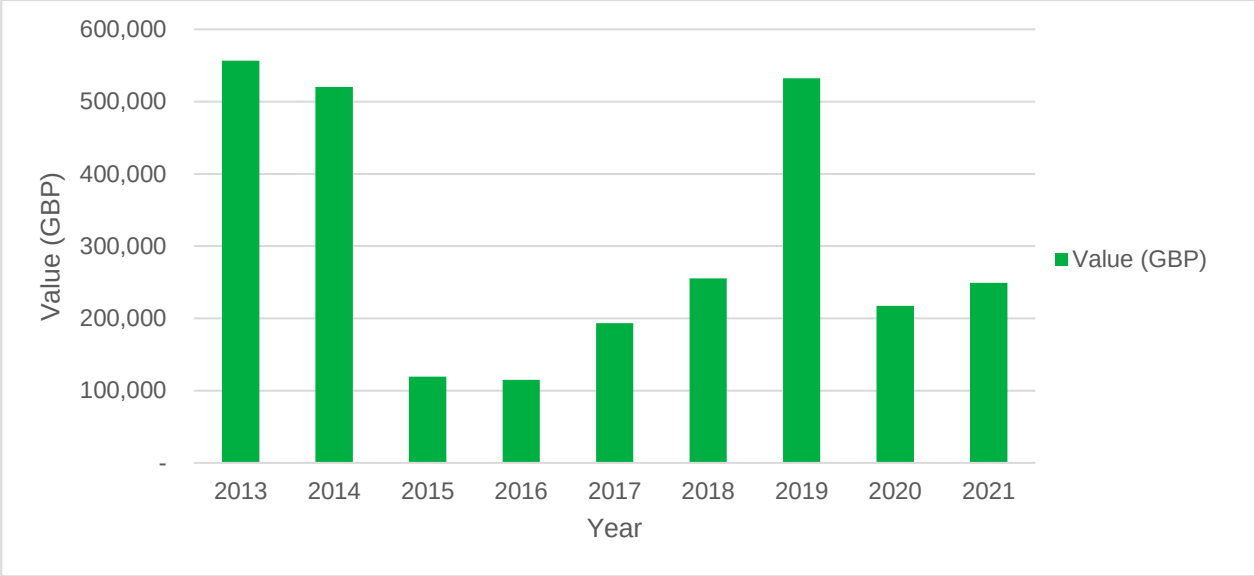

Figure 10: *Estimated value (GBP, nominal) of queen scallop landings from English waters by EU-27 vessels between 2013 and 2021.*

Table 5: Estimated landings of queen scallops by liveweight (tonnes) and value (£) from EU vessels in English waters between 2016 to 2021.

Metric	2013	2014	2015	2016	2017	2018	2019	2020	2021
Volume (tonnes)	668	520	122	167	243	206	373	232	245
Value (GBP)	556,796	520,260	119,426	114,726	193,484	255,460	532,307	217,174	249,032

Landings by ICES rectangle

Figure 11 shows the landings of queen scallops by all UK vessels by ICES rectangle as a total between 2012 and 2022. This corroborates the Cefas reports (Lawler 2020, Stott 2021) indicating the main fishery is in the Irish Sea and around the northern Welsh waters and Isle of Man, with an opportunistic fishery present in the English Channel, rather than a targeted fishery, as the landings were low and not constant throughout time (Stott et al. 2020). This is likely in response to large year classes recruiting to local stocks (Reeves 2020a).

In Figure 12, any rectangles with cumulative landings amounting to less than one tonne over the period between 2012 and 2022 have been removed, to highlight the main fishing areas. This reiterates that while queen scallops are landed from waters around the UK, the majority are coming from the Irish Sea. When looking specifically at activity in English waters, Figure 13 indicates that a significant proportion of landings are coming from the north-eastern Irish Sea. However, since 2021 vessels have been required to specify their catch location in more detail, meaning that data is now available to separate fishing activity in the Isle of Man waters from activity in UK waters. Figure 14 shows the total landings in English waters since 2021 and suggests that a significant proportion of historic landings that were proportionally allocated to UK waters, were actually caught in IoM waters. The central fishing area appears to be in ICES rectangle 36E6, which is located north of Wales.

When considering the three ICES rectangles with the most landings in the Irish Sea, Table 6 shows that in 2022, rectangle 36E6 has the largest proportion of queen scallops attributed to English waters consisting of 81% of the landings from that rectangle. This is to be expected as most of the rectangle lies in English waters. However, 37E5 has 28% of the landings attributed to English waters despite only a small area of the rectangle falling into English waters.

When broken down by year, the Irish Sea fishery has been active throughout the 10-year period, but the North Sea and English Channel fisheries appear to be more opportunistic (Lawler 2020, Reeves 2020a). In the period between 2009 and 2016, there were foreign vessels landing queen scallops abroad from the English Channel, with their main fishing areas around Jersey and Guernsey (Lawler 2020).

Figure 15 shows the landings of queen scallop in UK and Crown Dependency waters by ICES rectangle for EU27 vessels only. The most significant activity is in the western English Channel, likely from French vessels. There are also landings from EU27 vessels fishing in the Irish Sea, along the coast of the Republic of Ireland but these are small compared to the activity in the English Channel. Figure 16 shows the landings by EU27 vessels from English waters only.

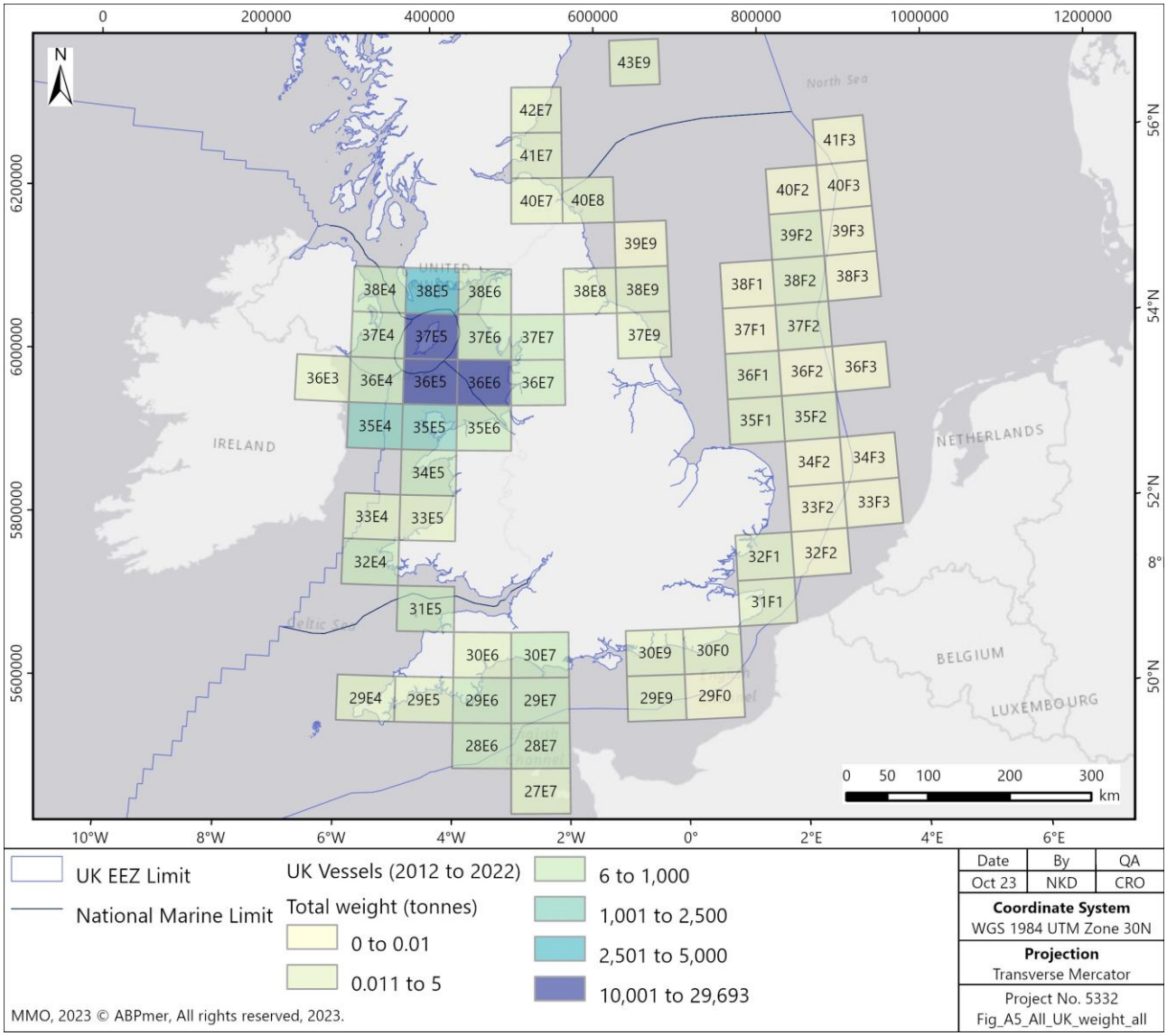

Figure 11: Estimated landings of queen scallops by ICES rectangle (total 2012 – 2022) by UK vessels fishing in UK waters.

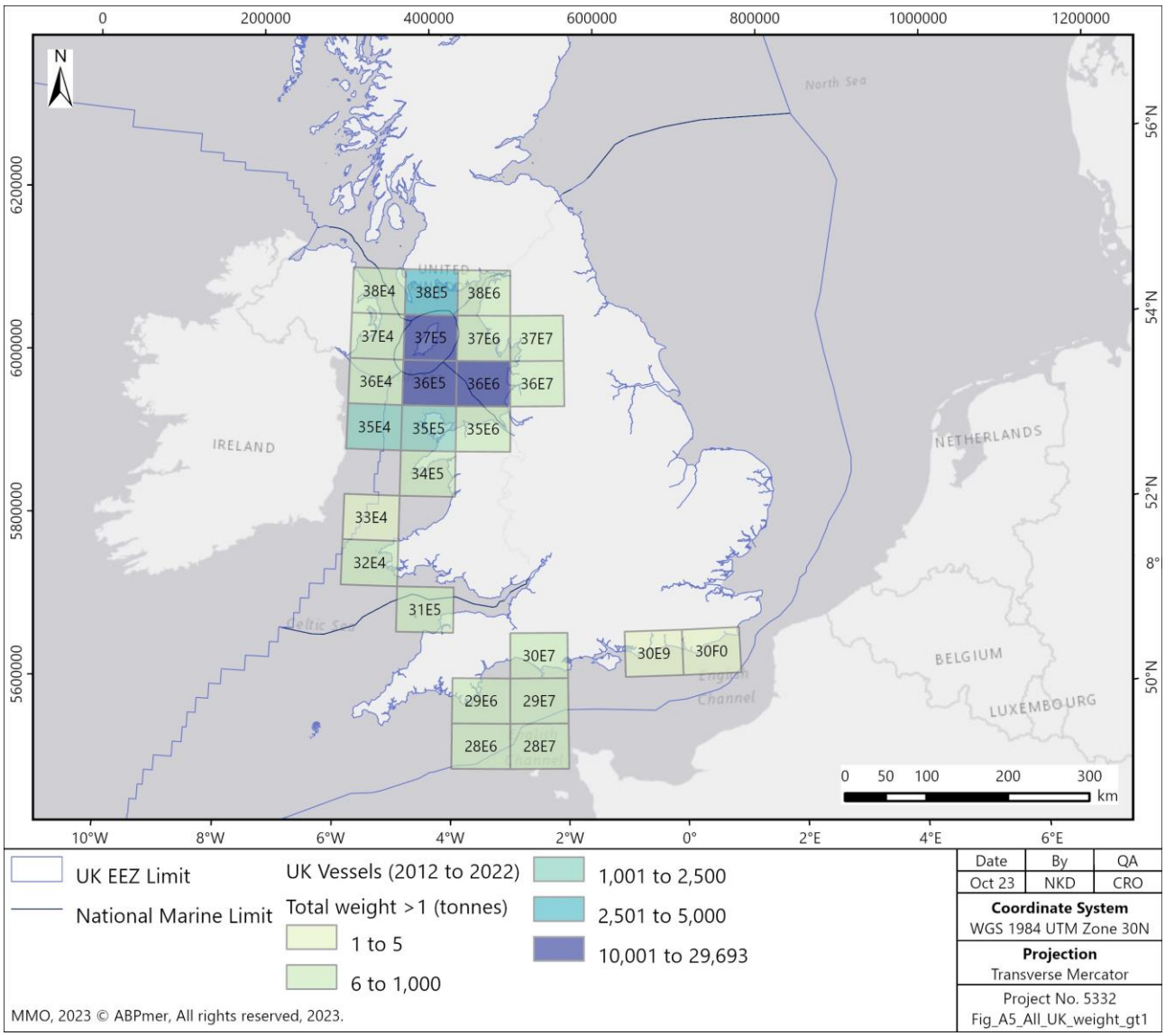

Figure 22: *Estimated landings of queen scallops by ICES rectangle (total 2012 to 2022) by UK vessels fishing in UK waters (filtered to remove any rectangle total landings of less than 1 tonne over the 10 year period).*

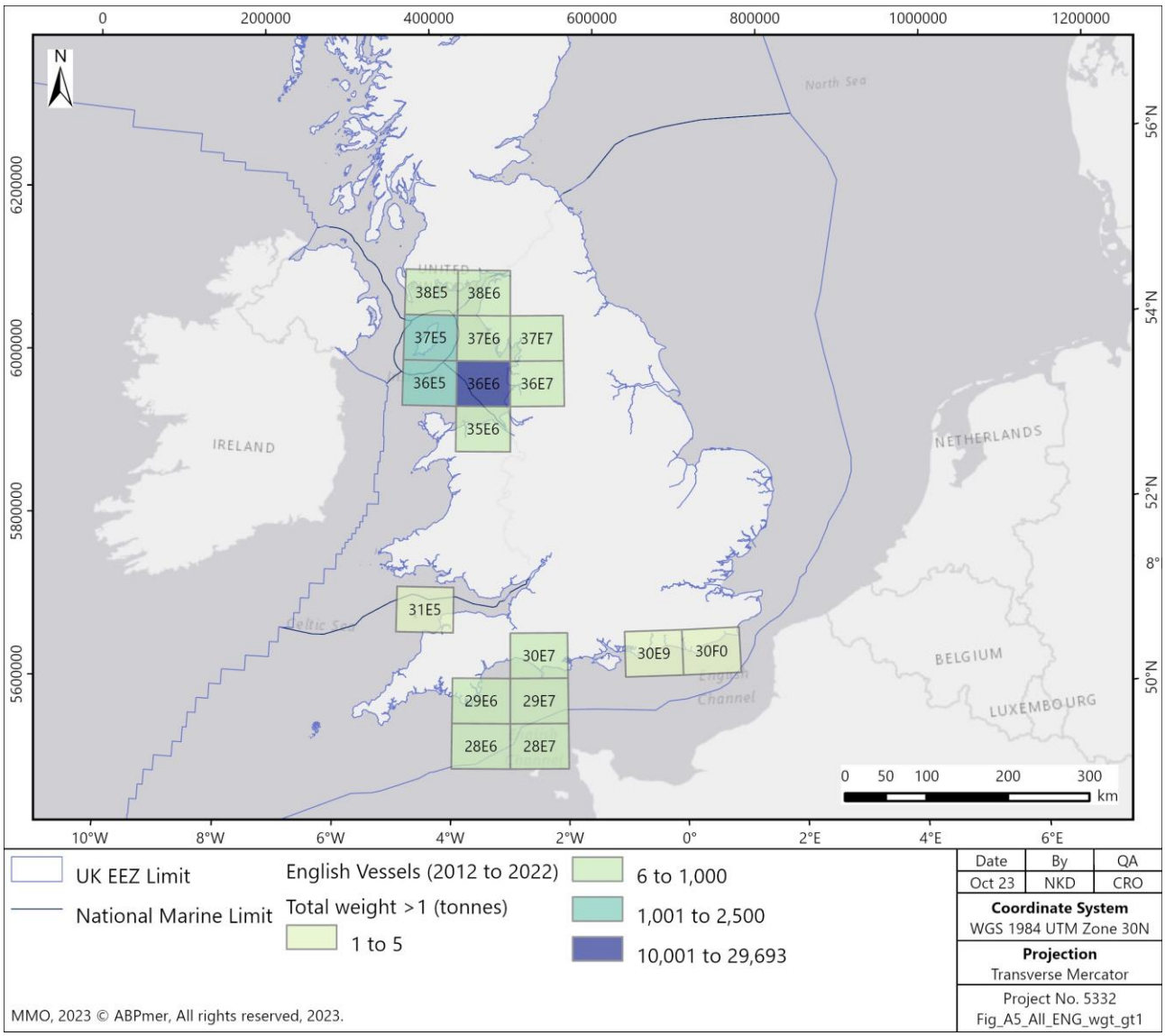

Figure 33: *Estimated landings of queen scallops by ICES rectangle (total 2012 to 2022) by UK vessels fishing in English waters (filtered to remove any rectangle total landings of less than 1 tonne over the 10 year period).*

