

NWIFCA Technical Science and Byelaw Meeting

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

Agenda Item

9

MUSSEL MINIMUM LANDING SIZE STUDY

Purpose: To report on the research undertaken into the minimum landing size of mussel on the Foulney Mussel bed.

Recommendation:

- 1) Receive the report.
- 2) Mussel currently remains at the 45 mm minimum landing size.

1. BACKGROUND

The purpose of this report is to present the results of the mussel minimum landing size study undertaken by Officers on the Foulney mussel bed in 2023.

At the TSB meeting in May 2022, Members of the Authority requested a reduction in the MLS of mussels from 45 mm to 40 mm (May 10th 2022 TSB Agenda Item 8). The main argument being: that mussels become barnacled or pearly before they reach size, and therefore, they should be allowed to be removed prior to them reaching size (45mm).

Table 1 provides a timeline of the workstream to date and the actions of officers in response to this request. Detailed reports have been provided at the relevant TSB meetings.

Table 1. Timeline of the mussel MLS study to date

Date	Report	Action
TSB 10 th May 2022	Agenda Item 8 Mussel MLS	Letter from Authority Members requesting a reduction in mussel MLS from 45 mm to 40 mm (Annex 1)
29 th June 2022	n/a	NWIFCA issue a consultation to Industry to establish the consensus and obtain views on the proposal.
17 th July 2022	n/a	Deadline for Industry consultation responses.
TSB 2 nd August 2022	Agenda Item 12 Mussel MLS Consultation	Officers present the results of the consultation to TSB. Fourteen out of twenty to 30 mussel fishermen had responded to the consultation. The consensus from industry being a localised, temporary reduction subject to biological conditions is the desired option. Industry indicated that there are areas of 'stunted mussel' on Foulney which should be the focus of further study. Members vote for officers to put together a plan for undertaking this work.
TSB 1 st November 2022	Agenda Item 9 Mussel minimum landing size	Officers present the strategy for investigating the stunted mussel on Foulney mussel bed and the potential for a localised, temporary reduction in mussel MLS in this area (Anne 1).
26 th January 2023	n/a	Officers visit Foulney mussel bed to map the area and discuss with fishers their views on the area of stunted mussel. Fishers report that the 2.5m tide contour would be appropriate to map.
TSB 9 th May 2023	Agenda item 8	Officers report to the TSB the progress of the study and preliminary results.

2. STUDY AIMS

The main questions this study looked to answer were:

- 1) Are there areas of the bed where mussel is 'stunted'?
- 2) Is the likelihood of a mussel being barnacled or pearled related to size and/or location on the bed?
- 3) Are mussels significantly more likely to be barnacled and/or pearled at 45 mm vs 40 mm?
- 4) Has there been any significant change in the composition of size mussel on the bed in recent survey history?

3. SURVEY DESIGN

Survey location:

In consultation with industry, the area of the bed above the 2.5m tide line was identified as the area where mussels are perceived to stunt and become unmarketable before they reach size due to pearl and barnacle. The location of Foulney mussel bed surveyed is provided in figure 1.

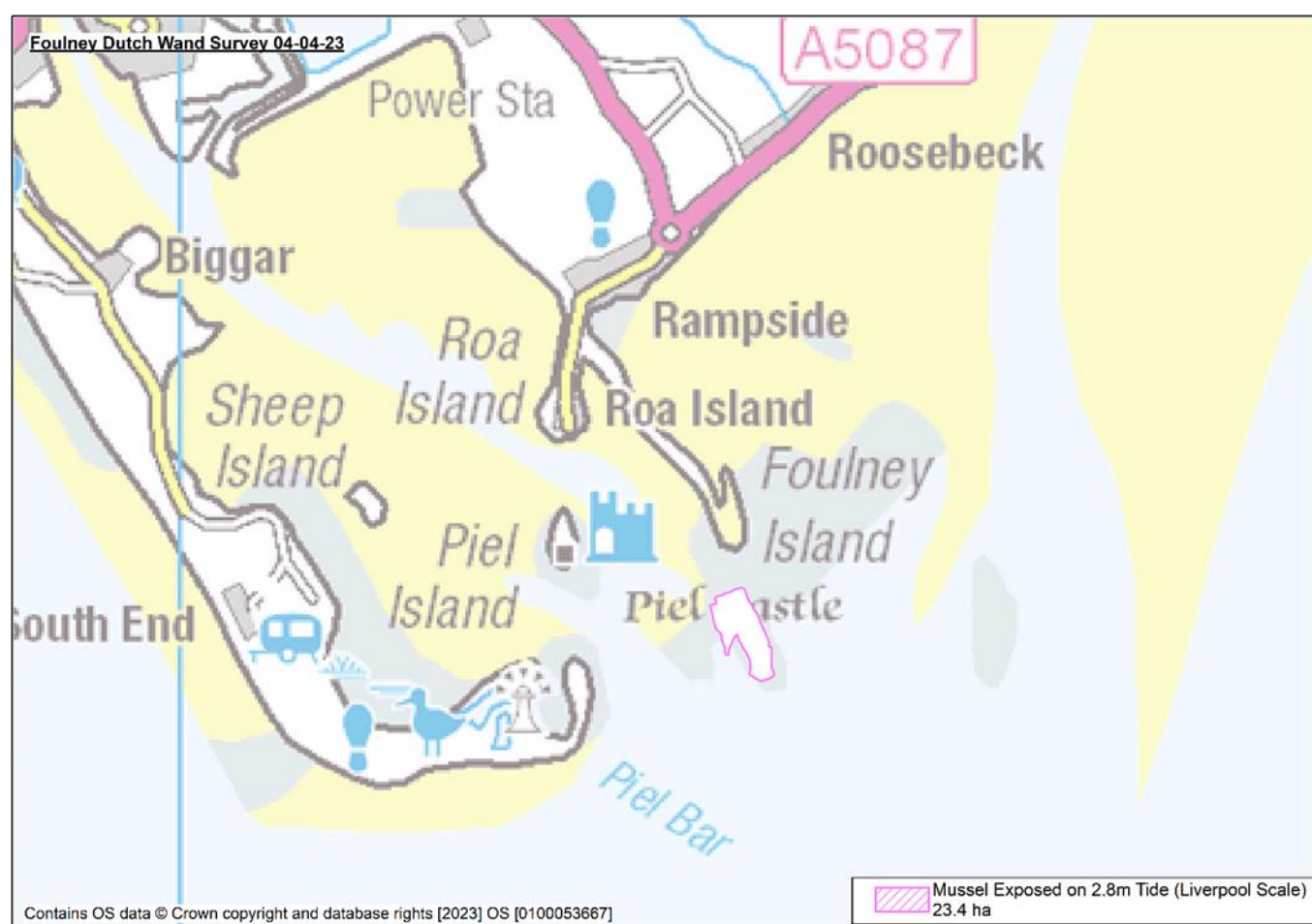


Figure 1. Location of Foulney Minimum Landing Size Reduction Study Area 2023.

Survey methodology:

To identify the size distribution and abundance of mussel above the 2.5m tide line, NWIFCA officers undertook a Dutch Wand survey in April. The tide height on the day was 2.8m. A description of the methodology used in a Dutch wand survey is provided in Agenda Item 7 – Survey and Inspection Report.

Typically, Dutch Wand surveys obtain samples every 50 'hits', however, to ensure greater coverage and obtain a higher resolution view of the bed, officers collected samples every 10 'hits' and split the bed into a

larger number of transects to cover a greater area (Figure 2). In total, 83 samples of mussel were taken from across the bed. Officers also noted the presence or absence of barnacles on individual mussels sampled.

