

NWIFCA Technical, Science and Byelaw Committee

7th of November 2023: 10:00 a.m.

Agenda Item

7

SURVEY AND INSPECTION REPORT 15TH OF AUGUSTY – 7TH OF NOVEMBER 2023

Purpose: To report on cockle and mussel surveys and inspections in the last quarter, and update members on the mussel and cockle fisheries in the district.

Recommendation: Approve the following:

- a) Receive the report and related survey and inspection notes.
- b) To approve that the cockle beds at Flookburgh remain closed until the 1st of September under Byelaw 3 paragraph 15.

BACKGROUND

Every year NWIFCA officers undertake extensive surveys and inspections of the cockle and mussel beds across the NWIFCA District. The aim of the surveys is to conduct stock assessments on each bed, and the aim of the inspections is to gather information in areas that either; a) do not have enough stock to warrant survey, and/or b) conditions of the bed preclude surveying – for example, large channels or short exposure times which limit the time officers can safely access. Inspections may also take place to see if a full stock assessment is needed.

Mussel bed surveys and inspections

Large, accessible mussel beds that are stable (large areas are not frequently washed away) are typically surveyed by the Dutch Wand method. This method allows officers to calculate an overall biomass of stock on the bed, identify the proportion of the population that is size, and map a perimeter. Beds that are typically surveyed by Dutch Wand include: Foulney mussel bed, Low Bottom, and Walney Channel. Mussel beds which are exposed for short amounts of time or are typically fished for seed mussel and are therefore liable to large changes over short periods are inspected visually, with reports presenting pictures and a description of the stock. Beds that are typically inspected using this approach include: Fleetwood, South America, Falklands, and Heysham.

Mussel inspection methodology overview

Inspections of mussel beds are undertaken by officers who will walk the perimeter of the mussel bed with GPS to map the location and extent. Officers will then access the middle of the bed and as much as can reasonably be accessed, taking notes on this size, coverage, presence of any important features (presence of sabellaria, exposed cobble and boulder substrate, depth of mud, indications of scour, looseness of mussel), and mussel size composition. Typically these surveys are limited by tides and can only be conducted on spring tides. Inspections are undertaken to assess the suitability of a bed for either a seed or size fishery.

Cockle bed surveys

The purpose of cockle surveying is to establish data regarding the abundance, density and location of cockle stocks to inform fisheries management. Most cockle beds in the district are surveyed using the methodology outlined below.

Cockle survey methodology overview

Cockle surveys are undertaken by splitting each bed extent into a grid of sample points spaced between 250 to 500 m apart. Typically, each bed has between 40 and 140 sample points depending on its size. Each year, officers survey a minimum of approximately 750 sample points across the main beds from Morecambe Bay, the Ribble Estuary and Leasowe.

Sample locations are mapped on a GPS to ensure each year the same locations are surveyed. Officers access each sample location by quad, jumbo the sand to fluidise the sediment to cause cockles to rise to the surface and lay down a 0.5 m² quadrat. Officers pick and rake the cockles within the quadrat and collect them for analysis in the lab. In the lab, cockles are separated into size cohorts (0.1-<5mm, 5-<15mm, 15-<20mm, 20-<25mm, 25-<35mm, +35mm) and record the number in each. A total of 200 cockles (100 undersize, 100 size) are taken from the bed as a whole, for analysis of weight and length. From this data, the overall proportion of size and undersize and total stock biomass is estimated.

1. MUSSELS

Between 15th of August and the 10th of October, NWIFCA science officers carried out five mussel inspections across NWIFCA District. Full inspection reports are provided in Annex 1 of this report. The location and extent of the beds inspected are provided in Figures 1 to 3.

Table 1. Mussel survey and inspections this quarter.

Surveys and inspections this quarter	Date
Mussels	
Morecambe Bay (Figure 1):	
Fleetwood x 2	29-08-23 & 03-10-23*
South America	01-09-23
Foulney (Dutch wand survey)	04-09-23
Low Bottom (Dutch wand survey)	02-10-23

*inspection report in draft – will be provided in the following TSB report

a) Morecambe Bay mussel beds overview:

The location and extent of mussel beds surveyed in Morecambe Bay from 15th of August and the 10th of October is provided in Figure 1. An overview of the status of the bed is provided in the following section. Full inspection reports with images are provided in Annex 1.

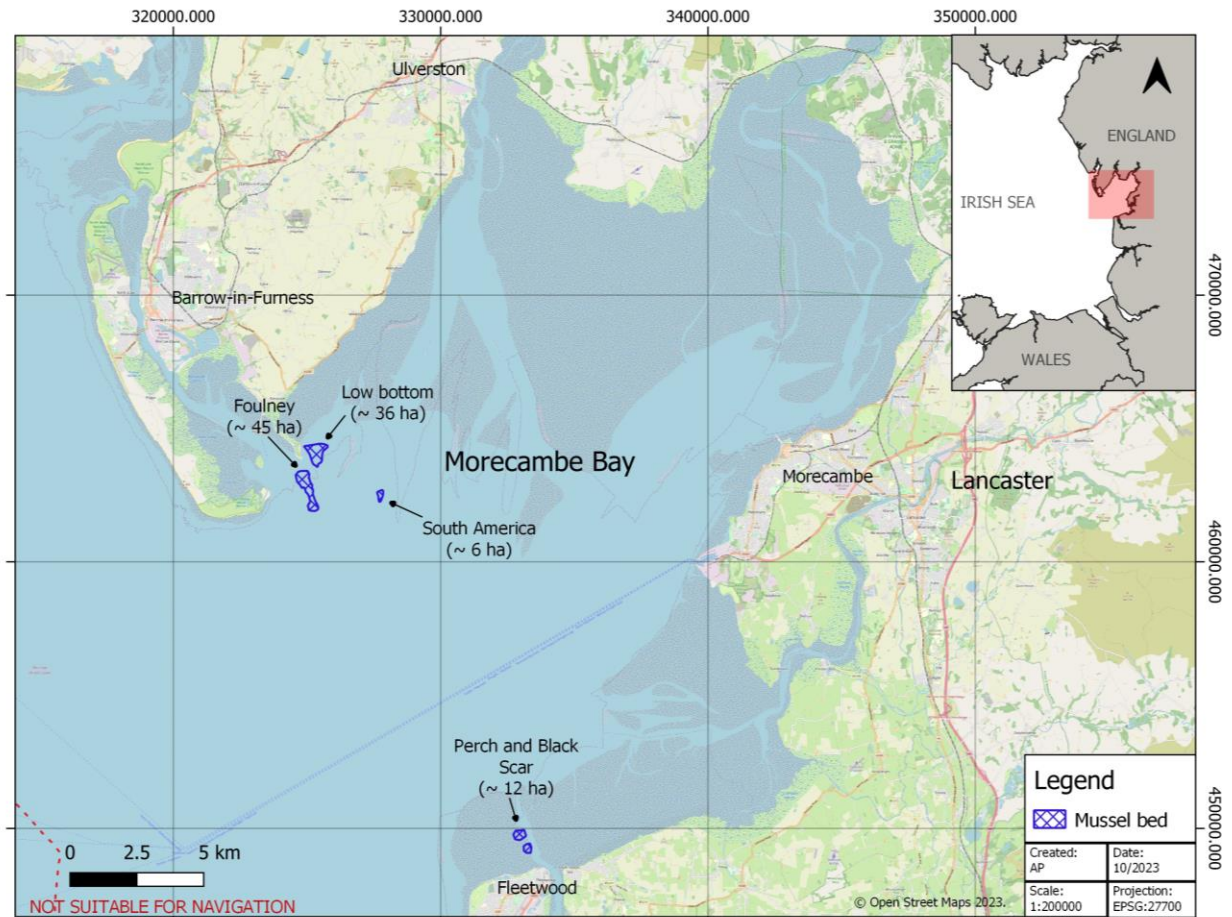


Figure 1. Surveyed and inspected mussel beds in Morecambe Bay from 15th of August and the 10th of October 2023.

1) Fleetwood (seed mussel):

Officers accessed Fleetwood mussel beds on the 29th of August and again on the 3rd of October to inspect the seed mussel and condition of the bed post the dredge seed fishery. The state of the bed at the time of the most recent inspection is as follows:

Black Scar

Black Scar was open to seed dredge fishing in August. On inspection, officers observed the top layer of mussels within the area had been removed, with discernable tracks from the dredge. The mud present over the main extent of the bed where dredging was permitted is still very deep with large numbers of mud hillocks, preventing any access beyond the perimeter. Any remaining mussel is approximately 30mm in size. A strip of undersize mussel along the channel edge of the permitted dredge area had been left. There was some evidence of scouring.

The mussel that has remained outside of the permitted area is on a thin mud and sand veneer, is approximately 25 mm in size and is sparsely distributed. The strip of cobble along the other shoreward edge is still present, and cobble was exposed along the bottom part of the bed. There were a number of oyster catchers and gulls observed on the bed. The inspection report with images is still in draft and will be reported at the next meeting.

Perch Scar

Perch Scar was also open to dredge fishing this summer. There was some evidence of dredging and also evidence of scour. The bottom part of the bed and the center was inaccessible due to the presence of thick mud. There was still considerable mud hillocks present. Access was limited along the channel edge due to the tide, however, mussel that was present was still on thick mud and had grown to approximately 30 mm. on the opposite side of the bed closer to the shore, there was thick mud and little mussel present. The inspection report with images is still in draft and will be reported at the next meeting.

2) South America (seed mussel)

Officers accessed South America mussel bed on the 1st of September to inspect the seed mussel and condition of the bed and identify if it was suitable as a dredge seed fishery. The state of the bed at the time of the most recent inspection is as follows:

The mussel bed can be split into three areas, the main bed which has been present for the last few years and requires crossing a large channel. The area of newly exposed stony substrate which received a 2023 settlement and a strip of patchy mussel to the North of the bed which has not been previously mapped and was colonised by *Sabellaria alveolata*, reported on in April.

Crossing over the channel, mussel in the channel was present in patches and on thick mud. On the main extent of the bed, the spread of mussel was patchy, with areas of exposed cobble and mussel on sand. Mussel was around 25mm+. The southern portion of the bed had high levels of exposed cobble, there is a significant area of cobble where previous mussel has been scoured off.

There has been a reduction in the density of mussel in the newly exposed and settled 2023 area to the West of the main bed. The area is a mix of bare stony substrate, mussel on a thin veneer of mud and/or sand and mussel on a thicker layer of mud. The mussel is approximately 20-25mm in length.

3) Foulney main (size mussel – dutch wand survey)

From the transect and sample data the total mussel bed surveyed was 48.17 hectares. There was no separation made between the main Foulney bed and Foulney Island. There is approximately 3864 tonnes of size mussel and 1633 tonnes undersize mussel currently on the bed. From the length frequency data the majority of mussel present on Foulney Skear is currently a mix of size and undersize with a wide spread of mussel from 6mm to 79mm but mainly between 30mm and 60mm. Size mussel (>45 mm) is predominantly on the lower half of the main skear and on the island. Undersize mussels were mainly congregated higher up the main skear with some mixed in with size mussel in the middle of the skear.

4) Low Bottom (size mussel – dutch wand survey)*

From the transect and sample data, the total mussel bed surveyed was 35.5 hectares. There were large areas of bare cobble and dead shell across the bed. There is approximately 1131 of size mussel and 1205 of undersize mussel on the bed.

2. COCKLES

a) Flookburgh re-survey

i) Justification for re-surveying

NWIFCA completed surveys of the districts main cockle beds on the 25th of July 2023 (for full report see Agenda Item 8 from August 15th TSB meeting). Each year cockle surveys are carried out from July to August, with the results used to determine the suitability of a fishery for September 1st.

The 2023 results demonstrated that both Morecambe Bay, and each cockle bed individually, had low biomass and density of size cockle, comparable with the previous year (Figure 2). On this basis we recommended the fishery remain closed until the 1st of September next year.

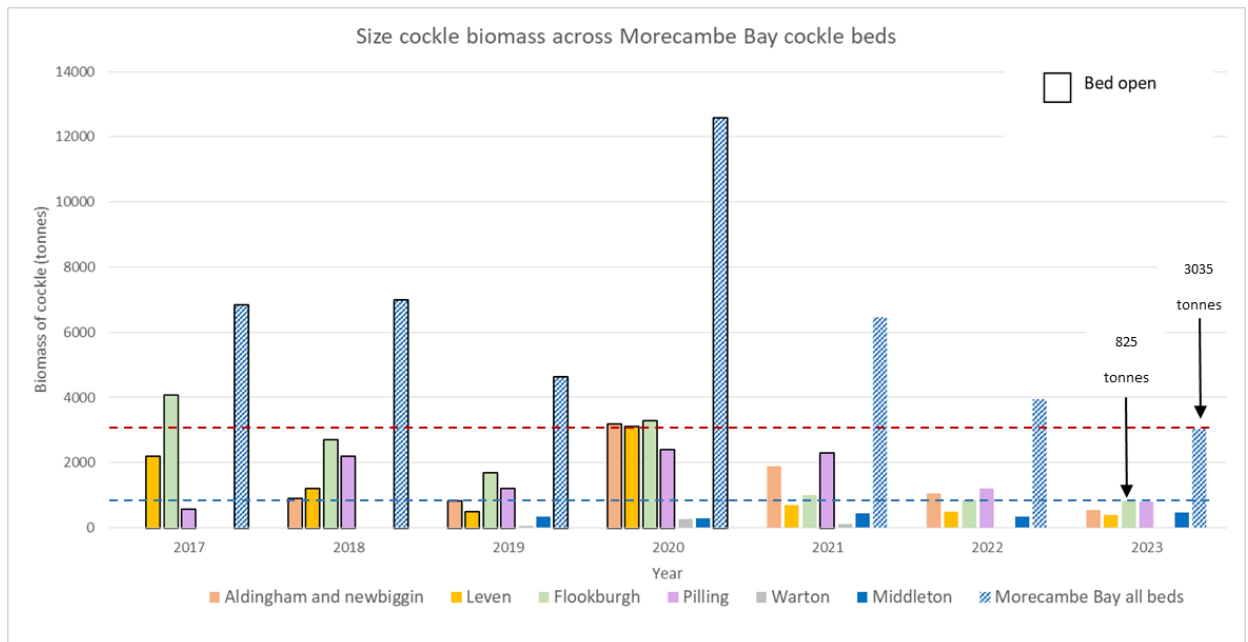


Figure 2. The biomass of size cockle by bed in Morecambe Bay from 2017 to 2023. The red line indicates how this year's biomass of size cockle compares with previous years. The blue line indicates how this year's results for Flookburgh cockle bed compare with previous years.

However, surveys identified there was proportionately large biomass of undersize cockle in the 20-25mm range, which had the potential to grow on to size during the final summer months from July to September. Therefore, during the August 15th TSB meeting, at the request of industry, Members voted for officers to re-survey Flookburgh cockle bed to identify if any of the undersize cockle had grown to size.

ii) Re-survey methodology

Weather and daylight hour limitations prevented a full resurvey, however, officers were able to carry out a partial re-survey of the bed.

Sixty one out of the original 153 sample points surveyed in July, were selected for re-survey. These points were selected as they had the highest proportion of 20-25mm cockle, which had

the potential to grow on to size. These survey points were sampled using the same methodology as previously used in July and detailed in the background section to this report.

Comparison between the October and July survey results are only between the survey points that were surveyed **both months** (not between the full and partial survey) to allow for accurate comparison.

iii) Results summary

Full results of the report are provided in Annex 2, a summary of the findings is as follows:

- **Total cockle (including size and undersize) had increased in density and total biomass** between July and October for the sampled points. Total cockle had increased in the surveyed area from 4730 tonnes to 7480 tonnes.
- **Biomass of size in the sampled area had increased** from 746 tonnes to 1821 tonnes.
- The **average number of size cockle in the survey area had increased** from 7 per m² to 15 per m², but there was little change in the maximum density of size cockle.
- **Biomass of undersize cockle has also increased** from 3984 to 5659 tonnes within the surveyed area.
- **The majority of cockle remains undersize** – at 83% (excluding <15mm cockle).

iv) Important considerations

1. Growth period

The main growing season for cockle is between May and August (www.marlin.co.uk). As the original survey was undertaken at the beginning of July, it can be expected that there would be some increase in the biomass of both size and undersize cockle during this period.

2. Comparison against previous years

NWIFCA as yet do not have a minimum biomass of size cockle on which to confidently recommend a fishery be opened on. Therefore, previous years can be used as a proxy for whether a fishery should be recommended for opening.

In previous years, the minimum biomass of size cockle that Morecambe Bay has been opened is 4635 tonnes, and the minimum biomass of size cockle that Flookburgh has been opened is 1700 tonnes.

Both the overall biomass of size cockle for Morecambe Bay and Flookburgh must be considered together, because the Morecambe Bay SPA covers the Bay as a whole, and though one year a bed may be opened with comparably low cockle, often other beds remain closed as mitigation.

The increase in the biomass of size cockle on Flookburgh to 1821 tonnes, brings it above the minimum threshold it has been opened in previous years (when not taking into consideration the overall biomass of size cockle in Morecambe Bay). Also note, this number is from a partial survey, and does not include the additional survey points which may increase this value.

However, it is not appropriate to compare the results of this year's October survey with historic surveys undertaken in July – as the biomass of the cockles in these years would have likely also increased during this same time period.

To make previous years 'comparable' with the October 2023 results – an estimated growth factor needs to be applied to the historical results.

3. Calculation of a growth factor

The increase in biomass of size cockle between July and October results depends on a number of factors, one of which being the biomass of undersize cockle in the 20-25mm range. If the number in this category is high, then more will increase to size during the final months of summer, when compared with if there is a lower biomass of this size class.

Results of the October survey indicate that approximately half the biomass of the 20-25mm group has grown on to size cockle. This is a generous estimate given that the biomass of size cockle identified in July will also have increased during this time period and account for some of the increase.

Therefore, to calculate comparable biomass estimates between the historical data and this year's October data, half the 20-25mm cockle biomass from each year was added to the biomass of size cockle surveyed in July. Please note, 2017 could not be used in this exercise as the proportion of 20-25 mm cockles was not available. The results of this exercise are provided in figure 3 and table 2.

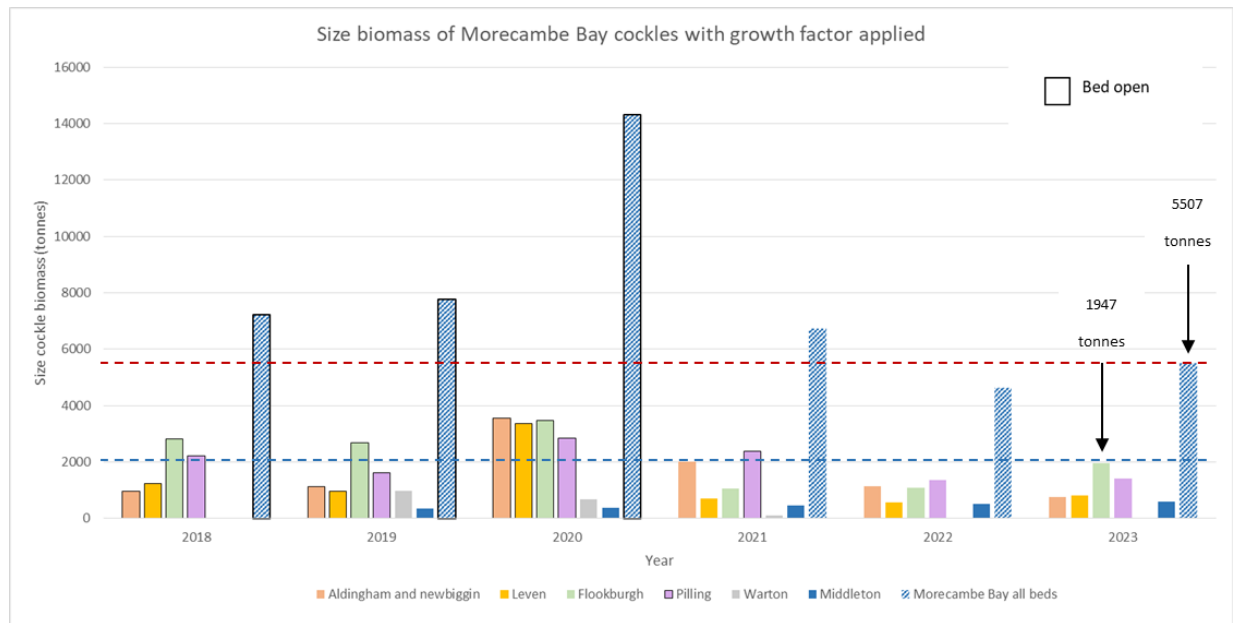


Figure 3. The biomass of size cockle by bed in Morecambe Bay from 2017 to 2023 with an estimated growth factor applied to account for additional growth between July and October. The red line indicates how this year's estimated biomass of size cockle with a growth factor compares with previous years. The blue line indicates how this year's results for Flookburgh cockle bed compare with previous years also with an estimated growth factor applied.

	2018	2019	2020	2021	2022	2023
Aldingham and newbiggin	965.807	1132.908	3561.506	2017.998	1131.143	751.1895
Leven	1227.537	969.1034	3376.084	718.2879	568.4788	817.7312
Flookburgh	2806.295	2674.107	3486.132	1050.564	1076.419	1947.239
Pilling	2226.339	1630.724	2846.928	2374.395	1348.23	1406.05
Warton	na	983.2459	666.2346	114.0768	na	na
Middleton	na	364.5	364.9314	468.9232	514.0303	585.364
Morecambe Bay all beds	7225.978	7754.587	14301.82	6744.245	4638.301	5507.573

Table 2. The estimated biomass of cockle on individual beds and Morecambe bay as a whole when an estimated growth factor is applied from the results of the October re-survey.

4. Accuracy of using a growth factor

Using a growth factor to predict the biomass of cockle from July to October is inherently unreliable, and does not take into consideration a number of other important factors such as weather, temperature, food availability, variability of bed conditions, predator influence etc. Therefore, a standard growth factor is not advisable. For example, fishery managers in the Dee Estuary have stopped applying a growth factor to stock models to concern over unreliability. In addition, this calculation is based on one-years data, so there is limited confidence in its reliability.

v) NWIFCA recommendation

Officers recommend that Flookburgh cockle bed remain closed until September 1st under paragraph 15 of Byelaw 3 (subject to the cockle open season review) for the following reasons:

- 1) The biomass of size cockle from the October survey is still low when compared with previous years, both when considering the growth factor and without. The biomass falls lower than when the fishery has previously been opened.
- 2) The biomass of size cockle will likely diminish from now onwards due to natural mortality over winter. In addition, their body weight typically declines over this period due to the unavailability of phytoplankton food sources (Newell & Bayne, 1980). Removal at this point from fishing will diminish the amount that could grow on to support the following year 's fishery.
- 3) Concerns remain over the availability of prey resource for birds given the limited size cockle available.
- 4) There is a large percentage of undersize cockle that would require riddling. Potential for disturbance to undersize and juvenile cockle during this riddling process, again reducing the potential to contribute to next year's fishery.