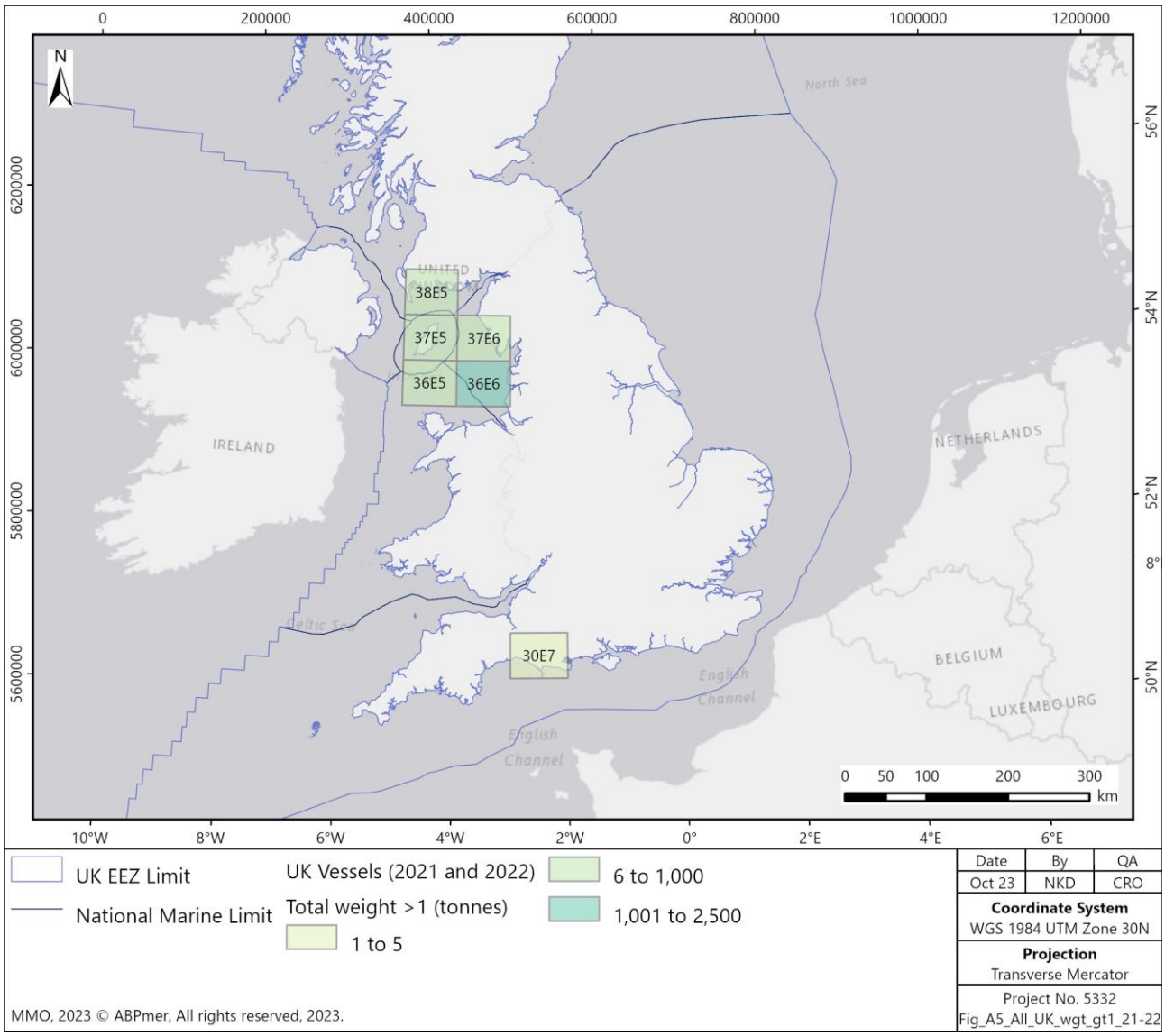

Figure 14: *Estimated landings of queen scallops by ICES rectangle (total 2021 to 2022) by UK vessels fishing in English waters (filtered to remove any rectangle total landings of less than 1 tonne over the 10 year period).*

Table 6: Estimated landings of queen scallops from the top three ICES rectangles (2022) by UK vessels.

	ICES rectangle		
	36E5	**36E6**	**37E5**
Total landings (tonnes)	1060	607	1112
Proportion of English landings (tonnes)	53	490	309
Percentage from English waters	5.00%	80.76%	27.78%

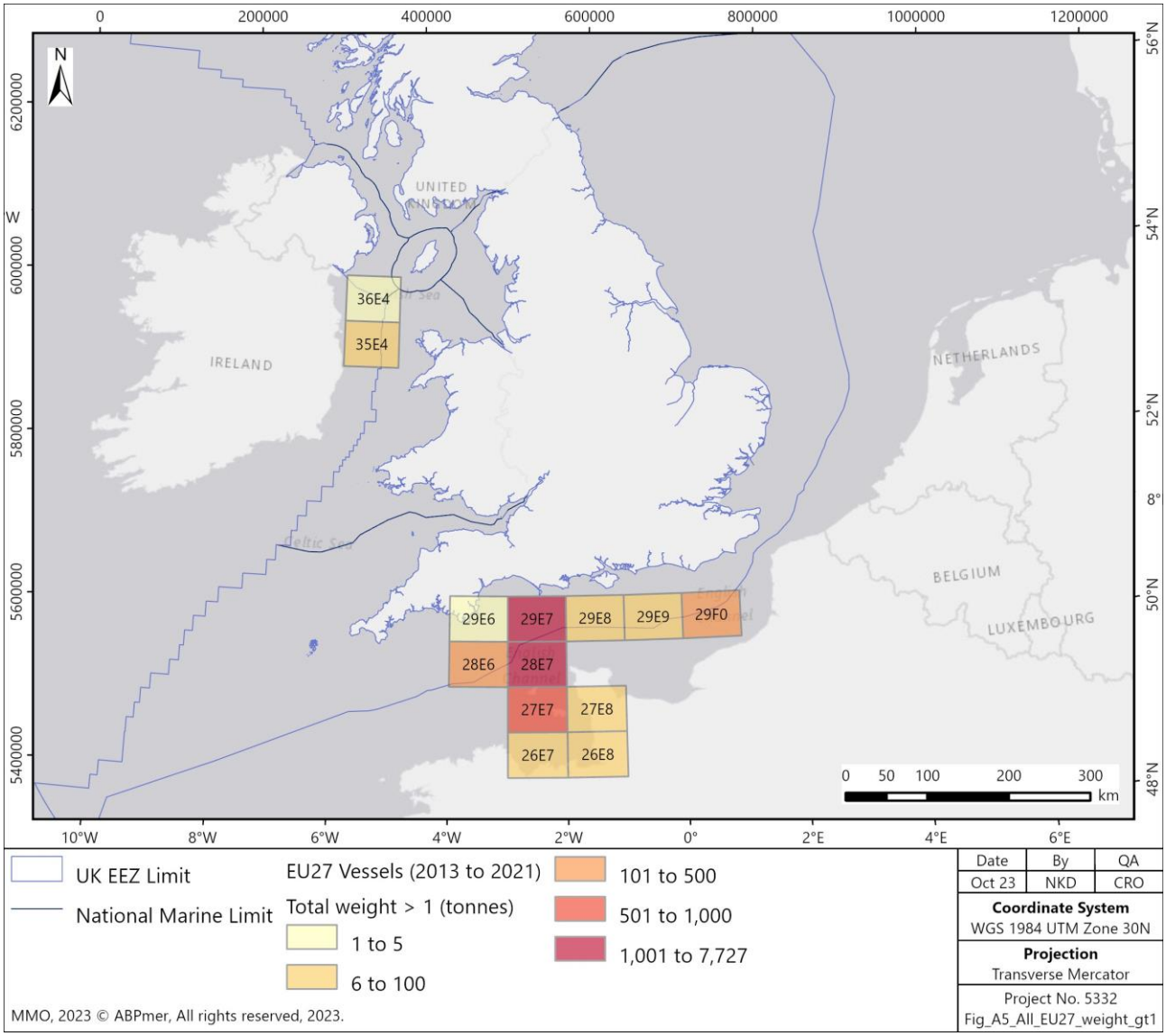

Figure 15: Estimated landings of queen scallops by ICES rectangle (total 2013 to 2021) by EU27 vessels fishing in UK and Crown Dependency waters (filtered to remove any rectangle total landings of less than 1 tonne over the 10 year period).

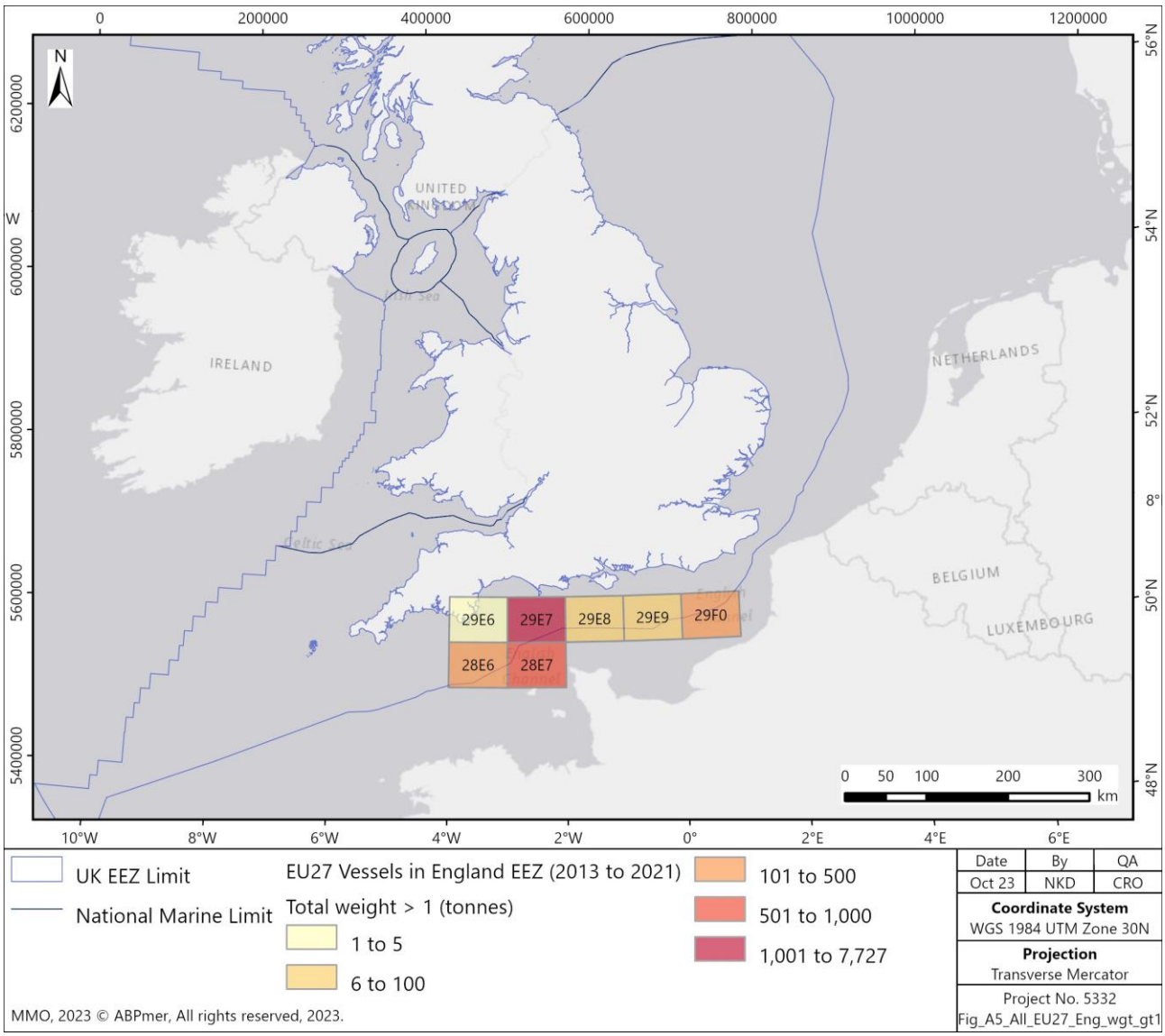

*Figure 46***:** *Estimated landings of queen scallops by ICES rectangle (total 2013 to 2021) by EU27 vessels fishing in English waters (filtered to remove any rectangle total landings of less than 1 tonne over the 10-year period).*

Stott et al. (2020) plotted the monthly landings of queen scallops from ICES Area 7 into England by UK vessels but noted that there was no clear trend in activity by season and no consistency in landings volume over the time period. In 2018 there was a closed season introduced for queen scallop fishing in ICES Area 6a and 7a, so recent data shows no landings between April and June. The trawl fishery operates for three months over summer targeting roe-on queen scallops, and the dredge fishery starts around September once the roe has gone and they can target the scallops for fatter white meat. In 2021, there was a peak in landings of queen scallops from English waters in October and November, although historically between 2017 to 2021 the average landings peak was in August. By comparison, landings of queen scallops in 2021 from the UK as a whole also peaked in November but were significantly lower in October.

Landings by vessel length (UK vessels)

MMO data indicates that historically the main volume of queen scallops from English waters has been landed by vessels between 18.01 to 24 m. During the period between 2013 and 2017 there were also significant landings from vessels between 24.01 and 40 m. Historical landings from under 12 m vessels are small, averaging 6 tonnes per year in total. Vessels over 15 m landed on average 80% of queen scallops from English waters since 2012 (MMO). Stott et al. (2020) also concluded that fishing effort (days at sea, DAS) of vessels with a length of 15 metres or above harvesting queen scallops was higher than the vessels of less than 15-meter vessel length; and in general the effort for harvesting queen scallop was low (on average 15 days per month in the years 2008 to 2019) (Stott et al 2020). A summary of the estimated landings (tonnes) of queen scallops from English waters by vessel length for all UK vessels is provided at Table 7, below.

Table 7: *Estimated landings (tonnes) of queen scallops from English waters by vessel length for all UK vessels.*

Vessel length	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
10.01 - 12.00m	12	13	2	5	3	1	1	0	0	N/A	N/A
12.01 - 15.00m	654	329	248	163	99	250	30	36	33	54	148
15.01 - 18.00m	875	464	116	49	36	15	16	7	14	36	99
18.01 - 24.00m	1636	1108	927	1283	917	744	493	476	69	823	602
24.01 - 40.00m	155	518	770	1785	2024	1042	9	N/A	N/A	0	N/A
8.01 - 10.00m	17	16	7	12	11	10	6	8	10	7	13
8.00m and under	N/A	N/A	N/A	N/A	N/A	0	1	0	0	0	3
Over 40.00m	N/A	N/A	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A

Economic and social importance

In this section, economic indicators have been defined as follows:

- Economic dependence: percentage of revenue associated with value of landings of stocks/species in FMP managed area compared to total fishing income;
- Fishing income: value of fish landed associated with FMP;
- GVA: a measure of the value of goods and services produced by an industry. GVA is calculated as the sum of operating profit and crew share;
- Operating profit: the difference between total income and operating costs;
- Net profit: the result of subtracting finance costs, depreciation and interest costs from operating profit; and
- GVA to fishing income margin: the economic efficiency and profitability of operations, and evolution over time.

