Fal Oyster Survey 2022

Final report for the 2022 Fal Oyster Survey
(2022_CIFCA_SAC_FAL_FOS)

Cornwall Inshore Fisheries and Conservation Authority (Cornwall IFCA)

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Contents

List of Figures

List of Tables

List of Annex Figures

List of Annex Tables

Glossary of Terms and abbreviations

Area A	North Bank, Mylor Bank and Parsons Bank
Area B	East Bank and St.Just Flats
Area C	North of a line drawn due east from Pill Point to the coast on Turnaware Point
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
FFMC	Fal Fishery Management Committee
FOS	Fal Oyster Survey
H	Harbour section
IFCA	Inshore Fisheries and Conservation Authority
MCRS	Minimum Conservation Reference Size
MLS	Minimum Landing Size
OH	Outer harbour
R	River

1 Introduction

Cornwall Inshore Fisheries and Conservation Authority (IFCA) has been responsible for the management of the Fal Oyster Fishery since July 2014. Prior to this, Cornwall Council (Port of Truro), as the grantee under the Truro Port Fishery Order 1936 (as amended), was responsible for the management of the fishery until the Order expired in July 2014. Cornwall IFCA initially authorised access under the Closed Areas (European Marine Sites) Byelaw 2 then as Regulator of the Fal Fishery Regulating Order 2016. As part of the management of the fishery, the Authority assumed responsibility for monitoring the stock of oysters by continuing the yearly surveys of the fishery. Previous Cornwall IFCA surveys have been reported on since 2015 (Jenkin *et al*., 2021, 2020, 2019; 2018; 2017; Latham *et al*., 2016; and Latham and Trundle, 2015).

The oyster stocks were monitored intermittently by the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) in the 1950s and 1960s. An annual survey was started in 1971 and continued until 1984, when they were discontinued due to low stock levels resulting from mortalities caused by the oyster parasite, *Bonamia ostrea*. Following recovery of the stock, joint CEFAS/ Cornwall Council Maritime Division oyster surveys were restarted in 2002 and have been undertaken annually since. These surveys initially targeted 95 sample sites, spread across the River (R), Harbour (H) and Outer Harbour (OH) sections (Annex Figure A). The abundance and size of the oysters were recorded, with oysters allocated into size classes that reflected recruitment to the fishery in future seasons. The reported size classes were updated in 2020 so that the upper size class matches the minimum size of oysters (67 mm) which can be removed from the fishery[1].

From 2020, the analysis was done by Management Areas A, B and C so that the survey data corresponds with the Fal Fishery shellfish return statistics. Area A covers the North Bank, Area B covers East Bank and Area C covers the river section (Figure 1). Areas A and B cover the area from the southern boundary of the fishery to Turnaware Point and are fished predominantly by sail and Area C covers the area from Turnaware Point to Malpas and is fished by oyster punts using haul tow methods.

The number of sites which are surveyed has decreased over time. This is because some sites were located where sensitive habitats such as maerl were found and some of the sites in Area C (north of Turnaware Point) were set up as clusters, with three sites located very close to each other, so these have been replaced with just one site being surveyed. The Fishery area has also reduced under the Fal Fishery Order 2016 as the new area was set out to avoid sensitive habitats including seagrass.

A number of changes were made to the Fal Fishery Order 2016 Regulations prior to the 2016 fishing season starting due to expressions of interest made through the Fal Fishery Management Committee (FFMC). Previously under the regulatory order, a person that retained on board or landed native species of bivalve or gastropod shellfish had to ensure that the combined weight of species other than oysters (*Ostrea edulis*) and mussels (*Mytilus edulis*) (bycatch) did not exceed 20% of the weight of all the native species retained on board or landed. In the Fal Fishery Order 2016 Regulations this was removed which has changed the previously non-target species such as the queen scallop,

[1] Regulations under the Fal Fishery Order 2016 https://secure.toolkitfiles.co.uk/clients/17099/sitedata/Fal_Fishery/2017-Regulations-under-the-FFO-2018-09-04-161532.pdf

Aequipecten opercularis[2] and the variegated scallop, *Mimachlamys varia*[3] (queenie scallops) to a target species. It is thought that the species referred to as 'queenies' within the Fal Fishery Area are thought to be primarily the variegated scallop (*M. varia*) as opposed to the queen scallop (*A. opercularis*). The queenie scallops have been included as part of the survey since 2016. For the remainder of this report they are referred to as scallops.

The minimum size of native oysters (*O. edulis*) which can be removed from the fishery is 67 mm under the Fal Fishery Order 2016 and the minimum conservation reference size (MCRS) of queen scallops (*Chlamys* spp.) is 40 mm under Council Regulation 1241/19 Annex VI[4]. Due to the nature of the vessels targeting the fishery, they are not subject to the minimum conservation reference size (MCRS) for *Chlamys* spp. as this applies to commercial fishing vessels that are registered and licensed.

In 2018, an addition to the survey was made to record the number of individual slipper limpets (*Crepidula fornicata*) at each site instead of the subjective broad approach of a SACFOR style recording system which was used prior to this. This has been continued as part of the survey since 2018.

In 2022, a list of bycatch was recorded across the whole survey area although this remains a small part of the survey and the list is unlikely to be a definitive list of every species observed due to time constraints.

1.1 Aims and objectives

1.1.1 Aims

- To investigate the temporal changes of the relative abundance and distribution of native oysters, *O. edulis*, within the Fal Oyster Fishery located in the Fal Estuary, Cornwall.
- To investigate the temporal changes of the relative abundance and distribution of scallops (queen scallop, *A. opercularis*; variegated scallop, *M. varia*) within the Fal Oyster Fishery.
- To investigate the temporal changes of the relative abundance and distribution of slipper limpets (*C. fornicata)* within the Fal Oyster Fishery.
- To investigate the distribution of substrate types across the fishery.
- To investigate the species of bycatch present across the survey area.

1.1.2 Objectives

- To re-survey Fal oyster survey sites, as previously surveyed by Cornwall Council/ CEFAS, recording abundance and size of native oysters (*O. edulis)*.
- To record the abundance and size of scallops (queen scallop, *A. opercularis*; variegated scallop, *M. varia*).
- To count the number of slipper limpets per site (*C. fornicata)*.
- To record bycatch across the survey area.
- To record the volume of each dredge sample.

[2] Synonymised name: *Chlamys opercularis* (unaccepted) http://www.marinespecies.org/aphia.php?p=taxdetails&id=152997 [Accessed 07/09/2022]

[3] Synonymised name: *Chlamys varia* (unaccepted) http://www.marinespecies.org/aphia.php?p=taxdetails&id=140696 [Accessed 07/09/2022]

[4] Regulation (EU) 2019/1241 of the European Parliament and of the Council of 20 June 2019 on the conservation of fisheries resources and the protection of marine ecosystems through technical measures

- To record the composition of each dredge sample.
- To record and retain any invasive species observed during the survey.
- To provide recommendations for future survey work.

2 Methodology

2.1 Survey Area

The survey was carried out within the Fal Oyster Fishery Area, in the Fal Estuary on the south coast of Cornwall. A chart showing the management areas A, B and C is shown in Figure 1. Area A represents North Bank, Mylor Bank and Parsons Bank, Area B represents East Bank and St Just Flat and Area C represents the area north of a line drawn due east from Pill Point to the coast on Turnaware Point.

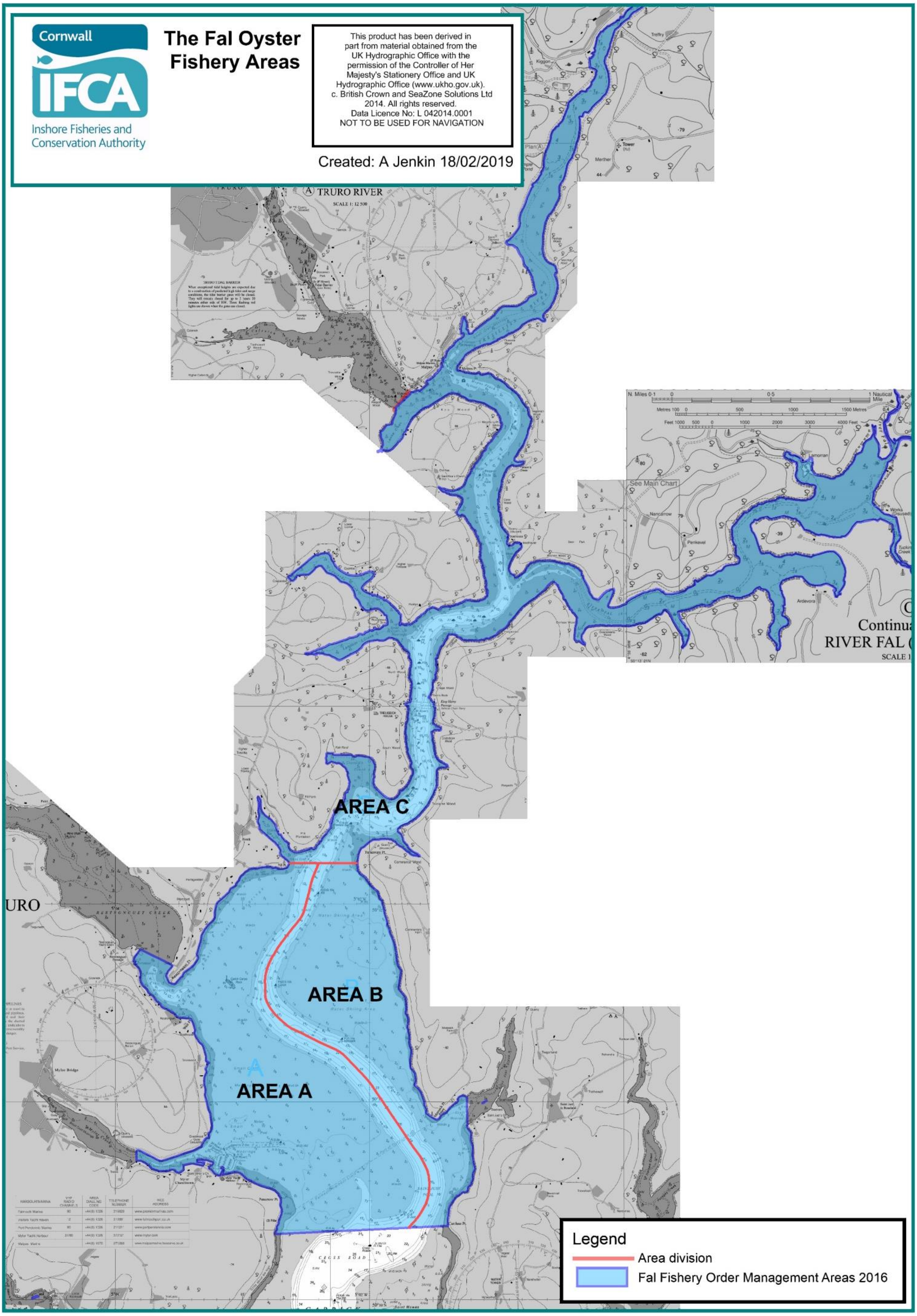


Figure 1: The management areas, Area A, B and C of the Fal oyster survey.

2.2 Vessel Specifications

Research vessel (R/V) Tiger Lily VI is Cornwall IFCA's research survey vessel (Figure 2) and was used as the platform for this survey. She is a South Boats 11 m Island MkII catamaran with twin IVECO 450hp engines; her Callsign is MRWR7. The survey methodology was the same as recent years, with the use of the hydraulic anchor winch on the starboard side providing towing capabilities and the use of the A frame on her stern from which the dredge was towed (outlined in section 2.5). The general layout of Tiger Lily VI is shown in Annex 2.

Tiger Lily VI has been refitted for survey work and includes a purpose built survey station within the wheelhouse, fitted with an uninterruptable power supply (UPS) and a dedicated Global Positioning System (GPS) with NMEA outputs.

Figure 2: R/V Tiger Lily VI – Cornwall IFCA's research survey vessel.

2.3 Personnel

The crew during the surveys consisted of the skipper and three scientific officers. The crew roles rotated during the surveys and included data recording, operating the winch, deploying and recovering the dredge, measuring and counting bivalves and the identification of bycatch species.

2.4 Personal Protective Equipment (PPE)

Life jackets, steel toe capped waterproof boots and waterproofs were worn while working on deck. Hard hats were worn whilst the A frame was being used. Thick, waterproof gloves provided protection against sharp shell edges and any anthropogenic debris whilst sorting through the dredge sample. There were no reported accidents or near misses during the survey.

2.5 Survey methodology

Each survey station was transferred to the vessel's Olex navigation plotter for navigation purposes and into HYPACK MAX 2019 software for data logging. The dredge used was a 72 cm blade, Essex-style oyster dredge, rigged with 34 mm diameter steel belly rings and a 45 mm (twin 3 mm nylon twine) mesh back. It varies slightly from those used within the fishery but was used previously by Cornwall Council and CEFAS for the survey work within the fishery. The dredge was deployed and recovered using the A frame on the stern of Tiger Lily VI.

For all sites, a tow haul method was adopted, similar to that used by the oyster punts. This allowed the dredge tow to be of a known distance and to be easily and consistently replicated. At each survey site the survey vessel was anchored and 60 m of anchor line was let out. The dredge was shot by hand and the vessel's slave hauler winch was used to take up 50 m of marked anchor line, resulting in a 50 m dredge tow at a steady 0.5 to 1 knots. The towing warp was run via the A frame mounted hydraulic winch. The towing warp was marked off so that the length (m) of cable deployed at any time was known; this was generally fixed for an average depth and altered only if a depth change was sufficient to cause the dredge to fish too heavily or lightly. At some of the sites in the river the anchor was not used due to proximity to the bank.

Surveys carried out prior to 2016 used a towing method where the dredge was towed for approximately 1 minute at around 1.6 knots (3 kph). This equates to a tow distance of 50 m, the same as the new method, but with less consistency over speed and direction.

During recovery, the dredge was lifted using the hydraulic winch and/ or A frame, then tilted and emptied into the sorting table which was positioned beneath the frame. A deck wash was available to aid in clearing muddier samples, particularly from sites within the upper reaches of the Fal (Area C). The set up for the dredge tow, A frame and sorting table is shown in Figure 3.

A target was created in HYPACK MAX 2019 to indicate the start of line (SOL); this was repeated at the end of line (EOL). All positions were recorded using WGS84 projection and sourced from the dedicated survey GPS (Navnet). All times are recorded as Coordinated Universal Time (UTC) and taken from the same source as the position data. The data and HYPACK target positions were saved to the network at the end of each survey day.

If the dredge did not fish, due to being blinded or flipped over, or the sample appeared smaller than it should be for particular areas, the dredge haul was repeated and labelled with the site name followed by the letter b and the initial haul was labelled with the site name followed by the letter a.

During the survey, photographs were taken using an Olympus Tough TG-5 digital camera and a printed image identification plate ('clapper' board) was used for sample identification. All measurements (mm) were taken using Vernier callipers.

Figure 3: Survey setup or the Fal Oyster Survey 2022 on the deck of R/V Tiger Lily VI.

Each sample was photographed on the sorting table alongside the clapper board prior to sorting. Live native oysters, scallops (queen/ variegated scallop) and slipper limpets were removed and set aside as the sample was sorted (Figure 4).

Figure 4: Samples sorted into buckets containing native oysters, scallops and slipper limpets from the 2019 Cornwall IFCA Fal Oyster Survey.

All live oysters were then counted and measured across the widest point, to the nearest mm using callipers. All queen or variegated scallops were counted and measured along the length of the valve (from the hinge to the outer edge), to the nearest mm using callipers. All slipper limpets were counted, this included live individuals or live individuals which were part of a chain (Figure 5). The weight (g) was recorded for oysters where possible. This was done at sea with stabilised marine scales positioned on an anti-vibration mat. If shell or stone was attached to the individual or they were joined, a weight was not taken. Once the catch was measured and weighed (oysters only), the sample was returned to the survey site (except for the slipper limpets which were retained onboard in sacks due to their invasive nature).

Figure 5: Examples of slipper limpets (*Crepidula fornicata)* growing on substrate as individuals (left) or chains of two or a longer chain of individuals (right) as observed on the 2019 Cornwall IFCA slipper limpet survey.

Observations of the catch composition (substrate) were recorded for each dredge sample. A clapper board was filled out per site for the volume of the dredge as a percentage (25%, 50%, 75% and 100%) of how 'full' the dredge was when it was at the surface. Of this volume, the percentage composition for the following categories was also recorded; mud, shell (live and dead), weed, gravel, vegetation (sticks and leaves), dead maerl and stone, in increments of 5% so that the catch composition per dredge equalled 100%. Live maerl was recorded as the number of fragments.

A list of previously recorded bycatch was made and species were ticked off as they were observed and previously unrecorded species were added. The bycatch recording in 2022 was a minor part of the oyster survey due to time constraints.

The values for all measurements recorded were relayed verbally to a member of staff in the wheelhouse who was recording the data into a Microsoft Excel spreadsheet.

2.6 Data handling

Data was entered *in situ* into a recording sheet which was set up in Microsoft Excel. This enabled data to be easily transferred into data analysis Excel spreadsheets in the office.

The measurements for oysters were tallied into four size ranges (≥ greater than or equal to, ≤ less than or equal to);

- ≥ 67 mm
  Oysters of a size to be fished this season. Currently oysters removed from the fishery must not pass through a ring of 67 mm.
- ≥ 51 to ≤ 66 mm
  Oysters of a size likely to enter the fishery within the next two seasons.
- ≥ 36 to ≤ 50 mm
  Small oysters unlikely to attain fishable size within the next two seasons.
- ≤ 35 mm
  Spat, oysters spawned within the last 18 months. Sampling of oysters in this size category is often inaccurate due to difficulties in measuring and counting.

These categories have changed from the previous surveys as it was thought it would be more beneficial to record the data so the larger size category matched the minimum landing size of oysters in the fishery. The previous categories were ≤ 35 mm, ≥ 35 to ≤ 49 mm, ≥ 50 to ≤ 64 mm and ≥ 65 mm.

The measurements for scallops were tallied into four size ranges (≥ greater than or equal to, ≤ less than or equal to);

- ≥ 60 mm
- ≥ 40 to ≤ 59 mm
  Scallops of a size to be fished this season.
- ≥ 20 to ≤ 39 mm
  Scallops of a size likely to enter the fishery within the next two seasons.
- ≤ 19 mm

Juvenile scallops. Sampling of scallops in this size category is often inaccurate due to scallops only being measured if they are attached to other species.

These categories have changed from the reporting from previous years as it was thought it would be more beneficial to record in four categories instead of seven without losing resolution in the data. The previous categories were ≤ 29 mm, ≥ 30 to ≤ 39 mm, ≥ 40 to ≤ 49 mm, ≥ 50 to ≤ 59 mm, ≥ 60 to ≤ 69 mm, ≥ 70 to ≤ 79 mm and ≥ 80 mm.

2.7 Data analysis

The analysis was split into management areas; Areas A, B and C (Figure 1). From the oyster and scallop tally data, abundances (actual and as a proportion of the total) were calculated, and size frequency distributions for the three areas were calculated and graphed. The average size (mm) and the average number of oysters and scallops for each of the three areas were calculated. The reports from the survey in previous years split the analysis into geographic sections (H, OH and R Annex 1 – Fal Oyster Fishery Areasx 1) as well but it was thought that it would be more beneficial if the sections represented those in the fishery and are compatible with how the licence holder monthly shellfish statistics are reported.

All photographs taken as part of the survey were transferred to Cornwall IFCA's servers, labelled with the survey name, date, site number and replicate, [Name]_[Date]_[Site]_[*Replicate*]_[Photograph Reference].jpg, e.g. FOS_20220123_A19_P1232083.JPG and filed. To compare the dredge sample photographs from 2014 to 2022, a folder was created per site with the photos from each year alongside one another, for all sites surveyed in at least one of those years. This was used for a visual comparison of the site characteristics and sample volume.

The GPS derived locations of all sample sites were plotted in MapInfo Pro Advanced Version 17.0.4 over hydrographic charts of the area. For sites within Areas A and B where dredge samples were arranged in a dense grid, density maps were created for oysters, scallops and slipper limpets to enable a visual comparison from 2018 to 2022. Density maps were not created for sites within Area C (except for the sites around Turnaware Point which were included in the density map as part of Area B) as the sites are randomly spaced along the stretch of river between Turnaware and Malpas and not in a grid pattern which is used in other sections of the survey area. The mooring areas around Mylor were deliberately excluded from the density maps as they are not fished or sampled, and it is not classified as a bivalve mollusc production area. Oyster, scallop and slipper limpet densities per sample were converted to densities per 10 m^2. MapInfo Pro Advanced was used to create a colourised grid of the selected values from each sample station. The colourised grid was generated by using the Natural Neighbour interpolation function. A pre-generated standardised .vcp colour palate was applied to the grid to allow the density contouring to be viewed using different colour palates for oysters, scallops and slipper limpets. This was used across all density grids. From this modified colourised grid, it was possible to estimate the distribution of oyster and scallop size-classes within the fishery, identify hotspots and make a comparison with previous years.

The oyster and scallop size composition charts were produced using the Thematic Mapping function in MapInfo Pro Advanced. The size frequency data for each sample station were grouped into four size ranges for oysters (≥67 mm, ≥51-≤66 mm, ≥36-≤50 mm and ≤35 mm) and four size ranges for scallops (≥60 mm, ≥40-≤59 mm, ≥20-≤39 mm and

≤19 mm) as described in section 2.6). This data was then used to calculate the proportion of each size range of the whole sample at each site. The data was displayed as pie charts with the size of the pie chart being indicative of the overall oyster or scallop abundance at each station.

The same approach was applied to the substrate composition data to create pie charts showing the percentage volume of the dredge as the size of the pie (25%, 50%, 75% and 100%) and the composition of mud, shell, weed, gravel, vegetation (sticks and leaves), dead maerl and stones.

2.8 Data normalisation

The data from 2021 were normalised to include sites sampled during the survey but weren't due to time constraints. The average from 2018 to 2020 was used for the number of oysters and scallops for the size categories, the average number and the density of oysters. This resulted in an additional 50 sites being included in the analysis for 2021.

3 Results

3.1 Survey metadata

The time of year that previous surveys have been carried out has varied (Table 1) but they are usually completed in the second half of the oyster fishery season. The timing of the 2022 survey was consistent with surveys since 2016 and carried out in mid-January. The survey is normally planned over consecutive days for consistency although in 2022 an additional day was carried out in February.

A number of the original 95 sample sites have been dropped during recent years due to sensitive habitats or sample replication. The discontinued sites are located in the southern section of the fishery (Areas A and B) where live maerl has been recorded and in the river (Area C) where sites were originally clustered together. A total of 81 sites were completed in 2022 (Table 1) as site H 22 has been dropped from the survey since 2020 as over five fragments of live maerl were recorded in 2019. The positions of the survey stations surveyed during the 2022 survey are shown in Figure 6 and detailed in Annex 3. They are based on the original survey station positions which were provided to Cornwall IFCA, some of the original positions were moved slightly to make stations accessible or move stations out of the channel.

Table 1: The dates of previous Fal oyster surveys and the number of sites surveyed from 2015 to 2022 during the Fal oyster survey.

Year	Survey dates
2022	23rd, 24th, 26th 27th January, 11th February
2021	24th, 25th and 27th January
2020	19th to 22nd January
2019	15th to 18th January
2018	9th to 13th January
2017	22nd to 24th January
2016	17th to 19th January
2015	11th to 18th February

A summary of the dates of the survey, the sites sampled and the members of staff on each survey day are shown in Table 2. The daily logs are shown in Annex 4.

Table 2: A summary of the dates, sites completed and the staff involved in the Fal oyster survey 2022.

Date	Sites Completed		Number of completed sites	Cornwall IFCA staff	Skipper	Visitors
23/01/2022	B18 A19 A20 A21 A23 A45 A46 A47	A48 A49 A50 A56 A55 A54 A53 A52	16	Colin Trundle, Annie Jenkin, Steph Sturgeon	David Raymond	Cherilyn Mackrory
24/01/2022	A58 A59 A60 A61 A66 A67 A68 A71 A70 A69 A82	A81 A84 A83 A89 C88 C24 B87 B85 B86 B94	21	Colin Trundle, Annie Jenkin, Steph Sturgeon	David Raymond	None
26/01/2022	C26 C27 C28 C29 C30 C32 C33 C43 C42 C41 C41 C40	C36 C34 C31 B92 B93 B77 B78 B78 B79 B80 B97 B72	22	Colin Trundle, Annie Jenkin, Steph Sturgeon	David Raymond	None
27/02/2022	B98 B100 B76 B75 B99 B73 B74	B106 B105 B104 B103 B65 B64 B63	14	Colin Trundle, Annie Jenkin, Steph Sturgeon	David Raymond	Claire Szostek
11/02/2022	B44 B51 B123 B57	B111 B110 B109 B62	8	Colin Trundle, Annie Jenkin, Steph Sturgeon	Chris Lowe	Victoria Hobson Two University of Exeter Students

The local MP for Truro and Falmouth joined on the first day of the survey, a post doc researcher who is investigating resilience in coastal communities with small scale fisheries joined on the fourth day and a committee member and two students from the University of Exeter joined for the last day of the survey.

A total of 81 sites were surveyed, 30 were in Area A, 35 were in Area B and 16 were in Area C, as shown in Figure 6.

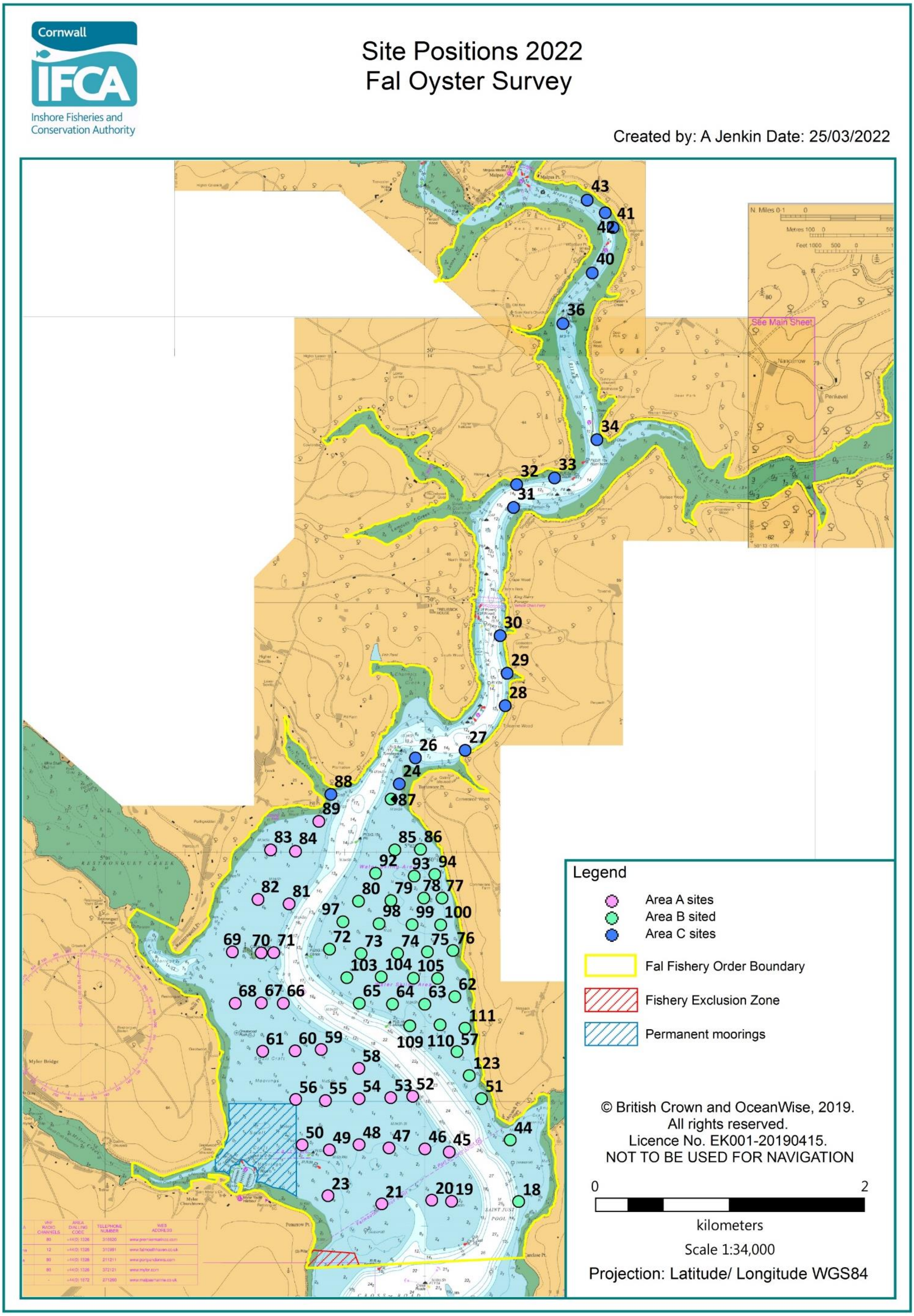


Figure 6: The Fal Oyster Survey area and survey sites in the Fal, split by management areas A, B and C from the 2022 survey.