NWIFCA, 16th of October 2023

Annex 1

Mussel Inspections and surveys:

Fleetwood Mussel Inspection 29-08-23

Officers: JH, GG

LW: 17:15 2.0m (Liverpool Tides)

The Fleetwood mussel beds of Perch and Black Scar were surveyed to check the condition of the mussel and that the flexible permit conditions issued under, NWIFCA Restriction on Use of a Dredge were still appropriate. The perimeter of the permitted fishing was inspected (Figure 1). It was not possible to walk the channel side (East) of Perch Scar as the mussel mud was too soft and being slightly restricted from the tide height.

Black Scar

The 2023 mussel settlement on Black Scar is still present and the mussel is of a similar size of approximately 20-25mm mm in length (Figure 2). The coverage of mussel has reduced due to fishing and scour, on the western of the bed, where density has reduced to 30-40% (Figure 3). On the eastern edge of the bed the density of mussel is still high with 70-80% coverage (Figure 13 and 14). The mussel is still on a significant layer of mussel mud (Figure 13 and 14). There has been little to no change in the area of seed mussel suitable for fishing and therefore the previous bed area is still appropriate of approximately 4.1 hectares. The thin strip of exposed cobble along the channel edge, outside of the permitted fishing area is still present.

Perch Scar

The 2023 mussel settlement on Black Scar is still present and the mussel is of a similar size of approximately 20-25mm mm in length (Figure 13). Coverage varies across the bed depending on the level of scour. To the South and East of the bed coverage remains high at 80-90% (Figure 4, 5 and 11), to the North and West of the bed coverage has reduce to 30-50% coverage (Figure 7 and 9). Similar to Black Scar the mussel mud was thick (Figure 7 and 9), in places up to a metre thick. There is some exposed stony substrate (Figure 6, 8 and 10) to the East of the mussel bed which was previously covered by soft sediment (Muddy sand). This area will be removed from the permitted fishing area. There has been little to no change in the area of seed mussel suitable for fishing and therefore the previous bed area is still appropriate of approximately 9.7 hectares.

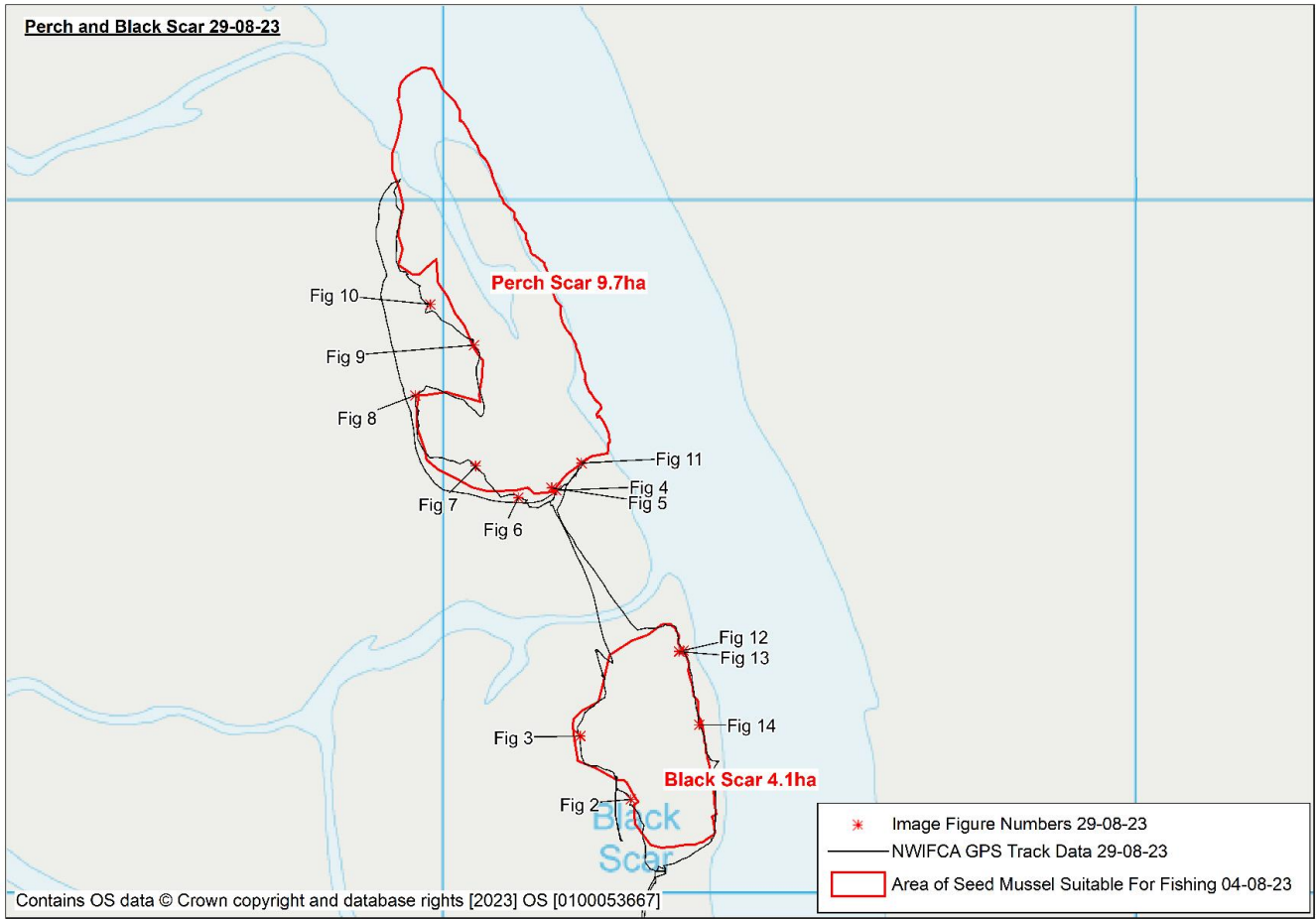


Figure 1. Location and extent of the Perch and Black Scar seed mussel and locations of figure numbers 29-08-23.



Figure 2. 20-25mm Seed Mussel on Black Scar 29-08-2023.



Figure 3. Scoured Mussel on Eastern Edge of Black Scar 29-08-2023.

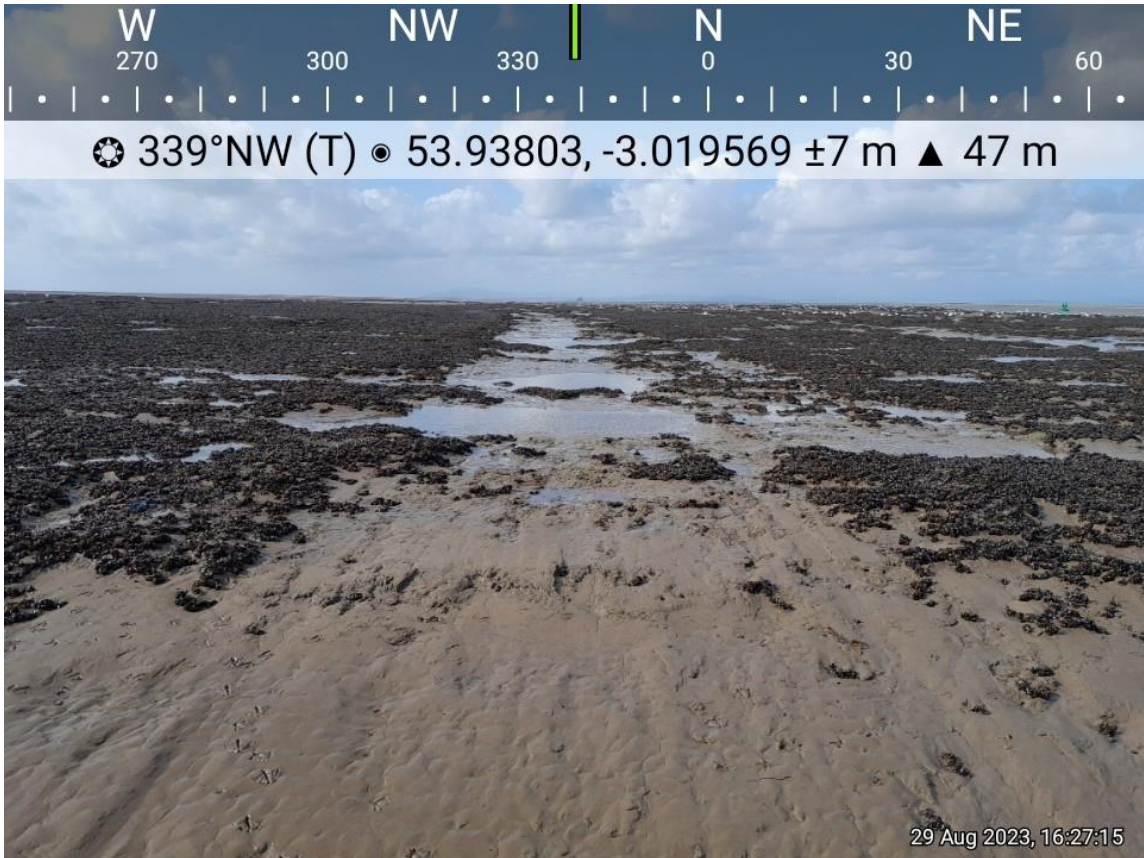


Figure 4. Loose, dense mussel on thick mud with dredge track on Perch Scar 29-08-2023

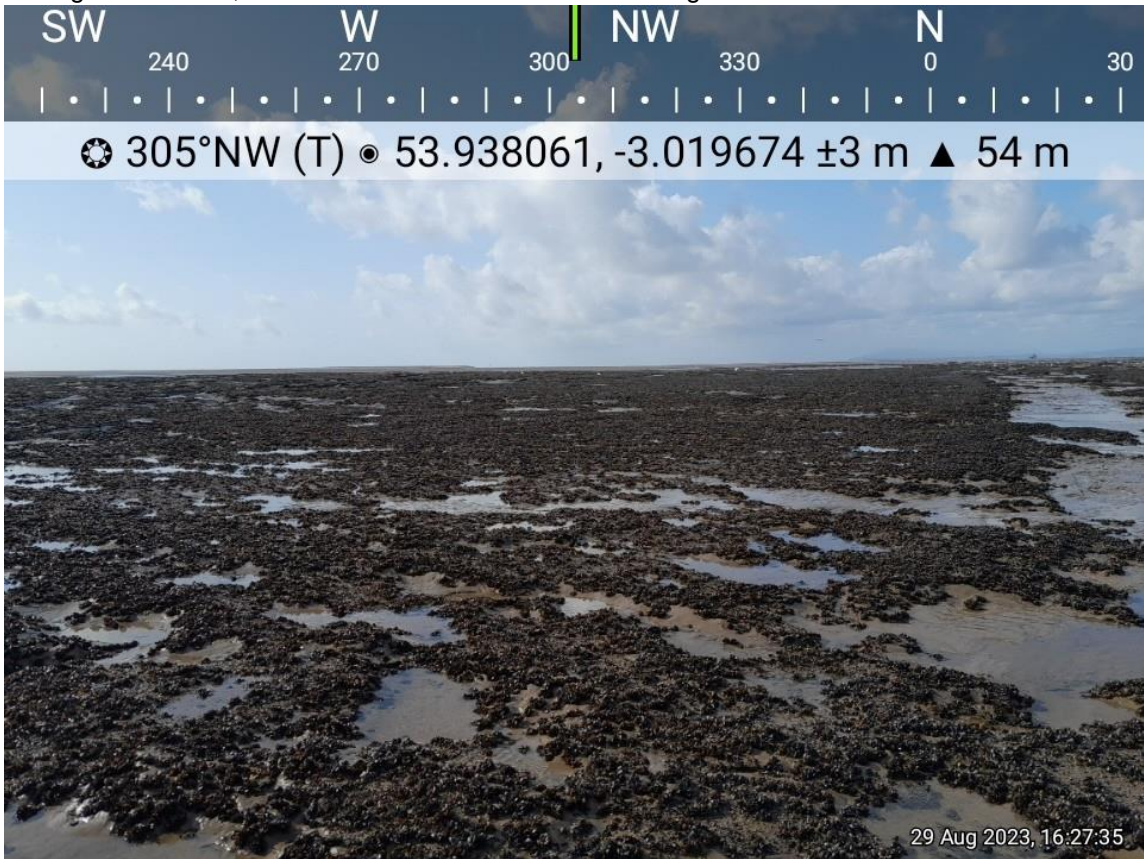


Figure 5. Loose, dense mussel on thick mud Perch Scar 29-08-2023.

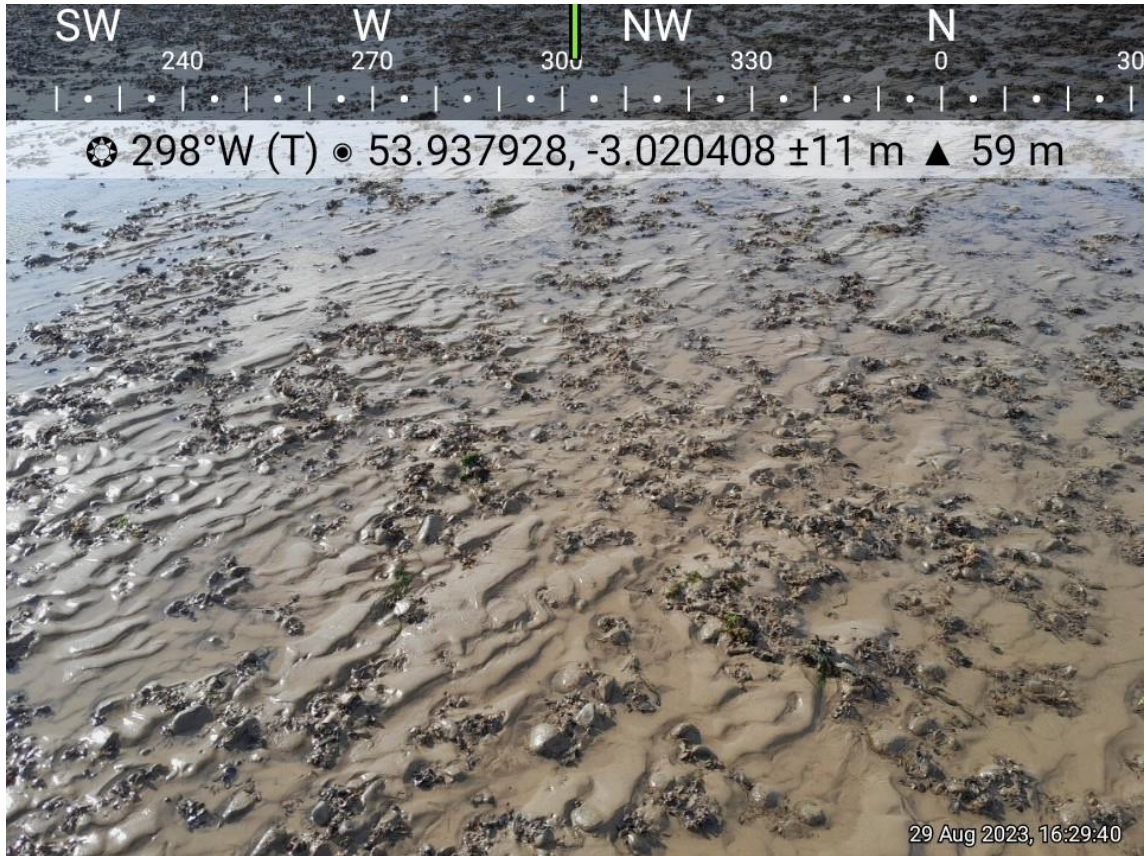


Figure 6. Exposed Stony substrate previously covered by sand Perch Scar 29-08-2023



Figure 7. Evidence of Mussel Scour and deep mussel mud on Perch Scar 29-08-2023.

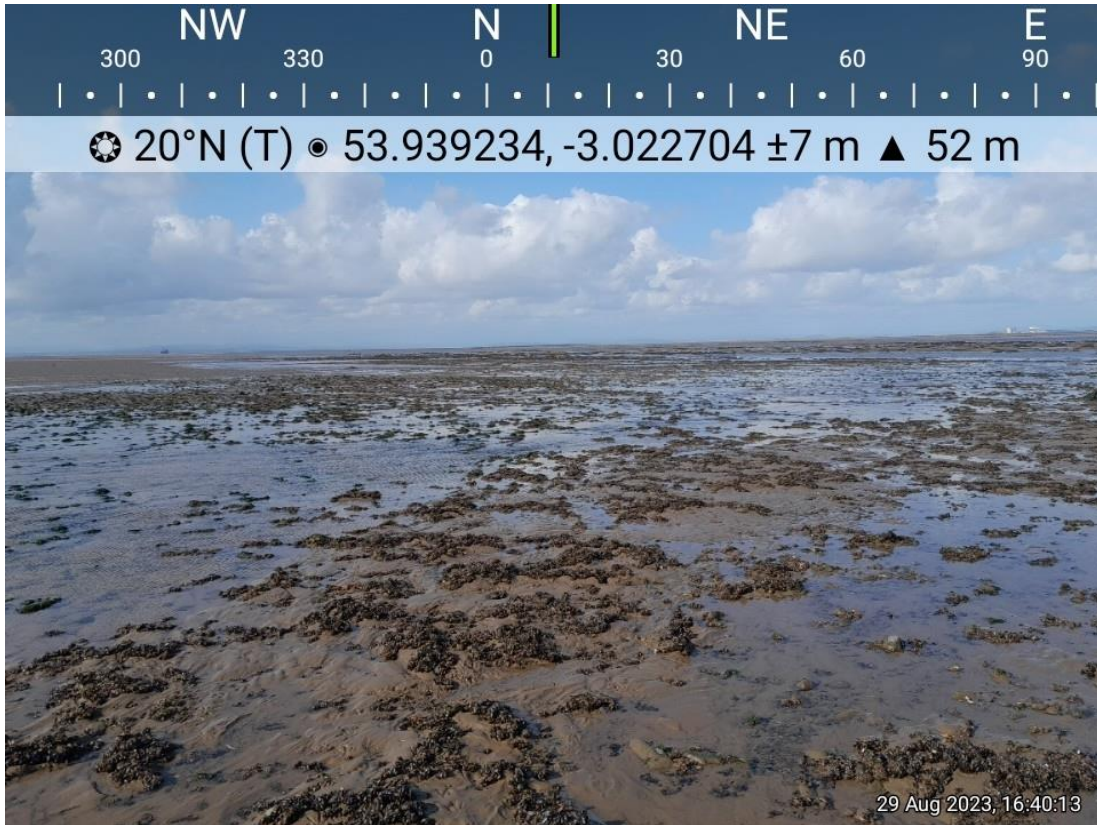


Figure 8 Exposed Stony substrate previously covered by sand Perch Scar 29-08-2023.

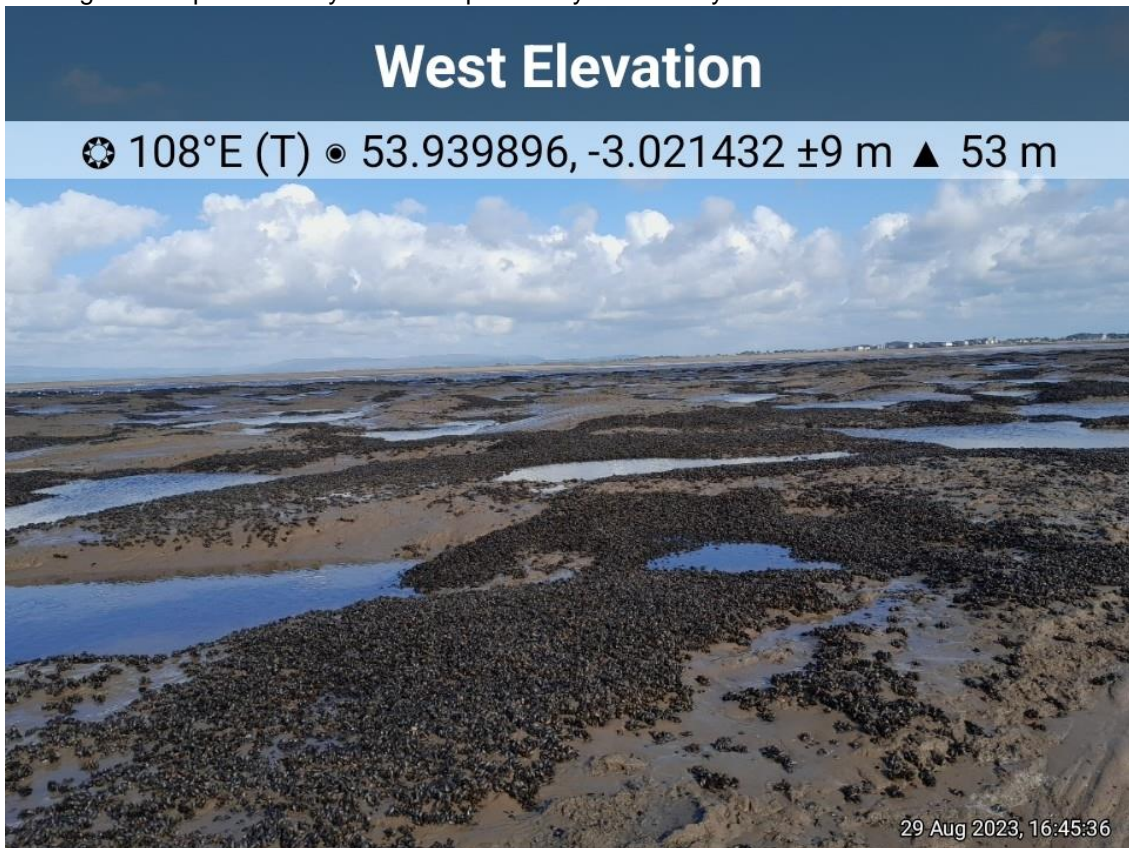


Figure 9. Evidence of Mussel Scour and deep mussel mud on Perch Scar 29-08-2023.