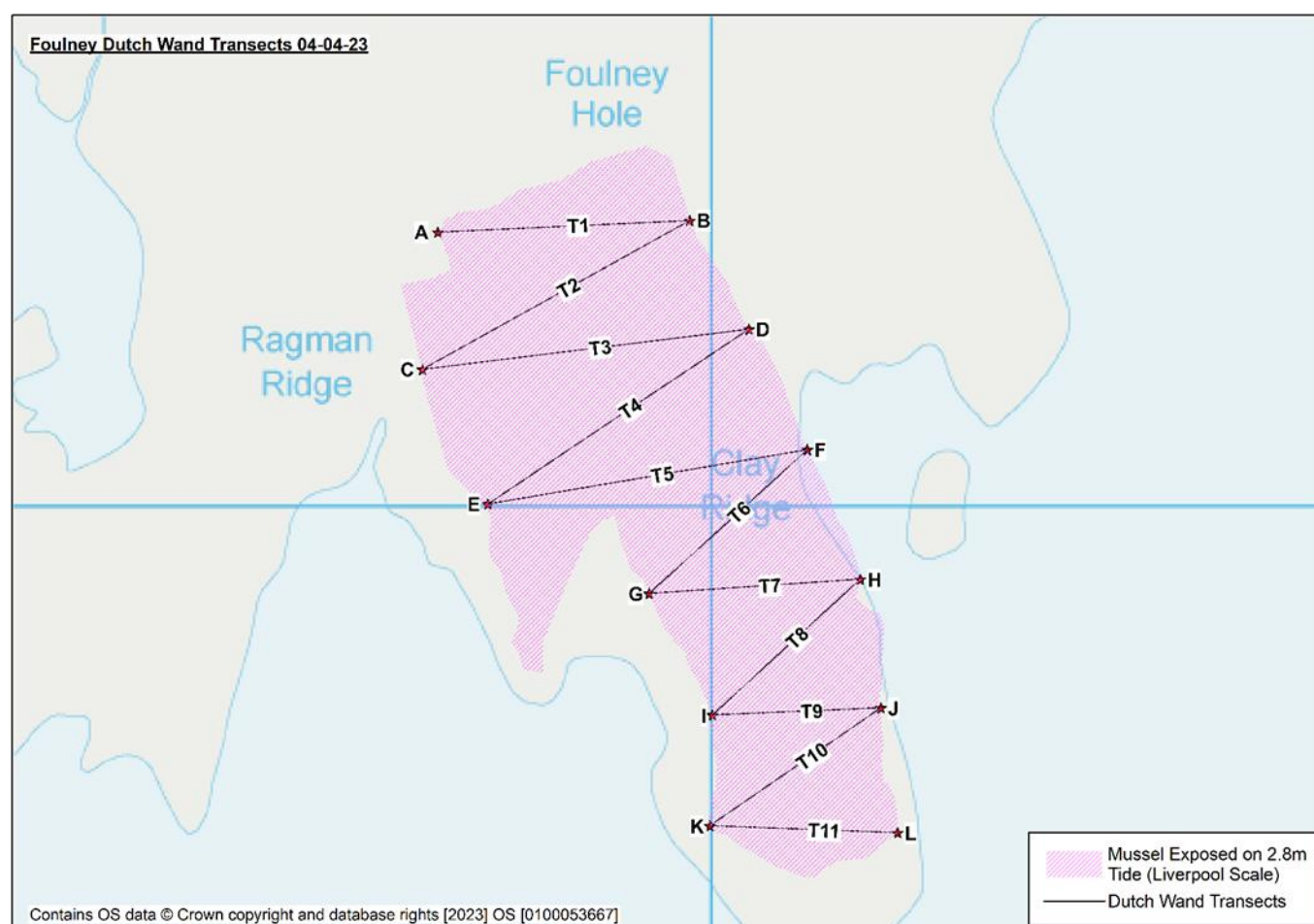


Figure 2. High resolution Foulney Dutch Wand survey transects

To get a view of the full extent of the bed (below the 2.8m tide height), the results of the full Dutch Wand survey undertaken in March (TSB Agenda Item 6 Survey and Inspection Report) were included for comparison. Officers also obtained an additional 39 samples for analysing the presence of pearl and barnacle across the full extent of the bed. In total >2400 mussels were sampled for this study.

Timings of inspections, surveys and sampling are provided in table 2.

Table 2. Timings of surveys and sampling

Date	Action
26 th of January 2023	Met with industry to discuss area of study
13 th of February 2023	Mapped low water on a 2.8m tide (Liverpool Scale) in optimal conditions
21 st of March 2023	Typical Resolution Dutch Wand survey completed on the entire mussel bed
4 th of April 2023	Higher Resolution Dutch Wand survey of the higher up (2.8m tide line) mussel bed
18 th of April 2023	Collection of samples for analysis of barnacles, pearl, and age

4. RESULTS

Question 1: Are there areas of the bed where mussel is 'stunted'?

1.1. Results of the high-resolution Dutch Wand survey:

The aim of the high-resolution survey was to identify the size composition of mussel on the bed, and identify areas where mussel was notably smaller.

Figure 3 shows the size distribution of mussel across the extent of Foulney mussel bed, mussel above the 2.8m tide line.

The pie charts show the proportion of the mussels in a sample that fall within a size cohort. Darker blue colours represent mussels that are larger in size (≥ 35 mm) and lighter colours represent mussels that are smaller (< 35 mm). The size of the pie chart is indicative of the weight of mussels per sample, larger pie charts demonstrate a greater overall biomass of mussel in a sample compared with a smaller chart.

