Annex A **Cockle and Mussel Survey Report – TSB – 8th August 2017**

Mussels:

a) Dee Estuary

No mussel present on West Kirby and Thurstaton beds. Industry report of seed mussel on an area between these beds further out has not been substantiated.

b) Ribble Estuary

i. Training Walls – mussel is scarce. A small amount of size is being fished on bigger tides.

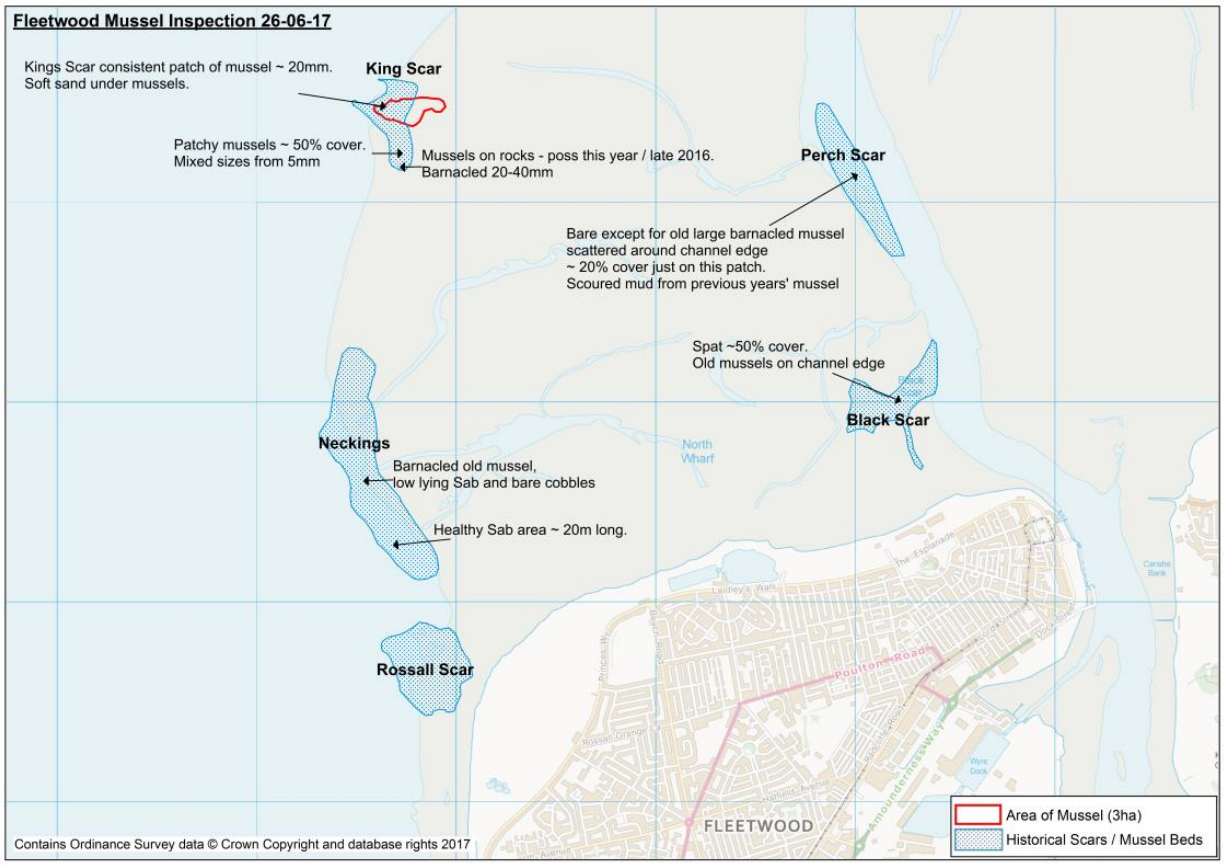
ii. Seafield Road – no settlement so far this year.

c) Morecambe Bay

i. Fleetwood (5 scars) – Rossall, Neckings, Kings Scar, Perch Scar, Black Scar

Inspection 26-06-17 0.6m tide.

Patches of live *Sabellaria alveolata* on Rossall and Neckings scar. Patchy old barnacled mussel present on all scars but at low densities. Kings Scar contains a consistent patch of mussel three hectares in size which consists of mussel approximately 20mm in length. Perch Scar is bare except for old barnacled mussel scattered around channel edge ~ 20% cover just on this patch. Scoured mussel mud remains from previous years. Black Scar has had a spat settlement (50% coverage) of small spat (less than 5mm).

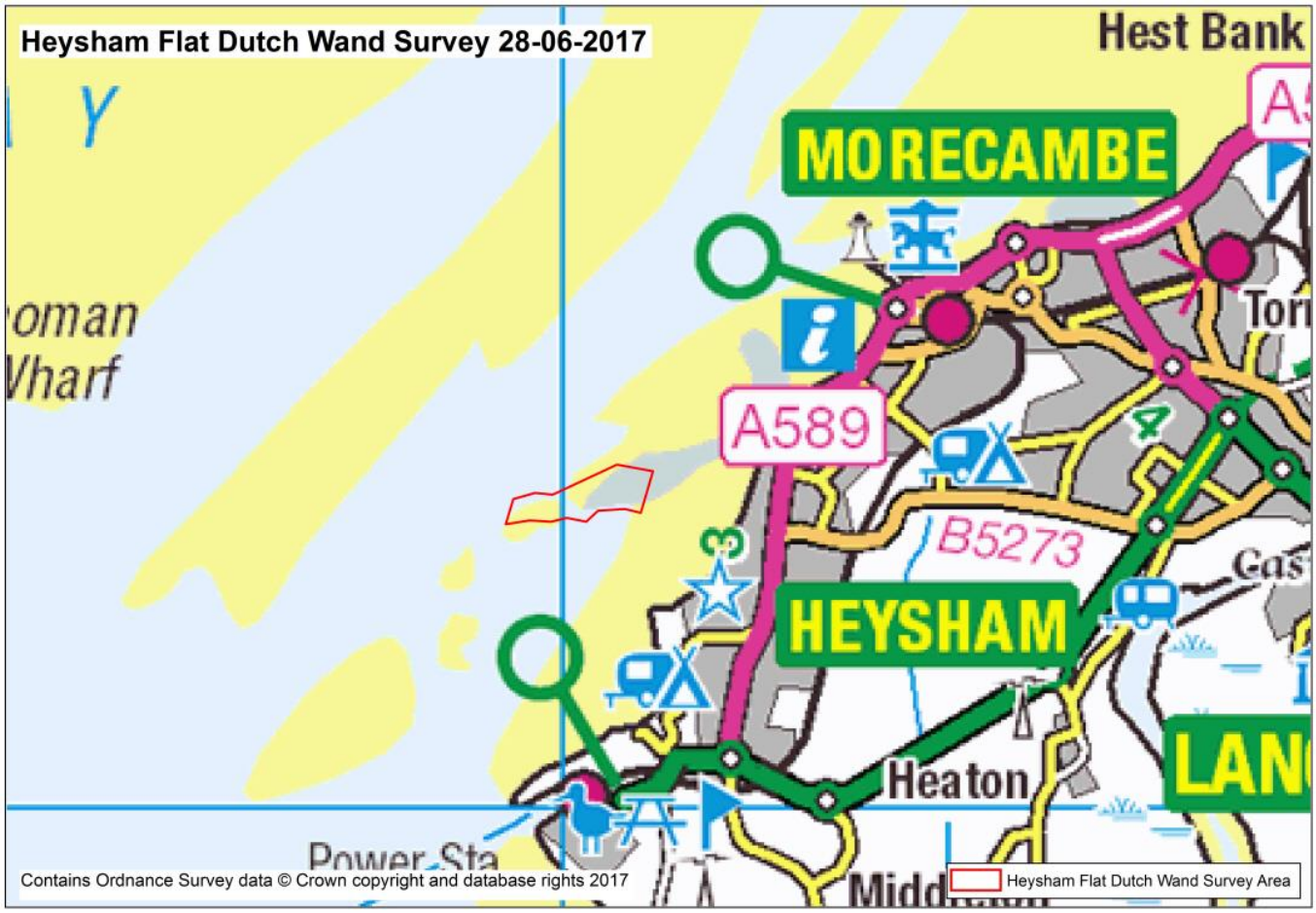


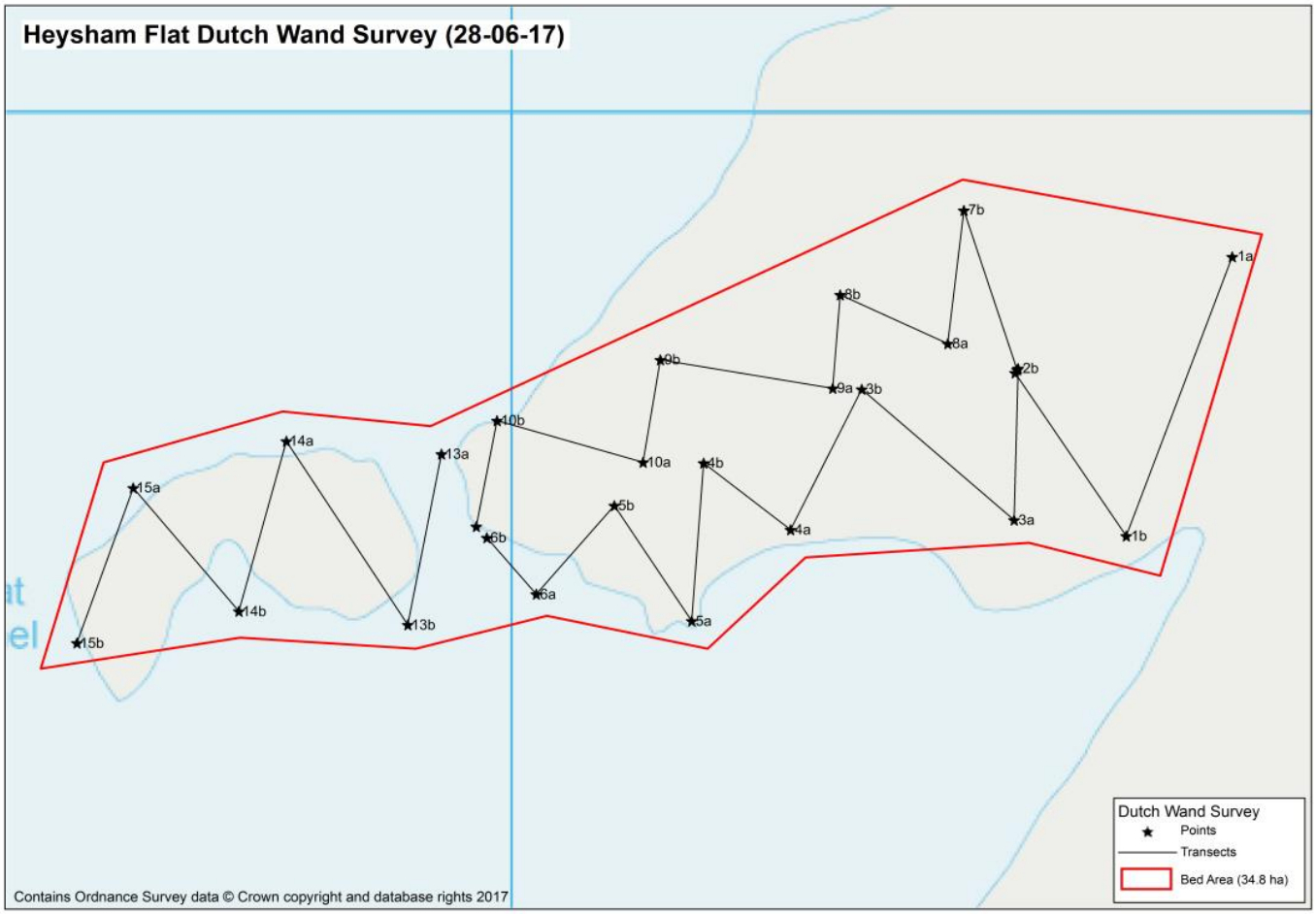
Heli-flight 25-07-17 0.5m tide.

It could be seen from the Heli-flight that beds remain in the same condition as when surveyed on the 26th June 2017 with the addition of Rossall Scar having a settlement of seed mussel on it.

ii. Heysham Flat

Dutch Wand Survey 28-06-17 – 1.0m tide





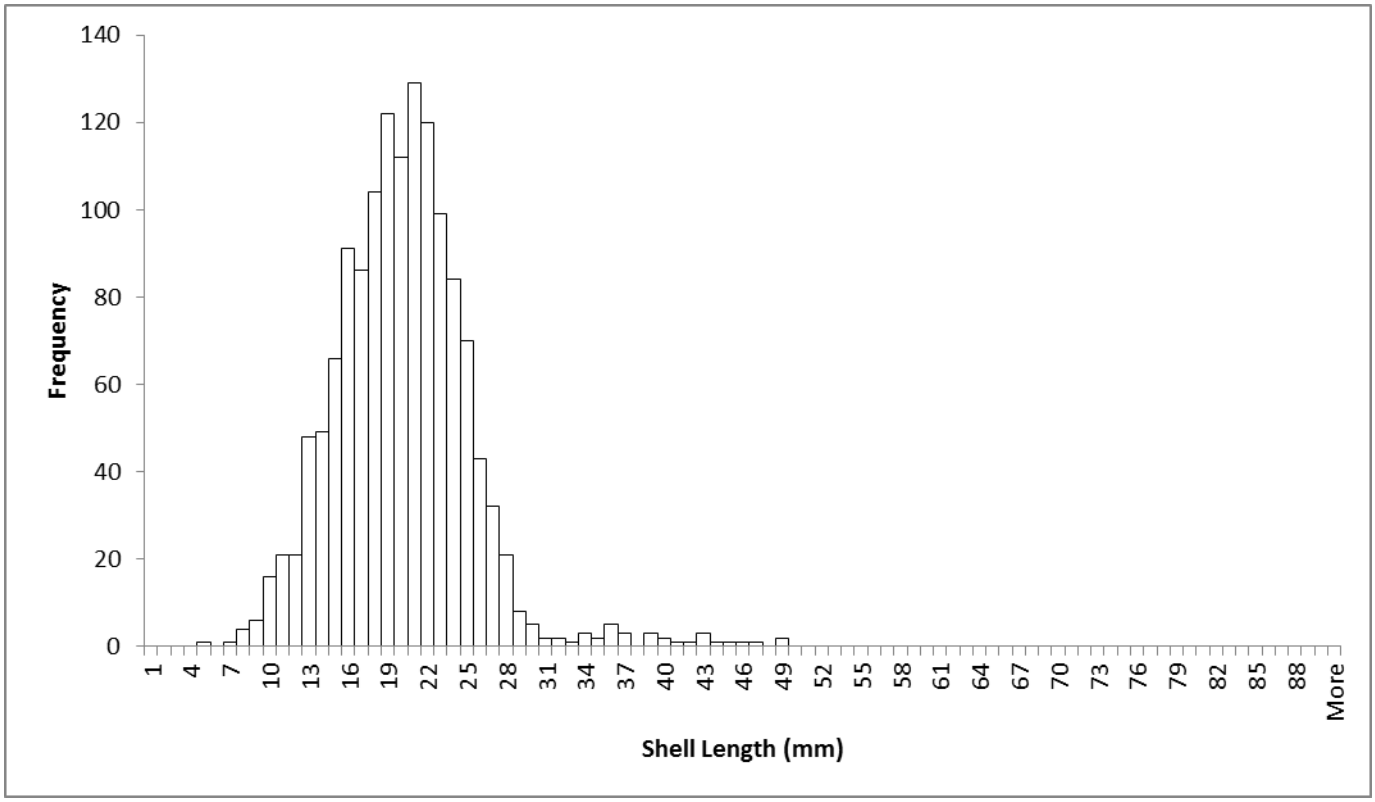
Line transects were completed and using a Dutch Wand the number of hits and misses of live mussel were recorded to give percentage cover. The transects start and finish at the edge of the mussel bed. A mussel sample was taken every 40 hits using a 10cm diameter corer. Twenty-two transects were completed and twenty-eight samples collected.