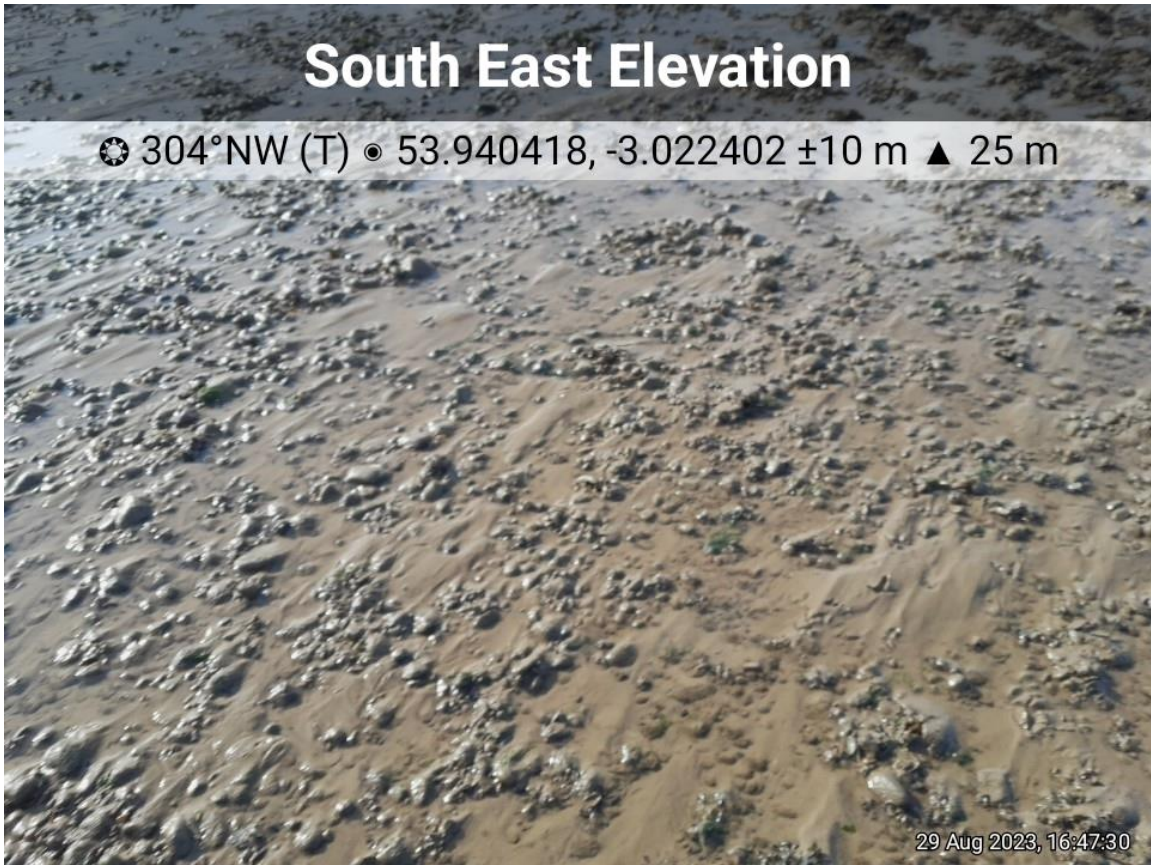


Figure 10. Exposed Stony substrate previously covered by sand Perch Scar 29-08-2023.



Figure 11. Loose, dense mussel on thick mud Perch Scar 29-08-2023.



Figure 12. Channel edge of Black Scar with higher density seed mussel and mussel mud 29-08-2023.



Figure 13. Mussel at 20 mm on Perch Scar 03-08-2023.



Figure 14. Channel edge of Black Scar with higher density seed mussel and mussel mud 29-08-2023.

South America Mussel Inspection (Quad) 01-09-23

LW: 07:32 0.5m (Liverpool tides)

An inspection of South America was completed to assess the condition of the mussel on the bed since the last inspection completed on the 4th August.

Although tide and conditions were good, access remains limited to a short period over low water due to the depth and size of the channel needing to be crossed. However, officers did manage to access a significant portion of the bed and obtain evidence of the condition and extent of the mussel present included an area to the North which due to tide restraints has not previously been mapped.

Figure 1 shows officer tracks (grey), the estimated area of mussel (blue) and the geolocations of the photographic evidence provided below.

The mussel bed can be split into three areas, the main bed which has been present for the last few years and requires crossing a large channel (Figures 2 to 22). The area of newly exposed stony substrate which received a 2023 settlement (Figures 23 to 31) and a strip of patchy mussel to the North of the bed which has not been previously mapped and was colonised by *Sabellaria alveolata*, reported on in April (Figure 32 to 34).

Crossing over the channel, mussel in the channel was present in patches and on thick mud. On the main extent of the bed, the spread of mussel was patchy, with areas of exposed cobble and mussel on sand (Figure 2,3,4,5,6,7,8 and 9). In the northern, central part of the upper bed, mussel was still patchy but there was softer mud, some loose mussel, large areas of exposed cobble and a mix of mussel sizes with coverage around 50% (Figure 10,11,12).

On the seaward side of the northern part of the bed, the mussel was around 25mm+ in higher densities and on thicker mud, but still patchy (Figure 13). This area gradually changed into a mix of shell and mussel on a thin layer of mud over cobble.

Further south, the bed had high levels of exposed cobble, with thin mud veneer and mussel (Figure 14 and 15) changing to mussel on exposed cobble with no mud beneath. Beyond the centre of the bed on the seaward side, there is a small area of uniform mussel on thin mud (16 and 17), this thin band of mussel runs along the seaward edge towards the bottom, however, along the landward side, there is a significant area of cobble where previous mussel has been scoured off (Figure 18).

Along the southern part of the channel edge there was areas of thicker mussel on mud that was showing signs of becoming loose and with little exposure of cobble (Figure 19,20 and 21). This area ran into the channel (Figure 22) where there was patches of mussel (25mm) and mud.

There has been a reduction in the density of mussel in the newly exposed and settled 2023 area to the West of the main bed. The area is a mix of bare stony substrate, mussel on a thin veneer of mud and/or sand and mussel on a thicker layer of mud (Figures 23 to 31). The mussel is approximately 20-25mm in length (Figure 24).

The strip of mussel North of the previously mapped area is less dense than the rest of the mussel with a sandy substrate and less exposed hard substrate (Figure 32). The mussel is approximately 25mm in length (Figure 33). Some mussel has settled on *Sabellaria alveolata* which was previously observed in April of 2023. The mussel becomes less dense as you move further North (Figure 34).

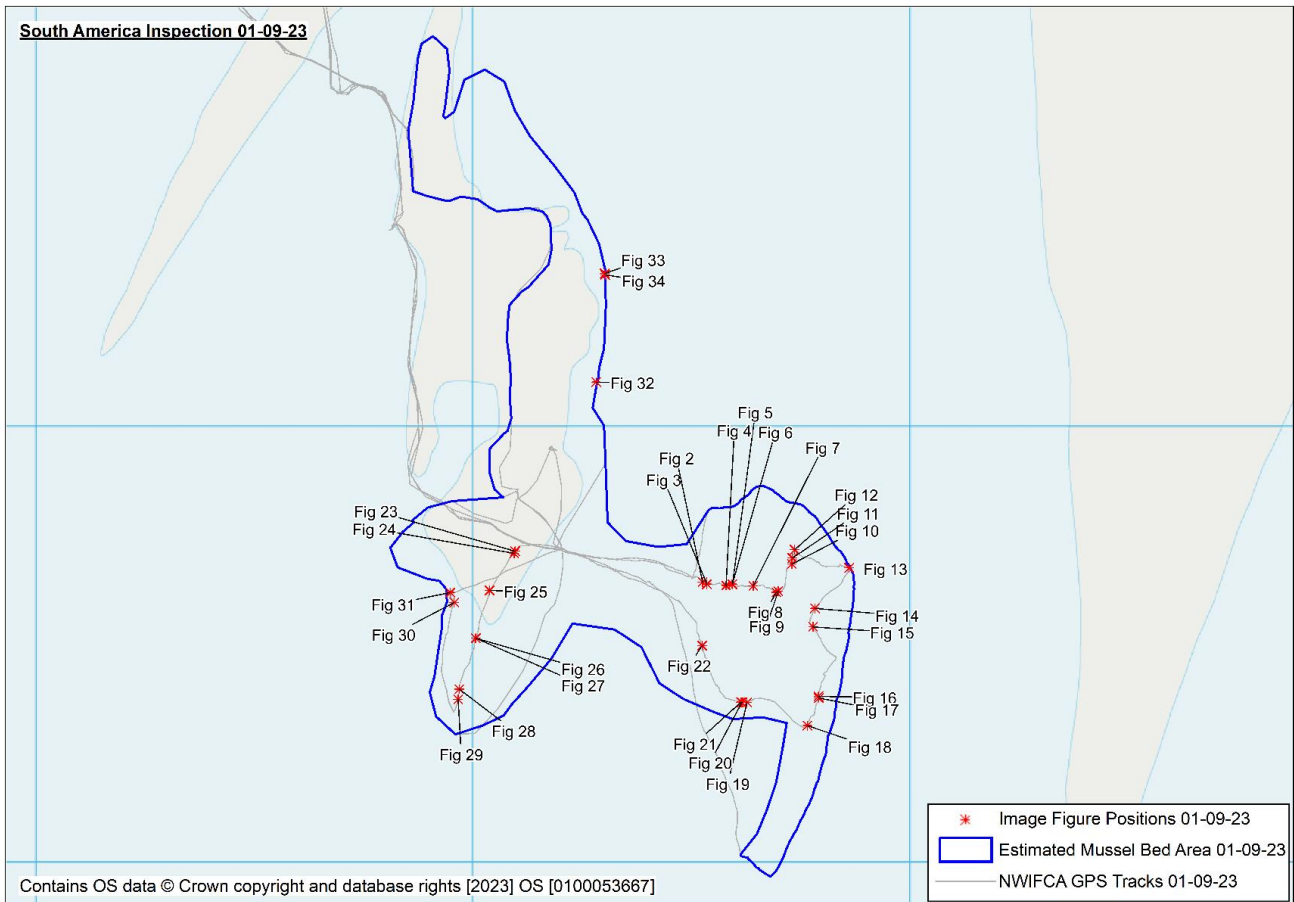


Figure 1. The extent of the South America mussel bed in Morecambe bay, and the geolocations of survey photos.

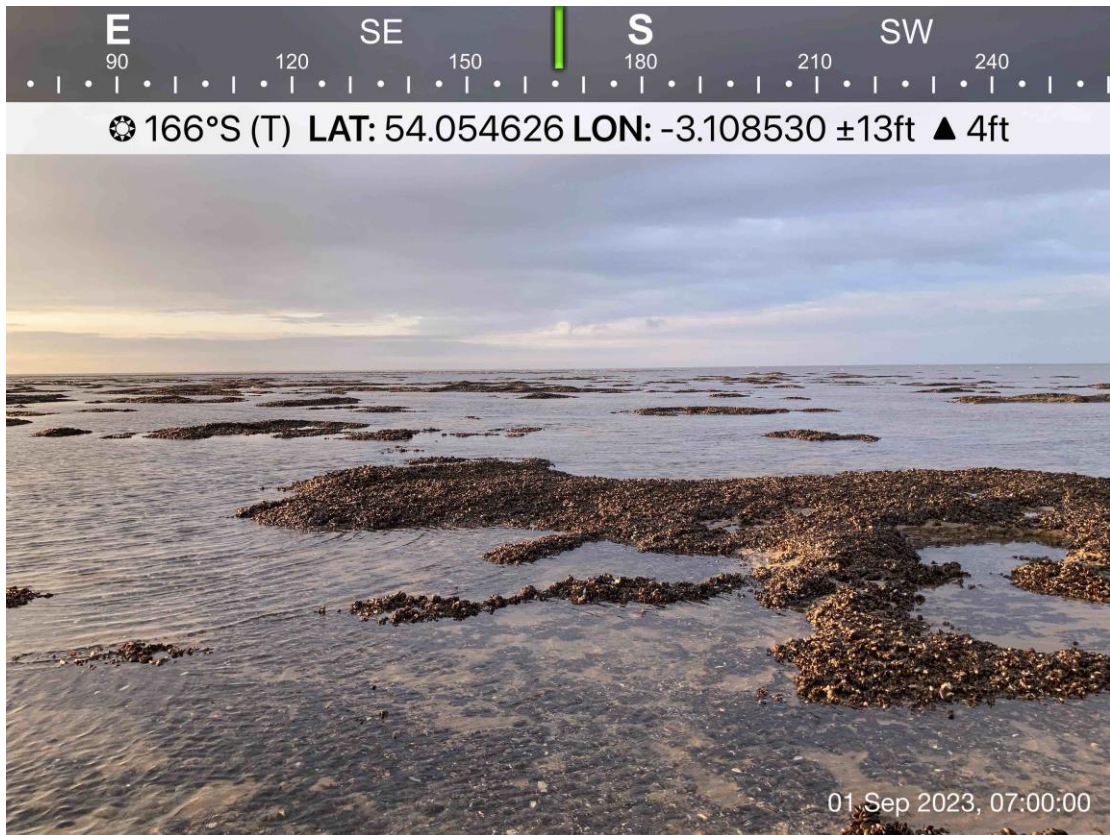


Figure 2. Mussel on thin mud along the edge of the main bed and channel 01-09-2023



Figure 3. Mussel on thin veneer of sand and mud over cobble 01-09-2023

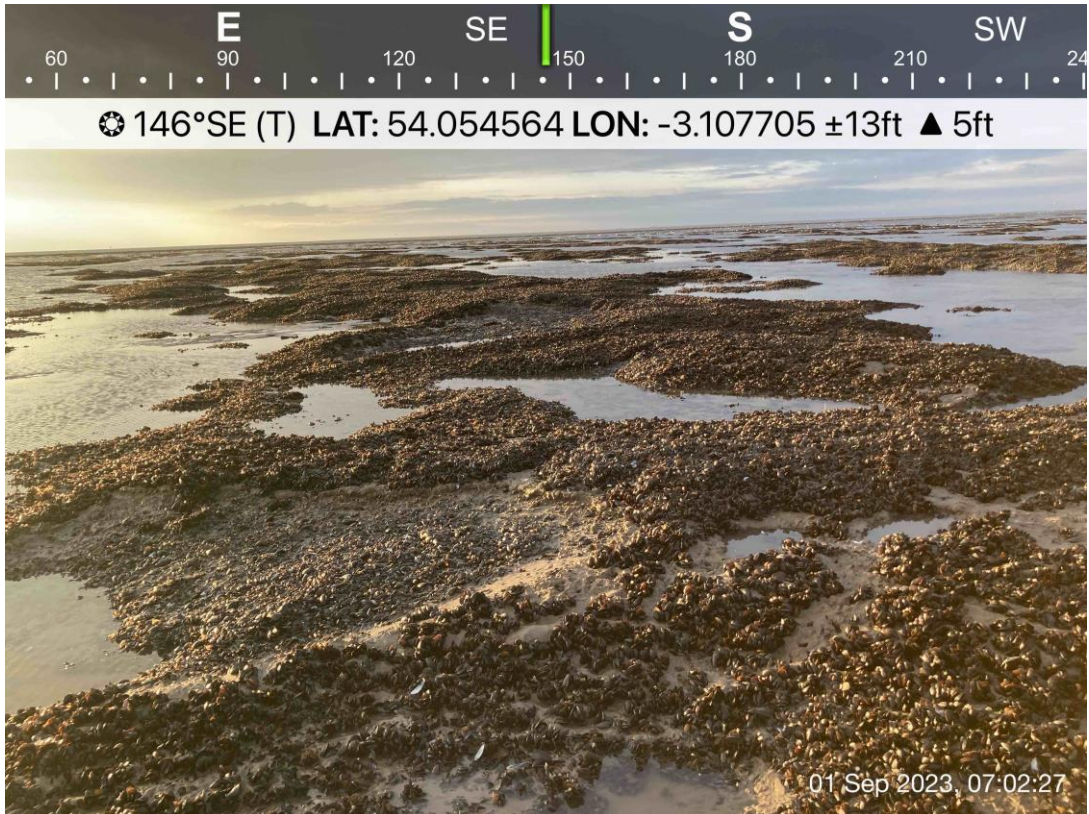


Figure 4. Mussel, scour and cobble exposure in the central north of the bed 01-09-2023