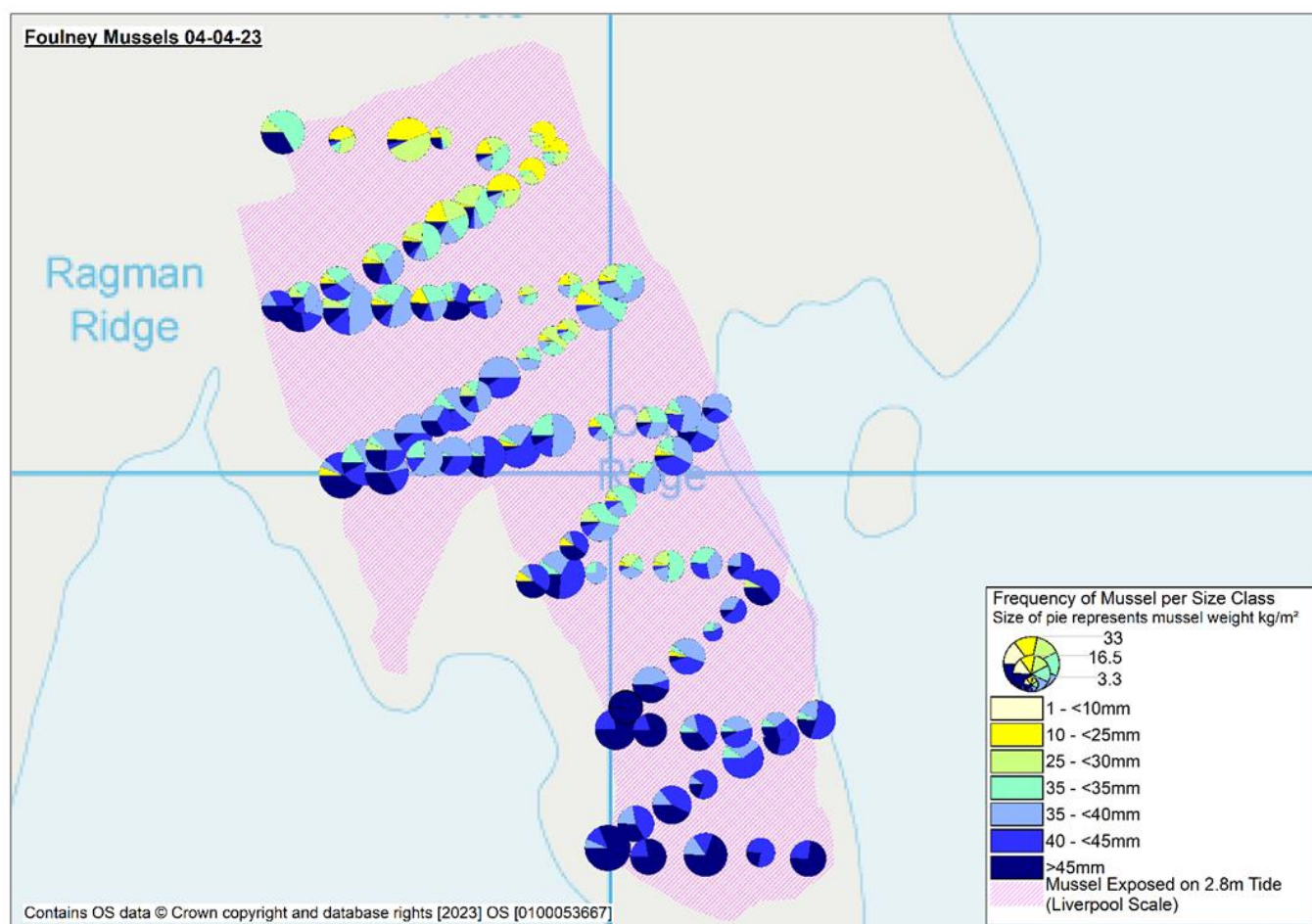


Figure 3. The size distribution of mussel across the upper 2.8m tide line of the Foulney mussel bed.

The figure shows that mussel higher up the bed, closer to shore, are typically smaller than that lower down the bed. This is expected due to the longer periods of exposure from tides which reduces the time mussels can feed in comparison to those lower down the bed. In addition, the results show a band of mussel running lengthways down the middle of the bed that is also smaller in both size and overall weight of mussel. In comparison, larger mussel is found along the edges near the channel. The ground in this central portion of the bed is higher than the surrounding edges, and the increased submersion time of the mussel at the edges of the bed is likely the reason for its increased size and total weight in comparison to the proportion in the upper, middle part of the bed.

Figure 4 shows the proportion (by weight) of size ($\geq 45\text{mm}$) and undersize ($<45\text{mm}$) mussel across the bed. This figure also demonstrate that there is typically undersize mussel on the inner, upper portion of the bed, with larger mussel on the edges and lower down.

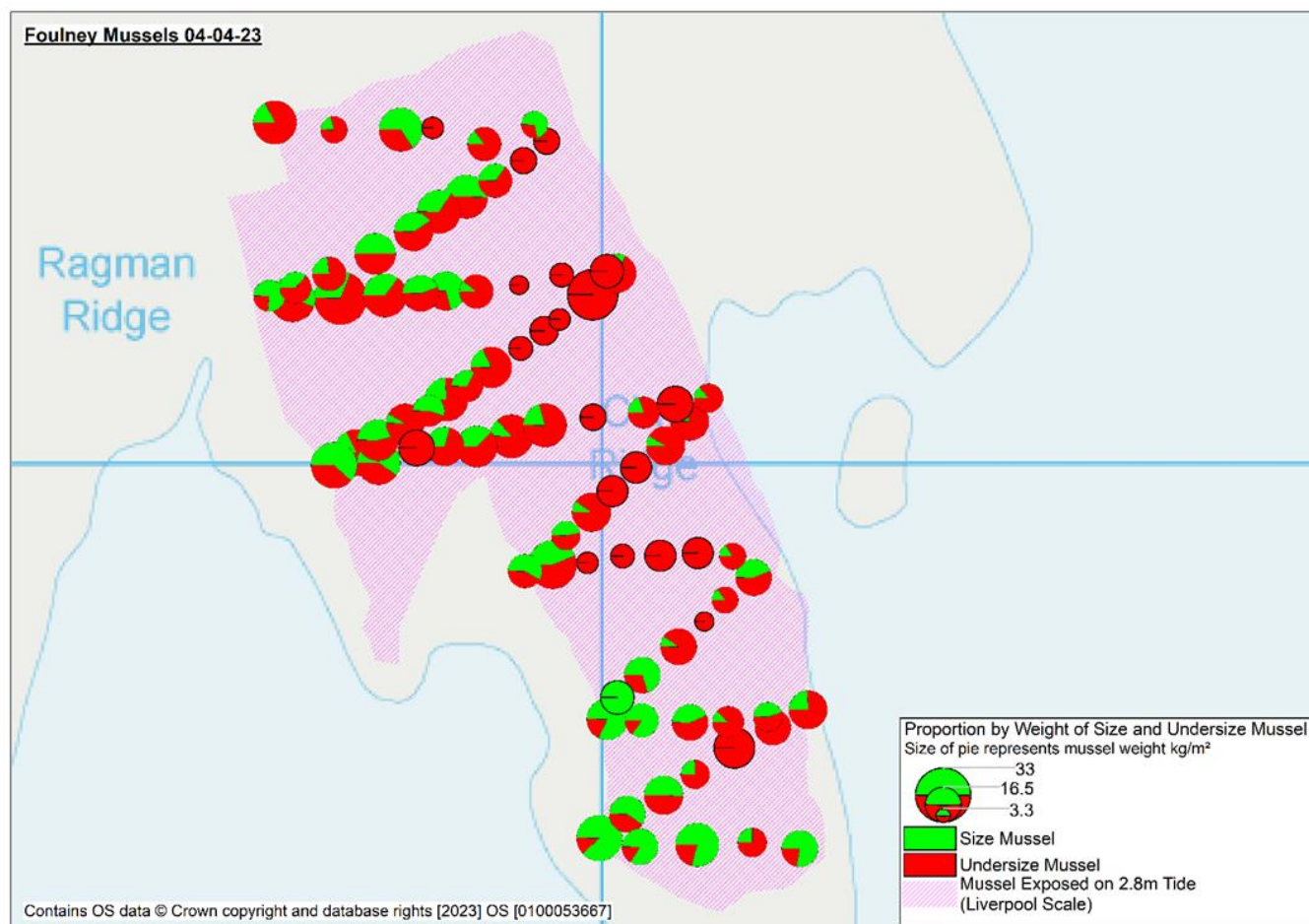


Figure 4. The frequency and distribution of size ($\geq 45\text{mm}$) and undersize ($<45\text{mm}$) mussel per sample point.

1.2. Comparison of size across the full extent of the mussel bed:

The full extent of the Foulney mussel bed extends down to the $<1\text{ m}$ tide line. Areas at the extremes of its extent only reveal themselves during low spring tides. To give a comprehensive view of size distribution across the full extent of the bed, figure 3 combines the results of the high-resolution survey, with the results from the standard Dutch Wand from March the same year.

The figure shows that mussel lower down the bed increases in both size and biomass, as expected given their position further down the intertidal zone. The limited number of pie charts below the 2.8m tide line is due to the lower number of sample points taken during the first survey and is not indicative of low numbers of mussel.