The total weight of live mussel and the size frequency of each sample were recorded. The samples were sub-sampled with 50 individuals from each sample measured and recorded. From the transect and sample data, it is estimated that within the bed area highlighted on the map (34.8 ha) there are 3212 tonnes of mussel. The value for tonnage of size mussel within this total has been extrapolated from only four individual size mussels found in the samples and must be viewed with caution. It proves an estimate of 37 tonnes. These four size mussels where collected from the edge of Dallam Dyke within the remaining area of *Sabellaria alveolata* reef, which is the area of the proposed exclusion zone.

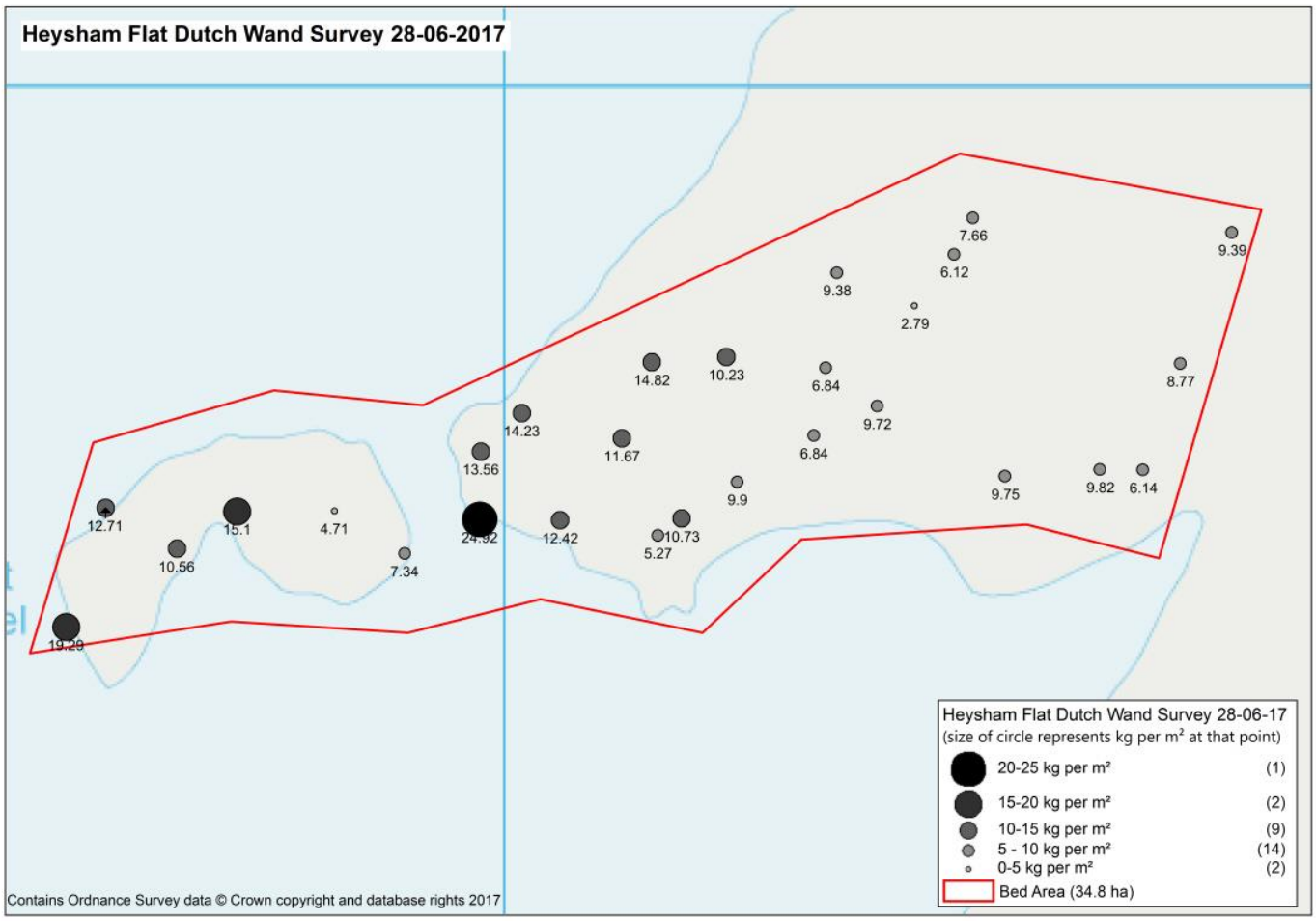
The bed area surveyed here (34.8 ha) is smaller than surveyed in previous years (62.6 ha). In 2015 a Dutch Wand survey was carried out covering a larger area of the main skear (Knott End skear was not included), starting where the mussel began in 2015. This area was not surveyed this time as much of it is cobble/boulder and dead shell. The north east of this area has also been covered in gut weed with little mussel underneath, and so was not included in this survey.

Condition information (percentage of mussel meat) of the 4 size mussel was collected. The mussels ranged from 45mm to 49mm in length, and the condition varied between 36.5% and 44.1% with a mean of 40.5%.

The total length frequency of mussels for the bed area is provided below with the highest frequency of mussel in the 15 to 25mm size ranges – ie. seed mussel.



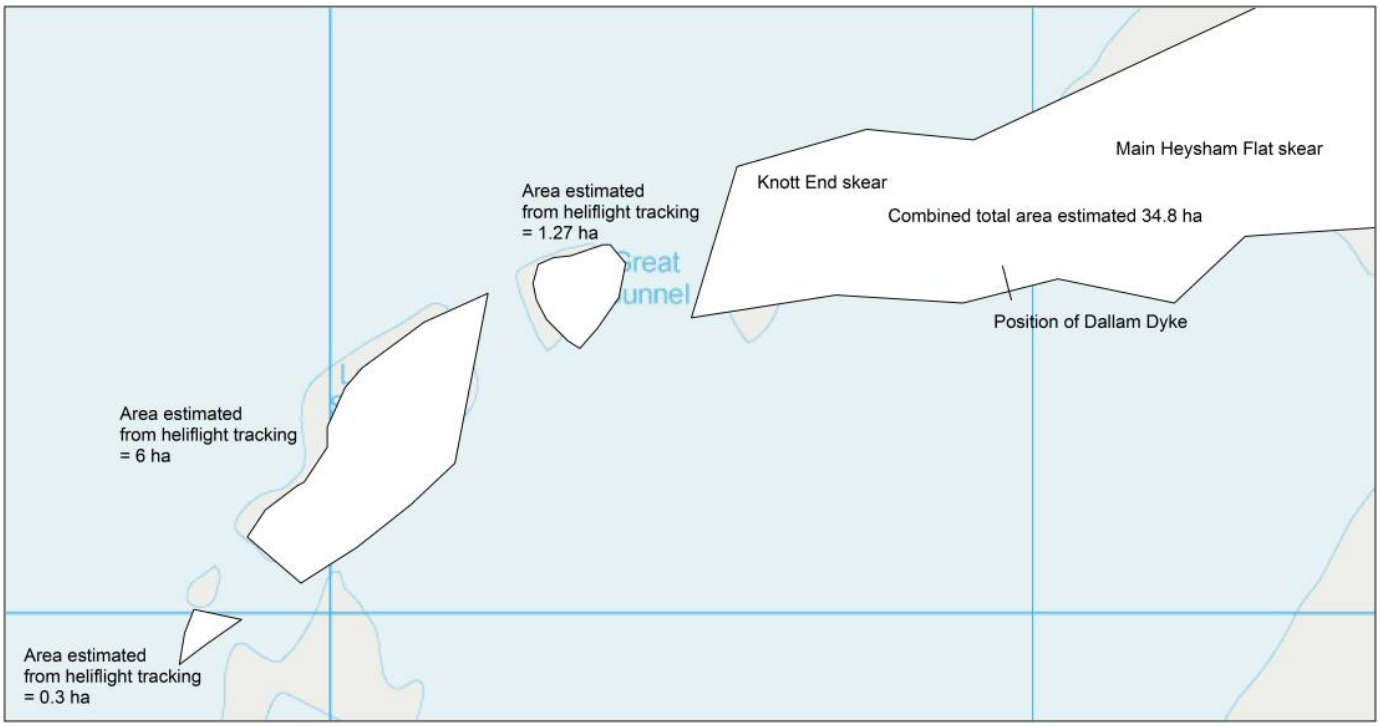
The weight of each sample has been standardised for the weight of mussel (kg per m^2) and has been mapped below. The biomass of mussel varies across the bed, increasing towards Dallam Dyke, and on to Knott End skear where the mussel coverage of mussel is highest and covers most of the ground. The highest densities, and the size mussel, are found along Dallam Dyke within the area of remaining *Sabellaria alveolata* reef. Across the rest of the bed there is a dense settlement of seed mussel, within the 15-25 mm range. This continues up to the area around Big Stone, after which the mussel becomes less dense. The majority here are still within the 15-20 mm size range.



<u>Heysham Flat Bottom skears</u>

From the heliflight carried out on 23rd June and tracking round the bottom skears the following map was produced.

Heysham Flat Seed Mussel Areas June 2017 - combined mapping from heliflight 23rd June and Dutch Wand foot survey 28th June



The estimated area of the bottom skears may be an over-estimate as tracking from the helicopter is not exact – however it provides an indication of the extent of the seed mussel, which was very dense, uniform and level, on these skears, giving a combined total of 7.57 ha.

From the Heli-flight carried out on the 25th July 2017 it can been seen that on some parts of the outer skears there has been a second settlement of mussel. The end two skears still contain areas which hard substrate including large boulders. (Images provided in separate pdf of the Heysham Outer skears).

iii. Low Bottom (Between oyster frames and Foulney Ditch) and Foulney Ditch North Morecambe Bay

Dutch Wand Mussel Survey 22-06-2017 – 1.3m tide

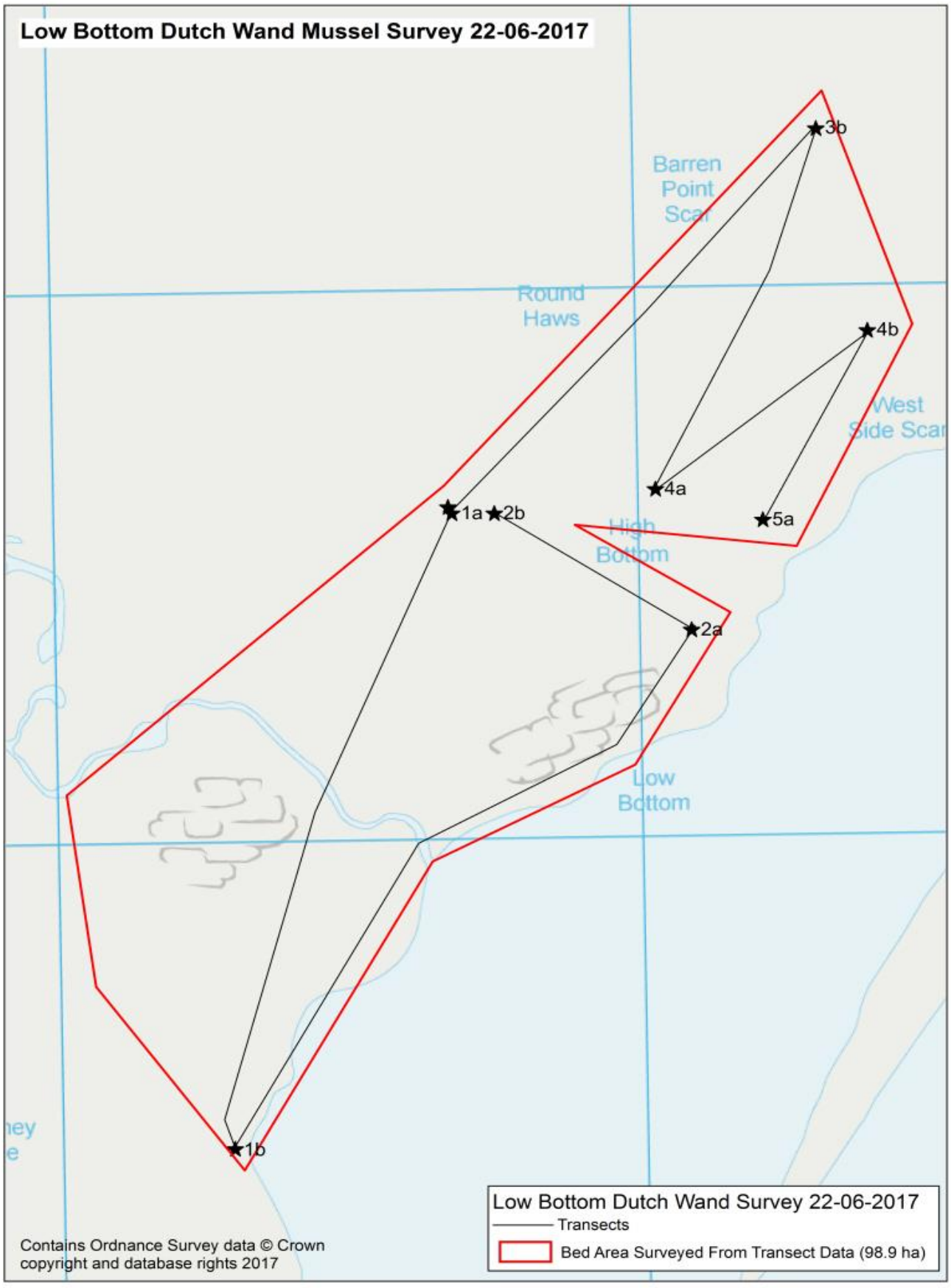
Line transects were completed and using a Dutch Wand the number of hits and misses of live mussel were recorded to give percentage cover. The transects start and finish at the edge of the mussel bed on the west of the bed and at the oyster frames on the east of the bed. A mussel sample was taken every 50 hits using a 10cm diameter corer. Seven transects were completed and 22 samples collected.