Economic dependence by fleet segment

Based on Seafish economics data, Table 8 shows that queen scallops make up less than 5% of revenue for the majority of vessels in the fishery, and there have been no vessels relying on queen scallops to make up more than 40% of their revenue since 2017. Recently the majority of landings by weight were caught by vessels that rely on queen scallops for less than 20% of their revenue, with only one vessel in 2021 with a dependency over 20% on queen scallop. However, that vessel landed 59% of the total weight of queen scallops from English waters (Figure 17), representing between 20 to 40% of its revenue. The queen scallop fishery does not operate year-round, and even the largest operators switch to targeting king scallops for part of the year to maintain their income. The importance of queen scallop as a target species varies between boats, with some fishing queen scallops as a target species, whereas others may land infrequently or small amounts when the opportunity arises (Marine Scotland 2016).

Table 8: *Estimated number of vessels involved in the queen scallop fishery by level of economic dependence (Seafish). NB. Seafish data differs from MMO data due to the apportioning of landings by ICES rectangle in the underlying data used by Seafish, whereas MMO are able to attribute landings directly to UK or CD waters since 2021.*

FMP dependence groups	2016	2017	2018	2019	2020	2021	2022
Under 5%	49	50	48	42	33	30	37
5-20%	6	7	7	5	3	2	4
20-40%	6	3	2	1	N/A	1	N/A
40-60%	1	N/A	N/A	N/A	N/A	N/A	N/A
60-80%	2	2	N/A	N/A	N/A	N/A	N/A
Total	**64**	**62**	**57**	**48**	**36**	**33**	**41**

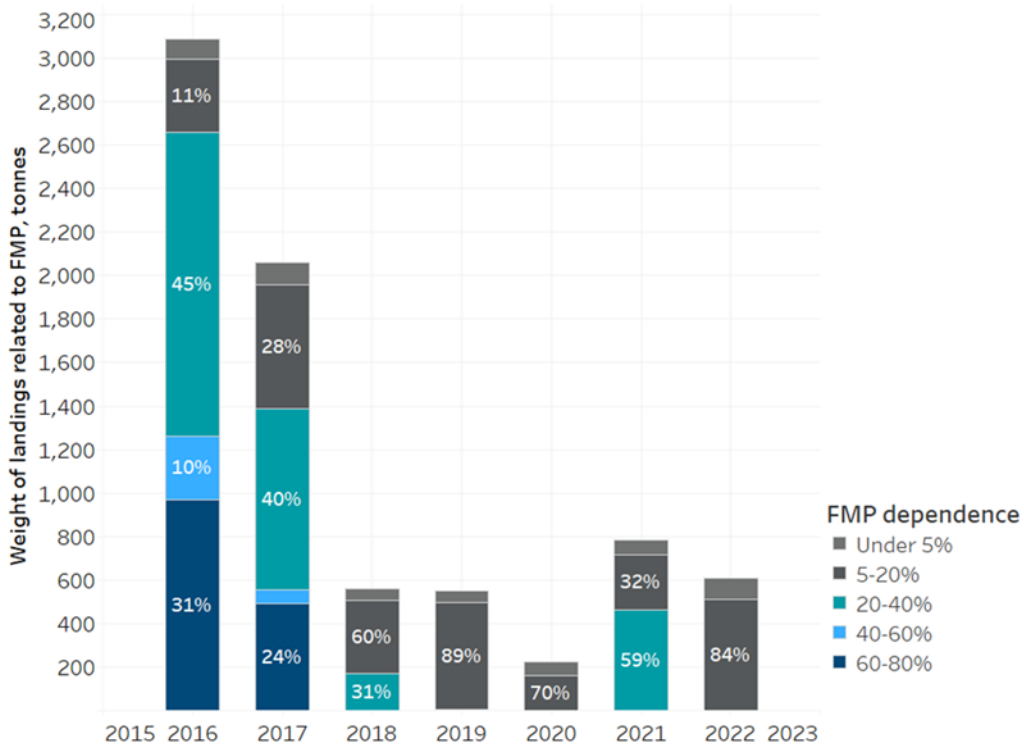

Figure 17: Estimated weight of queen scallop landed by level of economic dependence by year in terms of queen scallop landings from English waters (Seafish).

Since 2016 there has been a steady decline in the number of vessels dependent on the queen scallop fishery for over 20% of their income. The majority of these vessels are over 18 m, with only one 12 to 18 m vessel more than 20% economically dependent on queen scallops in 2017 (Figure 18). Since 2016 there have been no vessels under 12 m that are more than 20% economically dependent on the queen scallop fishery.

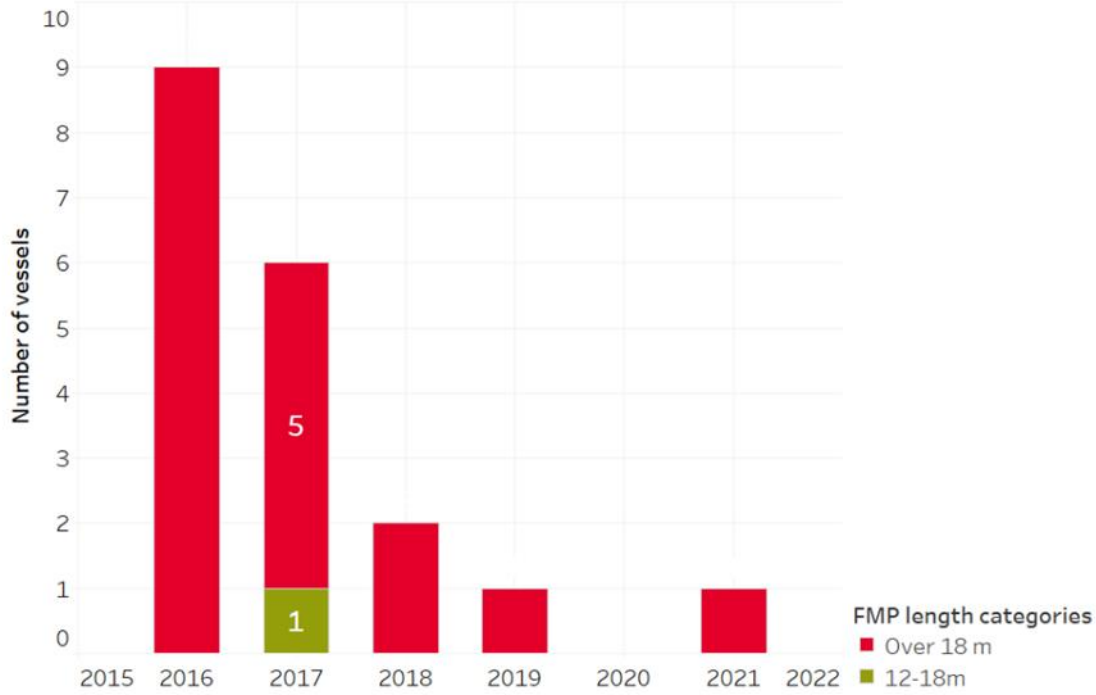

Figure 18: Estimated number of vessel >20% economically dependent on queen scallops in English waters by size category (Seafish).

Port reliance on the queen scallop fishery

Figure 19 indicates that queen scallops from English waters do not make up a significant proportion of the total value of overall landings into any UK port, suggesting that no UK ports are overly dependent on the landings of queen scallops. The MMO data in Figure 20 shows that in 2022 the largest proportion of landings of queen scallops by UK vessels from English waters was in Kirkcudbright (Scotland). Three of the top five ports for queen scallop landings from English waters were on Isle of Man (Peel, Port St Mary and Douglas). Landings into ports in England were small, and only Whitehaven had landings of more than five tonnes of queen scallops in 2022. Reeves (2020a) also concluded that there are only minor landings of queen scallop from English waters going into English ports, further reiterating the sporadic and opportunistic nature of the queen scallop fishery in English waters. It is clear from Figure 21 that queen scallop landings from English waters are predominantly landed into Scottish ports, and that there are only small volumes landing into English, Wales or Northern Ireland. Figure 22 from Seafish reiterates that the majority of landings between 2016 and 2022 are from vessels over 18 m in length, and that most 12 to18 m boats are landing into Wales and Isle of Man, although this may be skewed by the proportioning of landings prior to 2021.

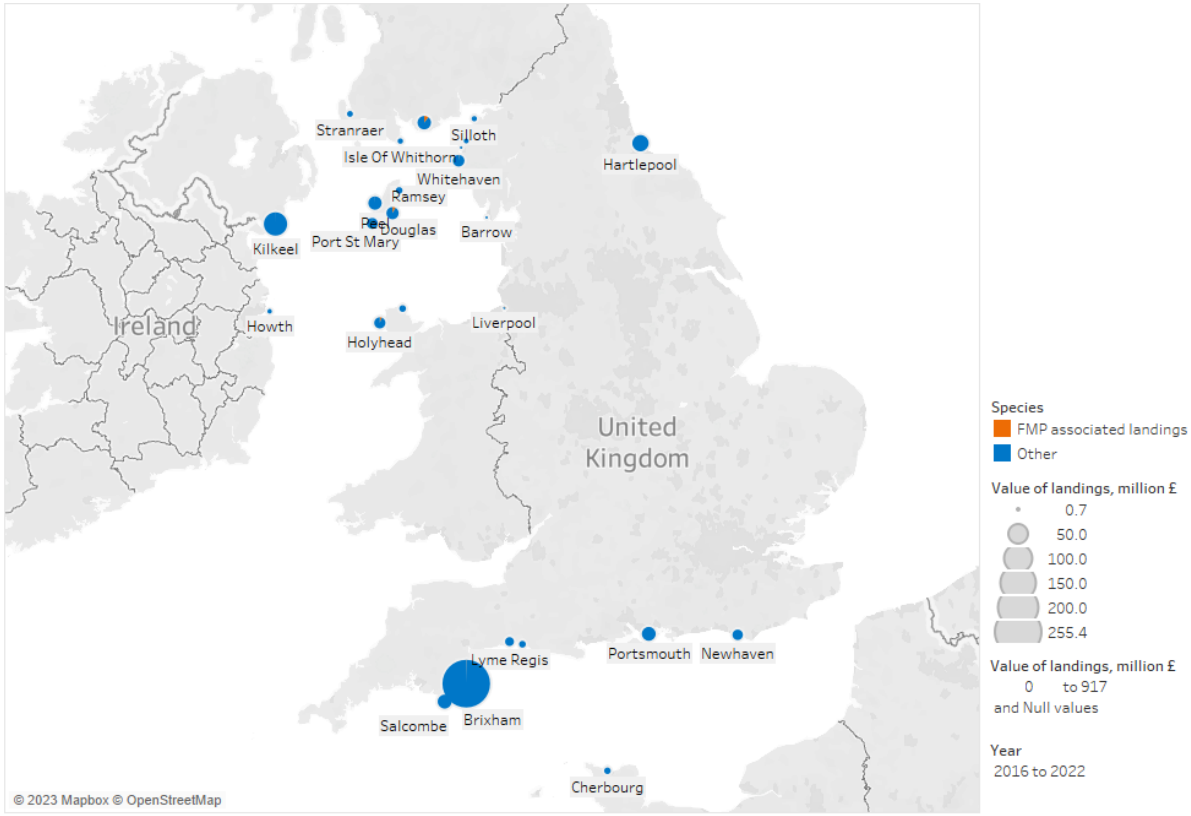

Figure 19: Estimated total value of all species landings into ports and the proportion of their reliance on queen scallop landings from English waters by value compared to all other landed species between 2016 – 2022. The proportion of queen scallop landings is so small that it is not visible on the pie charts (Seafish).

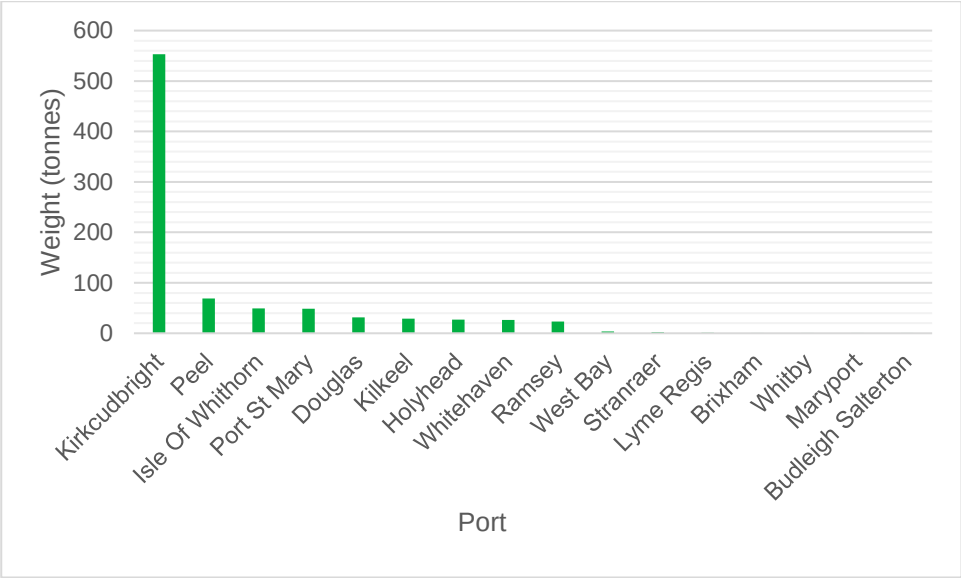

Figure 50: Estimated landings by weight from UK+CD vessels fishing in English waters, by port of landing, 2022 only (live weight tonnage).

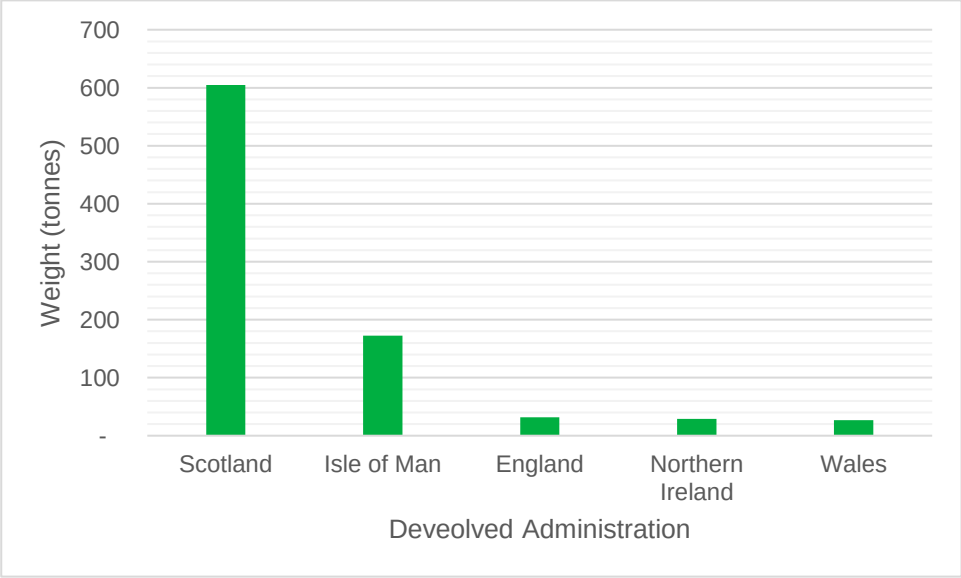

Figure 21: Estimated FMP landings by weight from UK+CD vessels fishing in English waters by landing port nationality, 2022 only (live weight tonnage).