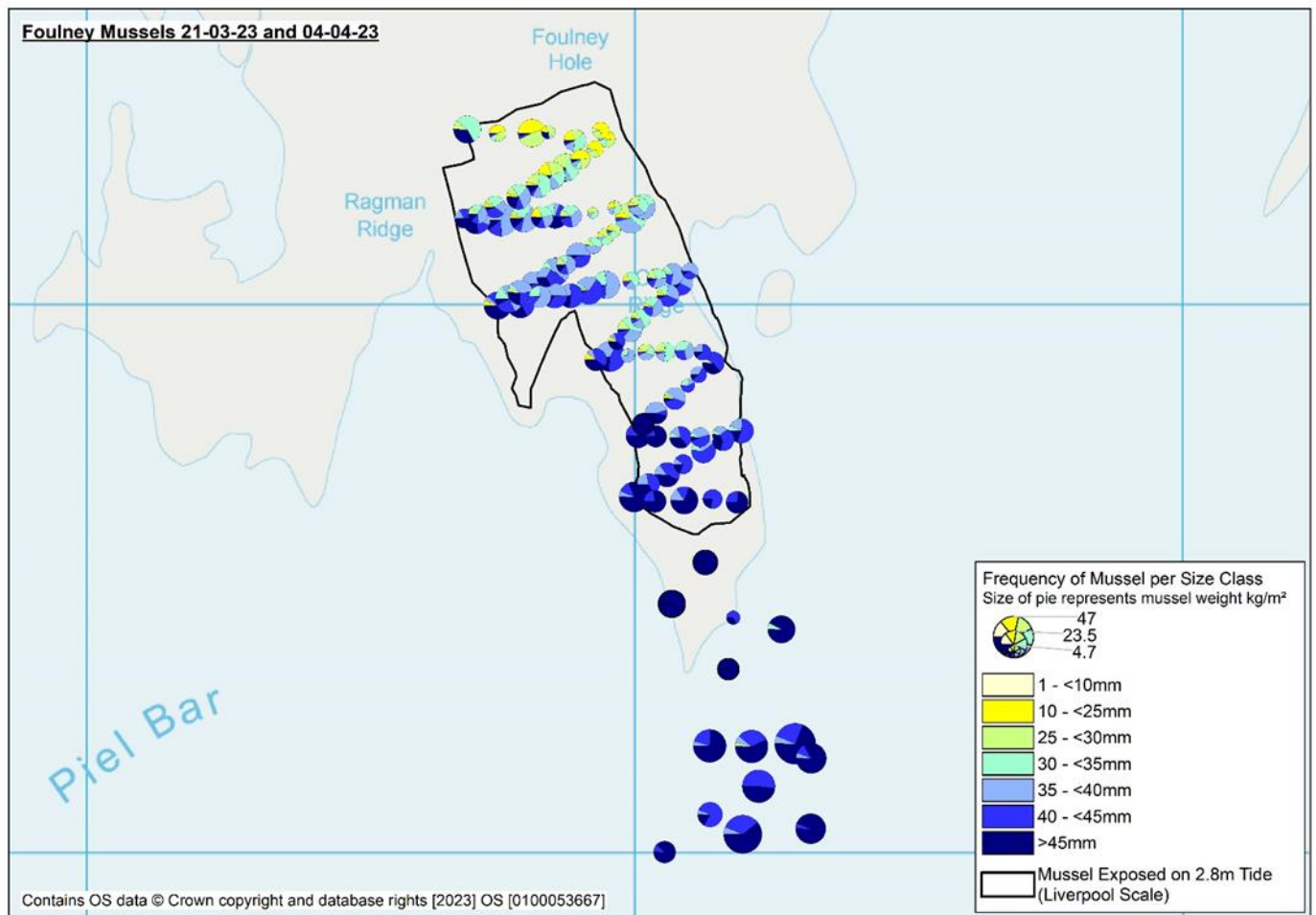


Figure 5. The size distribution of mussel across the full extent of the Foulney mussel bed.

For further analysis, officers divided the bed into five discrete areas (figure 6) based on visual changes in the size of mussel across the extent of the bed. These areas were subsequently used to make comparisons of size, presence of barnacle and pearl in the mussels within each location.

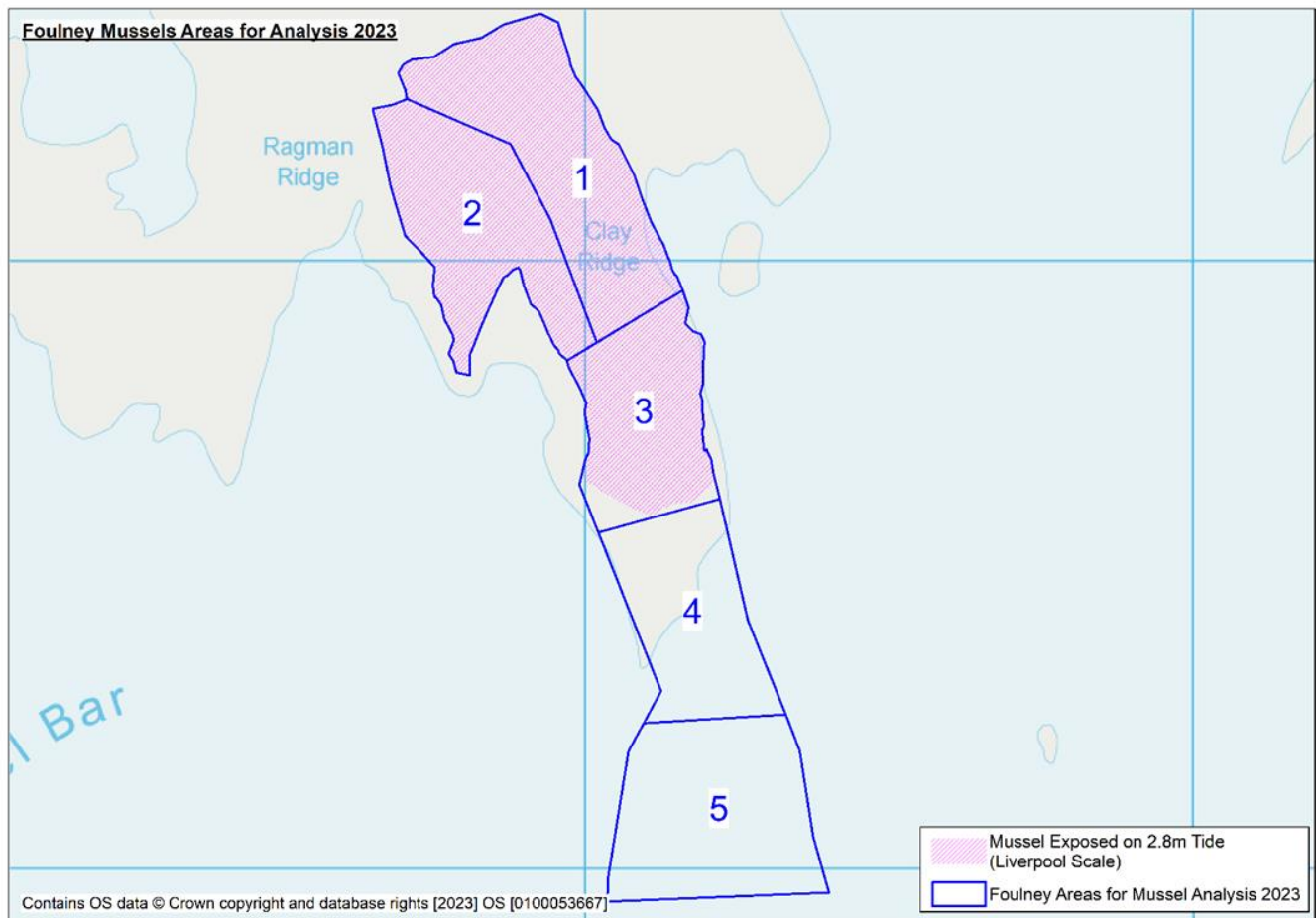


Figure 6. The five areas of Foulney mussel bed identified for comparison.

Table 3 provides summary statistics on the average size, and proportion of size and undersize mussel in each of the 5 areas of the bed. The statistics demonstrate that the percentage of size mussel increases further down the bed, and percentage undersize decreases. Figure 7 shows the size frequency of mussel down the full extent of the bed, the shift in the average size increases with location and the more mussel is at size or above.

This is expected given the natural influence of tidal submersion on growth times.

Please note these results are from the spring surveys before mussel have had the chance to grow through the summer.

Table 3. Summary statistics for the average size, and proportion size and undersize at each location on the bed.

