Identification of black bream (*Spondyliosoma cantharus*) nesting grounds in Jersey waters.

Marine Resources, Jersey, 2024

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Contents

1. Background

The black bream (*Spondyliosoma cantharus)* is a deep-bodied fish in the Sparidae family (Figure 1). Black bream are an omnivorous species, feeding primarily on seaweeds and small invertebrates (The Wildlife Trust, 2022), but they are also opportunistic and will scavenge food when it is available. They are commonly found in north-eastern Atlantic shelf waters, from Norway to the Mediterranean and the west coast of Africa (Doggett & Baldock 2022). Black bream are particularly abundant within the English Channel (south coast). During the winter they are found in the deeper waters of the English Channel and migrate inshore to breed (between April and June) around the south and west coasts of the UK and Channel Islands.

Figure 1. Black bream in Jersey on shallow (5-10m) sandy substrate.

Black bream are demersal spawners and eggs are laid in nests that are made by the males. Nests are typically made by excavation of sediment to expose the more stable stones or bedrock beneath. In some cases, the male may remove algal turf from already exposed bed rock on which the females can lay their eggs, as has been observed by divers on the south coast of England (Doggett & Baldock 2022). The male will then protect the nest until the eggs have hatched (all hatch by July) (Collins and Mallinson, 2012).

2. Bream fishing in Jersey

Black bream is a valuable species and particularly vulnerable to exploitation by both sport and commercial fishers during its nesting season. Black bream are targeted in Jersey waters by both Jersey and French fishing vessels. Landings by Jersey boats have varied over the years, but typically landings have stayed below 2,500 kg and in recent years have regularly been under 1,000 kg a year (Figure 2). In the years where bream landings have exceeded 8,000 kg (2009 and 2012) this was due to one boat targeting them with trawls whereas typically they are caught through netting or angling in Jersey. French vessels also have access to the majority of Jersey waters due to a fishing agreement. French vessels typically trawl for bream and bream caught by

French vessels in Jersey waters were reported to vary between 100,000 and 200,000 kg a year between 2015 and 2018[1].

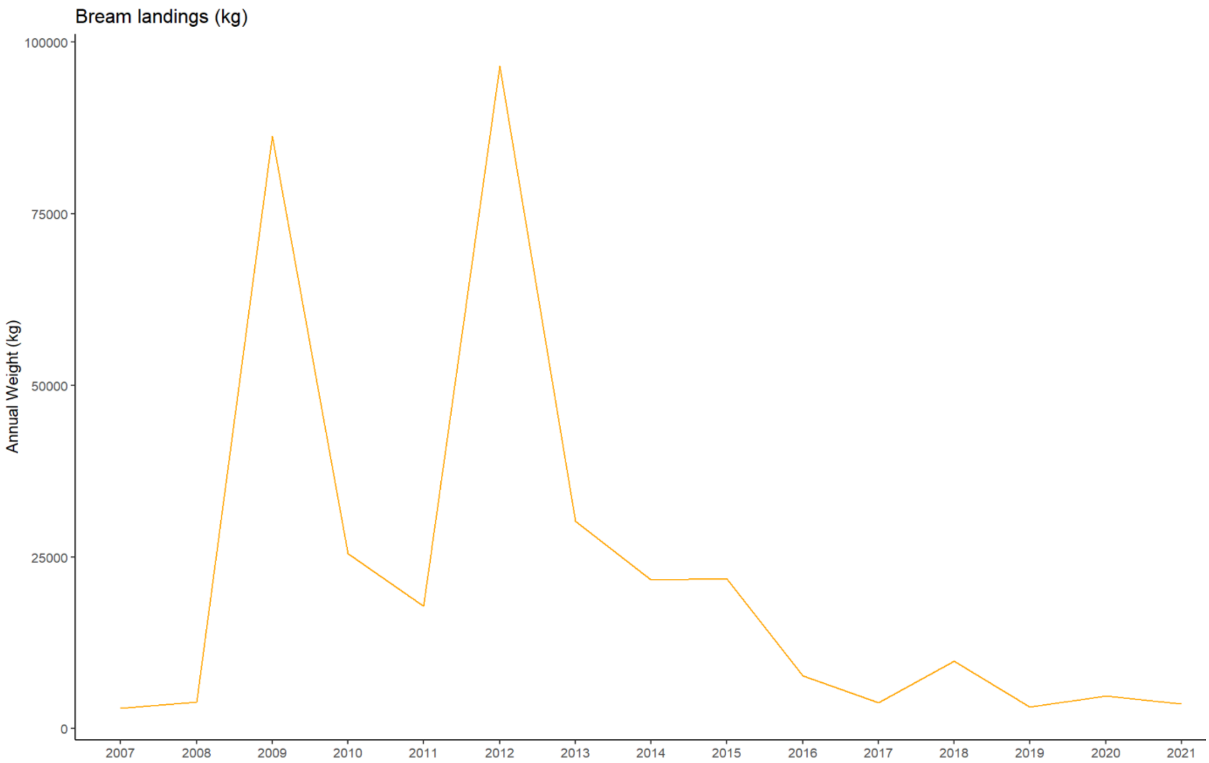

Figure 2. Annual landings (kg) of black bream into St. Helier by Jersey vessels between 2007 and 2021.

Concerns were raised over the amount of fishing taking place in areas known to support high densities of spawning adults (as identified by the high proportion of females caught that were in roe (carrying unfertilised eggs)) during the breeding season. Black bream is currently not a protected species under UK and EU quota or Total Allowable Catch (TAC) mechanisms but is suitable for protection under spatial planning measures used to restrict specified fishing metiers. As a precautionary approach, several Bream Management Areas identified as having a high proportion of spawning adults (Figure 3) were closed to trawling during their breeding season in 2021 and 2022. This was to allow for research to be carried out to understand whether black bream were nesting in these sites.