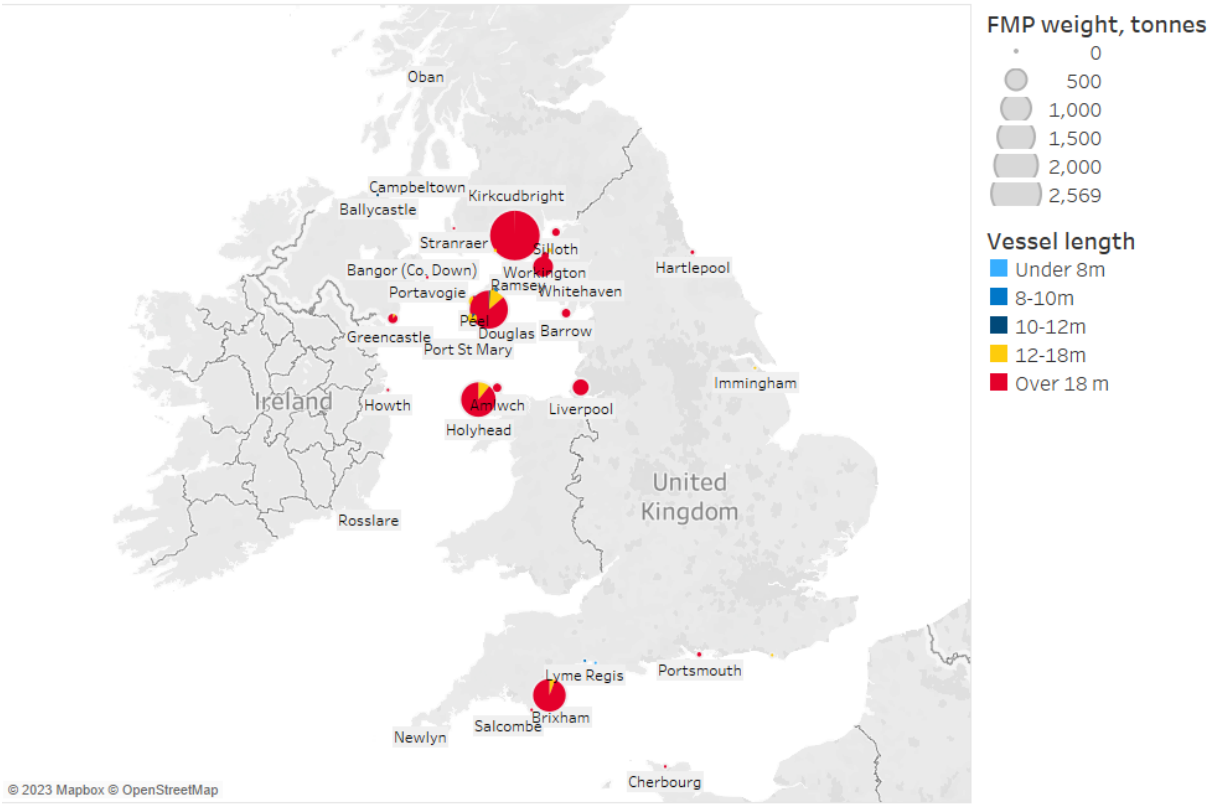

Figure 62: Estimated volume of queen scallop landings from English waters by port between 2016 and 2022, by length of vessel (Note: all ports with cumulative FMP related weight of landings in 2016-2022 above 1 tonne are selected) (Seafish).

Economic data

Table 9 and Figure 23 set out the economic performance indicators associated with queen scallop landings from English waters. The GVA is normally considered to be a proxy of sector contribution to gross domestic product and is important as a measure of value created by the sector to society. Operating as well as net profits are measures representing business performance and important for business owners as indicators of their business profitability. Operating profit only accounts for operating costs, while net profit also considers depreciation of the capital invested and financial business costs, such as loan interest. The margin of each economic indicator as a ratio of fishing income could show economic efficiency and profitability of the operations and its evolution over time.

There has been a gradual drop in income from queen scallops since 2016. The lowest point for all indicators was 2020, likely as a result of the impact of Covid-19 restrictions on the fishery. In 2018 there was a significant drop in fishing income (down 58%), which correlates with the notable drop in landings in 2018.

Table 9: *Economic performance indicators associated with queen scallop landings from English waters in 2016 to 2022.*

Indicator	2016	2017	2018	2019	2020	2021	2022
Fishing income (£000)	2,138	1,625	689	649	196	512	377
GVA (£000)	902	804	219	309	94	239	128
Operating profit (£000)	256	292	15	120	34	88	33
Net profit (£000)	82	210	-24	61	10	47	
GVA to fishing income margin	42%	49%	32%	48%	48%	47%	34%

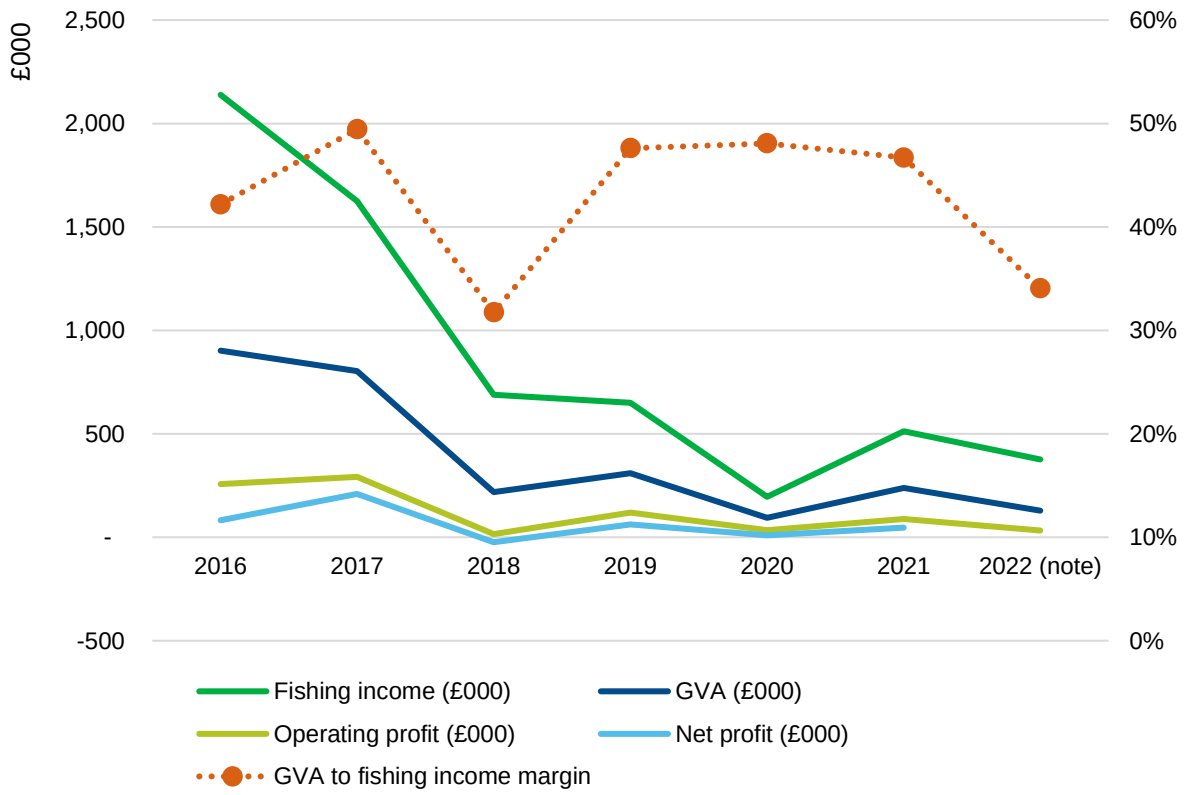

Figure 73: *Economic performance indicators associated with queen scallop landings from English waters, 2016 to 2022 (2022 data is a forecast based on 2022 preliminary activity data provided by MMO and 2021 costs structure).*

Figure 24 indicates that when there are low to no landings the average price significantly increases; presumably because demand significantly outweighs supply at these points. A 2020 European Market Observatory for Fisheries and Aquaculture (EUMOFA) analysis stated that seasonality in the UK queen scallop fishery is not clearly defined and several

Cefas reports reference the opportunistic nature of the fishery which may impact the average price. Over the last ten years there was substantial variability in price obtained within each year (EUMOFA, 2020), but Stott et al. (2020) reported that these fluctuations in landing values per kilogram could not be adequately explained by landing month, port or gear employed.

There were peaks in average price in 2018, but the 2022 average price is at the lowest point since 2016, despite relatively low landings. The low average price in 2022 may be a result of inflation across Europe, meaning consumers are less willing or able to pay high prices for food as their budgets are stretched.

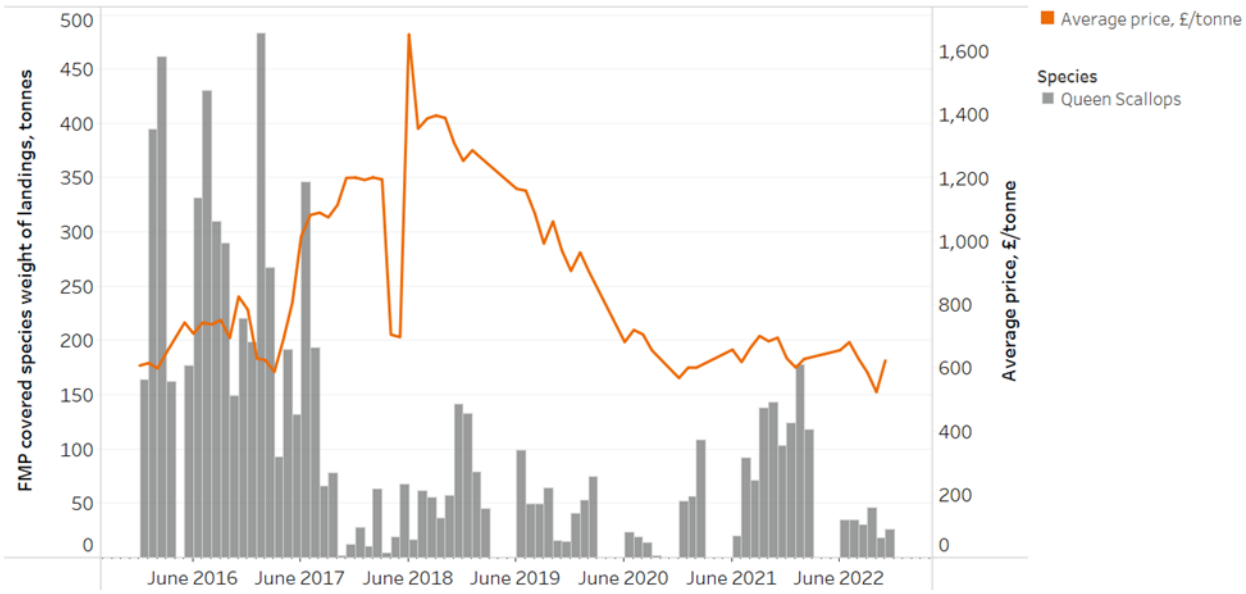

Figure 84: Queen scallop landings from English waters by month (grey bars) in 2016 to 2022 and average price (orange line) during the same period (Seafish evidence statement). Average prices are shown for those months with landings over 1 tonne.

International sales and exports

HMRC trade data does not distinguish between queen and king scallops. Scallop exports might include queen scallops, but are mostly represented by king scallops. The UK is a net exporter of scallops, which are relatively high value. In 2022, the UK exported £89.6 million of scallop products and imported £20.9 million of scallop products. The average price of both imports and exports has been increasing since 2016.

Approximately 60% of scallops are exported live/fresh and the remainder are exported frozen. While the overall amount of fresh exports has decreased since 2016, there has been an increase in frozen exports over this period. France is the largest scallop export market (70% of tonnes in 2022) followed by Italy (9%) and Spain (7%). Historically France has been the primary destination for exported UK scallops, although it may not be the final destination for a substantial amount of exported scallops with likely onward transportation to elsewhere in the EU. As the majority of the scallop exports are king scallops it is not

possible to determine a trend in exports specific to queen scallops, which make up only a small proportion of overall scallop exports based on landings volumes.

Employment (FTE) by fleet segment

Figure 25 shows employment calculated in full time job equivalent (FTE) published as part of Seafish 2021 Employment in the UK Fishing Fleet report.

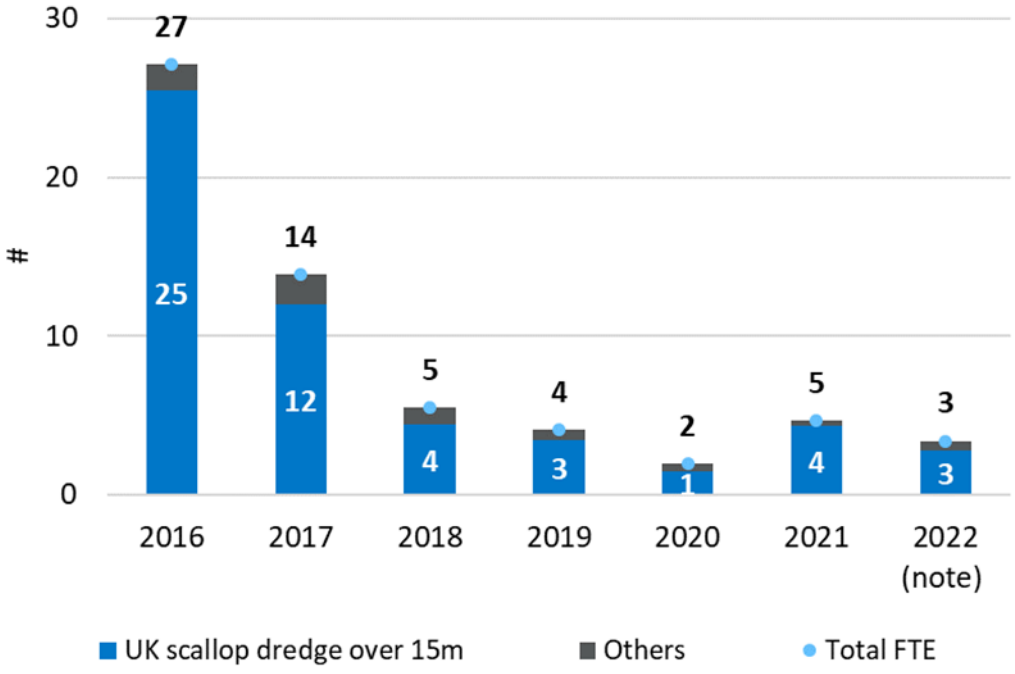

Figure 95: Employment (FTE) associated with queen scallop activity in English waters by Seafish fleet segments in 2016-2022 (total number rounded to the nearest whole number).

NOTE: data has been calculated using pro-rata economic indicators of the relevant vessels based on the value of queen scallop as a proportion of the total value of their landings

Overall FTE associated with the scallop fishery has declined between 2016 and 2022, following the decline in volume landed. This decline in FTE is more prominent in the over 15 m scallop dredges, which has decreased from 25 FTE in 2016 to 3 in 2022. The number of FTEs on under 15 m vessels remains that same in 2022 as it was in 2016, despite some fluctuations throughout the time series.

In 2020 there was only one FTE across all fleet segments, which could be an impact of Covid-19 restrictions. This low level of activity in 2020 is seen throughout the analysis so far, including landings, vessel numbers, and value.

Biology of the FMP species

Life history

The queen scallop is a filter-feeding bivalve mollusc which usually grows to a maximum shell height of around 90 mm (Schmidt et al., 2008). It is commonly found on sand or gravel along the British and Irish coasts, from tidemark down to a depth of about 100 m (Carter, 2008), but predominantly at depths between 20 to 45 m (Brand, 2006b). It is frequently found together with the king scallop, (Pecten maximus), on the same grounds but can live also on harder gravel and shelly bottoms because, unlike king scallop, it does not usually recess in the seabed (Brand, 2006a). It also occurs amongst beds of horse mussels (Modiolus modiolus) (Carter 2008).