Site	Average size (mm)	Size (≥45mm)	Undersize (<45mm)
1	37.4	15%	85%
2	43.3	27%	63%
3	44.3	56%	44%
4	51	89%	11%
5	48.5	78%	22%

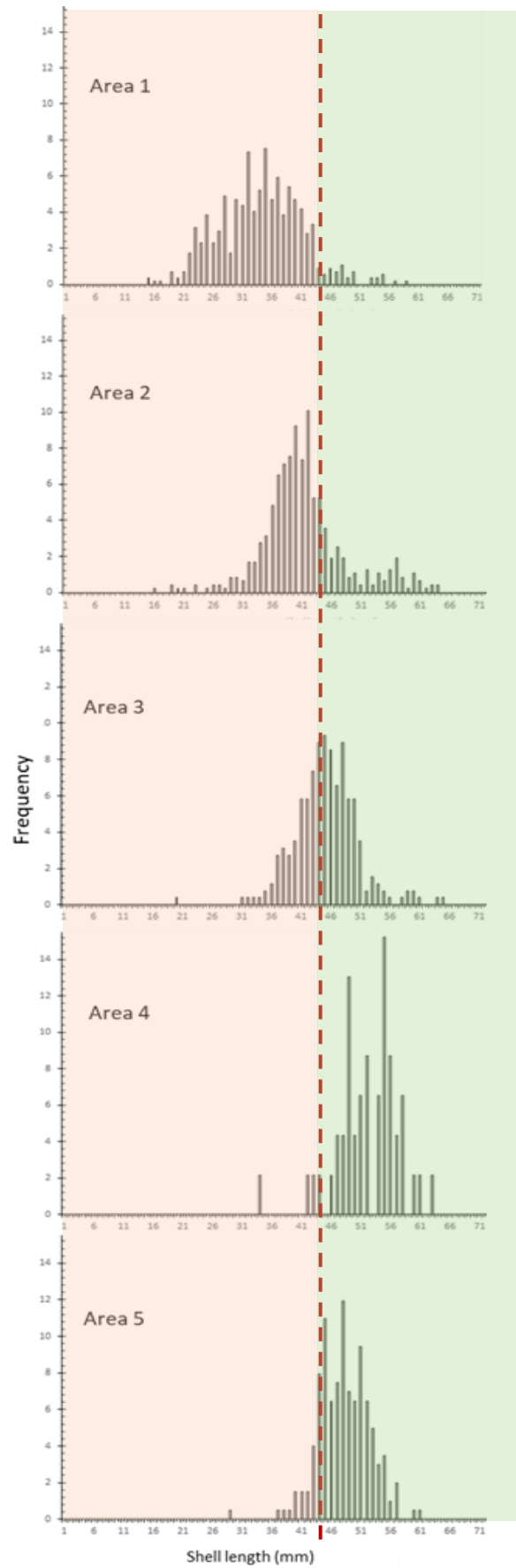


Figure 7. Size frequency histograms showing the size frequency of mussel in each area of the bed.

Question 2: Is the likelihood of a mussel being barnacled or pearled related to size and/or location on the bed?

To identify whether location on the bed influenced the likelihood of a mussel being pearled or barnacled, officers returned on the 18th of April to collect samples from 39 additional sample points from across the full bed extent. Thirty mussels per sample site were dissected and assessed for the presence of pearl and barnacle. The location of the additional sample points is provided in Annex 1.

2.1. The impact of location on likelihood of being pearled or barnacled:

The proportion of barnacled mussel was highest at the top of the bed in area two, and decreased down the tidal zone to area five where mussel was predominantly clean (Figure 8)

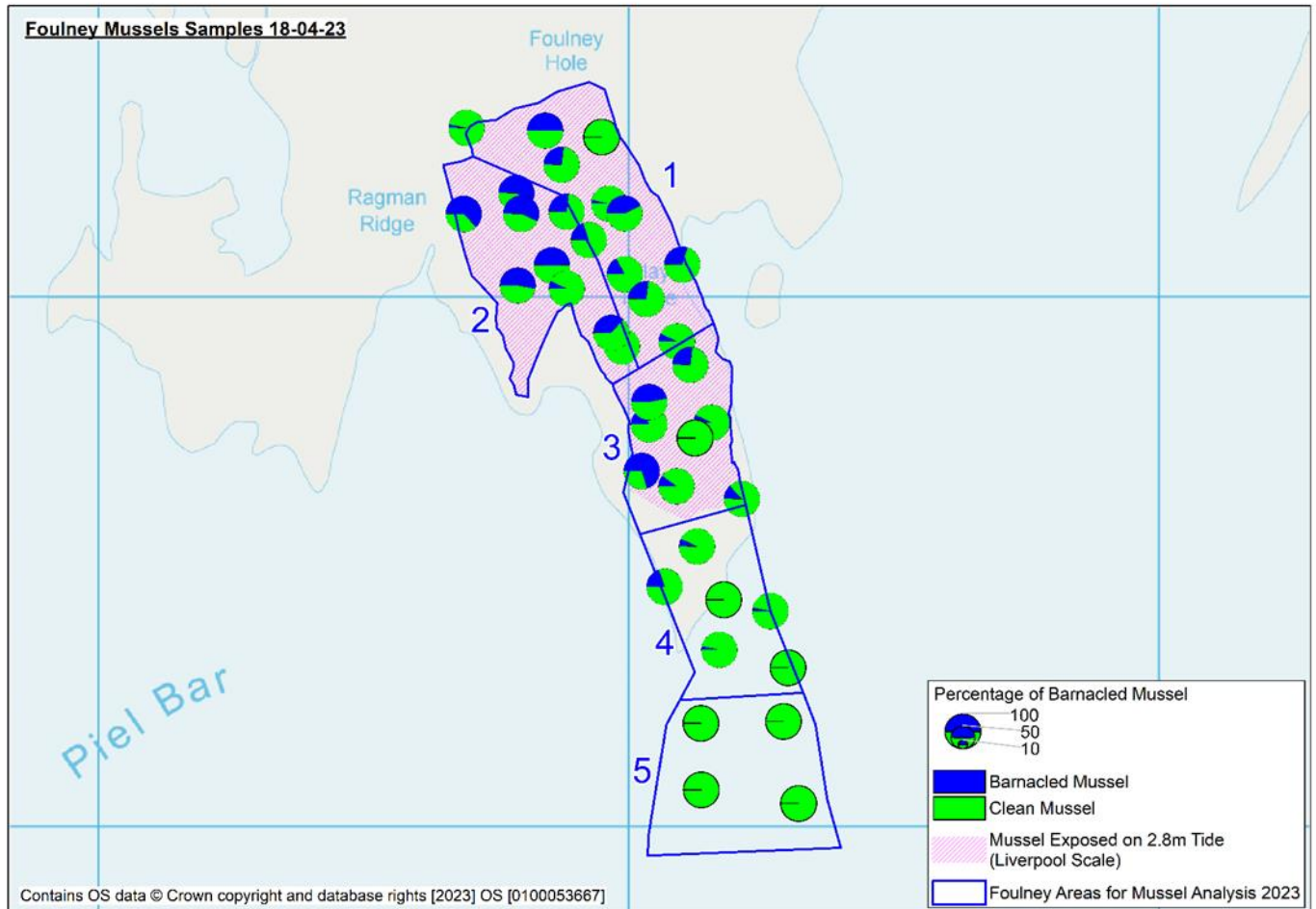


Figure 8. Proportion of barnacled mussel on the five main locations on the Foulney mussel bed.

In comparison, the proportion of mussel with pearl was consistent across the areas 1,2,3 and 4, decreasing slightly in area 5 (Figure 8).