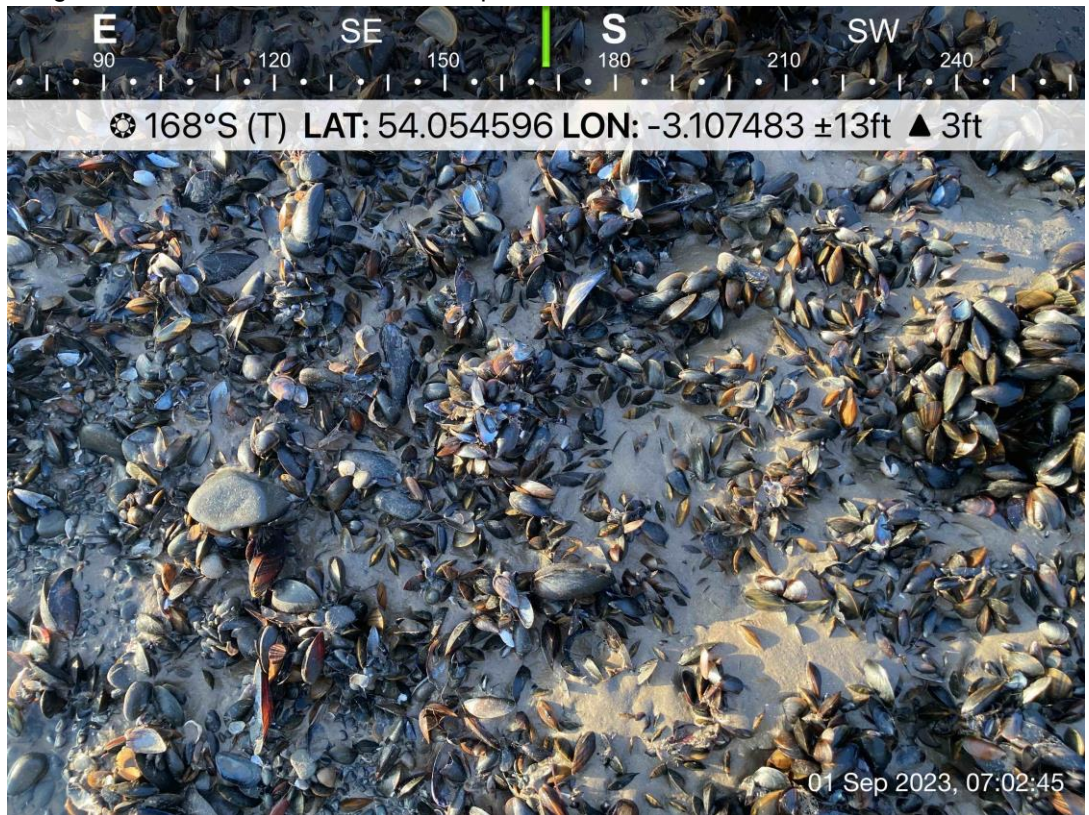


Figure 5. Mix of sizes and mussel with cobble 01-09-2023

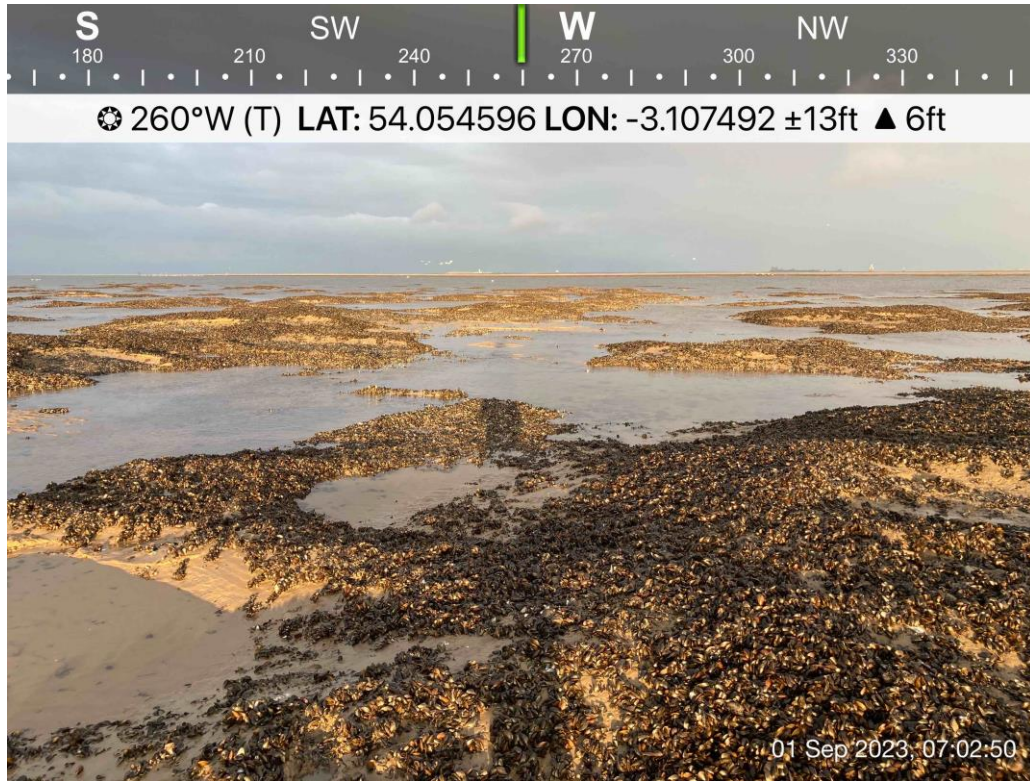


Figure 6. Thin mud and patchy mussel 01-09-2023



Figure 7. Exposed cobble beneath thin mud 01-09-2023

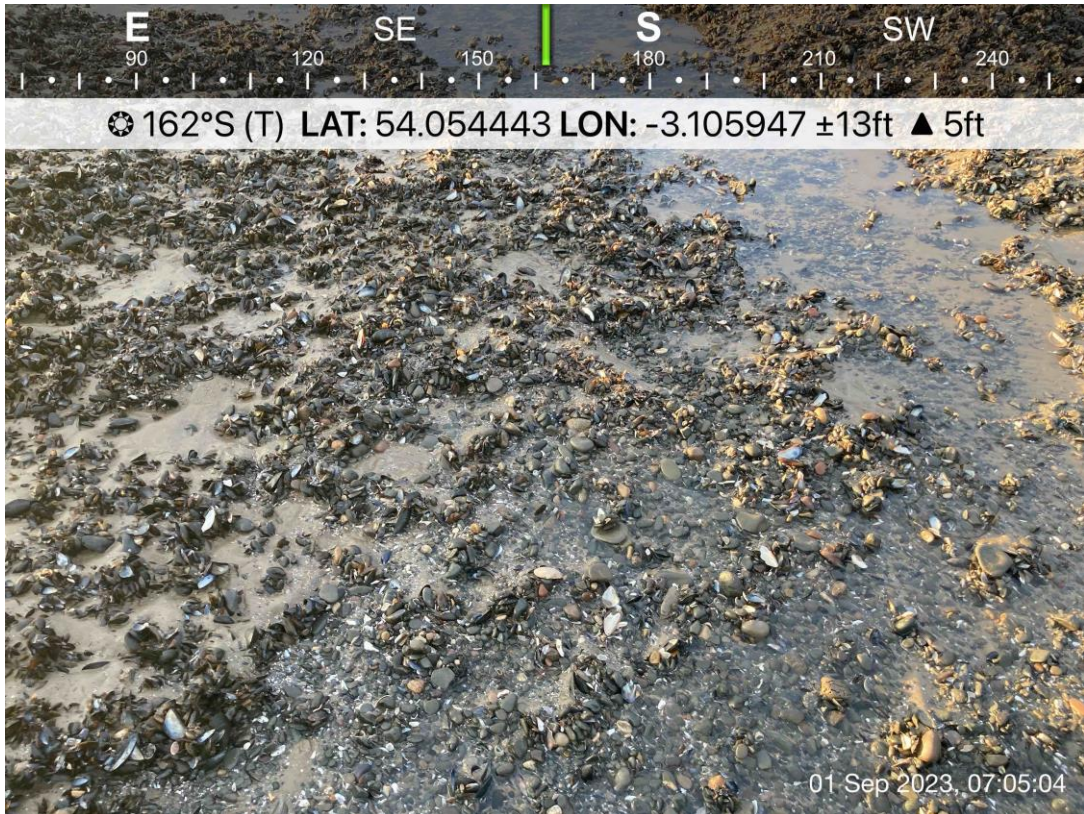


Figure 8. Exposed cobble and thin mussel coverage 01-09-2023

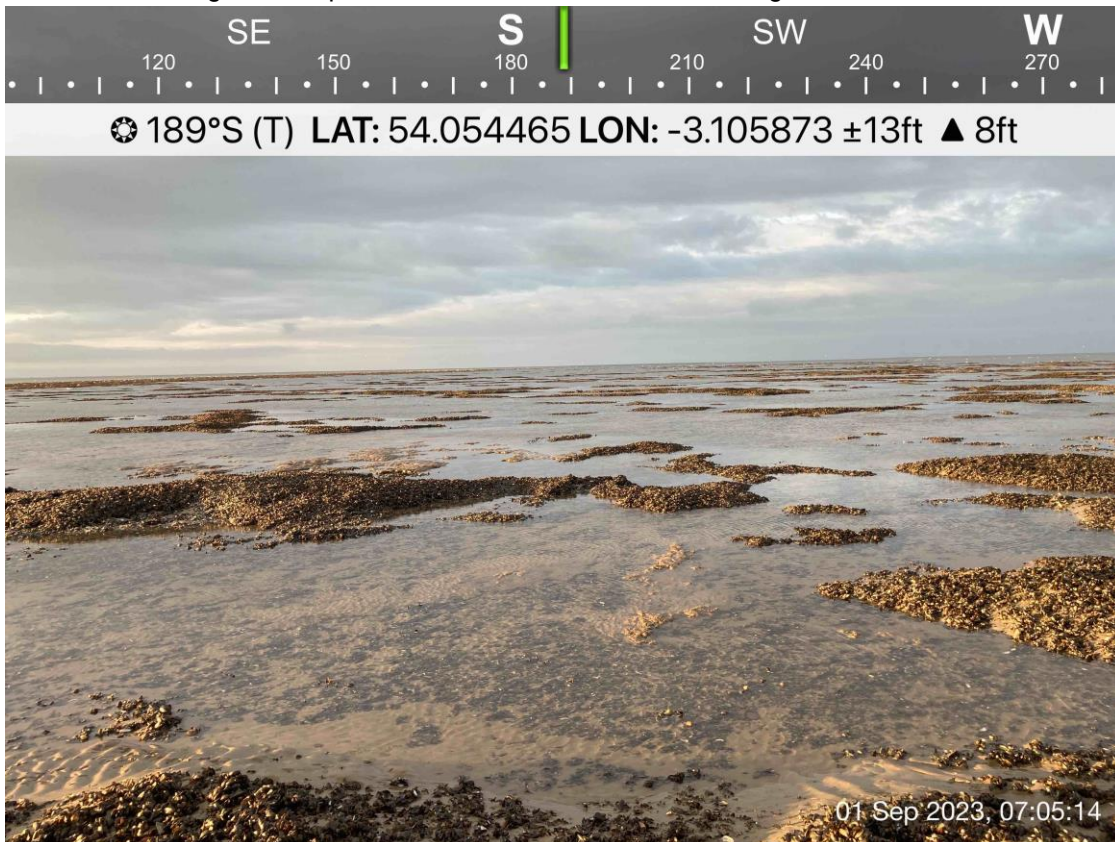


Figure 9. Exposed cobble and patchy mussel 01-09-2023

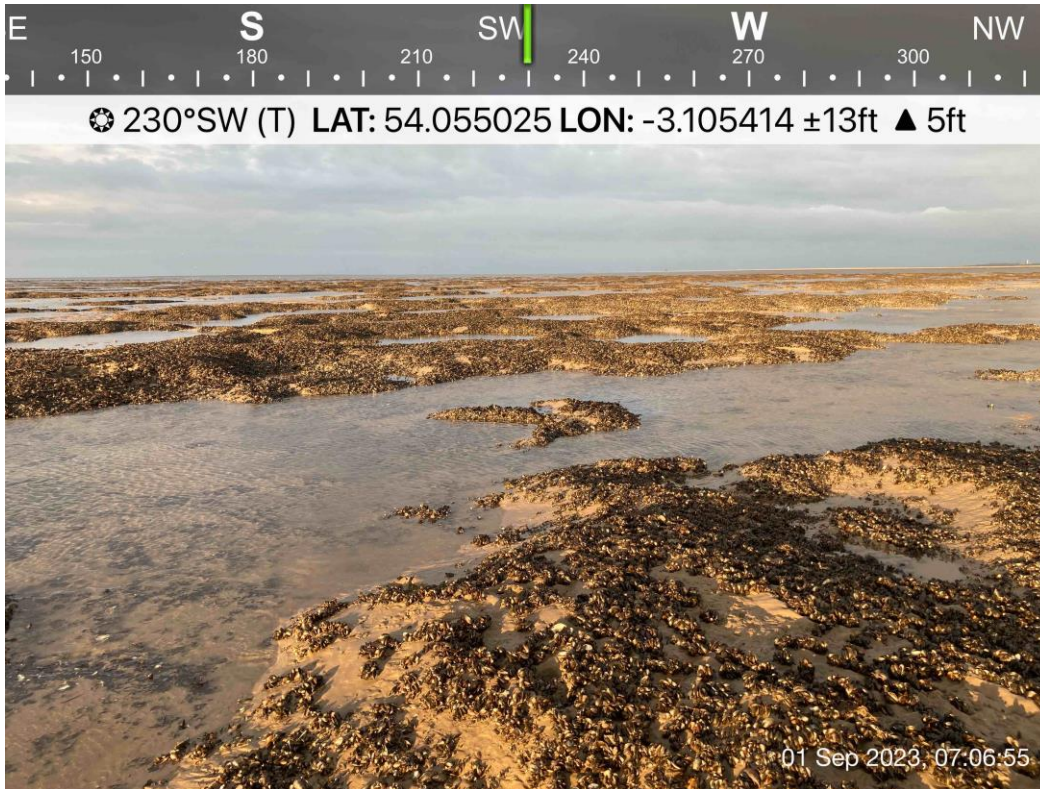


Figure 10. Shallow mud 01-09-2023.

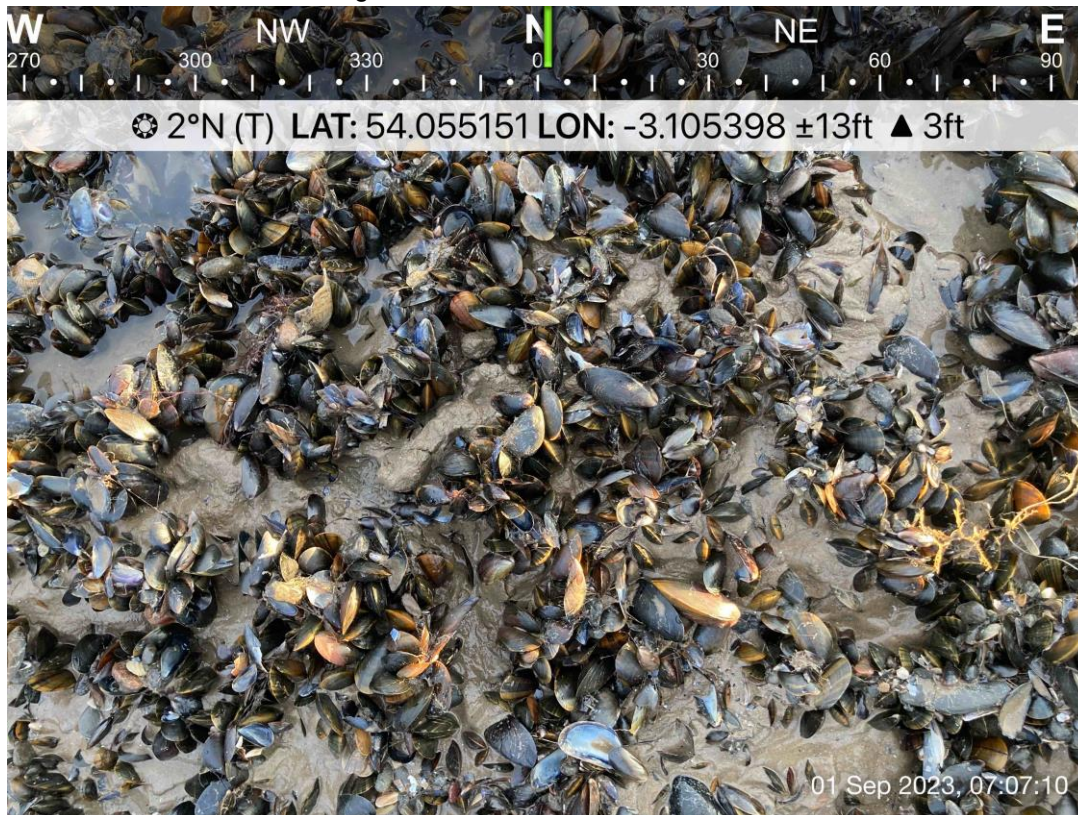


Figure 11. Mix of mussel sizes 01-09-2023.



Figure 12. large exposed areas and thin mussel coverage 01-09-2023.