Of the 81 sites, valid tows were completed at all sites. Two of the tows were repeated; C 32 which was empty and A 19 which flipped upside down.

A visual comparison of the survey photos from 2014 to 2022 indicates that the dredged volumes for samples are reasonably consistent between the surveys although some of the samples from the river section contained more volume than previous years. This has not been included as each site is saved as a folder on the network with the images.

3.2 Native oysters (*Ostrea edulis*)

In total, 1,660 oysters were measured and recorded. Previous oyster counts are shown in Table 3. The number of survey stations changed year on year so the numbers recorded across the years are not directly comparable and the 2014 data has not been included because the method was different. In 2021, sites were chosen based on previous high counts of oysters, then scallops which is why the number of oysters appears high for the number of sites sampled and this site selection process in 2021 resulted in a reduction in the volumes of scallops and slipper limpets recorded during the survey. The total number of oysters per site is shown in Annex 5.

Table 3: The number of native oysters (*Ostrea edulis)* recorded during the Fal oyster survey between 2015 and 2022.

Year	Number of sites	Number of native oysters	Difference from previous year	Percentage difference from previous year
2022	81	1,660	596	56%
2021	32	1,064	-201	-16%
2020	82	1,265	-445	-26%
2019	83	1,710	+209	14%
2018	83	1,501	+20	1%
2017	80	1,481	-184	-11%
2016	89	1,665	+896	117%
2015	79	769	-	-

The following analysis is for the years 2018 to 2022 to enable a five year temporal comparison of the fishery.

3.2.1 Density

The density of oysters per 10 m^2 for 2022 for all management areas is shown in Figure 7. The density of oysters was lowest in Area A and highest in Area C. There was a noticeable increase in the number of oysters in Area C since 2020 with a slight decline in Area B since 2021 and a slight increase in Area A.

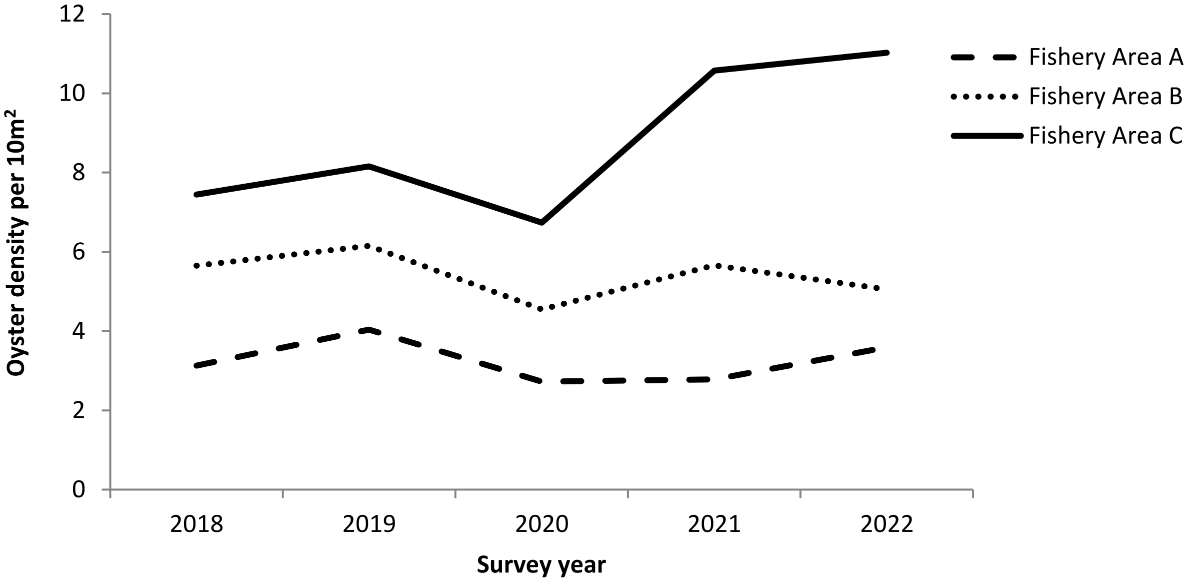
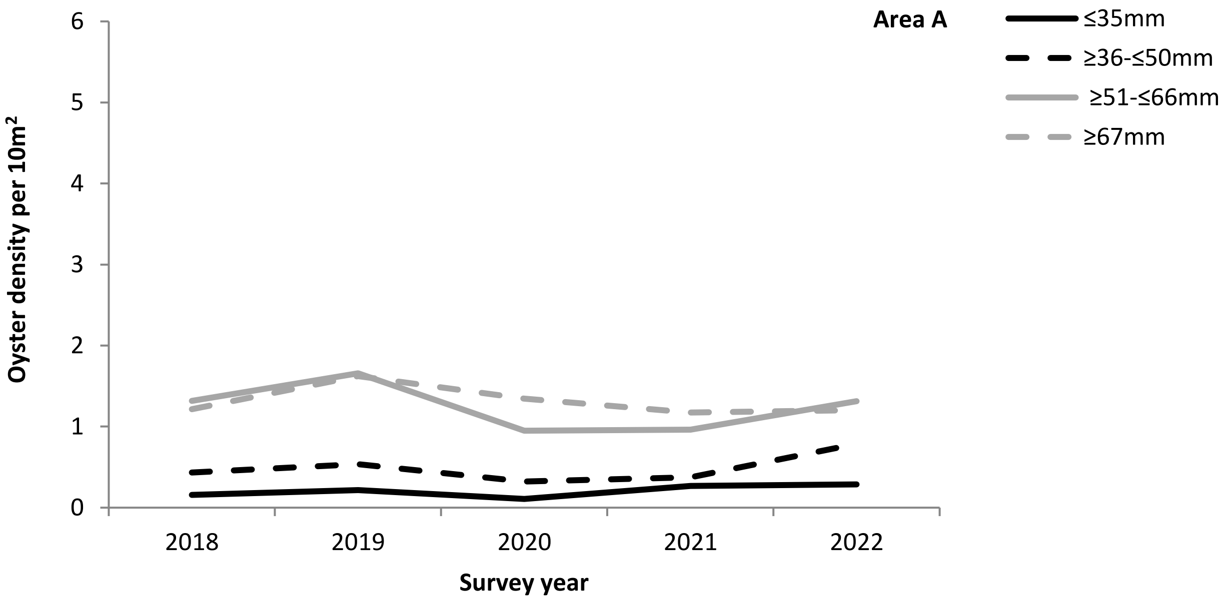
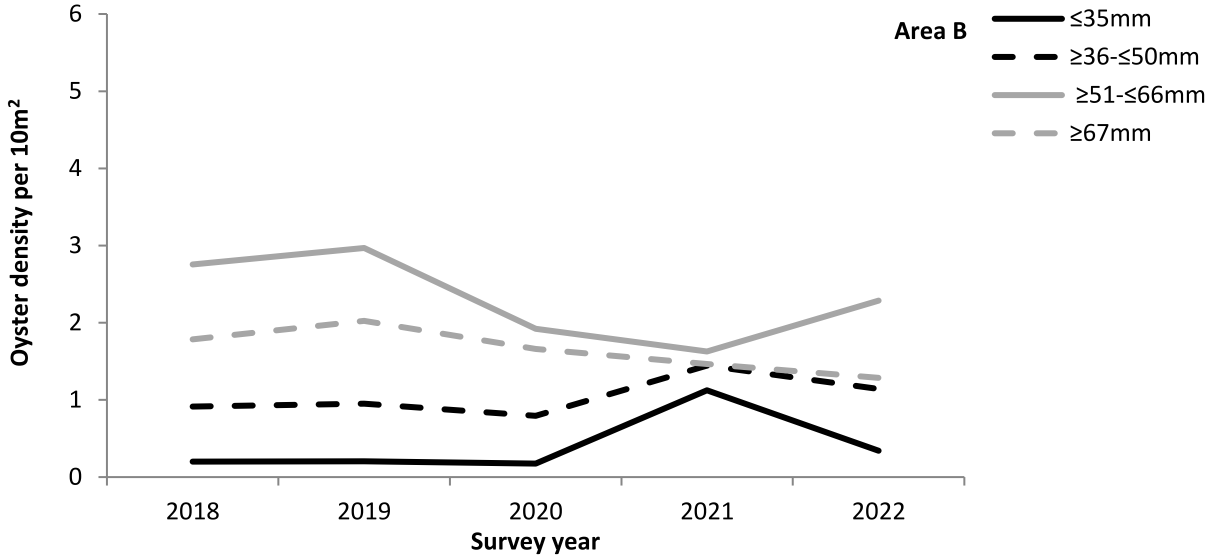


Figure 7: The density of native oysters (*Ostrea edulis)* per 10 m^2 for the three management areas (Area A, B and C) from 2018 to 2022.

The density of oysters per 10 m^2 from 2018 to 2022 for all three management areas per size class is shown in Figure 8. The density of oysters was low in Area A for all size classes from 2018 to 2022. In Area B, the densities of the smaller size classes remained steady and increased in 2021 then decreased in 2022 and the largest size class has decreased steadily since 2018. There was a slight increase in oysters in the ≥51-≤66 mm size class in 2022 which was recorded across all three areas. There was a decrease in density for all other size class, the most noticeable in the smallest size class (≤35 mm). In Area C, there was a decrease in the density of small oysters -≤50 mm and an increase in oysters ≥51 mm.





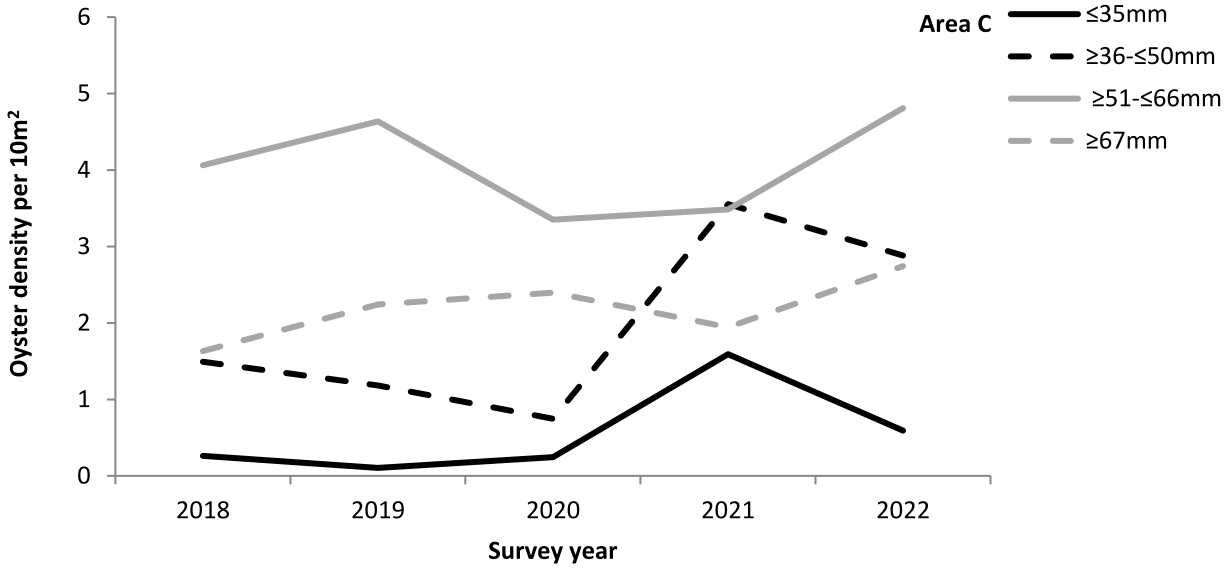


Figure 8: The density of native oysters (*Ostrea edulis*) per 10 m² for the three management areas (Area A, B and C) per size class from 2018 to 2022.

3.2.2 Density plots

Density plots were created for the total number of oysters per 10 m^2, the number of oysters ≥67 mm per 10 m^2 and the number of oysters between ≥51 to ≤66 mm per 10 m^2 for Areas A and B. Density plots of Area C, the upper reaches above Turnaware Point, were not mapped by density due to the lack of samples and their scattered distribution which could lead to misleading interpolation.

Total number of oysters per 10 m^2

The distribution of the total number of oysters per 10 m^2 is shown in Figure 9. The distribution of the total number of oysters per 10 m^2 from 2018 to 2022 shows similar patches with a higher density of oysters, around Turnaware Point, the central part of East Bank and the central part of North Bank directly to the north-east of the moorings in Mylor although there were slight dips in the densities shown in 2020. The density recorded in 2022 was comparable to 2021. Patches with a low density of oysters were the patch just to the south of Turnaware Point where the 'basin' exists and the west side of North Bank. The density in the remainder of the survey area was low, between ≥0.1 to <4 oysters per 10 m^2.

Oysters ≥67 mm per 10 m^2

The distribution of oysters ≥67 mm per 10 m^2 is shown in Figure 10. In 2022, the density of large oysters was low across most of the fishery with scattered patches of higher densities recorded at Turnaware Point, a patch north-east of the moorings at Mylor on North bank and a central part of the East bank. These patches of higher distribution are similar to the pattern observed in previous years although the patches are smaller than previously observed in 2018 to 2020 although the density increased at Turnaware Point in 2022. The density in the remainder of the survey area was low, between ≥0.1 to 2 oysters per 10 m^2.

Oysters ≥51 to ≤66 mm per 10 m^2

The distribution of pre-recruits between ≥51 and ≤66 mm per 10 m^2 is shown in Figure 11. The distribution of oysters in this size class was similar to previous years from 2018 onwards. In 2022, the patches with a higher density were Turnaware Point, a patch north-east of the moorings at Mylor on North bank and central parts of East Bank which had decreased in size but had a higher density of oysters at Turnaware and the central part of East Bank. The density in the remainder of the survey area was low, between ≥0.1 to 2 oysters per 10 m^2.

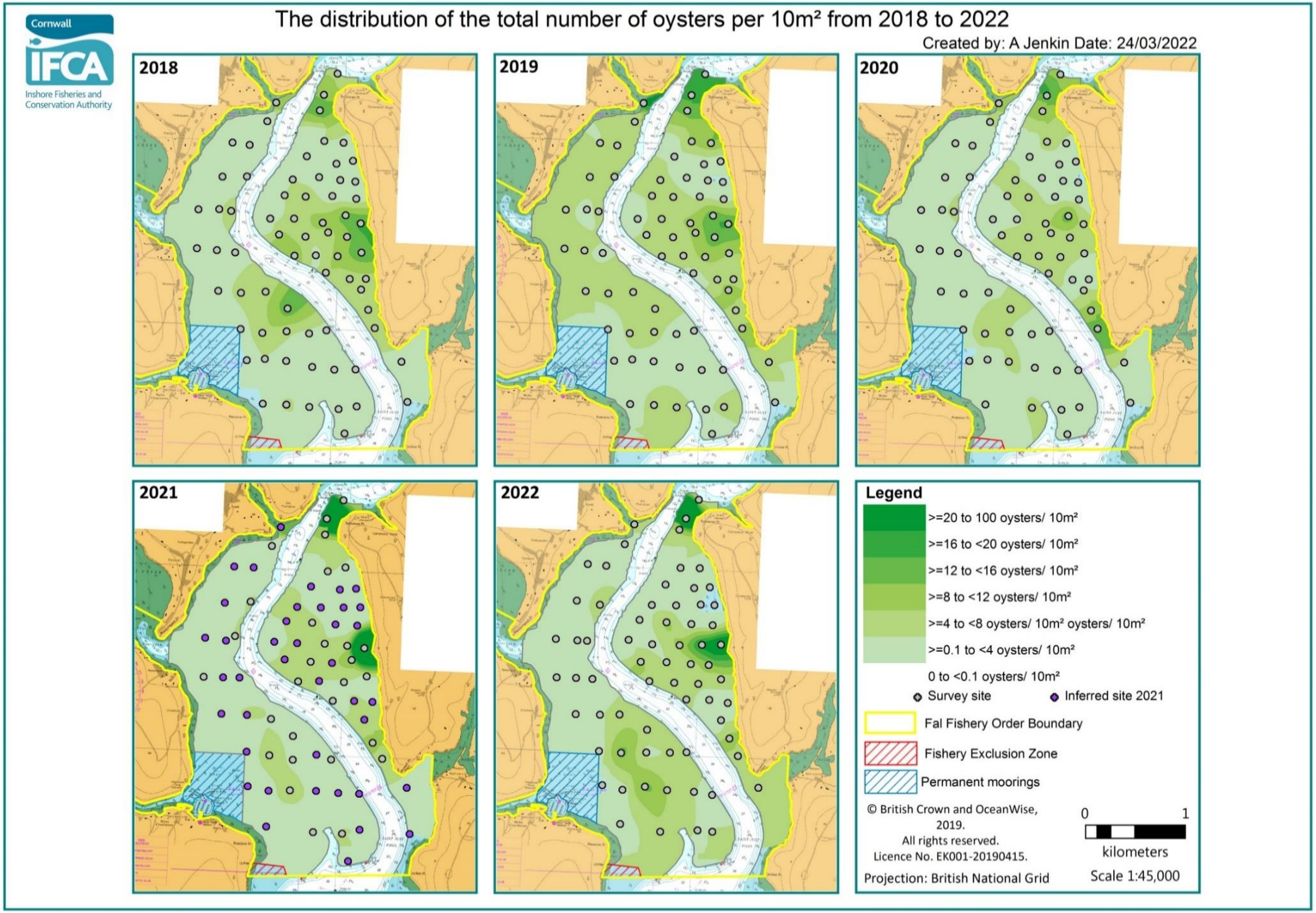


Figure 9: Density map displaying the total number of native oyster (*Ostrea edulis)* per 10 m² within Areas A and B from 2018 to 2022.

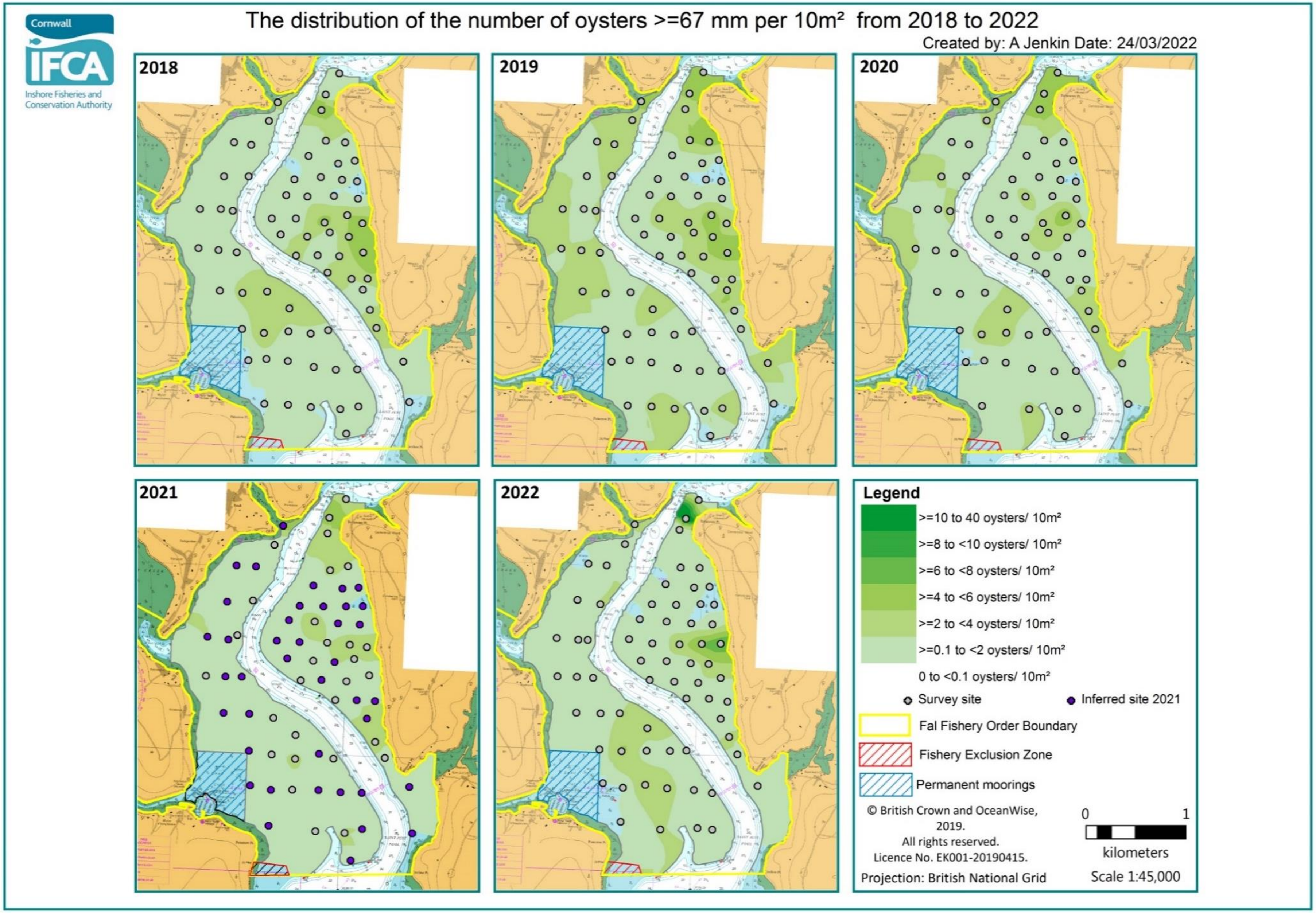


Figure 10: Density map displaying native oyster (*Ostrea edulis)* ≥67 mm per 10 m² within Areas A and B from 2018 to 2022.

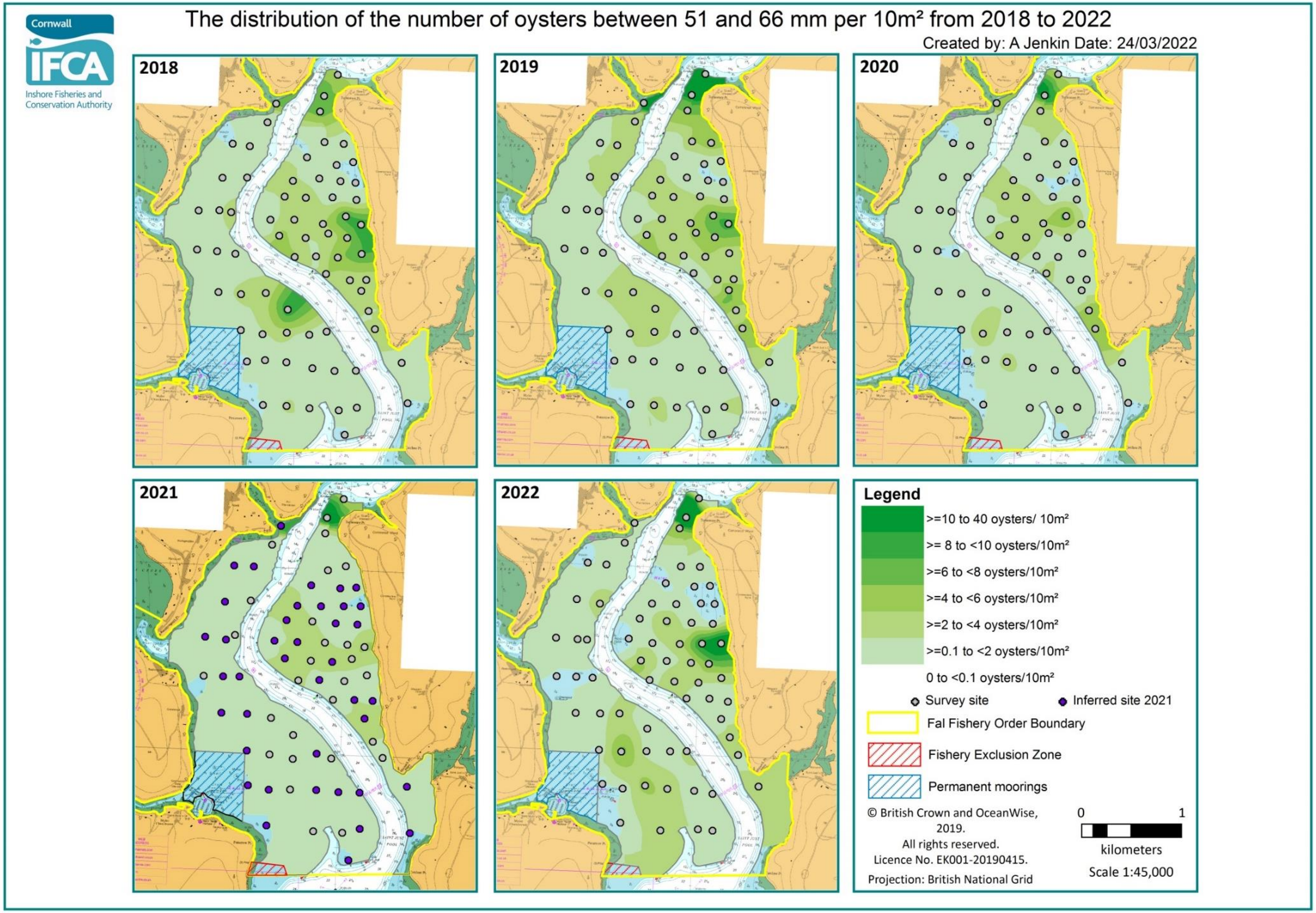


Figure 11: Density map displaying native oyster (*Ostrea edulis)* between ≥51 and ≤66 mm per 10m² within Areas A and B from 2018 to 2022.

3.2.3 Average number per dredge

Figure 12 shows the average number of native oysters per dredge by management areas A, B and C from 2018 to 2022.

The average number of oysters per site by management area from 2018 to 2022 was consistently highest in Area C and lowest in Area A. The average number of oysters has remained steady in Areas A and B from 2018 to 2022. In Area C there was a decrease from 2019 to 2020 followed by an increase to 2022 with the highest average number of oysters recorded (39.7). For all three areas the lowest average number of oysters was recorded in 2020.

For all five years a very low number of oysters were recorded in the 'basin', an area of deeper water on the East Bank, this is likely due to be large amounts of red weed (*Soliera chordalis*) observed during the survey in this area reducing the number of oysters.

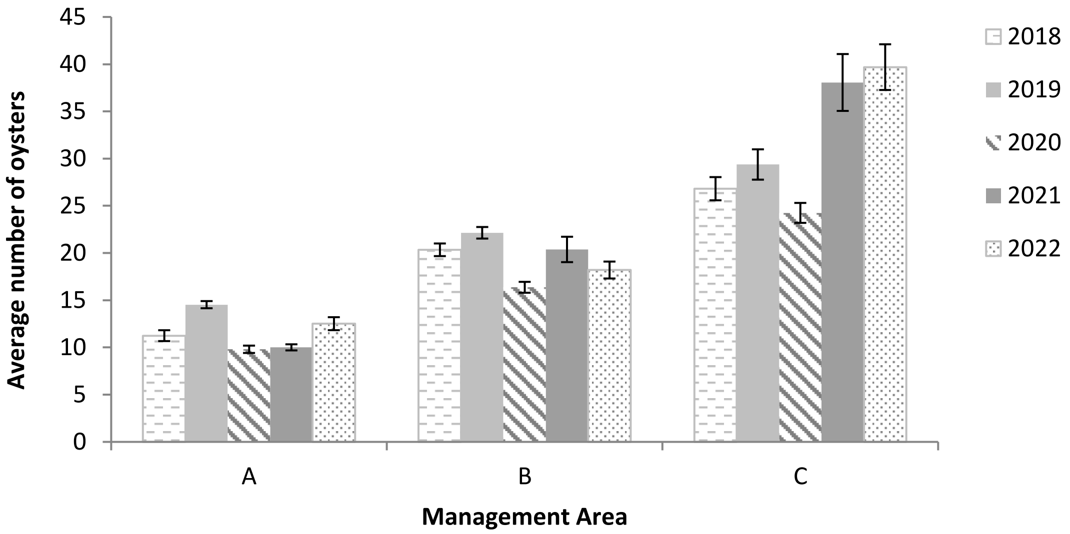


Figure 12: The average number of native oysters (*Ostrea edulis)* per dredge ± standard error for the management areas (Area A, B and C) of the survey from 2018 to 2022.