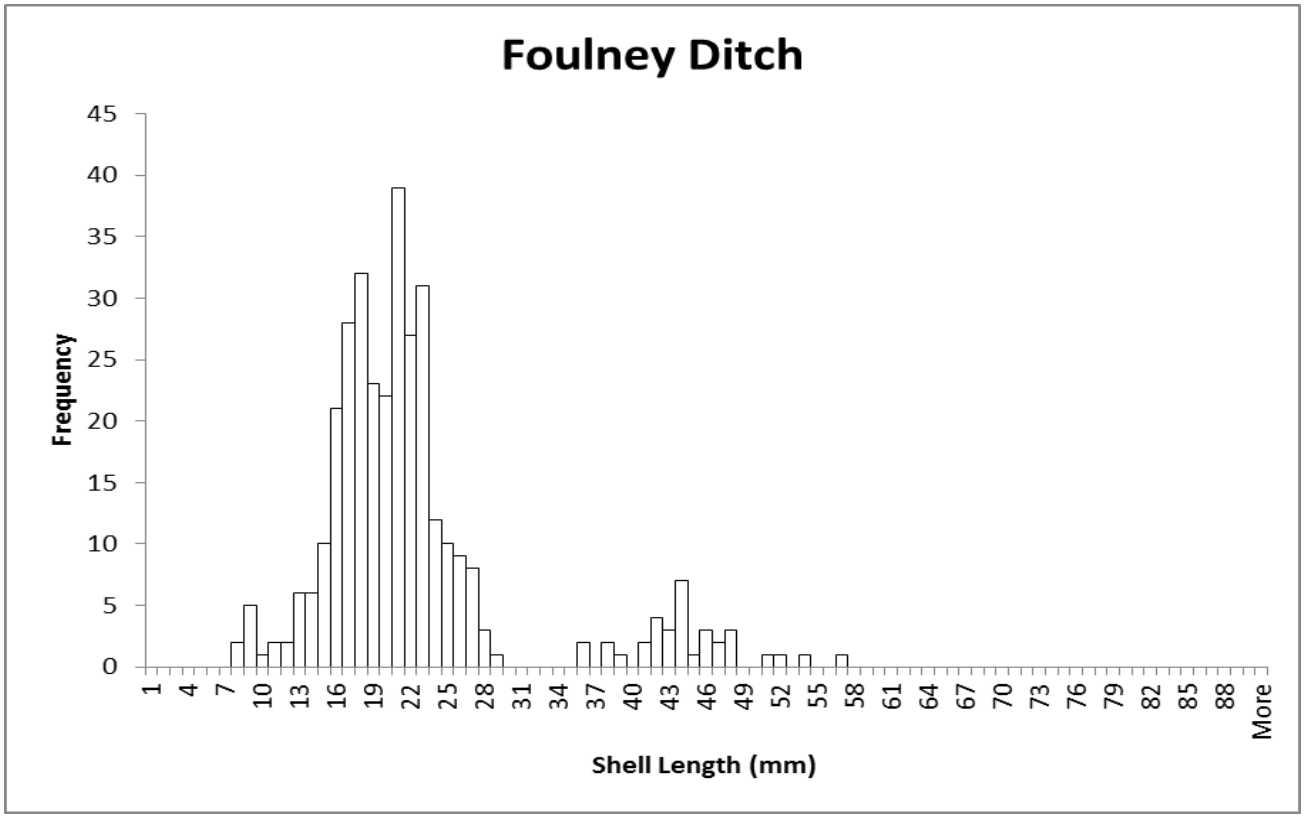
For analysis the bed was split into two areas: Foulney Ditch and Low Bottom. Foulney Ditch has a resource of larger mussel that would be under-represented if combined with the whole bed. This area is demarcated by the grey line in the map below (percentage and weight frequency).

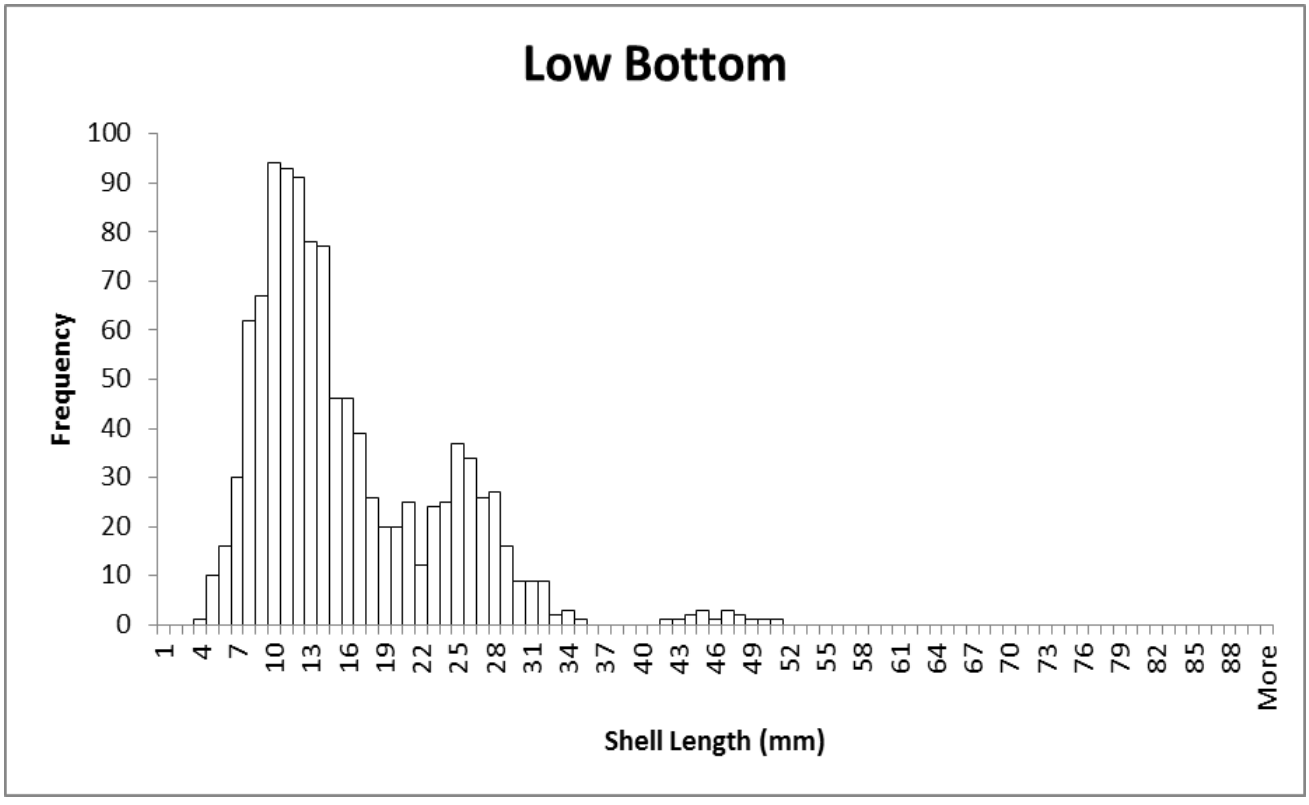
The total weight of live mussel and size frequency of each sample was recorded. Where the number of individuals in a sample totalled >100, a sub sample of 100 were measured. Condition (percentage of mussel meat) of all mussel greater then 45mm was collected. From the transect and sample data, it is estimated that on the Foulney Ditch bed area (35.8 ha) there is 3888 tonnes of mussel of which 1075 tonnes was size mussel. On the Low Bottom bed area (62.2 ha) there is 2935 tonnes of mussel of which 404 tonnes was size mussel.

The total length frequency for the bed area is provided below, at Foulney Ditch the highest frequency of mussel is in the 15 – 25 mm range. At Low Bottom the highest frequency is in the 10-15 mm range.

A large swathe of the bed is now covered with gutweed.

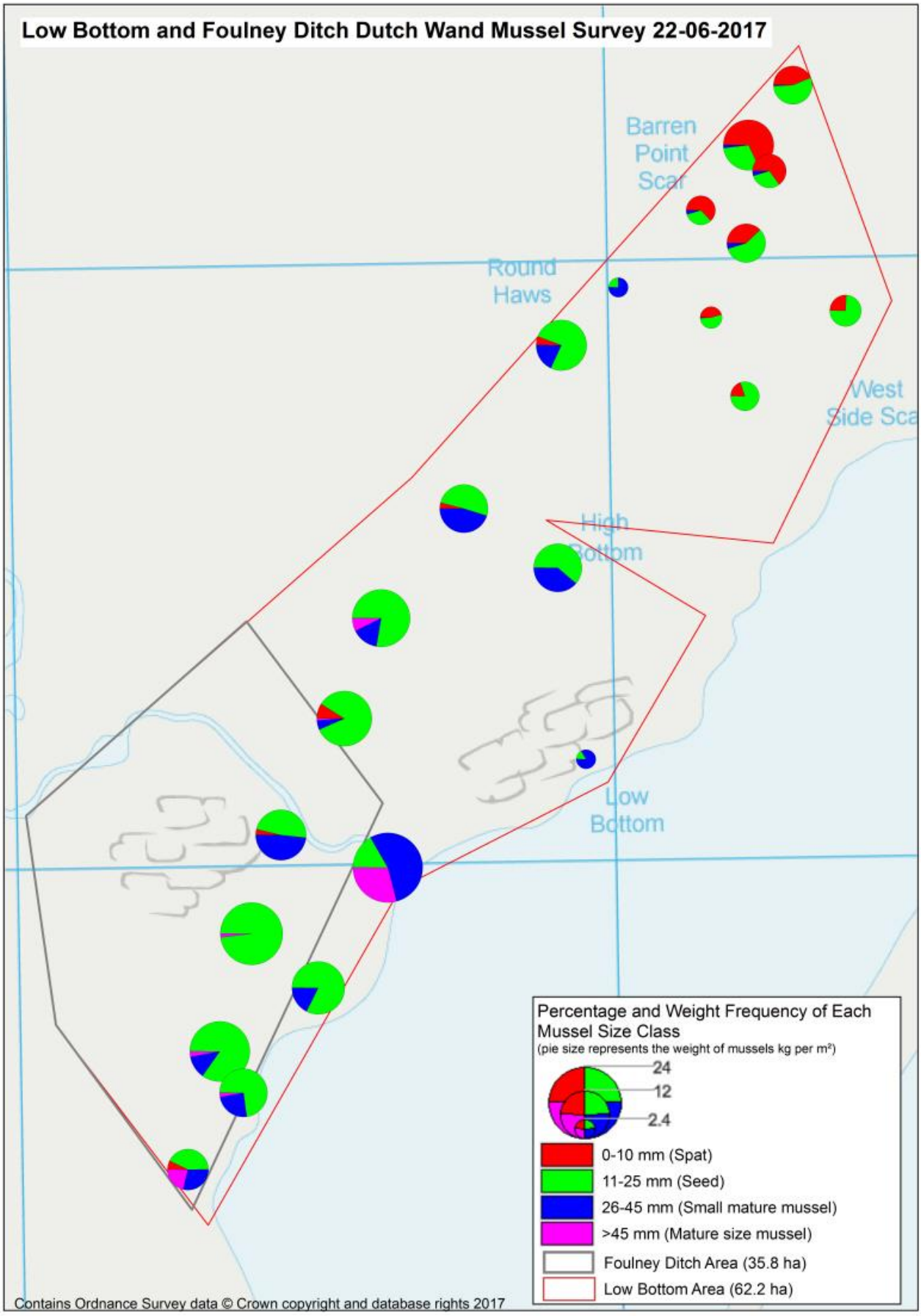






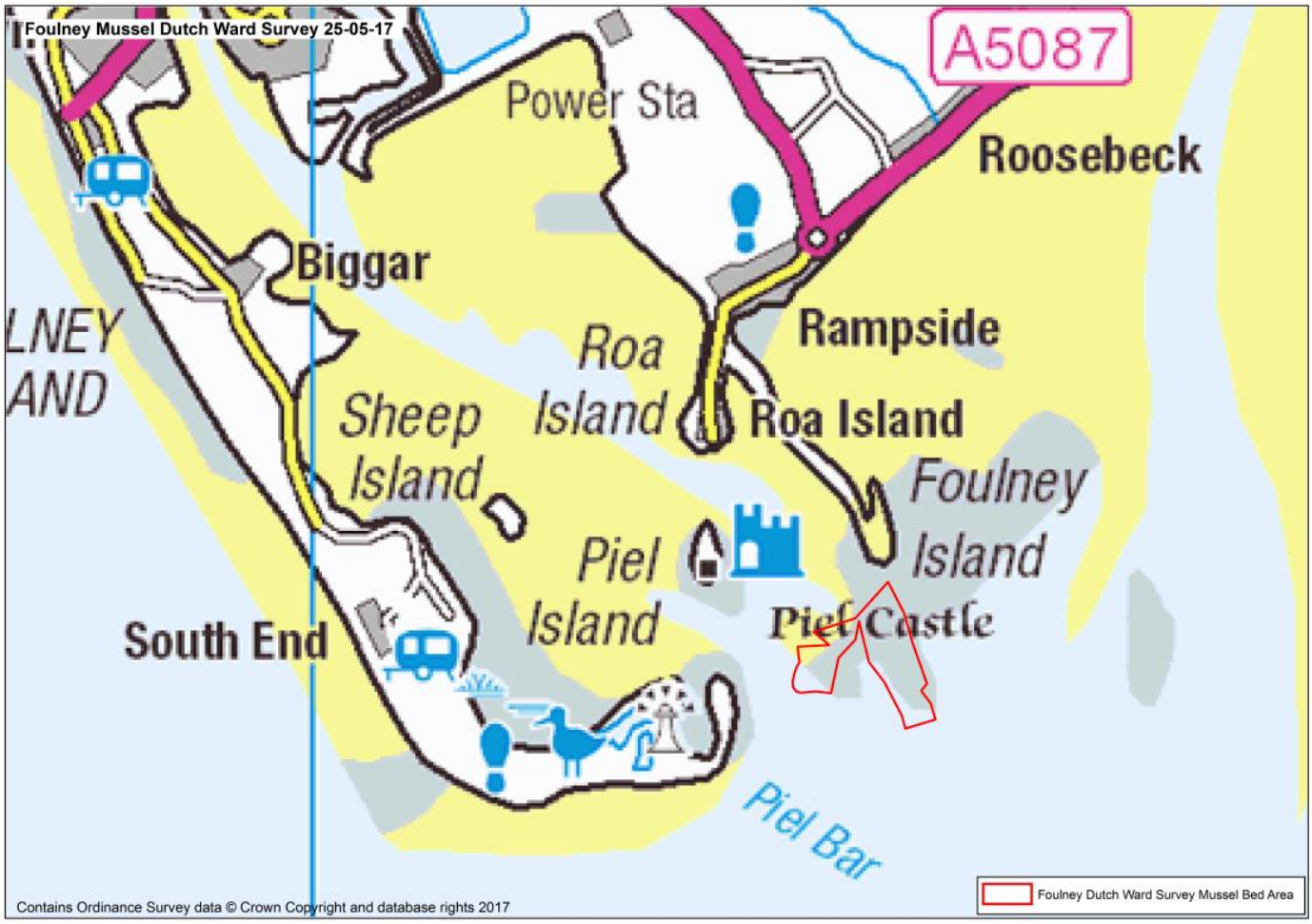
The condition (meat content) of 11 mussels over 45 mm at Foulney Ditch, ranging from 45mm to 57mm in length was recorded, and varied between 10.77% and 30.85% with a mean of 20.88%. At Low Bottom the condition of 8 mussels over 45 mm were recorded, ranging from 45 mm to 50 mm. This varied between 17.86% and 30.08% with a mean of 24.27%.

