Annex B - NWIFCA Mussel Inspections and Surveys 2021

a) Solway Subtidal Mussel Survey 20/04/21

A subtidal survey of the Solway subtidal mussel bed located near Silloth was carried out on 20th April 2021 using the Authority's Tritech Seaking Towfish Side Scan Sonar (SSS). The SSS data was ground-truthed using a Hamon Grab. Survey data is still being processed but indications are that although some mussel has persisted, the coverage has reduced from the survey done in March 2020. There are signs of a new settlement, but from the grab samples it does not seem to be extensive. A full report should be available for the August TSB.

b) Duddon Estuary Mussel Inspection 27/04/21

LW: 19:06 0.4m (Liverpool tides)

The Duddon channel was inspected to assess an area where there was a fishery in 2014-2015. The area is in a main channel and even on a low water spring tide much of the area remains under water. Annual inspections since 2015 by quad bike and on foot have shown very little mussel present.

There was an area of mussel and bare cobble present in the channel estimated at 13.5ha shown in Figure 1. Due to the majority of the area remaining under water and the limited amount of time on the bed, the exact perimeter could not be mapped but instead waypoints were taken at the edges of the bed and the area estimated.

There was a mix of mussel size classes with some 20-30mm mussel present, (likely to have persisted from 2020), and a 2021 mussel settlement. The 20-30mm was on a mixture of cobble and sand, and was patchy across the area (Figure 2 and 3). Where the mussel was on sand it was mixed in with Sand Mason worm tubes (Figure 4). Some areas of mussel were buried under a thin layer of sand. The 2021 mussel settlement was 5-8mm in size and patchy across the bed (Figure 5). Where the mussel remained underwater regular samples were taken to observe the mussel (Figure 6). Officers will continue to monitor the bed.

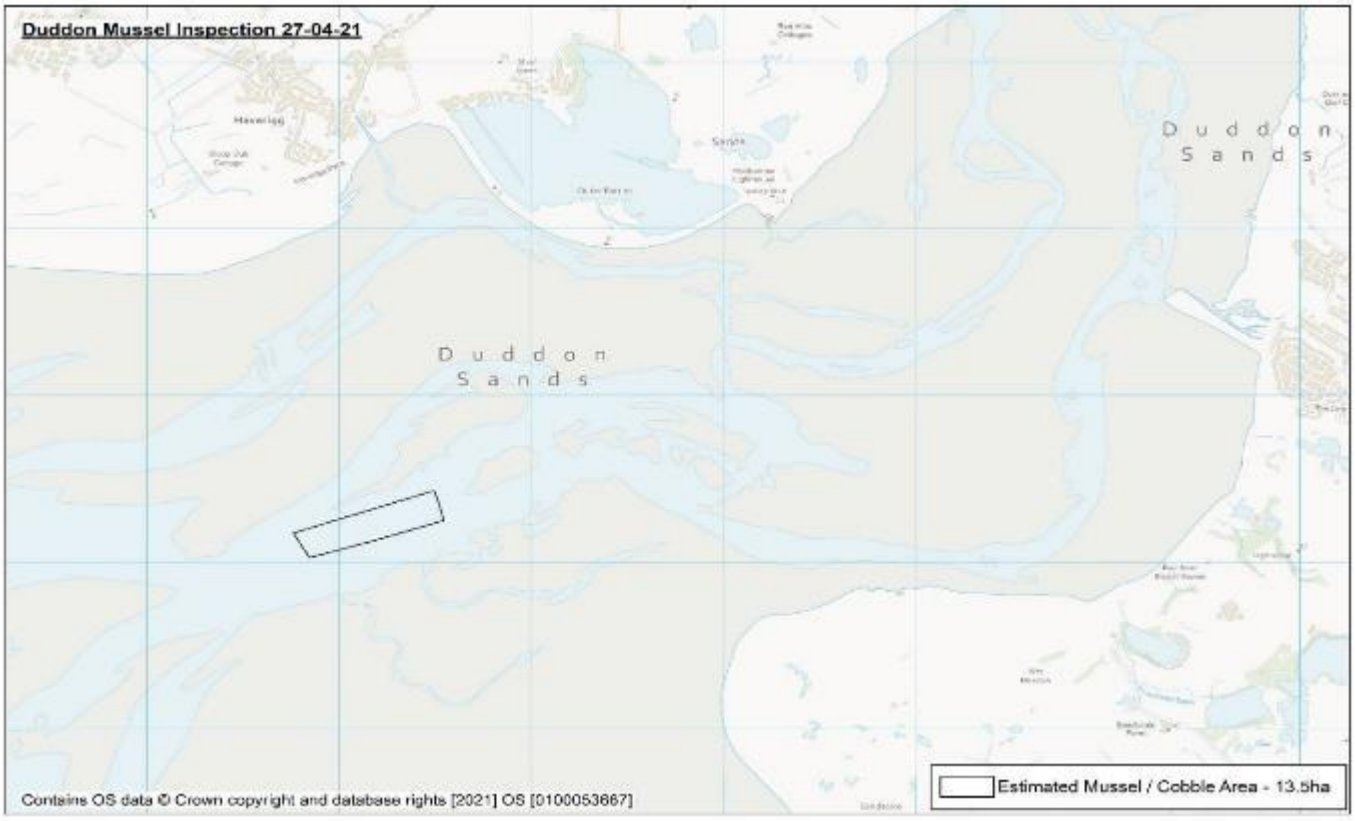

Figure 1. Estimated extent of mussel in the Duddon Channel 27-04-21.

Figure 2. Area of 20-30mm mussel 27-04-21.

Figure 3. Area of patchy 20-30mm mussel 27-04-21.

Figure 4. Area of 20-30mm mussel mixed in with Sand Mason 27-04-21.

Figure 5. Area of patchy 2021 mussel settlement 27-04-21

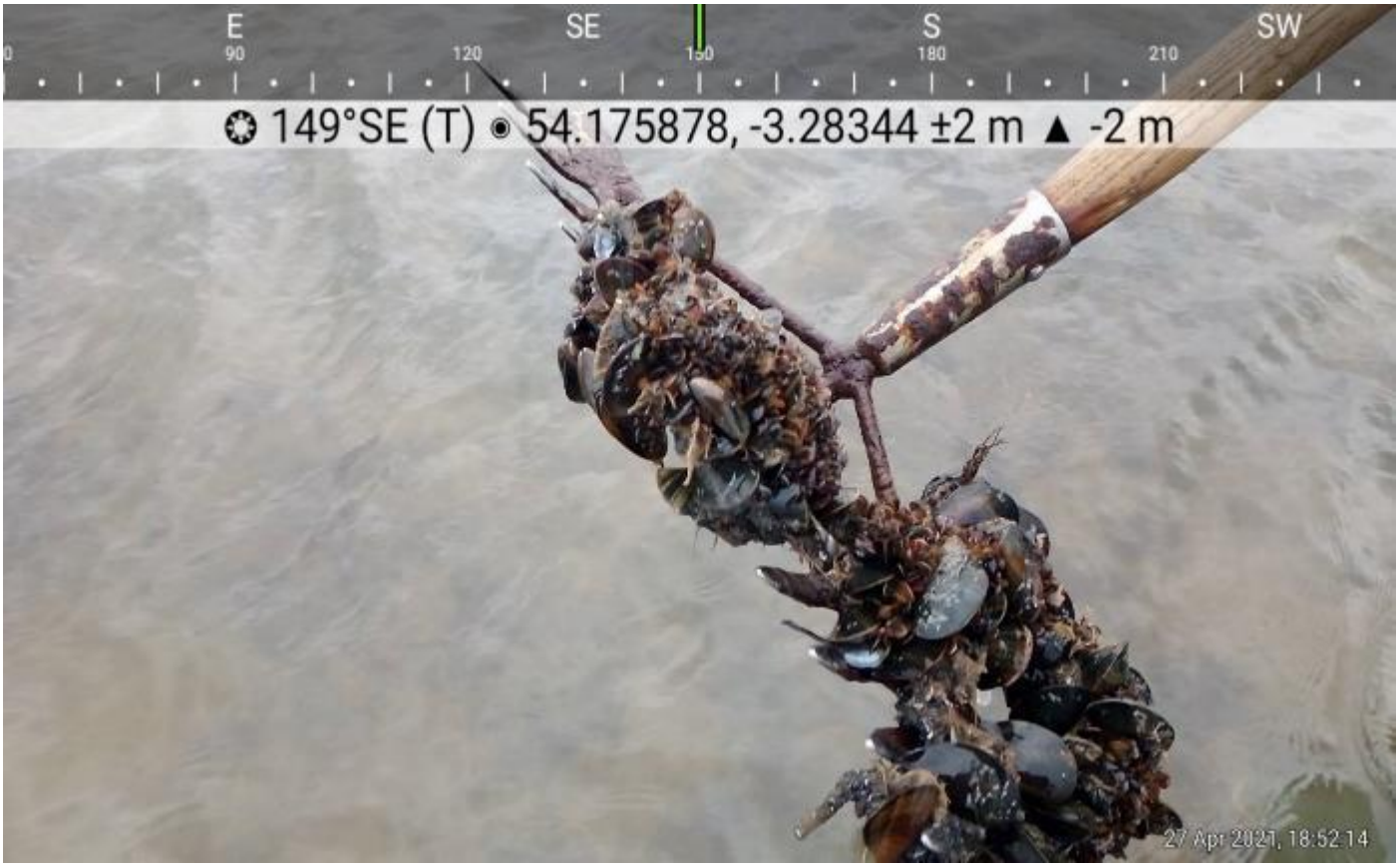

Figure 6. Sample of 20-30mm and 2021 mussel from an area which did not uncover 27-04-21

c) Morecambe Bay Mussels

I. Industry Heli-flight 26/04/21

Low water: 18:21 0.7m (Liverpool Tides)

Survey method: Heliflight Visual Inspection

On 26th April 2021, a helicopter survey was undertaken to assess the mussel stocks in Morecambe Bay, figure 1. This report outlines the observations of mussel stock on mussel beds: Falklands, Small Island and Trailer Bank.

Falklands

The area of exposed ground witnessed in 2019-2020 was covered in a large area of *Sabellaria alveolata,* waypoints 18 and 19*.* The *Sabellaria alveolata* is covered in a significant 2021 mussel settlement. As shown below in Figures 2 and 3.

Small Island

There was an area of exposed hard ground, waypoint 17, in the location of small islands (2020). There was no observed mussel on the hard ground.

Trailer Bank

Trailer bank consisted of mussel which has persisted through the winter, the mussel appeared to be consistent across the area, waypoint 15 and 16. There was no observed mussel settlement from the heliflight. There was also a significant number of starfish covering large areas of this mussel as shown in Figure 4.

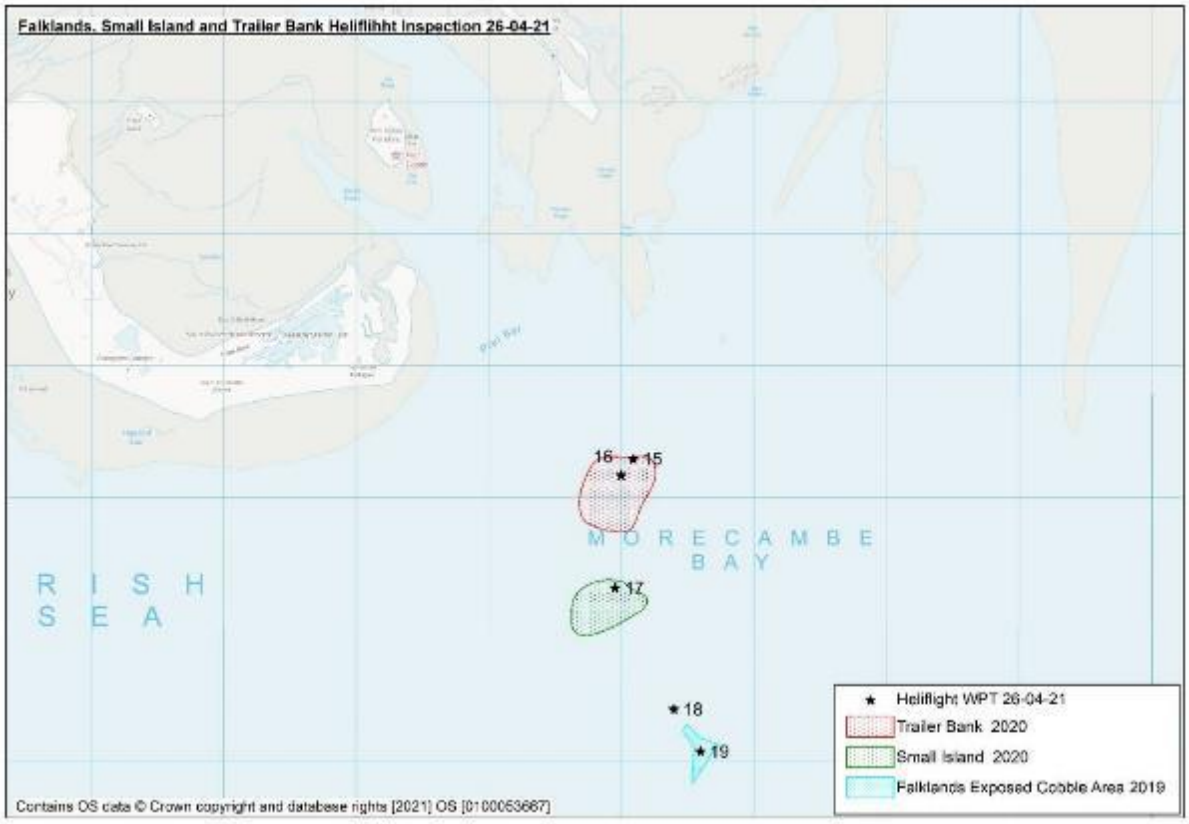

Figure 1. Map of previously mapped areas and waypoints taken by NWIFCA on Industry Heliflight 26-04-21

Figure 2. Falklands *Sabellaria alveolata* and 2021 mussel settlement 26-04-21.

Figure 3. Falklands *Sabellaria alveolata* and 2021 mussel settlement 26-04-21.