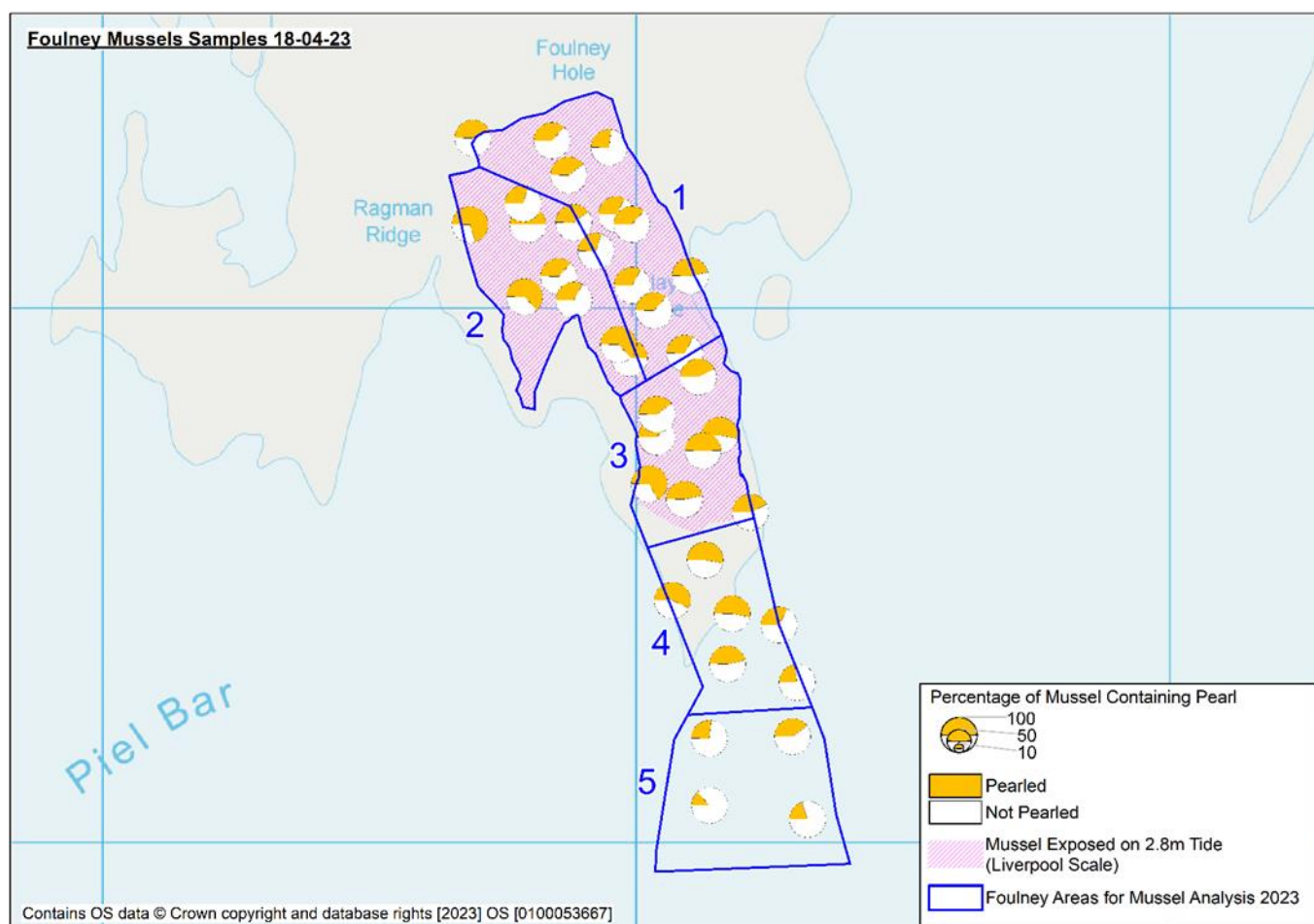


Figure 9. Proportion of pearled mussel on the five main locations on the Foulney mussel bed.

A summary of the proportion of mussels barnacled and pearled at each of the bed locations is provided in table 4.

Table 4. The proportion of mussel pearled or barnacled by area on the Foulney mussel bed.

Site	Pearled (all sizes)	Barnacled (all sizes)
1	35%	22%
2	48%	42%
3	48%	24%
4	45%	6%
5	25%	0%

2.2. The impact of size on likelihood of being pearled or barnacled:

Table 5 gives the proportion of mussels barnacled and pearled at size and undersize for each bed location.

Table 5. The proportion of mussel pearled or barnacled at size and undersize across the Foulney mussel bed.

Site	Pearled at size and above (≥45mm)	Barnacled at size and above (≥45mm)	Pearled at undersize (<45mm)	Barnacled at undersize (<45mm)
1	68%	56%	30%	16%
2	81%	86%	30%	16%
3	56%	31%	36%	14%
4	48%	6%	16%	<1%
5	30%	<1%	8%	<1%

The results show that the proportion of pearled and barnacled mussel is highest in area 2, and lowest in areas 4 and 5. The presence of barnacle and pearl decreases down the extent of the bed from area 2 to 5, and the proportion of pearled or barnacled size mussel is typically higher in areas 1,2 and 3 (the areas >2.8m tide height).

Question 3: Are mussels significantly more likely to be barnacled and/or pearled at 45 mm vs 40 mm?

A logistic regression analysis was applied to the data to identify the likelihood of a mussel in each of the five locations being pearled or barnacled respectively. The results of this analysis are provided in table 6.

The results show that the likelihood of a mussel being pearled or barnacled increases between 40 to 45 mm. However, a significant proportion of mussel at 40mm is still likely to be pearled in areas 1,2 and 3. Similarly, the likelihood of being barnacled increases between 40 and 45mm, but decreases further down the bed, with area 2 being the highest, and area 5 the lowest.

Table 6. The likelihood of a mussel being pearled or barnacled at 40 mm and 45 mm respectively.

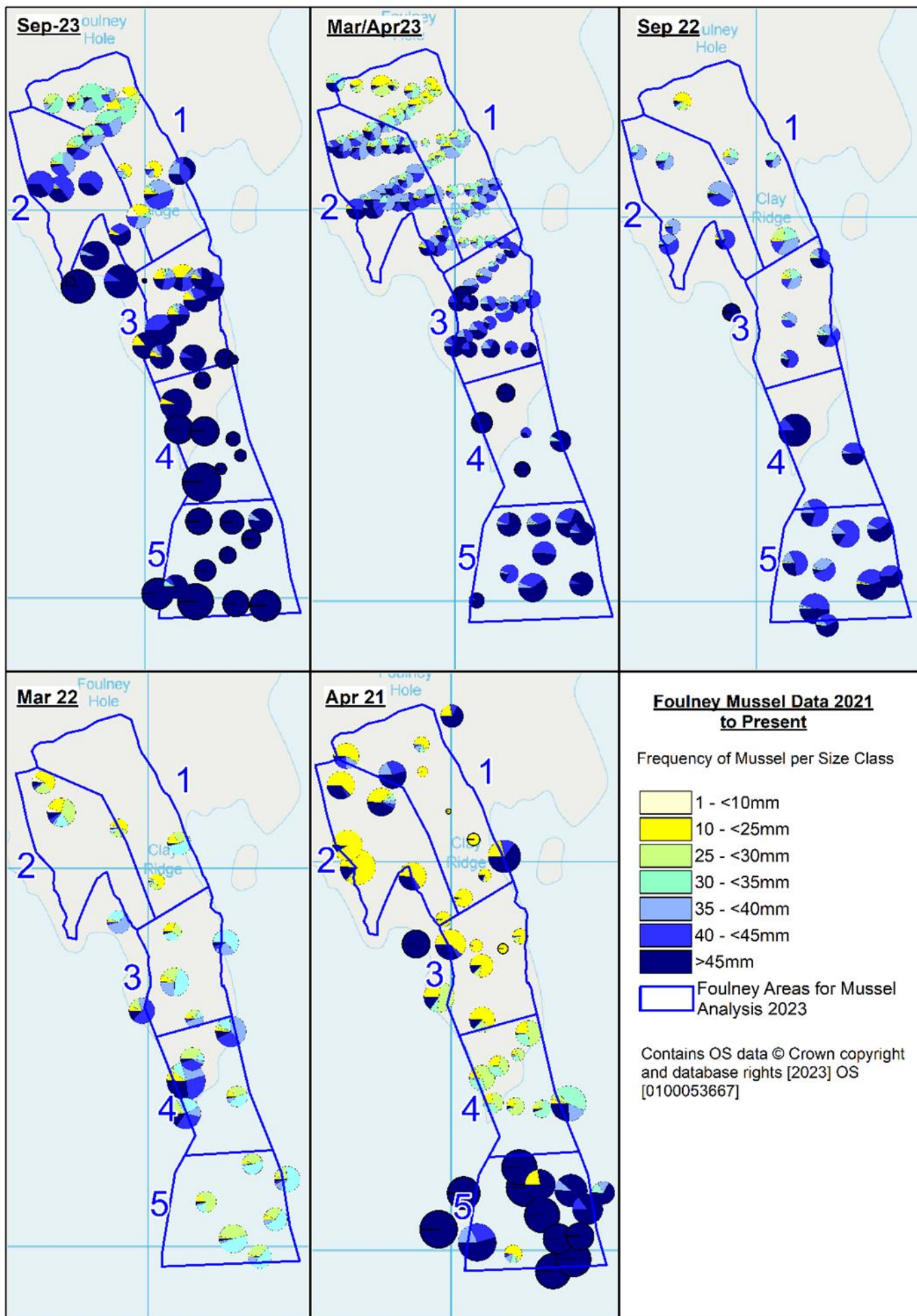
Site	40 mm		45mm	
	Pearled	Barnacled	Pearled	Barnacled
1	41.4%	23.3%	62%	40.6%
2	33%	19.5%	56.5%	49%
3	34.1%	10.6%	48.5%	21%
4	15.8%	<1%	26.5%	1.7%
5	3%	<1%	9.4%	<1%