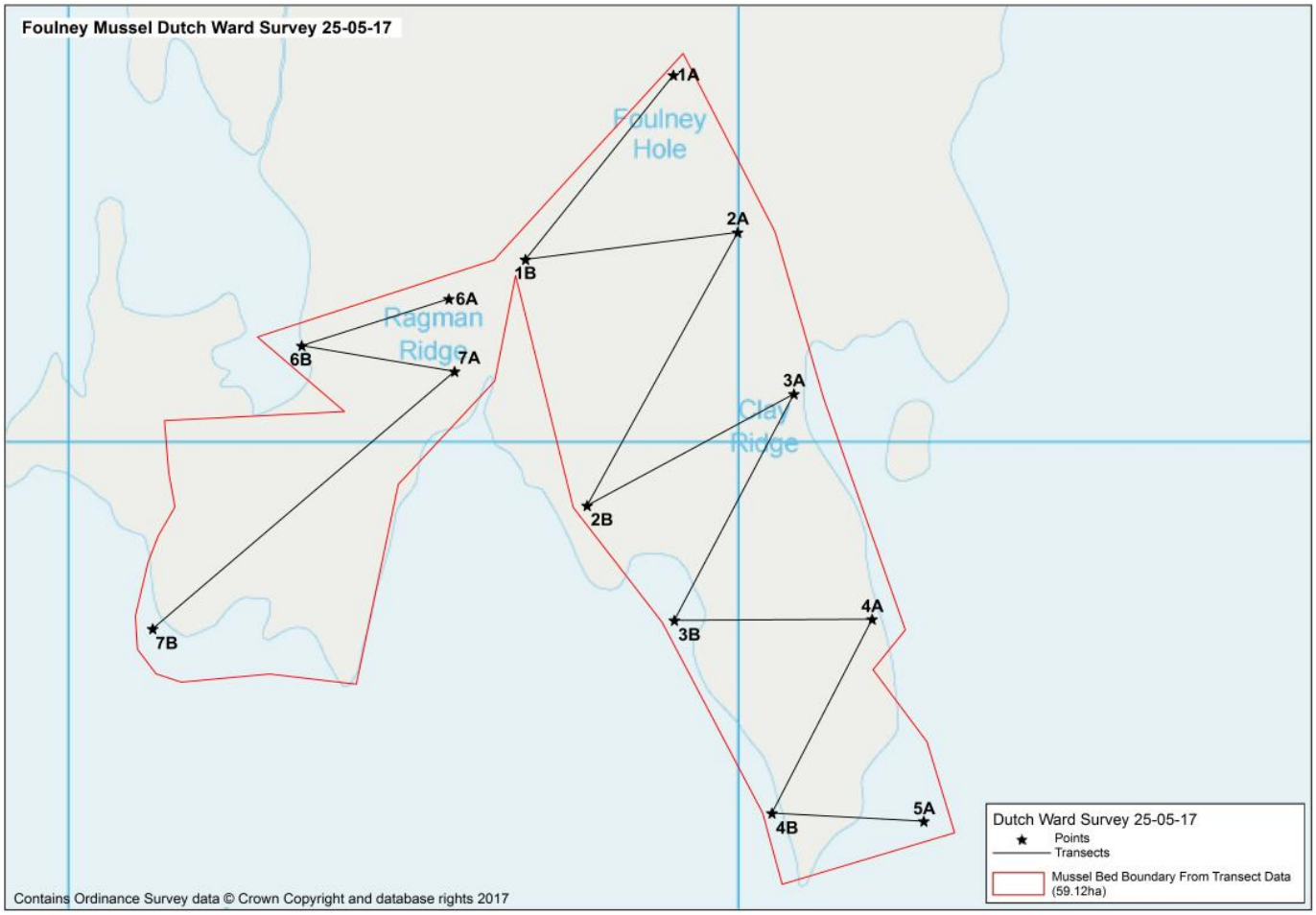
The weight of each size class has been standardised to the weight of each size class per metre squared. This has been mapped below. The size of the pie chart represents the weight of each sample.



iv. Foulney

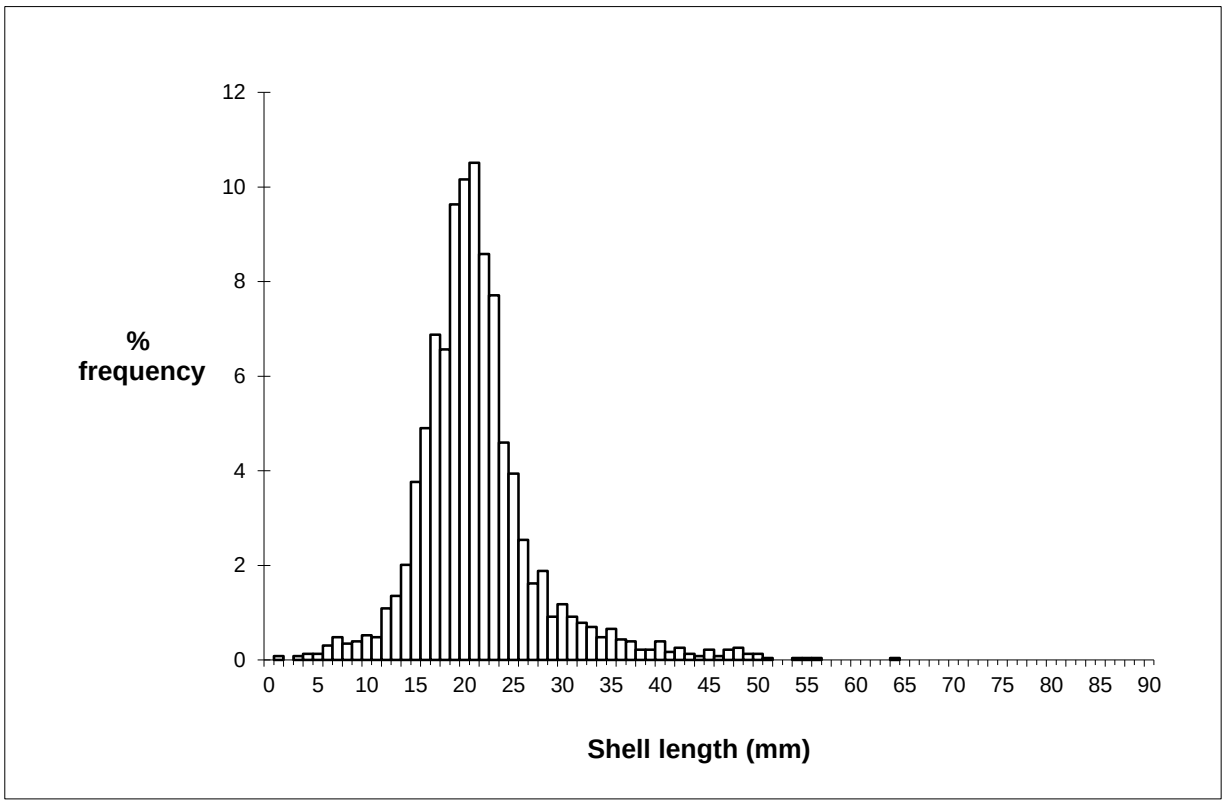
Dutch Wand Survey 25-05-17 0.8m tide

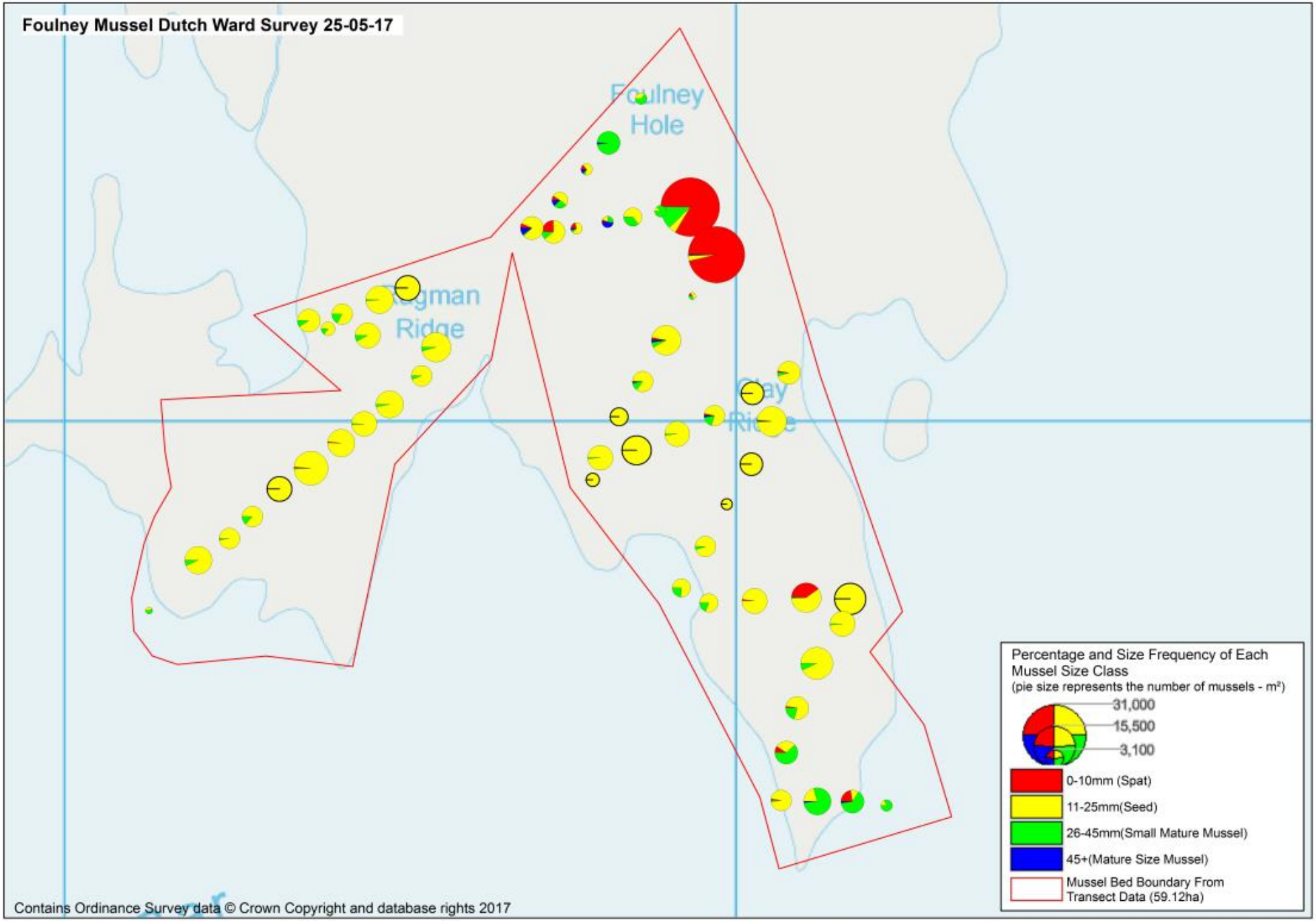




Line transects were completed and using a Dutch Wand the number of hits and misses of live mussel were recorded to give percentage cover. The transects start and finish at the edge of the mussel bed. A mussel sample was taken every 25 hits using a 10cm diameter corer. Eleven transects were completed and 57 samples collected.