3.2.4 Oyster Size Class Composition

The total number of native oysters has varied by size class (≤35 mm, ≥36 to <50 mm, ≥51 to ≤66 mm and ≥67 mm) from to 2018 to 2022 (Figure 13). The composition of size classes remained relatively constant from 2018 to 2020 with a change in 2021 of a higher number of smaller oysters and fewer large oysters. In 2022, the number of oysters in the ≥51 to ≤66 mm size class increased and the number of smaller oysters dropped off slightly. The predominant size class for all years was the ≥51 to ≤66 mm size class.

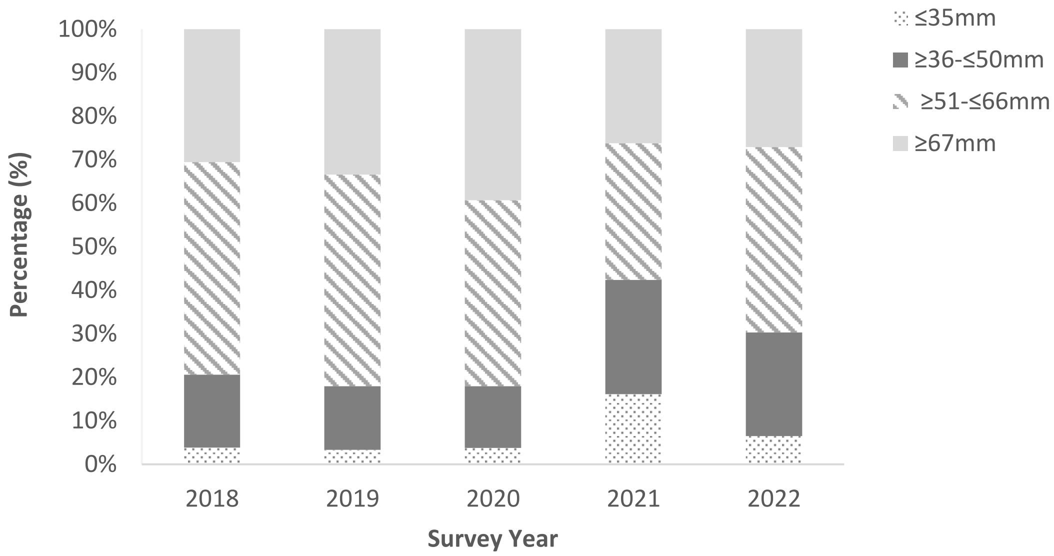


Figure 13: The percentage of native oysters (*Ostrea edulis)* per size class (≥67 mm, ≥51-≤66 mm, ≥36-≤50 mm and ≤35 mm) from 2018 to 2022.

The composition of size classes of oysters at each site in Areas A, B and C has varied from 2018 to 2022 (Figure 14 and Figure 15) with most sites composed of a range of size classes. The composition of samples remained relatively constant with a greater portion of oysters in the ≥51 to ≤66 mm size class followed by the ≥36 to ≤50 mm and ≥67 mm size classes. The sites with a high number of oysters sampled in 2022 were dominated mostly by the ≥36 to ≤50 mm size class followed by the ≤35 mm size class in Areas A and B, but not Area C.

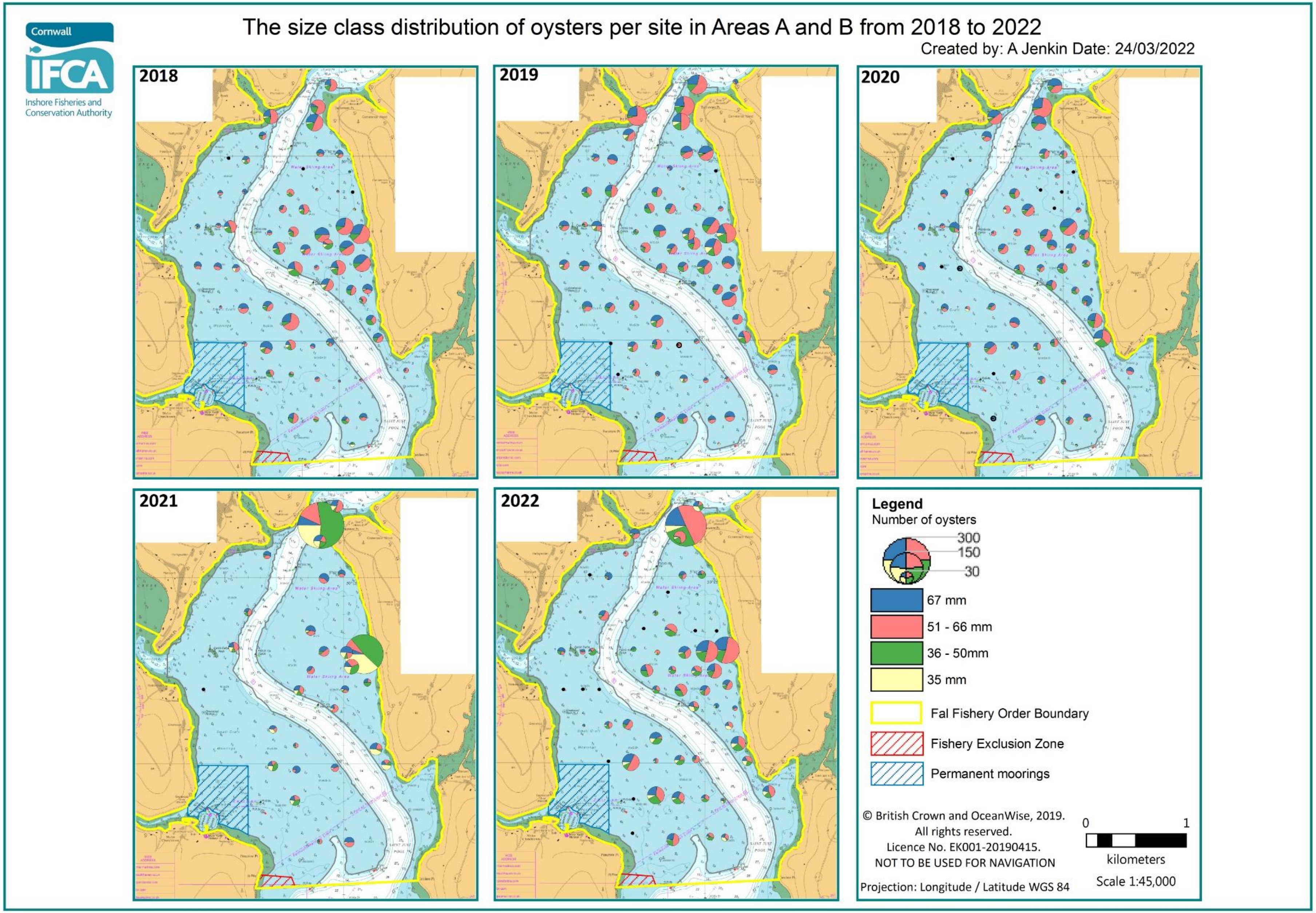


Figure 14: The composition of size classes (≥67 mm, ≥51 to ≤66 mm, ≥36 to ≤50 mm and ≤35 mm) of native oysters (*Ostrea edulis*) per survey station within Areas A and B from 2018 to 2022.

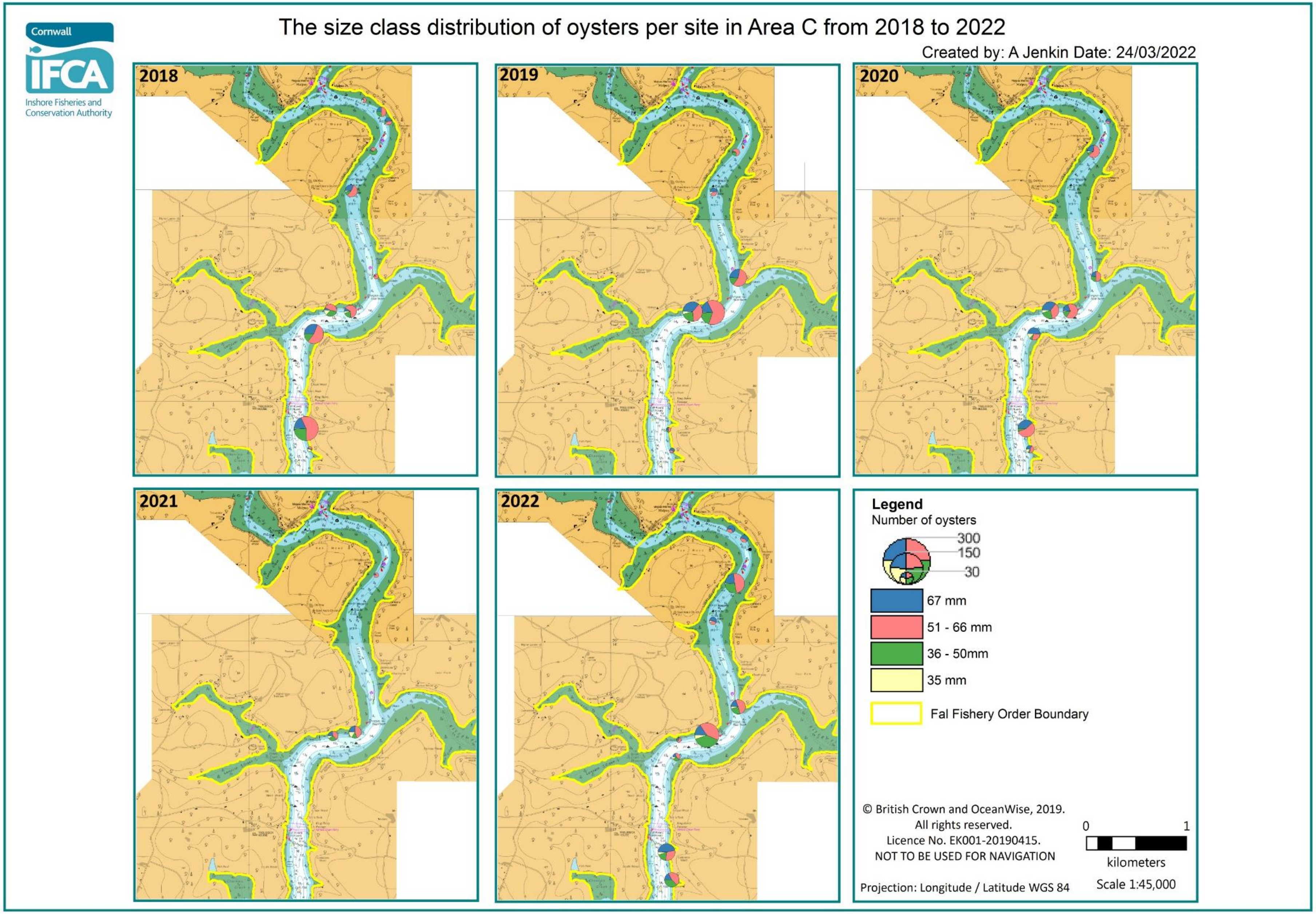


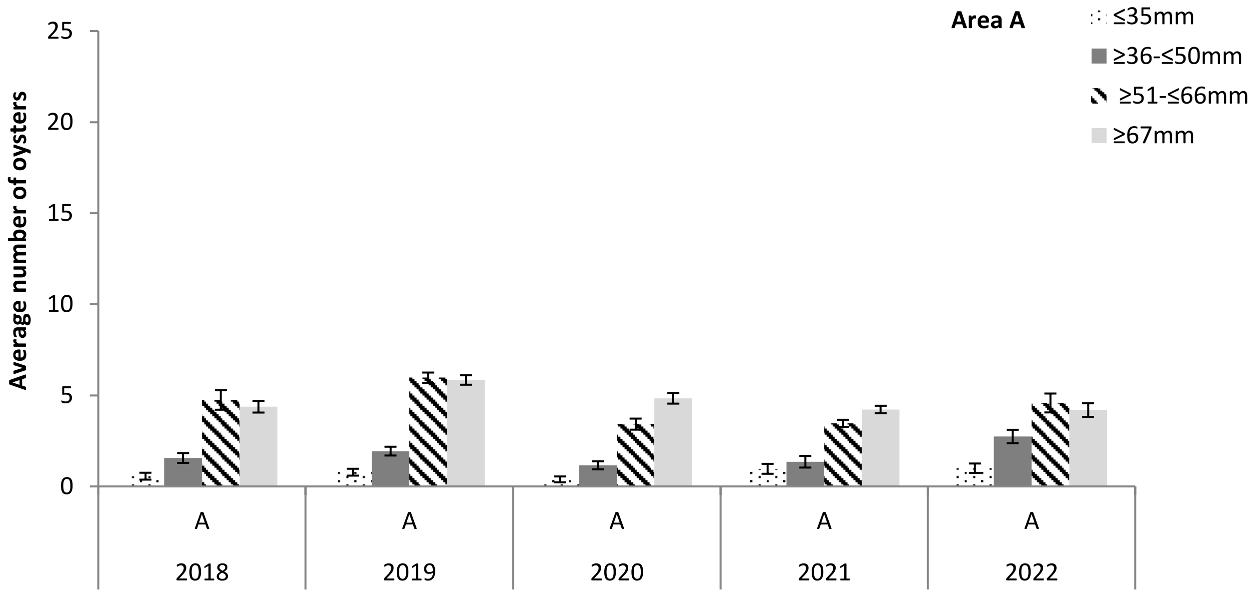
Figure 15: The composition of size classes (≥67 mm, ≥51 to ≤66 mm, ≥36 to ≤50 mm and ≤35 mm) of native oysters (*Ostrea edulis*) per survey station within Area C from 2018 to 2022.

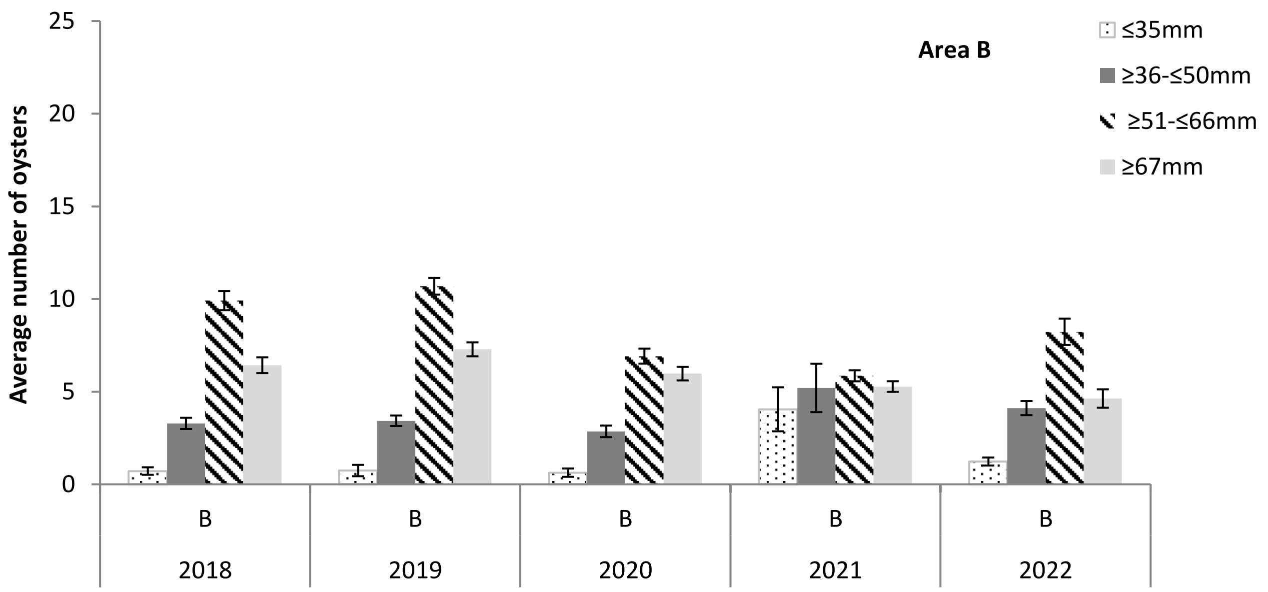
When split by management area and size class, the average number of oysters per dredge was highest in Area C and lowest in Area A (Table 4). The average number of oysters per dredge was highest in Area C for the ≥51-≤66 mm size class (17.3) and lowest in Area A for the ≤35 mm size class (1.0).

Table 4: The average number of native oysters ± standard error (*Ostrea edulis)* recorded in the three management sections (Area A, B and C) by each size class ≥67mm, ≥51-≤66 mm, ≥36-≤50 mm and ≤35mm during the Fal oyster survey 2022.

Section	≥67 mm	≥51-≤66 mm	≥36-≤50 mm	≤35 mm	Area average
A	4.2 ± 0.4	4.6 ±0.5	2.7 ± 0.4	1.0 ± 0.3	12.5 ± 0.7
B	4.6 ± 0.5	8.2 ± 0.7	4.1 ± 0.4	1.2 ± 0.2	18.2 ± 0.9
C	9.9 ± 0.9	17.3 ± 1.8	10.4 ± 1.4	2.1 ± 0.6	39.7 ± 2.4

The average number of native oysters per area (Figure 16) varied for all three areas year by year with a greater number in the ≥51-≤66 mm size class for all three areas for most years. The average number of oysters in the ≤35 mm size class per dredge remained low in all three areas across all years.





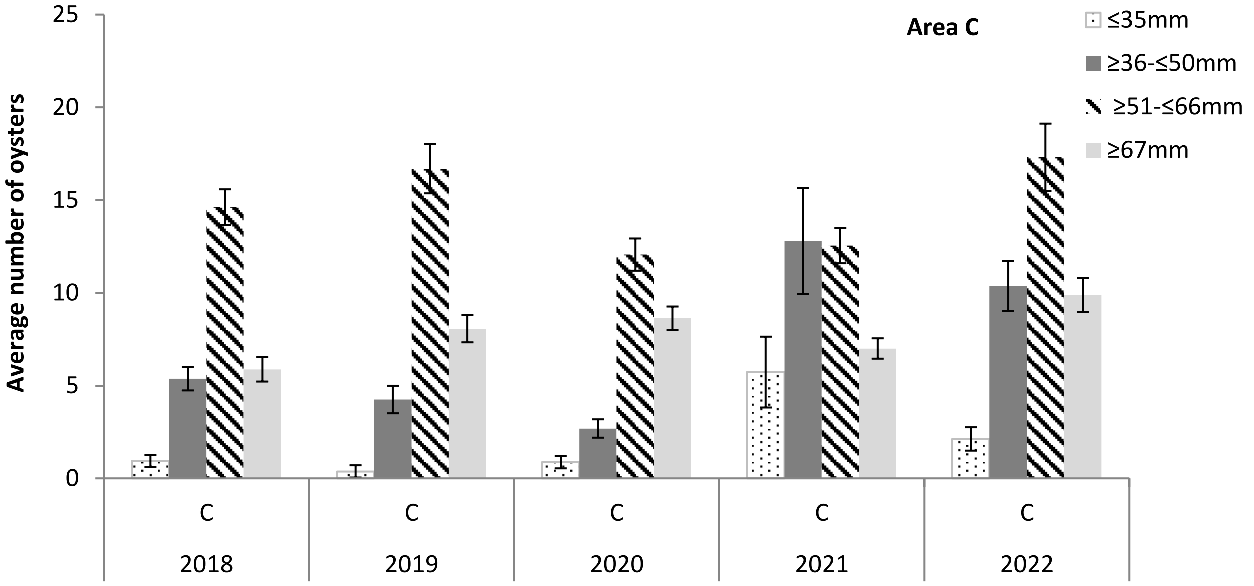


Figure 16: The average number of native oysters (*Ostrea edulis*) per size class (≥67 mm, ≥51-≤66 mm, ≥36-≤50 mm and ≤35 mm) per dredge from 2018 to 2022 for the management areas (Area A, B and C).

3.2.5 Average size and size frequency

Table 5 shows the average length (mm) of native oysters recorded in Areas A, B and C from 2018 to 2022. For all three areas, the average size (mm) of native oysters has decreased from 2020 to 2022 with the most marked drop seen in 2021 in Areas B and C.

Table 5: The average size (mm) ± standard error of native oysters (*Ostrea edulis*) in the Area A, B and C management areas from 2018 to 2022.

Year	Area A	Area B	Area C
2022	59.2 mm ± 0.87 mm	57.3 mm ± 0.57 mm	57.2 mm ± 0.56 mm
2021	58.8 mm ± 1.44 mm	49.4 mm ± 0.81 mm	47.0 mm ± 0.72 mm
2020	65.4 mm ± 0.87 mm	61.6 mm ± 0.58 mm	62.9 mm ± 0.70 mm
2019	62.8 mm ± 0.72 mm	61.3 mm ± 0.46 mm	60.8 mm ± 0.54 mm
2018	61.9 mm ± 0.79 mm	60.5 mm ± 0.49 mm	59.1 mm ± 0.62 mm

The length frequency for all oysters sampled from 2018 to 2022 is shown in Figure 17. The total mean length varies between 2019-2022 though the spread of sizes appears to be increasing slightly over time.

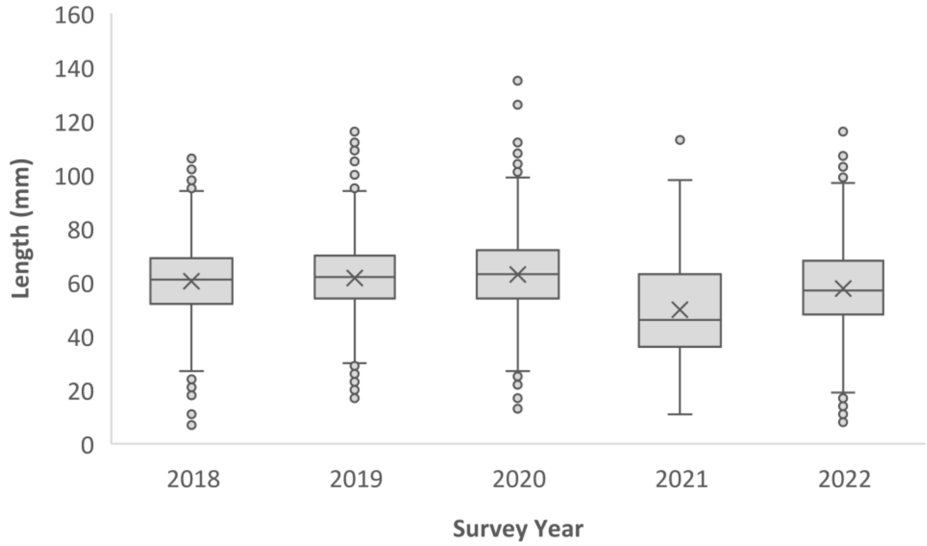


Figure 17: Length frequency plot for all native oysters (*Ostrea edulis)* from 2018 to 2022. Data is grouped by year. X represents the mean, the line represents the median, boxes represent the interquartile range, whiskers represent 1.5* interquartile range, and the filled circles represent outliers.

The length frequency for all oysters sampled in Areas A, B and C from 2018 to 2022 are shown in Figure 18.

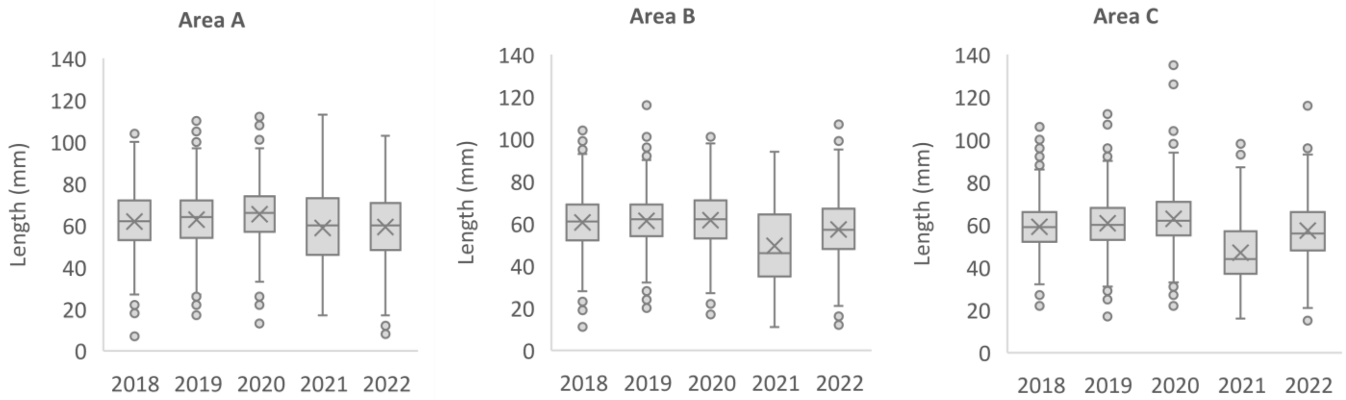


Figure 18: Length frequency plot for all native oysters (*Ostrea edulis)* in Areas A, B and C from 2018 to 2022. Data is grouped by year. X represents the mean, the line represents the median, boxes represent the interquartile range, whiskers represent 1.5* interquartile range, and the filled circles represent outliers.

The size distribution of oysters were graphed (in size frequency plots) for the management areas A, B and C are shown in Figure 19. The frequency distribution of oysters has remained largely unimodal across the areas from 2018 to 2022 with a normal distribution observed. Exceptions to this are Areas A and B in 2021 and Areas A in 2020 when a bi-modal distribution was recorded with a larger number of smaller oysters measured. A high proportion of oysters below the MLS were recorded across all areas and years.

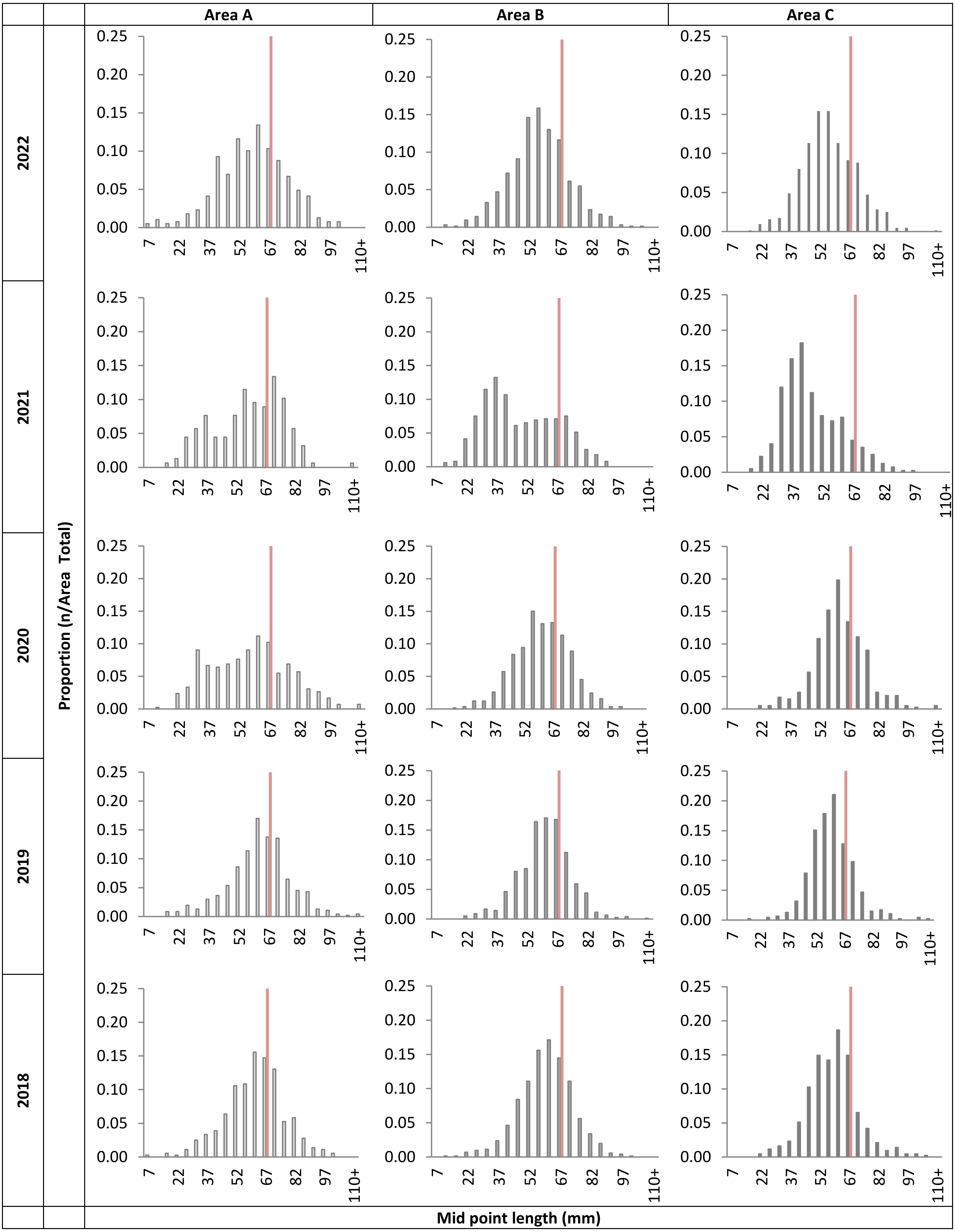


Figure 19: Size frequency distributions of native oysters (*Ostrea edulis*) for the management areas, A, B and C of the fishery from 2018 to 2022. The minimum landing size for native oysters from the fishery is shown with the red line (67 mm).