Queen scallops have a natural life expectancy of 6 to 10 years. Common predators are starfish, demersal fish, and crabs (Hayward & Ryland, 1995).

Queen scallops reach sexual maturity when they are about one year old (Hayward & Ryland, 1995). However, at this time, the gonads are very small and do not make a significant contribution to total egg production until the later years. As with all scallops, fecundity of the adult queen scallop is high and increases with age (Andrews et al., 2011). Spawning occurs in the spring (March to May), although secondary spawning can occur later in the year (autumn), and also periodically throughout the summer. In the north Irish Sea there are generally three more-or-less distinct peaks of spawning each year in the inshore populations, occurring in February to March, June to July and September to October, with the autumn spawning appearing to be the most important (Aravindakshan, 1955; Duggan, 1987). However, for a deeper water population farther offshore, Wanninayake (1994) reported only two peaks, with no evidence of the autumn spawning and the redevelopment of the gonads through the autumn and winter proceeding some two months earlier than for the inshore populations (Andrews et al 2011).

Queen scallops are permanent hermaphrodites, and gametes are separately released into the water column, closely synchronised with other members of the species to maximise fertilisation (Hayward & Ryland, 1995). The resulting larvae are carried in water currents for typically 11 to 30 days, before settling into their nursery habitats – complex substrates that provide shelter, such as maerl grounds (Kamenos et al., 2004) – to which they attach themselves by means of their byssal threads. They remain attached to these elevated structures until they reach a size of 15 to 20 mm and attain the ability to swim freely, at which point they settle onto the seabed (with a preference for high current velocities and low suspended sediment concentrations) and remain excellent swimmers throughout life (Ansell & Ackerly, 1994). Although swimming is an effective short-distance escape response, queen scallops are not capable of swimming far before they become fatigued (Chapman et al., 1979).

Stock distribution

Scientific surveys

There are both fishery-dependent and independent data sources available for queen scallops around the UK. A few regular surveys provide information about biology, as well as temporal changes in stock size and population structure.

English waters

Queen scallops have sporadically been monitored on some of the Centre for Environment Fisheries and Aquaculture Science (Cefas) annual fishing surveys, namely the Quarter 1 South Western Beam Trawl Survey (Q1SWBEAM) carried out in ICES Divisions 7e and 7f, the Quarter 1 South Western Otter Trawl Survey (Q1SWOTTER) in Division 7e, the Quarter 3 Beam Trawl Survey (BTS7D) in Divisions 4c and 7d, and the Quarter 3 North West Ground Fish Survey (NWGFS) in the Irish Sea (Division 7a), the Bristol Channel and the Celtic Sea (Division 7f).

These surveys are designed for flatfish and are therefore not best suited to sample scallops. Cefas does not hold any age sampling data for queen scallops. However, queen scallop size samples have been obtained on two of the surveys. Q1SWOTTER has provided records of queen scallops since 2017. The survey has a random stratified design, with fluctuating station locations each year. Therefore, the survey does not provide time series of local abundance indices, but rather a time series of abundance for the whole survey area. Data quality for queen scallops from NWGFS has evolved over the years. For 1988 to 2015, only the presence or absence of queen scallops was routinely recorded at all stations, with counts and weights recorded at 20 key stations. From 2016, queen scallops were counted and weighed at all stations, and from 2019, individual queen scallops were also measured.

Isle of Man

Fishery-independent surveys were carried out in IoM territorial seas from 1992 to 2006 by Port Erin Marine Laboratory, and subsequently by Bangor University on behalf of the IoM Department for the Environment, Fisheries and Agriculture (DEFA).

There are two annual scallop surveys undertaken by Bangor University (Bloor & Kaiser, 2016; Bloor & Jenkins, 2021). One survey is a long-standing dredge survey, currently conducted with the Research Vessel Prince Madog, covering 64 fixed stations with a spacing of about 3 NM between neighbouring stations. The survey is carried out in the first half of April, before the start of the queen scallop fishing season, which runs from June to May the following year (Bloor & Jenkins, 2021). The standard survey gear comprises a set of two king scallop dredges (with 80 mm mesh ring diameter and 9 teeth of 110 mm length) and two queen scallop dredges (with 60 mm mesh ring diameter and 10 teeth of 60 mm length). At each station the dredges are towed for 20 minutes at a speed of about 2.6 knots, whereby the direction of the tow depends on tidal and current conditions. Each dredge is fitted with video cameras to verify whether the gear fished correctly throughout

each operation. For each tow, the total biomass of queen and king scallops is recorded, and a subsample of 90 queen scallops and 90 king scallops from each dredge is individually weighed and measured.

The second survey is a higher-resolution dredge survey which has been undertaken since 2019. It is currently conducted on two commercial fishing vessels, and sampling is coordinated by the Manx Fish Producers Organisation (MFPO) with scientific support from Bangor University. Survey cells (with a spatial extent of 1 min (1/60 degree) in longitude and 0.5 min in latitude) are sampled randomly within each seabed strata (defined predominately by depth), whereby approximately equal effort is expended within individual strata. Inside each survey cell a 10-minute tow is undertaken at a speed of about 2.5 knots. Each vessel deploys fishing gear on two bars. One bar tows two king and two queen scallop dredges with the same technical specifications as the standard survey gear described above. The other bar tows four dredges that differ from those on the opposite side in that the queen scallop dredges have 17 teeth of 60 mm length, with a mesh attached internally that, when stretched into a fixed position, results in a maximum mesh size of 38 mm. These dredges are designed to target juveniles. The catch from each dredge is counted, and a subsample of 90 queen scallops and 90 king scallops from each dredge is individually weighed and measured.

Northern Ireland

Since 2013, the Agri-Food and Biosciences Institute (AFBI) has carried out annual fishery-independent surveys in the North Channel of the Irish Sea (part of ICES Division 6.a), on behalf of the Northern Irish Department of Agriculture, Environment and Rural Affairs (DAERA). Additional sites in ICES Division 7.a are surveyed to the south-east of the IoM, and within the IoM territorial seas in collaboration with Bangor University. The survey deploys Under Water Towed Video (UWTV) at a total of 94 stations (52 in the Irish Sea and 42 in the North Channel), randomly selected from a fixed grid. At each station the camera sledge is towed for 15 minutes at a speed of 0.8 to 1.2 knots, and the number of queen scallops within the survey track per minute are counted. Some stations with a high density of scallops are selected for fishing, using either dredges (two king scallop dredges, one of which is fitted with a fine mesh liner, and two queen scallop dredges), or a queen scallop trawl net. Caught queen scallops are measured and aged.

Scotland

Annual scallop surveys have been carried out by Marine Scotland around the Scottish coast since the mid-1990s, although a partial survey of the west coast began in the late 1980s (Dobby et al., 2017). Currently, three annual dredge surveys are undertaken: along the west coast, in the North Sea, and around Shetland, each using a fixed station design originally determined based on sediment type and local fisher knowledge. During these surveys, queen and king scallops are routinely measured and aged.

Stock assessment units

Queen scallops are known to have a patchy distribution, even within individual fishing grounds, and currently insufficient information exists about their biology and ecology to allow a scientific identification of distinct populations.

Genetic and larval dispersal modelling studies have been carried out in an attempt to determine connectivity between spatially distinct groups of various fish and shellfish species in the Irish Sea (Macleod et al., 1985). Dispersal of queen scallop larvae both within the Irish Sea, between the Irish and the Celtic Sea, and through the North Channel into Division 27.6.a is likely to occur, but the understanding of connectivity between adjacent sea areas remains limited (Reeves 2020b). Cefas is not aware of connectivity studies for queen scallops in English waters, but anecdotal information indicates that the Liverpool Bay area is the source of spat for queen scallop population in IoM waters, and that spawning in IoM waters is feeding the queen scallop population around Rathlin Island.

Laptikhovsky and Kaiser (2015) explained that all scallop stocks are structured as “metapopulations” in which subpopulations of sedentary adult individuals are connected with each other through the dispersal of pelagic larvae. This structure brings with it the need to identify appropriate spatial scales for the observation, analysis and management of exploited scallop stocks.

ICES does not assess or provide advice for queen scallops and no formal stock assessment units have been agreed for queen scallops around the UK. Data on stock health is most comprehensive from the Isle of Man territorial waters (up to 12 nautical miles (NM) from the coast) but is variable elsewhere in UK waters. Lawler (2020) considered stocks off Northern Ireland and the wider Irish Sea to be ICES Category 3 or 4 (catch data available), and stocks around English coasts in the English Channel and North Sea are data poor (Category 5 – landings data available).

It has not been determined whether the stocks in English waters belong to a single population or comprise sub populations (Stott 2021). If it is one population, the large removal of one part of the biomass will have a knock-on effect on the biomass of the whole area and therefore may lead to an overall decrease in population (stock recruitment relationship). If there are sub populations, the large removal of one part of the biomass may have more or less of an impact depending on the migration patterns (Stott 2021). Understanding the stock structure will have significant impact on the approach taken to manage this fishery.

Published assessments

No formal stock assessments have been carried out in English waters.

In 2020, Cefas published several reports (Lawler 2020, Lawler and Laptikhovsky 2020, Stott 2021) reviewing data available for the queen scallop fishery and potential stock assessment models that could be applied. They determined that there was a need for more data collection and suggested that in the future, Cefas annual surveys would provide

length distributions and catch numbers of queen scallops for each fishing position. LPUE was calculated for the Irish Sea and a surplus production (SPiCT) assessment model tested, but it needed further investigation (Stott 2021).

Lawler (2020) concluded that those occasional fisheries off the English coasts may have enough information to carry out a basic length-based assessment to determine mortality. These data may be acquired relatively inexpensively and at short notice, but such analyses provide indicative results rather than those provided by structured models with a suitable time series of data. For a more robust assessment of the fisheries, a biological sampling programme may be required to provide a time series of the age structure of the removals. Such monitoring may be achievable with a modest budget given that few processors may offer numerous sampling opportunities. Long-term monitoring would require a commitment to long-term funding.

Cefas recommended that future work on queen scallop stock assessments be undertaken through the ICES WGScallop group due to the level of international collaboration required to manage shared resources (Lawler and Laptikhovsky 2020). While this would ensure the relevant experts are available, there is a chance queen scallops may not be prioritised over the more valuable king scallop research. In 2020, the ICES WGScallop updated its terms of reference and is starting to look specifically at queen scallop stocks and fisheries in more detail for the first time. The working group received landings and effort data on queen scallops during a data call issued in 2019, and aims to continue doing this annually (Stott 2021). A biological sampling program within the working group will be set up to collect samples via surveys or processors from each ICES area to enable age, growth and other biological parameters to be assessed and compared across the distribution area (ICES WGScallop 2020). The most recent meeting took place in October 2023, and included updates on the progress of this workstream.

Summary of stock assessments outside of the FMP area

Queen scallop stocks in Scotland and Northern Ireland are not subject to a formal stock assessment, but survey data is used to indicate stock trends to determine fishing advice for the next year (Lawler and Laptikhovsky 2020).

Estimates of stock biomass from scientific surveys are an important component of the management system in the majority of the scallop fisheries (Reeves 2020a). In most scallop fisheries globally, stock abundance is estimated directly from the survey results without the use of a stock assessment model. Biomass estimates are also used to inform the management actions, including setting a TAC, implementing an area closure as part of a rotational harvesting approach, or an escapement approach which seeks to maintain a certain minimum biomass so that any surplus can be harvested (Reeves 2020a). An alternative approach is to monitor commercial catch rates which decrease during the season as more of the stock is harvested. The fishery is closed once the catch rate reaches a specified minimum value (Reeves 2020a).

Isle of Man

A Catch-Survey Analysis (CSA) has been carried out by Bangor University in the IoM Territorial Sea to determine stock status of queen scallops since 2012 (Bloor & Kaiser, 2016). This method uses abundance indices from the two annual surveys undertaken by Bangor University. CSA has been advocated as a valuable method to support management advice where a time series of abundance indices exists, but age data are not available (Bloor & Jenkins, 2021). Absolute estimates of stock size and fishing mortality derived from CSA are sensitive to input parameters, although trends over time are more robust (Bloor & Jenkins, 2021).

The basic data required by CSA are time series of the total number of animals in commercial catches, as well as survey indices for under- and commercial-sized animals. Annual mean individual weights for under- and commercial-sized animals are also needed for translating stock numbers into biomass. These are obtained from sampling data. Currently, the assessment area is situated within, and draws commercial landings data from ICES statistical rectangles 36E5, 37E5, and 38E5.

The most recent stock assessment (Bloor & Jenkins, 2021) indicates small increases in pre-recruit and harvestable biomasses from 2019 to 2021 (no surveys were conducted in 2020 due to the COVID-19 pandemic). However, both values remain close to their respective historic lows, and well below the peak pre-recruit biomass in 2007, which had progressed to peak harvestable biomass in 2010. Whilst the densities in many fishing grounds remain low, and the model indicates only a slight increase in biomass, there are spatially discrete areas within grounds with exceptionally high densities of post-recruits. Under those conditions, assessment at a fishing ground level may provide a better basis for spatial management than assessment of the overall stock biomass (Bloor & Jenkins, 2021).

Biological reference points

Queen scallops have not been formally categorised under the ICES framework in terms of their data availability, although Lawler (2020) considers the stocks to range from ICES Category 3 to 5. Currently, no reference points have been defined for the biomass and the fishing pressure on queen scallops in the area covered by the queen scallop FMP.

The development of reference points is considered challenging in most scallop fisheries, but estimates have been provided in some cases either through proxy calculations or based on Catch Per Unit Effort (CPUE). The ICES WGScallop are working on potential stock assessment methods for scallop fisheries and committed to discuss possible reference points (following ICES guidelines from WKREF2) in year two of their current work plan (WGScallop 2022). Progress in this area will be valuable in identifying best practice data collection processes for queen scallops that contribute to the most appropriate stock assessment methodology, along with an agreed approach to stock assessments across management jurisdictions.

Fishery management

Fisheries management in the UK is the responsibility of the Devolved Administrations. The queen scallop fishery in England is managed by Defra through the MMO outside of 6 NM and the regional IFCAs inside of 6 NM. The Trade and Cooperation Agreement outlines access arrangements for EU vessels fishing in English waters.

There is currently little queen scallop-specific management in the UK and for several years there has been concern from the catching sector about the potential for fishing effort to increase if the market value of queen scallops increases.

Current management approaches

Inside the FMP area (outside 6 NM)

Queen scallop fisheries are not governed by any UK or European Union TAC (Cappell et.al, 2013, 2018). Any vessel fishing in UK waters must have a commercial fishing licence, but unlike king scallops, vessels landing queen scallops do not require a dredge permit. Vessels over 15 m are managed by Days at Sea (DAS) through the Western Waters Effort Regime, although effort for king and queen scallops is combined (Defra 2023). DAS are allocated on a quarterly basis and counted in calendar days (midnight to midnight). Any days remaining at the end of a management period will not be transferred across management periods and are not transferrable between fishing vessels. The number of days spent at sea are monitored for enforcement purposes by MMO/Devolved Administrations, and any vessel exceeding the maximum number of days at sea may be subject to prosecution.

There is a Minimum Conservation Reference Size (MCRS) of 40 mm in place for UK waters (originating from EU legislation) and queen scallops must be landed whole (Reeves 2020b). Generally, most vessels land queen scallops greater than 50 mm based on market demand as it is more efficient for the supply chain to process fewer, larger scallops (Reeves 2020a).

Since 2018, there has been a seasonal closure between April and July in ICES Division 6a and 7a designed to protect queen scallops during part of their spawning season and support future growth in the population (UK Government, 2023). The closure applies to all EU, Isle of Man and UK vessels.

Inside the FMP area (inside 6 NM)

Inshore management measures vary depending on the IFCA area. All IFCAs have general Byelaws restricting the size and power of vessels permitted to fish within their 6 NM zone. All IFCA areas have a MCRS for queen scallops of 40 mm.