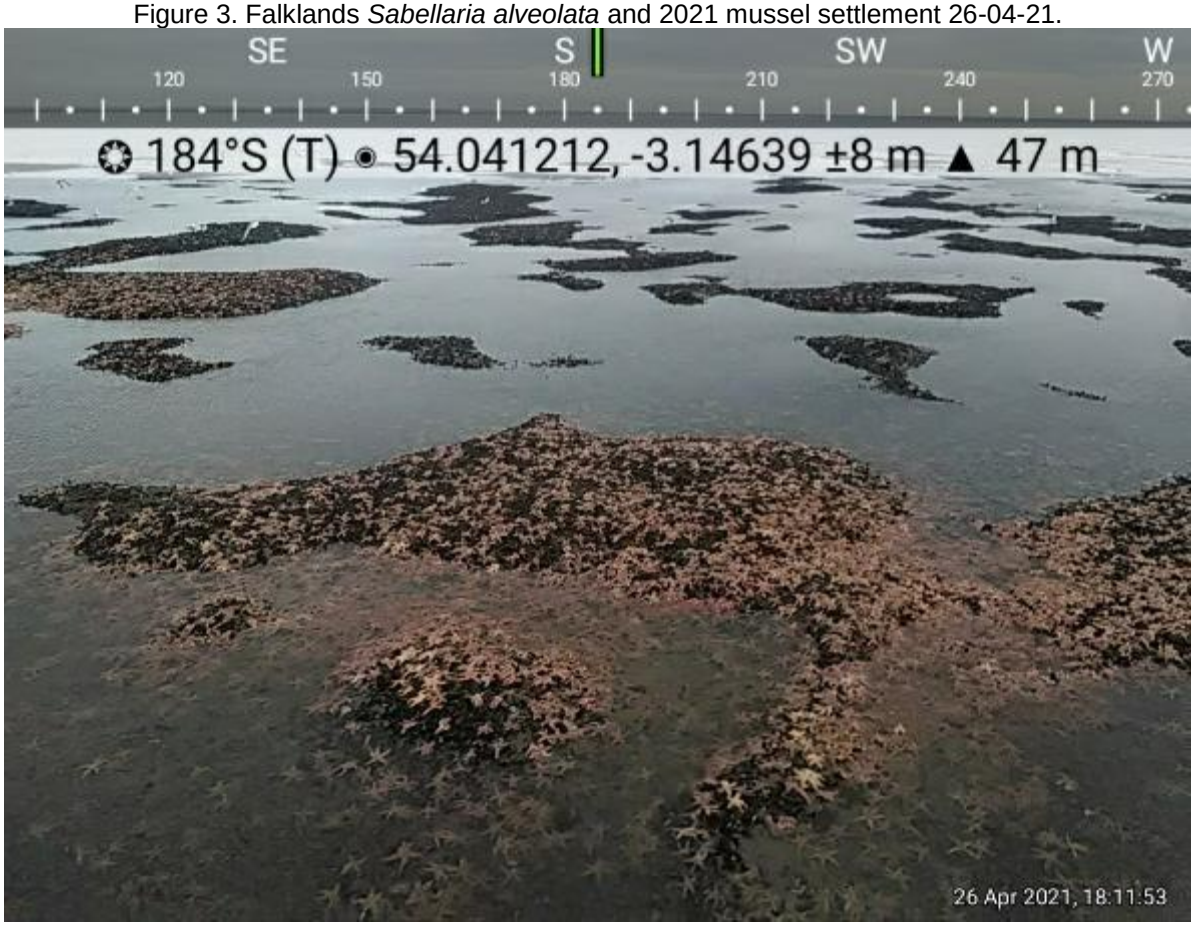

Figure 4. Trailer Bank mussel bed with starfish present 26-04-21.

II. Heliflight Mussel Survey, Falklands, Trailer Bank and Small Island 26-05-21

Low water: 18:49 0.7m (Liverpool Tides)

Survey method: Heliflight Visual Inspection

This report outlines the observations of mussel stock on the following mussel beds: Falklands, Small Island and Trailer Bank. On 26th May 2021, a return heliflight survey was undertaken to assess the mussel stocks of the North Morecambe Bay drying areas which are not accessible from land. An estimated perimeter was obtained by flying around the area of mussel on Falklands (Figure 1), the perimeter of Small Island and Trailer Bank was not mapped but images and notes taken.

Falklands

As previously reported a large area of *Sabellaria alveolata* has had a dense settlement of 2021 mussel as shown in Figures 2 and 3. Since the inspection in April there has been at least once additional settlement. The area of exposed ground on the western edge had received a newer settlement and extended into the water. The estimated size of the area is 36 hectares.

Small Island

No change from April inspection, exposed hard ground but no mussel observed.

Trailer Bank

Similar situation to the April inspection, with larger mussel which had persisted through the winter and dense areas of starfish (Figures 5 and 6). No observed dense 2021 mussel settlement.

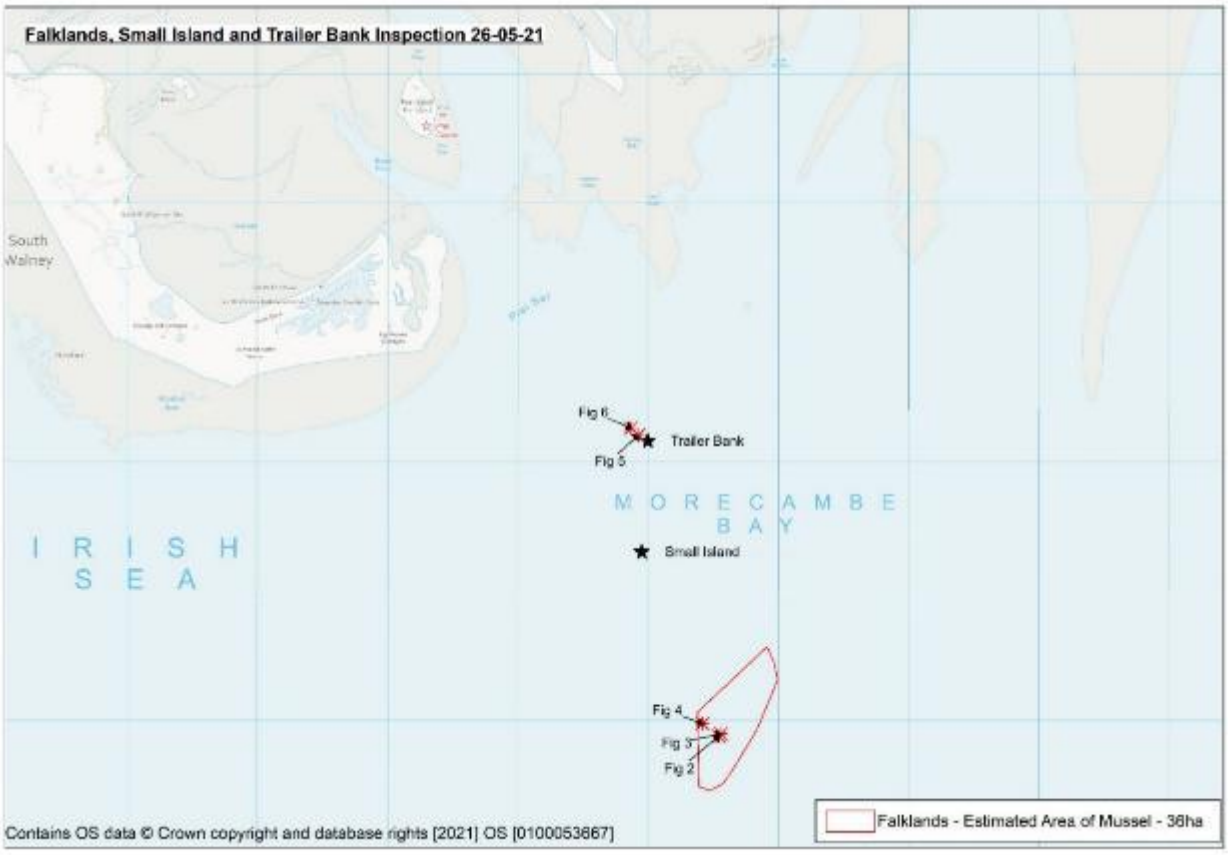

Fig 1 – Map of previously mapped areas and waypoints taken by NWIFCA on Industry Heliflight 26-05-21

Fig 2 – Falklands *Sabellaria alveolata* and 2021 mussel settlement 26-05-21, looking NNW

Fig 3 - Falklands *Sabellaria alveolata* and 2021 mussel settlement 26-05-21, looking SWW

Fig 4 - Falklands 2021, western edge mussel settlement 26-05-21

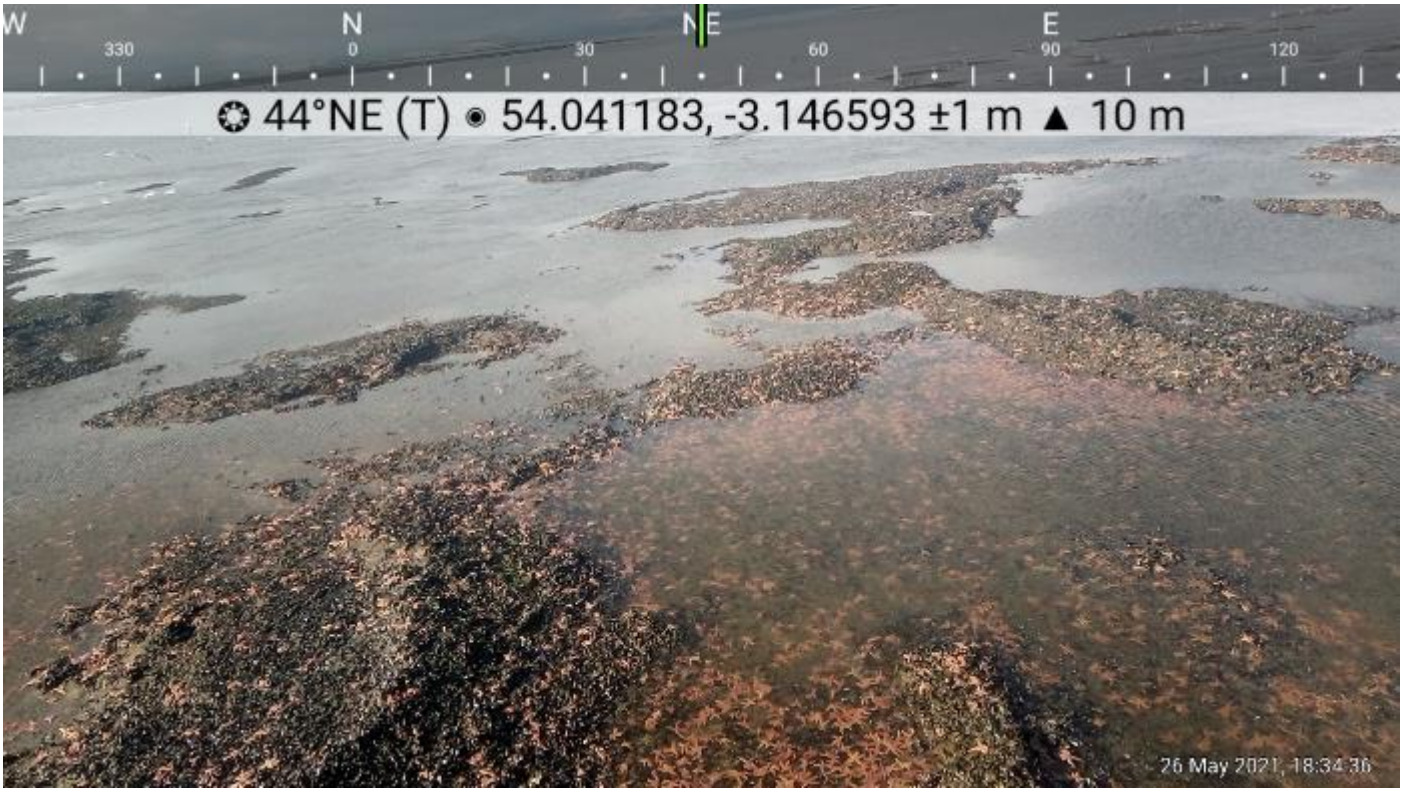

Fig 5 – Trailer Bank mussel bed with large mussel and starfish present 26-05-21

Fig 6 – Trailer Bank mussel bed with large mussel and starfish present 26-05-21

III. Falklands Quad Access Inspection 31/03/21

Quad bike access to the Falklands, Small Island and Trailer Bank was not possible due to the channels, in particular a deep channel between the end of the sand bank and the areas of mussel.

IV. Walney Channel / Green Buoy (Foulney) Dutch Wand Survey 30/04/21

Low water: 08:45 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. Due to the GPS data being lost, the transect lines and sample points have been estimated and mapped as shown in Figure 2. The number of hits and misses of live mussel were recorded to give percentage cover. The transect data and bed area were estimated from coordinates taken at the end of the survey after the initial data had been lost. It was not possible to walk the perimeter of the bed due to time restraints. A mussel sample was taken every 50 hits using a 10 cm diameter corer. Five transects were completed and 11 samples collected. The total weight of live undersize and size mussel was recorded as well as the size frequency of each sample.

The cobble bank that had developed along the channel edge, and noted in previous surveys, is still prominent and it is hypothesized that this could offer some protection against scour. Similar to the previous year's survey, the mussel along the channel edge was noted as present in banks of mussel with bare cobble in between.

Due to the amount of time required to sort the relatively mixed samples, mussel under 10mm was excluded from calculations and maps except the seed map (Fig. 6). Rather than count the seed individually amounts in each sample were assessed as high, medium, low or none.

From the estimated transect and sample data, the total mussel bed surveyed was **18.67 hectares**.

Biomass estimates:

2671 tonnes of size mussel and **410 tonnes of undersize mussel**

Length Frequencies for the surveyed bed are shown in Figure 3 below. From the length frequency data the mussel present on the Walney Channel bed ranged from 18 – 71mm with the highest frequency of mussel being equal at 24, 26 and 62mm.

Maps

The mussel frequency of each size class of mussels per sample has been mapped as shown in Figure 4. The size of the pies are adjusted for sample weight standardised to kg/m². The weight of the size and undersize mussel has been mapped and represented in Figure 5. (NB neither of these maps include spat)

It can be seen from the map that the most abundant size class towards the channel edge is greater than 45 mm. Across a large proportion of the bed, there is a mix of three size classes 10-<25mm, 25-<45, and 45<mm.