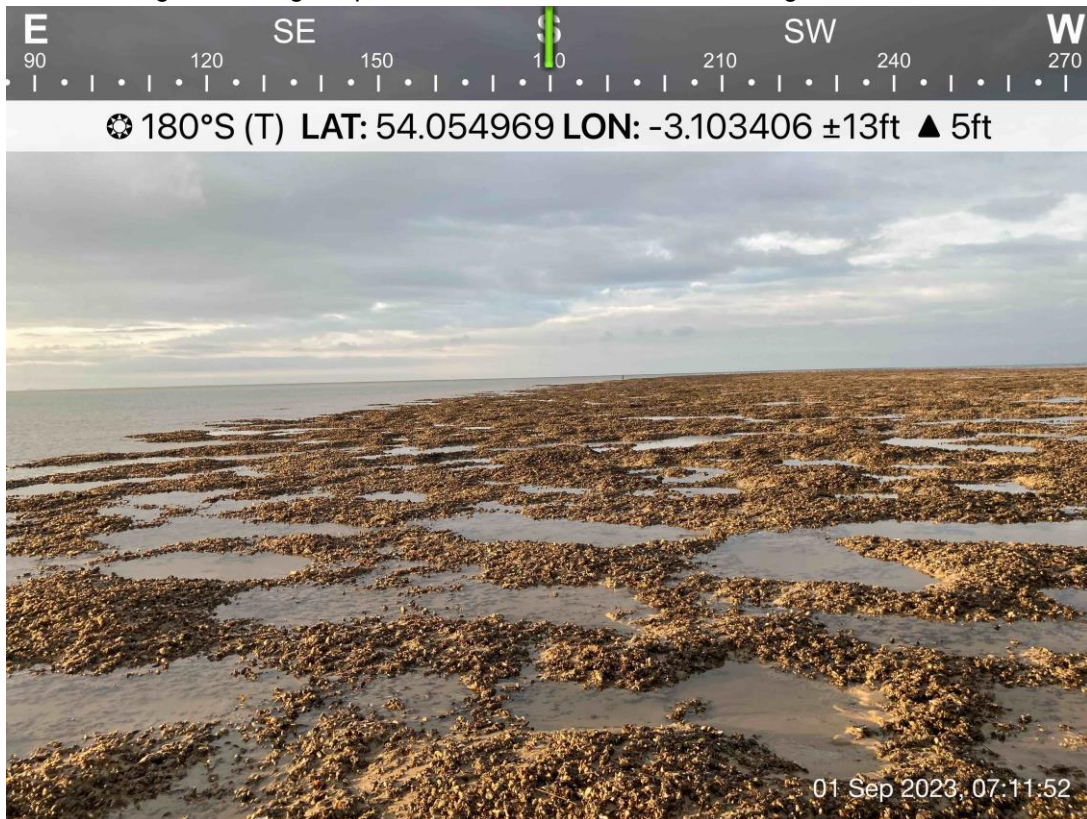


Figure 13. Area of mussel on mud 01-09-2023



Figure 14. Exposed cobble, thin mud and mussel shell 01-09-2023



Figure 15. Exposed cobble 01-09-2023

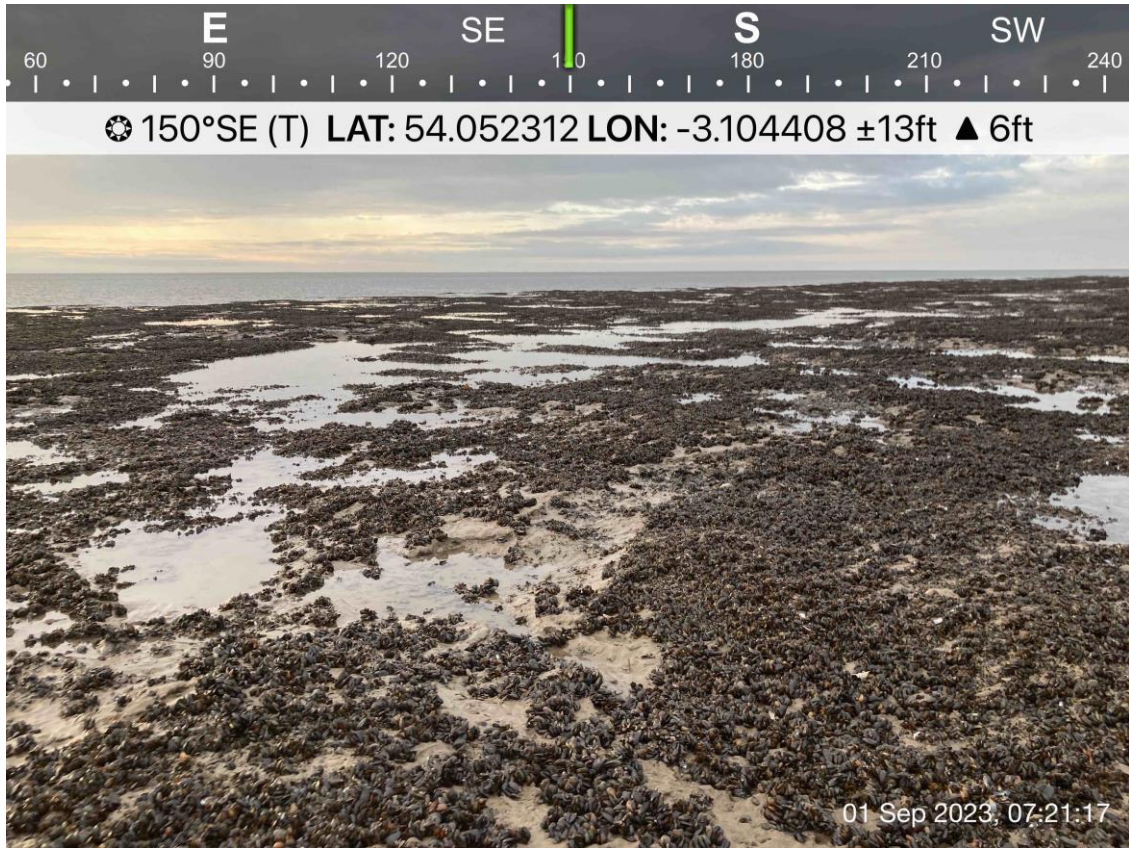


Figure 16. Denser area of mussel with thin mud 01-09-2023

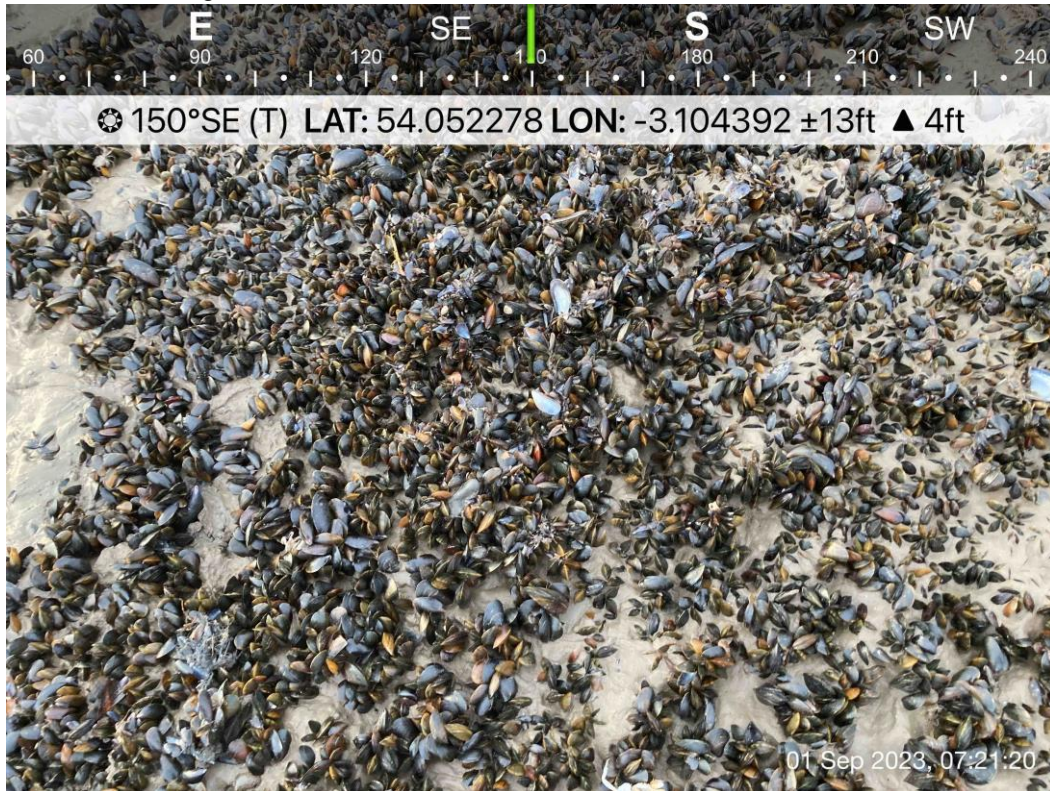


Figure 17. Mussel coverage on sand 01-09-2023



Figure 18. large area of exposed cobble 01-09-2023

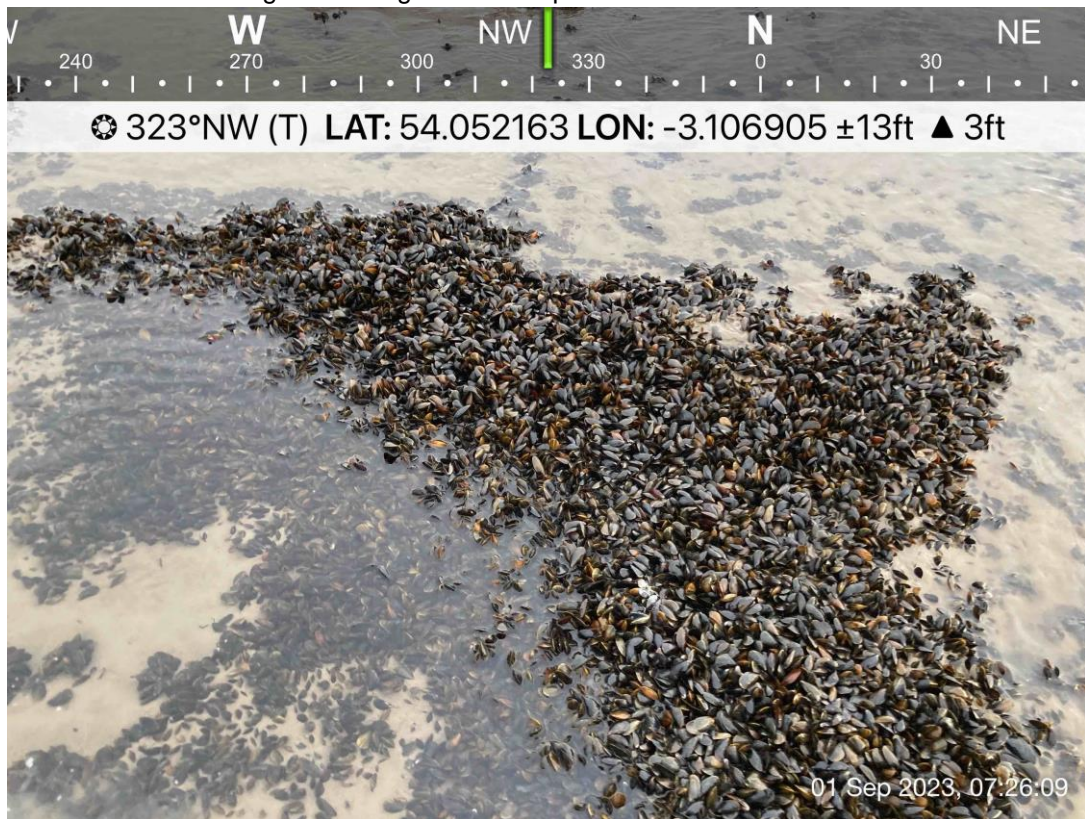


Figure 19. small patches of loose mussel on mud 01-09-2023

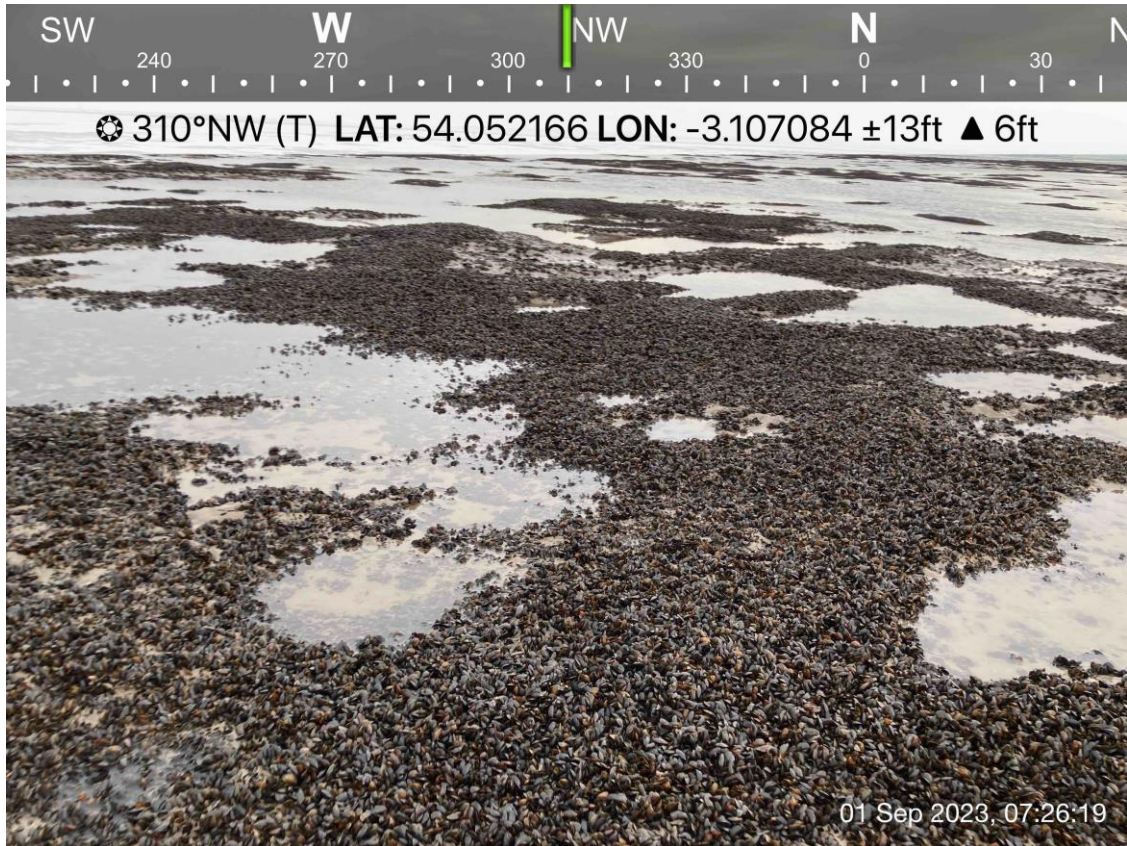


Figure 20. Mussel on mud on channel edge facing inshore 01-09-2023

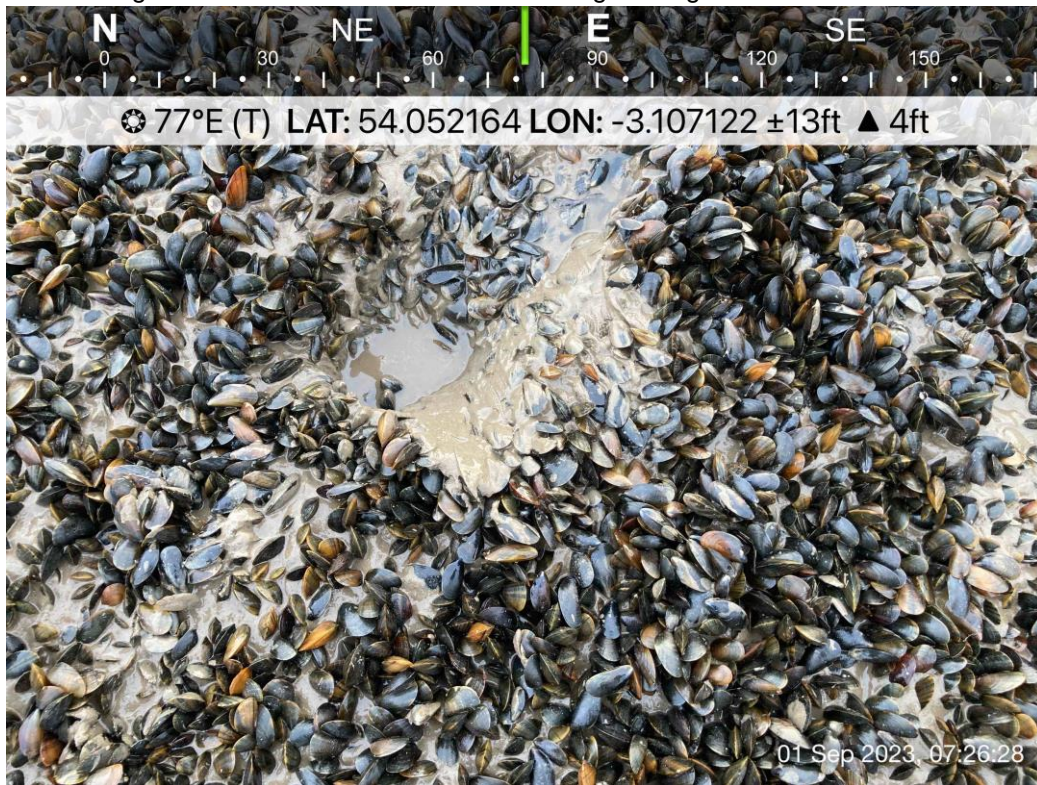


Figure 21. Loose mussel 01-09-2023



Figure 22. Patchy mussel on mud close to channel edge 01-09-2023

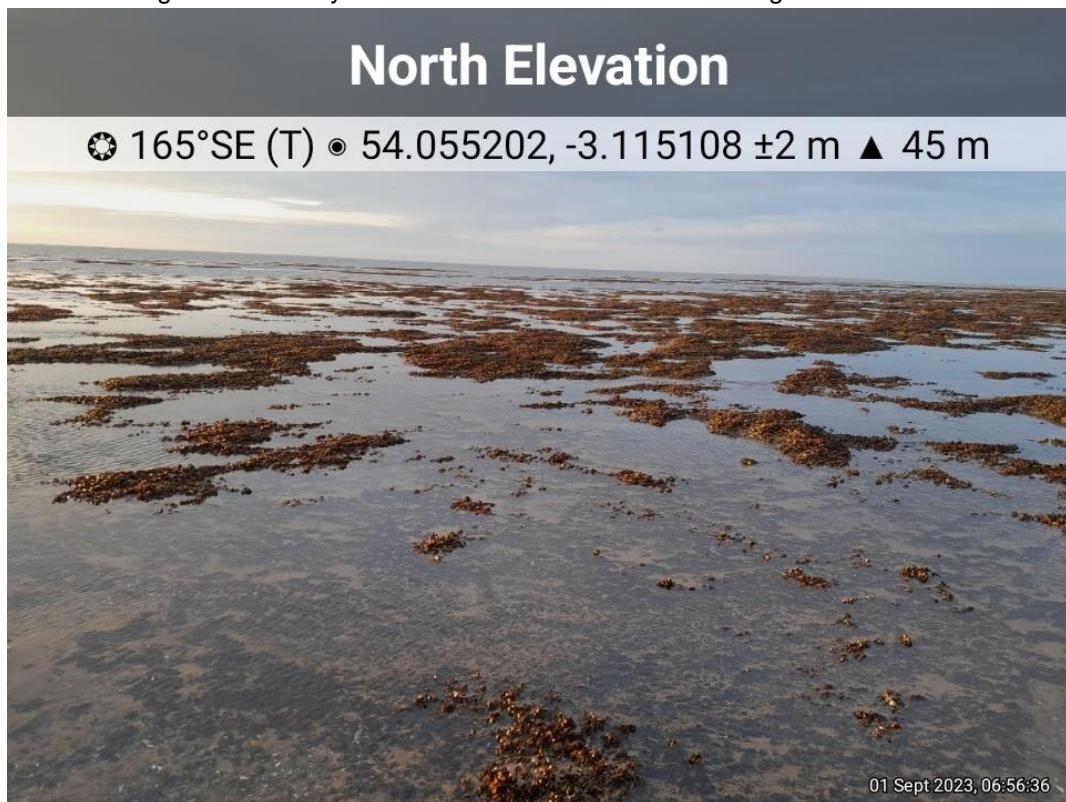


Figure 23. Area of mussel on soft mud, mussel on a thin veneer of sand/mud and bare stony substrate 01-09-2023



Figure 24. Mussel 20-25mm in length 01-09-2023

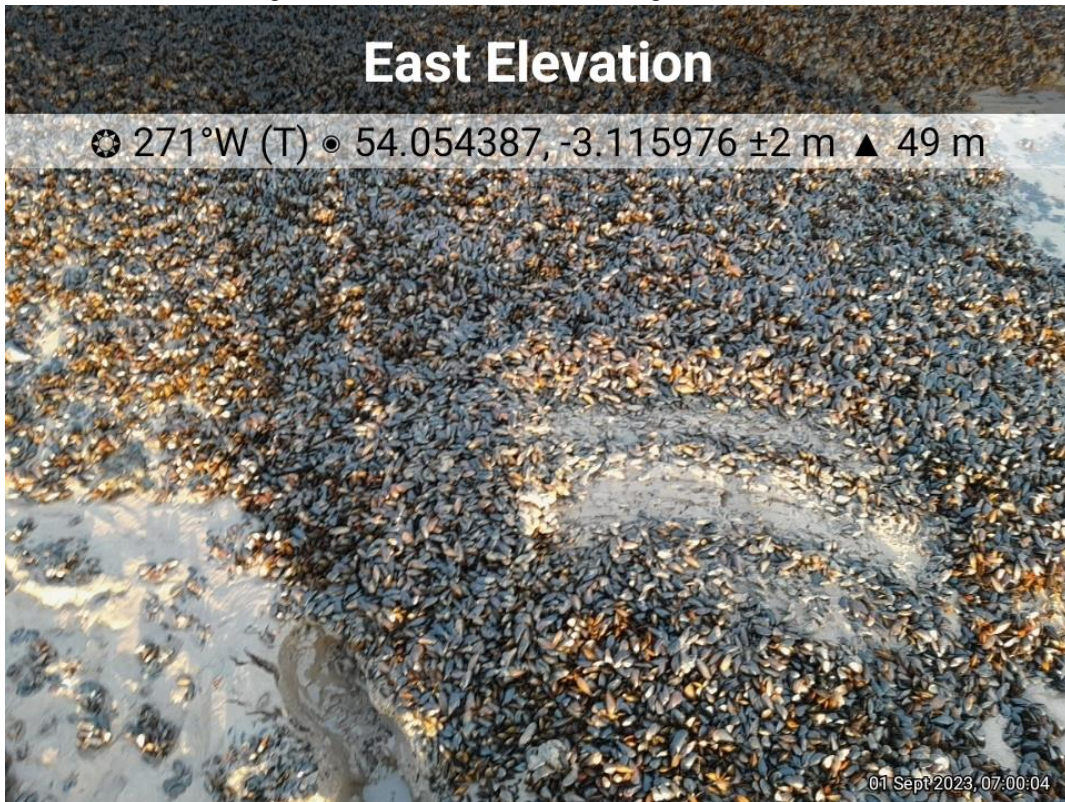


Figure 25. Area of loosed dense mussel on mussel mud 01-09-23



Figure 26. Area of mussel on mud and exposed stony substrate 01-09-23

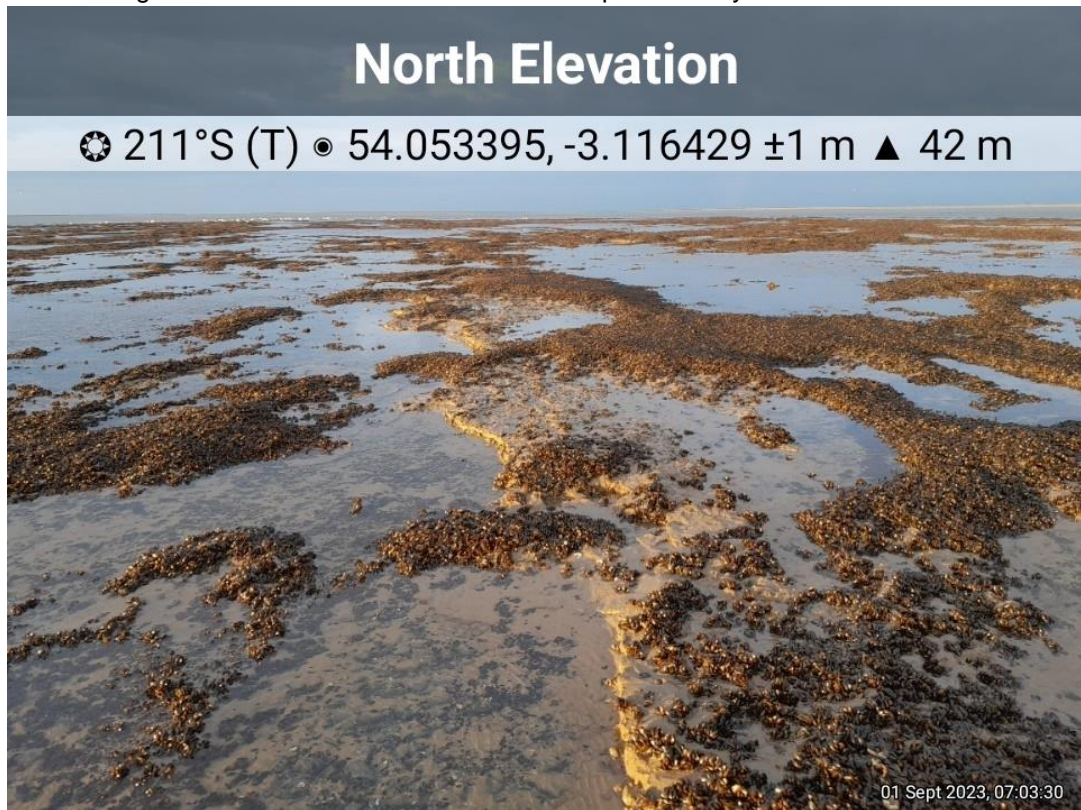


Figure 27. Area of mussel on soft mud, mussel on a thin veneer of sand/mud and bare stony substrate 01-09-2023

North East Elevation

☀ 254°SW (T) ● 54.052342, -3.116985 ±2 m ▲ 47 m



Figure 28. Area of mussel on a thin veneer of sand/mud and bare stony substrate 01-09-2023

North East Elevation

☀ 221°SW (T) ● 54.052132, -3.117018 ±1 m ▲ 45 m



Figure 29. Area of stony substrate with less dense mussel with thin sediment veneer 01-09-23



Figure 30. Area of dense loose mussel on a thicker layer of mussel mud 01-09-23



Figure 31. Strip of exposed stony substrate within the bed area 01-09-23

South East Elevation

☀ 308°NW (T) ● 54.05871, -3.112354 ±10 m ▲ 46 m



Figure 32. Overview of Northern extent of the bed, where mussel is less dense 01-09-23

East Elevation

☀ 258°SW (T) ● 54.06095, -3.112116 ±14 m ▲ 43 m



Figure 33. Less dense mussel in the Northern extent of the bed 01-09-23

South East Elevation

☉ 339°NW (T) ● 54.060923, -3.112104 ±8 m ▲ 51 m



01 Sept 2023, 07:46:01

Figure 34. Overview of Northern extent of the bed, where mussel is less dense 01-09-23

Foulney Dutch Wand Mussel Survey 04-09-23

Officers present: MC, GG, AP, ID

Low water: 09:32 1.0m (Liverpool Tides)

Survey method: Dutch Wand

Line transects were completed across the mussel bed using a Dutch Wand, transects start and finish at the edge of the bed as shown in Figure 2. The number of hits and misses of live mussel were recorded to give percentage cover. The bed area was calculated from the start and end of transects and from observations of officers whilst surveying. It was not possible to walk the perimeter of the bed due to time and tide restraints. A mussel sample was taken every 25 hits using a 10 cm diameter corer. 13 transects were completed and 56 samples collected. The total weight of live undersize and size mussel was recorded as well as the size frequency of each sample. No seed settlement was observed during the survey. Note, not all size mussel is fishable due to the presence of fouling species on slower growing individuals or the mixing of undersize and size in close proximity that prevents the removal of sizeable mussel without removing undersize.

From the transect and sample data the total mussel bed surveyed was **48.17 hectares**. There was no separation made between the main Foulney bed and Foulney Island.

Biomass

3864 tonnes size mussel and 1633 tonnes undersize mussel.

Length Frequencies

The total length frequency for the surveyed bed is provided in Figure 3. From the length frequency data the majority of mussel present on Foulney Skear is currently a mix of size and undersize with a wide spread of mussel from 6mm to 79mm but mainly between 30mm and 60mm.

Maps

The frequency of each size class of mussels per sample has been mapped in Figure 4 with the size of the pie adjusted for sample weight standardised to kg/m². The weight of the size and undersize mussel has been mapped and represented in Figure 5.

It can be seen in Figures 4 and 5 that the size mussel >45 mm is predominantly on the lower half of the main skear and on the island. Undersize mussels were mainly congregated higher up the main skear with some mixed in with size mussel in the middle of the skear.

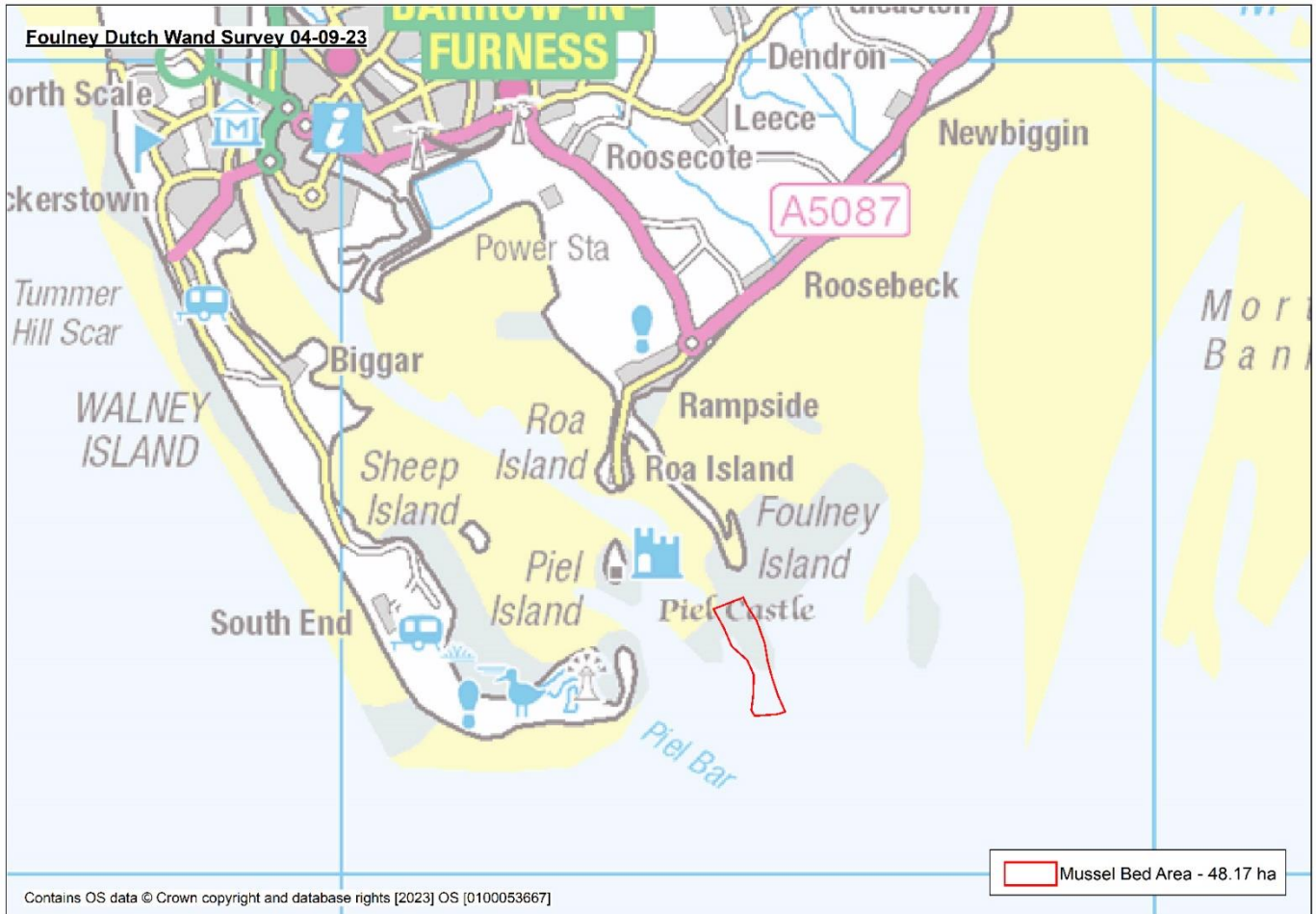


Figure 1 - Location of Foulney Mussel Bed surveyed 04-09-23.

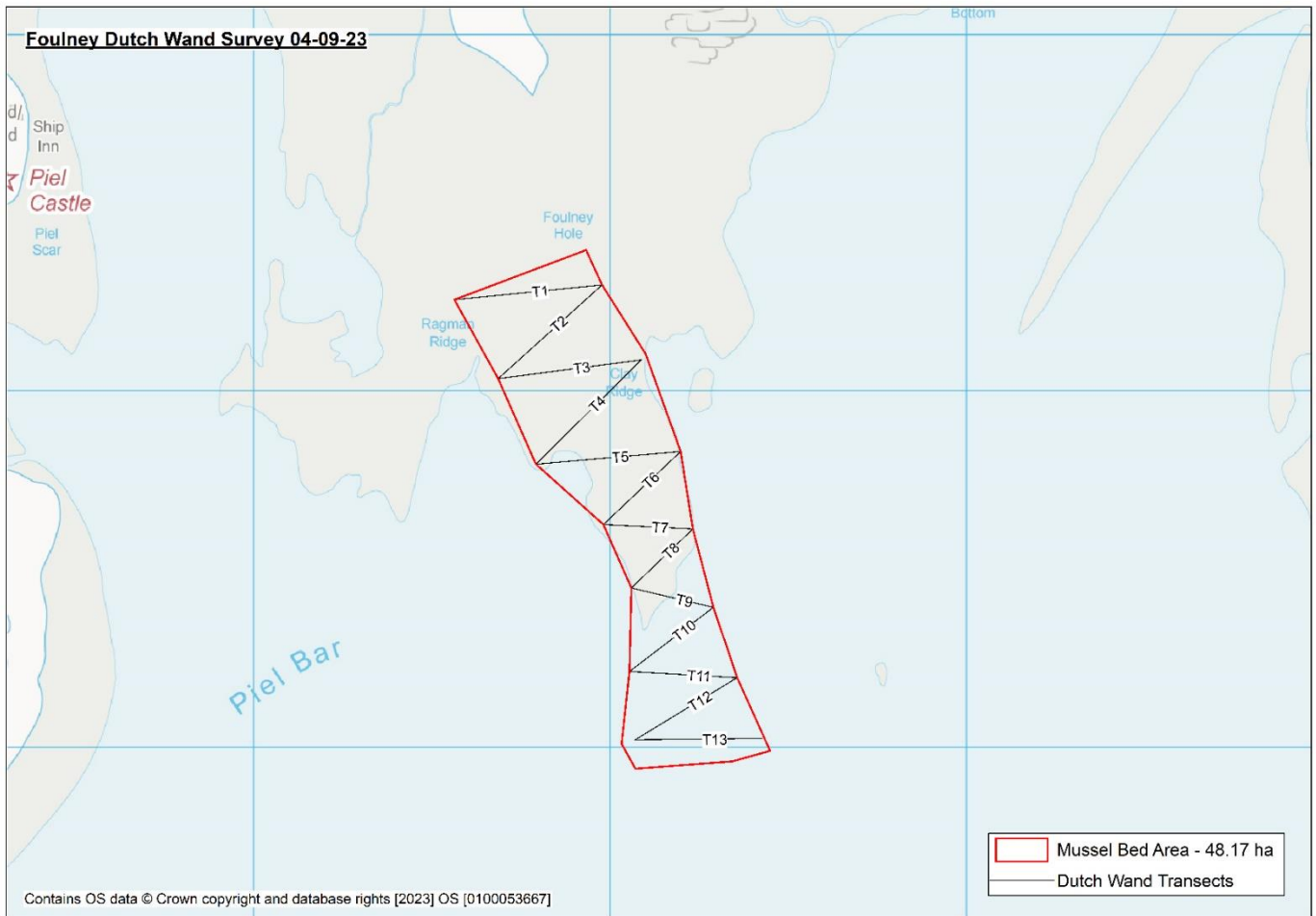


Figure 2 - Foulney Dutch Wand survey transects and estimated bed area.