[1] Ifremer, personal communication

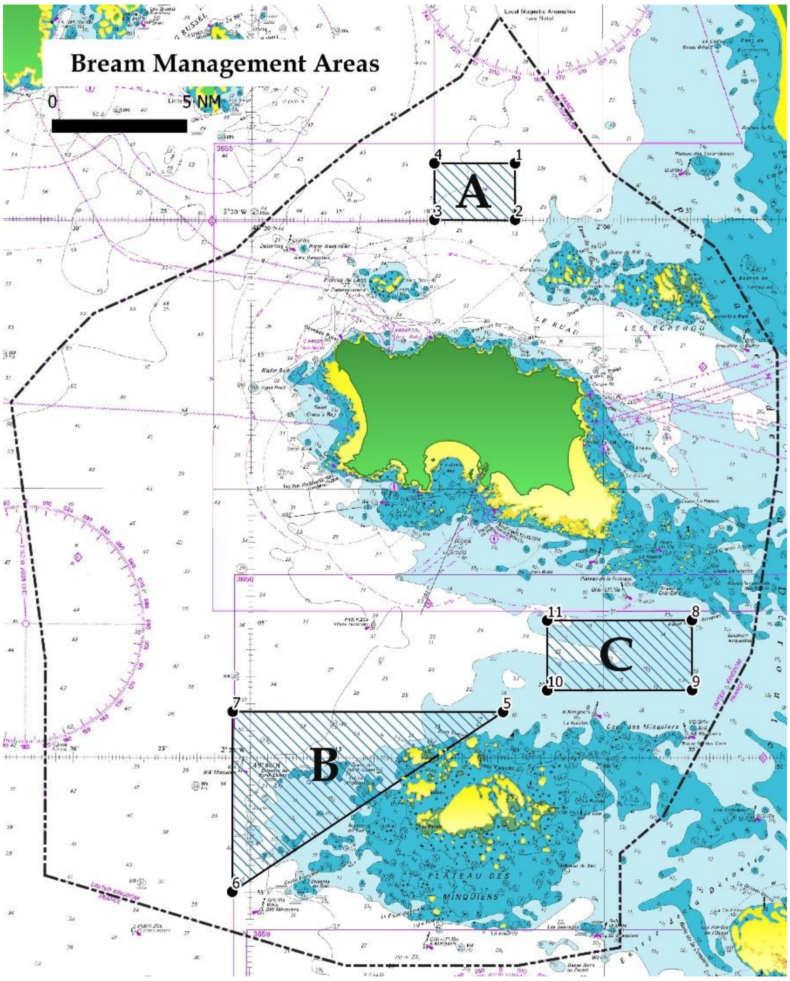

Figure 3. Bream Management Zones that were closed to trawling between 1st May and 13th June in 2021 and 14th March and 31st July in 2022.

1. Study objectives

Following the closure of the Bream Management Areas there were several aims and objectives:

- Identify the location of bream nests
- Describe the substrates (habitats) associated with the nests
- Predict the extent of suitable nesting grounds within the closed areas based on substrate data and features associated with the bream nests
- Estimate the density of nests

2. Methods

A combination of methods were used to identify the location of nests and subsequently map their extent. These are detailed below.

2.1. Identifying potential nesting areas

Areas of potential bream nesting activity were identified using a combination of VMS data from French trawling vessels and historical fishing information and sightings data of Jersey fishing activity (due to VMS not being available for <12metre vessels). A heat map of fishing activity was created in QGIS using the VMS data to show the number of hours fished in 1 km^2 areas between 2015 and 2018. Fishing hours of less than two were removed in order to show the hot spots of fishing activity.

2.2. Locating the nests using side scan sonar

Side scan sonar (towfish) was trialled in all three areas, but on processing it was found to have delivered a low-quality image that did not give conclusive signatures of bream nests. The poor image quality was a factor of the gear deployment using a vessel that was not suitable. The Jersey Fisheries Patrol Vessel (FPV) Norman Le Brocq was overpowered for the required scanning speed of the unit meaning that the engines could not be constantly run but had to be driven in cycles. This, combined with the high tidal regime, resulted in 'snatching' on the cable that in turn impacted image quality. A second issue identified, despite poor image quality, is that the seabed in the likely nesting areas is physically harder than in other recognised bream breading areas of the English Channel. Nests range from 0.6 to 1.3 metres wide and consist of an area of compact ground or rock cleared of loose overlying sediment by individual black bream. It is thought that in areas lacking this soft sediment the fish nest directly on hard substrate and without this soft sediment to move there is not a ground signature to detect via side scan sonar. As a result of these issues, it was decided that different methods would need to be employed to identify bream nesting areas.

2.3. Mapping the substrates

NAVAQ software (provided by Beamworx) was used on the FPV Norman Le Brocq for multibeam data acquisition. Multibeam sonar is a type of active sonar system used to map the seafloor and detect objects in the water column or along the seafloor. The physical sensors of the sonar, called a transducer, send and receive pulses that map the seafloor or detect other objects (https://oceanexplorer.noaa.gov/technology/sonar/multibeam.html). The WASSP multibeam is mounted directly to the hull of the FPV Norman Le Brocq. Multibeam sonar sends multiple, simultaneous sonar beams in a fan shaped pattern. This covers the space directly underneath the ship and at an angle of 120 degrees to port and starboard. The seafloor depth is calculated by the amount of time it takes for the sound to leave the array, hit the seafloor and return to the array (transducer). The speed of sound is taken using a Valeport Swift sound velocity profiler. This is to ensure the speed of sound in the survey area is known to be able to translate the two-way time travel from the ship to the seafloor and back as a depth measurement. Backscatter (intensity of the sound echo) can also be recorded to understand seafloor hardness in the survey area. The WASSP multibeam echosounder was used to map the topography of the bream protection areas to identify substrates and features on the seafloor that could be suitable for bream nesting activities. Post processing of this data was then conducted in data cleaning software (AutoClean).

2.4. Locating the nests using visual surveys

Towed video surveys, using a towed video array adapted from Sheehan et al. (2010)[2], were carried out to visually assess areas identified using the WASSP multibeam. Towed video is a cost-effective way of surveying large areas of seabed that is also non-destructive to the seabed. The towed video array consisted of a real-time underwater video system (SpotX™ Underwater Vision), housing a GoPro Hero4, connected to a console on the survey vessel via a cable to allow for live viewing of the seabed. This system was integrated into a bespoke frame to improve the stability of the video system and also enabled the addition of two underwater lights (bigblue 1200 Lumen dive torch) for illumination of the seabed in low light conditions. Two lasers (Z-Bolt® Green Dive Laser 5MW) of a known distance (0.2 m) apart were used to allow for scaling of images during video analysis (Figure 4 a and b). The array was maintained approximately 10 cm above the

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[2] Sheehan, E. V, Stevens, T. F., *et al.* (2013) 'Recovery of a Temperate Reef Assemblage in a Marine Protected Area following the Exclusion of Towed Demersal Fishing', *Plos One*, 8(12). doi: 10.1371/journal.pone.0083883.

seabed and towing speed was kept below 0.25 knots to ensure image quality. The time was recorded when the towed video unit was on the seabed (as viewed by the real time video feed on the vessel). This time could then be used to work out the 'time to nest'.

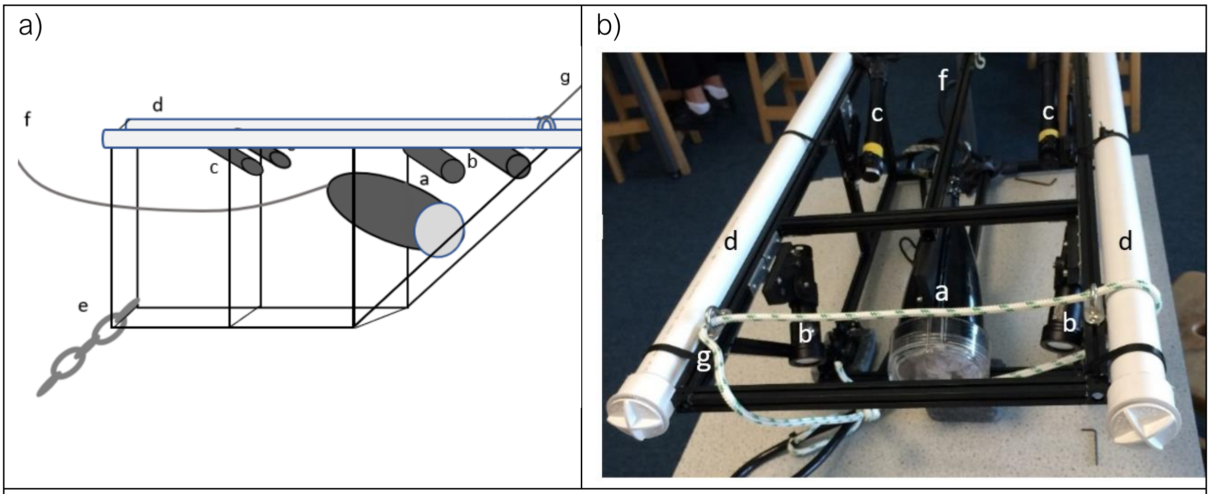

Figure 4. Underwater towed video array a) Side view diagram and b) front view image showing the underwater video system (a), lights (b), lasers (c), buoyancy tubes (d), chain weight (e), cable (f), and tether (g).