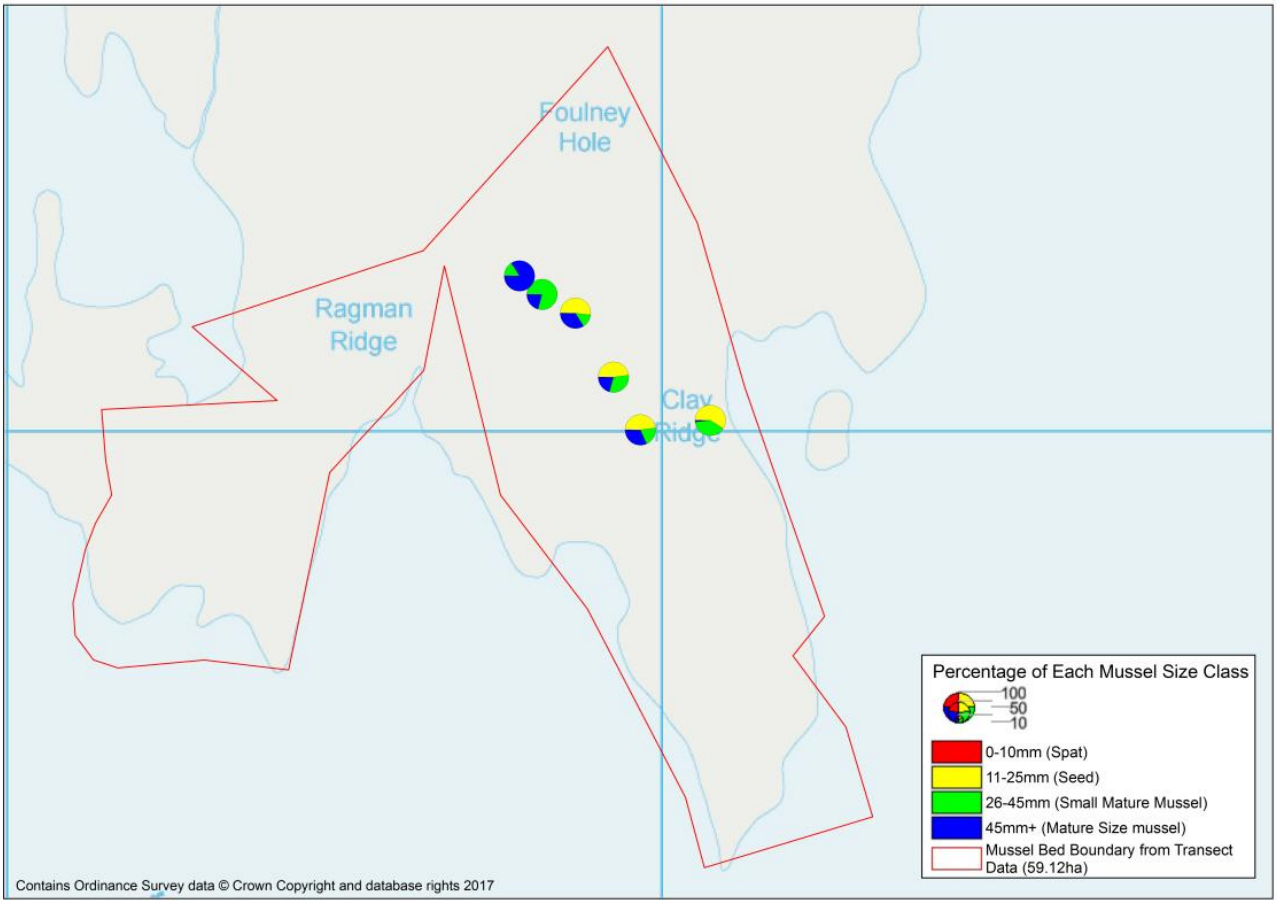
The total weight of live mussel and size frequency of each sample was recorded. Condition (percentage of mussel meat) of all mussel greater then 45mm was collected. From the transect and sample data, it is estimated that in the bed area highlighted in the map (59.12ha) there is 4611 tonnes of mussel with 322 tonnes of size mussel. The total length frequency for the bed area is provided below with the highest frequency of mussel in the 15 to 25mm size ranges. The percentage of each size frequency which has been standardised for the number of mussel per m² for each sample and has been mapped below. It can be seen there is a mix of sizes classes across the bed and within each sample, with the most abundant size class being 11-25mm which is present in all but one sample. The condition of 31 mussels over 45mm, ranging from 45mm to 65mm in length was recorded, and varied between 12.77% and 29.57% with a mean of 21.28%.




Foulney Mussel Dutch Ward Survey 25-05-17
Foulney Hole
Percentage and Size Frequency of Each Mussel Size Class
(pie size represents the number of mussels - m²)
31,000
15,500
3,100
0-10mm (Spat)
11-25mm(Seed)
26-45mm(Small Mature Mussel)
45+(Mature Size Mussel)
Mussel Bed Boundary From Transect Data (59.12ha)
Contains Ordinance Survey data © Crown Copyright and database rights 2017

Foulney - Inspection 13-06-17 - 1.8m tide

A return inspection was carried out to look for an area of size / larger mussel which had be seen on previous inspections but had not been captured in the Dutch Wand survey transects on the 25th May 2017. The area of size / larger mussel was located and six samples were collected for size class analysis. The position and percentage of each size class has been mapped below. Due to the samples containing a greater percentage of larger mussels than that recorded during the Dutch Wand survey it is likely that the estimated figure for bed biomass is lower than what is actually present. In addition the size frequency for the larger size class intervals will be under-represented. Due to the Dutch Wand methodology the two sets of data cannot be combined, nor the estimated biomass adjusted to incorporate the larger mussel.



From the heliflight on 23rd June – the bottom end of Foulney and Foulney island is now covered with gutweed. This may serve to protect the mussel as in some years, or it may smother it as in others.

v. South America

Heliflight 23rd June. 1.1m tide. Sanded over. No mussel.

vi. Falklands

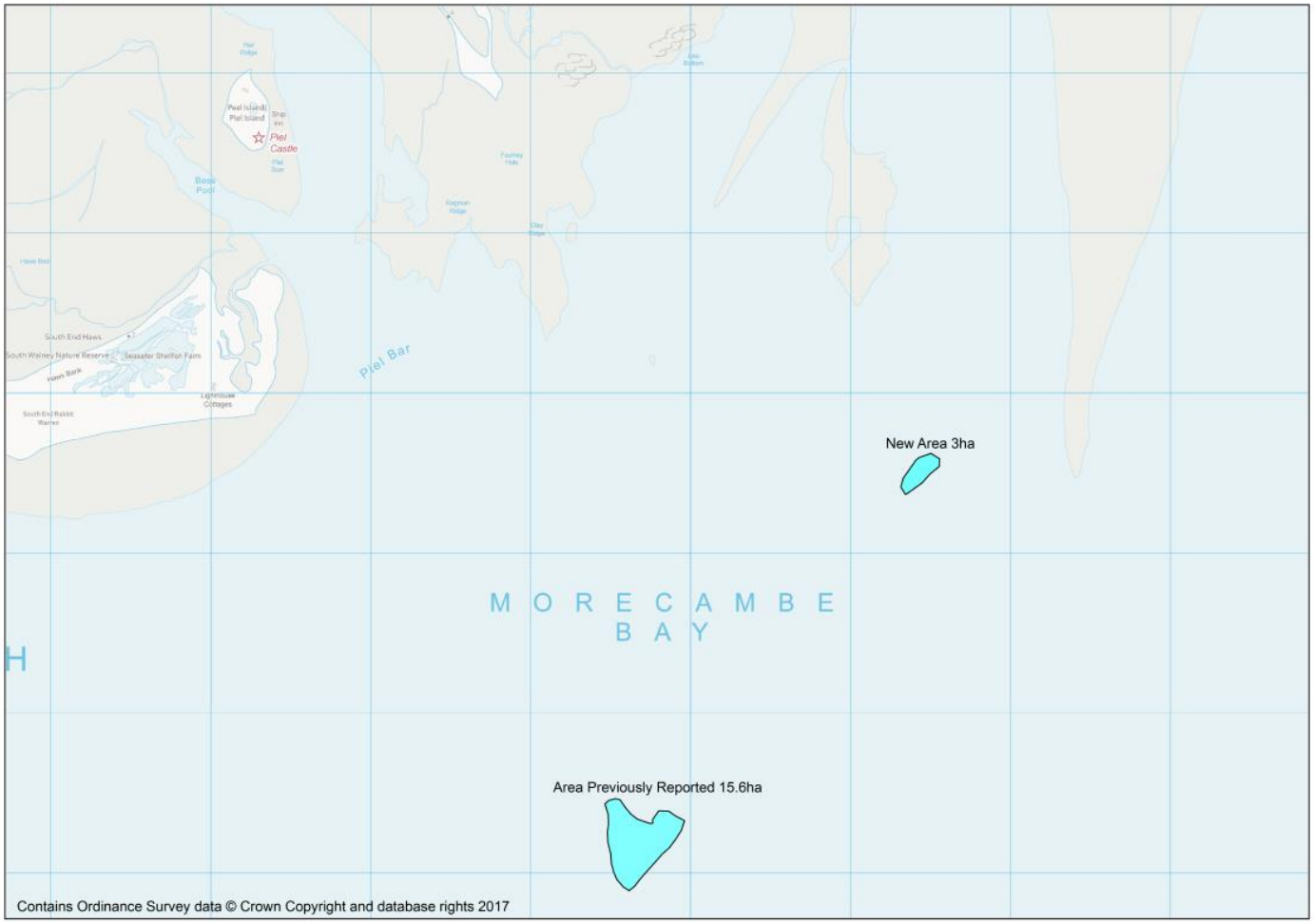
Photographs received from industry (Tim Manning) in showed that on the ground there is a substantial seed mussel settlement, but that there is a lack of mussel mud to date. As has been seen from the air on previous heliflights there are many gulls feeding on the bed. Mr Manning's tracking was provided, and it shows an area of estimated at 15.6ha.

Heliflight 25th July 2017 0.5m tide

The area of mussel on the Falklands persists; the mussel is patchy and sitting on a thin layer of mud. There is a new area of dense mussel to the North East which is estimated at 3ha in size. (Images provided in separate pdf -Heysham Outer Skears and Falklands).

A further heliflight has been booked by industry for August. Science officers will attend.

The scheduled RIB inspections due on 27th June and the 24th July were aborted due to winds and weather.



d) Duddon Estuary - Hardacre

An inspection was carried out on 27th June following a report from a fisherman he had seen 'black' under the water in the channel. There is no mussel present, and only scarce patches of cobble in the channel. The rest is sanded over.

e) <u>Solway</u>

No indication from IFCO patrols or industry that significant quantities of mussel present. Not scheduled in for survey at present.

Cockles

Maps

Maps were created showing the overall survey area, density of undersize cockle and the frequency of size classes (pie charts show the frequency of different size classes, the size of the pie chart indicates the total density of cockles present).

a) Wirral

i. Hoylake - Survey 22-05-17

The ground is quite soft on the shore so officers carried out the inspection on foot. The area where the cockles were found was sand covered in a thin layer of slimy mud, with an anoxic layer a few centimetres under the sand. The vast majority of the cockles were found in channels. The sand grain size was larger than we have come to expect as the preferred habitat for cockles and the distribution of cockles was not typical of what we would class a 'cockle bed'. No cockles were found outside of the channels, and thus the science team is of the opinion that these cockles have washed in from elsewhere- perhaps Leasowe, where the cockle were a similar size- between 16-19 mm.

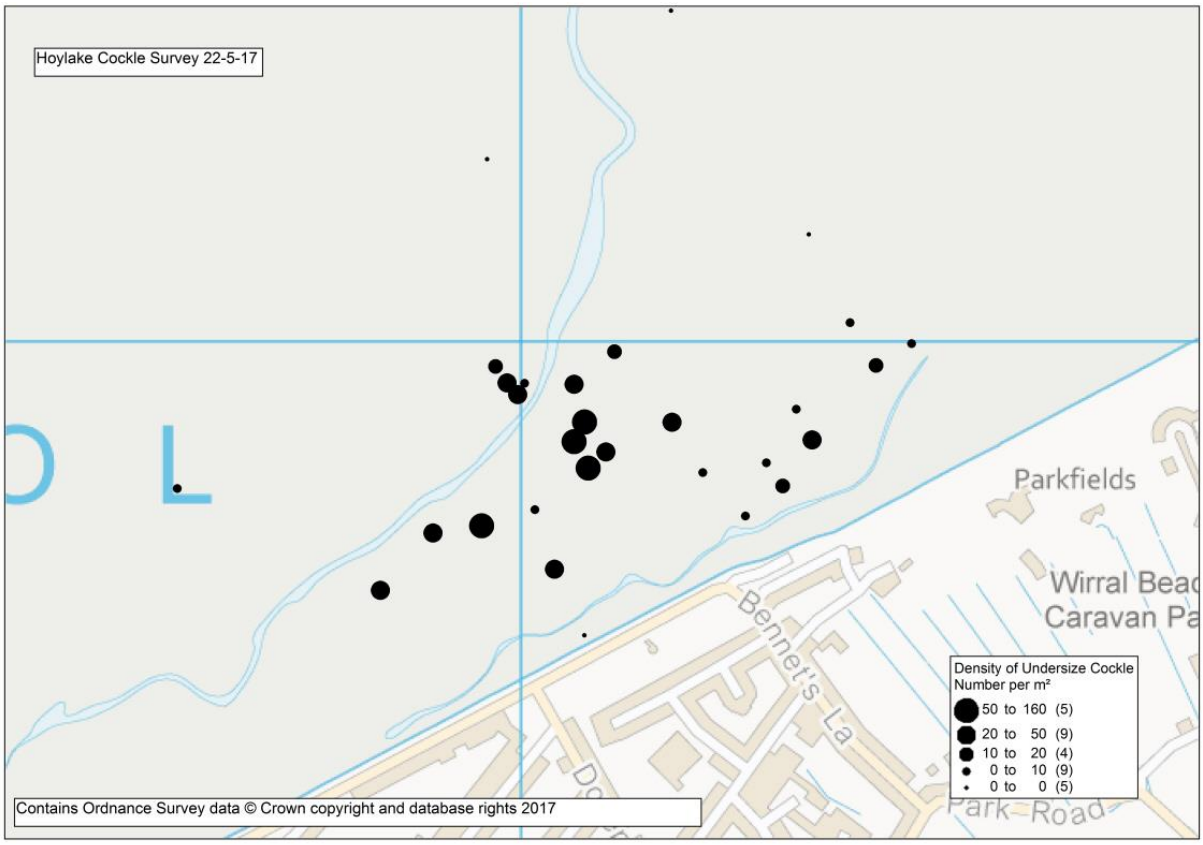
Means

Means were calculated with zero counts removed. However, these results should be viewed with caution as the bed area has not been calculated, and sampling occurred mostly within the channels where the cockles were found to be present.

Mean number of size cockle = 5 per m^2(min. 0, max 30)

Mean number of undersize cockle = 32 per m^2 (min. 0, max 160)

The Senior Scientist proposed that hygiene sampling should not go ahead unless there was reasons such as a future stock requiring a new Sanitary Survey.



ii. Leasowe

Return survey has been scheduled for August with potential for a commercial fishery in September.

b) Ribble Estuary

i. Penfold North – Survey 27-07-2017

Due to the extremely muddy nature of the ground on this bed it is not accessible by quad bike and difficult to get to on foot. The bed was tracked around and survey stations were sampled at random. As previously reported for the survey in March the bed contains a dense patch of cockles (grey shaded area) greater than 20 mm, this appears to have spread out further. Within this patch there were also high numbers of spat (0-5 mm size range). Outside of this dense patch the majority of cockles were in the 5-10 mm size class. In total 10 stations were sampled.