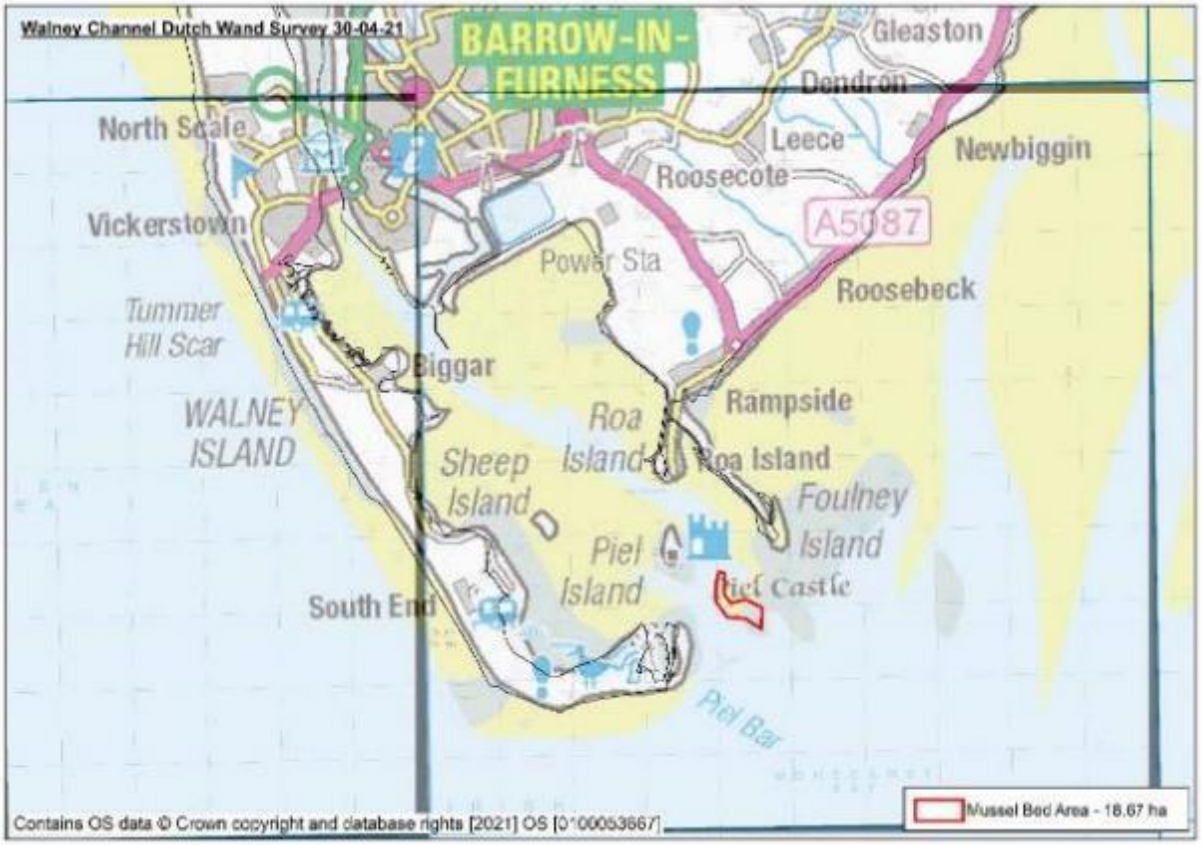

Figure 1. Location of Walney Channel Mussel Bed 30-04-21.

Figure 2. Walney Channel Dutch Wand survey transects and estimated bed area.

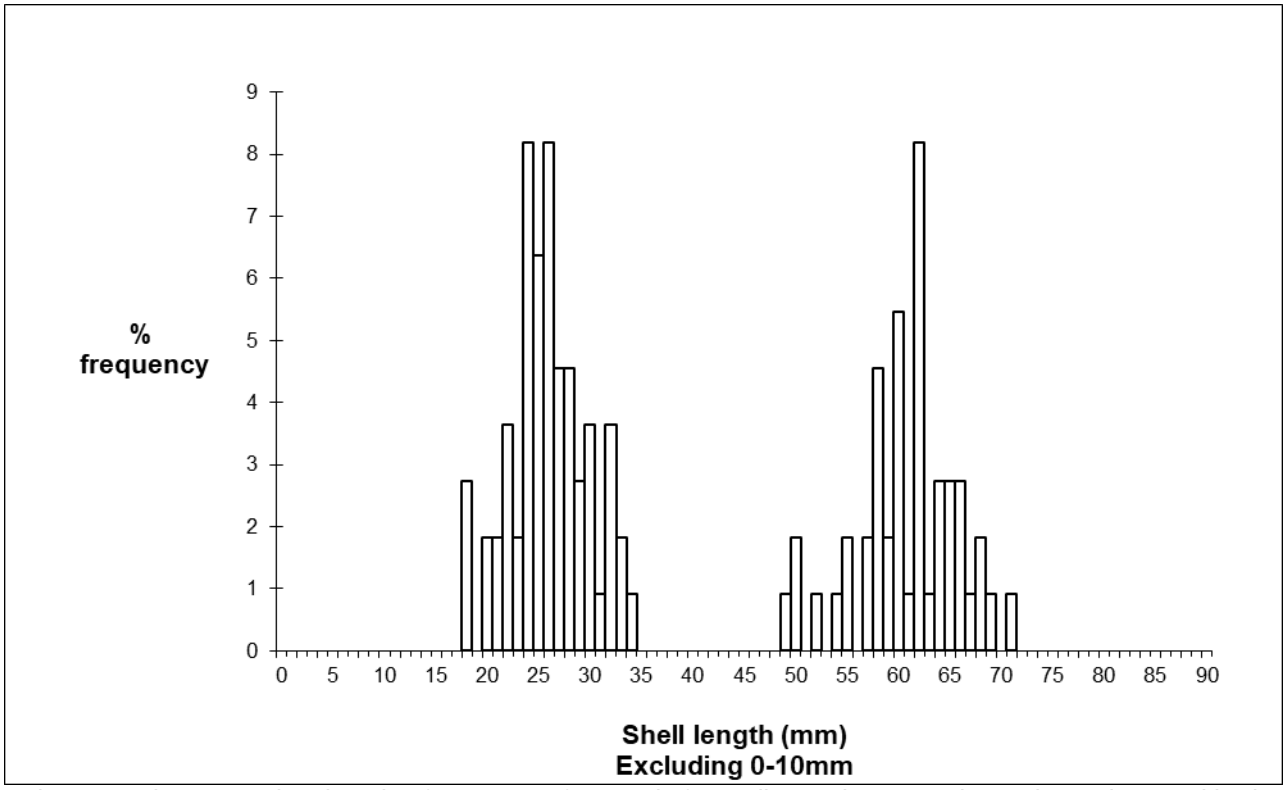

Figure 3. Histogram showing size frequency of mussels from all samples on Walney Channel mussel bed.

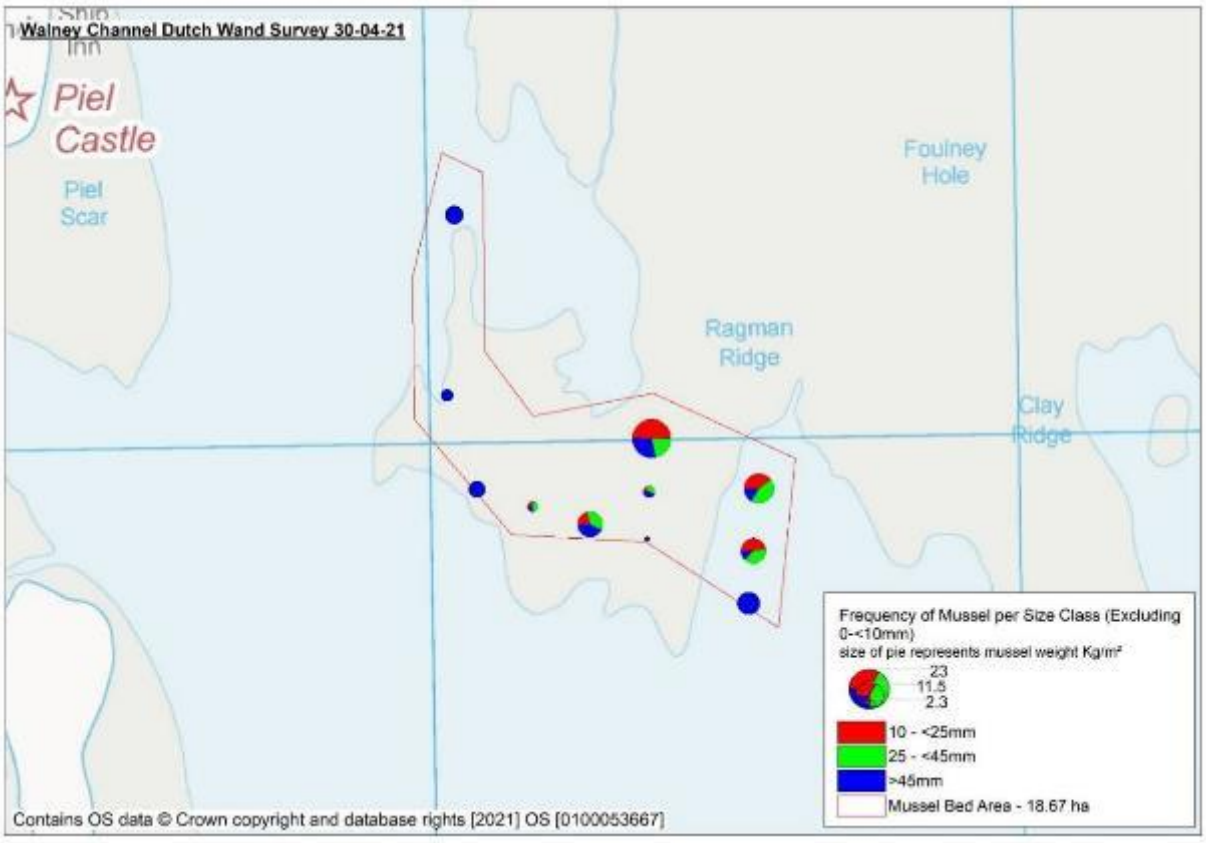

Figure 4. Frequency of mussel by size class.

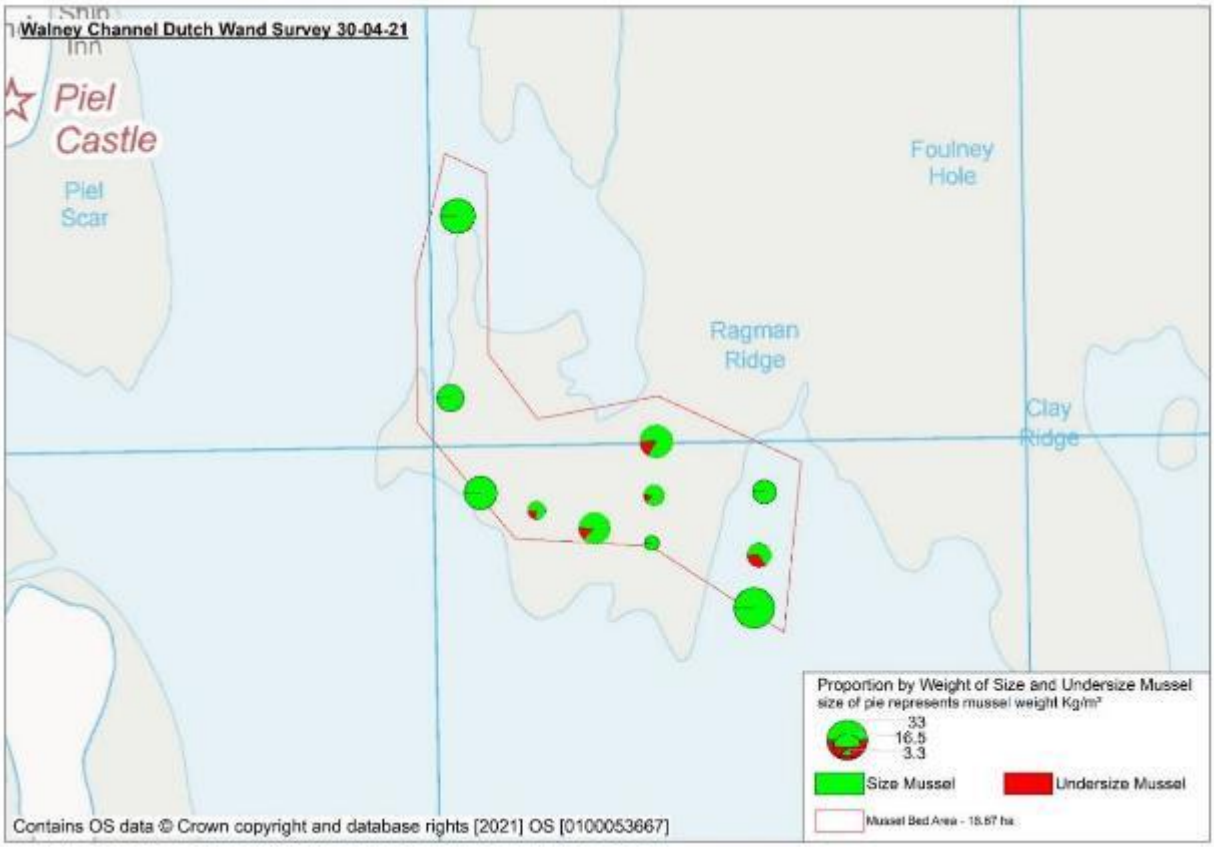

Figure 5. Proportion of size and undersize mussel by weight represented as kg/m^2.

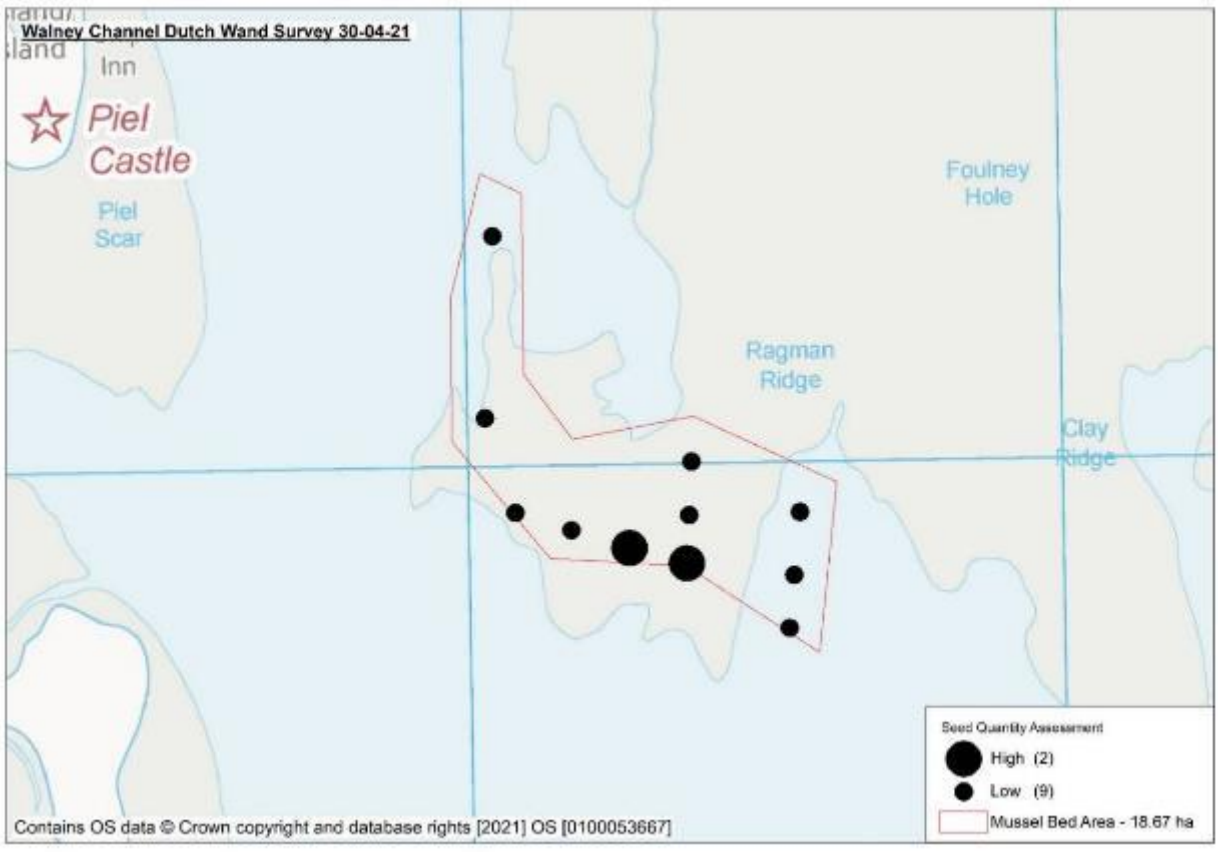

Figure 6. Estimated assessment of seed quantity categorised as high, medium, low and none.