3. Data analysis

VMS data and historical fishing data were used to determine which areas were likely spawning grounds for black bream. Towfish side scan sonar was assessed by Cornwall IFCA and found that it was not possible to identify nests on the imagery. WASSP multibeam imagery was visually assessed by members of Marine Resources and used to identify features, such as ridges that may provide protection from the prevailing currents, or habitats that may have suitable substrate for building nests. Towed videos were watched post field to record the time of each bream nest occurrence. Additionally, associated information such as the substrate and nearby features/species were recorded. A feature (bed rock protrusion or boulder) was recorded as being present if it occurred within the same frame as the bream nest. The time of bream nest occurrence ('time to nest') was related back to the real time in the field and matched to the time on the survey vessels track to geolocate the position of the nests. The location of bream nests were overlaid onto a previously modelled habitat map[3].

4. Results

4.1. Identification of potential nesting areas

Three areas were identified as having a high level of bream trawling activity based on VMS data between 2015 and 2018 (Figure 5). The hours of trawling effort per 1 km^2 area was typically below 60 hours with the majority observed to be approximately 20 hours. The greatest level of fishing effort was observed to the north of Jersey, with 205 hours of fishing effort within a 1 km^2 area (dark red box on Figure 5).

[3] Paul Chambers, government of Jersey, Marine Resources, pers. Comm.

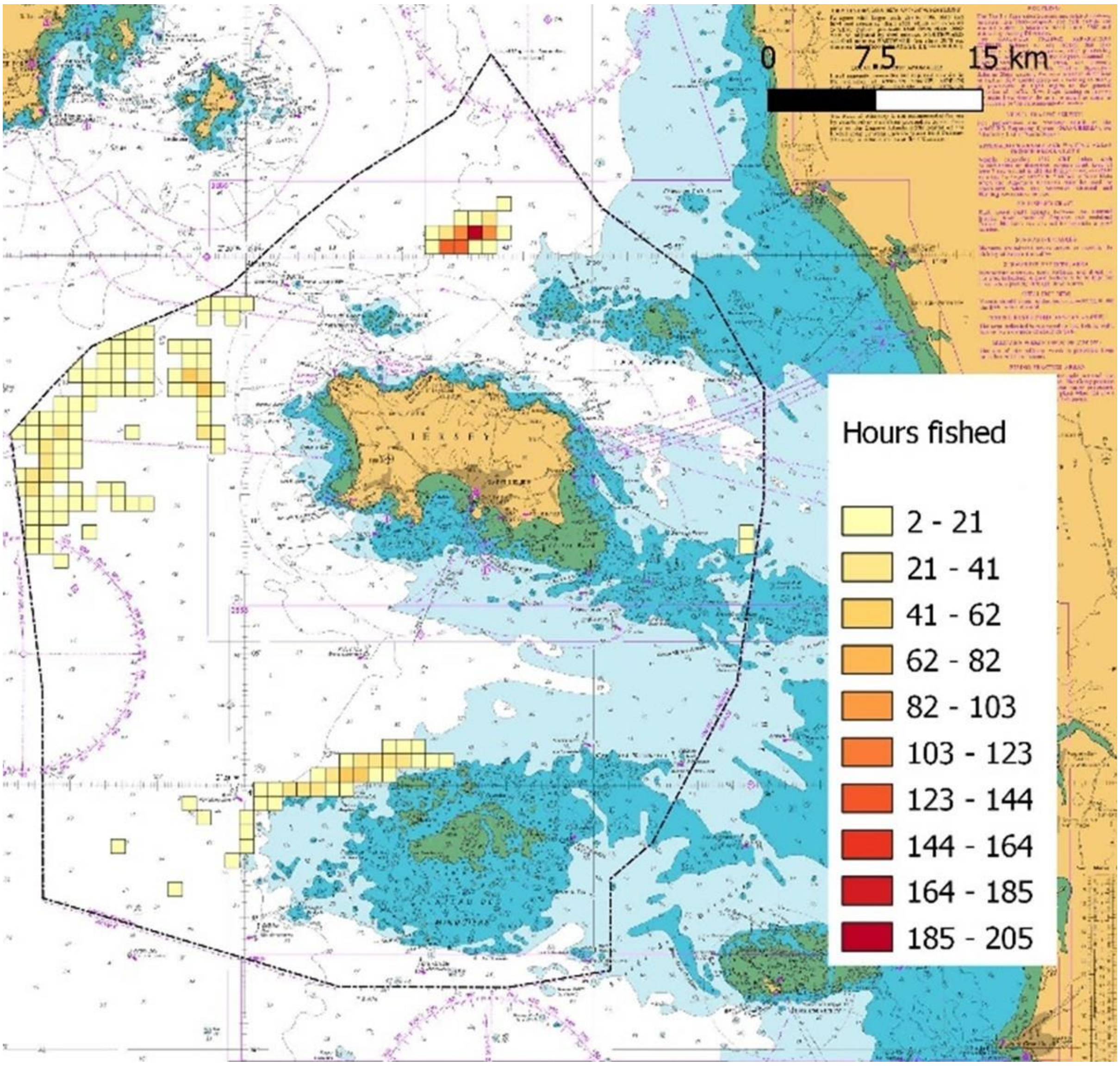

Figure 5. Hours of bream trawling effort within 1km² areas between 2015 and 2018. Effort shown ranged between 2 hours (light yellow) and 205 hours (dark red). The black line shows the extent of Jersey's territorial waters.

Two of the areas identified through VMS were closed to mobile fishing during the spawning season (north of Jersey and south southwest of Jersey (Figure 6). A third area was closed to the southeast of Jersey based on historic fishing and sightings information (Figure 6).