Means

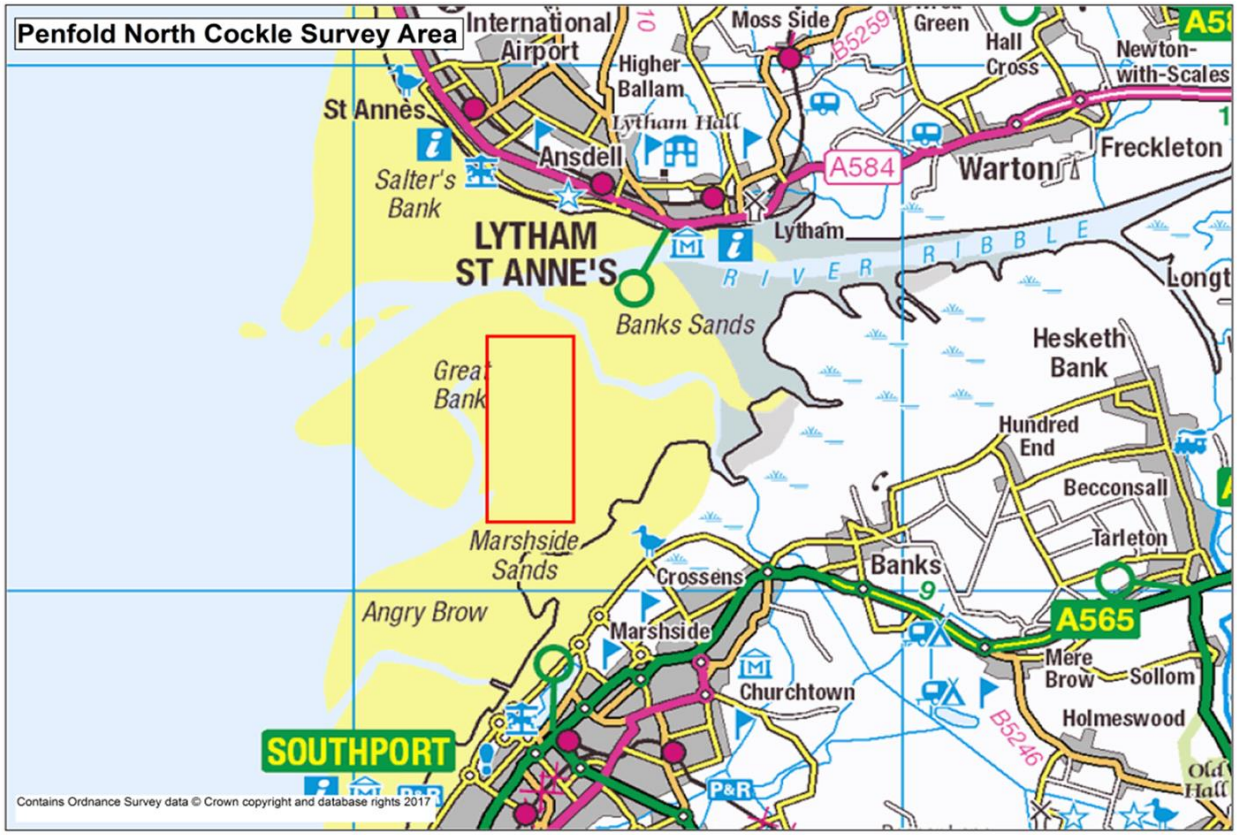
Mean number of size cockle = 71 per m^2 (min. 0, max 290)

Mean number of undersize cockle = 760 per m^2 (min. 30, max 1630)

Bed Area

Total Bed Area = 112.3 ha

Area of dense patch = 36.8 ha


Penfold North Cockle Survey Area
International Airport
Moss Side
Green
Hall Cross
Newton-with-Scales
St Annes
Higher Ballam
Lytham Hall
Ansdell
Salter's Bank
A584
Warton
Freckleton
LYTHAM ST ANNE'S
Lytham
RIBBLE RIVER
Banks Sands
Great Bank
Hesketh Bank
Hundred End
Becconsall
Tarleton
Marshside Sands
Crossens
Banks
Angry Brow
Marshside
A565
Churchtown
Mere Brow
Sollom
Holmeswood
SOUTHPORT
B5246
P&R
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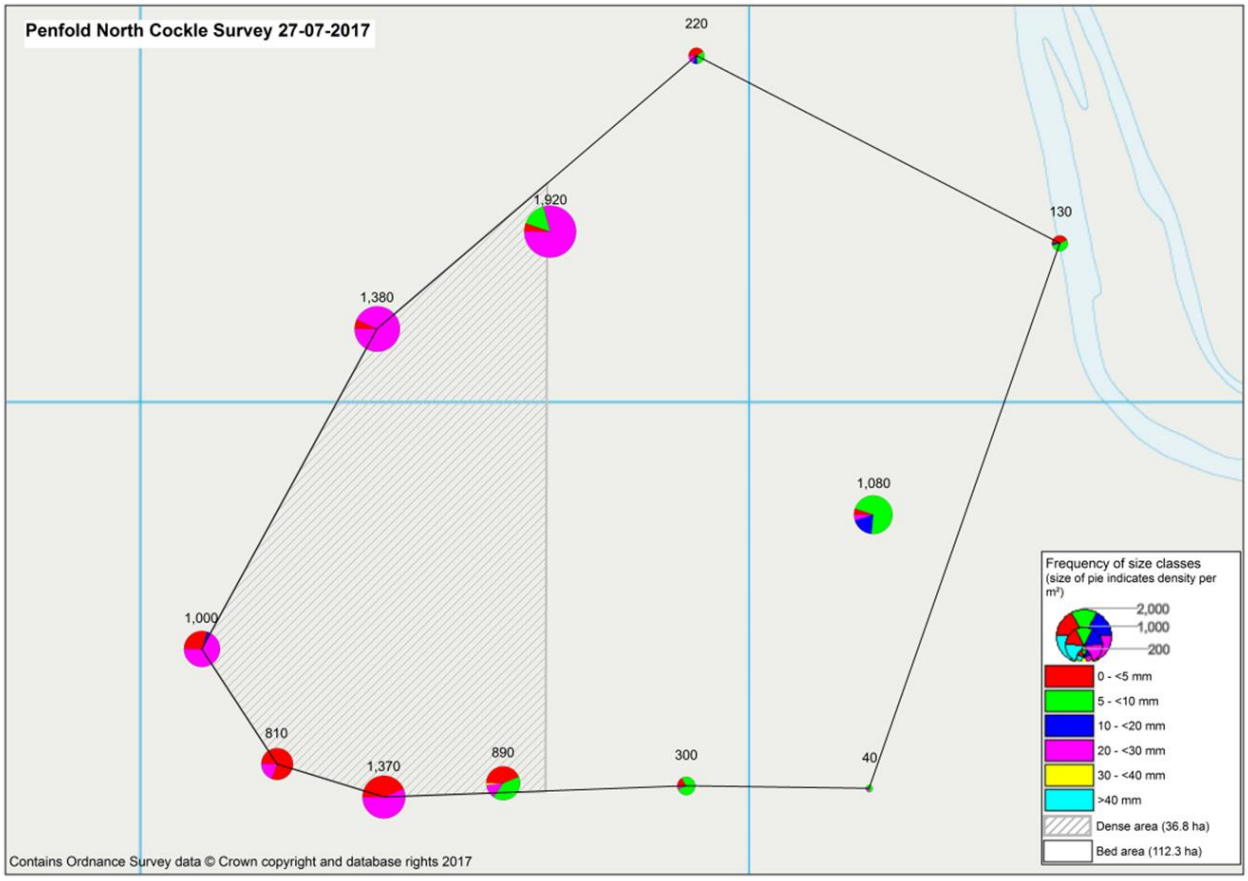
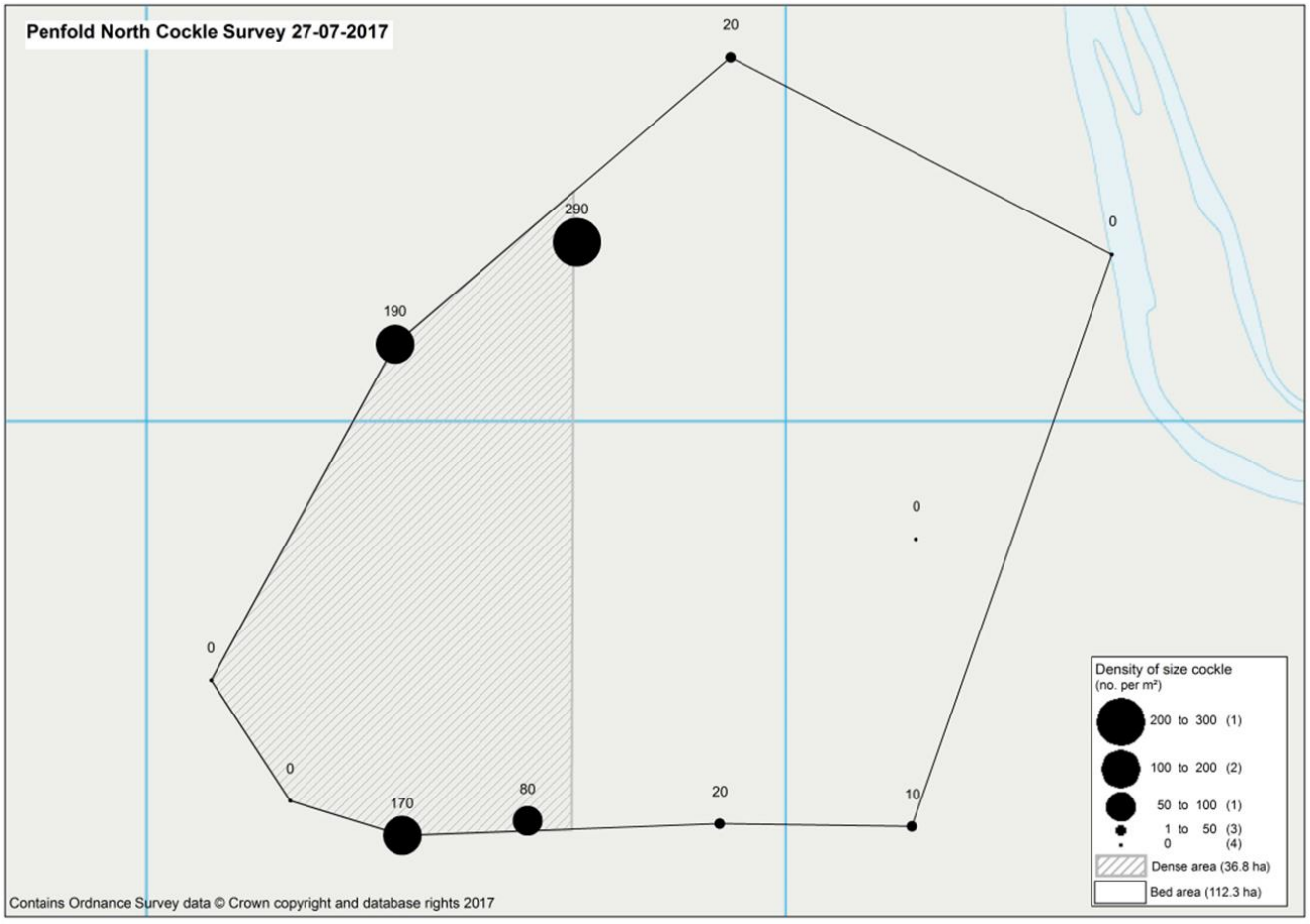
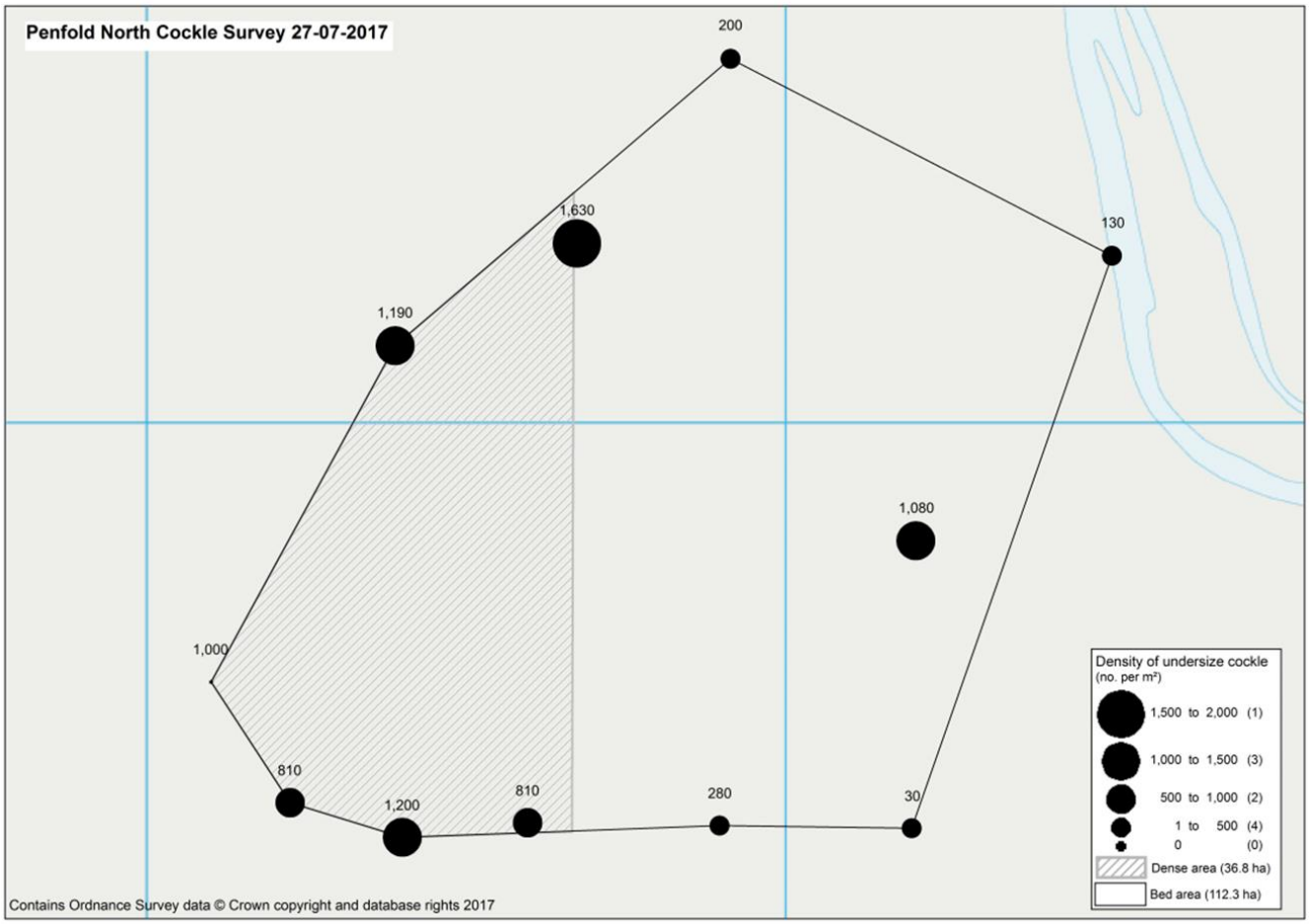

Penfold North Cockle Survey 27-07-2017
220
1,920
130
1,380
1,080
1,000
810
1,370
890
300
40
Frequency of size classes
(size of pie indicates density per m²)
2,000
1,000
200
0 - <5 mm
5 - <10 mm
10 - <20 mm
20 - <30 mm
30 - <40 mm
>40 mm
Dense area (36.8 ha)
Bed area (112.3 ha)
Contains Ordnance Survey data © Crown copyright and database rights 2017


Penfold North Cockle Survey 27-07-2017
20
290
0
190
0
0
0
170
80
20
10
Density of size cockle
(no. per m²)
200 to 300 (1)
100 to 200 (2)
50 to 100 (1)
1 to 50 (3)
0 (4)
Dense area (36.8 ha)
Bed area (112.3 ha)
Contains Ordnance Survey data © Crown copyright and database rights 2017


Penfold North Cockle Survey 27-07-2017
200
1,630
130
1,190
1,080
1,000
810
1,200
810
280
30
Density of undersize cockle
(no. per m²)
1,500 to 2,000 (1)
1,000 to 1,500 (3)
500 to 1,000 (2)
1 to 500 (4)
0 (0)
Dense area (36.8 ha)
Bed area (112.3 ha)
Contains Ordnance Survey data © Crown copyright and database rights 2017

ii. Lytham North Run – no significant stock present.

c) Morecambe Bay

i. Pilling

Survey scheduled for August. Possible low-level fishery in September.

ii. Middleton Sands - Inspection with industry on 01-06-2017. 2.0m tide

Method: Jumbo and 0.5m^2 quadrat randomly across the bed

An inspection was carried out north and south of Middleton car park. To the north there were small patches of cockle up to 150 per m² but overall the stock is low.