3.2.6 Minimum landing size (MLS)

As mentioned previously, the MLS for oysters from the fishery is 67 mm. The percentage of oysters over and under the MLS for the management areas, A, B and C is shown in Table 6. For all three areas in all years the percentage under the MLS was greater than over the MLS.

Table 6: The percentage (%) of native oysters (*Ostrea edulis*) over and under the minimum landing size (67 mm) for all three management areas (Area A, B and C) of the Fal Oyster Survey area from 2018 to 2022.

	Area A % under 67 mm	Area A % over 67 mm	Area B % under 67 mm	Area B % over 67 mm	Area C % under 67 mm	Area C % over 67 mm
2022	66.49	33.51	74.57	25.43	75.12	24.88
2021	62.42	37.58	76.88	23.12	88.78	11.22
2020	50.66	49.34	63.53	36.47	64.43	35.57
2019	59.78	40.22	67.10	32.90	72.55	27.45
2018	61.11	38.89	68.40	31.60	78.09	21.91

3.2.7 Length weight comparison

The total number of oysters weighed and the average weight of oysters from 2019 to 2022 are shown in Table 7 and Figure 20. One outlier was removed from the following analysis, an oyster recorded in 2020 which measured 135 mm and weighed 507.6 g. The average weight of oysters (g) has varied from 2019 with a peak recorded in 2020 and the lowest value recorded in 2021. The decline in 2021 is likely to be due to a smaller size of oyster being recorded bringing the average weight down. A decrease in weight from 51.1 g and 53.6 g per oyster in 2019 and 2020 respectively to 37.4 g in 2021 was recorded and an increase to 45. 8 g per oyster in 2022.

The total number of oysters ≥67 mm weighed and the average weight (g) of oysters ≥67 mm from 2019 to 2022 are shown in Table 7 and Figure 20. There appears to be an upwards trend in the weight of oysters > 67 mm with 2021 showing the highest weight (83.0 g).

Table 7: The number of native oysters (*Ostrea edulis*) weighed and the average weight of native oysters (g) ± standard error and number of oysters ≥67mm weighed and the average weight of native oysters (g) ≥67mm ± standard error from 2019 to 2022

	Number of native oysters weighed	Average weight (g) of native oysters	Number of oysters ≥67 mm weighed	Average weight of oysters ≥67 mm (g)
2022	1135	45.8 ± 1.1	395	80.61 ± 2.0
2021	810	37.4 ± 1.2	217	83.02 ± 2.2
2020	1107	53.6 ±1.0	465	78.24 ± 1.4
2019	787	51.1 ± 1.0	298	74.74 ± 1.8

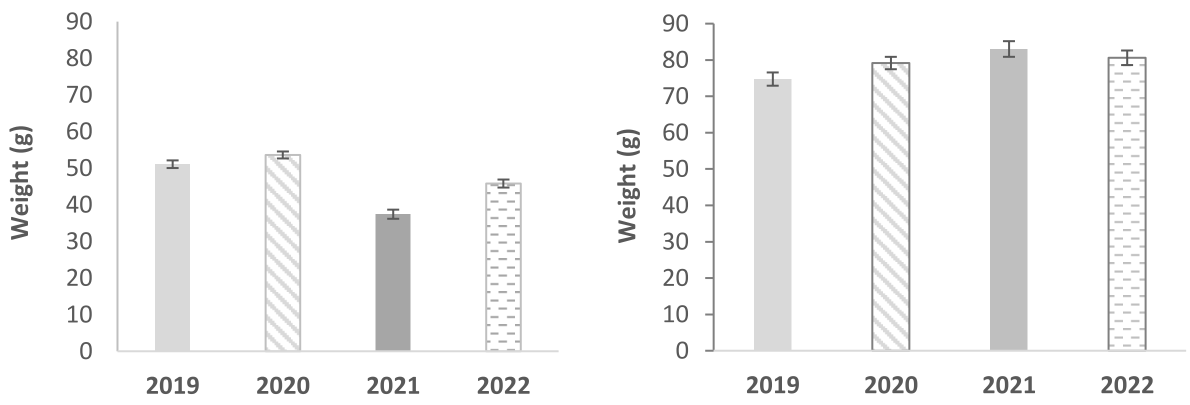


Figure 20: The average weight (g) of oysters ± standard error and the average weight (g) of oysters ≥ 67 mm ± standard error from 2019 to 2022.

A weight frequency plot for all oysters weighed from 2019 to 2022 is shown in Figure 21. There is no obvious trend in total weight mean or distribution over 2019-2022.

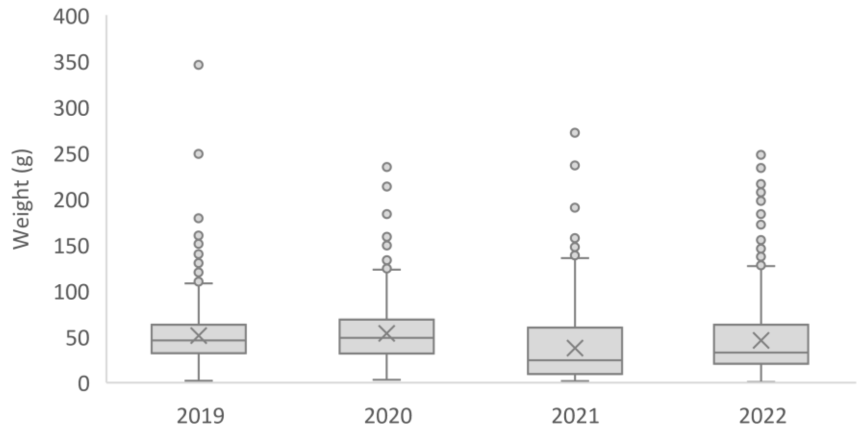


Figure 21: Weight (g) frequency plot for all native oysters (*Ostrea edulis)* from 2019 to 2022. Data is grouped by year. X represents the mean, the line represents the median, boxes represent the interquartile range, whiskers represent 1.5* interquartile range, and the filled circles represent outliers.

The length weight relationship of oysters from 2019 to 2022 is shown in Figure 22 with polynomial regressions for all years. A total of six outliers removed from the data (Two from 2020, two from 2021 and two from 2022). The polynomial curves for 2019, 2021 and 2022 are similar, but the slope of the line is smaller in 2020 suggesting a lighter weight of oyster for given lengths during that year.

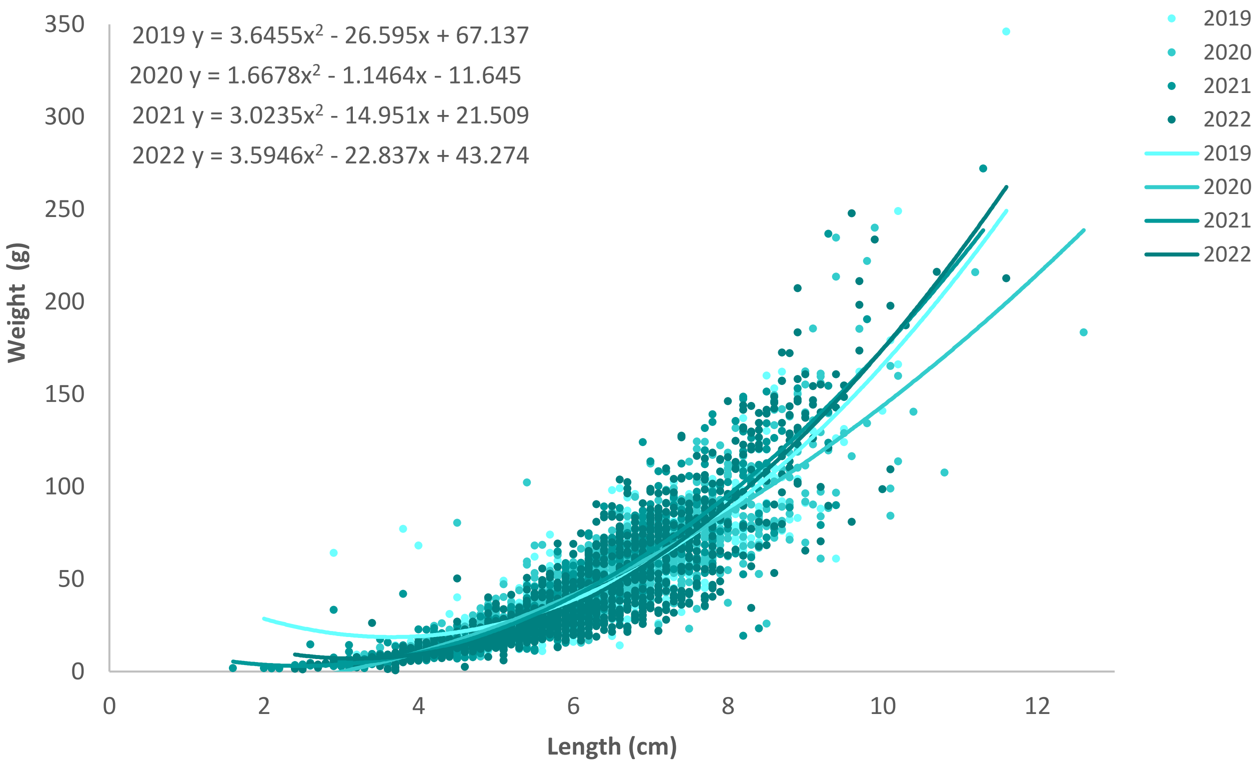


Figure 22: The length (mm) weight (g) relationship of native oysters (*Ostrea edulis)* of the FaL Oyster Survey from 2019 to 2022.

3.3 Scallops (queen or variegated scallop)

In total, 3,708 scallops were measured and recorded. Previous scallop counts including the number of sites sampled, the average number of scallops per site and the difference per year are shown in Table 8. The number of survey sites changed year on year so the total number of scallops recorded across the years are not directly comparable. In 2021, sites were chosen based on previous high counts of oysters and sites with previous high counts of scallops were a secondary factor in site selection.

Table 8: The number of queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) recorded during the Fal oyster survey between 2018 and 2022

Year	Number of sites sampled	Number of scallops	Average number of scallops per site	Difference from previous year	Percentage difference from previous year
2022	81	3,708	45.8	1129	43.78%
2021	32	2,579	80.6	-2398	-48.18%
2020	82	4,977	60.7	-2038	-29.05%
2019	83	7,015	84.5	2870	69.24%
2018	83	4,145	49.9	1193	40.41%

The results presented in the following sections are for the years 2018 to 2022 to enable a five year temporal comparison of the fishery.

3.3.1 Density

The density of scallops per 10 m^2 for all three management areas across five years of surveys from 2018 to 2022, is shown in Figure 23. The density of scallops was highest in Area A and lowest in Area C from 2018 to 2022. The density in Areas A and B has shown a marked decrease since levels in 2019 and Area C has remained relatively steady.

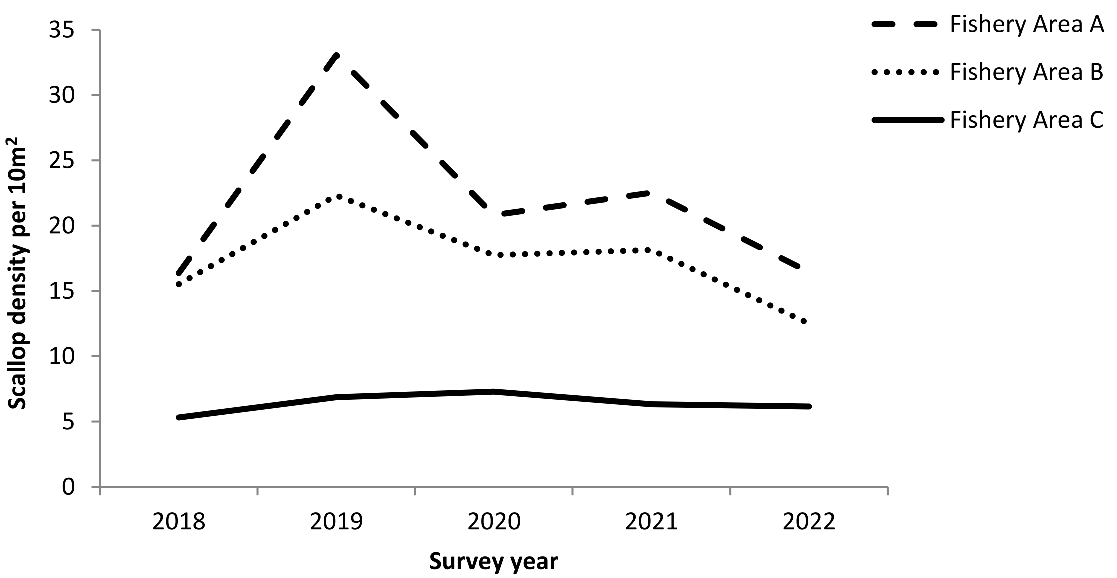


Figure 23: The density of queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) per 10 m^2 for the three management areas (Area A, B and C) from 2018 to 2022.

The density of scallops per 10 m^2 across 2018-2022 for areas A, B and C separated by per size class is shown in Figure 24. The density of scallops for all size classes has varied across the years, in all three areas, and remained lowest in Area C. The density of scallops has generally been highest in the larger size classes and lowest in the smaller size classes since 2018. The density of small scallops <40 mm has declined since 2021 in all areas except Area C with a slight increase of scallops ≤19 mm. The density of large scallops -≥60 mm has remained steady and a reduction in scallops in the ≥40-≤59 mm size class was seen across all areas.

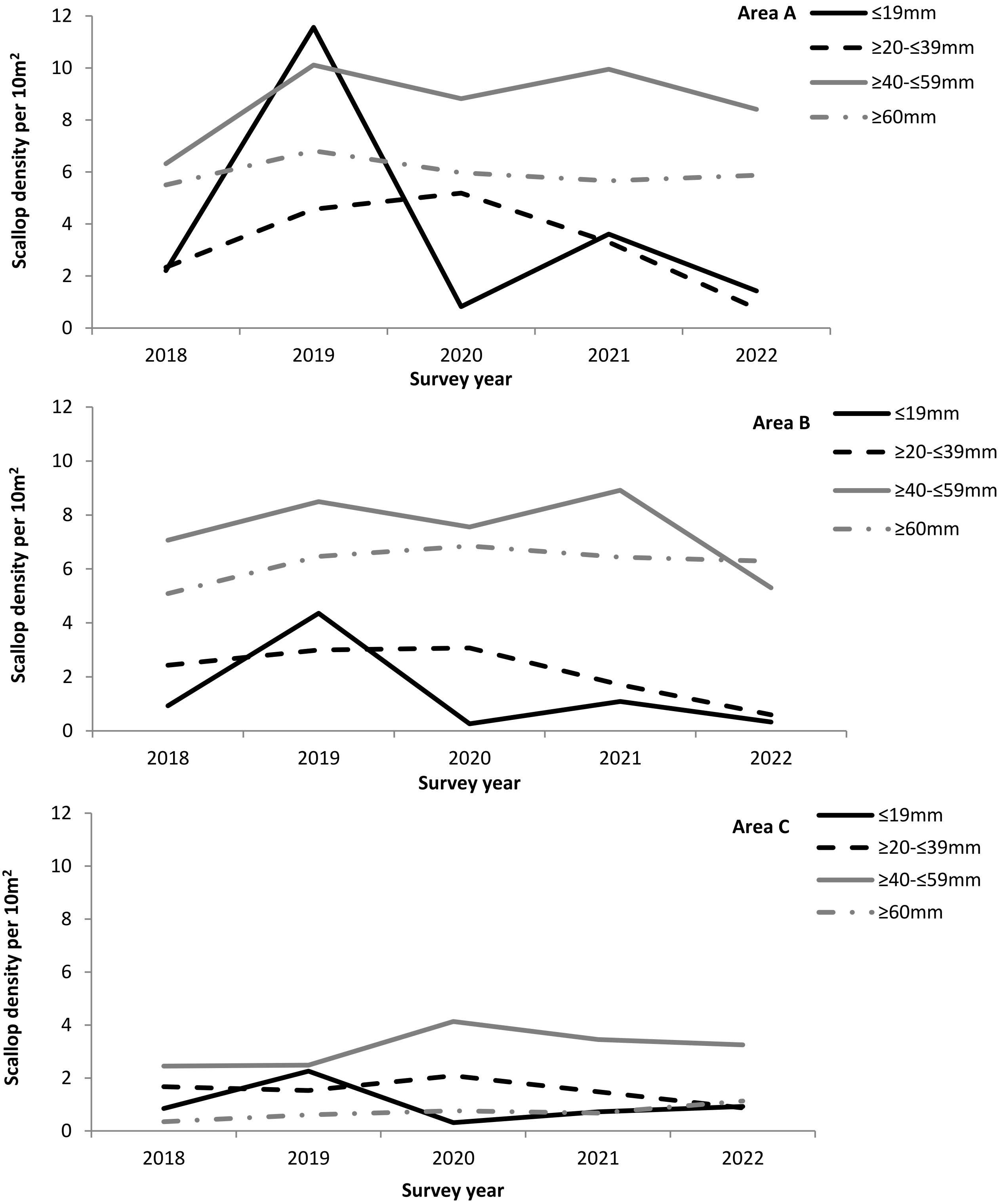


Figure 24: The density of queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) per 10 m^2 for the three management areas (Area A, B and C) per size class from 2018 to 2022.

3.3.2 Density plots

Density plots were created for the total number of scallops per 10 m^2 (Figure 25) the number of scallops ≥60 mm per 10 m^2 (Figure 26) and the number of scallops between ≥40 to ≤59 mm per 10 m^2 (Figure 29) for Areas A and B. Density plots of Area C, the upper reaches above Turnaware Point were not mapped by density due to the lack of samples and their scattered distribution which could lead to misleading interpolation.

Total number of scallops per 10 m^2

The distribution of the total number of scallops recorded from 2018 to 2022 is shown in Figure 25. This shows that the density of scallops has declined from 2018 to 2022 with smaller patches of higher density recorded although one patch in the southern part of the fishery recorded a higher density than in 2018. In 2022 a patch of ground with a high density of scallops between 60 to 200 scallops per 10 m^2 was observed to the west of the channel in the southern part of the fishery. This patch of high scallop density declined with distance from the channel on the North bank. The density in the remainder of the survey area was low, between 0.1 to 12 scallops per 10 m^2.

Scallops ≥60 mm per 10 m^2

The distribution of the total number of scallops ≥60 mm recorded from 2018 to 2022 is shown in Figure 26. This shows that the density of scallops ≥60 mm has remained relatively similar and/or increased from 2018 to 2022 with patches of high density recorded either side of the channel on the East bank and North bank throughout the survey years but more markedly in 2022. The density in the remainder of the survey area was low, between 0.1 to 4 scallops per 10 m^2.

Scallops ≥40 to ≤59 mm per 10 m^2

The distribution of the total number of scallops for the ≥40 to ≤59 mm size class recorded from 2018 to 2022 are shown in Figure 27. This shows that the density of scallops in this size class has declined since 2021 with a reduced distribution of higher-density patches of scallops in this size class. The densest patches in 2022 were observed in the southern part of the fishery on the east side of the channel. There has been a shift from scallops in the central part of the fishery to the southern extent over the years. The density in the remainder of the survey area was low, between 0.1 to 4 scallops per 10 m^2.

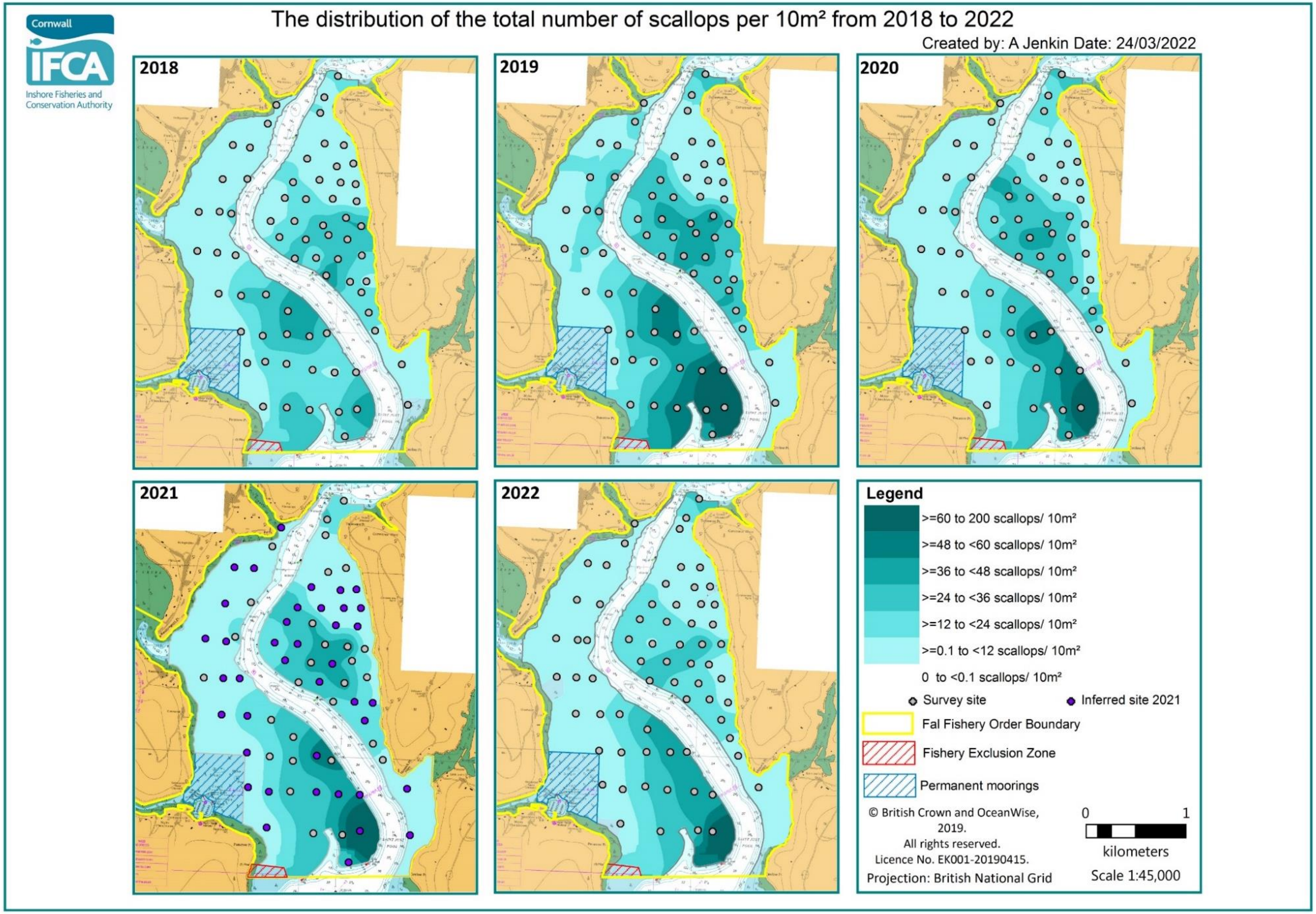


Figure 25: Density map displaying the total number of queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) per 10 m² recorded within Areas A and B from 2018 to 2022.

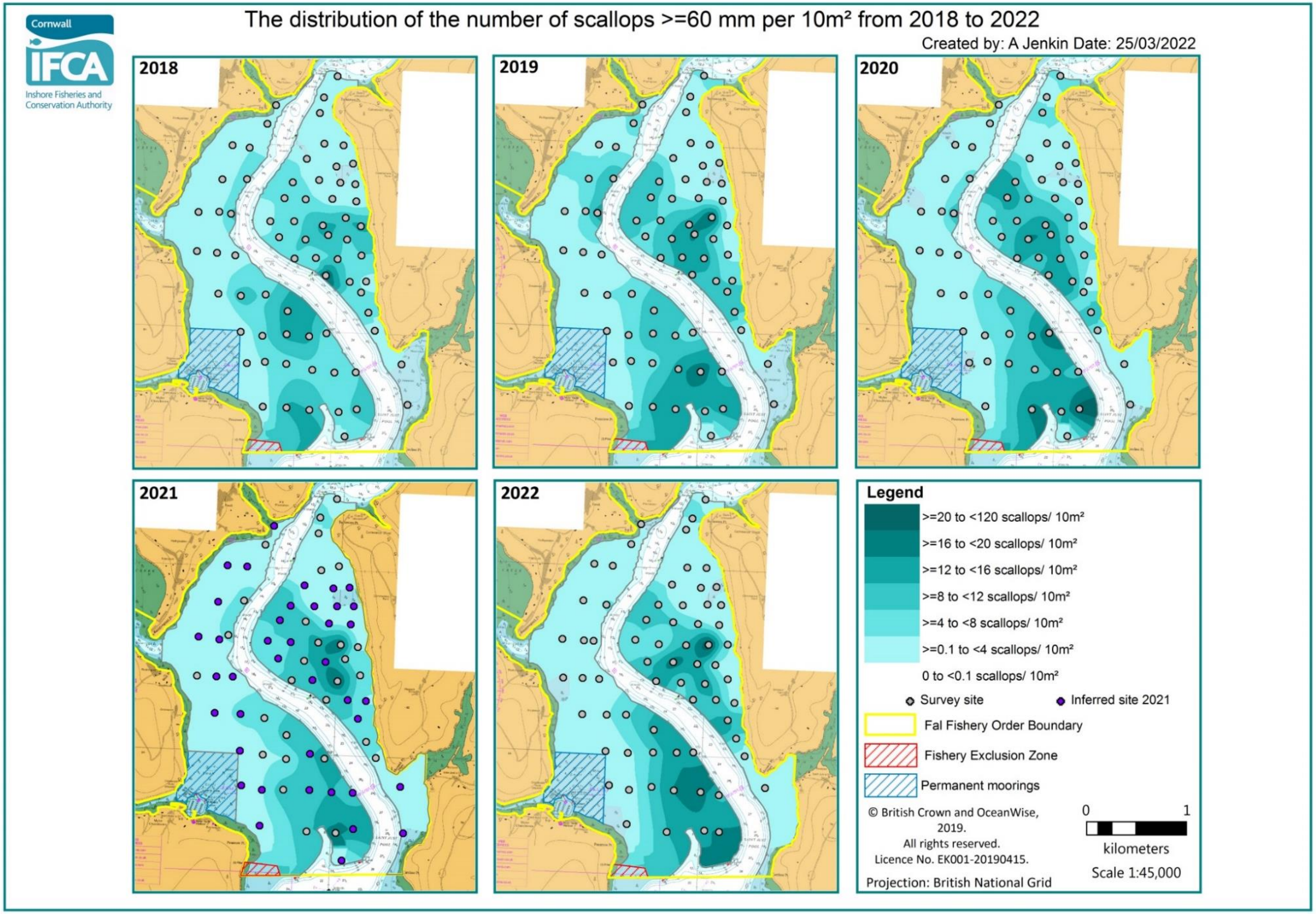


Figure 26: Density map displaying queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) ≥60 mm per 10 m² recorded within Areas A and B from 2018 to 2022.