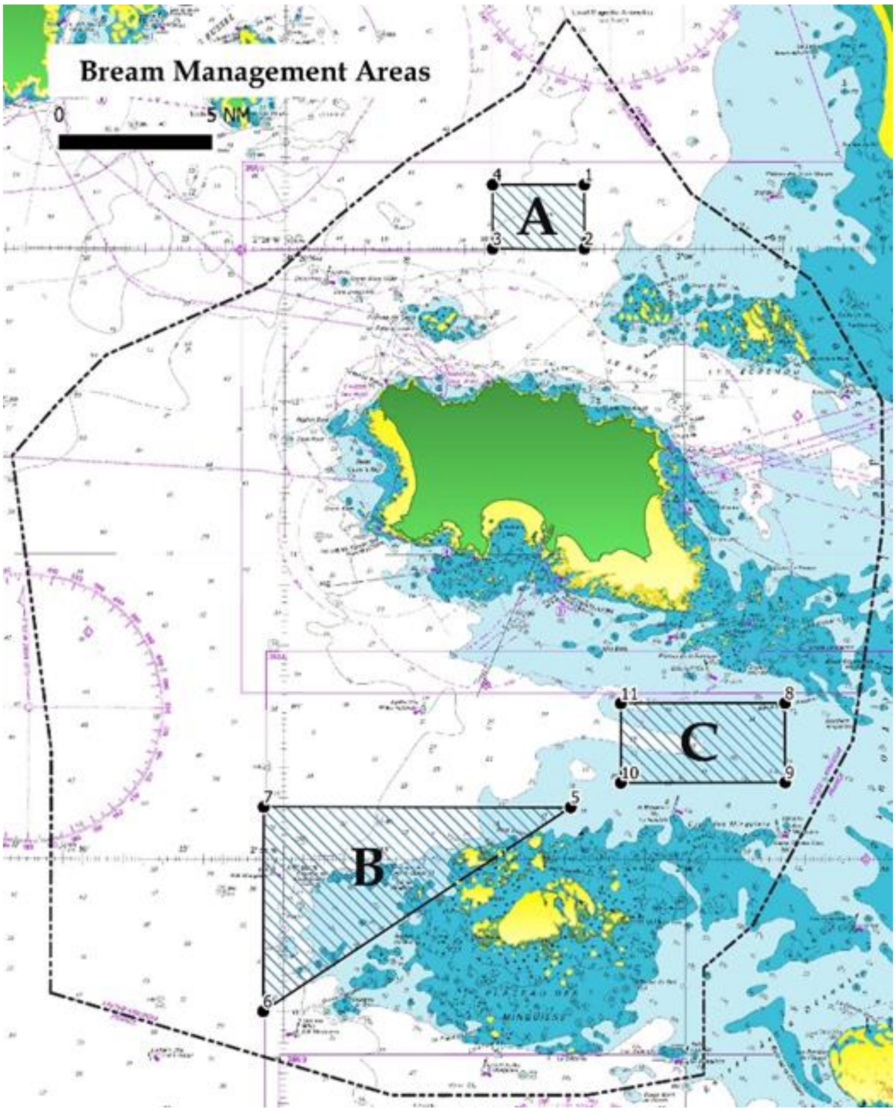

Figure 6. Three potential bream nesting sites in Jersey Territorial waters as identified from VMS, sightings and historical information.

4.2. Benthic Mapping

Using the WASSP across four separate surveys it was possible to build a benthic map of the seabed within the North box (Figure 7. Benthic map of the north box generated from multibeam sonar surveys.Figure 7), and a partial map of the Frouquie box (Figure 8). Red colouring is the shallowest depth and dark blue is the deepest. In the North box, the shallowest area was 31-34 m below Chart Datum (CD) and the deepest was 25-26 m below CD. There appears to be a ridge feature running from southwest to northeast across the North box (Figure 7), following the yellow depth shading. This matches up nicely with a depth contour on the admiralty chart where the depth drops from around 26 m to 31 m. Some difficulties were encountered on the first day which resulted in inaccurate depths (far left of image) that do not match the rest of the map, but the location of changes in depth are still accurate and the inclusion of this data allows the continuation of the ridge to be observed. In the Frouquie box, the shallowest area was around 15 m below CD and the deepest area was within a trench down to a max of 40 m below CD but most deep areas were around 30 m.

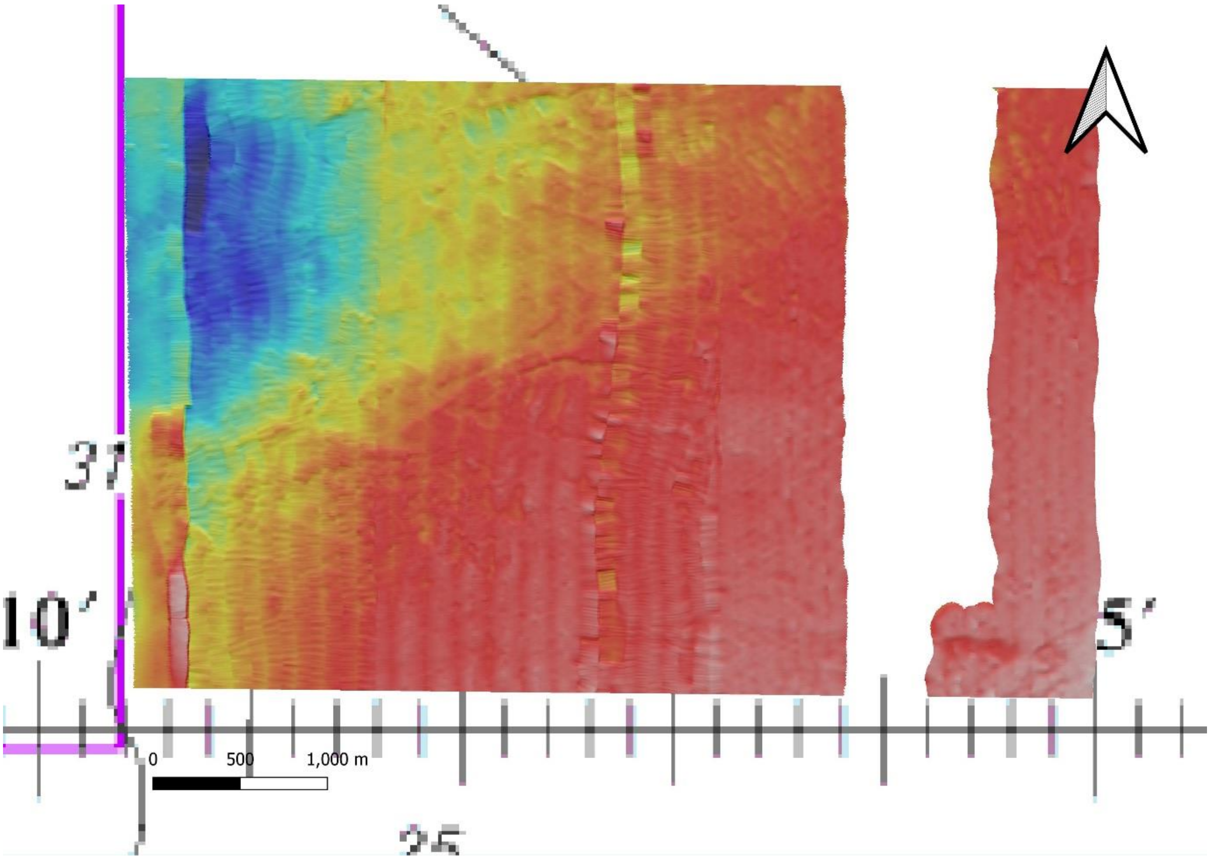

Figure 7. Benthic map of the north box generated from multibeam sonar surveys.