To the south there is a small patch of high density cockle indicated in the maps below. The cockle is one year class and ranges between 20mm and 30mm in size. The densest patch covers 3.2ha with estimated mean 700 per m². Surrounding that is a less dense area covering 7.7ha with estimated mean density of 200 per m².

It is proposed to leave this bed unfished as an undisturbed area for bird feeding should other fisheries in the Bay go ahead.

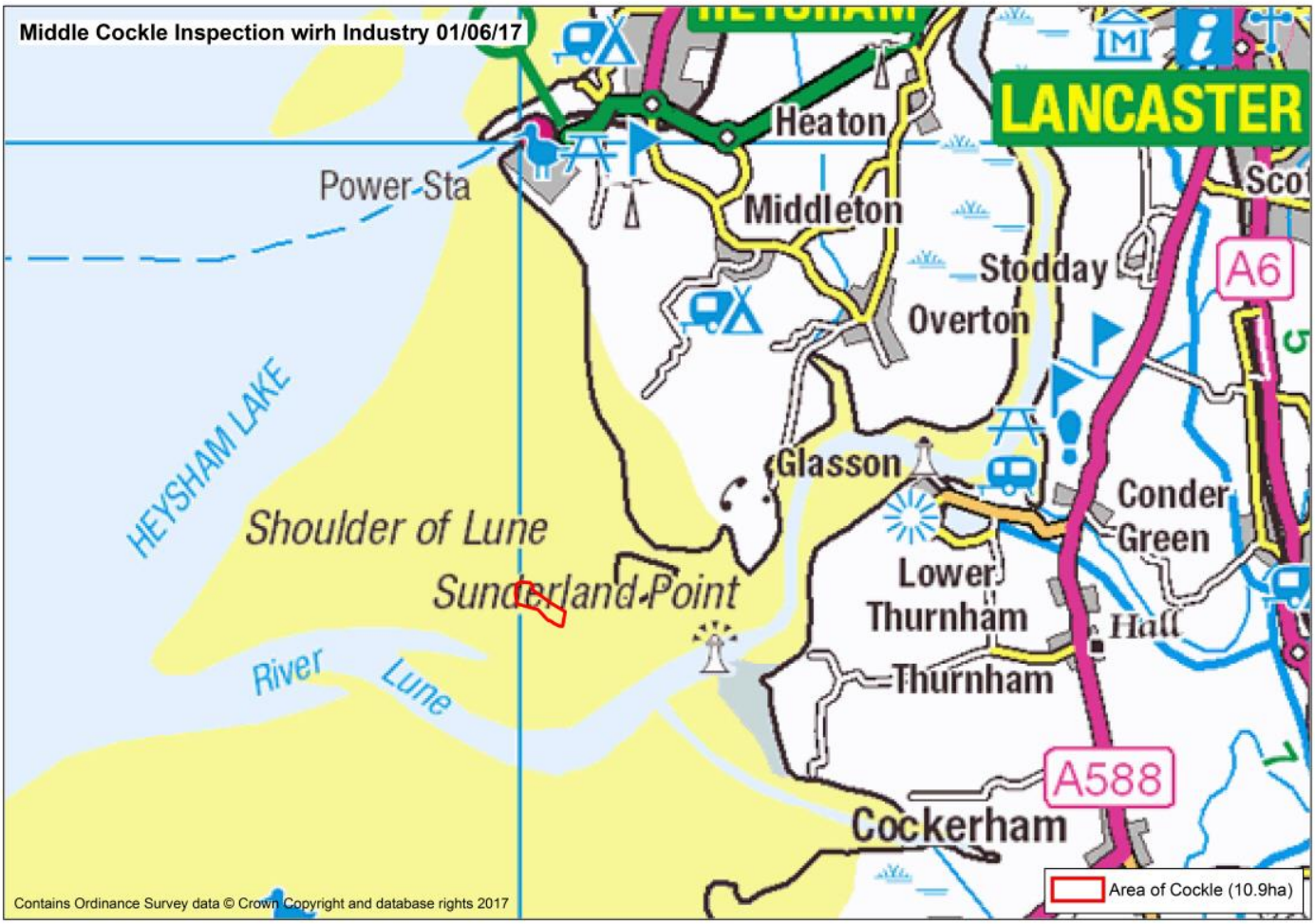
Biomass – crude estimate

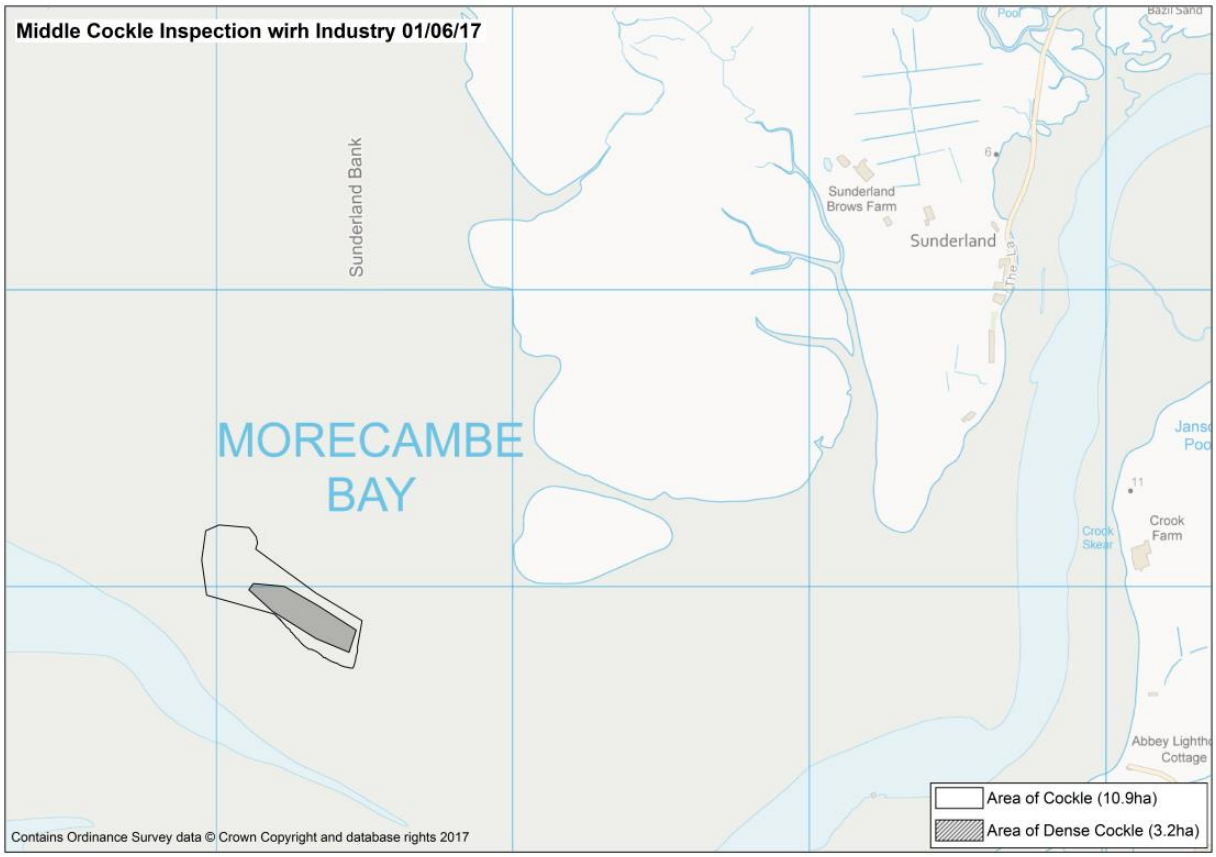
Note of caution - This is a crude estimate of biomass in the dense area to the south from the data collected from the inspection, and is not supported by full survey data.

Total Area of Dense Patch to the south = 10.9ha

A crude estimate of biomass has been calculated by assigning an average weight of 7g per cockle (based on a cockle with a shell length of 26mm), with a mean density of 700 per m² for the densest area (3.2ha) and 200 per m² for the remaining area (7.7ha).

Dense Area	157 tonnes
Other Area	108 tonnes
Total	**265 tonnes**


Middle Cockle Inspection wirh Industry 01/06/17
HEYSHAM
LANCASTER
Heaton
Middleton
Stodday
Overton
Sco
A6
Power Sta
HEYSHAM LAKE
Shoulder of Lune
Sunderland Point
Glasson
Conder
Green
Lower
Thurnham
Hall
Thurnham
River
Lune
A588
Cockerham
Area of Cockle (10.9ha)
Contains Ordinance Survey data © Crown Copyright and database rights 2017



iii. Warton Sands – survey scheduled for August.

iv. Flookburgh - Survey 25-07-2017 and 26-07-2017

Due to the large area of the bed the survey was split over two days.

Day 1 (25/07/2017) 0.5 m tide

Day 2 (26/07/2017) 0.6 m tide

Survey method: Jumbo and 0.5 m quadrat

159 survey stations were sampled across the two days from a grid with stations 500m apart.

Means

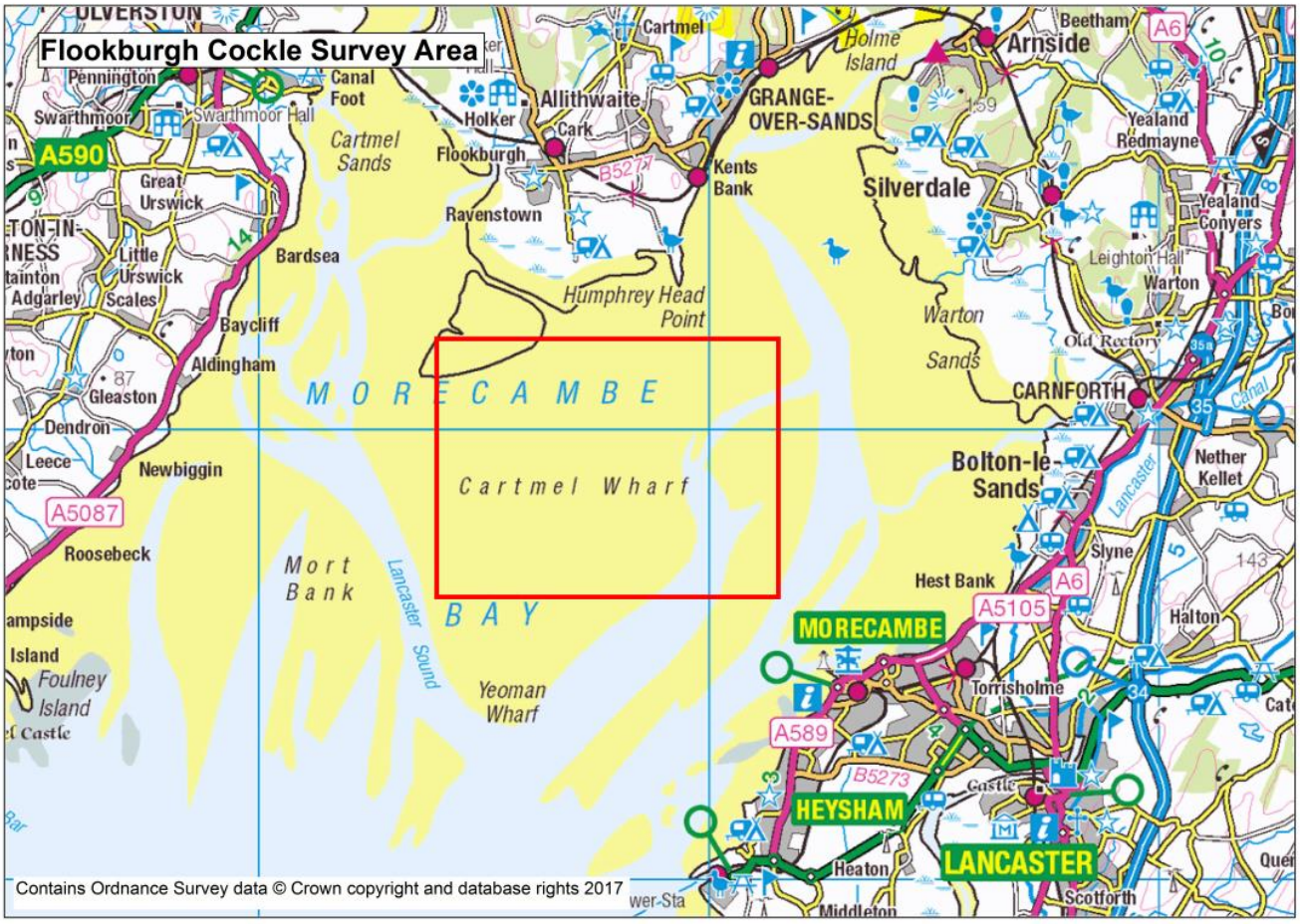
Means were calculated from all survey stations from both days within the defined bed area (zero counts on the edge of the bed have been removed).