Other IFCA management measures include seasonal and spatial closures for dredge gear, permit requirements for dredge gear, requirements for catch returns, requirements to minimise shell damage, and limits on number of dredges towed. These measures are not

currently aligned across IFCA districts and are not specific to the queen scallop fishery. The North West IFCA manages the English inshore area of the Irish Sea and operates a permit system for dredge vessels but does not have any other scallop specific byelaws.

Outside the FMP area

Within the Isle of Man territorial sea, a range of management measures for queen scallops are in place, which are covered under the Isle of Man Fisheries Act 2012, various secondary legislation, and restrictive licensing conditions. Due to adaptive changes in secondary legislation and licensing conditions, annual catch quotas, the spatial extent of closed areas, and closure periods, change over time. Commercial fishing of queen scallops within the IoM territorial sea is prohibited, unless the vessel is granted an IoM Sea Fishing Licence, issued by DEFA under the Sea Fisheries (Licensing) (Fishing Vessels) Regulations 2021. This legislation specifies, among other measures, permitted gear, area specific gear limitations, vessel power, and monitoring requirements. Manx vessels fishing for queen scallops now exclusively use otter trawls, while UK vessels continue to deploy queen scallop dredges, in addition to otter trawls (Bloor & Jenkins, 2021).

The IoM Scallop Management Board is a non-statutory advisory Board formed by the Isle of Man Government Department of Environment, Food and Agriculture (DEFA) to provide advice on scallop management. Following their recommendations, the queen scallop survey data is used to estimate annual total allowable catch (TAC) using the ICES approach for Category 3 data limited stocks. This approach requires a minimum of five years of survey indices, whereby the two most recent survey indices are summed and divided by the sum of indices from the previous three years. This ratio is then used to adjust the previous year's TAC up or down by a maximum of 20%.

A precautionary management approach has been implemented since 2010, and the IoM queen scallop trawl fishery became Marine Stewardship Council (MSC) certified the following year, indicating the fishery was operating at a best practice level. However, following the decline in stock status, the MSC certificate was suspended in 2014.

The Electronic Daily Scallop Catch Return Forms provide almost real-time fisheries-dependent data for monitoring TACs and catch rates (landings per unit effort, LPUE). Entry to the fishery is restricted and on provision that participants complete accurate reporting processes to help monitor the status of the stocks (Reeves 2020a). Based on this data, the IoM has moved towards spatial management of the queen scallop fishery at the level of individual fishing grounds using landings and LPUE thresholds, whereby additional harvest control rules are discussed once these thresholds have been reached at a particular fishing ground (Reeves 2020a).

For the 2020 fishing season, the following additional management measures were in place in IoM waters (Bloor & Jenkins, 2021):

- Spawning protection closure (1 April to 30 June), as part of the wider statutory closure in ICES Divisions 27.6.a and 27.7.a (since 2018)
- Weekend ban

- Daily curfew (fishing permitted 06:00 to 18:00)
- 55 mm MCRS inside IoM territorial seas
- Weekly catch limits for trawl fishery:
    - Weeks 1 – 4: maximum of 2,695 kg per vessel
    - Week 5: maximum of 3,150 kg per vessel
- Individual quotas for dredge fishery: 14,575 kg per vessel
- Total Allowable Catch:
    - Weeks 1 – 10: trawl fishery 557 t
    - Week 11: trawl fishery 90 t
    - Dredge fishery: 58.3 t (opened 1 October)

Technical measures

The Scallop Fishing (England) Order 2012 defines the legal specifications and maximum number of dredges that can be deployed for the capture of king scallops. There is no equivalent legislation for queen scallops. The number of nets or dredges deployed during fishing operations varies, depending on the size and power of the vessel (Cefas evidence statement 2023).

Sectoral representation

The main queen scallop fishery in the UK is based in the Irish Sea and in Isle of Man territorial waters, however there are vessels fishing this area from England, Scotland, Wales, Northern Ireland and Isle of Man. Ahead of the 2016 queen scallop management consultation, a queen scallop management group (QSMG) was set up to represent members of the catching sector involved with the queen scallop fishery. This group still exists, but with fewer members since the number of vessels in the fishery has reduced significantly in recent years. The Scallop Industry Consultation Group (SICG) is a collaborative group set up to consider the management of king and queen scallops, although the majority of members target king scallops.

Other interested groups include: Welsh Fishermen's Association, Northern Irish Fishermen's Federation, Scottish Fishermen's Federation, Scottish Whitefish Producers Association scallop committee, Manx Fish Producers Organisation, Shellfish Association of Great Britain, South West Fish Producers Organisation, and National Federation of Fishermen's Organisations.

UK queen scallop management consultation

In 2016, Marine Scotland led a consultation on management measures for the queen scallop fishery, which can be accessed here Consultation on New Controls in the Queen Scallop Fishery in ICES Divisions VIa and VIIa - Scottish Government consultations - Citizen Space. Feedback was sought on:

- Increasing the minimum conservation reference size (MCRS)

- Introducing an annual closed season
- Introducing limits on the number of vessels able to prosecute the fishery, specifically via entry restrictions
- Effort reduction measures (restricting time that vessels can fish)
- Catch quotas
- Closed areas
- Gear-specific management

There was significant industry support for the introduction of management measures and a summary of the feedback received during this consultation can be found in appendix 1. The only management measure to come from the consultation is the seasonal closure in ICES Divisions 6a and 7a. Since 2016, the number of vessels in the fishery has reduced due to fewer market opportunities, leaving only 5 to 6 vessels actively targeting queen scallops in English waters. These vessel owners remain supportive of improved management of the fishery, and the relatively low number of vessels provides an opportunity to implement appropriate management now before the fishing pressure increases again.

The lack of information on stock status (other than landings) or stock assessments covering the whole Irish Sea impacts the ability to develop and implement appropriate management for queen scallops. However, this should not hold up progress toward management based on current information, which can be improved as more information becomes available (Marine Scotland 2016).

The multiple management jurisdictions in the Irish Sea may lead to different approaches to management and data collection. Reeves (2020b) and Lawler (2020) recommended that collaboration across these jurisdictions is required to deliver sustainable fisheries management, and suggested that the ICES WGScallop is best placed to coordinate the data collection and stock assessments.

Global best practice

Management measures used in a number of scallop species and their fisheries globally were reviewed and are summarised in Table 10.

Reeves (2020b) established that TACs are the main management measure in the majority of scallop fisheries, with seasonal closures being used as a supplementary measure. In some cases there is also a spatial component to management with rotational harvesting used to determine areas subject to fishing one year then left to recover for a number of years while other grounds are fished (Reeves 2020b). All fisheries reviewed had a limited entry system to help control the level of fishing pressure, as well as a minimum conservation reference size.

In all cases, a suite of measures are used to ensure that fishing pressure is controlled in the long term, while adaptive harvest control rules enabled annual and in-year flexibility to implement further measures based on the stock biomass and performance of the fishery.

The fisheries have short- and long-term objectives that help scientists determine how best to undertake stock surveys and assessments, provide appropriate advice and support fishery managers in implementing suitable management. More detail on each of the case studies and the type of management can be found in appendix 2

In the case of Full Bay and Georges Bank, management was introduced in the 1990s because of a collapse in the stock biomass. Over the last 10 to 15 years, both fisheries have seen a significant increase in biomass and have been successfully certified against the MSC Standard. All of the global scallop fisheries reviewed have been through at least one MSC assessment, and although several have conditions against their certificate, these are generally related to further understanding the habitat impacts of the fishery, or demonstrating over time that the harvest strategy and harvest control rules are successfully delivering the management objectives. The only exception is Isle of Man, which lost its MSC certificate for scallops in 2014 after the drop in stock biomass.

Table 10: Summary of management approaches in global scallop fisheries.

Case study	Assessment model	Capped licences	Seasonal closures	Catch limits	Gear restrictions	MLS
Full Bay, Canada	Bayesian delay-difference population model	Yes	Yes	TAC	Yes	Yes
Georges Bank, USA	Spatially explicit Catch-at Size Analysis (CASA)	Yes	Yes	DAS and TAC	Yes	Yes
Patagonia	Biomass estimates	Yes	Yes	TAC	No	Yes
Bass Straight, Australia	Biomass estimates	Yes	Yes	TAC	No	Yes
Isle of Man	Catch-Survey Analysis	Yes	Yes	TAC	Yes	Yes

Faroe Islands	Use CPUE	Yes	Yes	TAC in some areas	Yes	Yes
Baie de Saint Brieuc, France	Not public	Yes	Yes	Calculated but not used	Yes	Yes
English waters	None	No	Yes	No	No	Yes

Ecological impacts

Scallop fisheries have the potential to impact the wider marine environment, which can cause disruption to ecosystem state and function, in relation to both seafloor disturbance and bycatch of non-target species. Each of the Devolved Administrations is in the process of defining management measures in Marine Protected Areas (MPAs) throughout UK waters, including Special Areas of Conservation (SACs), Special Protection Areas (SPAs), and Marine Conservation Zones (MCZs). This also includes considering the impact of bottom towed gear on habitats and management of Priority Marine Features (PMFs) in Scotland. Figure 26 shows the planned wind farms in the Irish Sea which not only have significant overlap with the main queen scallop fishing grounds but may also cause disturbances that alter the preferred settlement location for spat. ICES rectangle 36E6 has the most queen scallop fishing activity in English waters, and Figure 26 highlights the significant number of spatial restrictions taking place there.

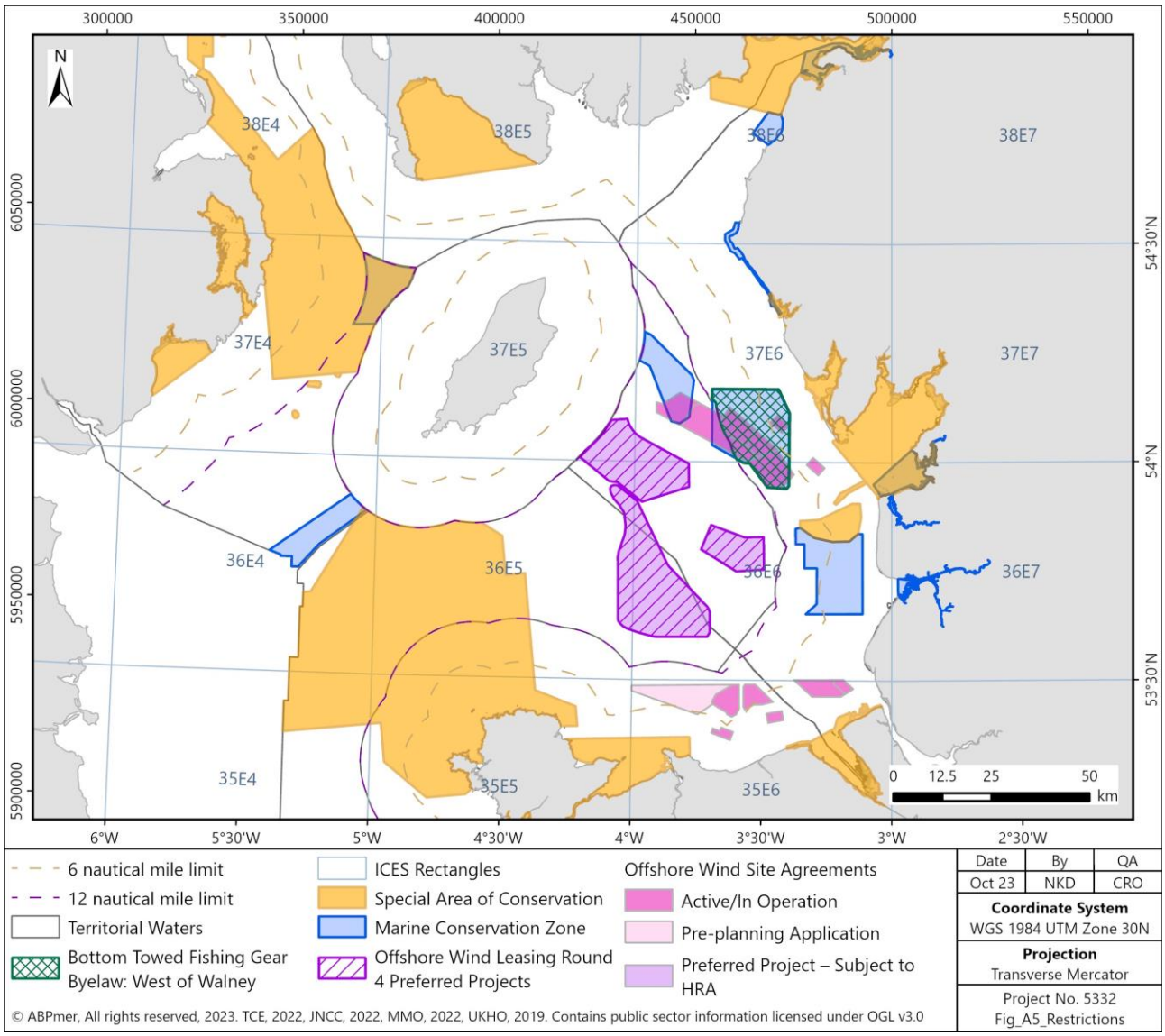

Figure 26: Spatial restrictions overlapping with the main queen scallop fishing grounds in the Irish Sea, including designated Marine Protected Areas and offshore wind sites.

Environmental Considerations

All Fishery Management Plans are subject to legal and environmental obligations arising from the Habitats Regulations, Marine and Coastal Access Act, UK Marine Strategy, and the Environmental Principles policy statement for the Environment Act 2021.

Defra sought advice from the JNCC and Natural England on the potential risk posed by the FMP king scallop fisheries to the features in Marine Protected Areas (MPAs). The UK's Statutory Nature Conservation Bodies (SNCBs) were also commissioned to provide advice on whether king scallop fisheries are likely to affect any of the UK Marine Strategy (UKMS) descriptors and our ability to achieve the targets for Good Environmental Status (GES). The evidence and advice provided by JNCC and Natural England is summarised within the main FMP document and described in more detail in Proposed Queen Scallop FMP - Statutory Nature Conservation Body Advice.

Seafloor disturbance

The fishing methods primarily used to target queen scallops are trawling (Isle of Man) and dredging. Of all fishing gears used in the UK, dredging is considered to cause the most damage to non-target benthic communities and seafloor habitats. The level of damage caused varies greatly between different types of seabed and groups of organisms, with biogenic reefs and benthic epifauna being the most vulnerable. This damage can have severe consequences for biodiversity, due to removing structurally complex species like hydroids, and negatively impact recruitment, including for scallops. This is because these habitats are key nursery and feeding areas for a wide range of species. There can also be physical impacts to the seabed, such as homogenisation and resuspension of sediments, causing alterations in seabed topography and nutrient cycling. Understanding the efficiency of scallop dredges is important for understanding the impact of dredging on the seabed, as it has been shown that dredges with a catch efficiency higher than the benthic depletion rate would cause a greater environmental impact.

Figure 27 shows the benthic habitat in the Irish Sea, which overlap with the queen scallop fishery.