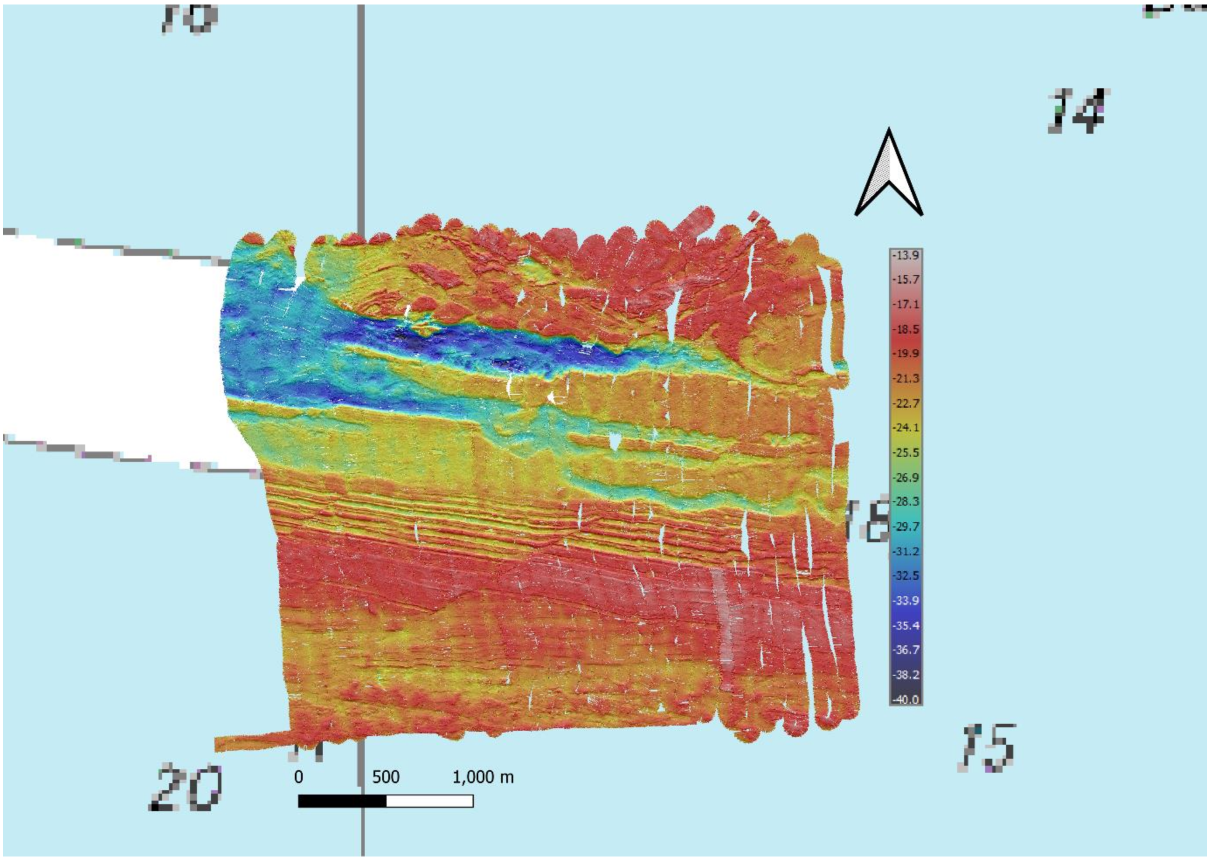

Figure 8. Benthic map of the Frouquie box generated from multibeam sonar surveys. Scale bar shows depth below Chart Datum.

4.3. Towed video

The majority of surveys were focussed on the north box where the most recent historic fishing activity for bream has been recorded during the spawning season. As a result of strong currents, it was only possible to use the towed video to record the seabed for a maximum of two hours each trip when tidal flow was at its weakest. Four successful towed video transects were carried out (three in the North box (totalling 1,638 m of seabed) and one in the Frouquie box (1,230 m)) and of these, bream nests were confirmed on two transects in the North box (Figure 9). Potential nests were identified in the Frouquie box on rock that had been cleaned of algae and turf organisms, but these have not been confirmed (Figure 10).

The nests in the North box were all located on a mixed substrate of sediment and boulders, with the majority of the nests excavated from the sediment within close proximity of rock features. The primary composition of nests fell into three categories: dug, in which sediment could be observed to the bottom of the nest (Figure 9a-b); cleared sediment veneer, in which a loose sediment layer had been cleared to reveal the bedrock beneath (Figure 9c); and finally, cleaned rock, in which any turf and algae species appear to have been cleaned from the surface of the rock (Figure 10). The final category is unconfirmed as a bream nest. Of the 39 nests, 22 were dug (North box), 14 were cleared (North box) and three were unconfirmed nests of cleaned rock (Frouquie box, **Error! Reference source not found.**). These three unconfirmed nests were located in the Frouquie box where the substrates in the area surveyed differed to those surveyed in the North box. Of all the confirmed nests (n=36), 33 had features nearby, with just three observed that were not in proximity to a rock feature.

a) b)

c)

Figure 9.a-c) examples of excavated bream nests from the North box. a) Excavated bream nest (depression in the foreground) with dead man's fingers in the background. b) Excavated bream nest (depression in the centre of view) and c) Bream nest where the sediment has been cleared to reveal the bedrock (centre of view) with a male bream present (right foreground).

Figure 10. Suspected bream nests on rocks (circled in white) in the Frouquie box that appear to have been cleaned of algae and other turf organisms.

4.3.1. Associated species

There were several species that occurred in close proximity to the nests in the North box that could serve as indicators of bream nest habitat suitability outside of the nesting season (Figure 11). Species that were frequently observed were deadmans fingers (*Alcyclonium digitatum*), horn wrack (*Flustra foliacea*) and finger sponge (*Adreus fascicularis*). Also observed were the potato crisp bryozoan (*Pentapora foliacea*), seafan (*Eunicella verruscosa*) and golfball sponge (*Tethya citrina*) but these were not present at every bream nest site. Seafans are a protected species and their abundance was recorded. Five seafans were recorded during the first towed video (13/05/2022) in the North box and four were recorded on the towed video in the Frouquie box.