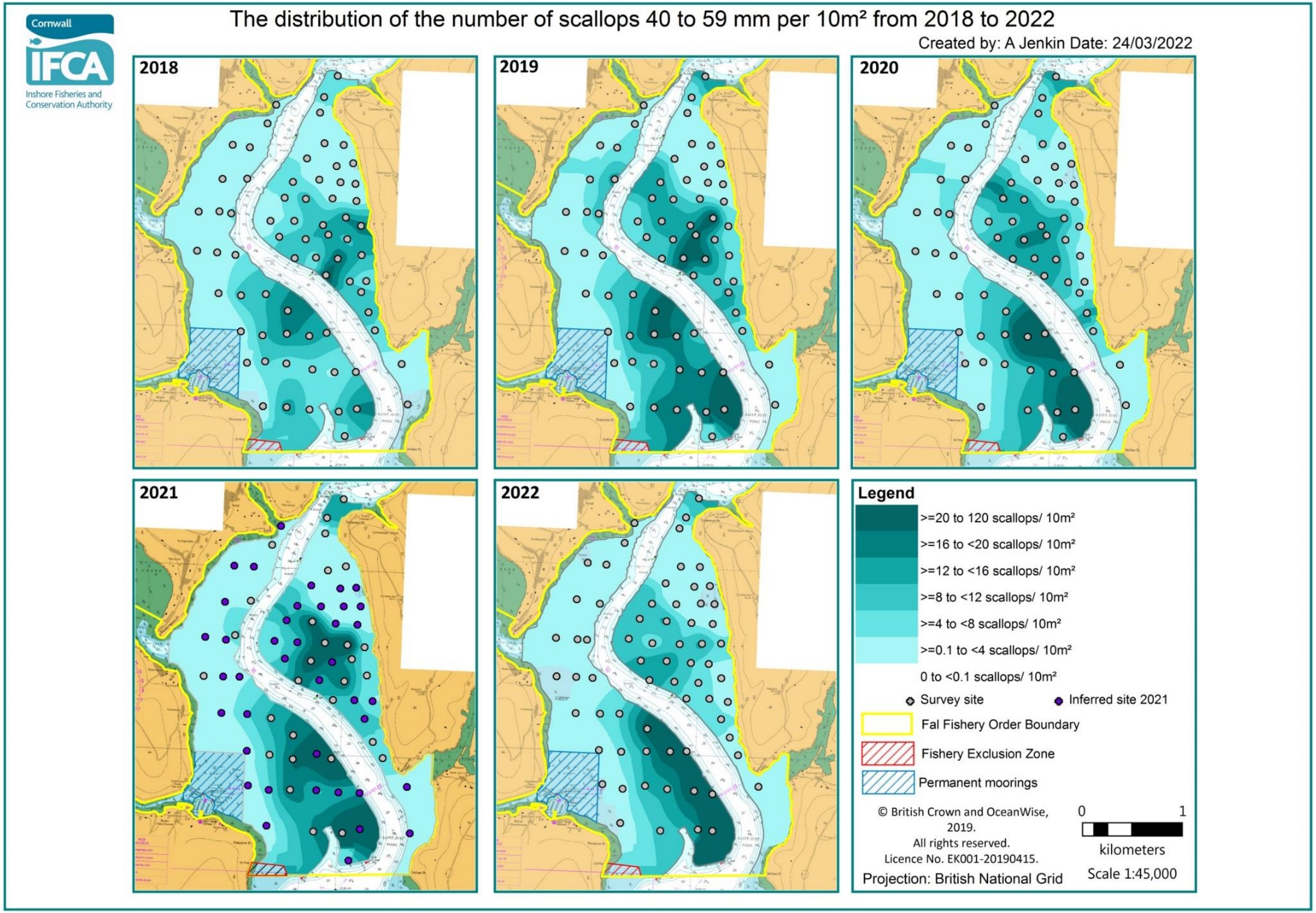


Figure 27: Density map displaying queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) ≥40-≤59 mm per 10 m² recorded within Areas A and B from 2018 to 2022.

3.3.3 Average number per dredge

Figure 28 show the average number of scallops per site recorded in the management areas (Area A, B and C) from 2018 to 2022. The average number of scallops per dredge decreased in Areas A and B in 2022 and remained steady in Area C.

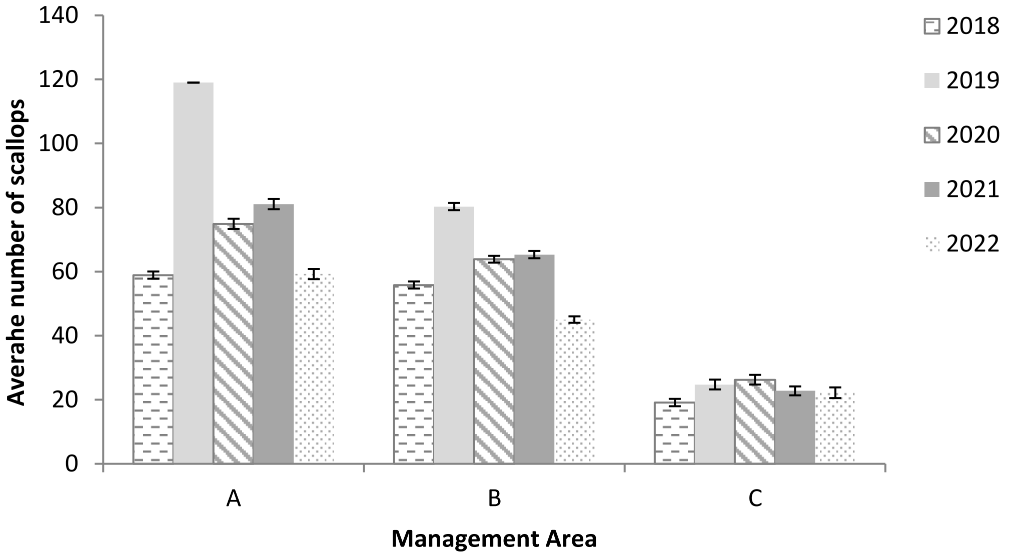


Figure 28: The average number of queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) per dredge ± standard error for the management areas (Areas A, B and C) of the survey for the years from 2018 to 2022.

3.3.4 Scallop Size Class Composition

The percentage of scallops per size class (≤19 mm, ≥20 to ≤39 mm, ≥40 to ≤59 mm and ≥60 mm) from 2018 to 2022 is shown in Figure 29. The size class composition for all classes has remained relatively consistent since 2018 though there is a slight trend of the smaller size classes (≤19 mm and ≥20 to ≤39 mm) becoming less prevalent over time.

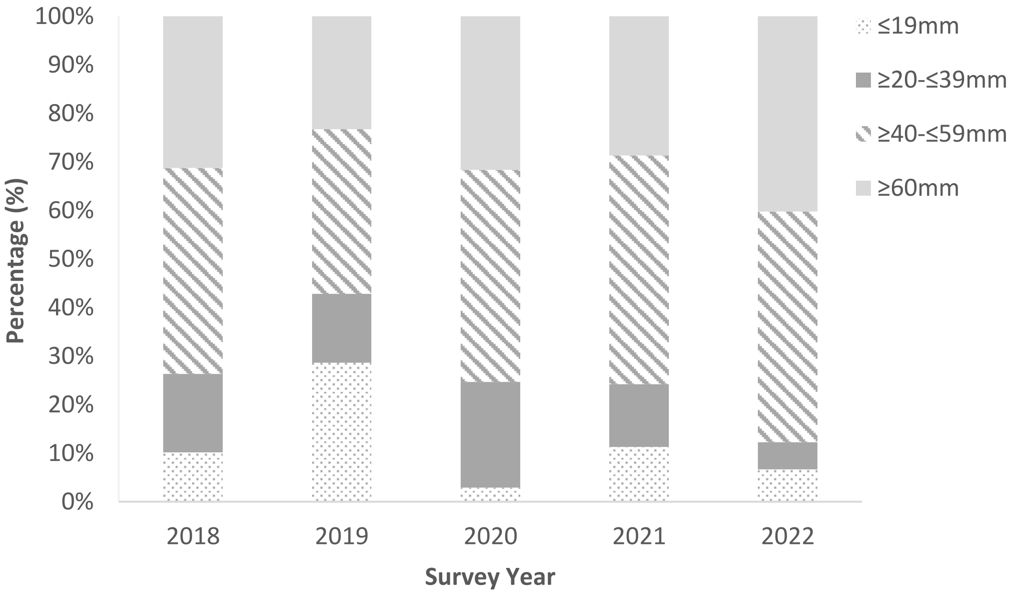


Figure 29: The percentage of queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) per size class (≥60 mm, ≥40-≤59 mm, ≥20-≤39 mm and ≤19 mm) from 2018 to 2022.

The size composition and distribution of size classes (≥60 mm, ≥40-≤59 mm, ≥20-≤39 mm and ≤19 mm) of scallops for each site is shown in Figure 30 and Figure 31. The plots show that for Areas A and B there is a definite reduction in the smaller size classes over time and an increase in larger size classes >40 mm which have dominated in 2021 and 2022.

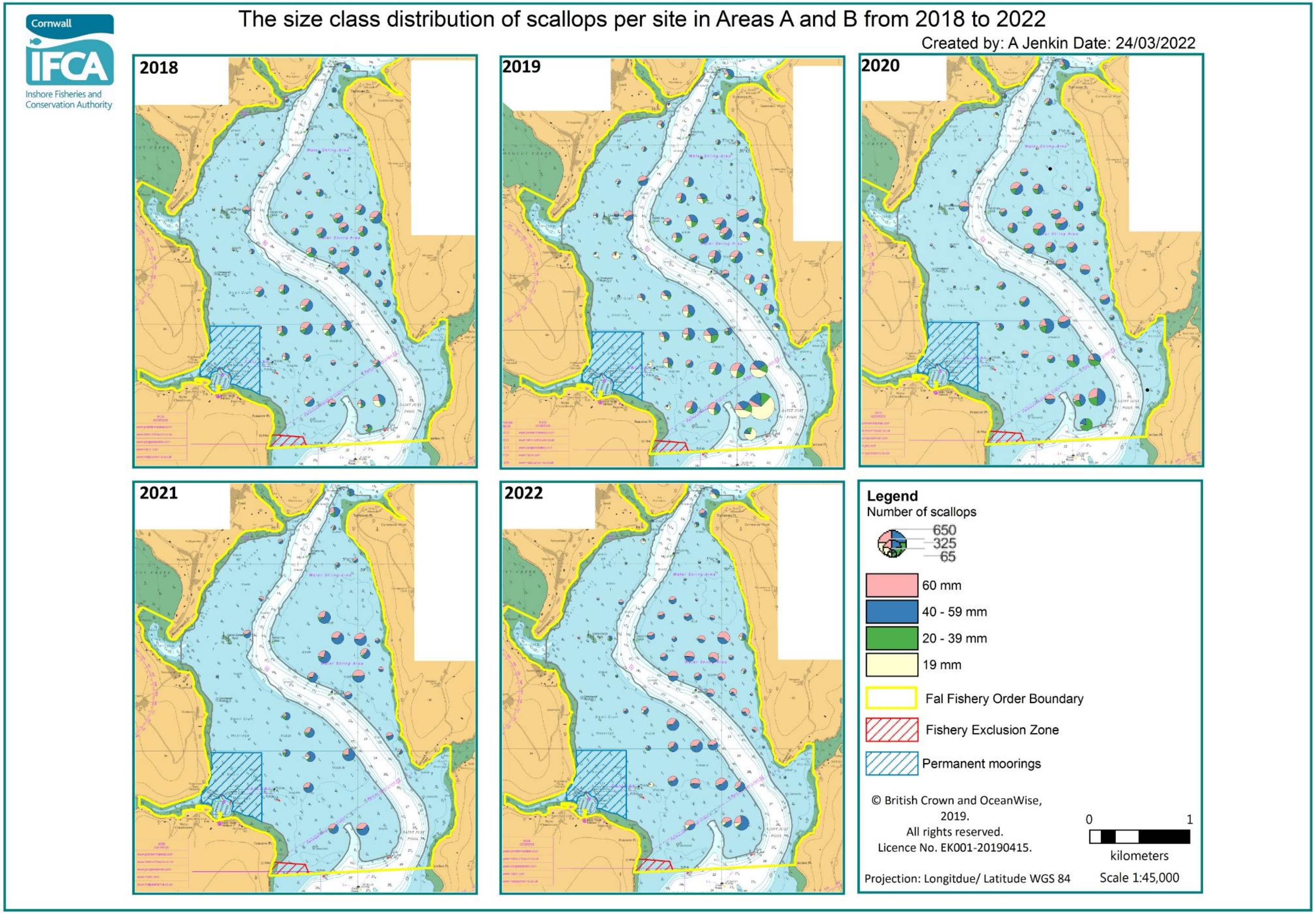


Figure 30: The size composition and distribution of size classes (≥60 mm, ≥40-≤59 mm, ≥20-≤39 mm and ≤19 mm) of queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) for each site within the Outer Harbour and Harbour from 2018 to 2022.

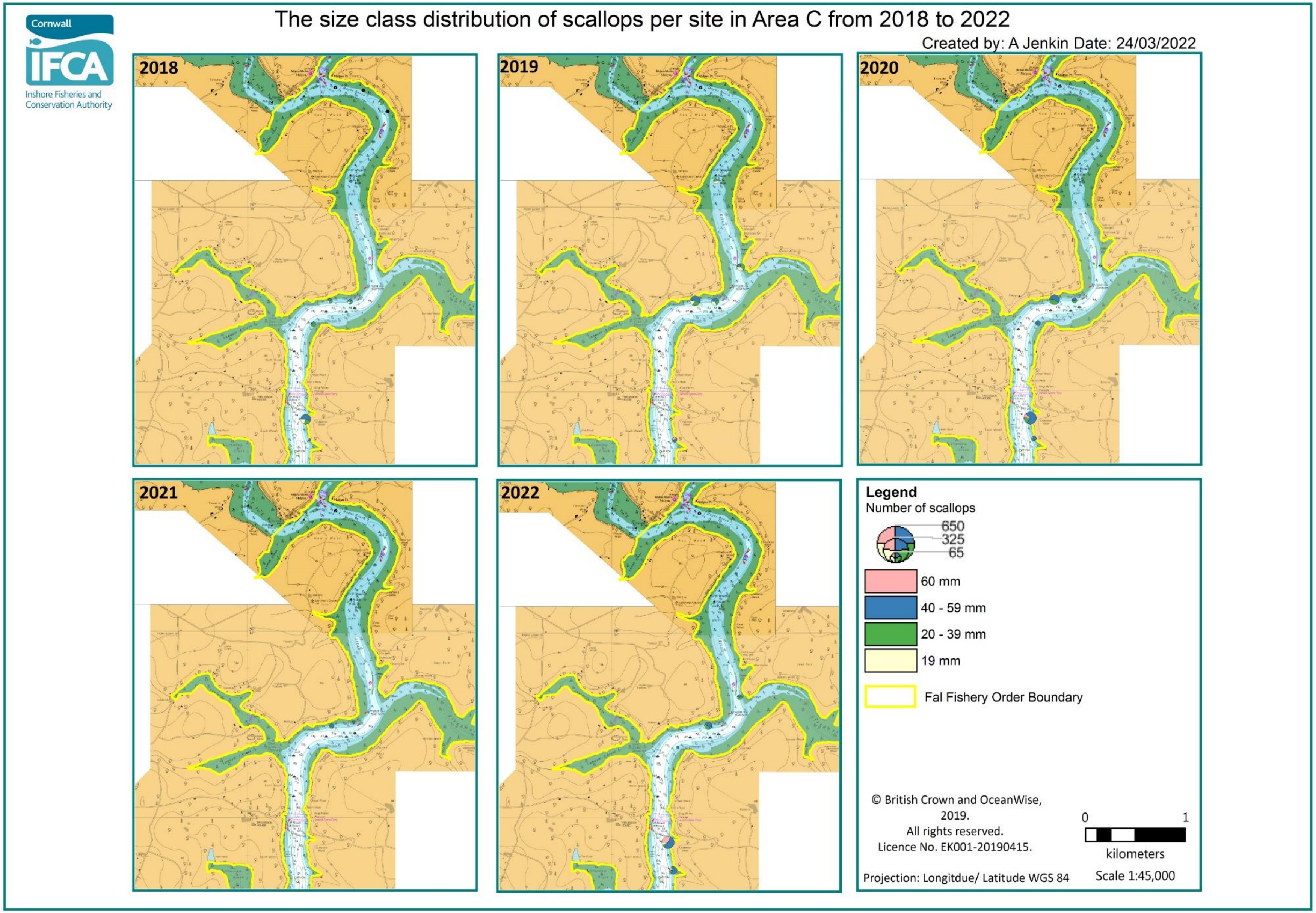


Figure 31: The size composition and distribution of size classes (≥60 mm, ≥40-≤59 mm, ≥20-≤39 mm and ≤19 mm) of queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) for each site within Area C from the 2018 to 2022.

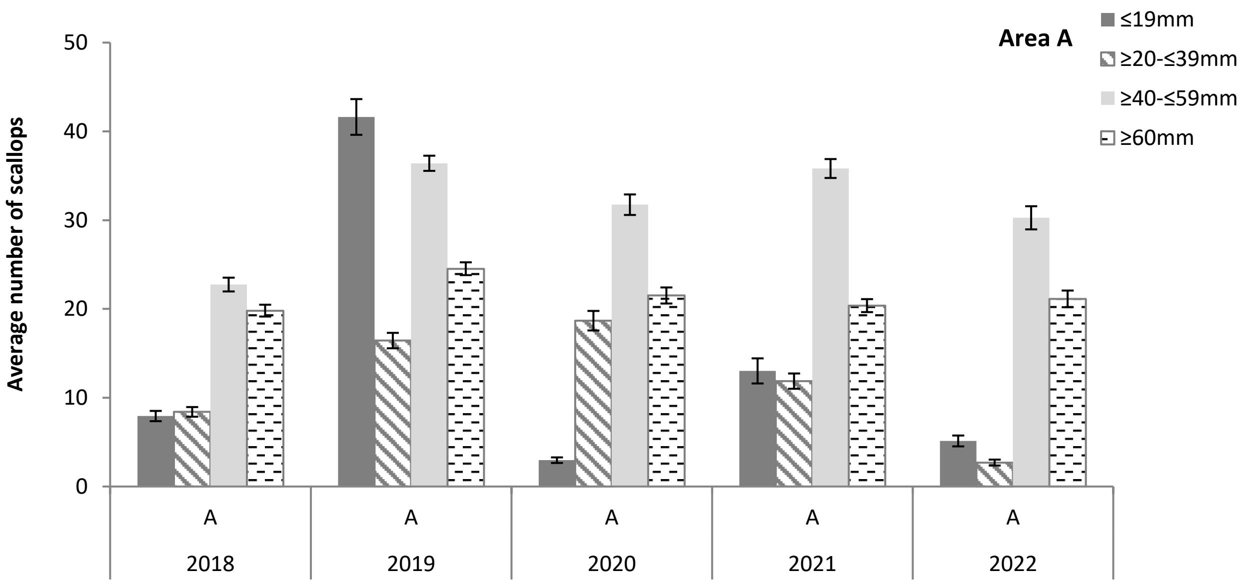
Of the total number of scallops (3,708), 1,777 were from Area A, 1,576 from Area B and 355 from Area C. The total number of scallops per site is shown in Annex 5.

The average number of scallops per size class by management area is shown in Table 9. The average number of scallops was highest in Area A for all size classes except the ≥60 mm size class which was highest in Area B (Table 9). The average number was lowest in Area C for the largest size classes (≥60 mm and ≥40-≤59 mm) and lowest in Area B for the smallest size classes (≥20-≤39 mm) and size classes. The average number of scallops by management area by size class was highest in Area A for the ≥40-≤59 mm size class (30.3 scallops) and lowest in Area B for the ≤19 mm size class (1.2 scallops)

Table 9: The average number ± standard error of queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) recorded in the management areas (Areas A, B and C) recorded by total number, total number of scallops ≥60 mm, ≥40-≤59 mm, ≥20-≤39 mm, and ≤19 mm during the Fal oyster survey 2022.

Section	≥60 mm	≥40-≤59 mm	≥20-≤39 mm	≤19 mm	Area average
A	21.1 ± 0.9	30.3 ± 1.3	2.7 ± 0.3	5.1 ± 0.6	59.2 ± 1.6
B	22.6 ± 4.8	19.1 ± 4.1	2.1 ± 1.4	1.2 ± 2.1	45.0 ± 1.0
C	4.1 ± 1.0	11.7 ± 1.1	3.1 ± 0.5	3.3 ± 1.2	22.2 ± 1.7

The average number of scallops per area by size class varied from 2018 to 2022 (Figure 32). The average number of scallops was generally lower in the smaller size classes (≤19 mm and ≥20-≤39 mm) and greater in the larger size classes (≥40-≤59 mm and ≥60 mm), with the exception of 2019 in Area A.



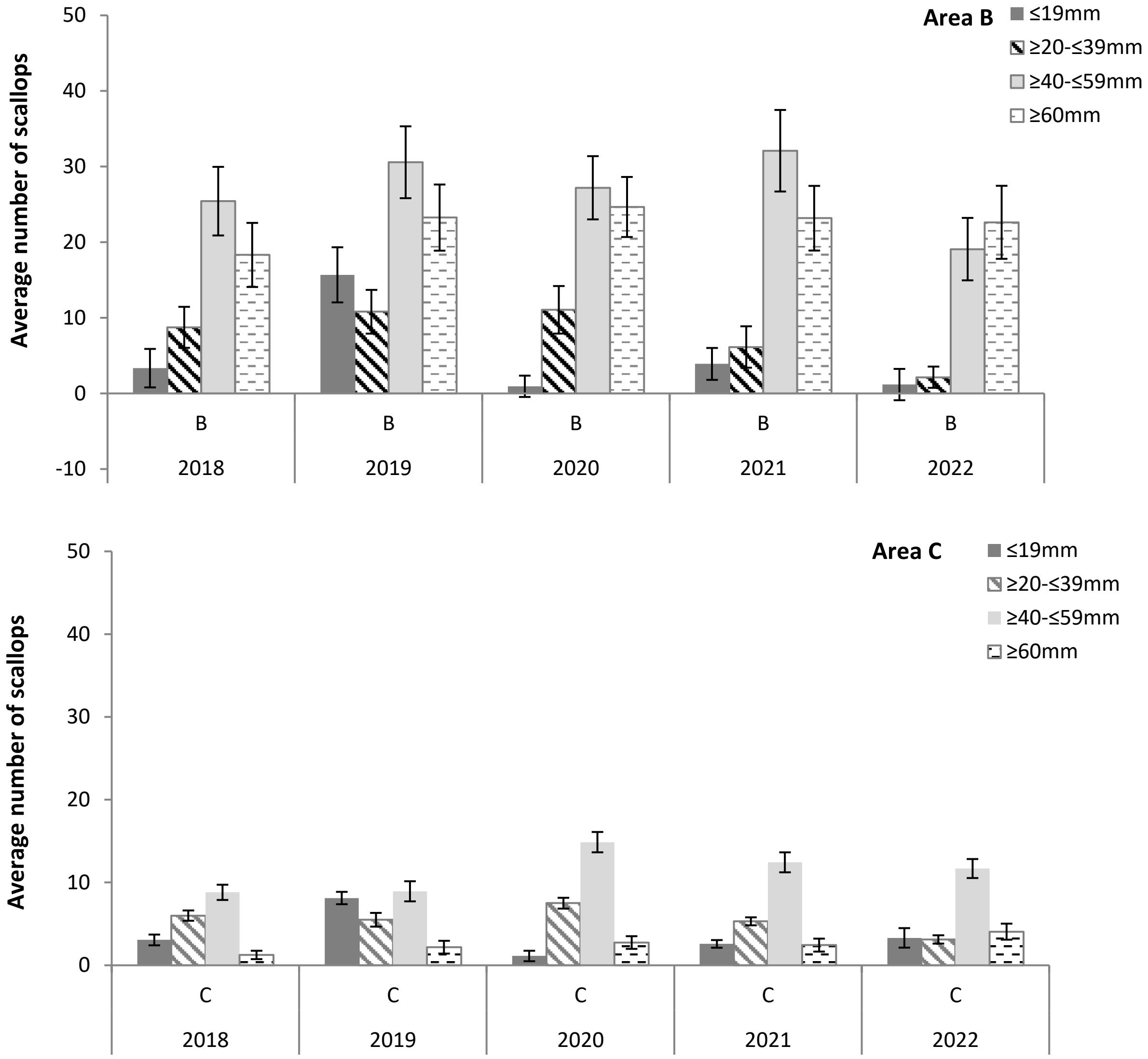


Figure 32: The average number of queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) per size class (≥60 mm, ≥40-≤59 mm, ≥20-≤39 mm and ≤19 mm) per dredge from 2018 to 2022 for the management areas, Area A, B and C.

3.3.5 Average size and size frequency

Table 10 shows the average size (mm) of scallops recorded in the A, B and C management areas from 2018 to 2022. For the management areas of the survey, the average size (mm) of scallops has varied yearly. In all three areas the average size of scallop has increased from 2019 to 2021, though in 2022 decreased again in areas A and C.

Table 10: The average size (mm) ± standard error of queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) in the management areas, Area A, B and C from 2018 to 2022.

Year	Area A	Area B	Area C
2022	52.3 mm ± 0.4 mm	57.1 mm ± 0.3 mm	44.6 mm ± 0.7 mm
2021	53.5 mm ± 0.4 mm	54.4 mm ± 0.3 mm	46.4 mm ± 0.9 mm
2020	48.5 mm ± 0.3 mm	52.9 mm ± 0.3 mm	45.1 mm ± 0.7 mm
2019	36.6 mm ± 0.4 mm	44.4 mm ± 0.4 mm	34.0 mm ± 1.0 mm
2018	47.8 mm ± 0.5 mm	50.4 mm ± 0.4 mm	38.6 mm ± 0.9 mm

The length frequency for all scallops sampled from 2018 to 2022 in shown in Figure 33. The total mean length increases from 2019-2022 and the spread of sizes appears to be decreasing over time.

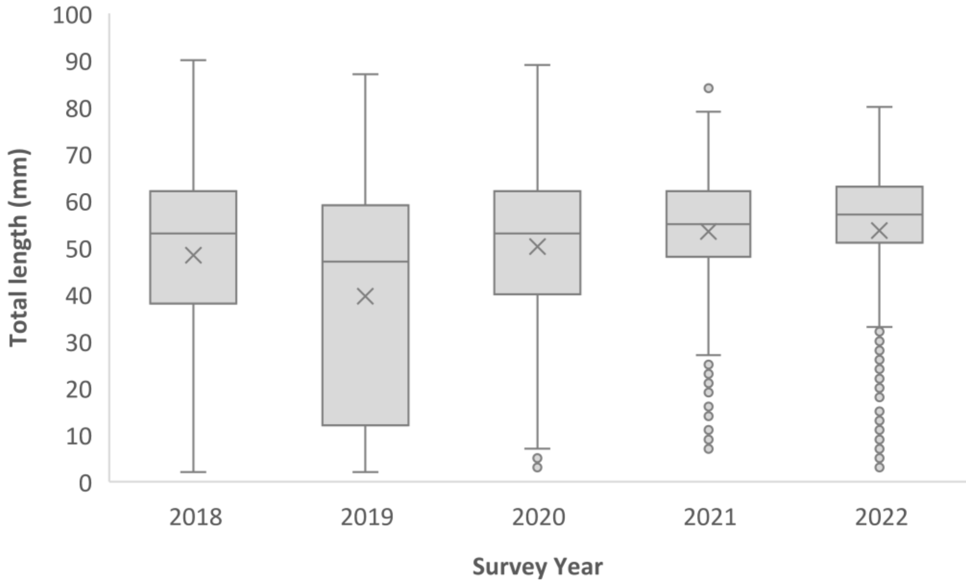


Figure 33: Length frequency plot for all queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) from 2018 to 2022. Data is grouped by year. X represents the mean, the line represents the median, boxes represent the interquartile range, whiskers represent 1.5* interquartile range, and the filled circles represent outliers.

The length frequency for all scallops sampled in Areas A, B and C from 2018 to 2022 are shown in Figure 34. All areas show similar patterns of decreasing mean length in 2019 and increasing between 2020 and 2022.

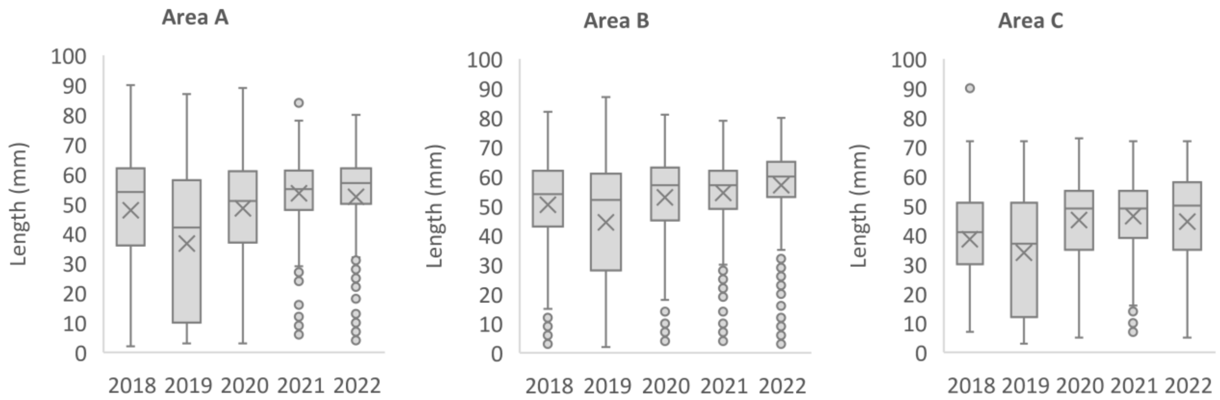


Figure 34: Length frequency plot for all queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) in management areas A, B and C from 2018 to 2022. Data is grouped by year. The X represents the mean, the line represents the median, boxes represent the interquartile range, whiskers represent 1.5* interquartile range and the filled circles represent outliers.