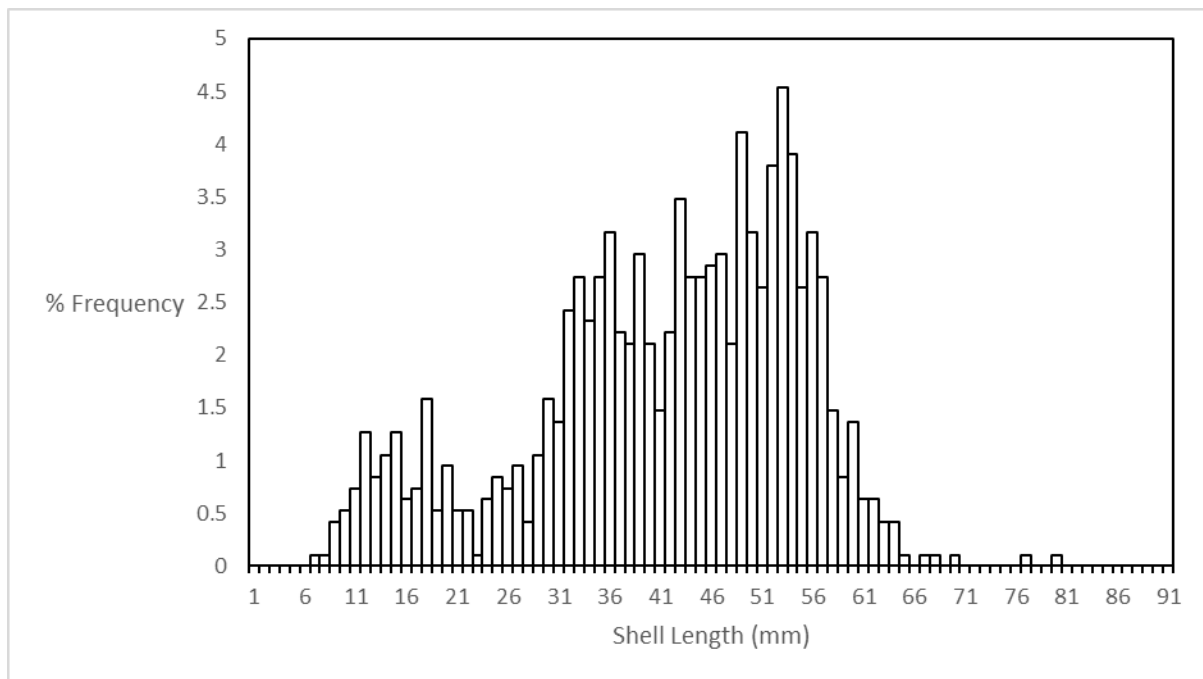


Figure 3 - Histogram showing size frequency of mussels from all samples on Foulney.

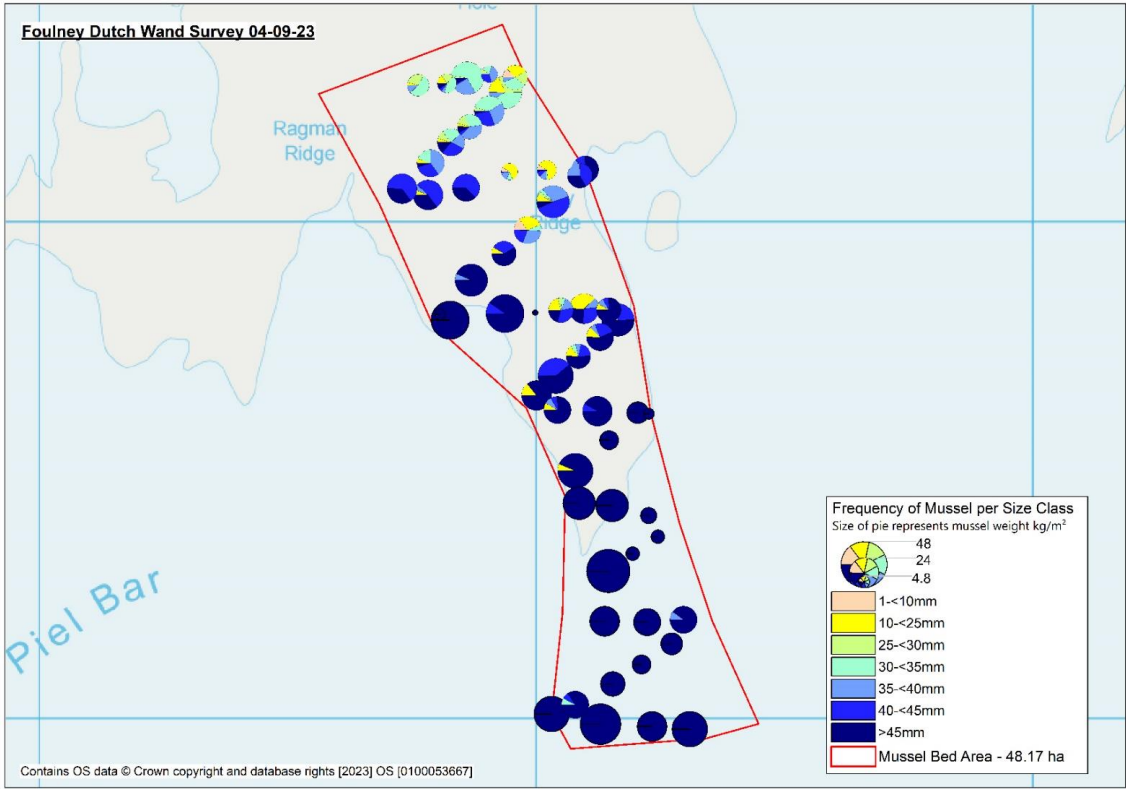


Figure 4 - Frequency of mussel by size class.

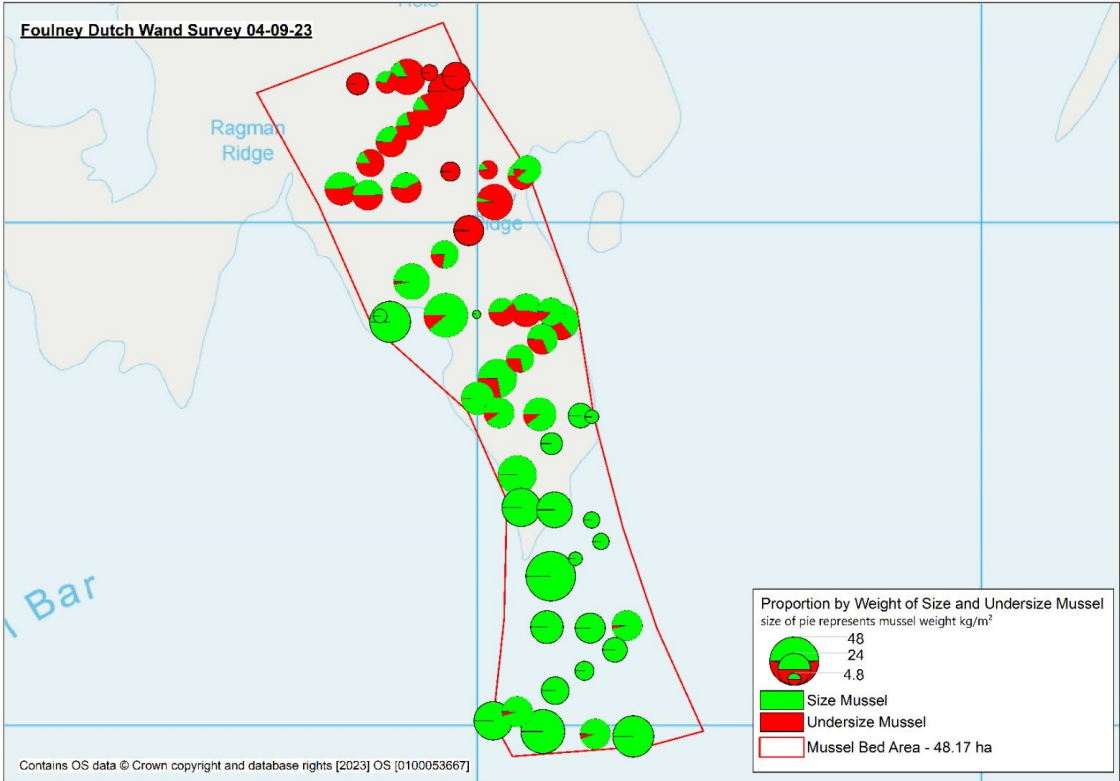


Figure 5 -

Proportion of size and undersize mussel by weight represented as kg/m².

Annex 2

Flookburgh Cockle Size Check Survey 3rd October 2023

Officers present: ID, RL, JH, GG
Tides: 08:59 1.3 (Liverpool Scale)

Survey method - Jumbo and 0.5m² quadrat

61 stations were sampled from the usual 500m grid surveyed on Flookburgh, as the reason for the survey was to check if the cockle had grown significantly since the survey completed in July, stations were chosen due to the likelihood of reaching size and those with a higher density. Therefore, no bed areas have been provided in the maps, all calculations are based on a 15.25 square kilometre survey area. The July survey data has been reworked based on the same survey stations and survey area to allow for comparison.

Overall the cockle has increased in density and total biomass which is to be expected between July and October. The average number of size cockle in the survey area has over doubled from 7 per m² to 15 per m² and from an estimated biomass of 746 tonnes to 1821 tonnes. There has only been a small change to the maximum number of size cockle in any one survey station from 66 to 68 per m². This is mainly due to some of the 20-25mm cockle reaching size. The average number of undersize cockles has increased from 122 per m² to 188 per m² with an increased estimated biomass from 3984 tonnes to 5659 tonnes. This increase in density is due to the inclusion of cockle classified as spat in the July survey and the increase in biomass is due to the inclusion of July spat and a growth of all size classes.

Although some cockle has reached size, the majority of the cockle remains undersize, with the average percentage of undersize cockle for all surveyed station of 90%, even when removing less than 15mm cockle the percentage of undersize remains high at 83%. Further calculations have been produced in table for where all station where the density of size cockle is below 20 per m² have been removed, the percentage of undersize remain high at 82% when removing less than 0-5mm cockle and 70% when removing less than 15mm cockle.

Means

Means were calculated from all survey stations to provide a comparison with the previous survey. Less than 5mm cockle was not used in the undersize figures due to the high variable survivability of cockle at this small size but has been included as a separate figure.

Size Class	Category	July (no. per m ²)	October (no. per m ²)	+/- (no. per m ²)	+/- (%)
Size Cockle	Mean	7	15	+8	+114
	Min	0	0	0	0
	Max	66	68	+2	+3
Undersize Cockle	Mean	122	188	+66	+54
	Min	16	0	-16	-100
	Max	590	978	+388	+66
0-5mm Cockle	Mean	23	28	+5	+22
	Min	0	0	0	0
	Max	200	800	+600	+300

Table 1. Comparison of mean, minimum and maximum cockles per m² of biomass for 0-5mm cockle, size, and undersize for the total surveyed area.

Size Class	Category	July (kg/m ²)	October (kg/m ²)	+/- (kg/m ²)	+/- (%)
Size Cockle	Mean	0.049	0.119	+0.070	+143
	Min	0	0	0	0
	Max	0.171	0.543	+0.372	+218
Undersize Cockle	Mean	0.261	0.371	+0.110	+42
	Min	0.022	0	-0.022	-100
	Max	1.072	2.216	+1.144	+107

Table 2. Comparison of mean, minimum and maximum weight of cockles per m² of biomass for 0-5mm cockle, size, and undersize for the total surveyed area.

Maps

Maps were created showing the overall survey area, density of size cockle, density of undersize cockle (excluding cockles in the 0-5mm size range) the density of the 0-5mm size class, the frequency of size classes, the size of the pie chart indicates the total density of cockles present, and the weight of undersize and size cockle.

Biomass

Size Class	July (tonnes)	October (tonnes)	+/- (tonnes)	+/- (%)
5-15mm	148	734	+586	+396
15-20mm	1644	1323	-321	-20
20-25mm	2131	3623	+1492	+70
25-35mm	778	1784	+1006	+129
>35mm	29	16	-13	-45
Size ¹	746	1821	+1075	+144
Undersize ²	3984	5659	+1675	+42
Total	4730	7480	+2750	+58

¹In regards to biomass size cockle defined as cockle which will not pass through a square gauge 20 x 20mm in size.

²The biomass of undersize cockle does not include any estimates of cockle less than 5mm due to the high variability of survival of this size class.

Table 3 – Comparison of biomass for each size class of cockle, size, undersize and total for the surveyed area.

Cockle Composition

The cockle composition in table 4 has been split into different categories. Survey stations with no cockles have been removed from all calculations. The percentage of undersize has been provided for all surveyed stations with cockle present, one calculation for excluding 0-5mm, due to the high variable survivability of small cockle and 0-15mm cockle as not likely to be effected by fishing. Values have also been provided for survey station of a density of 20 cockle per m² or more, as this is likely to be the lowest density of cockles that would be fished.

Category	Percentage of undersize cockle			
	All surveyed stations (0-5mm cockle excluded)	All survey stations (0-15mm cockle excluded)	Size ¹ cockle >20m ² (0-5mm cockle excluded)	Size ¹ cockle >20m ² (0-15mm cockle excluded)

Average	90	83	82	70
Min	58	38	58	38
Max	100	100	95	93

¹ Size cockle defined as cockle which will not pass through a square gauge 20 x 20mm in size.

Table 4 – Percentage of undersize cockle October 2023

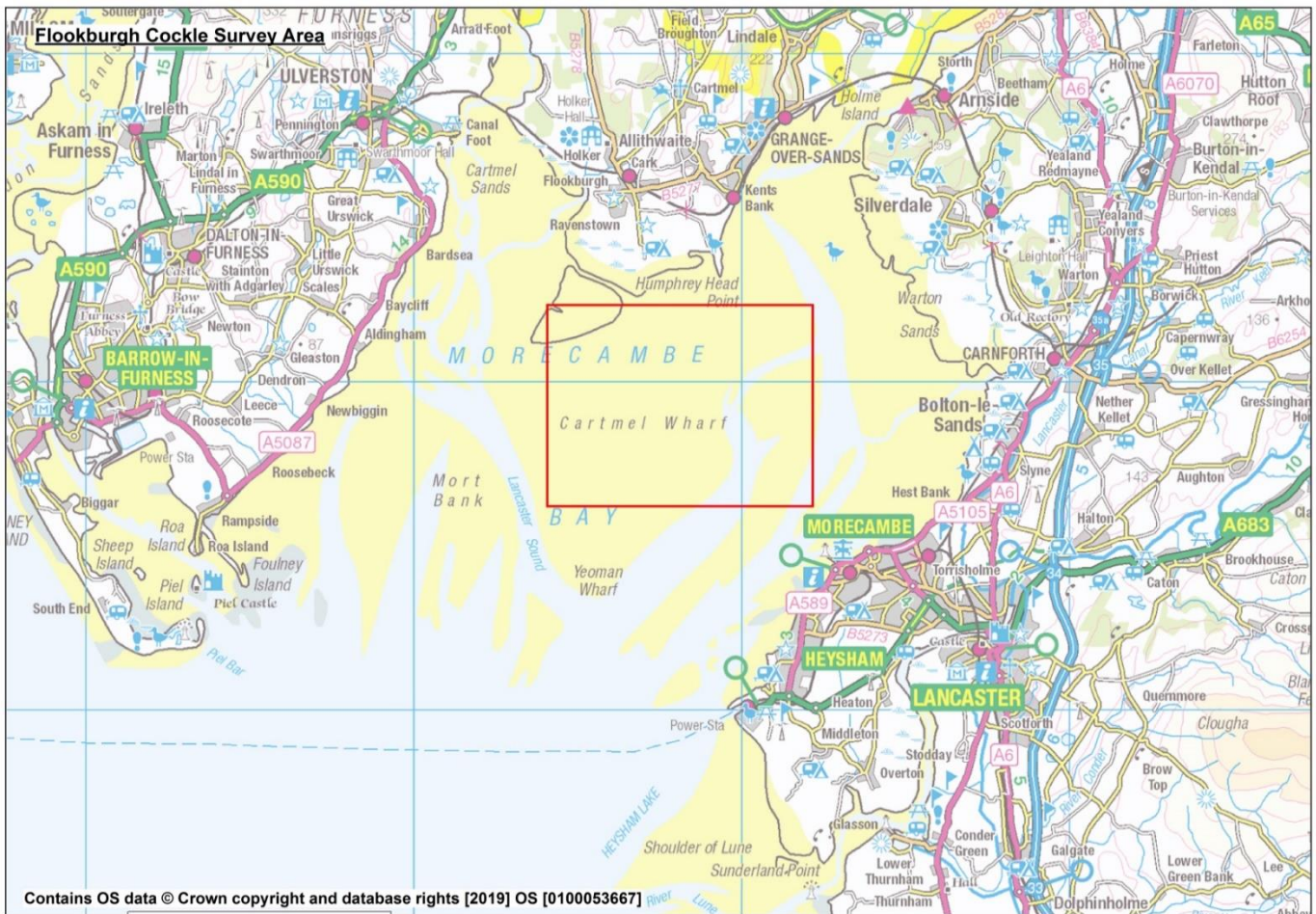


Figure 1. Illustration of position of Flookburgh Survey Area.



Figure 2. Density of size cockle per m² Flookburgh July 2023.

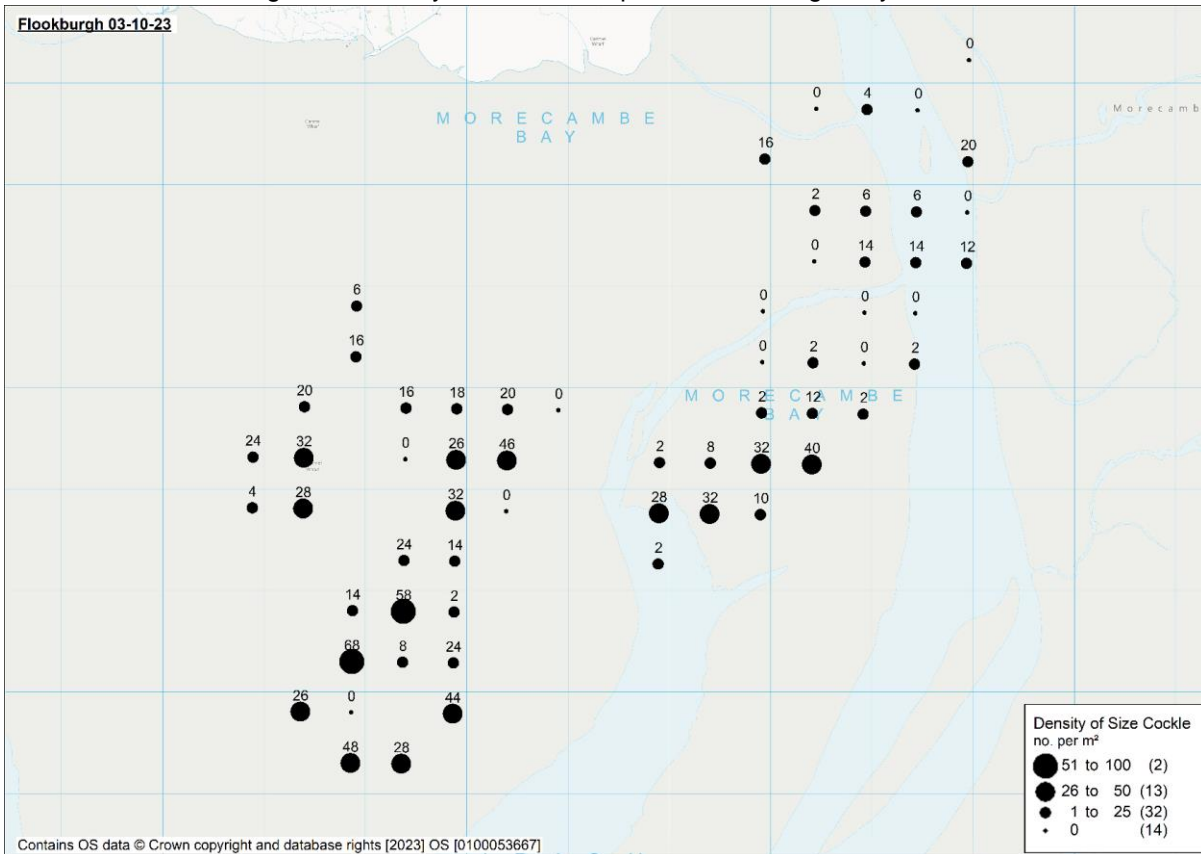


Figure 3. Density of size cockle per m² Flookburgh October 2023.