Figure 7. Illustration of the banks of mussel near to the channel edge – 30-04-21.

V. Foulney Skear Dutch Wand Survey 29/04/21

Low water: 08:02 0.6m (Liverpool Tides)

Survey method: Dutch Wand

Line transects were completed across the mussel bed using a Dutch Wand, with transects starting and finishing 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 constraints. A mussel sample was taken every 50 hits using a 10 cm diameter corer. 18 transects were completed and 47 samples collected. The total weight of live undersize and size mussel was recorded as well as the size frequency of each sample. Due to the amount of time required to sort the relatively mixed samples, the mussel under 10mm was excluded from all calculations and maps except the seed map (Fig. 6). Rather than count the seed individually amounts in each sample were assessed as very high, high, medium or low.

From the transect and sample data the total mussel bed surveyed was **56.8 hectares**. There was no separation made between the main Foulney bed and Foulney Island as the mussel had spread between the two and the channel had filled in (Fig. 1). There were large starfish observed at the far low water line of the South-Eastern area of the main skear (Fig. 9).

Biomass estimates: **6332 tonnes size mussel** and **1919 tonnes undersize mussel**

Length Frequencies

The length frequency of mussels on the surveyed bed is shown in Figure 3. From the length frequency data the mussel present on Foulney Skear is varied with a wide spread of mussel from 11mm to 71mm.

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. (NB neither of these maps include spat).

It can be seen in Figure 4 that the size class is varied across the bed, with the size mussel >45 mm predominantly on Foulney Island and an area of 25-45mm mussels in the middle section of the main skear.

Figure 6 illustrates the settlement of 2021 mussel spat which extends across the majority of the skear and is heavily mixed in with the size mussel. Photographs are provided for further evidence of this in Figures 7 and 8. The size mussel bed on Foulney Island can be seen in Figure 10.

Industry report there have been a number of settlements this year some of which have stuck but others that haven't. This is evident in areas where there are two size classes of 2021 mussel.

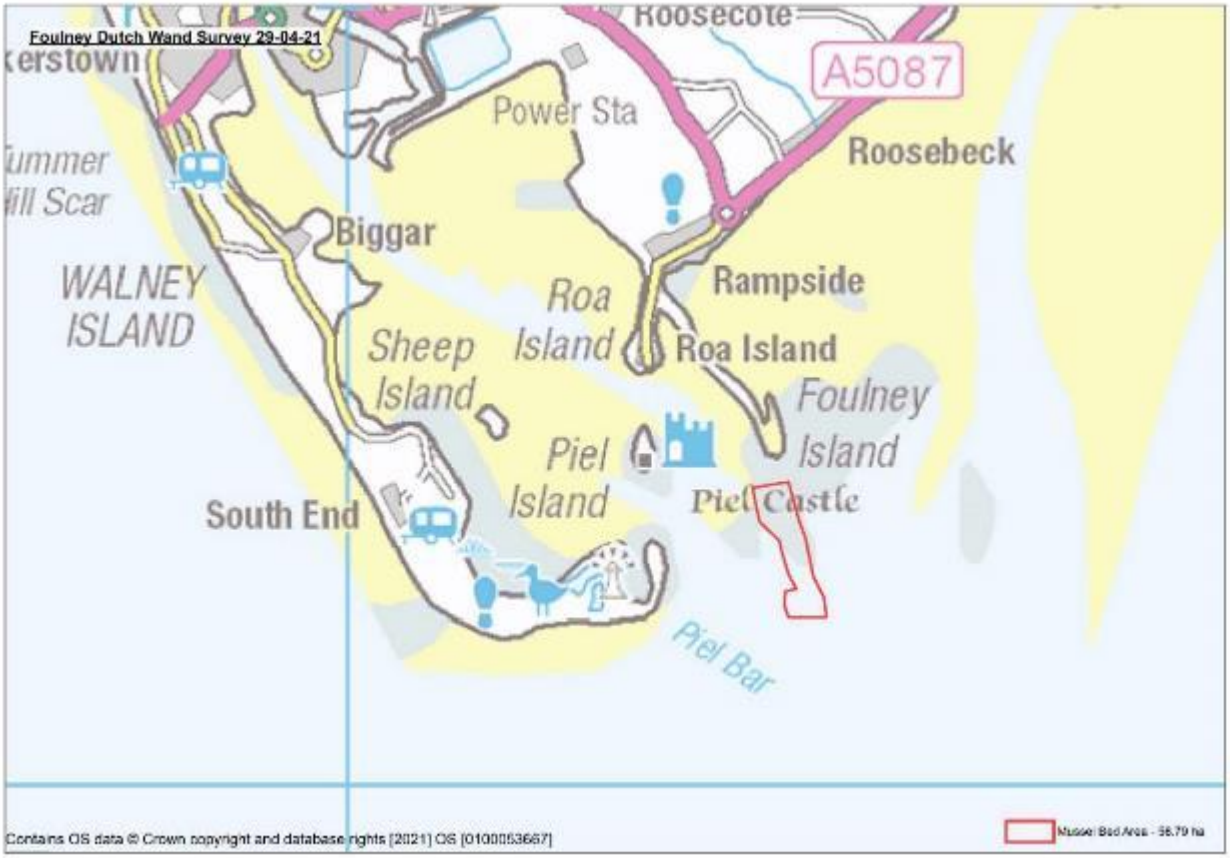

Figure 1. Location of Foulney Mussel Bed surveyed 29-04-21.

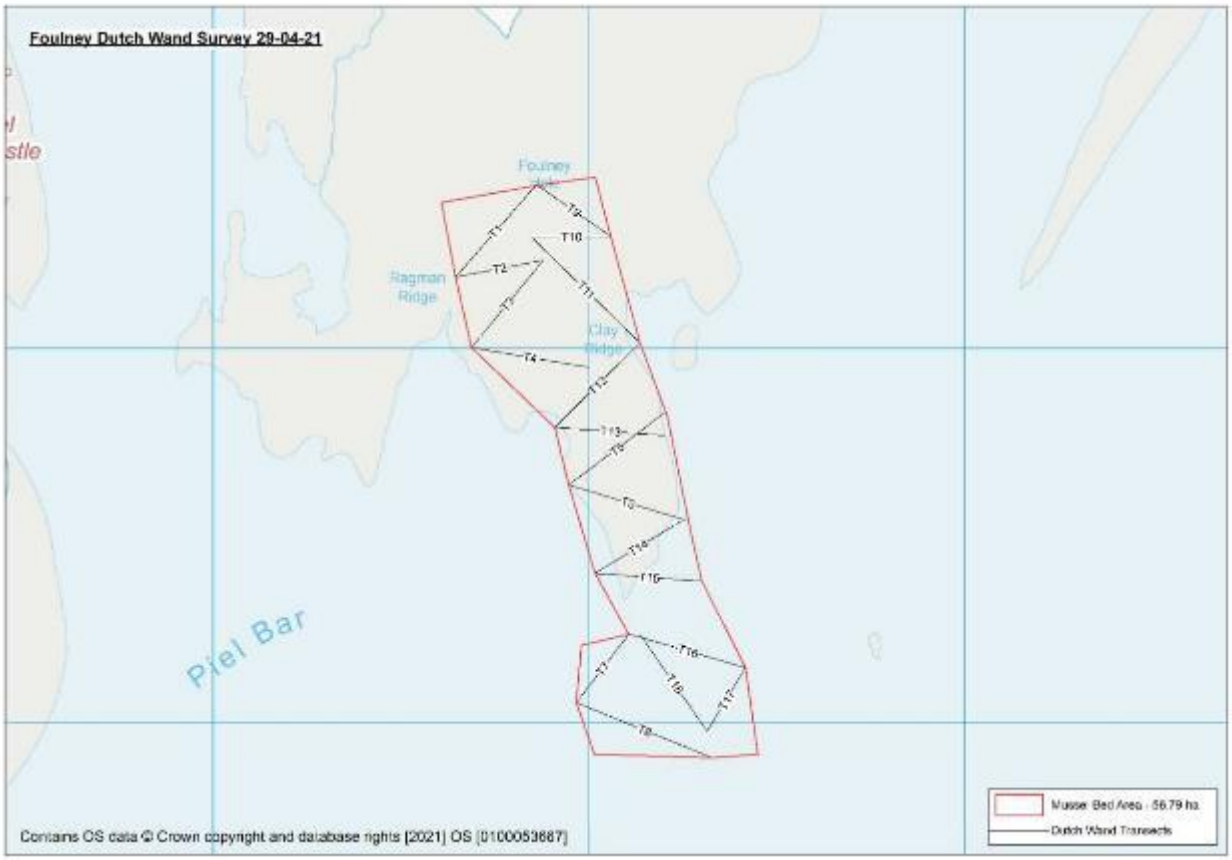

Figure 2. Foulney Dutch Wand survey transects and estimated bed area.

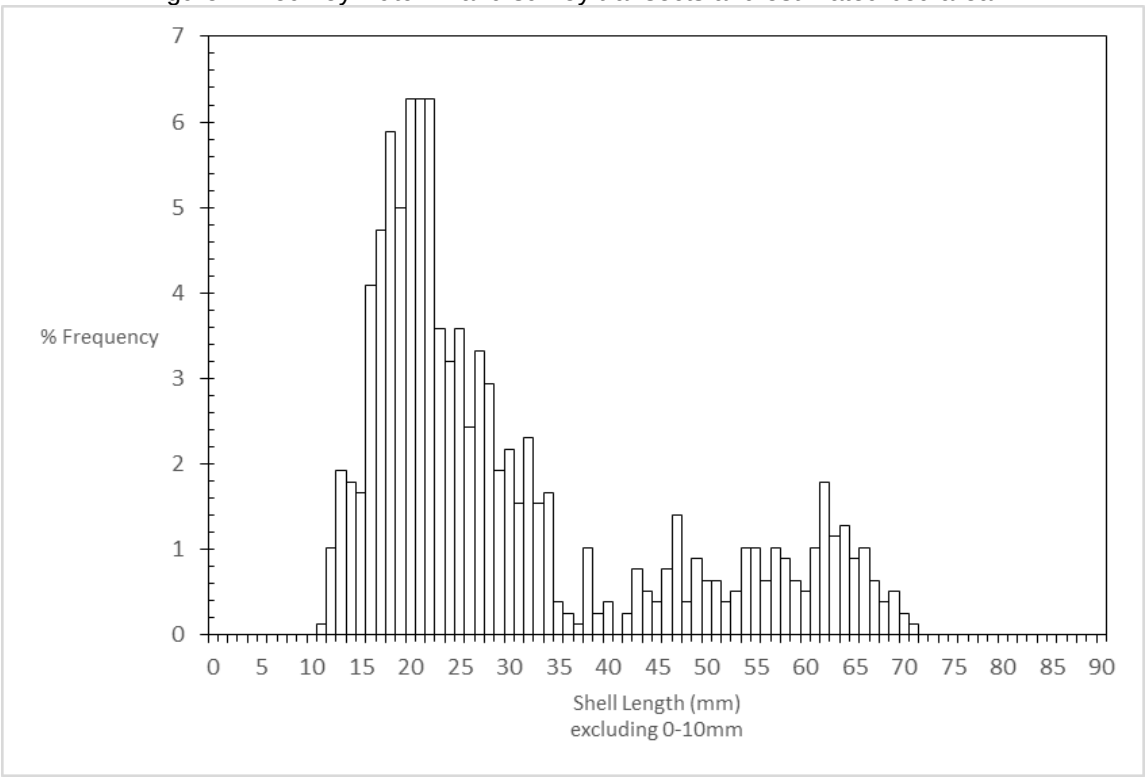

Figure 3. Histogram showing size frequency of mussels from all samples on Foulney.

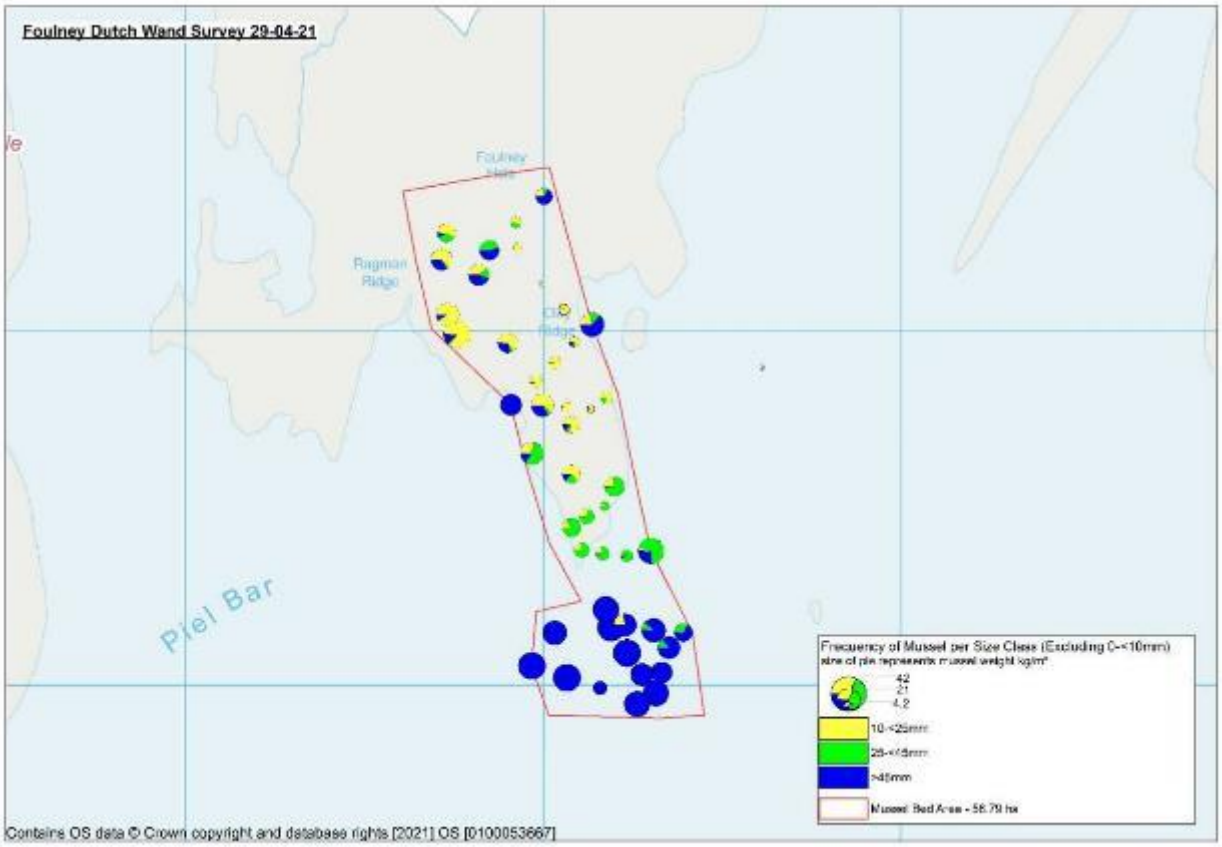

Figure 4. Frequency of mussel by size class.