The size distribution of scallops were graphed (in size frequency plots) for the management areas; Areas A, B and C across the survey years (Figure 35) with reference to the EU MCRS so the stock can be viewed in a wider context. In 2022 a uni-modal distribution was recorded in Area A and B and a bio-modal distribution in Area C. The frequency distribution for most areas from 2018 to 2022 were normally distributed except in 2018 and 2019 when a larger number of smaller scallops were recorded in all areas causing a bi-modal distribution. A high proportion of the population across all areas for all years is above the MCRS for queen scallops.

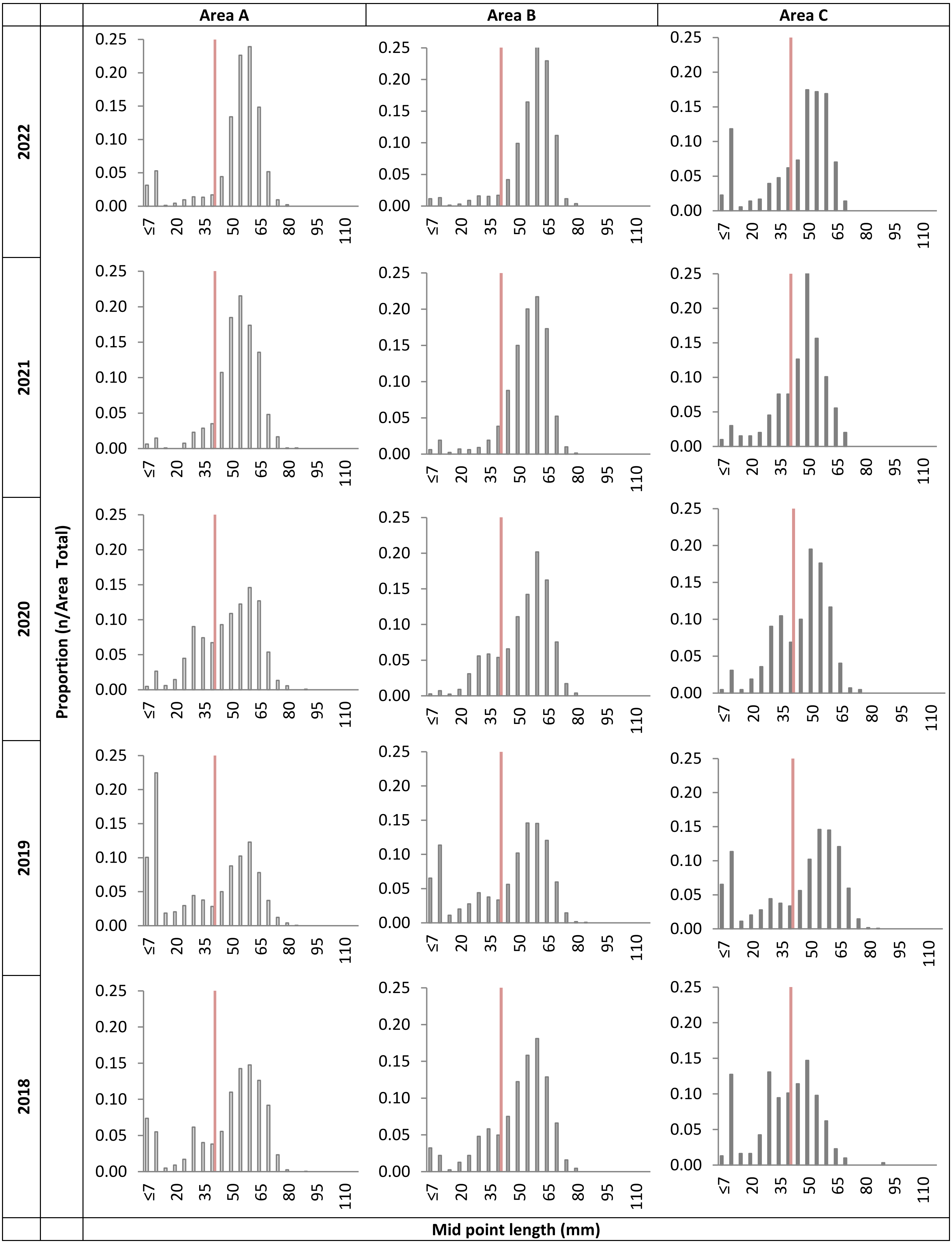


Figure 35: Size frequency distributions for queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) for the management section Area B of the fishery from 2018 to 2022. The minimum conservation reference size for queen scallops (*Chlamys* spp.) is shown with the red line (40 mm).

3.3.6 Minimum Conservation Reference Size (MCRS)

As mentioned previously, the MCRS for queen scallops (*Chlamys* spp.) is 40 mm[5]. Despite this not applying to vessels targeting the fishery, it was felt that it was appriopriate to analyse the data in respect of the MCRS.

The percentage of scallops over and under the MCRS is shown in Table 11. For all three areas in all years the percentage over the MCRS was greater than under the MCRS except for Area C in 2019.

Table 11: The percentage (%) of queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) over and under the minimum conservation reference size (40 mm) for all three management areas (Area A, B and C) of the Fal oyster survey area from 2018 to 2022.

	Area A % <40 mm	Area A % >=40 mm	Area B % < 40 mm	Area B % >=40 mm	Area C % <40 mm	Area C % >=40 mm
2022	13.22	86.78	7.36	92.64	29.01	70.99
2021	9.80	90.20	7.93	92.07	25.76	74.24
2020	28.90	71.10	18.79	81.21	32.86	67.14
2019	48.79	51.21	32.98	67.02	55.05	44.95
2018	27.75	72.25	21.65	78.35	47.39	52.61

3.4 Slipper limpets

A total of 4,507 slipper limpets were recorded during the 2022 survey (Table 12). The number of survey stations changed year on year so the numbers recorded across the years are not directly comparable and a reduced number of sites were surveyed in 2021, none of which were chosen for having a high number of slipper limpets, which is why the number recorded in 2021 is likely to be lower than other years.

Table 12: The number of slipper limpets (*Crepidula fornicata*) recorded during the Fal oyster survey between 2018 and 2022

Year	Number of sites	Number of slipper limpets	Area A	Area B	Area C
2022	81	4,507	1,459	991	2,057
2021	32	1,879	980	661	238
2020	82	8,753	3,929	2,313	2,511
2019	83	11,412	6,364	3,166	1,882
2018	83	11,525	5,295	3,830	2,400

All slipper limpets recorded during the survey were retained onboard Tiger Lily VI in sacks and not returned to the fishery unless they were attached to a live oyster or scallop and couldn't be detached.

3.4.1 Density plot

The distribution of slipper limpets in areas A and B is shown in Figure 36. The density of slipper limpets has decreased across the fishery since 2018. The 2021 data was not inferred for slipper limpets.

It should be noted that patches with a higher density were recorded in Area C in the upper reaches of the Fal but a density map was not created due to the sparsity between sites.

[5] Regulation (EU) 2019/1241 of the European Parliament and of the Council of 20 June 2019 on the conservation of fisheries resources and the protection of marine ecosystems through technical measures

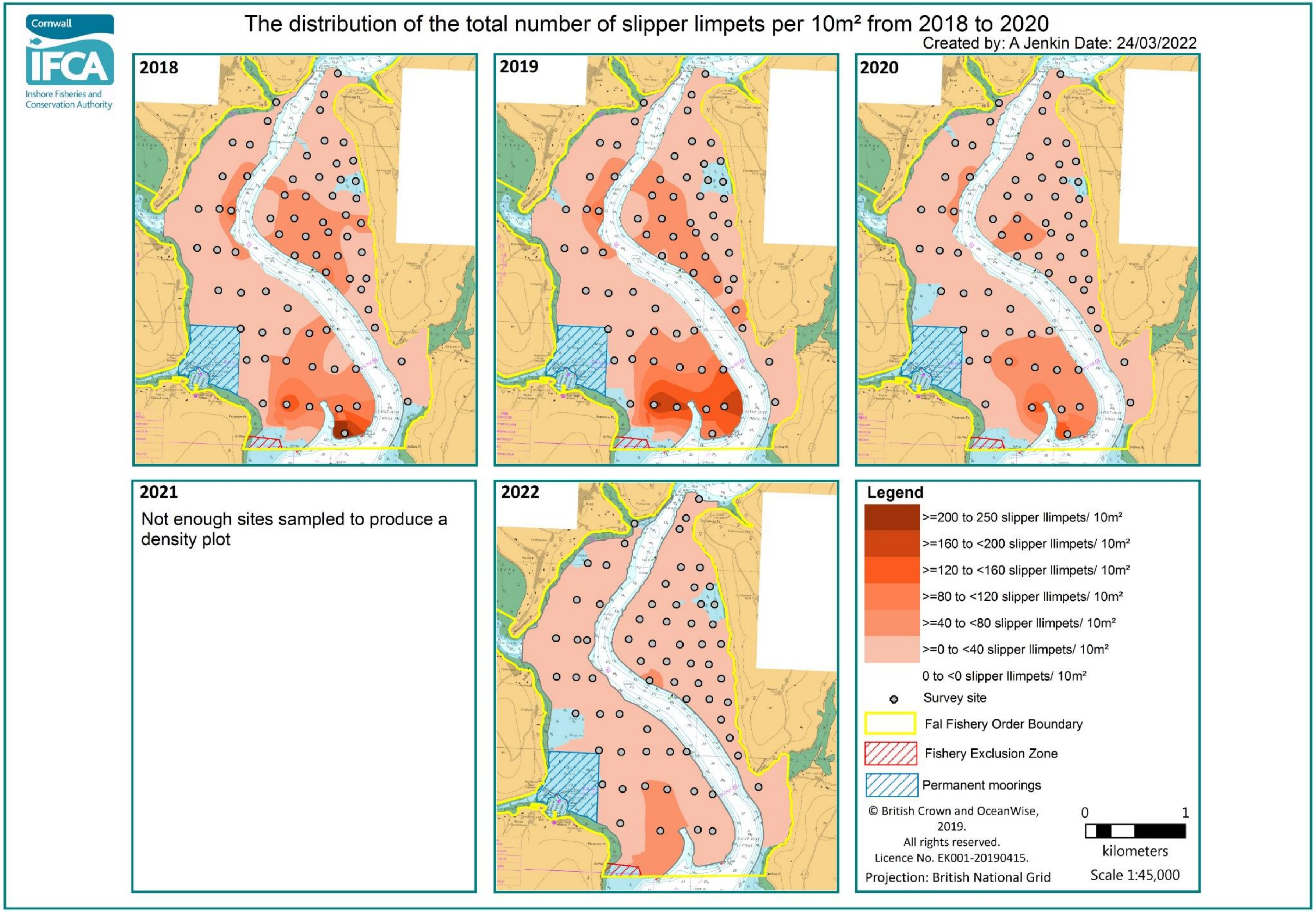


Figure 36: Density map displaying the total number of slipper limpets (*Crepidula fornicata*) per 10 m² recorded within Areas A and B from 2018 to 2022

3.4.2 Average number per dredge

The average number of slipper limpets per dredge by management area is shown in Figure 37. The average number of slipper limpets decreased from 2019 to 2022 in Areas A and B and increased in Area C from 2021 to 2022, although this is likely to be due to sites with a high number of slipper limpets typically not being sampled in 2019. If comparing to 2020 in Area C the average number has decreased.

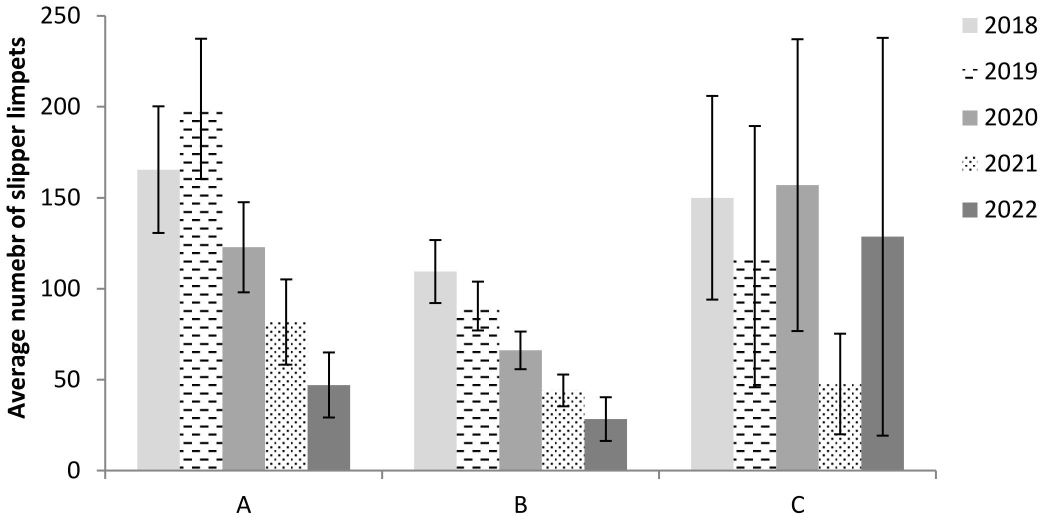


Figure 37: The average number ± standard error of slipper limpets (*Crepidula fornicata*) per dredge for the management areas, Area A, B and C of the survey for the years 2018 to 2022.

3.5 Bycatch

Bycatch species were present in all 81 dredge samples. Recording bycatch was a minor part of the survey due to time constraints. A list of previous recorded species was checked regularly with marks made against species observed in the samples and a list was collated at the end of each survey day, however, the number of species recorded is likely to be underestimated. A total of 81 species were identified, with the majority down to species level and the reminder identified to genus, or family level. This number is likely to be an underestimate as unidentified species were often grouped to family level, e.g. unidentified Polychaete species were recorded as Polychaete spp. The species identified are listed in full in Annex 6. Due to the light footprint of the dredge and short tow durations bycatch species were good condition and returned alive to the water straight away (unless they were identified as non-native species).

Arthropods and molluscs were the commonly observed families in the samples. As in previous years, commonly observed molluscs included; slipper limpets (*Crepidula fornicata*), topshells (*Gibbula* spp.), chitons (*Lepidochitona cinerea)*, and spiral shells (*Turitella / Bittium* sp.). An additional mollusc which hadn't been recorded in the fishery before was the Portuguese oyster (*Crassostrea angulate*). Regularly recorded crab species were similar to those observed in 2020; common shore crab (*Carcinus maenas*), navigator crab (*Liocarcinus navigator*), harbour crab (*Liocarcinus depurator*), long-legged spider crab (*Macrapodia* sp.), hermit crab (*Pagurus bernhardus)* and long-clawed porcelain crab (*Pisidia longicornis)*. Two species of red algae; coralline algae (*Lithophyllum* sp.) (which was likely under-recorded) and red string weed (*Soliera chordalis*) were also commonly seen. Sponges were noticeable throughout the survey, but often couldn't be identified to species level. The football jersey worm (*Tubulanus* spp.) a type of polychaete was recorded during the 2022 survey for the first time.

The bycatch species found demonstrates that the Fal Oyster Fishery supports a high number of other species and they were distributed across the fishery.

The species of red algae, *Solieria chordalis* was recorded in abundance at many sites. This species has been present in large quantities in previous years. It has been reported that the weed is most prolific after southerly swells when the weed is pushed up the estuary. Figure 38 shows sites with a great abundance of the red weed in 2022. The distribution of *S. chordalis* as a composition of the dredge sample can be seen in Figure 40. The area with a high abundance of red weed was the central part of East Bank where a basin exists but it was also recorded in scattered samples across the survey area.

Figure 38: A species of red weed (*Solieria chordalis)* in two recovered samples during the Fal oyster survey 2022.

3.6 Non-native species

Three non-native species were found during the survey; slipper limpets, *C. fornicata*, leathery sea-squirts, *Styela clava* and one Portuguese oyster (*Crassostrea angulate*) as shown in Figure 39. No pacific oysters (*Magallana gigas*) were recorded during the survey. The distribution and abundance of slipper limpets is explained in more detail in section 3.4. All non-native species recorded during the survey were kept onboard and removed from the fishery and were collected by a biological waste company from Mylor.

Figure 39: A Portuguese oyster (*Crassostrea angulate)* recorded during the survey in 2022.

3.7 Dredge composition

The percentage volume of each dredge and the distribution of mud, shell (live and dead), weed, gravel, vegetation (sticks and leaves), dead maerl and stone is shown for Areas A, B and C in Figure 40. Shell was prevalent across the central part of the survey area with large quantities of mud present in the northern part of Areas A and B, western part of A and in the river (Area C) above Turnaware Point. Large areas of red weed were recorded on the East bank. When comparing the images of the dredge contents from 2014 to present, the dredged volumes for samples were relatively consistent at each site for all years except for sites in the upper reaches of the river which had a greater volume of shell than previously recorded.

Maerl

- Live maerl

Live maerl (one fragment) was recorded at one site, B 109. This site will not be dropped from the survey as only one fragment of live maerl was recorded.

- Dead maerl

Fragments of dead maerl were recorded at six sites (A 19, A 20, A 23, A 45, B 76, B 106). Dead maerl was recorded as a percentage as part of the substrate composition with a maximum of 30% recorded at site B 106.

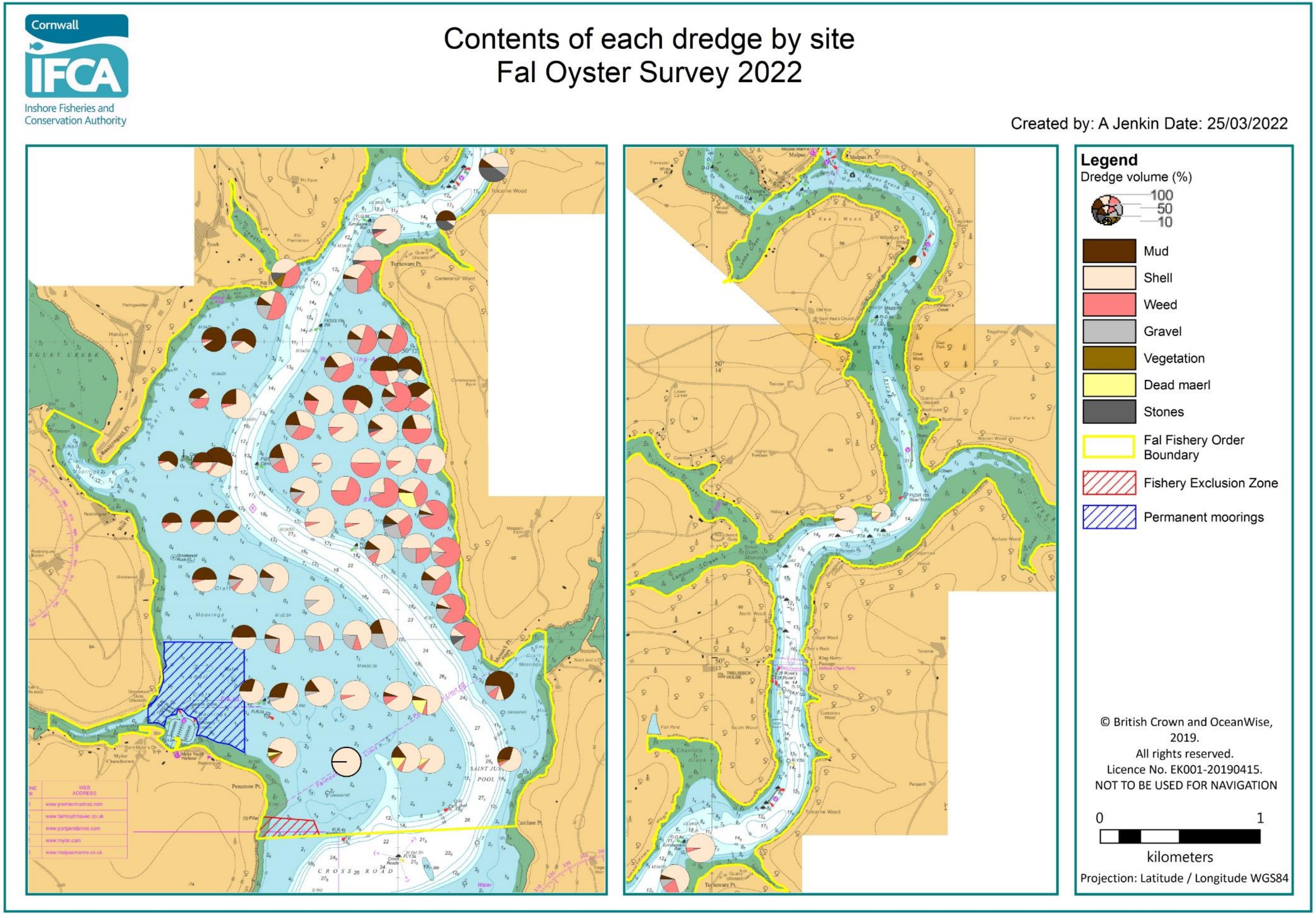


Figure 40: The dredge volume and the contents of each dredge per site recorded during the Fal oyster survey 2022.

3.8 Fishery as a whole

The density of oysters, scallops, slipper limpets and the contents of the dredge (%) recorded in 2022 are shown in Figure 41. The areas with a high density of oysters, scallops and slipper limpets corresponds with areas of samples with a high shell content.

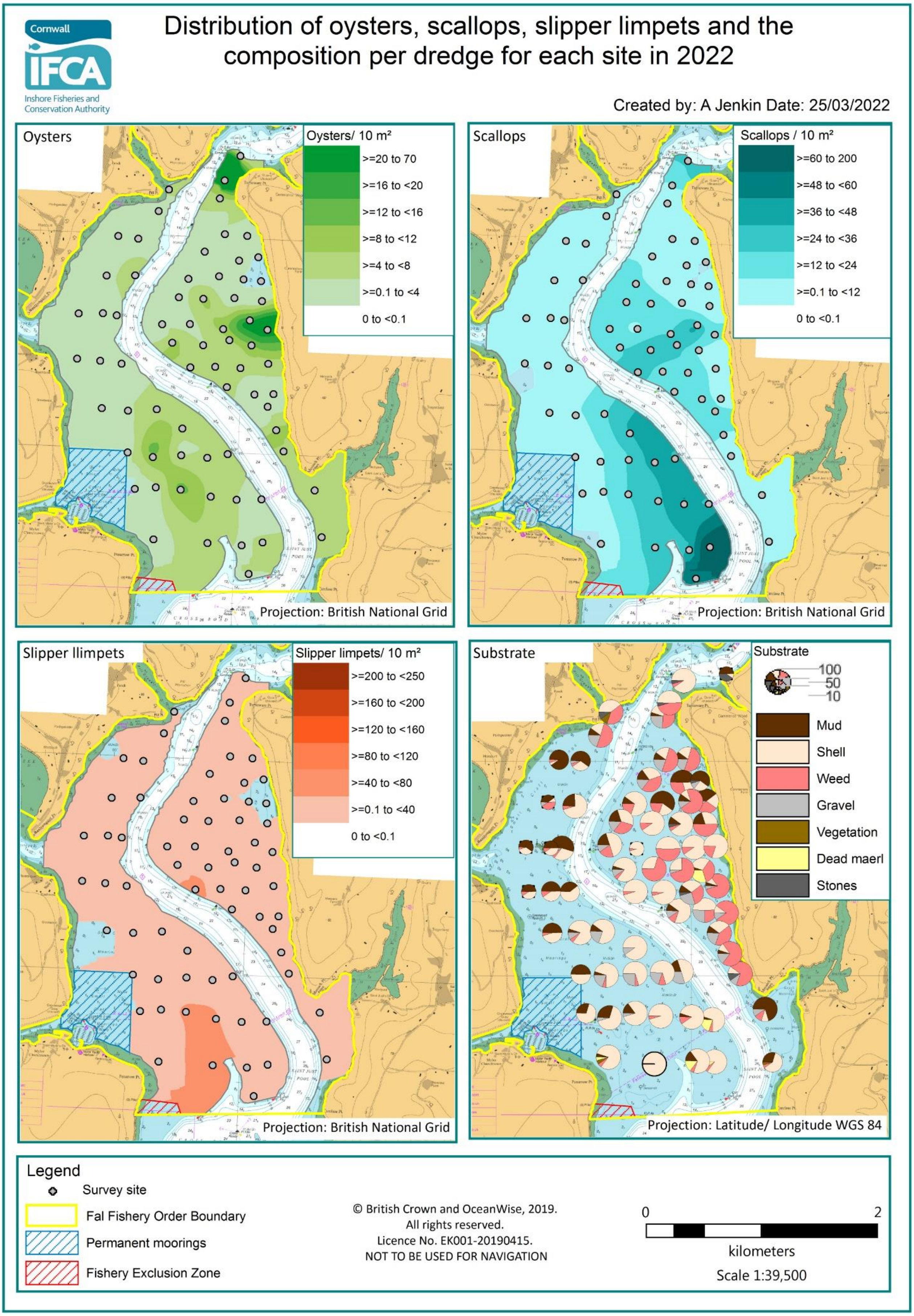


Figure 41: Density maps displaying the total number of native oysters (*Ostrea edulis)* per 10 m², the total number of scallops queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) per 10 m², the total number of slipper limpets (*Crepidula fornicate)* per 10 m² and the dredge volume and the contents of each dredge per site recorded within Areas A and B from 2022.

3.9 Anthropogenic impact

Anthropogenic impact was recorded at eleven sites with a mast rope, a clay pipe, seven pieces of glass, a trowel and two pieces of rope recovered by the dredge. These were all removed from the fishery.

4 Discussion

Cornwall IFCA has completed yearly surveys of the Fal Oyster Fishery since the 2013-14 season although this report makes comparisons from 2018 onwards. This data has enabled a temporal comparison to be made to assess the abundance and distribution of oysters and queen scallops, the distribution of slipper limpets, between 2018 and the present survey. As well as a brief assessment of the composition of the dredge contents and bycatch species.

The fishery has gone through a frustrating time in recent years due to Brexit, the Covid-19 pandemic and a decline in the market for oysters locally. One of the issues effecting the Fal Fishery arose from the UK leaving the European Union (EU) at the end of 2020. From the 1st January 2021 there were changes in the legal requirements for exporting live bivalve molluscs (LBM) outside of the UK into the EU. This was because any LBM from wild capture fisheries with a Class B or C shellfish production area were classed as exports of live animals and required an accompanying Live Animal Health Certificate. Although this certification was due to come into force from the 21st April 2021, the EU maintained a stance of not accepting into any member state, any LBM that required further processing to enter the human food chain. LBM which are suitable for direct human consumption, which are either purified (depurated) or from a Class A production area, are considered to be food products of animal origin and therefore were still able to be exported to the EU accompanied by an Export Health Certificate.

Oysters (*O. edulis*), queen scallops (*M. varia*) and mussels (*Mytilu*s spp.) in the Fal Fishery were from within a Class B production area (Cefas, 2021). Therefore, depurated oysters and mussels from the Fal Fishery could continue to be exported to the EU with an Export Health Certificate. However, oysters for relaying or purification could not be exported without a Live Animal Health Certificate restricting the export market of these products.

The Covid-19 pandemic caused the closure of restaurants which caused the local market to decline. The market in France picked up and an additional market in Spain was established. The production of oysters in Europe, mainly in France has been very successful over the last couple of years meaning the supply is good weakening the demand for oysters from the UK and their value is low. A 70 g minimum weight was also applied by the merchants, likely due to oysters being sent to restaurants and not relay markets. The poor marketing ability has led to an increased number of oysters being put on oyster ‘lays’.

Due to these issues some fishermen are focusing solely on scallops, which is now the main product exported from the fishery and have stopped fishing for oysters since the 2017-18 season when there were no restrictions on the number of scallops which could be removed from the fishery. The scallops were originally exported to France for processing. Cornwall Port Health Authority, with support from Cornwall IFCA, undertook fast track sampling process to obtain a Class B production area for queen scallops (*Mimachlamys varia*) from the Fal Fishery (Cefas, 2021). On 10th February the first export of purified queen scallops and oysters was made to the EU after expanded depuration capacity was established by merchants sourcing those products from the Fal Fishery (Trewhela (Cornwall Live), 2021).