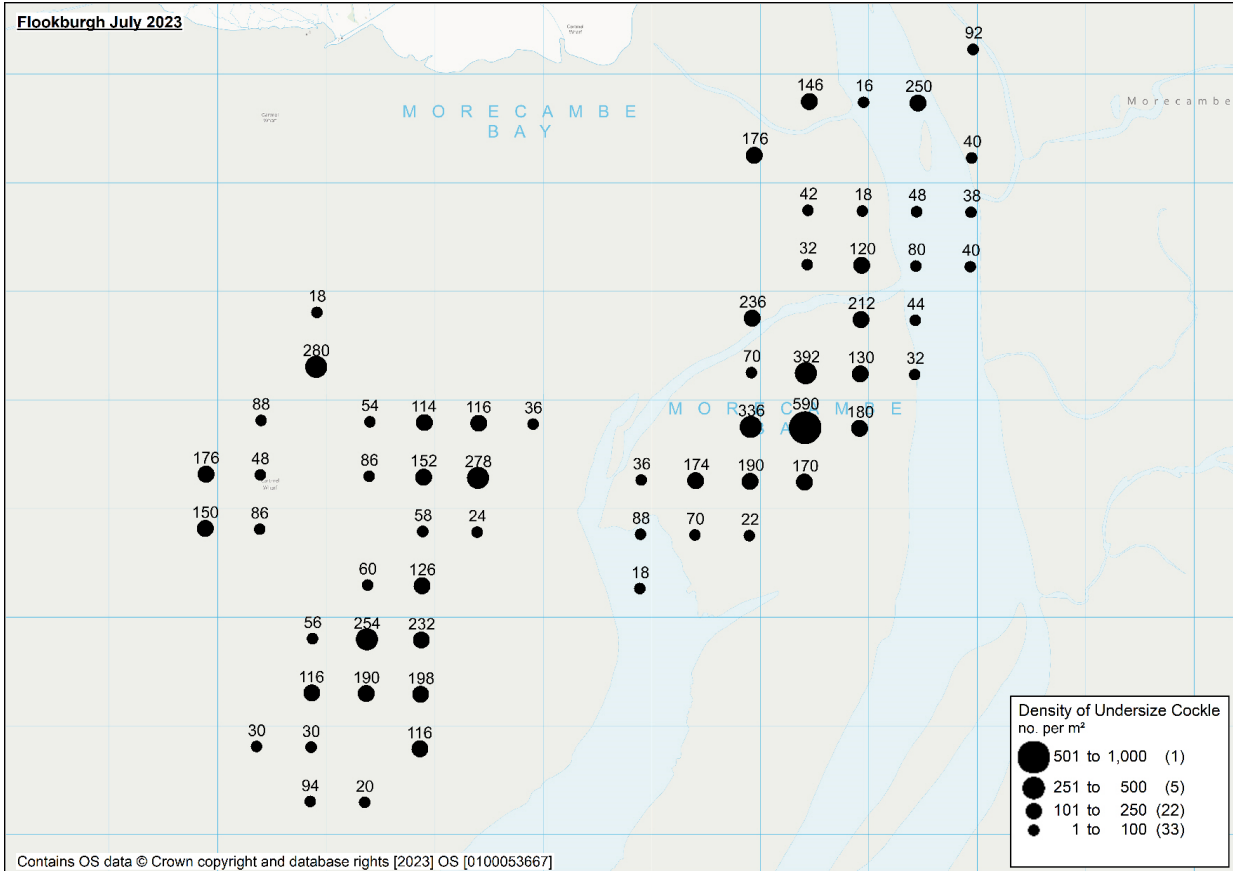


Figure 4. Density of undersize cockle per m² Flookburgh July 2023.

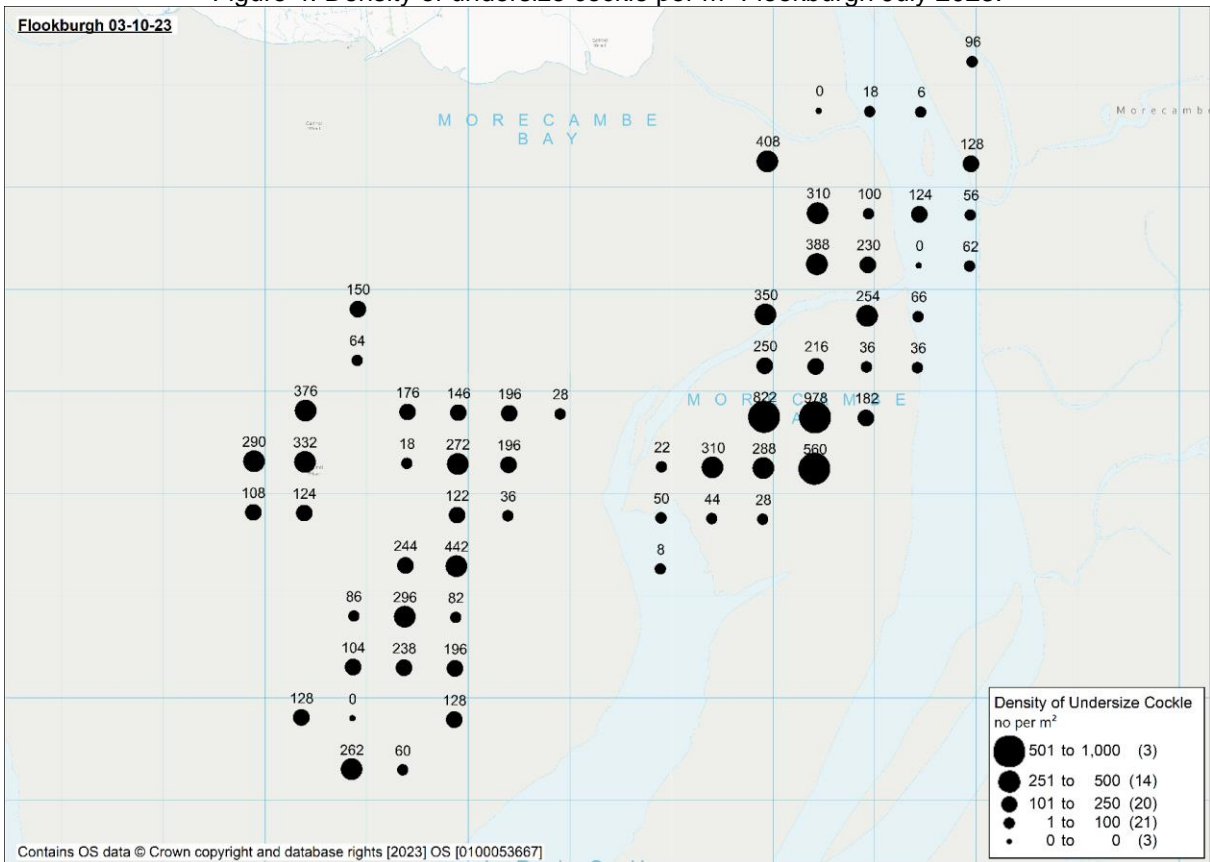


Figure 5. Density of undersize cockle per m² Flookburgh October 2023.

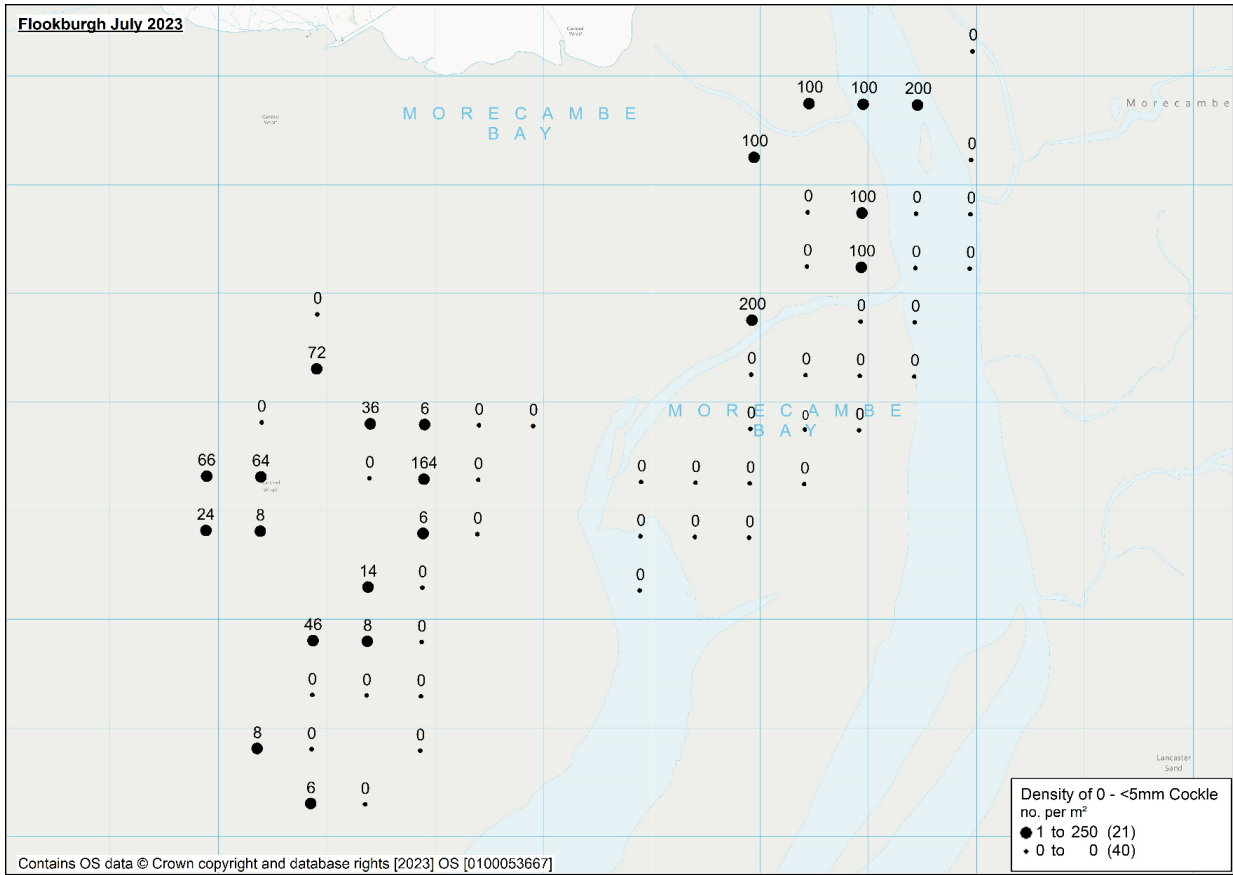


Figure 6. Density of 0-5mm cockle per m² Flookburgh July 2023.

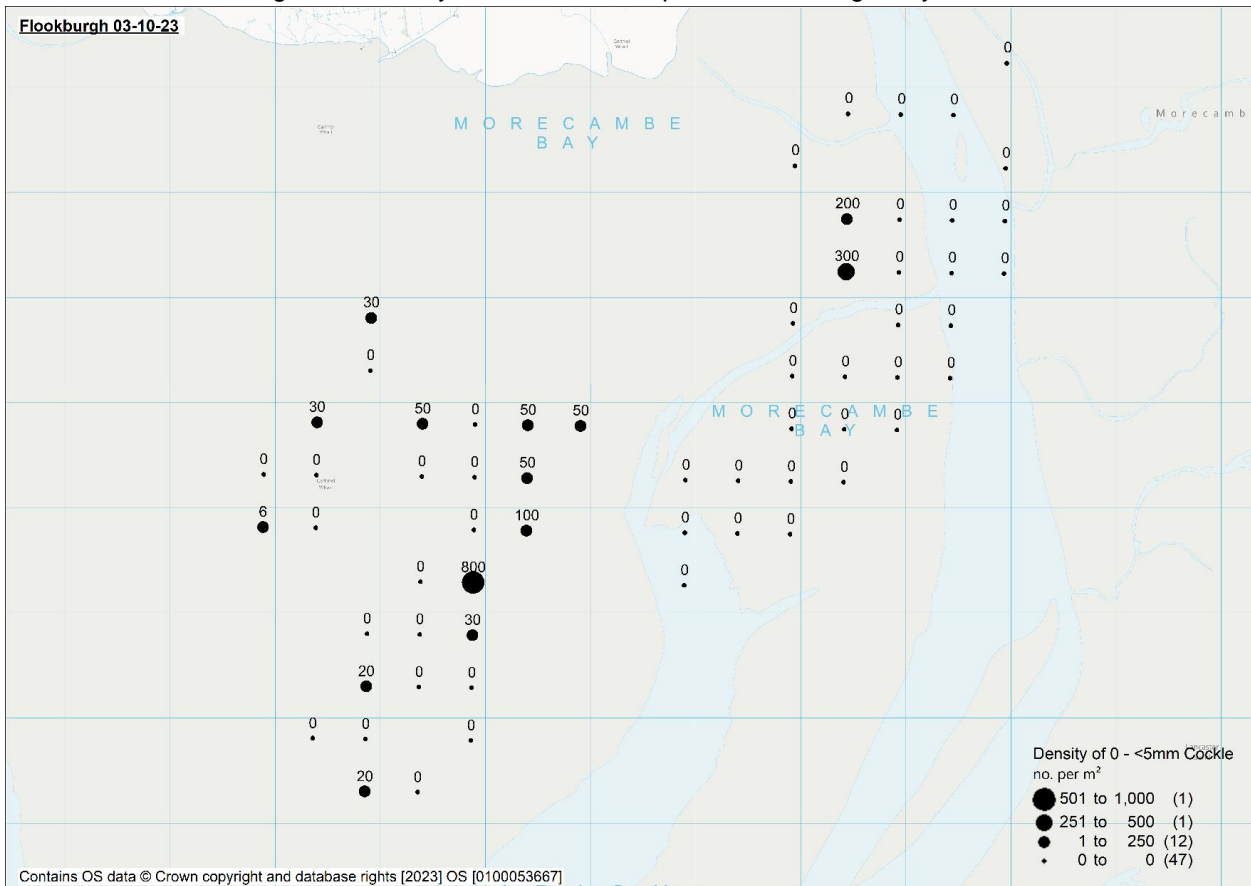


Figure 7. Density of 0-5mm cockle per m² Flookburgh October 2023.

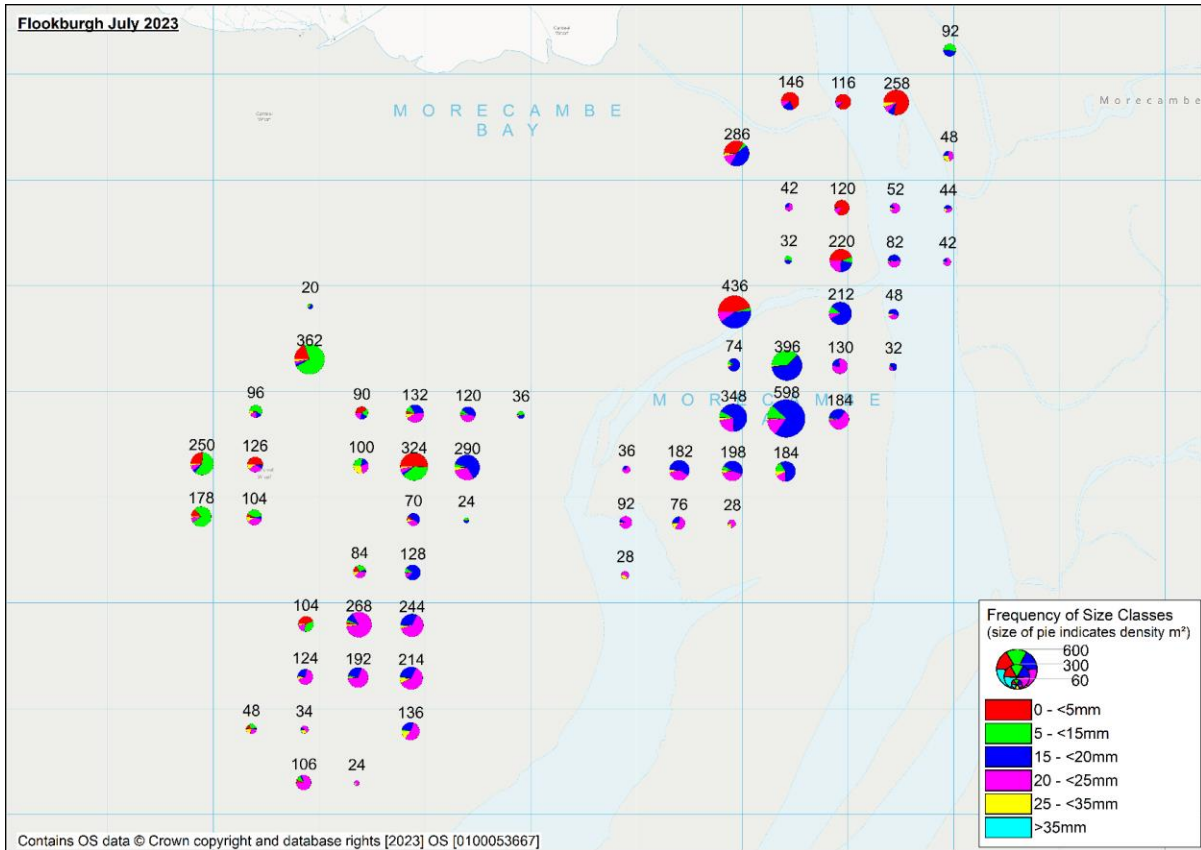


Figure 8. Frequency of size classes of cockle per m² Flookburgh July 2023.

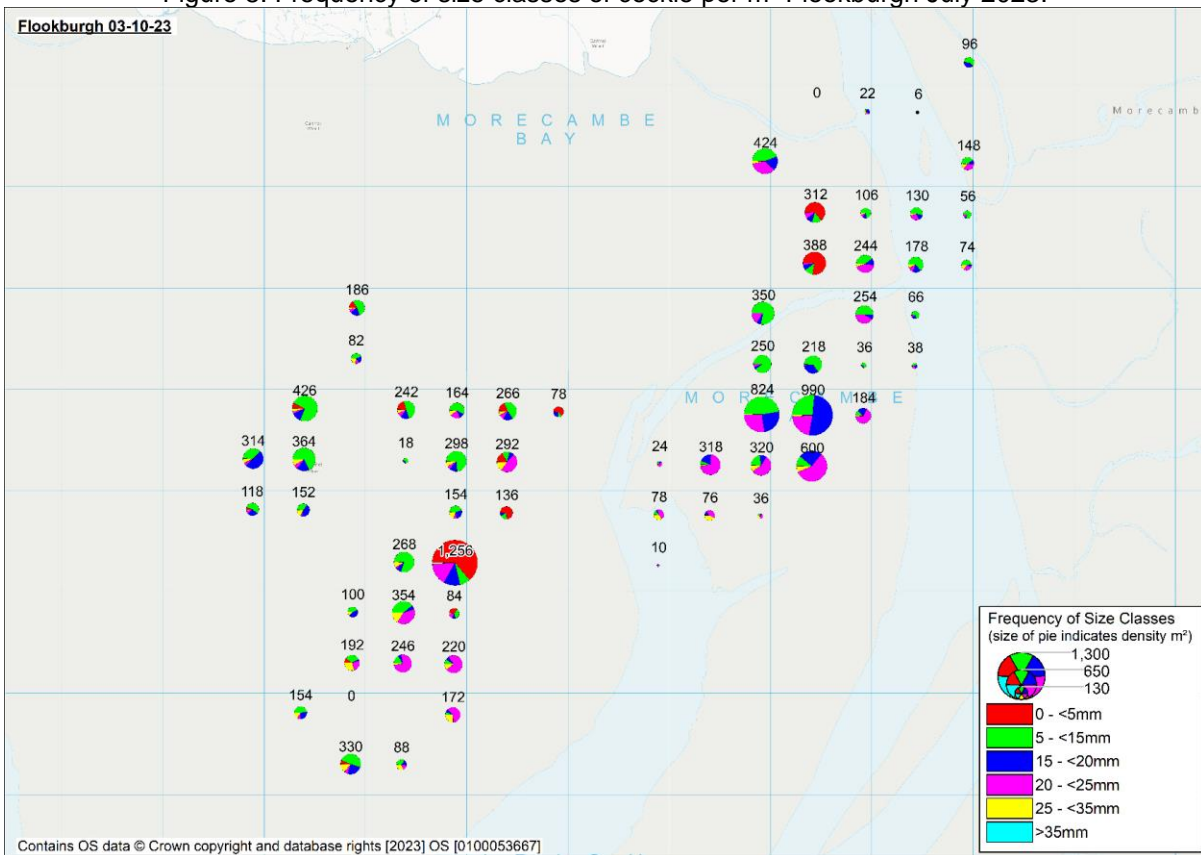


Figure 9. Frequency of size classes of cockle per m² Flookburgh October 2023.

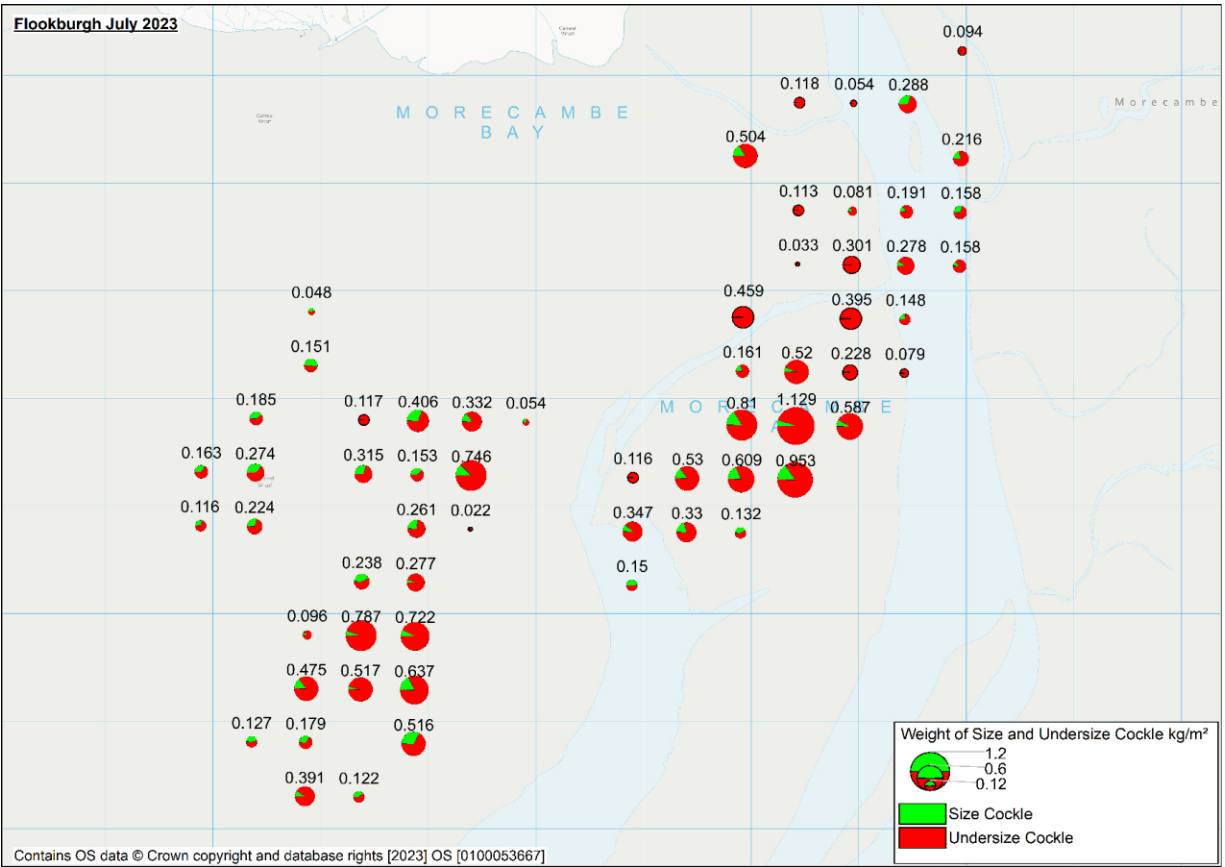


Figure 10. Weight of size and undersize cockle kg/m² at Flookburgh July 2023.