Question 4: Has there been any significant change in the composition of size mussel on the bed in survey history?

Significant changes in the size and age composition of mussel across the Foulney mussel bed can take place over relatively small periods of time. This is an important consideration given large areas of undersize can grow on to size in the course of a season.

A comparison between the spring and autumn 2023 survey data (Figure 10) shows that large areas of the bed in areas 2 and 3 have grown on to size over the summer. This change has also been reflected in the large number of permit holders targeting these areas for mussel now they are sizeable.

Inspection of the historical data (figure 10) also shows a potential cycle of growth and re-settlement over the past 6 years on the Foulney mussel bed. This change could be the result of many natural factors from weather, temperature, food availability, and successful recruitment, but indicates that the bed naturally cycles through changes in size due to wash off and re-settlement, and in all areas apart from 1, typically reach size.



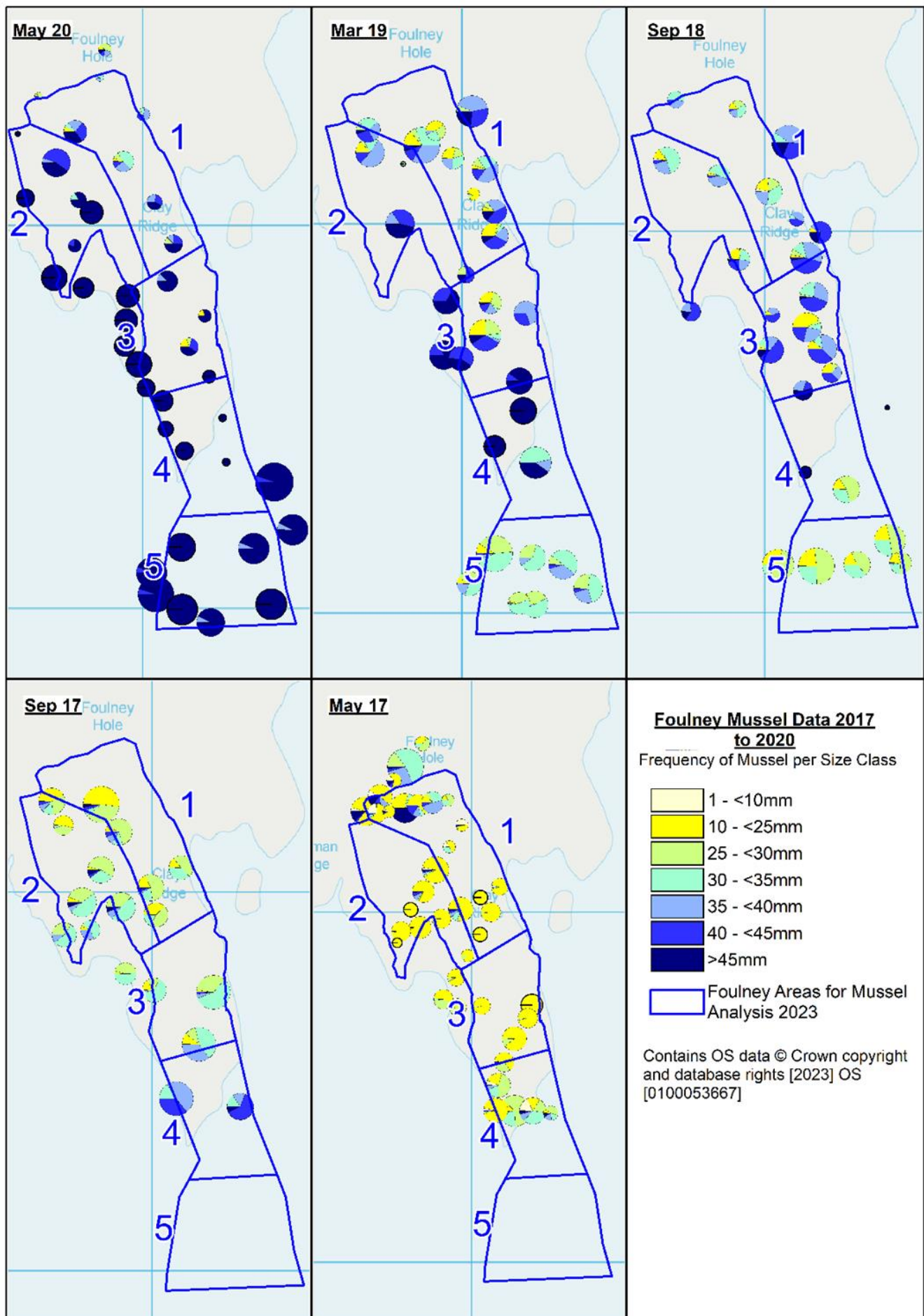
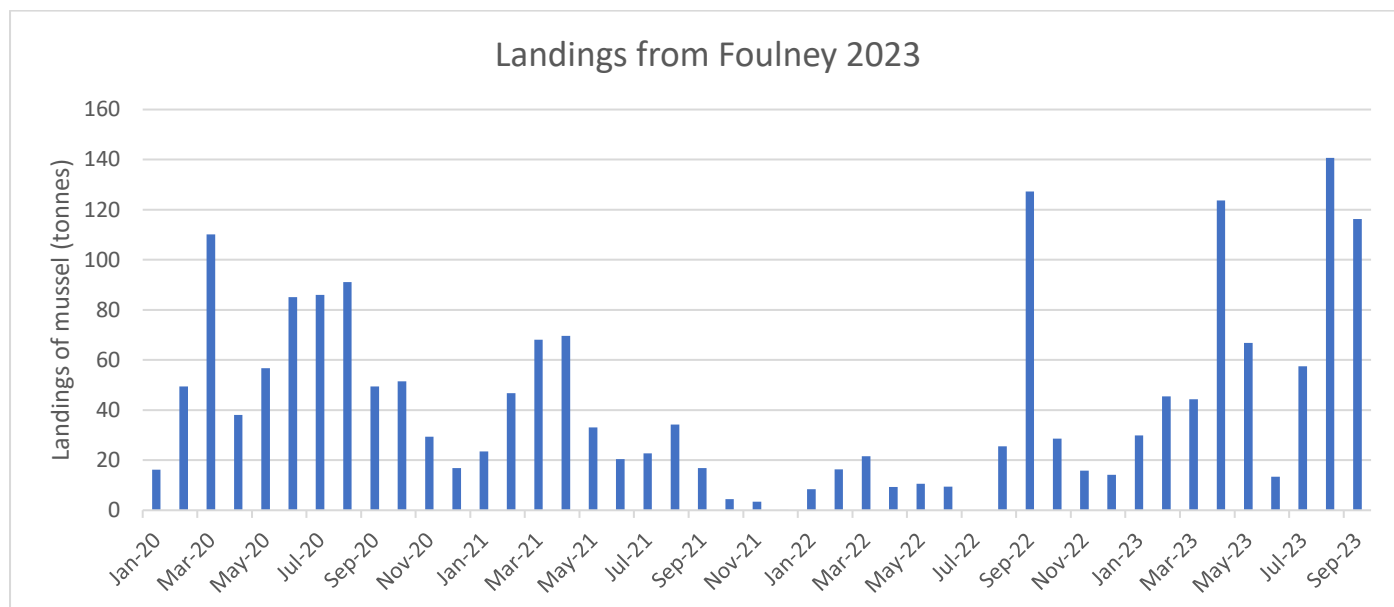


Figure 10. Historical changes in the size distribution of mussel on the Foulney mussel bed from 2017 to 2023.