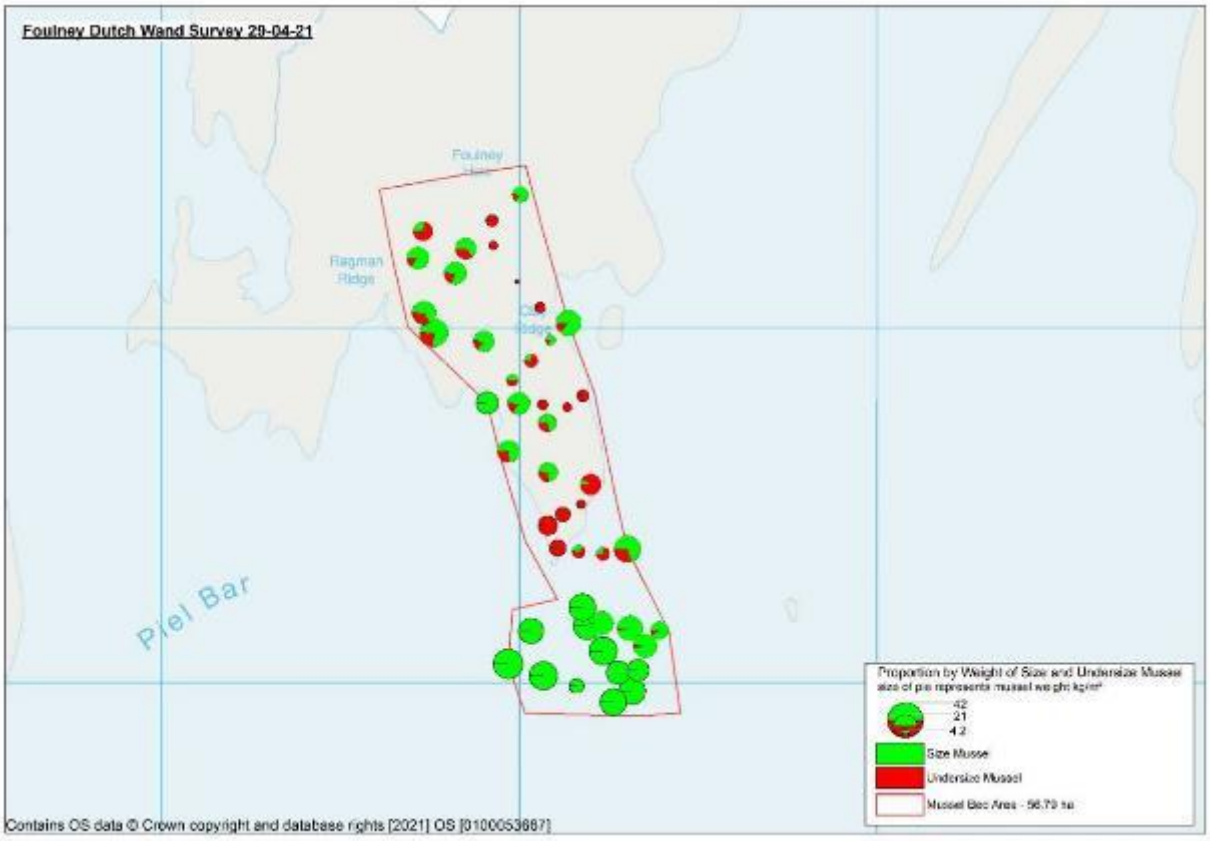

Figure 5. Proportion of size and undersize mussel by weight represented as kg/m^2.

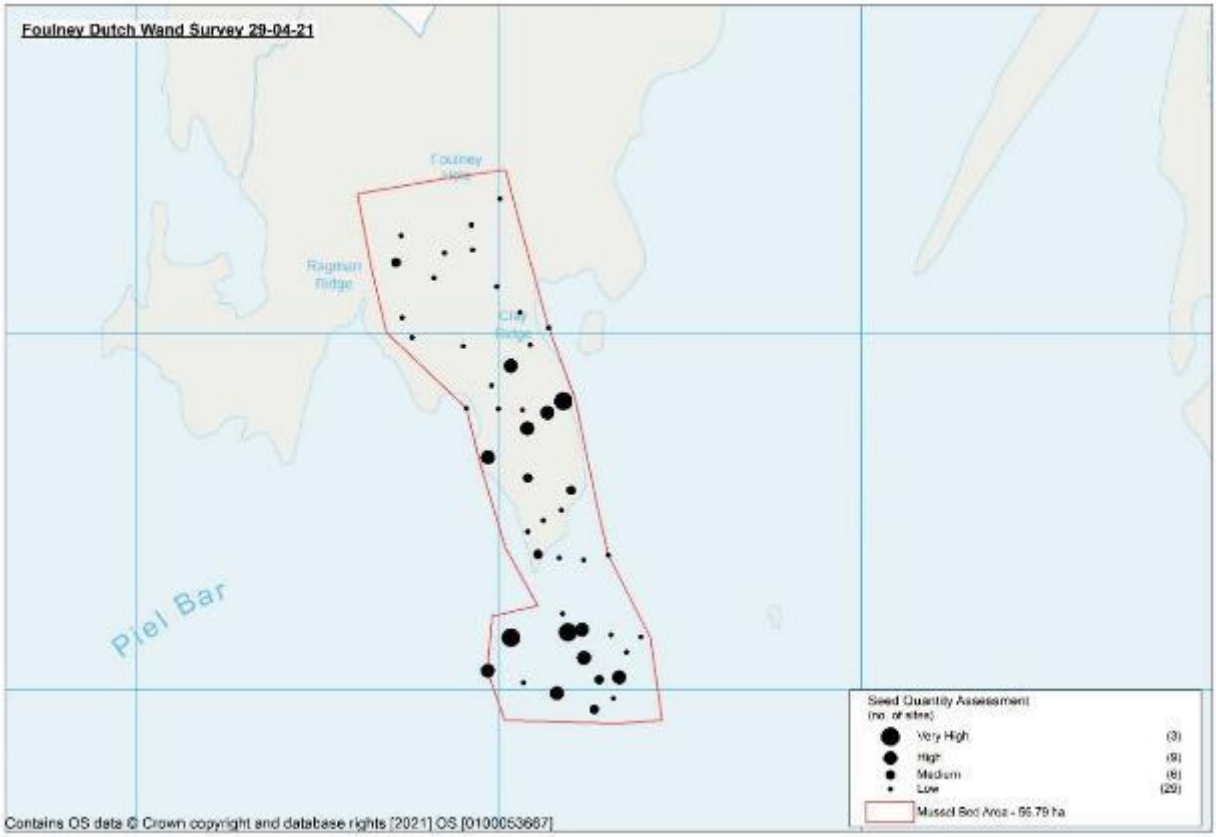

Figure 6. Estimated assessment of seed quantity categorised as very high, high, medium or low.

Figure 7. Illustration of the density of 2021 mussel settlement across Foulney skear 29-04-21.

Figure 8. Illustration of the density of 2021 mussel settlement across Foulney skear 29-04-21.

Figure 9. Large starfish feeding on mussel along the South-East edge of Foulney main skear.

Figure 10. Mussel Bed on Foulney Island 29-04-21.

VI. South America Quad Mussel Inspection 02/03/21

LW: 08:41 0.8m (Liverpool tides)

South America

The area of South America which had mussel present in October 2020 was inspected by quad buke and on foot to assess if any of the mussel had persisted through the winter.

The area was still visible but dominated by stony/sand substrate, shell debris, occasional live mussel and a 2021 mussel settlement (Figure 2). Officers mapped the perimeter but were limited by tidal height with the stony exposed ground continuing into the water on the Southern extremity as shown in Figure 3. The occasional live mussel was 35-45mm in length (Figure 4) and likely to have been from the 2020 settlement. There were some areas of dead historic *Sabellaria alveolata* patches which were covered in 2021 mussel settlement (Figure 7) and were present in 2020 and previously reported on, there were no signs of new *Sabellaria alveolata*. The area had received a dense 2021 mussel settlement which was present on stoney substrate, shell debris, dead *Sabellaria alveolata* and live 2020 mussel, the new settlement was approximately 2-3mm in size (figures 5 and 6). The settlement is earlier than what has been witnessed in recent years.

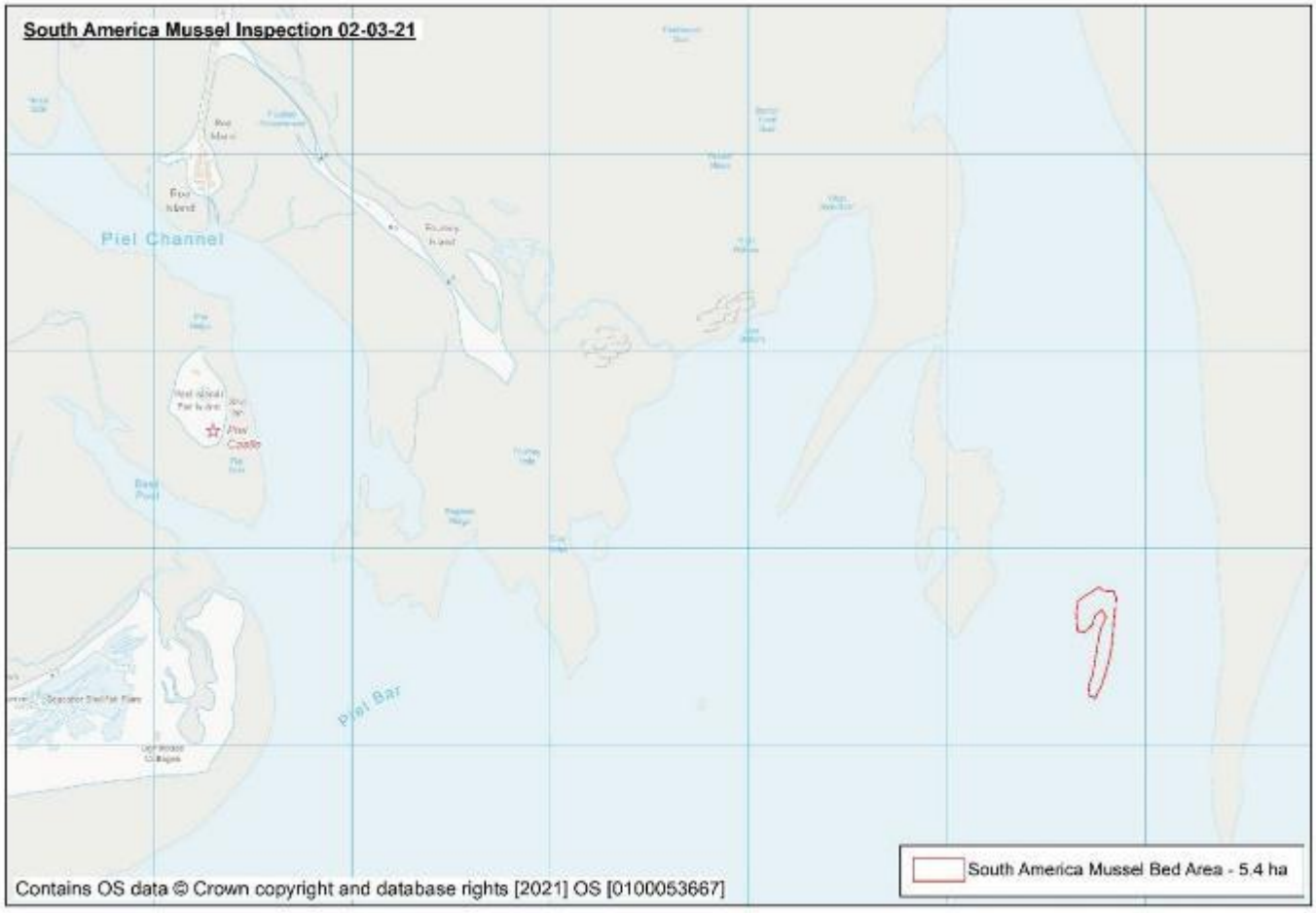

Figure 1. Estimated extent of the exposed stony substrate of South America 02-03-21

Figure 2. Mix of stony / sand substrate, shell debris, 2020 mussel and newly settled mussel 02-03-21.