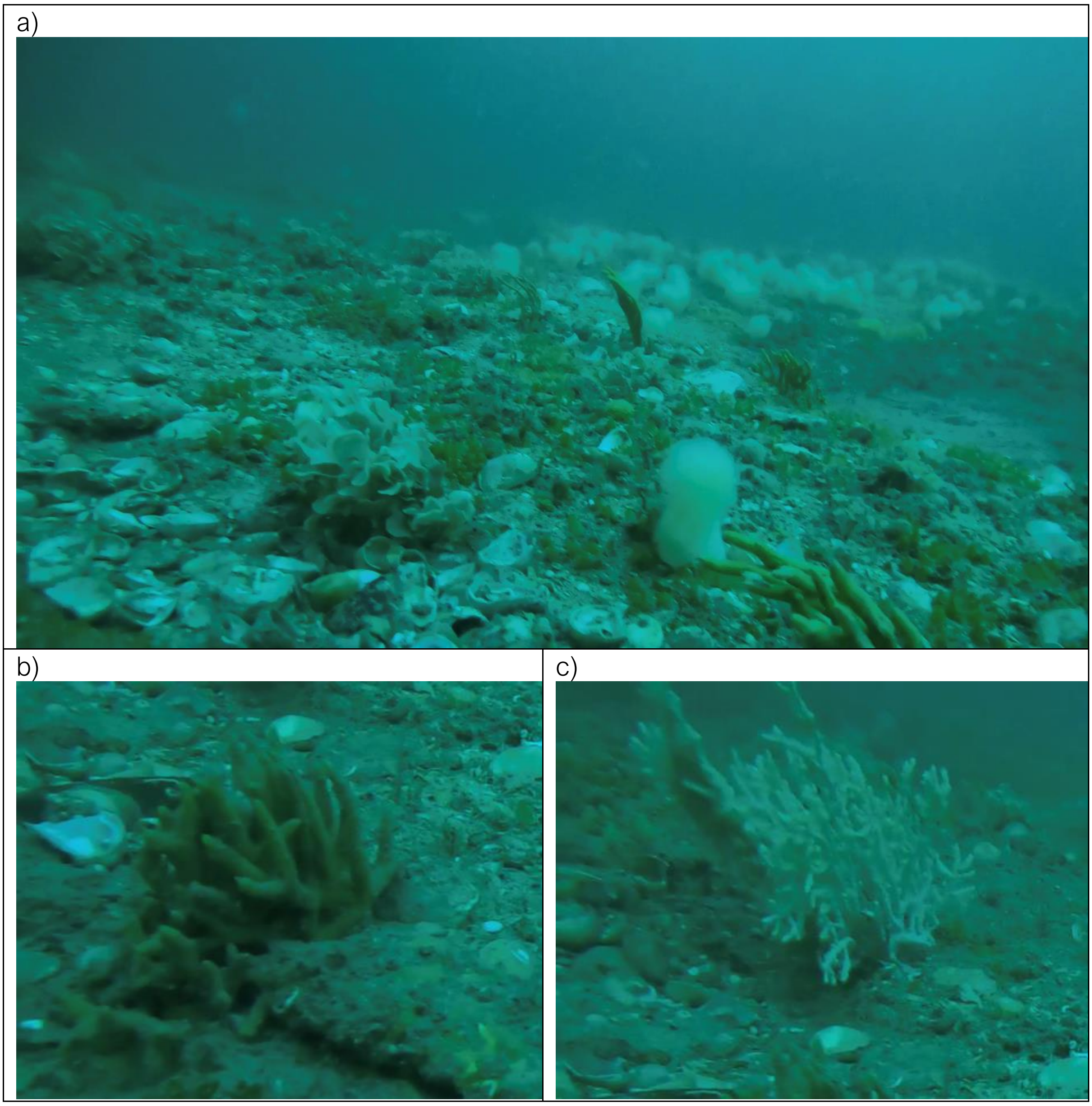

Figure 11. Images of associated benthic sessile species, a) deadmans fingers (Alcyclonium digitatum, white structures, one in the foreground and multiple in the background) with horn wrack (Flustra foliacea, left foreground), finger sponge and other sessile species present, b) finger sponge (Adreus fasicularis) and c) seafan (Eunicella verrucosa).

4.4. Collation of benthic topography and bream nest locations

The location of observed nests in the North box appeared to be associated with a ridge feature on the seabed where the topography dropped from 26 m to 31 m. The nests occurred over ~500 m (480 m on one transect and 540 m on the other) and all were recorded on the eastern side of the ridge (Figure 12). No nests were observed on the tow carried out in the southernmost region of the north box (Figure 13).

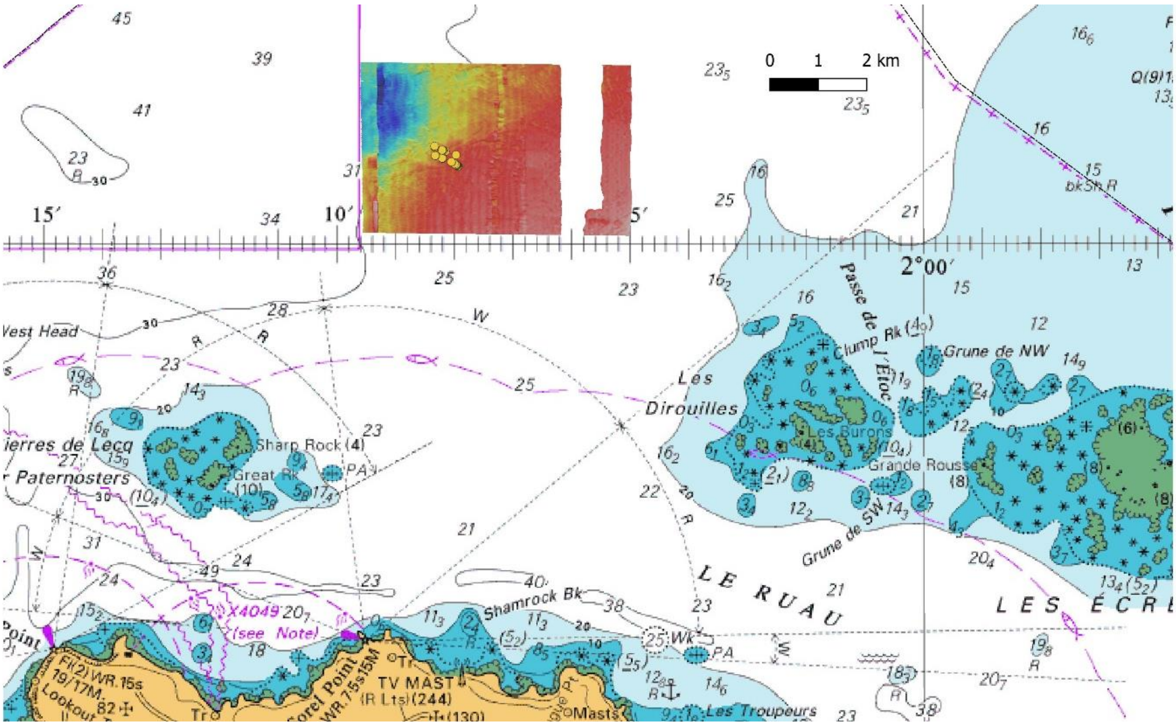

Figure 12. Benthic map of the north box generated from multibeam sonar surveys in relation to the north coast of Jersey with located bream nests overlain (yellow points).

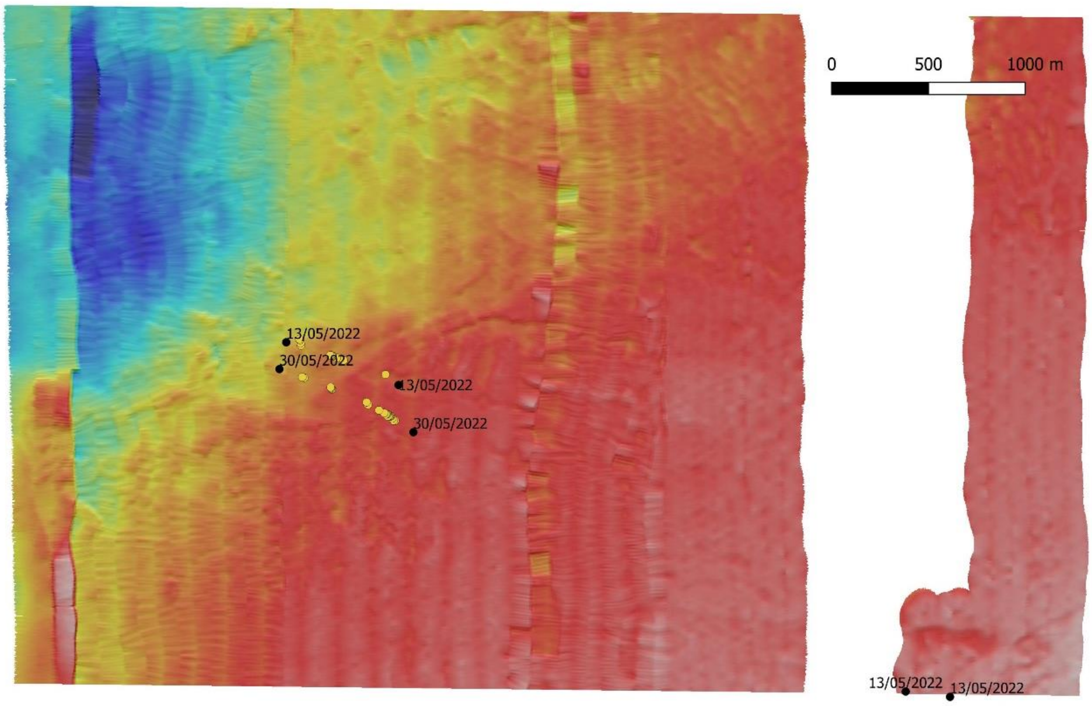

Figure 13. Black points show the entry and exit points of towed videos, and yellow points show the location of bream nests. The dates of the towed videos are labelled on the image.