5. MUSSEL FISHING ACTIVITY ON FOULNEY

This year between July and September, there has been increased fishing activity on the upper portions of the Foulney mussel bed. This increase in activity is evidenced both in the increase in returns (both in volume, and in number of days fishers are accessing the fishery), and in patch officer reports.

The area that was identified above the 2.8m tideline identified by industry members for this study, has been one of the main areas where fishing efforts has been focused (predominantly area 2 and 3). This increase is likely due to that area reaching size over the summer months, and demonstrates the area produces sizeable, marketable mussel in areas accessible for a large proportion of the month.



6. CONSIDERATION OF BIOGENIC REEF FEATURE

Mussels are a protected feature of the Morecambe Bay SAC under 'Intertidal biogenic reef mussel bed' features. They are also a supporting habitat of the Morecambe Bay and Duddon Estuary SPA designated to protect specified bird species. Any activity that has the potential to impact the feature which is not directly linked to its management has to undergo a habitats regulation assessment (HRA).

Morecambe Bay SAC is primarily comprised of soft sediment substrates, however, where cobbles and coarse substrates are exposed there is an opportunity for the formation of mussel *Mytilus edulis* reefs. Where the mussels form stable relatively persistent beds of mature mussel they represent a biogenic reef. Intertidal biogenic reefs are uncommon in the eastern Irish Sea therefore the presence of dense mussel beds within Morecambe Bay represents an important ecological and commercial feature. Biogenic reefs provide structural complexity and increase habitat heterogeneity meaning the species richness of associated fauna and flora is often comparatively high when compared to surrounding habitats (Holt et al., 1998), (Norling and Kautsky, 2007). Mussel beds in Morecambe Bay provide key feeding areas for wading birds and wildfowl and feeding or breeding areas for fish.

Any removal of undersize mussel would need to be HRA compliant – given their importance as a feature of the SAC and as a supporting feature of the SPA bird features. Considerations would need to include – increased duration and concentration of activity in the upper regions of the bed which would occur if a smaller MLS was permitted. Decreasing the MLS increases the proportion of mussel which can be removed which could impact the dynamics of the bed.

7. CONCLUSION

- 1) There is a clear difference in the size of mussel in each different area of the bed, though this is typical of an intertidal structure, with smaller mussel at the top of the bed, and larger mussel lower down, likely due to increased submersion and feeding times.
- 2) There is a higher proportion of pearl and barnacled mussel across the bed than expected, with all areas showing >50% likelihood of being pearled at size, apart from area 5 at 30%. The high likelihood of pearl is potentially a result of the conditions of the bed.
- 3) Though the likelihood of a mussel being pearled or barnacled is lower at 40 mm than 45 mm, it is still relatively high in areas above the 2.8 m line in comparison to areas lower down the bed.
- 4) The bed naturally experiences cycles of growth and re-settlement. And over the duration of a season, areas of the bed identified as being 'stunted', have reached size and are being targeted by fishers.

Given that the likelihood of pearling is still high for 40 mm mussels in the areas identified by industry, and that these areas have subsequently grown on to 45 mm over the summer and become marketable – there appears to be limited argument for a decrease in the MLS of mussel at this time.

NWIFCA recommend that mussel MLS remain at 45 mm on the Foulney mussel bed.

Annex 1

Additional pearl sample points

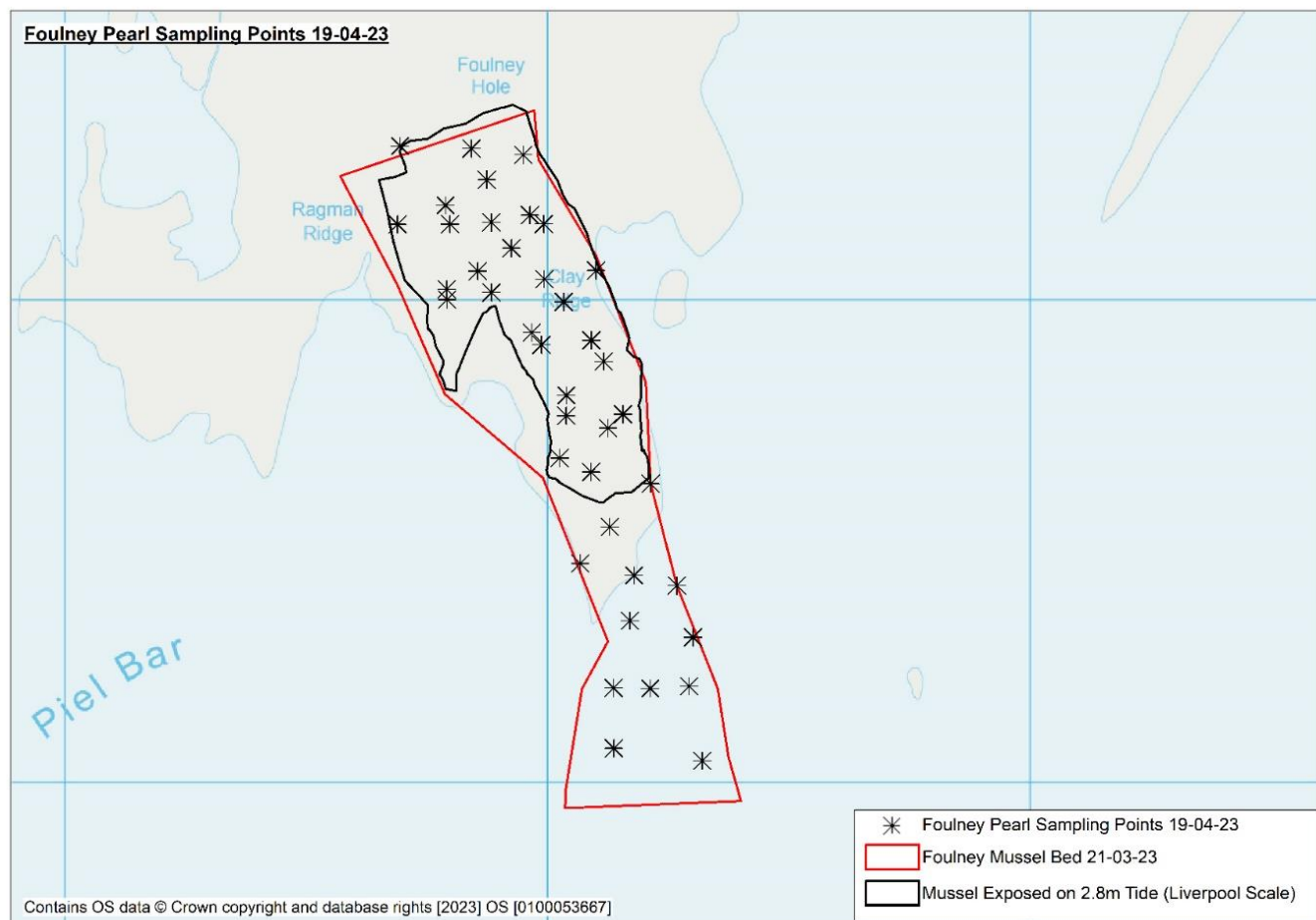


Figure 1. Sample locations for further study on the presence of pearl, age and size across the fished and non-fished areas.