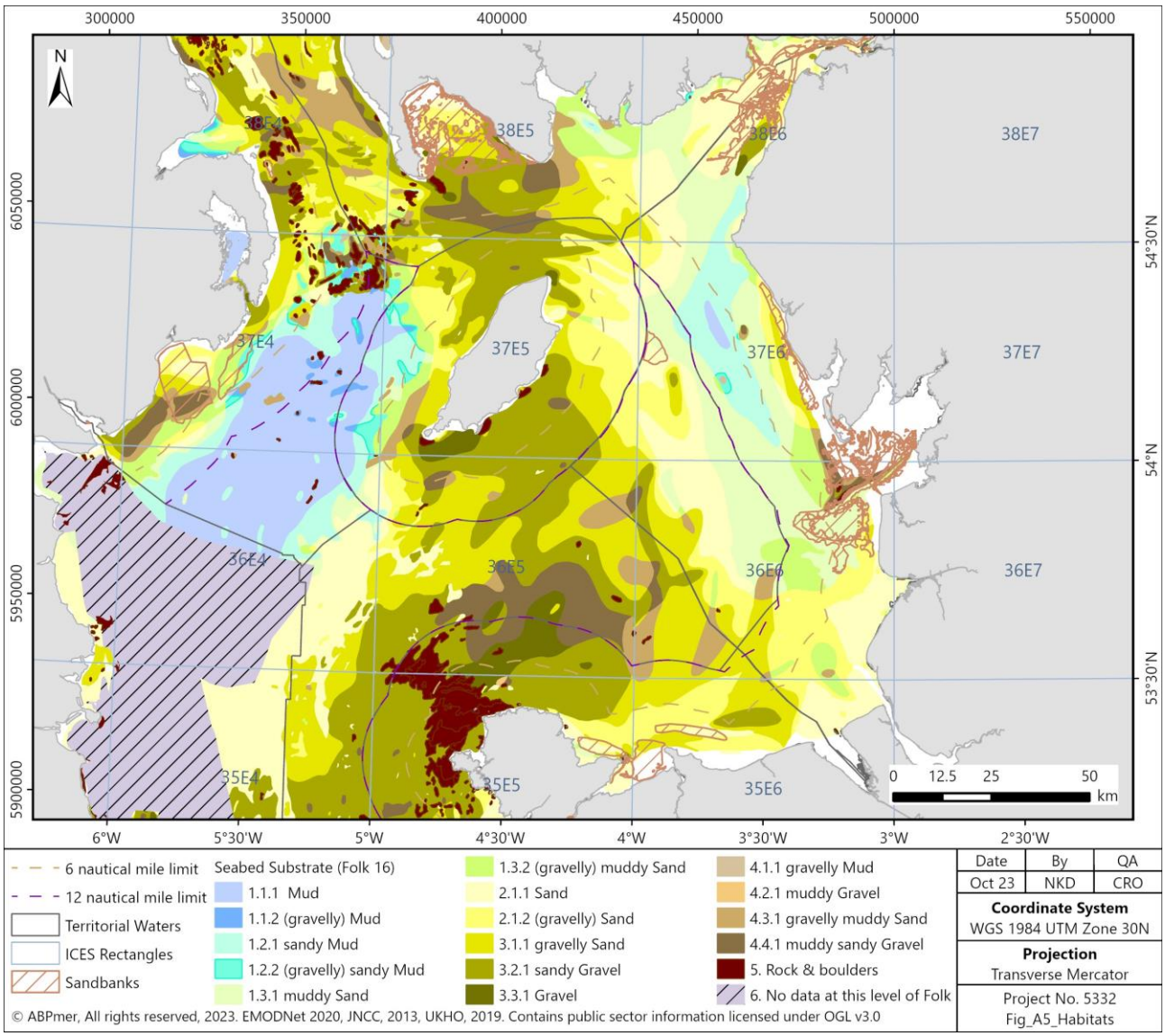

Figure 27: Benthic habitat types overlapping with the main queen scallop fishing grounds in the Irish Sea.

There does not seem to be significant presence of vulnerable marine ecosystems (VMEs) and, where there are, they are protected by MPAs. The main habitats overlapping with the queen scallop fishery appear to be sand and gravelly sand, but this map should be considered with some caution as the topography of the seabed will restrict the areas that vessels can actually access with bottom towed gear.

Bycatch

As Cefas does not undertake surveys specifically for queen scallops, it does not hold data on the catch composition and subsequent bycatch for the queen scallop fishery. Bycatch in the king scallop dredge fishery is dominated by commercial species including queen scallops but was considered by JNCC as unlikely to cause large-scale mortality of bycatch species populations due to the low proportion of individual species in the catch. Howarth and Stewart (2014) studied the efficiency and environmental impacts of otter trawls, dredges and modified queen scallop dredges, and determined that queen scallop skid dredges and otter trawls have similar target catch efficiency but varied in their bycatch

species (otter trawl bycatch comprised fish, and queen scallop dredge bycatch comprised invertebrates), and both have comparatively lower incidence of bycatch than the traditional dredge.

Climate Change

Scallop stocks and fisheries are sensitive to the environmental change brought about by climate change – such as ocean warming and ocean acidification. Whilst these stocks and fisheries are affected by this change, they are also one of the contributors. All fishing activity leaves a carbon footprint, which can further exacerbate the environmental impacts of climate change. The contribution of carbon emissions from scallop fisheries comes from vessel emissions, as well as potentially through the disruption and release of stored carbon from the marine environment via fishing gears impacting the seafloor.

To support the scallop fisheries to continue to sustainably harvest their stocks under changing climate, whilst also reducing their contribution to the cause, there is a need to move towards climate adaptive fisheries management.

Climate change impacts to queen scallop stocks and fisheries

Climate change and warming oceans are changing the distribution of commercially important shellfish species (Mieszkowska et al. 2020). Crustaceans (such as crabs and lobsters) are considered to be more tolerant to the changes in ocean acidification than bivalve molluscs such as scallops (Kroeker et al., 2010). Scallop larvae are particularly sensitive to the changes in ocean acidification, with experiments of predicted ocean acidification levels demonstrating deformity in larval shell formation and increased mortality (Andersen et al., 2013, White et al., 2014). These impacts can have significant economic implications to the scallop fisheries. A recent US model showed that under worst-case ocean acidification impacts, the US Atlantic Sea scallop fishery could decline by more than 50% by the end of this century (Rheuban et al. 2018).

The UK undertakes ocean acidification monitoring to allow trends in pH changes over time to be identified. In-situ ocean acidification data is gathered from two established monitoring stations in the UK (Western Channel Observatory and Stonehaven), supporting global ocean acidification monitoring and sharing efforts. Alongside this monitoring, the UK continues to build the evidence base on the impacts of climate change on fish and shellfish stocks and fisheries through the existing research and development projects. For example, the UK and devolved governments co-funds the Marine Climate Change Impact Partnership (MCCIP). The MCCIP provides a coordinating framework for the UK, delivering high quality evidence on the latest marine climate change impacts, and guidance on adaptation advice to policy advisors and decision makers.

Fishing vessel emissions

Total emissions by the UK fishing fleet are still substantial, estimated as 802 and 702 kt CO_2e in 2019 and 2020, respectively. This is equivalent to approximately 0.18% of UK total territorial emissions, or 0.66% of UK domestic transport emission. Recent analysis

conducted by Cefas has reviewed the “at-sea” emissions across nine main gear types. Wide differences in carbon emission levels exist between the main fleet segments, with passive gear types tending to have lower emissions than active gears.

Queen scallops in English waters are primarily fished using dredge gear (84%), with the exception of Manx vessels which predominantly use otter trawls. Recent analysis has shown that the total UK scallop dredge fishing fleet segment (which comprises of 209 vessels fishing queen and king scallops) produced 10.2% (85kt CO_2e) of the total carbon emissions at sea each year across the UK’s fishing fleets (Engelhard et al. 2022).

The scallop dredging fleet has expanded substantially on average from between 2005 to 2009 to 2015 to 2019, and with it has seen a rise in total carbon emission by more than 37%. The increase in fleet size has been seen in the smaller scallop dredges (under 15m length), with vessel numbers on average increasing from 120 between 2005 to 2009 to 203 between 2015 to 2019. Less of an increase has been seen in the over 15m dredges, which expanded on average from 74 to 86 over the same time period. Whilst total emissions are up by 37% over this time frame, overall, per-vessel emissions have decreased for the fleet by 8%.

Fishing gear impacts to blue carbon habitats

Healthy coastal and marine environments can provide nature-based solutions to help tackle climate change. For example, certain marine habitats (including those that are home to scallops such as sandy/ gravelly sediments), are able to store carbon - these are known as blue carbon habitats. If left undisturbed, these habitats can contribute to GHG emissions reductions.

Habitat disturbance through fishing practices may affect seabed carbon dynamics. Whilst seabed sediments are known to be one of the largest stores of organic carbon and capture, the fate of the resuspended sediment as a result of activities in contact with the seabed, for example mobile bottom fishing gears like scallop dredges, is particularly uncertain and often ignored in seabed biogeochemistry models. The number of studies that have directly measured the effect of bottom trawling on seabed carbon stores in controlled experiments is very limited meaning that the evidence-base needed to support justifications for designating sites to provide long term carbon stores are severely lacking.

Evidence Requirements

FMPs have identified evidence requirements which may need to be filled to achieve the stated FMP goals. In the short term, Defra will collate and prioritise these evidence gaps across the FMP programme, to look to deliver evidence to support in addressing some of the most pressing and key questions identified within the FMPs. However, all evidence gaps identified across the FMP programme will not be able to be funded by Defra alone. If all evidence gaps are unable to be addressed in a timely manner, the precautionary approach may be applied. In the longer term, to support the phased approach of FMPs and progress towards meeting the Fisheries Act Objectives, Defra are developing an

evidence pathway that promotes collaboration between industry, academia and fisheries managers to address these identified evidence gaps for FMPs.

Below is a summary of the evidence requirements identified so far, to support delivery of the FMP objectives and actions for developing and introducing management measures for queen scallops.

Evidence requirement	FMP objective/ measure	Action underway/ required
Improved evidence on age, growth and other biological parameters for queen scallops for assessment and comparison across queen scallop distribution areas**.**	Objective 1: Develop proposals for a comprehensive data collection programme for queen scallops	A biological sampling program to be developed by the ICES Scallop Working Group (due to the level of international collaboration required), to collect samples via surveys or processors from each ICES area.
Improve knowledge base on mitigation methods for reducing FMP gear type impacts on benthic habitats.	Objective 3: Assess and mitigate (where possible) interactions with the marine environment and potential impacts associated with queen scallop fishing.	Review existing research (including effectiveness of existing measures) on mitigating benthic impacts from queen scallop gear types.
Improved understanding of the impact that queen scallop vessels have on the marine environment (including seabed, blue carbon and CO2 emissions) through collaborative studies.	Objective 3: Assess and mitigate (where possible) interactions with the marine environment and potential impacts associated with queen scallop fishing. Objective 5: Develop climate change mitigation and adaptation methods for shared UK queen scallop fisheries.	Partially covered by king scallop FMP evidence priorities, to improve knowledge base on mitigation methods for reducing FMP gear type impacts on benthic habitats.
Improved understanding of the spatial and temporal extent of queen scallop fisheries in English waters, both for dredging and otter trawling, to improve confidence around the	Objective 3: Assess and mitigate (where possible) interactions with the marine environment and potential impacts associated with queen scallop fishing.	

assessments of wider environmental risks associated with queen scallop fishing.		
Identify key information gaps and evidence requirements relating to abandoned, lost, discarded fishing gear (ALDFG) in English and shared UK queen scallop fisheries.	Objective 3: Assess and mitigate (where possible) interactions with the marine environment and potential impacts associated with queen scallop fishing.	
Undertake a desk-based review of current and proposed future marine space use to better understand the social and economic importance of English queen scallop fisheries.	Objective 4: Explore the impacts of changes in marine spatial use on queen scallop fisheries.	
Identify and address evidence gaps to ensure the queen scallop sector has the appropriate data, evidence, narrative and means of engaging with regulators and potential marine users on marine spatial planning (feeding into the MSPri programme in England) and access issues.	Objective 4: Explore the impacts of changes in marine spatial use on queen scallop fisheries.	
Review existing scientific evidence relating to size at maturity for queen scallops in the Irish Sea and English Channel and assess the likely benefits and impacts of increasing MCRS.	Measure 1: Increased MCRS for queen scallops (from 40mm to 55mm)	

Evaluate options for managing fishing effort by input and output controls, in the absence of full time series data on effort.	Measure 5: Consider developing a scientifically based fisheries management framework, based on output or input controls.	Identified as priority evidence gap for the published king scallop FMP.
Map current fished areas alongside areas where queen scallop stocks are present but fishing is not permitted or feasible, such as in some MPAs and offshore windfarms, to improve understanding of the overall footprint of the fishery.	Measure 6: Assess and mitigate the effects of queen scallop fishing on seafloor integrity.	Partially covered by king scallop FMP evidence priorities, to identify important fishing areas.

Evidence gaps

Significant knowledge gaps remain that limit the reliability of potential stock assessment models within English waters. Several studies (Lawler 2020, Stott et al. 2020, Reeves 2020a) have reviewed the current data and identified knowledge gaps which this FMP will seek to review and build on where required (proposed measure 4, below).

Available information on queen scallops in English waters is currently restricted to fishing activity data, which on their own are unlikely to provide sufficient evidence for the determination of sustainable catches.

Insufficient information exists about the biology and ecology of queen scallops, including information on genetic differences, larval dispersal, adult migration, and the locations of nursery habitats in exploited and unexploited areas. This information would enable population dynamics and stock boundaries to be identified. There is limited information available on size and age distributions, total live weight, total meat weight including gonads, and gonad weight. Collecting this information would allow an assessment of general health and would help to determine maturity-at-age relationships, the size of the spawning population, and the timing of the spawning season within different fishing grounds. This improved knowledge of the stock-recruitment relationship would be necessary to inform fisheries management measures.

While fishing activity for queen scallops in the Irish Sea is structured around the seasonal quality of meat, the fishery in the rest of English waters (English Channel and North Sea) is considered opportunistic, which may make regular sampling difficult and limit data available to undertake an accurate stock assessment. Reeves (2020a) suggested that in

these areas fishing activity data and landings should be collected, and technical measures implemented as a baseline for fisheries management. As the queen scallop stock in UK waters is the responsibility of the devolved administrations, data collection and analysis would be most effective if coordinated across these jurisdictions to support the development and implementation of a stock level assessment (Lawler 2020)

Stock assessment evidence gaps

The queen scallop fishery in UK waters is considered data poor with the only published stock assessment for this region in IoM territorial seas. Significant knowledge gaps remain that limit the reliability of potential stock assessment models within English waters, and several studies (Lawler 2020, Stott et al. 2020, Reeves 2020a) have reviewed the current data and identified knowledge gaps. Available information is restricted to fishing activity data, which on their own are unlikely to provide sufficient evidence for the determination of sustainable catches.

Insufficient information exists about the biology and ecology of queen scallops, including information on genetic differences, larval dispersal, adult migration, and the locations of nursery habitats in exploited and unexploited areas. This information would enable population dynamics and stock boundaries to be identified.

There is limited information available on size and age distributions, total live weight, total meat weight including gonads, and gonad weight. Collecting this information would allow an assessment of general health and would help to determine maturity-at-age relationships, the size of the spawning population, and the timing of the spawning season within different fishing grounds. This improved knowledge of the stock-recruitment relationship would be necessary to inform fisheries management measures.

No information exists about the annual amounts of commercial discards of queen scallops, or about discard survival rates, either from targeted catches, or from bycatch. There is also no information about mortality on the seabed from the deployment of mobile fishing gear. Without this information on natural mortality, there would be significant levels of uncertainty in any stock assessment model used to determine stock biomass which will impact advice provided on sustainable fishing removals.

Worldwide, about 1 to 2% of fisheries first sale value is spent on fisheries science including monitoring and assessments (Reeves 2020a). Fisheries-dependent data collection is a potential opportunity for increased data provision, especially as technology develops. Self-sampling and self-reporting are often licence conditions applied to a number of fisheries, as is a financial contribution toward data collection from the fishing industry. Fisheries-dependent sampling in English waters is currently limited or non-existent. An industry sampling scheme (similar to the existing scheme in place for king scallops in English waters) would provide size and age data from catch (landings and discards).

While fishing activity for queen scallops in the Irish Sea is structured around the seasonal quality of meat, the fishery in the rest of English waters (English Channel and North Sea)

is considered opportunistic which may make regular sampling difficult and limit data available to undertake an accurate stock assessment. Reeves (2020a) suggested that in these areas fishing activity data and landings should be collected, and technical measures implemented as a baseline for fisheries management.