The weight (kg) of native oysters and queen scallops removed from the fishery since the 2014-15 season is shown in Table 13. The decline in the weight of oysters and the increase in scallops removed from the fishery since 2016-17 and the decline during the 2020-21 season can be explained by the reasons mentioned above.

Table 13: Total weight (kg) of native oysters (*Ostrea edulis)* and queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) removed by dredging from the Fal Fishery between October to March each season from 2014-2015 to 2020 - 2021.

Season	Number of dredge hours	Native oysters removed (kg's)	Queen scallops removed (kg's)
2014-2015	15,728	87,298	1,047
2015-2016	14,068	66,023	140
2016-2017	15,170	56,792	4,040
2017-2018	17,234	44,605	69,220
2018-2019	16,545	30,896	74,472
2019-2020	11,897	16,491	71,408
2020-2021	10,845	11,550	85,721
Total removed 2014 to 2021		313,655	306,048

The temperature logger data (Annex 7) provides an indication of when spawning might occur within the fishery, which is reported to happen when the water temperature is 15°C. At East Bank North this occurred on the 31st May in 2020 and 2nd June in 2021. At Parsons bank this occurred around the same time on the 29th May in 2020 and 3rd June in 2021.

4.1 Oysters

Survey catch rates of oysters have remained comparable to recent years and in the recent survey a good proportion of one and two year old year classes were recorded. An increase in the number of oysters from the survey was recorded in 2022. A high proportion of smaller oysters has been recorded in the survey since the 2021 which is likely to be due to the heavy spatfall of oysters recorded at Turnaware and East bank. Hopefully the number of large oysters will have an impact on the stock during the 2022-23 and 2023-24 seasons as the high number of spawning adults, will have an associated effect on the larval production and is related to the biomass of the oyster stock (Korringa, 1940). A number of clean, dead oyster shells were recorded during the survey. Mortality of adult oysters in the fishable stock can be caused by natural mortality, fishing pressure, disease and change in habitat and environmental conditions (Loughs Agency, 2018).

Fluctuations in the abundance of shellfish are mostly caused by variations in recruitment (spat fall) (Sissenwine, 1984) which is caused by several factors including the size of the spawning stock (Shepherd, 1982; Beverton and Holt, 1957; Ricker, 1954) and environmental conditions (Le Pennec *et al*., 2003; Hofmann and Powell, 1998; Neill *et al*., 1994; Caputi, 1993). Past studies investigating recruitment in invertebrates have proposed that variation is often independent of the abundance of high spawners and is mainly influenced by variability in environmental conditions (Hancock, 1973; Drinkwater and Myers, 1987; Caputi, 1993). A number of previous studies have investigated abiotic factors including temperature (Dickie, 1955; Fogarty, 1988; Mackenzie and Köster, 2004), salinity (Nell and Holliday, 1988; Laing, 2002), suitability of habitat (Stokesbury and Himmelman, 1995), and biotic factors, including food availability (Jackson *et al.*, 1995), indirect fishing mortality (Shepard and Auster, 1991), predator abundance and competition (Thouzeau, 1991). All of these factors vary spatially and temporally, which can explain why recruitment is often inconsistent (Vause *et al.*, 2007).

Oyster settlement is highly sporadic, and native oyster spat can suffer up to 90% mortality (Cole, 1951). Factors which affect mortality include, but are not limited to; temperature, food availability, suitable settlement areas, and the presence of predators (Lancaster, 2014; Kennedy and Roberts, 1999; Cole, 1951; Spärck, 1951). The larvae respond to environmental signals which lead them to settling within the most suitable locations (Woolmer *et al.,* 2011; Walne, 1974).

Cefas last undertook disease surveillance sampling of 150 *O. edulis* individuals within the Fal Estuary in 2020. Of these seven individuals tested positive for *Bonamia ostreae* (five from Messack, one from Turnaware point and one from Ruan Creek). *B. ostreae* is a microscopic single-celled parasite from the phylum Haplosporidia. It has no impact on human health and does not affect the taste of oysters in anyway or pose a health risk to a consumer. However, it can result in significant mortalities in affected oyster stocks of up to 90% mortality when initially introduced (Culloty and Mulcahy, 2007). It is transmitted through proximity and there is currently no known treatment (Cefas, 2005). The samples taken in 2020 were negative for *Marteilia refringens* and *Bonamia exitiosa.*

4.2 Scallops

The number of scallops were comparable with the 2018 data. The number of scallops in the smaller size class ≤19 mm increased compared to 2020 and 2021 and there was decrease in scallops in the ≥20 to ≤39 mm size class when compared to all other years in this size class. There was an increase in scallops in the number of scallops ≥60 mm and the ≥40 ≤59 mm size class appeared similar to all other years except 2021.

Scallop stocks are known for being temporally and spatially variable, and the main causes of this can be put into three groups; recruitment variability, catastrophic mortality and the longevity of species; (Vause *et al.,* 2007) scallops are a short lived species with rapid early growth and they have no buffer zone if there is a period of poor recruitment (Vause *et al.,* 2007).

The scallops have been a target species of the fishery since the 2017/18 season and are no longer subject to bycatch restrictions so effort within the fishery is now mostly directed at queen scallops rather than oysters and a higher number of larger scallops are being removed from the fishery. Queen scallops are broadcast spawners, therefore a decrease in density is likely to rapidly reduce the fertilisation efficiency of the larger scallops (Stoner and Ray-Culp, 2000). A study carried out in the northern Irish Sea queen scallop fishery showed that the fishery there is heavily reliant on recruiting two year olds and less so on three year olds making the fishery potentially vulnerable to recruitment overfishing (Vause *et al.*, 2007).

A survey carried out in the Isle of Man found that there was a significant relationship between the density of one year olds caught on survey and the commercial catch rates the following year (Vause *et al.*, 2007). Monitoring of a fishery by assessing the juvenile scallop density therefore allows the prediction of recruitment and differences in the fishery at least one year in advance (Vause *et al.*, 2007).

The low number of small scallops and high percentage of large scallops is indicative of poor settlement which could have implications for the fishery in future years. Cornwall IFCA will continue to monitor the distribution of scallops.

4.3 Slipper limpets

The number of slipper limpets has decreased from 2018 to 2022. The increase from 2021 to 2022 is likely to be due to the small number of survey sites sampled in 2021 which were chosen to target oysters primarily and queens so sites which typically have a high number of slipper limpets were not sampled during the 2021 survey. The gradual decline is likely to be due to licence holders continually removing them from the fishery with 16,699 kg removed from 2014 to 2021 (Table 14) and Cornwall IFCA removing, as part of their surveys, a total of 38,076 individuals from the fishery since 2018.

Table 14: Total weight (kg) of slipper limpets (*Crepidula fornicata*) removed by dredging from the Fal Fishery between October to March each season.

Season	Slipper limpets (*Crepidula fornicata*) removed (kg's)
2014-2015	5,111
2015-2016	2,363
2016-2017	1,863
2017-2018	2,429
2018-2019	2,497
2019-2020	1,045
2020-2021	1,391
Total removed 2014 to 2021	16,699

The areas with a high density of slipper limpet have decreased and were only observed in one small area in the southern part of the fishery which differs to what Fitzgerald recorded in 2006 when areas of high densities were observed either side of the channel running between East Bank and North Bank as well as an area north of Turnaware Point. This section did have a high density of slipper limpets but they were not mapped due to the scarcity of the sites.

All live slipper limpets recorded during the survey in 2022 were removed from the fishery by Cornwall IFCA. The presence of slipper limpets is a threat to native oysters as they compete with oysters by reducing the amount of food available which can slow oyster growth, and overcrowding which traps suspended silt, faeces and pseudo faeces which can smother oysters (Invasive Species Ireland, 2019; Cornwall Good Seafood Guide, 2017; Naylor, 2011). It is for this reason that Cornwall IFCA will continue to remove all slipper limpets recorded during the survey in 2023.

However, dead slipper limpet shell provides a habitat for oyster larvae to settle out on, a number of native oysters were seen growing on dead slipper limpet shell during the survey (Figure 42) which is why dead slipper limpet shell is not removed.

Figure 42: Native oysters (*Ostrea edulis*) growing on dead slipper limpet shell.

4.4 Bycatch

In 2022 a comprehensive bycatch study was not carried out, however, observations of the samples during the survey demonstrated that the oyster beds are still supporting a diverse range of epifauna including protozoa, sponges, hydroids, flatworms, ribbon worms, nematodes polychaetes, crustaceans including crabs, sea spiders, and amphipods, gastropod molluscs, ascidians, bryozoans, starfish and sea urchins which has also been documented by Yonge (1960) and Korringa (1951). Two European sting winkles or oyster drills (*Ocenebra erinaceus*) were recorded during the 2022 survey which is of interest as they are known predators of the native oyster. Dead shells which are present on the oyster beds make up a substantial portion of the substratum. Oyster drills are present in the fishery although signs of holes in the shells were not observed by Cornwall IFCA officers during the survey. The clumps of dead shell can support a large number of sponges, polychaetes and seaweeds, as well as scavengers such as hermit crabs and common whelks (Perry and Tyler-Walters, 2016) – all of which were recorded during the survey. A number of predators also feed on the oyster beds including starfish, slipper limpets, dog whelks and some species of crab (Perry and Tyler-Walters, 2016). A survey carried out in the early 1900's found that lots of the cultch in the fishery was overgrown with marine organisms, including sponges and *Lithothamnion* (a genus of thalloid red algae) (Orton, 1927).

Live maerl was recorded at one site during the survey with one fragment in Area B. This site will be sampled in 2023.

All non-native species recorded during the survey were removed from the fishery, the most dominant non-native species recorded during the survey was the slipper limpet (*Crepidula fornicata*). No pacific oysters were recorded however one Portuguese oyster was recorded for the first time during the survey which was removed from the fishery.

4.5 Dredge composition

Native oysters have a planktonic dispersal stage, therefore suitable substratum is a key habitat feature which influences settlement and recruitment (Bromley *et al*., 2016; Caddy and Stamatopolous, 1990). The oyster larvae will only settle out and metamorphose where suitable hard substratum is available (Brown *et al*., 2010; Walne, 1974; Waugh, 1972). The fishery is composed of a mix of substrates including shell (live and dead), mud, gravel and stone. The abundance of oysters and scallops appeared to correlate with shell dominated sediments as they provide a hard substratum for plankton to settle on. A number of oysters during the 2022 survey growing on dead slipper limpet shell (Figure 42).

However, in areas with a high number of live slipper limpets there was often an accumulation of mud, as recorded during the survey. Mud can prevent spat from settling out as there is no surface to settle on.

The red macroalgae (*S. chordalis*) was abundant across the basin on East bank. The red macroalgae is normally present after windy conditions from the south which blows this weed straight up the Fal estuary.

5 Recommendations

5.1 Recommendations for 2023

- Deploy spat collectors within the fishery to enable an assessment of the settlement rate and recruitment within the fishery of both native oysters and queen scallops.
- Make a note of any fresh dead oyster shells as a measure of recent mortality. These shells will show no fouling on the inner surface of the shell.
- Make a note of any possible signs that other predators were the cause of death, e.g. a hole from a dog whelk.
- Measure salinity and water quality within the fishery as water quality is a key component of healthy shellfish beds (Allison, 2017).
- Carry out a drop-down video survey of the southern extent of the fishery to assess the presence of live maerl.

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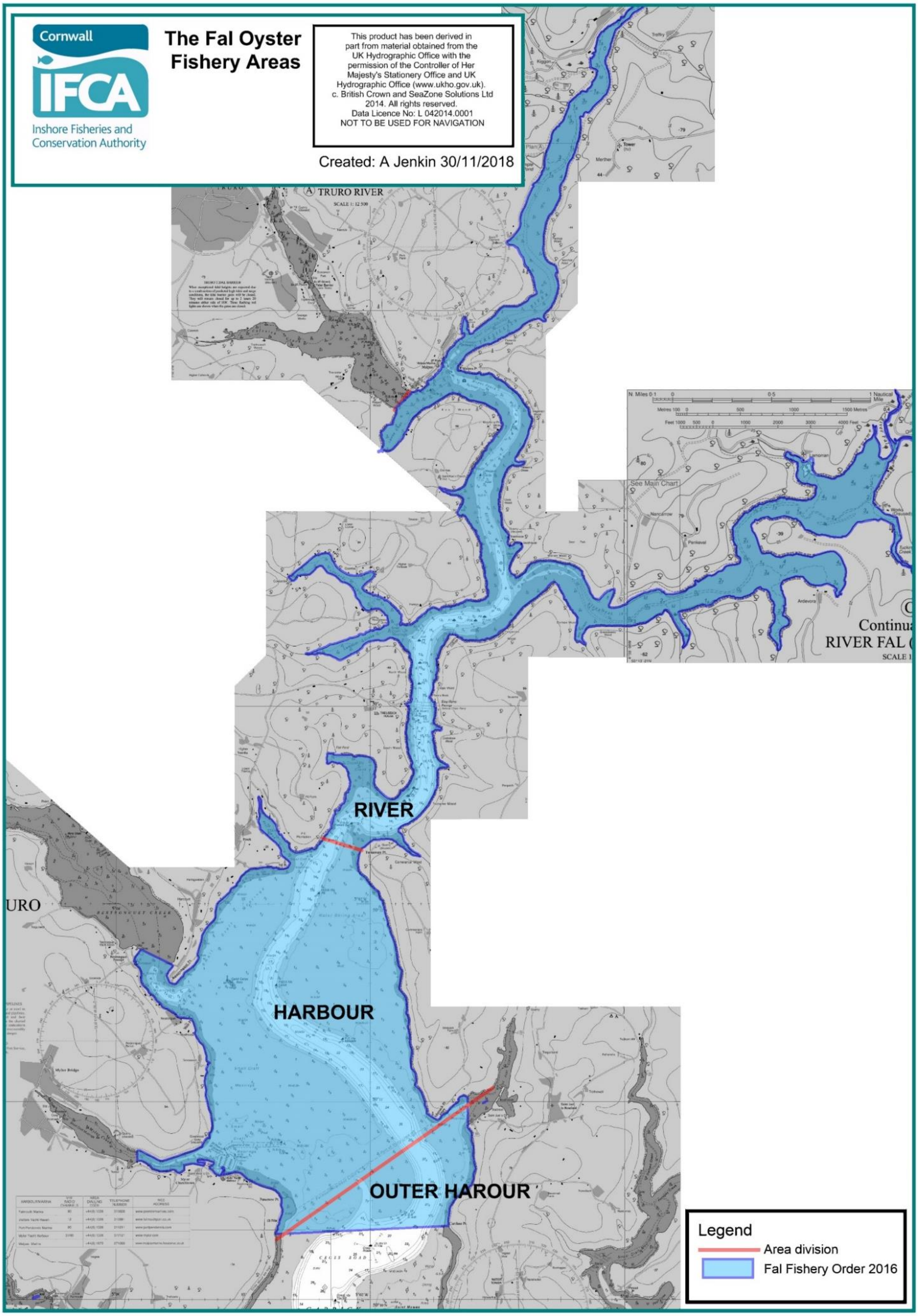
7 Appendices

Annex 1 – Fal Oyster Fishery Areas



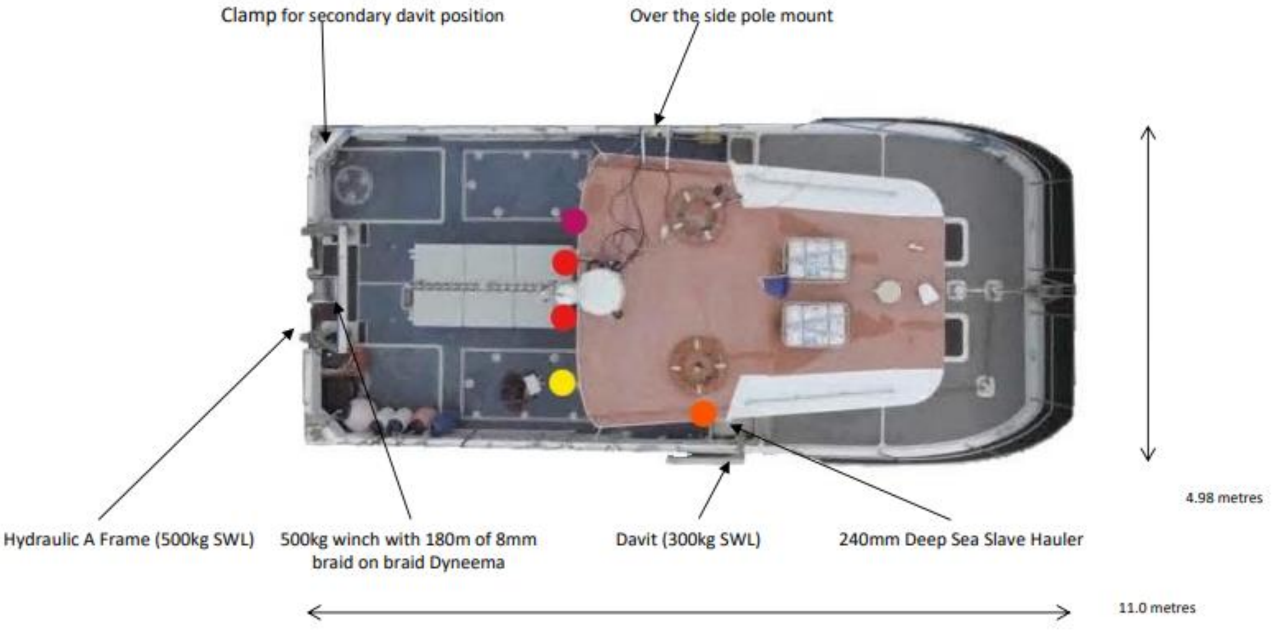
Annex Figure A: The Harbour, Outer Harbour and River areas previously used in the Fal oyster survey prior to 2020.

Annex 2 – R/V Tiger Lily VI Deck Plan, Positioning Software and Offsets

Annex Figure A: R/V Tiger Lily VI – Cornwall IFCA's research survey vessel.

Annex Table A: Specification of R/V Tiger Lily

Builder	South Boats Ltd
Model	Island MkII
Built	2007
LOA	11.0m
Beam	4.98m
Draught	1.1m (aft)
Tonnage	c.10 tonnes
Area of operation	MCA Category 2
Call sign	MRWR7
MMSI Number	235054954
MECAL Certification number	M07WB0111059
Complement	14 (including min 2 crew)
Propulsion	2 x 450hp Iveco NEF series
Speed	Cruising: 16 – 18 knots Top: 24 – 26 knots
Range	c. 400 nautical miles
240v AC supply	Victron 3Kw power inverter 5KvA Volvo-Perkins generator (All 240 AC power is accessed via APC Smart UPS C1500)
Stern Gantry	500kg SWL
Winch (on stern gantry)	Spencer Carter 0.5t with scrolling level wind
Slave hauler	Sea Winch 200m dia.
Electric line hauler	12v Spencer Carter Bandit
Positioning	Hemisphere V100 GNSS 3 x Furuno GP32
NMEA data outputs	4 x USB 4 x Serial 4 x banjo
Navigation	Olex with data export Knockle Hypack Max



Annex Figure B: Positioning software and offsets on the deck of R/V Tiger Lily

Annex Table B: Positioning software and offsets onboard R/V Tiger Lily

Equipment				Offset (m)		
NMEA Device	**Plan Symbol**	**Make/Model**	**Offset Name**	**X (Forw'd)**	**Y (Port)**	**Z (+/-)**
Navigation depth sounder	(yellow circle)	Furuno Navnet	Furuno transducer	7.0m	0.75m	- 0.5m
GPS	(red circle)	Furuno GP32 x 2	Furuno mushroom antenna	4.8m	2.1m & 2.35m	+ 3.5m
GPS	(orange circle)	Furuno GP32	Furuno mushroom antenna	3.5m	0.5m	+ 2.0m
GNSS	(magenta circle)	Hemisphere V500	Main GPS	4.8m	3.0m	+ 2.5m

Annex 3 – Site positions

Annex Table C: Positions of sites surveyed in 2022

Area	Site	Planned station position Latitude (decimal degrees)	Planned station position Longitude (decimal degrees)	Completed survey position SOL Latitude (decimal degrees)	Completed survey position SOL Longitude (decimal degrees)	Completed survey position EOL Latitude (decimal degrees)	Completed survey position EOL Longitude (decimal degrees)
Area A	A 19	50.176750	-5.030217	50.176639	-5.030546	50.176178	-5.030248
	A 20	50.176600	-5.032566	50.176711	-5.032612	50.176284	-5.032484
	A 21	50.176683	-5.036917	50.176461	-5.037819	50.176400	-5.037398
	A 23	50.176717	-5.043333	50.177005	-5.043422	50.176794	-5.042829
	A 45	50.180000	-5.030467	50.179923	-5.030776	50.179563	-5.030330
	A 46	50.179983	-5.033433	50.180132	-5.033328	50.179658	-5.033354
	A 47	50.180100	-5.036550	50.180198	-5.037072	50.179719	-5.036787
	A 48	50.180017	-5.040200	50.180417	-5.040185	50.179864	-5.039959
	A 49	50.179950	-5.043217	50.180072	-5.043299	50.179583	-5.042850
	A 50	50.180267	-5.046150	50.180415	-5.046122	50.180160	-5.045512
	A 52	50.183380	-5.034732	50.183651	-5.034595	50.183114	-5.034438
	A 53	50.183367	-5.036683	50.183563	-5.036888	50.183308	-5.036104
	A 54	50.183367	-5.040083	50.183494	-5.040187	50.183192	-5.039573
	A 55	50.183267	-5.043383	50.183369	-5.043688	50.183012	-5.043114
	A 56	50.183383	-5.046517	50.183442	-5.046791	50.183160	-5.046137
	A 58	50.185333	-5.040133	50.185515	-5.040205	50.185124	-5.039665
	A 59	50.186733	-5.043400	50.186774	-5.044136	50.186624	-5.043375
	A 60	50.186700	-5.046667	50.186691	-5.046847	50.186499	-5.046240
	A 61	50.186700	-5.050283	50.186660	-5.050248	50.186555	-5.049608
	A 66	50.190026	-5.047947	50.189865	-5.048093	50.189859	-5.047322
	A 67	50.189986	-5.050247	50.189893	-5.050379	50.189678	-5.049730
	A 68	50.190000	-5.052950	50.189862	-5.053095	50.189658	-5.052464
	A 69	50.193500	-5.052983	50.193306	-5.053413	50.193087	-5.052662
	A 70	50.193317	-5.050050	50.193240	-5.050408	50.193041	-5.049611
	A 71	50.193371	-5.048840	50.193253	-5.049077	50.192936	-5.048508
	A 81	50.196650	-5.046867	50.196505	-5.047487	50.196156	-5.046679
	A 82	50.196717	-5.050417	50.196811	-5.050730	50.196342	-5.050209
	A 83	50.200017	-5.049317	50.200114	-5.049410	50.199871	-5.048782
	A 84	50.200000	-5.046567	50.200024	-5.046817	50.199669	-5.046295
	A 89	50.201983	-5.044250	50.202016	-5.044380	50.201719	-5.043856
Area B	B 18	50.176550	-5.023183	50.176618	-5.023542	50.176106	-5.023365
	B 44	50.180717	-5.023850	50.180736	-5.024413	50.180694	-5.023791
	B 51	50.183489	-5.027584	50.183494	-5.027428	50.183802	-5.027798
	B 57	50.186700	-5.030167	50.186635	-5.029983	50.187050	-5.030245
	B 62	50.190017	-5.030133	50.190304	-5.030203	50.189956	-5.029592
	B 63	50.190050	-5.033467	50.189804	-5.033347	50.190264	-5.033928
	B 64	50.190017	-5.036750	50.189816	-5.036695	50.190232	-5.037146
	B 65	50.190140	-5.040059	50.189871	-5.040163	50.190268	-5.040419
	B 72	50.193383	-5.043250	50.193482	-5.043278	50.192994	-5.043139
	B 73	50.193350	-5.040033	50.193180	-5.039980	50.193494	-5.040482
	B 74	50.193333	-5.036617	50.193193	-5.036168	50.193130	-5.037021
	B 75	50.193383	-5.033367	50.193305	-5.033055	50.192937	-5.033602
	B 76	50.193400	-5.030433	50.193395	-5.030403	50.192991	-5.030621
	B 77	50.196800	-5.031366	50.196895	-5.031534	50.196389	-5.031276
	B 78	50.196733	-5.033733	50.196891	-5.033437	50.196407	-5.033592
	B 79	50.196650	-5.036917	50.196731	-5.036867	50.196325	-5.036742
	B 80	50.196617	-5.040233	50.196692	-5.040254	50.196275	-5.040235

	B 85	50.200033	-5.036467	50.200115	-5.036456	50.199680	-5.036366
	B 86	50.200000	-5.033467	50.200148	-5.033780	50.199760	-5.033426
	B 87	50.203367	-5.036717	50.203505	-5.036840	50.203029	-5.036894
	B 92	50.198500	-5.038417	50.198558	-5.038470	50.198087	-5.038296
	B 93	50.198333	-5.034333	50.198356	-5.034443	50.197912	-5.034378
	B 94	50.198467	-5.032083	50.198481	-5.032288	50.198088	-5.031960
	B 97	50.195283	-5.041667	50.195315	-5.041867	50.194936	-5.041729
	B 98	50.195067	-5.038317	50.195184	-5.038105	50.194673	-5.037998
	B 99	50.195167	-5.034767	50.195119	-5.034649	50.195492	-5.035007
	B 100	50.195150	-5.031700	50.195107	-5.031681	50.195011	-5.032453
	B 103	50.191833	-5.041683	50.191573	-5.041471	50.191978	-5.041859
	B 104	50.191833	-5.038333	50.191631	-5.037875	50.191968	-5.038626
	B 105	50.191683	-5.035033	50.191543	-5.034512	50.191809	-5.035230
	B 106	50.191717	-5.031900	50.191529	-5.032002	50.191846	-5.032513
	B 109	50.188350	-5.035000	50.188358	-5.034909	50.188699	-5.035309
	B 110	50.188333	-5.031700	50.188421	-5.031730	50.187995	-5.032017
	B 111	50.188317	-5.029139	50.188207	-5.029140	50.188660	-5.029157
	B 123	50.185083	-5.028883	50.185040	-5.028690	50.185400	-5.029116
Area C	C 24	50.204493	-5.036026	50.204523	-5.036001	50.204105	-5.036086
	C 26	50.206250	-5.034317	50.206257	-5.034302	50.206281	-5.035040
	C 27	50.206867	-5.028967	50.206769	-5.029116	50.206963	-5.028656
	C 28	50.209917	-5.024683	50.209751	-5.024948	50.210113	-5.024827
	C 29	50.212267	-5.024783	50.211922	-5.024746	50.212195	-5.024786
	C 30	50.214412	-5.025242	50.214428	-5.025474	50.214935	-5.025281
	C 31	50.223086	-5.023116	50.222995	-5.024078	50.223125	-5.023389
	C 32	50.224750	-5.022417	50.224525	-5.023752	50.224624	-5.022985
	C 33	50.224835	-5.019275	50.224961	-5.019795	50.225073	-5.019051
	C 34	50.227767	-5.015417	50.227514	-5.015383	50.228033	-5.015518
	C 36	50.235400	-5.018783	50.235274	-5.018920	50.235727	-5.018768
	C 40	50.238750	-5.015867	50.238663	-5.015862	50.239051	-5.015369
	C 41	50.241867	-5.013767	50.241695	-5.013700	50.242100	-5.014054
	C 42	50.242783	-5.014633	50.242680	-5.014509	50.243012	-5.015069
	C 43	50.243650	-5.016750	50.243528	-5.016392	50.243784	-5.017022
	C 88	50.203750	-5.043000	50.203824	-5.043134	50.203523	-5.042477

Annex 4 – Daily logs

Daily log 1

Annex Table D: Daily log for 23rd January 2022

Project information			
Project	Fal Oyster Survey 2022		
Survey code	2022_CIFCA_SAC_FAL_FOS		
Location	Fal Estuary		
Date	23rd January 2022		
Vessel	Tiger Lily VI		
Staff			
Survey role	**Company**	**Name**	
Principal Scientific Officer	Cornwall IFCA	Colin Trundle	
Scientific Officer	Cornwall IFCA	Annie Jenkin	
Scientific Officer	Cornwall IFCA	Stephanie Sturgeon	
Skipper	Independent	David Raymond	
Visitor		Cherilyn Mackrory MP	
Weather and tides			
High water time:	08:19		
High water (m)	4.85m		
Wind direction	SE		
Wind speed	10-12mph		
Beaufort scale	4		
Cloud coverage	8/8		
Time weather recorded	08.39		
Safety			
Toolbox talk time	07:30		
Induction	-		

Summary of operations			
Time start (UTC)	**Time end (UTC)**	**Type**	**Activity**
08:00			Onboard setting up
08:13			Depart Mylor
08:45			Arrive St.Mawes to collect visitor
09:15			Depart St.Mawes
09:38:30	09:39:54	Dredge	B18
09:56:11	09:57:35	Dredge	A19a – dredge upside down Repeat site
10:03:02	10:04:15	Dredge	A19b
10:46:59	10:48:23	Dredge	A20
11:20			Drop visitor at St.Mawes
11:39:15	11:40:18	Dredge	A21
12:10:59	12:12:49	Dredge	A23
12:29:55	12:31:28	Dredge	A45
12:50			Lunch break
13:38:41	13:40:24	Dredge	A46
14:12:08	14:13:38	Dredge	A47
14:46:05	14:49:31	Dredge	A48
15:18:44	15:20:22	Dredge	A49
15:40:47	15:42:25	Dredge	A50
16:05:40	16:07:03	Dredge	A56
16:15:30	16:16:52	Dredge	A55
16:50:01	16:54:30	Dredge	A54
17:14:45	17:16:24	Dredge	A53
17:44:50	17:46:46	Dredge	A52
18:25			Arrive Mylor
Overall progress			
Action	**Sites total**	**Sites completed**	**Remaining sites**
Dredge	81	16	65

2022_CIFCA_SAC_FAL_FOS

Daily log 2

Annex Table E: Daily log for 24th January 2020.