Only one towed video survey was conducted in the Frouquie box due to time constraints and no conclusive bream nests were found (Figure 14). The depths surveyed with the towed video ranged from 16 to 30 m. The substrates observed were primarily bedrock, rocky ledges and boulders, with very little sediment.

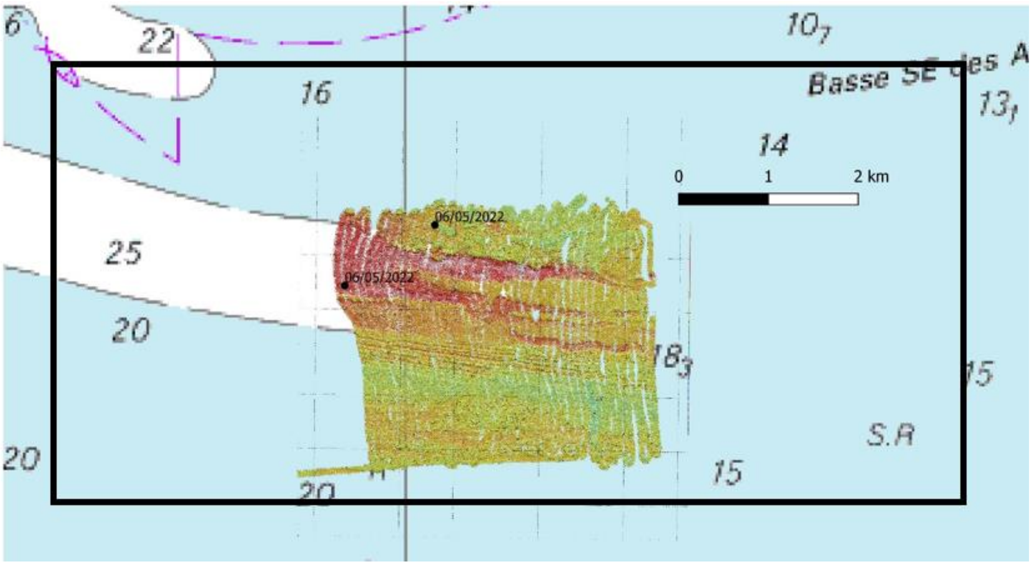

Figure 14. Benthic map within the Frouquie box (black outline) generated from multibeam sonar surveys. Yellow shows shallow areas, and red deep areas. Black points show the entry and exit points of the one towed video conducted in the Frouquie box.

4.5. Habitat Maps

The modelled habitat map shows the North box to be primarily composed of offshore gravel and sand (light blue), with some areas of hard ground (purple) and mobile sand (light pink) (Figure 15). This correlates with the substrates recorded on the towed video but with boulders being a predominant feature observed along the transects.

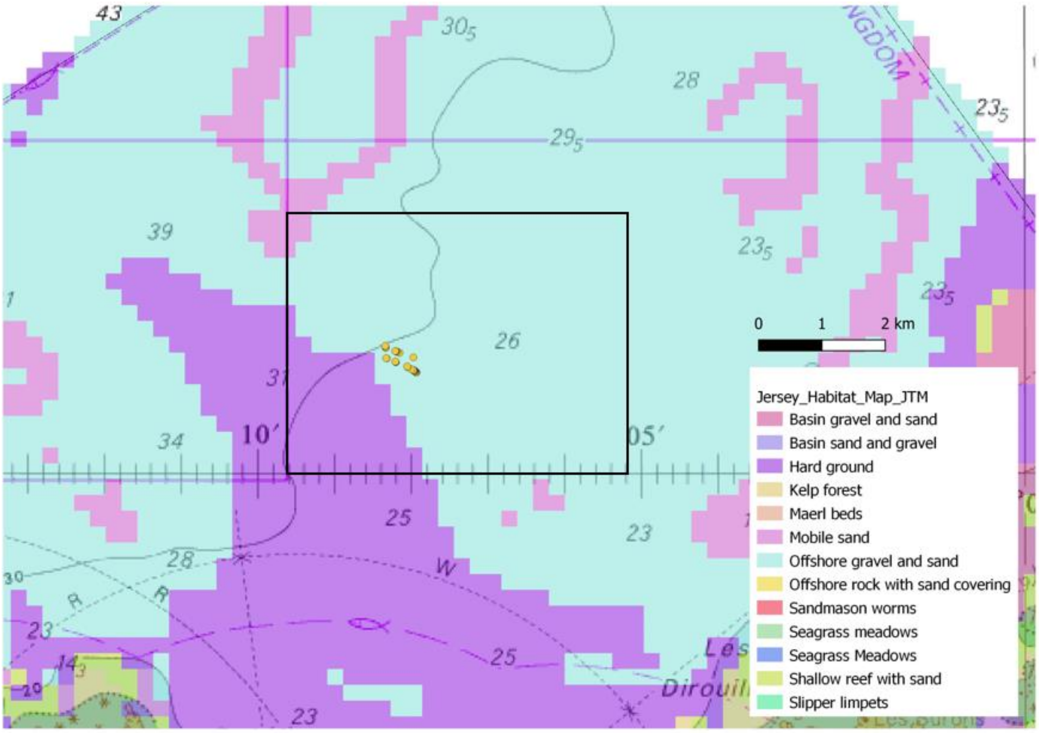

Figure 15. Modelled habitat map. North box outlined in black. The three habitat types within the North box are Hard ground (purple), offshore gravel and sand (light blue), and mobile sand (light pink in the northwest).

The modelled habitats in the Frouquie box are similar to that of the North box, but with a larger area of hard ground (purple) (Figure 16), which correlated with the substrate observed on the towed video. Also predominant were offshore rock with sand covering (yellow) and basin gravel and sand (pink). A small amount of mobile sand was modelled (light pink), similar to the North box.