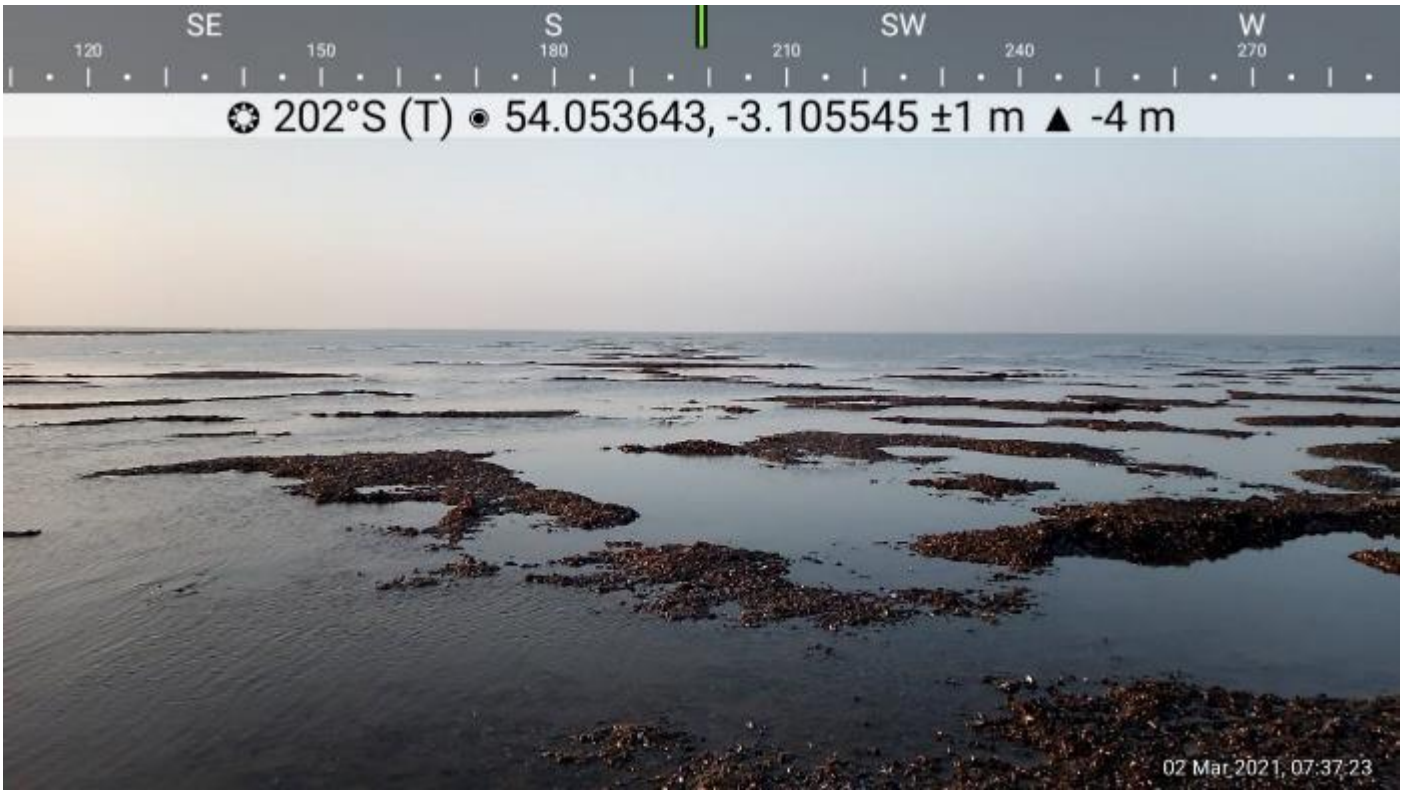

Figure 3. Area extended in the water on the Southern Extremity 02-03-21

Figure 4. Size of 2020 mussel 02-03-21.

Figure 5. 2021 mussel settlement 02-03-21.

Figure 6. Area matted with 2021 mussel settlement 02-03-21.

Figure 7. 2021 mussel settlement on historic dead patches of *Sabellaria alveolata.*

VII. South America Mussel Inspection (Quad) 27/05/21

LW: 06:58 0.8m (Liverpool tides)

The area of South America was inspected to monitor the condition of the mussel observed in March 2021 and to assess if there had been any further mussel settlement. South America was accessed by quad bike, and an inspection was carried out on foot. The perimeter was mapped (Figure 1) but officers were limited by tidal height with mussel continuing into the water on the Southern extremity. The area mapped had an area of 13.9ha.

There was a mix of size classes of mussel across the bed with what appeared to be a number of 2021 settlements ranging from 5-12mm (Figure 2 and 3). There were areas of 2021 mussel settlement mixed with areas of 25-30mm mussel (Figure 4) and areas of 2021 mussel settlement with some larger 40-50mm mussel (Figure 5). The amount of larger mussel 25-50mm was more abundant than in survey in March, it is possible that the mussel was not as visible as it was under the mat of newly settled mussel in March, the mussel has also likely grown since the March survey. The mussel was on a layer of sand meaning most of the hard substrate previously reported is no longer visible.

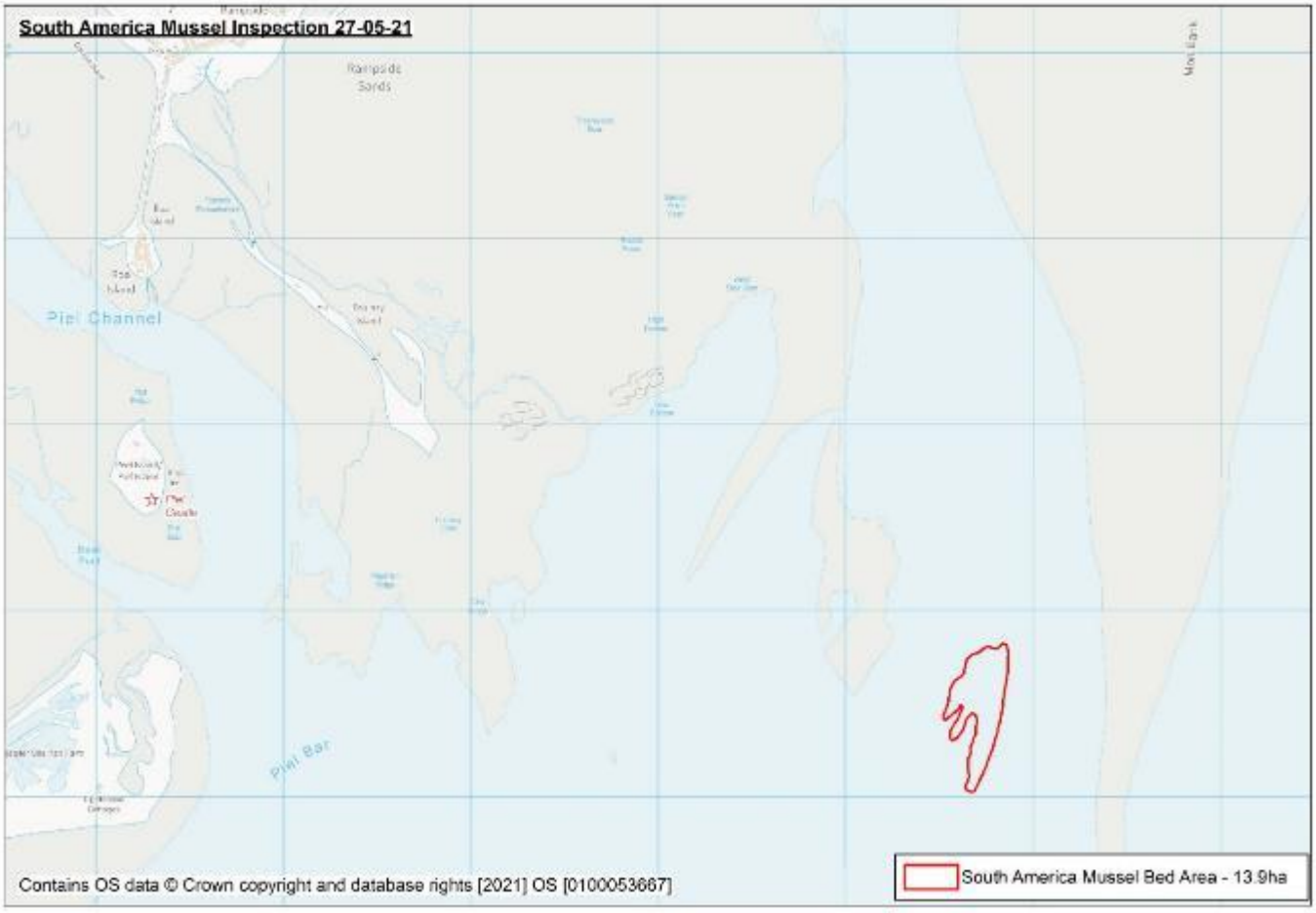

Figure 1. Estimated extent of mussel on South America 27-05-21.

Figure 2. Overview of mussel on South America 27-05-21.

Figure 3. Varying size of 2021 mussel settlement on South America 27-05-21.

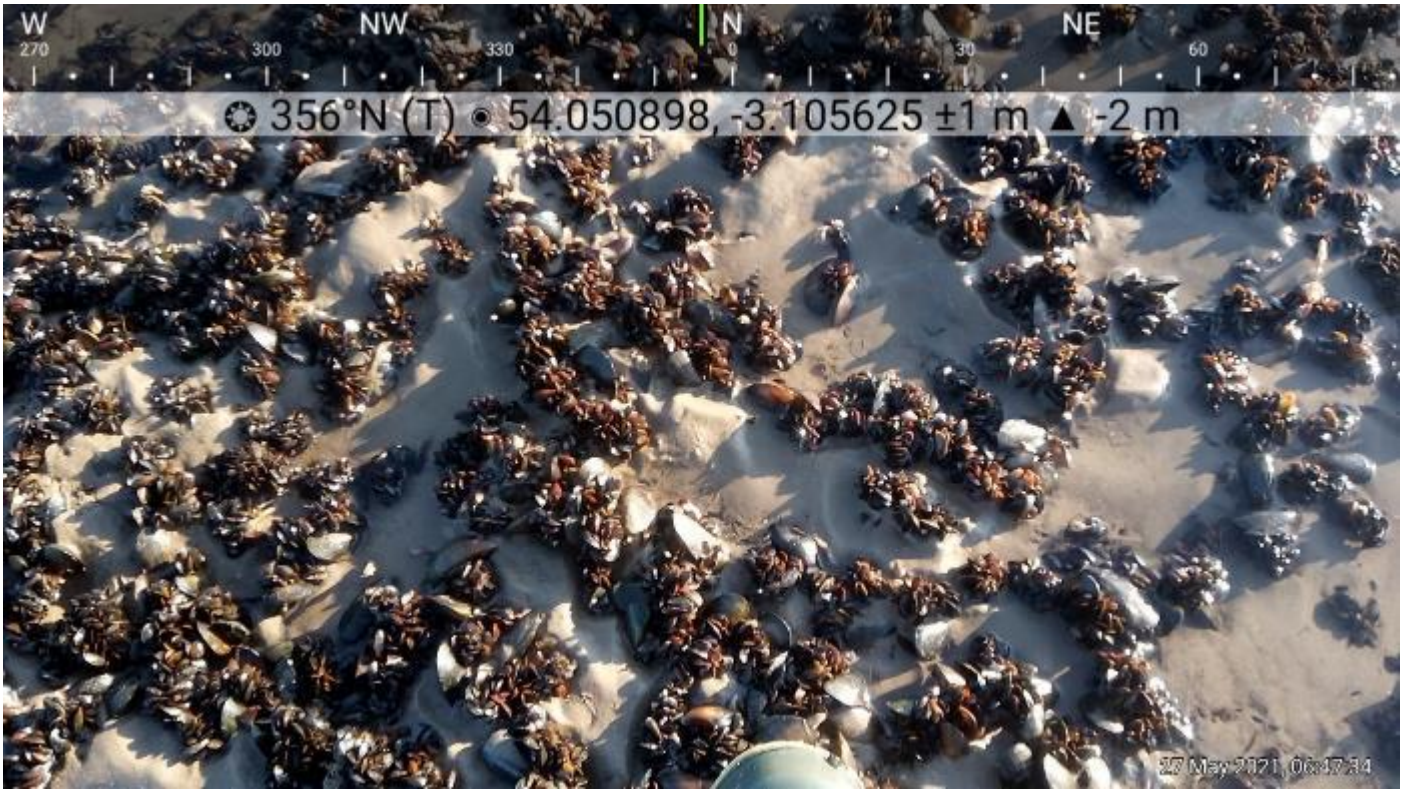

Figure 4. Seed mussel mixed with 25-30mm mussel on South America 27-05-21.

Figure 5. Seed mussel mixed with 40-50mm mussel on South America 27-05-21.

VIII. Heysham Flat Mussel skear and *Sabellaria alveolata* Inspection 30-03-21

Tides LW 06:42 0.6m (Liverpool tides)

The skear was accessed on foot. As other areas of Morecambe Bay have a 2021 mussel settlement, the aim was to find out if the settlement had also occurred on Heysham. Efforts were made to cross Dallam Dyke but due to water depth and tide this was not possible.

There has been a significant increase in the *Sabellaria alveolata* distribution with much of the skear containing large areas covered by reef (Figure 1). This made accessing many of the areas difficult. The extensive area of reef was present on the North and South of the Skear as seen in previous years but now extends across the skear from Conger Rock to Dallam Dyke (Figures 2 – 5). The extent is similar to that observed pre 2016 where much of the end of the skear was covered by *Sabellaria alveolata*.

Some mussel had persisted over the winter, with small patches of 30-45mm mussel, particularly along Dallam Dyke. Much of the live mussel was mixed in with the *Sabellaria alveloata*. There was the occasional size mussel present across the bed. There were some signs of a 2021 mussel settlement (Figure 6) but it did not seem to be constant across the bed and not in any significant amounts.

Knott End Skear appeared black in colour and had Oystercatchers in numbers present so it is presumed that there is mussel present but this cannot be confirmed as access was not possible by foot. There are a number of skears present beyond Knott End skear.

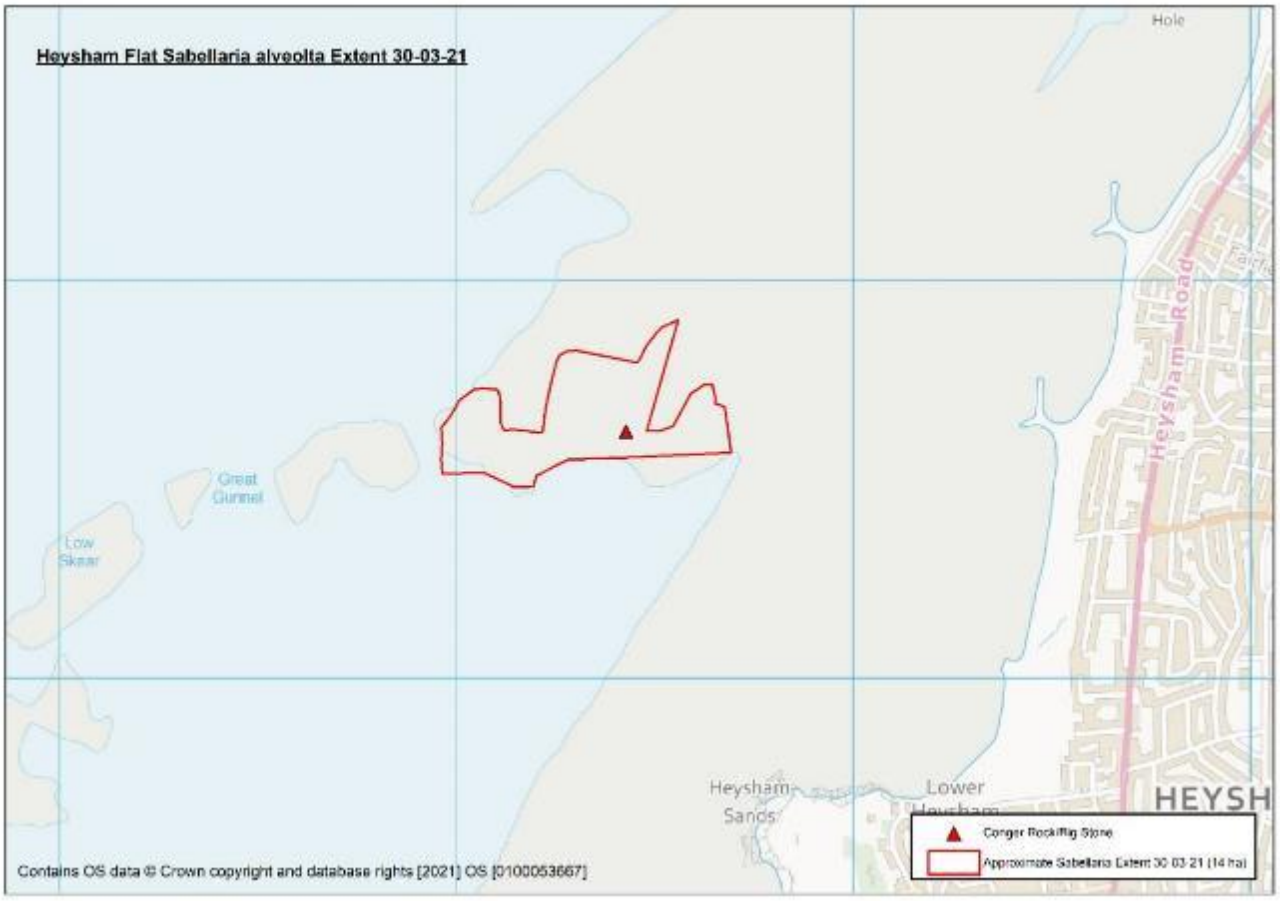

Figure 1. *Sabellaria alveolata* approximate extent 30-03-21.