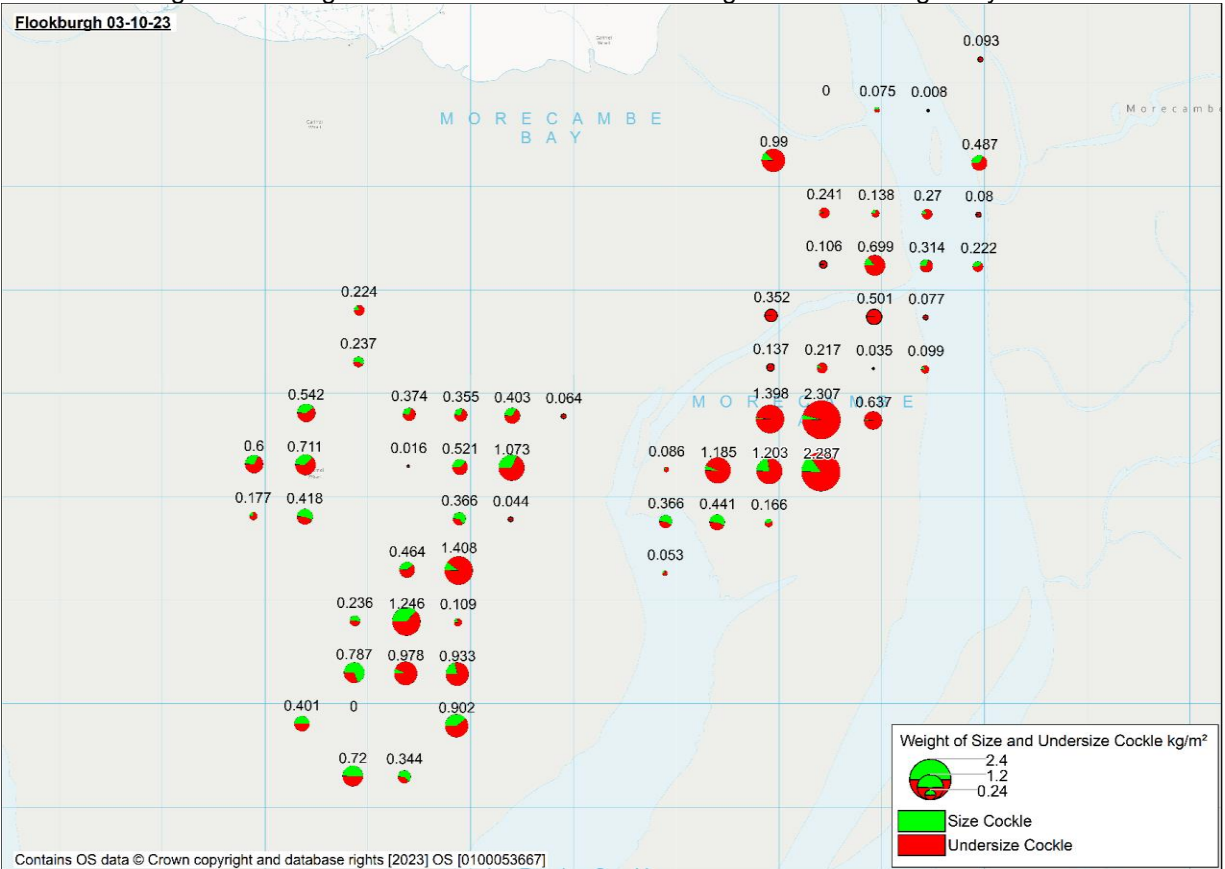


Figure 11. Weight of size and undersize cockle kg/m² at Flookburgh October 2023.

Low Bottom Dutch Wand Mussel Survey 02-10-23

Officers present: AP, GG

Low water: 07:24 0.8m (Liverpool Tides)

Survey method: Dutch Wand

Line transects were completed across the mussel bed using a Dutch Wand, transects start and finish at the edge of the bed as shown in Figure 2. The number of hits and misses of live mussel were recorded to give percentage cover. The bed area was calculated from the start and end of transects and from observations of officers whilst surveying. It was not possible to walk the perimeter of the bed due to time and tide restraints. A mussel sample was taken every 25 hits using a 10 cm diameter corer. 6 transects were completed and **15** samples collected. The total weight of live undersize and size mussel was recorded as well as the size frequency of each sample. Note, not all size mussel is fishable due to the presence of fouling species on slower growing individuals or the mixing of undersize and size in close proximity that prevents the removal of sizeable mussel without removing undersize. Almost all size mussel on this bed were fouled with barnacle.

From the transect and sample data the total mussel bed surveyed was **35.53 hectares**.

Biomass

1131 tonnes size mussel and **1205 tonnes undersize mussel**.

Length Frequencies

The total length frequency for the surveyed bed is provided in Figure 3. From the length frequency data the majority of mussel present on the Low Bottom bed is currently a mix of size and undersize mussel with the majority undersize between 25mm and 45mm.

Maps

The frequency of each size class of mussels per sample has been mapped in Figure 4 with the size of the pie adjusted for sample weight standardised to kg/m². The weight of the size and undersize mussel has been mapped and represented in Figure 5.

It can be seen in Figure 4 and Figure 5 that there is a mix of size mussel and undersize mussel across the bed, with the size mussel >45mm predominantly located on the seaward end and northern area of the bed and 24-45mm mussel spread across the centre of the survey area.

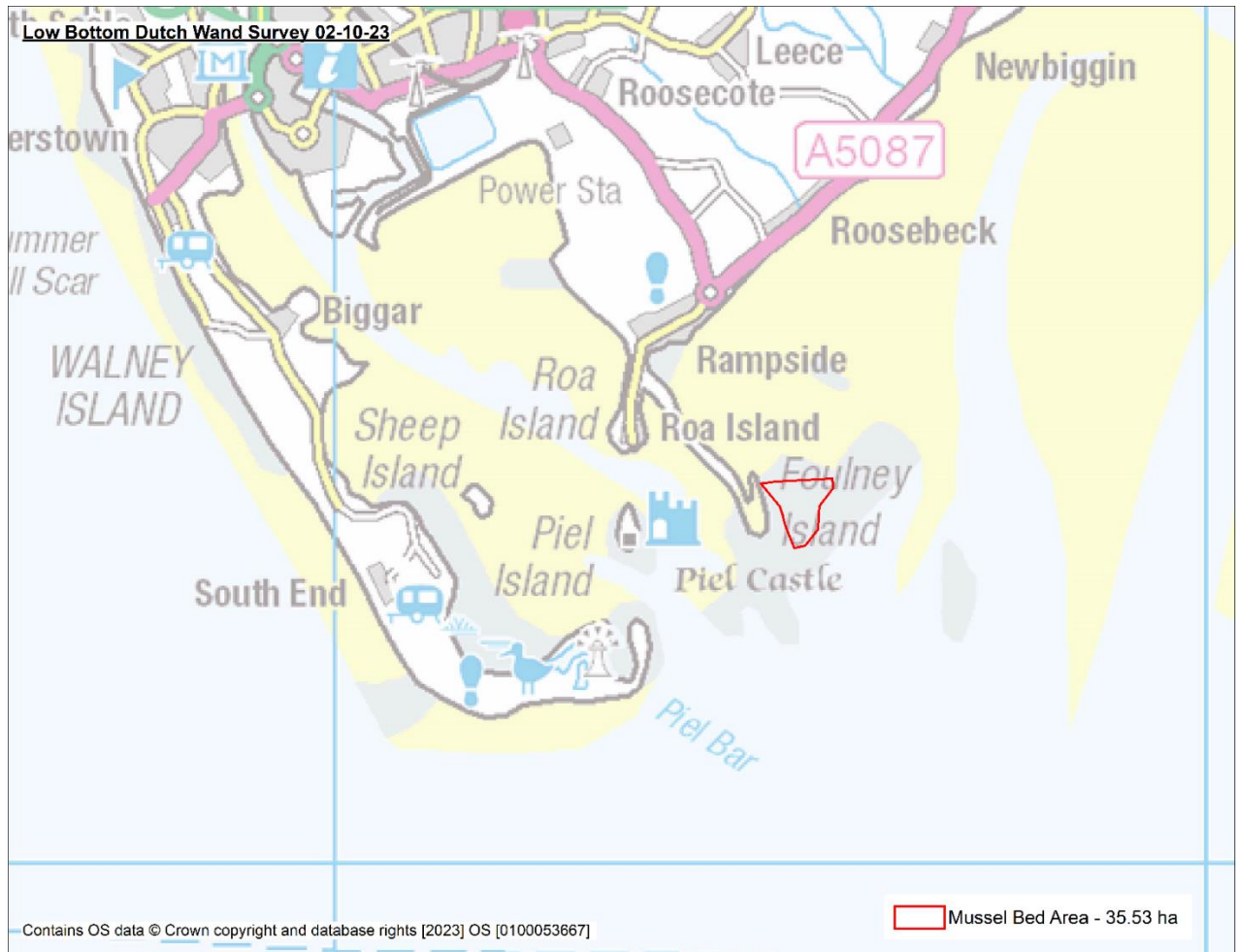


Figure 1 – Location of Low Bottom Mussel Bed surveyed 02-10-23.

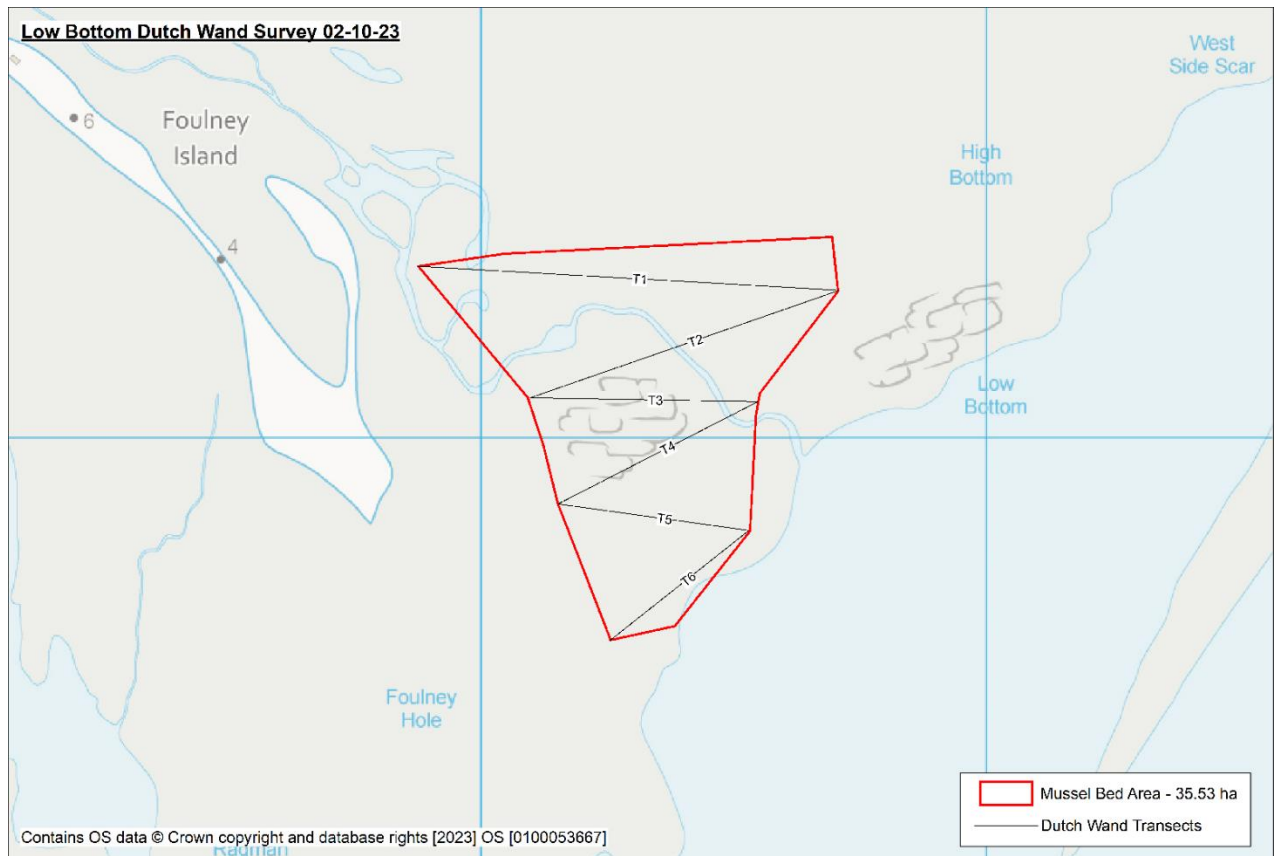


Figure 2 – Low Bottom Dutch Wand survey transects and estimated bed area.

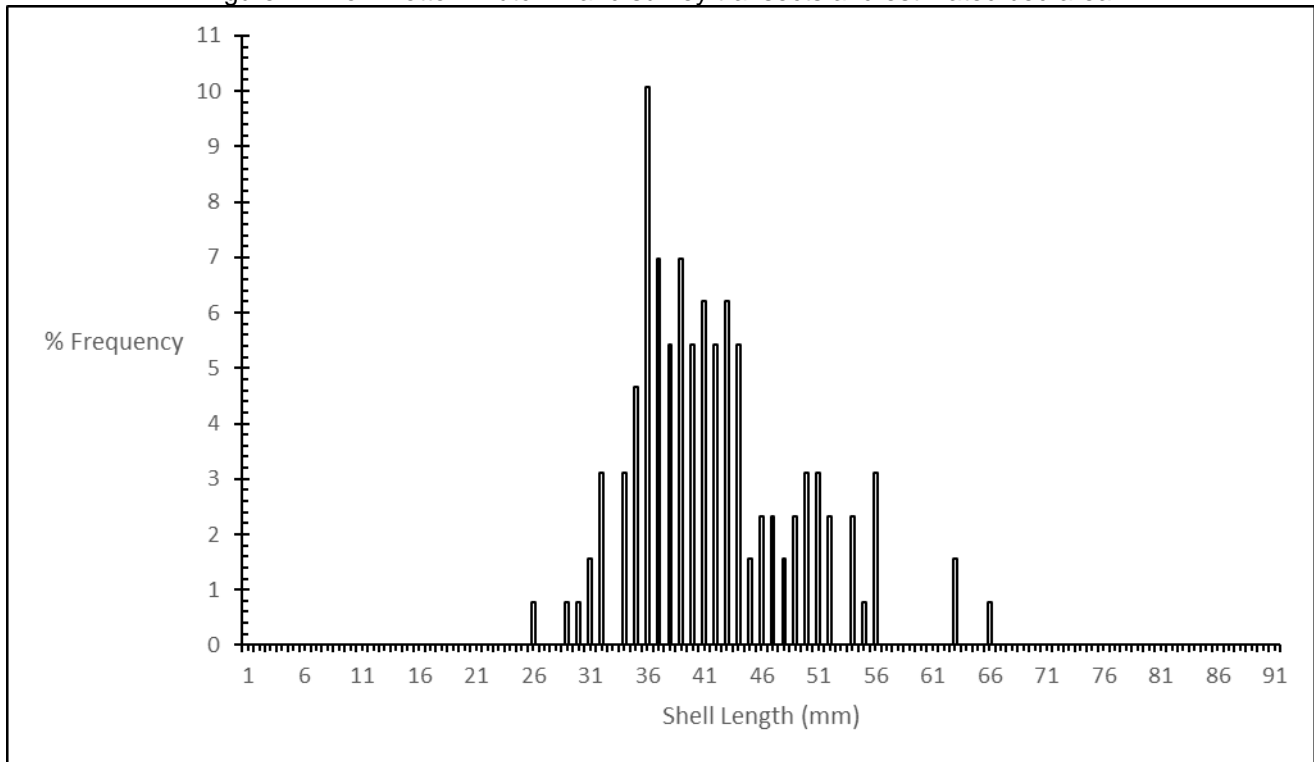


Figure 3 – Histogram showing size frequency of mussels from all samples on Low Bottom mussel Bed.

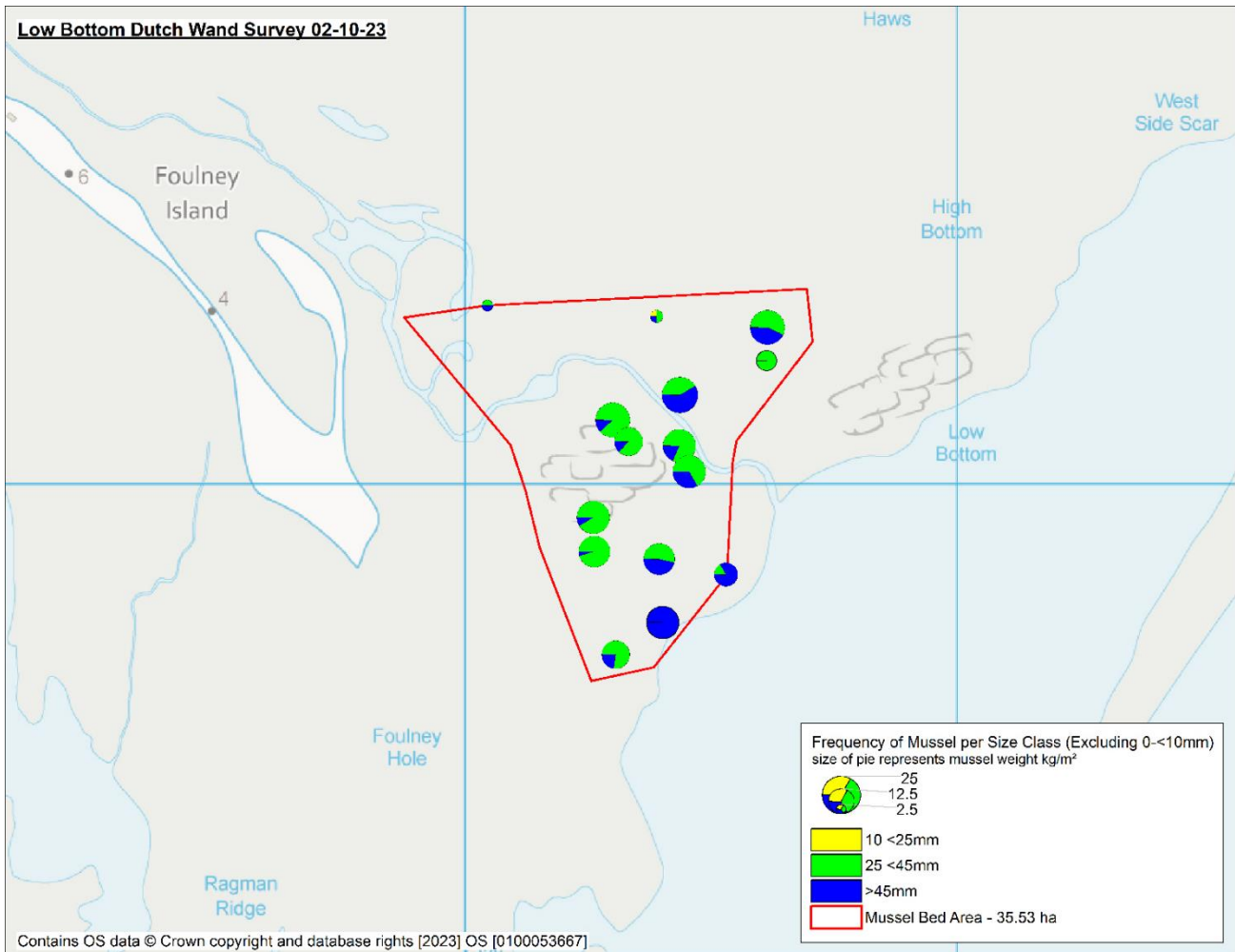


Figure 4 – Frequency of mussel by size class.

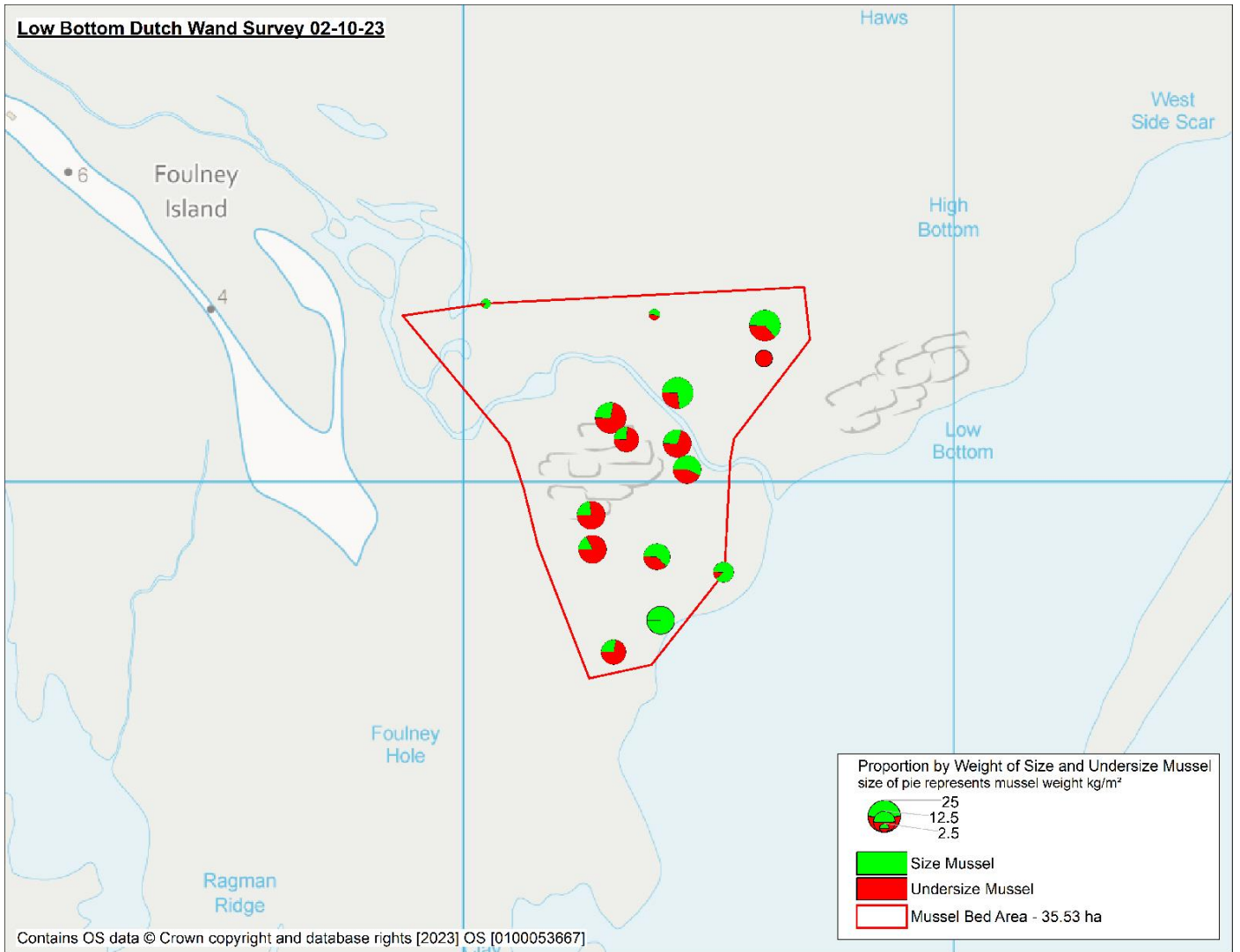


Figure 5 – Proportion of size and undersize mussel by weight represented as kg/m².