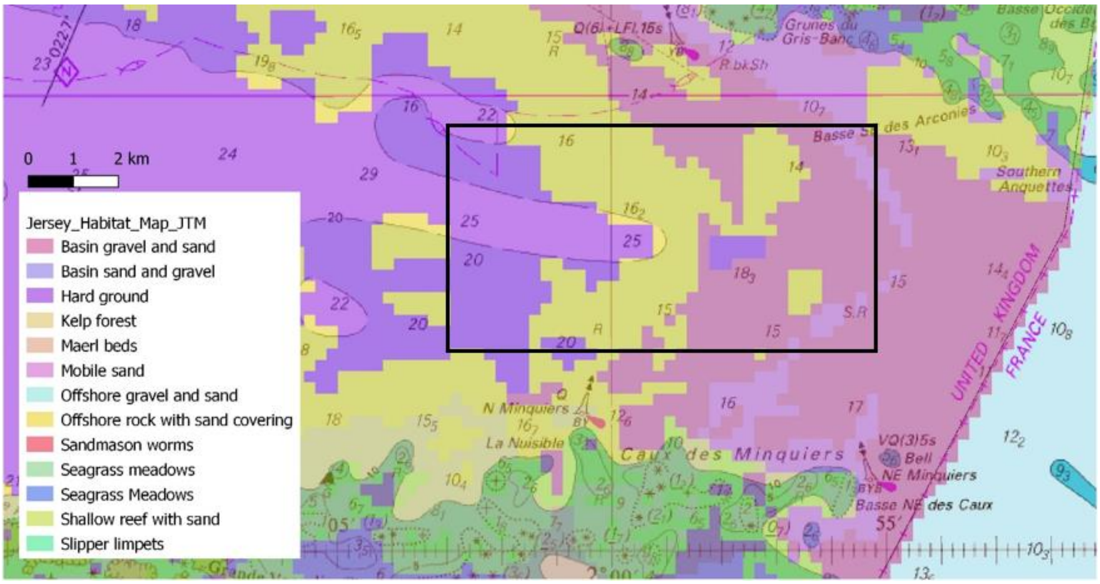

Figure 16. Modelled habitat map. Frouquie box outlined in black. The four habitat types within the Frouquie box are Hard ground (purple), offshore rock with sand covering (yellow), basin gravel and sand (pink) and mobile sand (light pink in the east).

4.6. Density of nests

The width of seabed visible on the towed video is ~ 5 m (depending on height from seabed). This width multiplied by the length of the tows gives the area surveyed, which equals 8,190m^2 for all three tows in the North box combined. The 36 nests recorded equates to 0.004 nests per m^2. The total area of the North box is roughly 19,000,000m^2 which equates to a potential 76,000 nests. However, this is based on a very small sample size and more towed videos are needed of other areas within the box to confirm the presence of nests, the average density of nests and the suitability of substrates.

5. Discussion

Using a combination of methods, bream nests have been identified for the first time in Jersey waters. The substrate on which bream nests were found was similar to that described in the literature (Doggett and Baldock 2022). Due to the short bream spawning period, combined with limited survey times based on currents and battery time of video equipment, it was only possible to survey small areas of the bream boxes. However, now that suitable substate has been identified for bream nests, further investigations can be conducted outside of the bream nesting season to locate similar substrates and improve predictions of bream nest distribution.

5.1. North box

Of the two areas surveyed, bream nests were only confirmed in the North box. Where the bream nests occurred, they were between 26 and 31 m depth. All confirmed nests were made through the excavation or removal of sediment as observed in the UK (Collins and Mallinson, 2012; Doggett and Baldock, 2022), but in closer proximity to rock features as recorded in the UK. This may be due to the high tidal currents experienced in Jersey and therefore successful nest building is reliant on finding protection from prevailing currents.

Nests were found to the east of the ridge, which, based on tidal charts, would not provide much shelter from the prevailing currents. It may be that the presence of features on the sediments, such as boulders, are more important for predicting the occurrence of bream nests, rather than depth gradients. Doggett and Baldock (2022) observed nests to be 'at the interface of sediment and rock'. The habitat maps showed the nests to be in an area of modelled sedimentary habitat adjacent to hard ground (bed rock and boulders), which matches previously described nest sites.

5.2. Frouquie box

Based on information gathered from the North box, the area of the Frouquie box surveyed was most likely on unsuitable substrate as there was very little sediment present. Observed in the Frouquie box were areas of cleaned rock but the quality of footage did not allow for the presence of eggs to be determined. It may be that bream in this area are able to make use of the rock features to nest on, or it may be that they are nesting in other, more sedimentary areas towards the east of the Frouquie box. The Frouquie box was originally designated based on a fishermen's agreement to reduce conflict between potting and netting vessels, with trawlers having sole access to this box during the spawning season. The historic fishing activity in this area during the spawning season indicates that the bream were nesting in this area. Offshore rock with sand covering and basin gravel and sand were predicted by the habitat map but were in areas that were not surveyed due to time constraints. These habitats are more likely to be suitable for bream nesting. Future research of the Frouquie should be focussed on the centre of the box, and further east of the current towed video transect where modelled habitat maps and bathymetry data suggests there is more sedimentary substrate overlaying rock.

5.3. Suitability of methods

The substrates on which black bream are nesting in Jersey waters may differ from that in UK due to the extreme tidal regimes experienced here. The excavation of sediment is a time consuming and energetically costly process for the male bream (Doggett and Baldock, 2022) and substrates that require minimal maintenance may be preferred for building nests. This is further evidenced by the high proportion of nests that were in close proximity to a rock feature and may indicate that they are selecting sediments in the lee of the prevailing currents. In addition to the problems incurred with the strong currents when deploying the tow fish (multibeam sonar), the association of nests with rock features may also have contributed to the difficulty in locating the nests with this method. This could have resulted in the nest signature on the image being obscured by the shadow of a rock feature. It is therefore more appropriate to use a combination of benthic mapping and visual survey methods to locate and predict the extent of nests.

5.4. Predicted nesting sites

Based on the findings from the north of Jersey's waters, the suitable substrate for nest building has been characterised and, in a precautionary approach, all areas of seabed known to comprise this type of substrate should be closed during the breeding season (March-May) to ensure sustainability of the bream fishery. Based on this information it is likely that bream are nesting in the other areas identified in the initial stages of this study based on trawling VMS data. Further ground truthing is needed in these areas during the next bream nesting season to confirm the presence of nests and to improve understanding of preferred nesting habitat in Jersey waters. Further, improved habitat maps would considerably aid in the location of suitable bream nest habitat and further surveys should be carried out to ground truth the modelled habitats.

5.5. Other findings

There was an association of deadmans fingers (*Alcyonium digitatum)*, finger sponge (*Adreus fasicularis*) and horn wrack (*Flustra foliacea*) around the nests. The distribution of these species, in combination with habitat information, could be used to predict the distribution of bream nests as the environmental conditions needed for these species may to be similar to the habitats targeted by bream to build their nests. Further, the identification of extensive soft coral beds (comprised of dead mans fingers) in the North box should be considered in future management as this type of habitat is sensitive to abrasion pressure (Readman and Hiscock, 2017), such as bottom towed fishing (which is currently permitted in this area). Additionally, the location of seafans (*Eunicella verrucosa*) is another important consideration as this is a protected species and is highly susceptible to damage from towed fishing gears (Budd, 2008). Further surveys would also help to improve understanding of the distribution and condition of these species.

5.6. Conclusion

This research has identified the best methods currently available for locating bream nests in Jersey: a combination of benthic topography mapping and visual surveys. These methods have identified the location of multiple nests in an area to the North of Jersey that was previously targeted by trawl fishing during the black seabream spawning season. The substrate type preferred by bream to build their nests appears to be coarse and mixed sediments either overlying bed rock (shallow sediment) or in the lee of rock features (deep sediment). However, due to limited resources and a short spawning season (~ 4 weeks), only small areas were surveyed and it is recommended that further surveys are carried out to identify more nests and build a more comprehensive picture of habitat preference and nest composition. Additionally, there appeared to be an association of dead mans fingers, horn wrack and finger sponge with bream nests, suggesting the depth and substrate type that is suitable for these species is also suitable for bream nests. These species are present all year round, unlike bream nests, and therefore could be used to help identify priority areas for bream management outside of the spawning season.

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