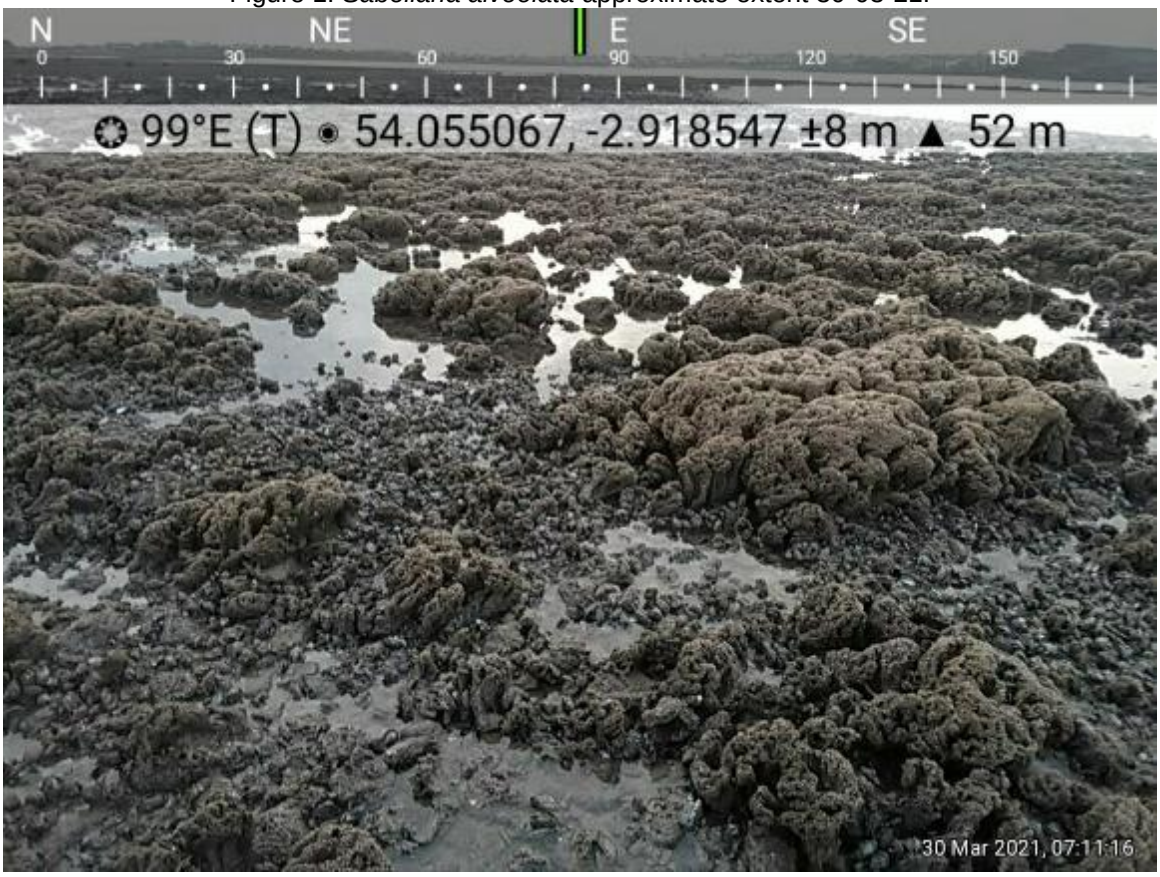

Figure 2. Extensive *Sabellaria alveolata* reefs 30-03-21.

Figure 3. Extensive *Sabellaria alveolata* reefs 30-03-21.

Figure 4. Extensive *Sabellaria alveolata* reefs 30-03-21.

Figure 5. Extensive *Sabellaria alveolata* reefs looking West towards Conger rock 30-03-21.

Figure 6. Seed settlement in cobble area 30-03-21.

IX. Heysham Flat Mussel and *Sabellaria alveolata* Inspection 26-05-21

Tides LW 18:39 0.7m (Liverpool tides)

The skear was accessed on foot to inspect the mussel on Heysham Flat to assess if there had been a mussel settlement since it was last inspected at the end of March, when there was little evidence of a settlement. As previously reported much of the end of the skear from Conger Rock to Dallam Dyke is covered in *Sabellaria alveolata.* Due to the extensive coverage of S*abellaria alveolata,* access was limited to the area East of Conger Rock to ensure no damage was caused. The Eastern edge of the *Sabellaria alveolata* was mapped to show approximate extent (Figure 1).

There was evidence of a 2021 mussel settlement (Figures 2 and 3) which was constant across the bed East of the line in Figure 1, on most of the exposed skear. The mussel had a dense coverage of 70-80% at a size of 8-10mm. On the edges of the *Sabellaria* alveolata the was evidence the mussel had settled on it (Figure 4), however the majority of the *Sabellaria* alveolata did not appear black in colouration and therefore it was assumed that seed has not settled on it. There were also some small patches of 20-30mm mussel mixed in with the settlement (Figure 5).

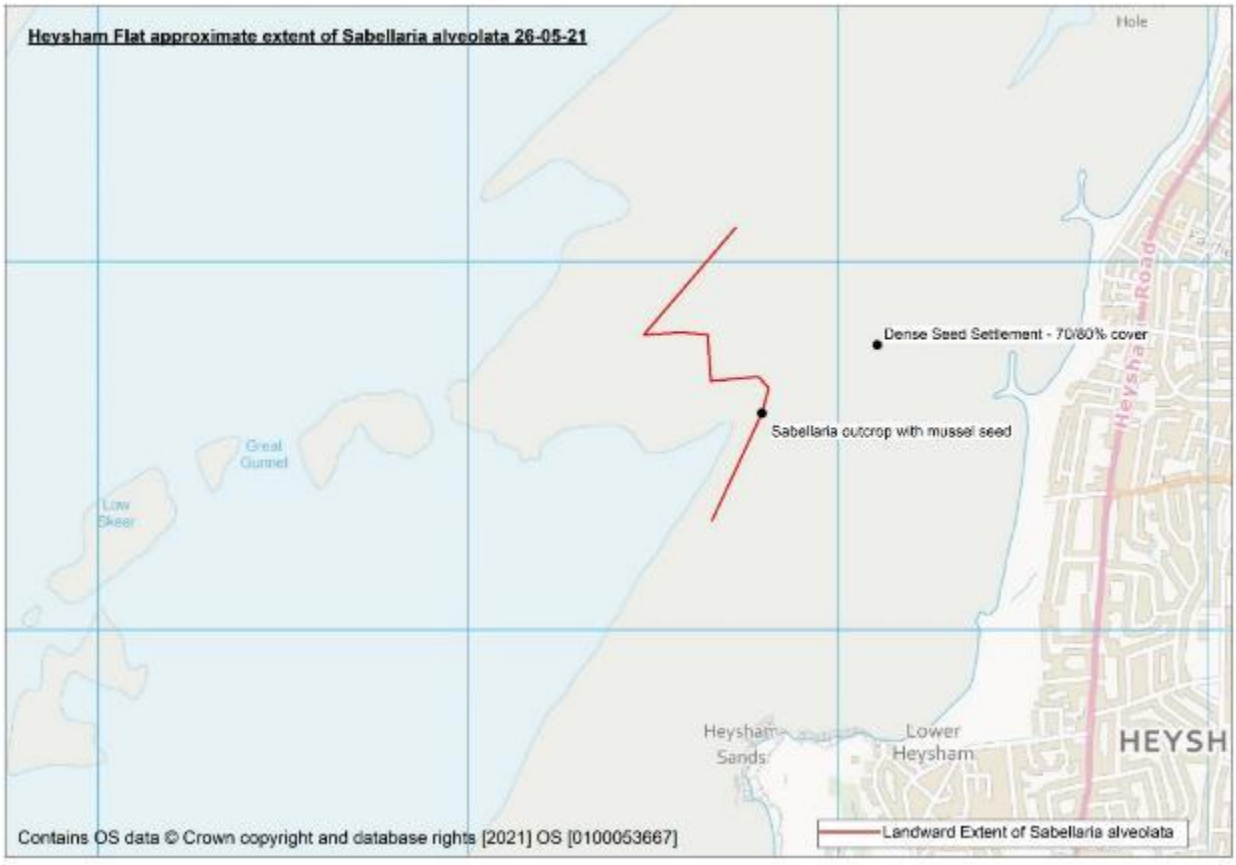

Figure 1. Approximate edge of *Sabellaria alveolata* 26-05-21.

Figure 2. 2021 Mussel settlement 26-05-21.

Figure 3. 2021 Mussel settlement 26-05-21.

Figure 4. *Sabellaria alveolata* and mussel seed settlement 26-05-21.

Figure 5. 2021 Mussel settlement and patch of 20-30mm mussel 26-05-21.

X. Wyre End Mussel Inspection 25-05-21

Tides LW 17:51 (0.9m) (Liverpool tides)

An inspection of Wyre End and areas of mussel was completed. The area of the main skear and a patches of mussel on the channel edge were mapped to determine areas shown in Figure 1. Observations of mussel and substrate were made across the skear and channel edge areas. There has been a dense 2021 settlement of spat across approximately two thirds of the main skear, with the northern edge of the bed having received no settlement. Small areas of raised cobble were observed which were either bare or with low spat settlement as indicated in figure 1. Along the eastern edge of the skear the 2021 mussel settlement was mixed with small areas of 15-40mm mussel.

Across the central area of the skear, mussel ranged in size from 10-30mm and was hard in to the sandy substrate amongst the cobble patches (figure 3). An area of >45mm mussel with no spat settlement was present on the north eastern side of the skear. This area, as indicated in figure 1, extended towards the channel edge over sandy substrate. Barnacled mussel was present at the northern edge of the bed at the channel edge (figure 4). The majority of the 2021 mussel settlement was around 2-5mm and an example of the coverage on the skear is shown in figure 2. The western edge of the bed had no spat settlement and consisted of patchy areas of >45mm mussel. Small

patches of *Sabellaria alveolata* were observed on the northern edge of the bed as shown in figure 6. A large flock of oystercatchers were observed feeding on the northern edge.

The two channel edge areas had 45-60mm mussel present along the western half of the both areas and is shown in figure 5. The other half of each area consisted of cobble with a mussel settlement with 40% coverage with the rest of the area containing empty shell with no mussel.

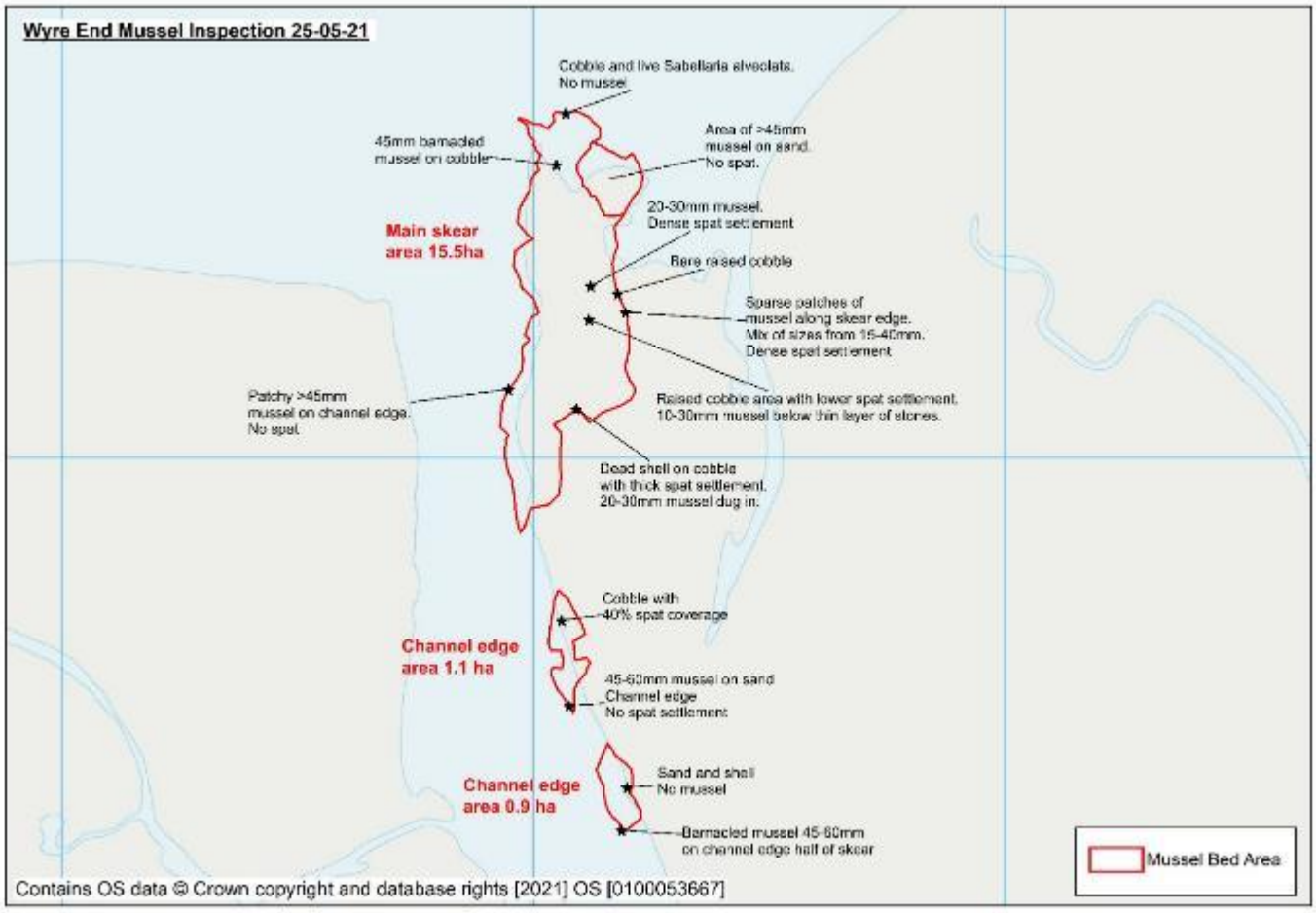

Figure 1. Approximate bed area boundaries and observations of the bed made by officers.