Project information			
Project	Fal Oyster Survey 2022		
Survey code	2022_CIFCA_SAC_FAL_FOS		
Location	Fal Estuary		
Date	24th January 2020		
Vessel	Tiger Lily VI		
Staff			
Survey role	**Company**	**Name**	
Principal Scientific Officer	Cornwall IFCA	Colin Trundle	
Scientific Officer	Cornwall IFCA	Annie Jenkin	
Scientific Officer	Cornwall IFCA	Stephanie Sturgeon	
Skipper	Independent	David Raymond	
Weather and tides			
High water time:	08:57		
High water (m)	4.73m		
Wind direction	E		
Wind speed	14-16mph		
Beaufort scale	4		
Cloud coverage	8/8		
Time weather recorded	08:10		
Safety			
Toolbox talk time	-		
Induction	-		

Summary of operations			
Time start (UTC)	**Time end (UTC)**	**Type**	**Activity**
08:20			Depart Mylor
08:33:26	08:34:49	Dredge	A58
09:10:41	09:12:06	Dredge	A59
09:38:24	09:39:34	Dredge	A60
09:58		Dredge	Lost anchor
10:15		Dredge	Retrieved anchor
10:36:01	10:37:12	Dredge	A61
10:48:00	10:49:18	Dredge	A66
11:02:38	11:04:06	Dredge	A67
11:15:36	11:16:49	Dredge	A68
11:30:30	11:31:43	Dredge	A71
11:51:28	11:52:43	Dredge	A70
12:09:58	12:11:14	Dredge	A69
12:23:06	12:24:34		A82
12:36:49	12:39:24		A81
13:15			Lunch break
13:53:50	13:55:02	Dredge	A84
14:09:51	14:10:56	Dredge	A83
14:21:19	14:22:25	Dredge	A89
14:41:57	14:43:16	Dredge	C88
15:06:37	15:08:05	Dredge	C24
16:12:20	16:13:28	Dredge	B87
16:36:32	16:37:29	Dredge	B85
16:54:19	16:55:26	Dredge	B86
17:17:01	17:18:03	Dredge	B94
18:25			Arrive Mylor
Overall progress			
Action	**Sites total**	**Sites completed**	**Remaining sites**
Dredge	81	21	44

Daily log 3

Annex Table F: Daily log for 26th January 2022.

Project information			
Project	Fal Oyster Survey 2022		
Survey code	2022_CIFCA_SAC_FAL_FOS		
Location	Fal Estuary		
Date	26th January 2022		
Vessel	Tiger Lily VI		
Staff			
Survey role	**Company**	**Name**	
Principal Scientific Officer	Cornwall IFCA	Colin Trundle	
Scientific Officer	Cornwall IFCA	Annie Jenkin	
Scientific Officer	Cornwall IFCA	Stephanie Sturgeon	
Skipper	Independent	David Raymond	
Weather and tides			
High water time:	10:50		
High water (m)	4.4m		
Wind direction	SW		
Wind speed	3-7mph		
Beaufort scale	2		
Cloud coverage	7/8		
Time weather recorded	08:16		
Safety			
Toolbox talk time	-		
Induction	-		
Summary of operations			
Time start (UTC)	**Time end (UTC)**	**Type**	**Activity**
08:50			Depart Mylor
09:10:04	09:11:30	Dredge	C26
09:42:41	09:44:55	Dredge	C27
09:52:49	09:55:09	Dredge	C28
10:11:00	10:12:57	Dredge	C29
10:38:44	10:41:32	Dredge	C30
11:17:48	11:18:39	Dredge	C32a – dredge empty
11:22:24	11:23:35	Dredge	C32b
11:36:37	11:37:38	Dredge	C33
12:19:51	12:20:51	Dredge	C43
12:37:55	12:38:59	Dredge	C42
12:49:04	12:50:10	Dredge	C41a - dredge flipped
12:53:14	12:54:13	Dredge	C41b
13:02:38	13:03:47	Dredge	C40
			Lunch
14:04:23	14:05:27	Dredge	C36
14:23:04	14:24:01	Dredge	C34
14:45:48	14:46:48	Dredge	C31
15:19:16	15:20:22	Dredge	B92
15:31:15	15:32:14	Dredge	B93
15:43:20	15:44:41	Dredge	B77
15:57:45	15:58:32	Dredge	B78
16:10:01	16:11:05	Dredge	B78
16:19:30	16:20:23	Dredge	B79
16:41:36	16:42:45	Dredge	B80
17:01:09	17:02:01	Dredge	B97
17:21:24	17:22:59	Dredge	B72
17:45			Arrive Mylor
Overall progress			
Action	**Sites total**	**Sites completed**	**Remaining sites**

2022_CIFCA_SAC_FAL_FOS			
Dredge	81	22	22

Daily log 4

Annex Table G: Daily log for 27th January 2022.

Project information			
Project	Fal Oyster Survey 2022		
Survey code	2022_CIFCA_SAC_FAL_FOS		
Location	Fal Estuary		
Date	27th January 2022		
Vessel	Tiger Lily VI		
Staff			
Survey role	**Company**	**Name**	
Principal Scientific Officer	Cornwall IFCA	Colin Trundle	
Scientific Officer	Cornwall IFCA	Annie Jenkin	
Scientific Officer	Cornwall IFCA	Stephanie Sturgeon	
Skipper	Independent	Chris Lowe	
Visitor		Claire Szostek	
Weather and tides			
High water time:	12:05		
High water (m)	4.27m		
Wind direction	W		
Wind speed	13-24mph		
Beaufort scale	3		
Cloud coverage	8/8		
Time weather recorded	07:56		
Safety			
Toolbox talk time	-		
Induction	08:00		
Summary of operations			
Time start (UTC)	**Time end (UTC)**	**Type**	**Activity**
08:00			Depart Mylor
08:41:56	08:43:09	Dredge	B98
09:07			Dredge damaged by propeller, switched to spare
09:30			Transit to Helford for divers to remove net off propeller
11:57:58	11:59:10	Dredge	B100
12:07:55	12:09:10	Dredge	B76
12:40:01	12:41:17	Dredge	B75
13:12:32	13:13:34	Dredge	B99
13:45			Lunch
14:22:50	14:23:54	Dredge	B73
14:37:03	14:38:34	Dredge	B74
15:02:39	15:03:49	Dredge	B106
15:23:47	15:25:01	Dredge	B105
15:44:47	15:46:20	Dredge	B104
16:07:13	16:08:18	Dredge	B103
16:31:10	16:32:35	Dredge	B65
16:53:41	16:54:52	Dredge	B64
17:17:38	17:17:38	Dredge	B63
17:45			Arrive Mylor
Overall progress			
Action	**Sites total**	**Sites completed**	**Remaining sites**
Dredge	81	14	8

Daily log 5

Annex Table H: Daily log for 11th February 2022.

Project information				
Project	Fal Oyster Survey 2022			
Survey code	2022_CIFCA_SAC_FAL_FOS			
Location	Fal Estuary			
Date	11th February 2022			
Vessel	Tiger Lily VI			
Staff				
Survey role	**Company**	**Name**		
Principal Scientific Officer	Cornwall IFCA	Colin Trundle		
Scientific Officer	Cornwall IFCA	Annie Jenkin		
Scientific Officer	Cornwall IFCA	Stephanie Sturgeon		
Skipper	Independent	Chris Lowe		
Visitor		Victoria Hobson Two University of Exeter students		
Weather and tides				
High water time:	13:01			
High water (m)	3.78m			
Wind direction	S			
Wind speed	4-12mph			
Beaufort scale	2			
Cloud coverage	2/8			
Time weather recorded	08.10			
Safety				
Toolbox talk time	-			
Induction	08:30			

Summary of operations			
Time start (UTC)	**Time end (UTC)**	**Type**	**Activity**
08:30			Depart Mylor
08:52:44	08:53:48	Dredge	B44
09:16:00	09:16:56	Dredge	B51
09:33:17	09:34:29	Dredge	B123
09:58:26	09:59:31	Dredge	B57
10:23:24	10:24:26	Dredge	B111
10:38:44	10:39:43	Dredge	B110
11:11:05	11:12:20	Dredge	B109
11:32:31	11:33:42	Dredge	B62
12:00			Arrive Mylor

Overall progress			
Action	**Sites total**	**Sites completed**	**Remaining sites**
Dredge	81	8	0

Annex 5 – Survey data

Annex Table I: Native oysters (*Ostrea edulis)*, queen scallop (*Aequipecten opercularis*) and variegated scallop (*Mimachlamys varia*) and slipper limpet (*Crepidula fornicata*) counts for the Fal oyster survey 2022.

Area	Site Code	No. of Oysters				Total Oyster Count	No. of Scallops				Total Scallop Count	Total Slipper Limpet Count
		≥67 mm	≥51-≤66 mm	≥36-≤50 mm	≤35mm		≥60 mm	≥59-≤40 mm	≥20-≤39 mm	≤19 mm		
Area A	A 19	4	5	1	5	15	59	156	12	26	253	122
	A 20	2	5	5	1	13	56	52	5	15	128	121
	A 21	8	13	6	1	28	43	35	2	14	94	229
	A 23	0	0	1	0	1	0	0	0	0	0	1
	A 45	2	1	2	2	7	37	71	3	9	120	97
	A 46	4	5	5	1	15	67	97	3	8	175	65
	A 47	9	9	8	2	28	59	47	3	3	112	167
	A 48	14	19	14	4	51	34	47	5	2	88	173
	A 49	0	0	1	0	1	3	2	0	29	34	27
	A 50	0	0	0	0	0	0	0	0	0	0	0
	A 52	4	9	2	0	15	51	67	2	0	120	39
	A 53	5	3	6	2	16	59	96	5	3	163	46
	A 54	2	3	1	1	7	30	50	7	4	91	18
	A 55	17	26	5	4	52	9	18	9	1	37	1
	A 56	1	0	0	0	1	1	1	0	0	2	1
	A 58	12	2	9	4	27	49	84	3	3	139	59
	A 59	7	10	3	0	20	26	28	6	9	69	21
	A 60	4	5	3	1	13	12	19	3	2	36	1
	A 61	2	1	0	0	3	1	1	0	0	2	0
	A 66	2	0	0	0	2	1	2	1	0	4	16
	A 67	2	0	0	0	2	1	0	0	0	1	5
	A 68	3	0	0	0	3	0	0	0	0	0	3
	A 69	5	2	2	0	9	2	1	0	0	3	6
	A 70	2	2	0	0	4	1	2	1	12	16	16
	A 71	2	3	7	1	13	3	10	5	2	20	112
	A 81	8	13	2	1	24	17	15	2	1	35	92
	A 82	1	1	1	0	3	5	3	0	0	8	1

	A 83	0	0	0	1	1	1	0	0	0	1	0
	A 84	7	1	1	0	9	2	2	1	1	6	13
	A 89	1	4	0	0	5	5	2	3	10	20	7
Area A Sub-total	**30**	130	142	85	31	388	634	908	81	154	1777	1459
Area B	B 18	0	0	0	0	0	0	0	0	0	0	1
	B 44	6	11	5	3	25	5	7	4	0	16	23
	B 51	3	7	4	4	18	4	3	1	0	8	1
	B 57	2	4	0	4	10	49	20	2	1	72	40
	B 62	7	9	3	1	20	10	9	1	6	26	11
	B 63	6	7	3	1	17	57	23	5	2	87	28
	B 64	3	14	8	0	25	24	36	2	3	65	54
	B 65	4	4	5	1	14	56	49	4	1	110	264
	B 72	2	0	3	0	5	26	36	1	0	63	19
	B 73	0	4	1	1	6	10	18	1	0	29	39
	B 74	13	11	7	2	33	44	31	3	0	78	51
	B 75	23	41	15	2	81	88	51	3	0	142	21
	B 76	30	56	18	3	107	15	20	8	11	54	9
	B 77	0	0	0	0	0	1	0	0	0	1	0
	B 78	0	0	0	0	0	0	0	0	0	0	0
	B 79	2	1	0	0	3	3	2	0	0	5	0
	B 80	2	1	3	1	7	29	36	2	0	67	18
	B 85	4	3	2	0	9	6	5	2	0	13	2
	B 86	2	2	6	0	10	1	4	0	1	6	3
	B 87	1	21	7	2	31	3	10	7	5	25	9
	B 92	0	0	0	1	1	2	2	0	0	4	3
	B 93	2	0	0	1	3	1	1	0	0	2	1
	B 94	0	0	0	0	0	0	0	0	0	0	0
	B 97	0	2	0	0	2	36	40	5	2	83	37
	B 98	3	17	12	2	34	31	48	3	1	83	59
	B 99	0	1	0	0	1	19	12	1	1	33	4
	B 100	1	0	0	0	1	1	1	0	0	2	0

	B 103	7	17	10	0	34	33	49	4	0	86	63
	B 104	3	4	5	1	13	68	60	2	1	131	61
	B 105	3	8	7	2	20	54	31	4	0	89	41
	B 106	10	22	6	1	39	12	14	3	1	30	8
	B 109	4	5	3	5	17	33	21	2	0	56	70
	B 110	6	0	1	1	8	41	17	3	3	64	14
	B 111	4	3	1	0	8	6	4	0	0	10	2
	B 123	9	13	9	4	35	24	8	2	2	36	35
Area B Sub-total	**35**	162	288	144	43	637	792	668	75	41	1576	991
Area C	C 24	46	122	66	14	248	19	25	4	2	50	10
	C 26	5	3	4	6	18	11	45	12	35	103	104
	C 27	0	0	0	0	0	0	0	0	0	0	1
	C 28	1	2	5	0	8	1	6	1	0	8	29
	C 29	7	18	15	0	40	8	30	6	1	45	581
	C 30	24	15	9	3	51	25	43	5	6	79	92
	C 31	2	4	3	1	10	0	2	1	0	3	109
	C 32	2	4	1	0	7	0	0	1	1	2	13
	C 33	14	37	34	5	90	1	18	8	2	29	877
	C 34	8	21	10	2	41	0	7	7	2	16	94
	C 36	7	4	0	1	12	0	0	0	1	1	16
	C 40	15	32	17	1	65	0	4	2	0	6	115
	C 41	1	0	0	0	1	0	0	0	0	0	0
	C 42	7	4	0	0	11	0	0	0	0	0	4
	C 43	10	5	0	0	15	0	0	1	1	2	12
	C 88	9	6	2	1	18	0	7	2	2	11	0
Area C Sub-total	**16**	158	277	166	34	635	65	186	50	53	355	2057
Total	**81**	**450**	**707**	**395**	**108**	**1660**	**1491**	**1763**	**206**	**248**	**3708**	**4507**

Annex 6 – Bycatch

Annex Table J: List of bycatch species recorded during the Fal oyster survey 2022 and in previous years. Species recorded in previous years which were unidentified have not been included

Species Name	Common Name / Descriptions	Species recorded in 2022	Species recorded in previous years	Non-native species
ALGAE - CHLOROPHYTA				
Ulva sp.	Sea lettuce	Y	Y	
ALGAE – OCHROPHYTA				
Ascophyllum nodosum	Knotted wrack	Y	Y	
Fucus serratus	Serrated wrack	Y	Y	
Fucus vesiculosus	Bladder wrack	Y	Y	
Laminaria hyperborea and *Laminaria ochroleuca*	Kelp	Y	Y	
Laminaria saccharina	Sugar kelp		Y	
ALGAE – RHODOPHYTA				
Chondrus crispus	Irish Moss		Y	
Lithothamnion corallioides	Maerl	Y	Y	
Lithophyllum sp.	Encrusting coralline algae	Y	Y	
Phymatolithon calcareum	Maerl	Y	Y	
Solieria chordalis	Red string weed	Y	Y	
RHODOPHYTA spp.	Red seaweed	Y	Y	
ANNELIDA				
Amphitritides spp.	Strawberry Terebellid worm	Y	Y	
Chaetopterus variopedatus	Parchment tube worm	Y	Y	
Lanice conchilega	Sand mason worm	Y	Y	
Nereis spp.	Ragworms		Y	
POLYCHAETA spp.	Polychaetes/ Bristle worms	Y	Y	
POLYNOIDAE spp.	Scale worms	Y	Y	
Pomatoceros triqueter	Keel worm	Y	Y	
Prostheceraeus vittatus	Candy striped flatworm		Y	
Sabella pavonica	Peacock worm tubes	Y	Y	
Serpula vermicularis	Fan worm / red tube worm	Y	Y	
Spirorbis spirorbis	Spiral worm	Y	Y	
Tubulanus spp.	Football Jersey worm	Y		
ARTHROPODA				
Austrominius modestus	Darwins barnacle		Y	
Balanus crenatus	Leaning barnacle		Y	

Species Name	Common Name / Descriptions	Species recorded in 2022	Species recorded in previous years	Non-native species
Cancer pagurus	Edible crab	Y	Y	
Carcinus maenas	Common shore crab	Y	Y	
Cirripedia spp.	Unidentified barnacles	Y		
Crangon crangon	Brown shrimp	Y	Y	
Galathea squamifera	Squat lobster	Y	Y	
Inachus spp.	Spider crabs	Y	Y	
Liocarcinus navigator	Navigator crab / Arch		Y	
Liocarcinus depurator	Harbour crab	Y	Y	
Liocarcinus holsatus	Flying crab		Y	
Necora puber	Velvet swimming crab	Y	Y	
Portumnus latipes	Pennant swimming crab		Y	
Macropodia spp.	Long legged spider crabs	Y	Y	
MALACOSTRACA spp.		Y	Y	
Pagurus bernhardus	Hermit crab	Y	Y	
Pagurus prideaux	Hermit crab (with anemone)	Y	Y	
Palaemon serratus	Common prawn	Y	Y	
Pilumnus hirtellus	Bristly crab	Y	Y	
Pisidia longicornis	Long clawed porcelain crab	Y	Y	
Porcella platycheles	Broad Clawed porcelain crab	Y	Y	
Portumnus latipes	Pennant swimming crab	Y		
Sacculina carcini	Crab hacker barnacle	Y	Y	
Semibalanus balanoides	Acorn Barnacle	Y	Y	
Xantho pilipes	Risso’s crab	Y	Y	
Xantho hydrophilus	Montagu’s crab	Y	Y	
BRYOZOA				
BRYOZOA spp.		Y	Y	
Flustrellidra hispida	Fleshy bryozoan		Y	
CHORDATA				
Callionymus lyra	Common dragonet	Y	Y	
Gaidropsarus vulgaris	Three bearded rockling		Y	
GOBIIDAE spp.	Goby	Y	Y	
Hippocampus hippocampus	Short snouted seahorse		Y	
Lepadogaster lepadogaster	Shore clingfish		Y	
Lotidae sp.	Rockling	Y		

Species Name	Common Name / Descriptions	Species recorded in 2022	Species recorded in previous years	Non-native species
Nerophis lumbriciformis	Worm pipefish	Y	Y	
Pholis gunnellus	Butterfish		Y	
Scyliorhinus canicula	Mermaid purse – dog fish		Y	
Solea solea	Sole	Y	Y	
Syngnathus acus	Greater pipefish	Y	Y	
Taurulus bubalis	Long-spined sea scorpion	Y	Y	
CNIDARIA				
ACTINARIA spp.			Y	
ACTINARIA sp.	Compass anemone	Y	Y	
Actinia equina	Beadlet anemone		Y	
Adamsia carciniopados	Cloak anemone	Y	Y	
Anemonia viridis	Snakelocks anemone		Y	
Calliactis parasitica	Parasitic anemone	Y	Y	
Urticina felina	Dahlia anemone	Y		
ECHINODERMS				
Asterina gibbosa	Cushion star		Y	
Marthasterias glacialis	Spiny starfish	Y	Y	
Psammechinus miliaris	Green sea urchin	Y	Y	
Ophiura spp.	Brittle star	Y	Y	
HYDROIDA				
Hydractinia echinata	Hermit crab fir (hydroid which grows on hermit crab shells)		Y	
HYDROIDA spp.	Hydroids	Y	Y	
Nemertesia/Hydractinia antennia)	Often found with sponges on shells	Y	Y	
MOLLUSCA				
Anomia ephippium	Saddle oyster	Y	Y	
Acanthorcardia aculeata	Spiny cockle		Y	
Acanthocardia tuberculata	Rough cockle	Y	Y	
Aporrhais pespelecani	Pelican foot shell		Y	
Buccinum undatum	Common whelk (or whelk eggs)		Y	
Calliostoma zizyphinum	Painted top shell	Y		
Calyptraea chinensis	Chinaman's hat shell	Y	Y	
Chamelia gallina	Striped venus		Y	
Chlamys varia	Variegated scallop		Y	

Species Name	Common Name / Descriptions	Species recorded in 2022	Species recorded in previous years	Non-native species
Cerastoderma edule	Common cockle	Y	Y	
Crassostrea angulata	Portuguese oyster	Y		Y
Crepidula fornicata	Slipper limpet	Y	Y	Y
Gibbula cineraria	Grey top shell		Y	
Gibbula magus	Turban topshell	Y	Y	
Hiatella arctica (probable)	Wrinkled rock borer		Y	
Lepidochitona cinerea	Chiton	Y	Y	
Littorina obtusata	Flat periwinkle		Y	
Mytilus edulis	Mussels	Y	Y	
Nucella lapillus	Dog whelk (or dog whelk eggs)		Y	
Ocenebra erinaceus	European sting winkle		Y	
Pecten maximus	Great scallop	Y	Y	
Tectura virginea	White tortoiseshell limpet		Y	
Tritia reticulate	Netted dog whelk	Y	Y	
Turitella / Bittium sp. (Possibly retuculatum)	Spiral shell	Y	Y	
Urosalpinx cinerea	Oyster drill	Y	Y	
MOLLUSCA – sea slugs/ sea hares				
Acanthodoris pilosa	White fluffy nudibranch		Y	
Aeolidia papillosa	Sheep sea slug		Y	
Akera bullata	Sea slug with shell	Y	Y	
Aplysia punctate	Sea hare		Y	
Archidoris pseudoargus	Sea lemon	Y	Y	
Berthella plumula	Yellow sea slug		Y	
Goniodoris nodosa	Small white nudibranchs		Y	
Lamellaria perspicua (probable)	Sea snail		Y	
Onchidoris bilamellata	Rough mantled doris nudibranch		Y	
Pleurobranchus membranaceus	Sea slug	Y	Y	
Rostranga rubra	Red sea slug	Y	Y	
PORIFERA				
Amphilectus fucorum	Shredded carrot sponge	Y	Y	
Cliona celata	Yellow boring sponge	Y	Y	
Dysidea fragilis	Goosebump sponge		Y	
Grantia compressa	Purse sponge		Y	
Haliclona sp.			Y	

Species Name	Common Name / Descriptions	Species recorded in 2022	Species recorded in previous years	Non-native species
Hymenaciodon perlevis			Y	
PORIFERA spp.			Y	
Sycon cilliatum	Purse sponge		Y	
*Suberites carnosus (*probable)			Y	
Suberites ficus	Orange sponge on queens	Y	Y	
Suberites spp.			Y	
*Ulosa stuposa (*probable)			Y	
TUNICATA				
Ascdiella aspersa	European sea squirt	Y	Y	
Ascidia mentula	Red sea squirt		Y	
Botrylloides leachi	Orange colonial ascidian		Y	
Ciona intestinalis	Sea vase sea squirt		Y	
Styela clava	Leathery sea squirt	Y	Y	Y

Annex 7 – Temperature

Tinytag Aquatic 2 temperature data loggers were used to record the temperature within the Fal Oyster Fishery at two locations, Parsons Bank and East Bank North. The loggers were attached to representative monitoring points (RMP) within the shellfish production area.

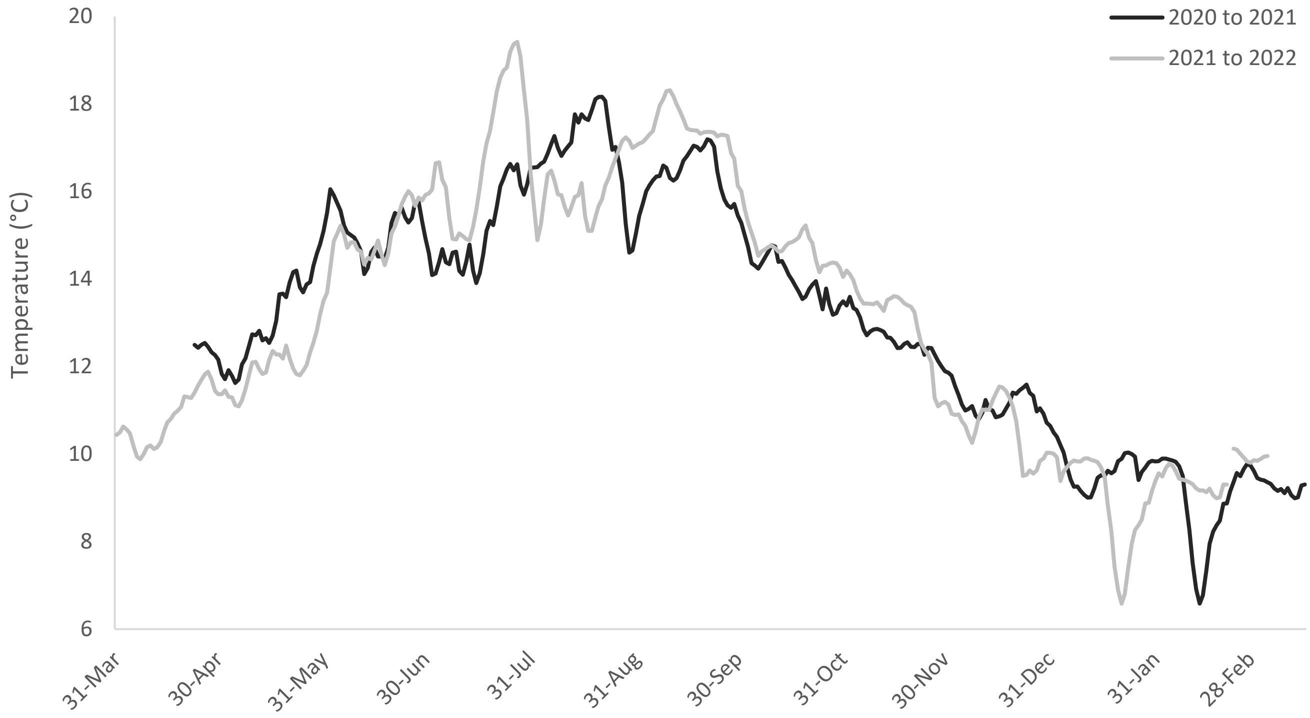
Parsons Bank

The results of the temperature data logger at Parsons Bank for time periods between 2020 and 2022 are shown in Annex Figure C.

Annex Figure C: Temperature data (°C) recorded using a TinyTag temperature data logger at Parsons Bank from 31st March to 16th March for 2020 to 2021 and 2021 to 2022.

East Bank North

The results of the temperature data logger at East Bank North for time periods between 2020 and 2022 are shown in Annex Figure D.



Annex Figure D: Temperature data (°C) recorded using a TinyTag temperature data logger at East Bank North from 31st March to 16th March for 2020 to 2021 and 2021 to 2022.