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Appendix 1

UK queen scallop management consultation (2016)

In 2014, queen scallop stock assessments in the Isle of Man showed reduced biomass in the fishery and led to the Isle of Man queen scallop trawl fishery losing its MSC certificate. At the same time concerns were raised about the stock health and level of fishing effort in the wider queen scallop fishery (Marine Scotland 2016). In 2016, UK Fisheries Administrations ran a public consultation on a number of proposed new management measures for the queen scallop fishery to assess stakeholder support for further management measures and longer-term management. Whilst a significant level of support was received for the new measures, introduction of new management has so far been restricted to a closed season (Reeves 2020a). Many of these management options remain relevant to the fishery, and recent conversations with the catching sector indicate that they are still supportive of many of these measures. Some of the consultation questions would require updated responses, such as seeking feedback on how to determine track record, given that the level of activity in the fishery has decreased significantly since the original consultation.

The consultation sought views on short-term and long-term options to help ensure the sustainability of the stock. These are summarised below.

Increasing the minimum conservation reference size (MCRS)

There is a 40 mm MCRS in UK waters and 55 mm MCRS in IoM waters. The size of maturity for queen scallops is between 22 to 45 mm and varies according to area, due to different growth rates. It has also been shown that larger scallops produce more larvae of better quality, and have had more opportunity to spawn (multiple years), so protecting scallops until they are larger is likely to be beneficial to the recruitment process. 94% of the respondents to the consultation supported an increase in MCRS and acknowledged that although this may cause short-term reductions in catch it would benefit stocks in the long term and increase the consistency and quality of the product landed. Most vessels are landing at least 50 mm already because it is inefficient to process queen scallops smaller than that. One respondent had concerns about the potential decrease in profitability from a reduction in catches, and the expense of new gear requirements to target larger queen scallops.

Introducing an annual closed season

There was unanimous support for this measure, from a conservation perspective (protecting stocks at key spawning times) and an economic perspective (low yields reducing earnings). An annual closure between April and June was implemented in 2018 for ICES Area 6a and 7a, and there remains support for this closed period to continue. The closed season protects scallops during their main spawning season, and allows scallops to spawn before they are caught. Research suggests that there may be a secondary spawning period in Autumn.

Considerations

It is difficult to determine the stock impacts of limiting overall removals of queen scallops from English waters until there is a more established understanding of the stock status inside and outside English waters, and stock assessments to provide appropriate harvest levels. The volume of landings from Welsh waters provides an argument for establishing a system that covers English and Welsh waters, rather than risk limiting harvest rates in English waters pushing more effort onto Welsh waters, especially if market conditions improve. If effort restrictions were only implemented in English waters, there would need to be additional landings inspections to check the accuracy of logbook returns. In addition, an effort limit in only English waters may shift fishing pressure to other areas in the Irish Sea once DAS limits are met, increasing pressure on other stock areas. If DAS are set in line with current volumes, and no additional vessels are able to enter the fishery, this should provide the required economic security to limit displacement from vessels already targeting queen scallops. The concerns raised in this report about the reliability of historic queen scallop landing data and vessel numbers will make it difficult to calculate the correct level of effort to maintain the level of activity in English waters. As landings data is allocated proportionally by ICES rectangle it may not provide an accurate measure of activity in English waters.

Introducing limits on the number of vessels able to prosecute the fishery, specifically via entry restrictions

The queen scallop fishery is open to any vessel with a commercial fishing licence, with the exception of the Isle of Man territorial sea, where fishing access is limited based on a track record of fishing activity. Limiting the total number of active fishing vessels enables fishery managers to have more control over the level of effort in the fishery and ensure the long-term sustainable management of the stock levels within safe biological limits (Marine Scotland 2016).

Respondents acknowledged that restricting entry was necessary for other management measures to be effective and that continued open access arrangements would have a further impact on stocks if the number of active vessels increased. This is increasingly relevant as the UK government delivers FMPs for other non quota species which may lead vessels to seek out other fisheries to target. The majority of respondents (94%) also supported the introduction of additional data collection as a condition of receiving access to the queen scallop fishery. They acknowledged that accurate data was essential to managing the fishery effectively, and several felt it was reasonable for fishermen to contribute data, similar to the process in the Isle of Man fishery.

Qualifying period and entry requirements were consulted on but given the significant changes in UK policy and the status of the fishery since the 2016 consultation, these would need to be discussed again through the FMP process. Previously there was no clear agreement on the approach to allocating access to the fishery, but consideration should be given to those reliant on the fishery as a primary source of income.

Effort reduction measures (restricting time that vessels can fish)

There are currently no effort restrictions applicable to the queen scallop fleet, except to vessels over 15 m through the Western Waters Effort Regime, although these are considered to be ineffective in relation to the queen scallop fishery (Marine Scotland 2016).

Due to concerns about the level of effort in the fishery there was a consensus supporting the introduction of effort controls that apply to all size classes of vessel fishing queen scallops. Respondents were split on the best approach to effort management, with a small majority favouring a Days at Sea scheme which would offer more flexibility than temporal restrictions. There was concern that temporal restrictions would constrain the activity of smaller vessels which are subject to weather conditions, while weekend or overnight bans would make fishing offshore uneconomical for larger vessels. Those who supported temporal restrictions felt that they would be easier to enforce and more effective at reducing effort than a Days at Sea scheme. Any new effort restrictions would need to be introduced in addition to entry restrictions so the total fishing pressure can be managed.

Catch limits

Quota systems have proven successful in increasing and conserving some stocks, but are reliant on stock assessments to calculate sustainable fishing levels. The majority (64%) of respondents supported this proposal, believing that it would be a good method for managing the fishery and beneficial for the stock. Several respondents also agreed that a quota system would need to be informed by evidence gathered through stock assessments. Opposition to the use of quotas to manage the fishery was due to negative experiences with the system used in the Isle of Man; that it would favour larger vessels; and that other measures were sufficient to manage the fishery. Recent conversations with the catching sector indicated there were still concerns about the impact of managing the fishery with quota. Further, since many queen scallop seem to be caught as bycatch in other fisheries rather than targeted, allocating or accessing quota for these small catches might be problematic.

Closed areas

The majority (78%) of respondents supported the use of closed areas to manage the queen scallop fishery, but highlighted the importance of closures being supported by scientific evidence, and had concerns about the potential for displacement to other areas. Those opposed to the introduction of closed areas believed that they would be difficult to enforce, cause displacement and that the science currently available wasn't adequate for determining the location of closures.

Gear-specific management

Trawl fishing is based on the principle that queen scallops swim in response to approaching gear. This behaviour is observed at temperatures above 12°C, which means that the trawl fishery is effectively limited to the six month period between approximately

June and November (Marine Scotland 2016). By contrast, dredge fishing can capture scallops all year round.

The majority (77%) of respondents supported management specific to trawl and dredge gear, with the understanding that vessels can fish using either method. However, a number of responses also called for net-only fishing areas, or for dredge activity to be prohibited entirely. Those opposed felt that gear-specific management was unnecessary as other measures would be sufficient and apply to vessels regardless of fishing method used.

Appendix 2 – Examples of global best practice

There have been several papers published reviewing management of scallop fisheries globally. Reeves (2020a) found that the main management measure used to regulate fishing mortality in scallop fisheries are TACs, with seasonal closures used in a few cases. There are also examples of spatial management using rotational harvesting to allow grounds to recover for a number of years while other areas are fished.

Full Bay scallop fishery, Nova Scotia, Canada

In 1997, the fishing industry proposed the implementation of an individual transferrable quota (ITQ) system based on historical catch level as the main measure to manage the scallop fishery. The ITQ system provides flexibility and allows fishermen to identify when prices are higher and fish to the market. Fishermen can also avoid fishing in bad conditions. Strong science helps set upper and lower reference points as well as informing appropriate exploitations rates which are converted to catch amounts and CPUE. There is no limit on temporary quota transfer within the quota system but there are limits on permanent transfers. Other measures include:

- A limited entry licensing system that specifies dates and areas of fishing, and any other requirements such as bycatch handling
- Seasonal and area closures recommended by industry to address localized issues
- Minimum shell height and minimum meat counts
- Gear restrictions on the maximum width of a drag or combination of drags (5.5 m) and the minimum size of bag rings (82 mm)
- Vessel length restrictions (19.8 m)
- Vessels must communicate when leaving port and when returning, before landing any scallops and are required to submit logbooks that record estimated retained catch, average tow time, number of tows, and location (latitude/longitude and fishing area) on a daily basis
- The weight of scallops landed is verified by a dockside observer
- At-sea observer coverage to monitor bycatch of fish and invertebrate species
- 100% Vessel Monitoring Systems (hourly reporting in most areas, 15 minutes in one area) A Full Bay vessel is chartered annually to conduct the two scallop surveys, funded by fishery managers and industry

Georges Bank scallop fishery, USA

In 1998, a 10-year rebuilding program was implemented using Days at Sea and TACs to control fishing pressure. The fishery has a pre-agreed harvest control rule (HCR) that sets Days at Sea based on the available annual exploitable biomass. The fishery is divided into fishing zones, and HCRs are applied to each zone based on reference points for stock

levels in each area, with rules for ‘healthy’, ‘cautious’ and ‘critical’ stocks. The Northern Gulf of Maine is managed separately from the rest of the Atlantic sea scallop stock, by creating a separate limited entry program for fishing in the area. The area is managed under an annual total allowable catch (TAC) and a daily possession limit of 90.7 kg. Other measures include:

- Permits issued to vessels with a history in the fishery and no new permits have been issued since
- A rotational area strategy to increase the size of scallops caught (a system for closing and opening areas to improve yield per recruit, using open areas, closed areas, areas temporarily closed and access areas). Areas re-open for fishing when the scallops are larger, boosting meat yield and yield-per-recruit, and include separate DAS or TACs for reopened area
- Gear restrictions on minimum ring size (102 mm), minimum size of the twine top mesh (10 inches) and crew limits (7)
- Minimum shell height (8.9 cm)
- Possession and trip limits
- 100% dockside monitoring
- Recording every 6 hrs the catch, location and effort of fleet

Industry fund dropdown camera surveys to count number of individual scallops on the seabed rather than weight of scallops. The approach gives an absolute measure of density that can be used to inform management immediately unlike timeseries where 7 to 8 years of data is required (Anhalzer et al, 2008).

Patagonia scallop fishery, Argentina

The fishery is managed using a TAC designed to prevent overfishing, and quota is allocated as a percentage of the TAC. Surveys determine 40% of the commercial biomass for each management unit, and fishing is allowed in an area if the abundance of commercial sized scallops is more than 10 tonnes per km². The amount of scallops caught is closely monitored by fishery managers and the catching sector, and when the quota is reached a closure is implemented for that management unit. Satellite monitoring and observer records confirm no further fishing occurs there. These actions are set out in the harvest strategy and harvest control rules to ensure that the exploitation rate is not exceeded the target level (Morsan et al. 2023). Other management measures include:

- Closed fishery with two companies holding 50% TAC each, and only vessels with national permission and capture authorisation may operate in scallop fishing beds
- Spatial and temporal closures may be established when required to protect the viability of the stock and fishing in spawning areas is forbidden
- High density reproductive reserves of 5-10% protected within each management unit
- Minimum landing size (>55 mm)
- Compulsory VMS and observer coverage

- Catch control by electronic slips (daily information on size, number of hauls, nets per haul, trawling time, and mean depth and position) and the fleet is warned when satellite monitoring detects fishing operations outside fishing zone
- Each vessel has 20 days per year for research tasks, and science is carried out by government and research institutes, partially funded by industry

Bass Straight scallop fishery, Australia

The fishery is managed through an annual TAC, with an initial allocation of 150 tonnes for exploration of high-density scallop beds suitable for commercial fishing (Brand-Gardner et al. 2022). This is used to inform the predefined harvest control rules (HCRs) to set the TAC by population area. HCRs set out two options for fishing based on the initial surveys of the biomass:

Tier 1: If beds containing at least 1500 t of >85 mm scallops are identified an initial TAC of 1000 tonnes is set. An area containing a minimum of 1500 tonnes of scallops >85 mm is also identified and closed for the season. The TAC may be increased during the season as it is approached if supported by scientific evidence.

Tier 2: If scallop beds containing at least 3000 t of >85 mm scallops are identified an initial TAC of at least 2000 tonnes is set. An area containing a minimum of 3000 tonnes of scallops >85 mm is identified and closed for the season.

In both instances, the area that is closed for the season has sufficient biomass to meet the opening criteria for the following season (subject to natural mortality, biomass estimate uncertainty etc.). This provides some surety for the TAC for the following season. Other management measures include:

- Annual closing of a scallop bed containing substantial biomass to support recruitment and the closing of beds containing a high proportion of small scallops
- Scallop beds with discard rates (due to scallops <85mm) exceeding 20% are closed
- Minimum landing size of 85mm (allows a minimum of two years of spawning)

This fishery is MSC certified but has conditions to be addressed that focus on reviewing the success of the harvest strategy and ensuring the harvest control rules are reactive to fluctuations in biomass (Dignan et al. 2018).

Faroe Islands queen scallop fishery

The Faroese queen scallop fishery is primarily managed through an effort system set out in the Commercial Fisheries Act, along with a TAC for one fishing area. There is a single licence available to fish for queen scallops in Faroese waters which is issued annually and is area and season specific. An increase in the number of licences is prohibited by the Commercial Fisheries Act. Other management includes:

- Seasonal closure between April and July
- Spatial restrictions limiting the fishery to fish on less than 8.5% of the scallop ground
- The Commercial Fisheries Act states that catching capacity of the vessel must be unchanged, which puts restrictions on the size/number of dredges and the size of the vessel
- VMS data is used to map the distribution of the fishing activity and monitor the stock through CPUE
- All landings must be logged and landed at the single processing factory, and are frequently verified by Ministry of Fishery officials.
- Undersized scallops (<55mm) are returned to the sea, and the processing factory does not accept scallops below 55 mm
- Gear mesh restrictions (75 mm) and belly ring size restrictions (55 mm), which allow at least two spawnings
- Move on rule triggered when CPUE falls below 1.5 tonnes/hour, requiring the vessel to move to another area to ensure the pressure on stock areas is rotated

No formal stock assessment has been carried out since the 1980s but there is a considerable amount of information available about the biology, ecology, stock abundance and distribution of queen scallops, and fishing pressure is monitored through CPUE (Bostrom et al. 2022)

Baie de Saint Brieuc scallop fishery, France

Stock biomass is estimated annually using a model (unpublished) to analyse scientific surveys and fisheries data, which provides management advice. This is not translated into TAC or DAS allocations by management authorities, instead, the fishery is primarily managed through a series of measures to limit effort (Beukers-Stewart and Beukers-Stewart, 2009)

- Licences are limited (230 scallop dredge licences for the 2020-2021 fishing season)
- Season is open from October to May, with specified fishing days and times
- The area of the fishery is divided into management zones which have different measures in place, are not open simultaneously, cannot be fished on the same day in multiple zones, and vessels must have the correct scallop licence for each area
- There is a maximum landing per vessel per day for each zone (an overshoot of up to 50 kg on the trip quota is tolerated but the profit goes to the management body for activities related to the fishery; above 50 kg is considered an infraction)
- Minimum landing size (102 mm) and no shucking scallops at sea is allowed
- At the end of the fishing period dredges must be clearly visible over the side of the vessel. Dredges must be removed from the vessel if going to sea outside authorised fishing days. No spare dredge is permitted on board. Dredges must be marked
- Landing to auction only, with specified landing ports for each area

- Gear restrictions include: ban on twin dredges in certain zones; single dredges must have a maximum fishing width (which can be one dredge of 4 m / 40 teeth or two dredges of 2 m / 20 teeth each), 90 mm spacing between teeth, interior diameter of rings 97 mm
- The number of dredges is limited to two per vessel or alternatively 6 per outrigger for twin dredges.

As well as these general measures, management is regularly adjusted throughout the season. Zones are opened on a strict timetable, and trip limits set (and adjusted). For the 2021/22 season there were 8 open days applying to Zones 1 and 3, with fishing allowed between 9am and 1pm. For the rest of the season in Zone 4 there were 42 open days and 27 additional days, during which fishing was permitted for 45 minutes. Management is therefore highly responsive to the state of the stock (Criquet et al. 2022).