Figure 2. Dense spat settlement on cobble.

Figure 3. Varying mussel sizes hard in amongst empty shell, cobble and sand on the main skear.

Figure 4. Barnacled mussel on the north western edge of the bed.

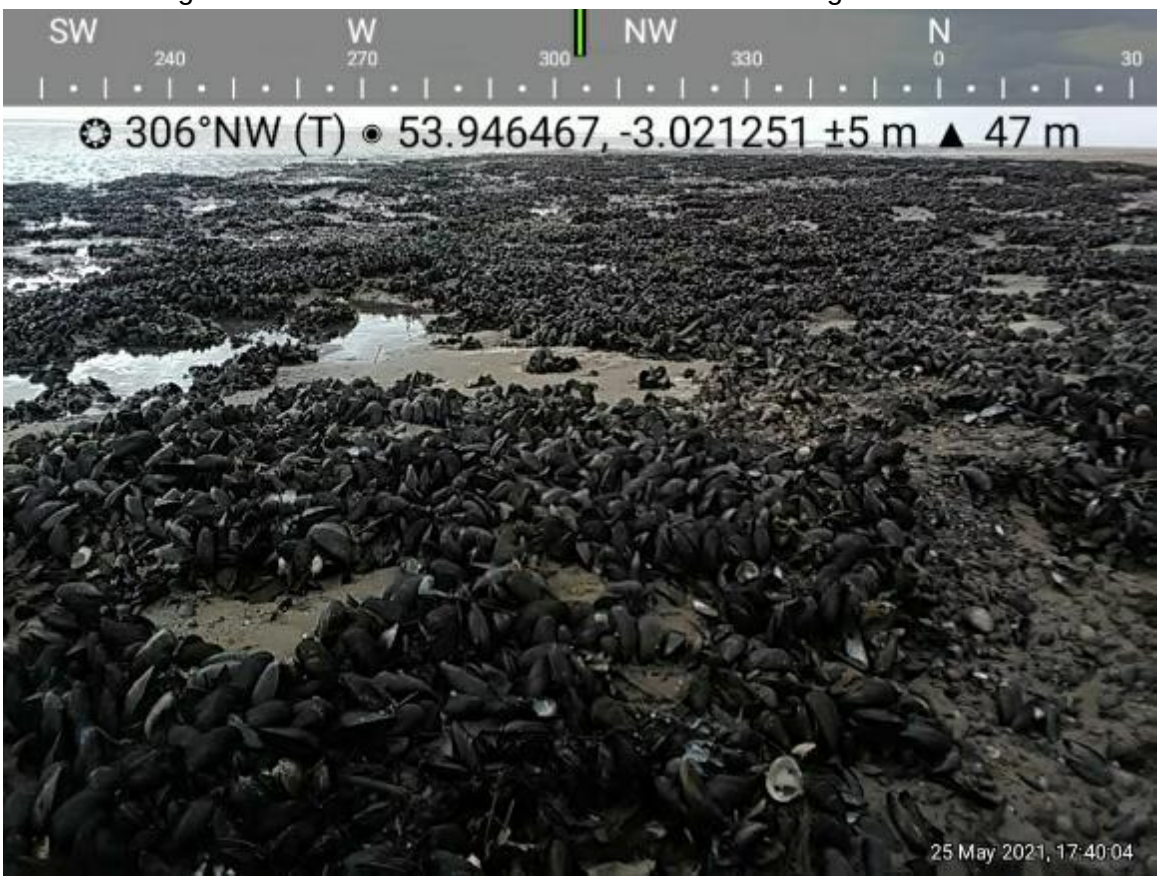

Figure 5. Larger mussel present on western edge of the channel edge areas with no spat settlement.

Figure 6. Remnants of *Sabellaria alveolata* on the northern edge of the bed with no mussel present.

XI. Fleetwood Mussel Inspection 04-06-20

LW: 07:46 0.7m (Liverpool Tides)

The Fleetwood mussel beds were inspected starting at Rossall Scar, then Necking, Kings and finishing on Perch and Black Scar as shown in Figure 1.

Black Scar

Black Scar has had a dense 2021 mussel settlement of approximately 80-90% coverage (Figure 2). The mussel was 2-4mm and had settled on the hard substrate (Figure 3). There were small areas of 2020 size mussel mixed in and on the channel edge (Figure 4). The approximate area of the mussel was 5.3 hectares.

Perch Scar

Perch Scar has had a dense 2021 mussel settlement of approximately 90% coverage on the main area (Figure 5). The settlement was less dense on the bed edges. The mussel was 8-10mm (Figure 6). There were occasional small areas of 30-45mm mussel mixed in with the seed and size mussel along the channel edge. Evidence of mussel mud from 2020 and there were a number of Oystercatchers present on the scar. The approximate area of the mussel was 7.9 hectares.

Kings Scar

Kings Scar has had a 2021 mussel settlement which varies across the skear in density, with some dense areas (Figures 7 and 8). Along the South Eastern edge the mussel seed was mixed with green algae. There was a strip of bare cobble running across the middle of the mussel bed which had not received a settlement of mussel. There were some small areas of *Sabellaria alveolata* on the northern edge of the mussel. The approximate area of the mussel was 8.9 hectares.

Rossall Scar

Rossall Scar has had a 2021 mussel settlement of approximately 40-50% coverage (Figure 9). The mussel was 5-10mm and was mixed in with some 25-35mm 2020 mussel. The full extent of the mussel was not mapped due to inspecting Rossall Scar first to ensure Perch and Black Scar were inspected at low water. Some live *Sabellaria alveolata* was present and covered in seed.

Neckings Scar

There was mussel (35-50mm) which had persisted through the winter on the scar with the majority being size (Figure 11). Some area had received a 2021 settlement but it was inconsistent with a dense band of 2021 seed. The full extent was not mapped due to the order the scars were inspected. There was *Saccharina sp.* present on some of the hard substrate.

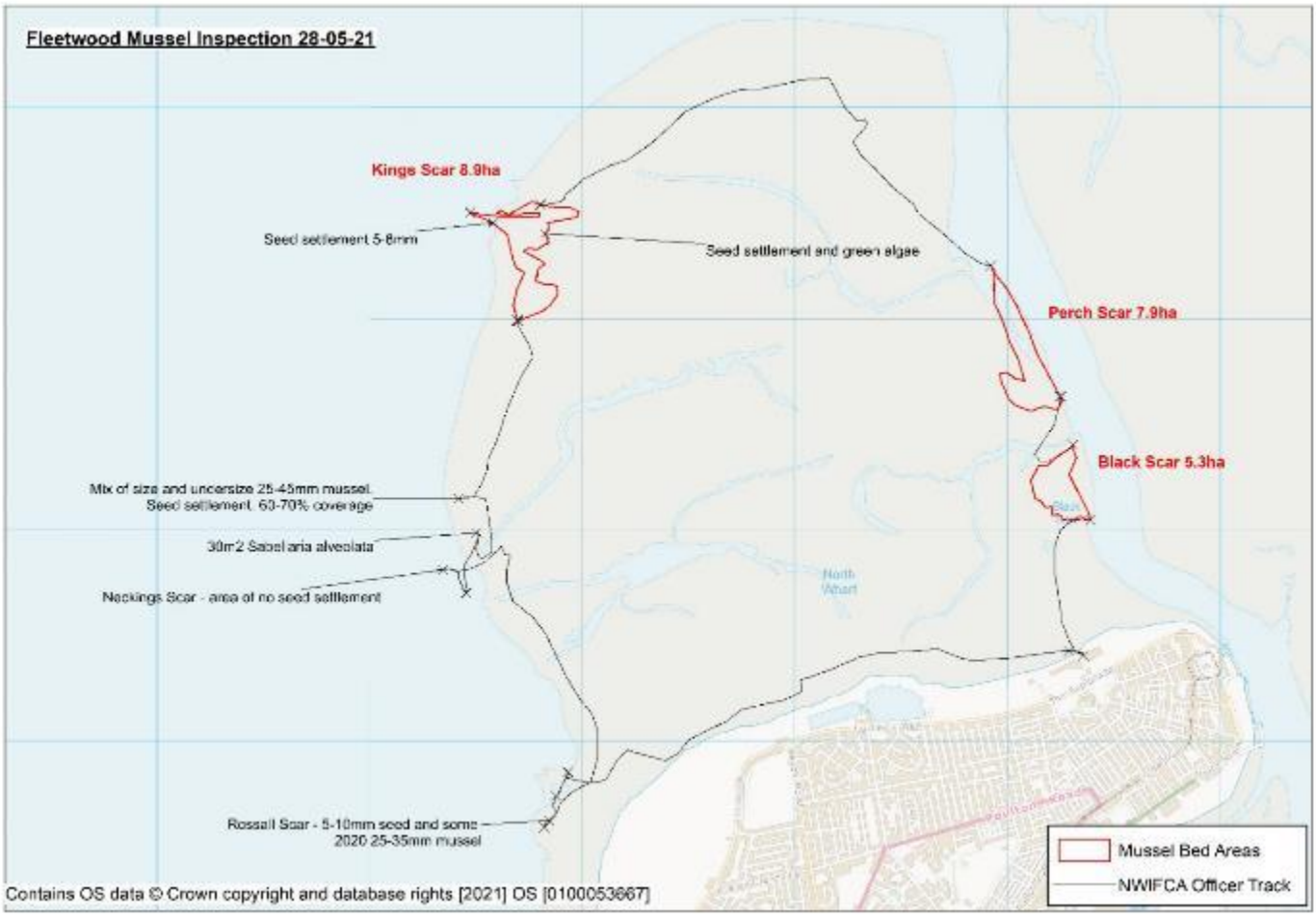

Figure 1. Overview of the mussel inspection 28-05-21.

Figure 2: Black Scar 2021 Mussel settlement 28-05-21.

Figure 3: Black Scar Mussel Bed 28-05-21.

Figure 4. Black scar 2020 mussel 28-05-2021.

Figure 5. Perch Scar 2021 mussel settlement 28-05-2021.

Figure 6. Perch Scar 2021 mussel settlement 28-05-2021.

Figure 7. Kings Scar 2021 mussel settlement 28-05-2021.

Figure 8. Kings Scar Mussel Bed 28-05-2021.

Figure 9. Rossall Scar 2021 mussel settlement 28-05-2021.

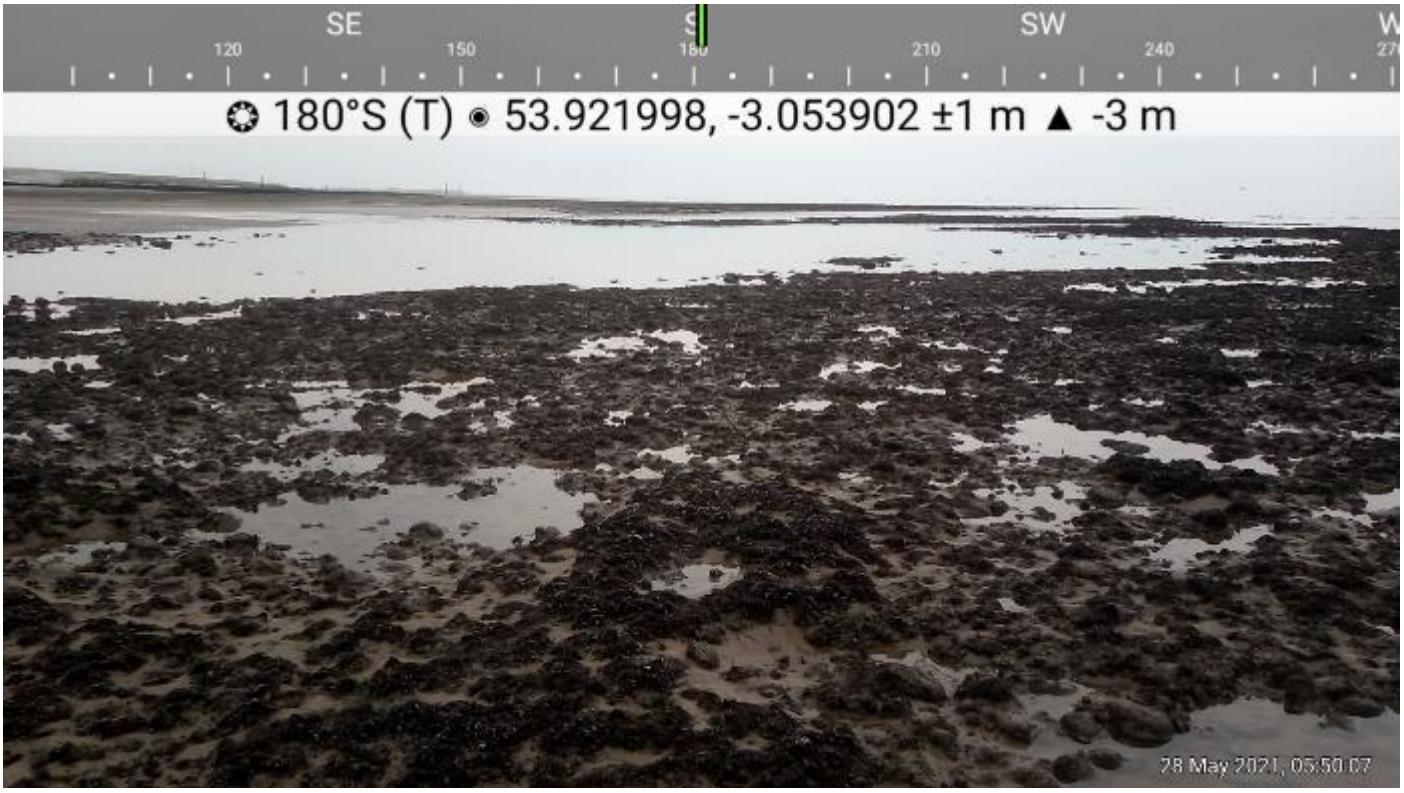

Figure 10. Rossall Scar mussel 28-05-2021.

Figure 11. Neckings Scar mussel 28-05-2021.

Figure 12: Neckings Scar Mussel Bed 28-05-21.