Mean number of size cockle = 14 per m^2 (min. 0, max 128)

Mean number of undersize cockle = 19 per m^2 (min. 0, max 264)

Bed Area

Total bed area = 3253 ha


Flookburgh Cockle Survey Area
Pennington
Canal Foot
Swarthmoor
Swarthmoor Hall
A590
Great Urswick
Little Urswick
Adgarley
Scales
Bardsea
Baycliff
Aldingham
Gleaston
Dendron
Leece
Newbiggin
A5087
Roosebeck
Mort Bank
Lancaster Sound
Foulney Island
Yeoman Wharf
Cartmel Sands
Flookburgh
Holker
Allithwaite
Cark
Cartmel
Holme Island
GRANGE-OVER-SANDS
Kents Bank
B5277
Ravenstown
Humphrey Head Point
MORECAMBE BAY
Cartmel Wharf
Arnside
Beetham
A6
Yealand Redmayne
Silverdale
Yealand Conyers
Leighton Hall
Warton
Warton Sands
Old Rectory
CARNFORTH
Bolton-le-Sands
Nether Kellet
Slyne
Hest Bank
A6
A5105
Halton
MORECAMBE
Torrisholme
A589
B5273
HEYSHAM
Castle
LANCASTER
Heaton
Scotforth
Middleton
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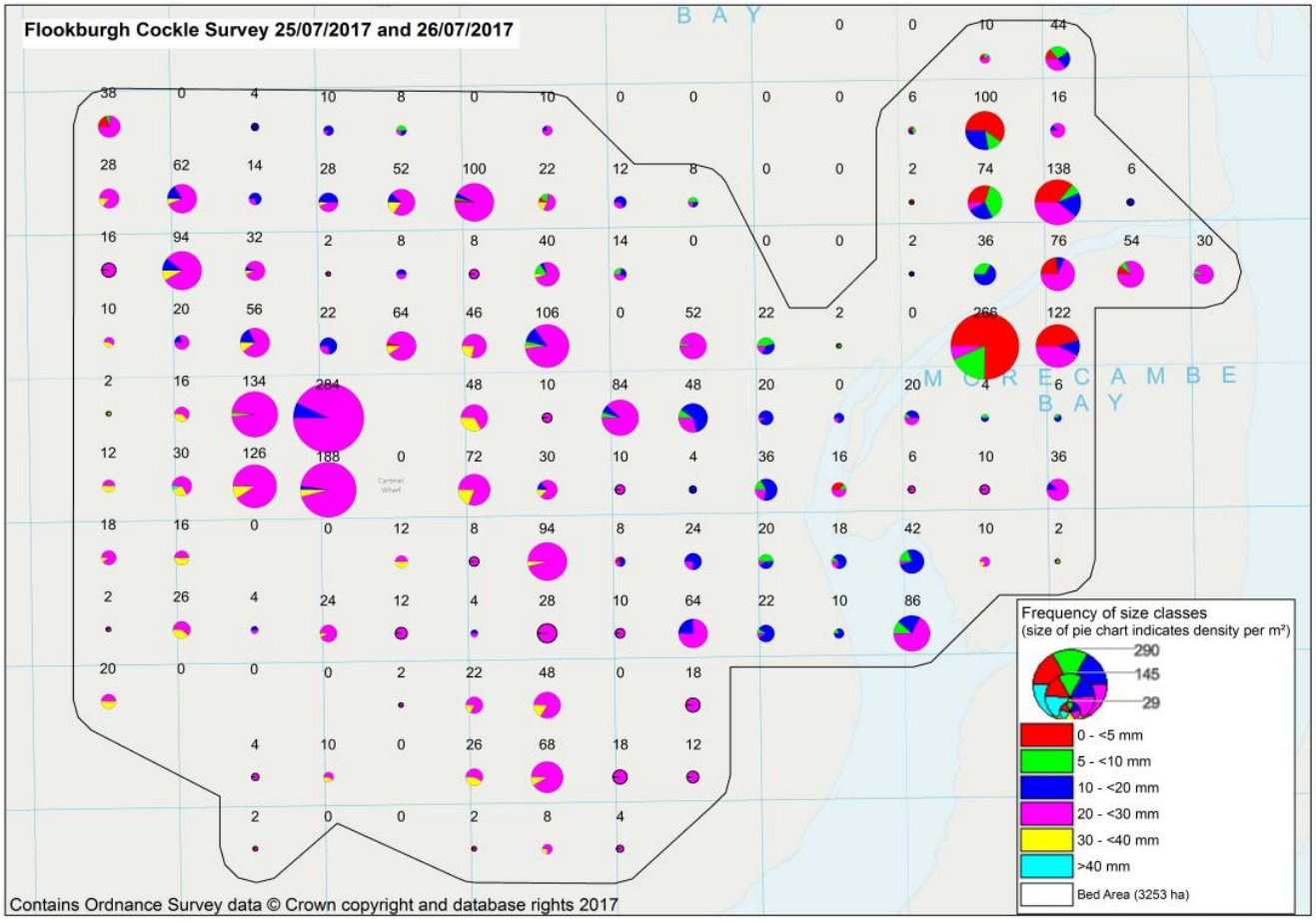
Flookburgh Cockle Survey 25/07/2017 and 26/07/2017
MORECAMBE BAY
Frequency of size classes
(size of pie chart indicates density per m²)
290
145
29
0 - <5 mm
5 - <10 mm
10 - <20 mm
20 - <30 mm
30 - <40 mm
>40 mm
Bed Area (3253 ha)
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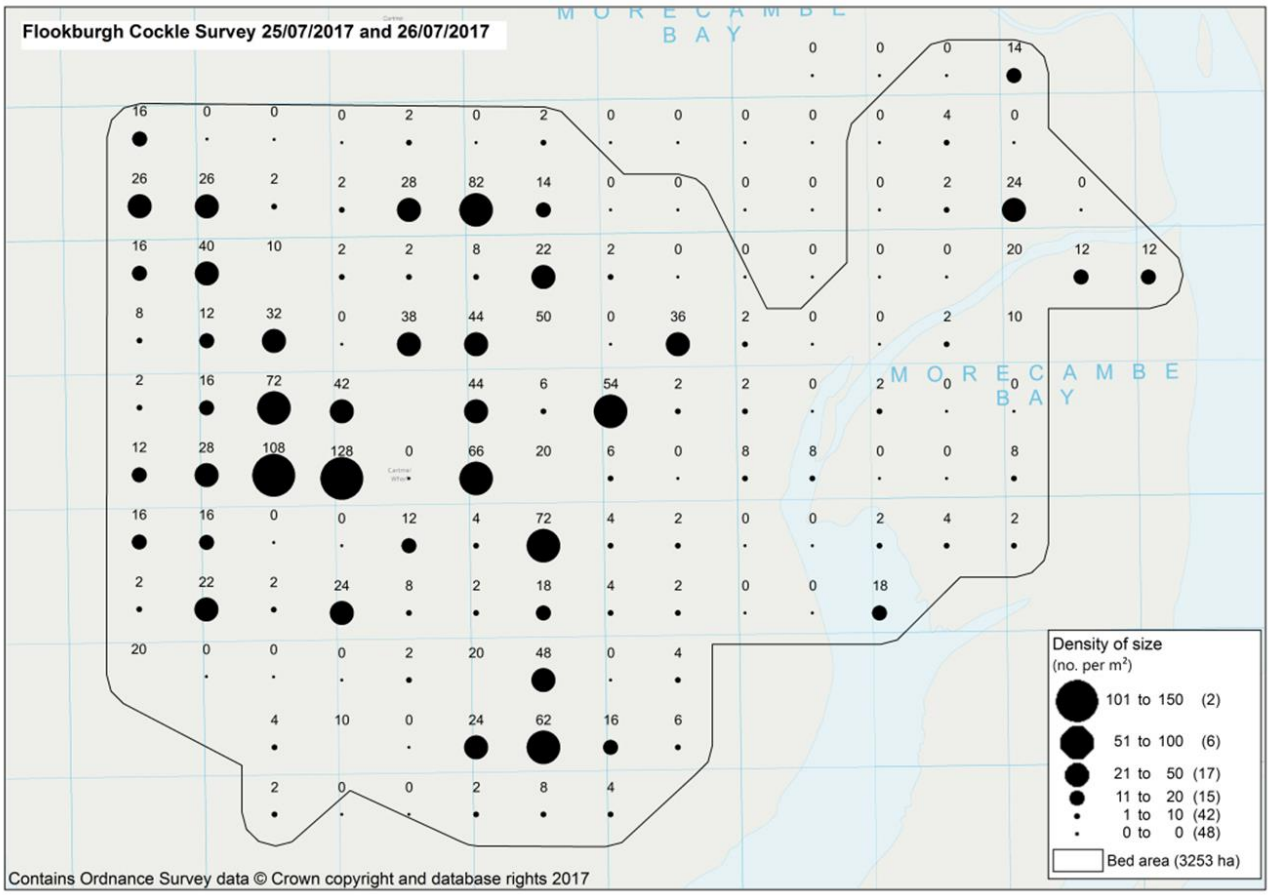
Flookburgh Cockle Survey 25/07/2017 and 26/07/2017
MORECAMBE BAY
Density of size
(no. per m²)
101 to 150 (2)
51 to 100 (6)
21 to 50 (17)
11 to 20 (15)
1 to 10 (42)
0 to 0 (48)
Bed area (3253 ha)
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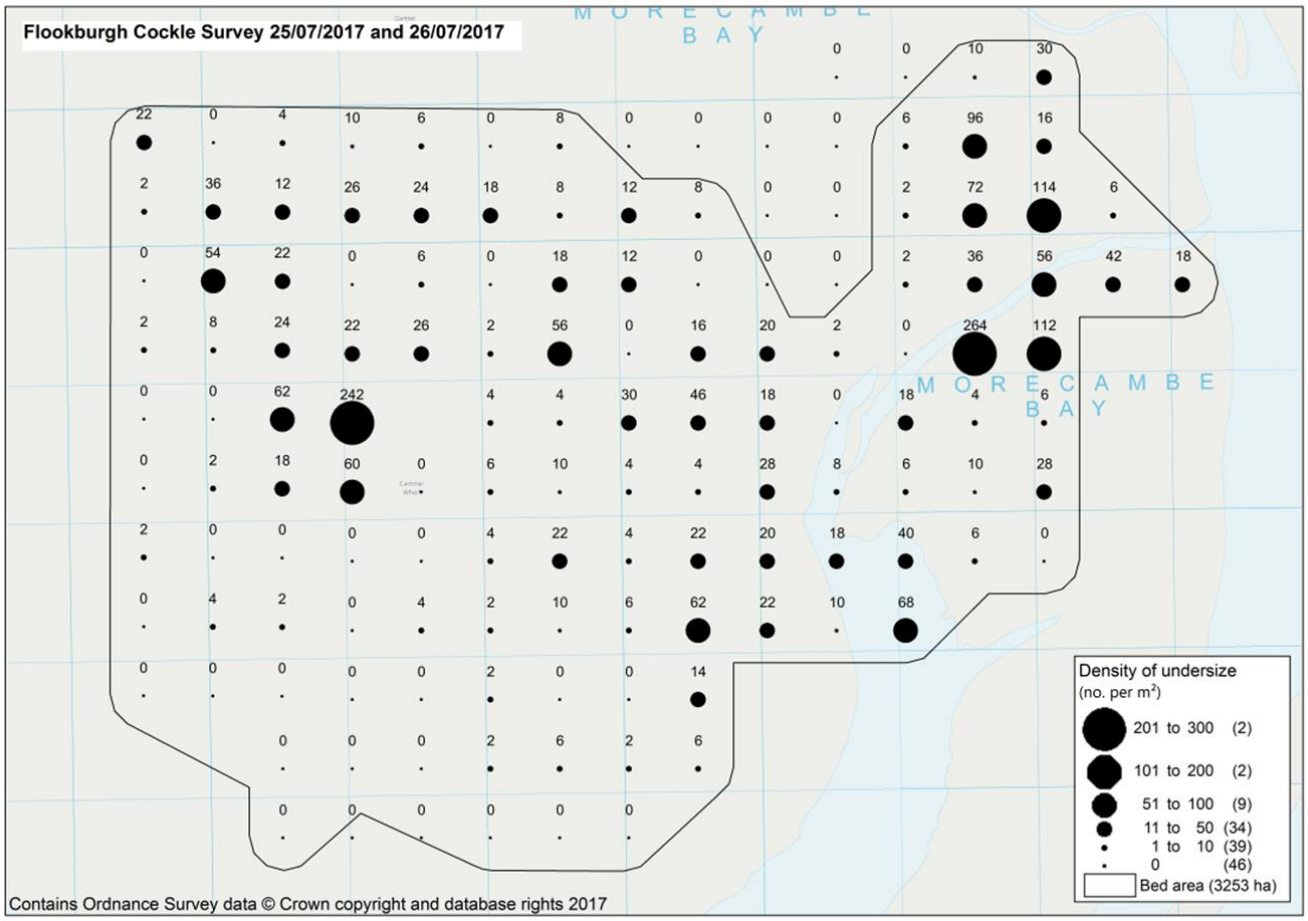
Flookburgh Cockle Survey 25/07/2017 and 26/07/2017
MORECAMBE BAY
Density of undersize
(no. per m²)
201 to 300 (2)
101 to 200 (2)
51 to 100 (9)
11 to 50 (34)
1 to 10 (39)
0 (46)
Bed area (3253 ha)
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v. Leven Sands survey 28-04-17. 0.5m tide.

Survey method: Jumbo with 0.5m^2 quadrat

The survey was carried out two days before the fishery closed. Thirty-three survey stations were sampled from a grid 500m apart. Thirteen of the stations were randomly added around the grid (mainly to the south-east).

Means

Means were calculated from all survey stations with the defined bed area (zero counts on the edge of the bed have been removed).

Mean number of size cockle = 20 per m^2 (min. 0, max 74)

Mean number of undersize cockle = 15 per m^2 (min. 0, max 66)

Biomass

Total Bed Area = 974 ha.

Biomass was calculated based on an average of 20 size cockles per m^2, with an average cockle weight of 7g and a bed area of 9.74 km^2.

Crude biomass = 1364 tonnes.

A return survey is scheduled for August with potential for a commercial fishery in September.


Leven Cockle Survey Area
A590
Backbarrow
Ayside
High Newton
Town End
Meathop
Beck Side
Shooting House Hill
Low Wood
Greenodd
Arrad Foot
FURNESS
Mansriggs
Field Broughton
Lindale
ULVERSTON
Cartmel
Holme Island
Storth
Pennington
Canal Foot
Holker Hall
Allithwaite
GRANGE-OVER-SANDS
Marton
Swarthmoor
Swarthmoor Hall
Lindal in Furness
Cartmel Sands
Holker
Cark
Flookburgh
Kents Bank
Silverdale
Great Urswick
Ravenstown
DALTON-IN-FURNESS
Little Urswick
Bardsea
Stainton with Adgarley
Scales
Humphrey Head Point
Warton Sands
Baycliff
Newton
Aldingham
MORECAMBE
Gleaston
Dendron
Leece
Newbiggin
Roosecote
Cartmel Wharf
Bolton-Sands
A5087
Roosebeck
Mort Bank
Lancaster Sound
BAY
Hest Bank
Rampside
Roa Island
MORECAMBE
Foulney Island
Piel Castle
Yeoman Wharf
A589
HEYSHAM
Piel Bar
Heaton
Power-Sta
Middleton
Stodday
Overton
HEYSHAM LAKE
Glasson
Shoulder of Lune
Sunderland Point
Lower Thurnham
Thurnham
River Lune
A588
Cockerham
TWOOD to
8 hrs
Bernard
Braides
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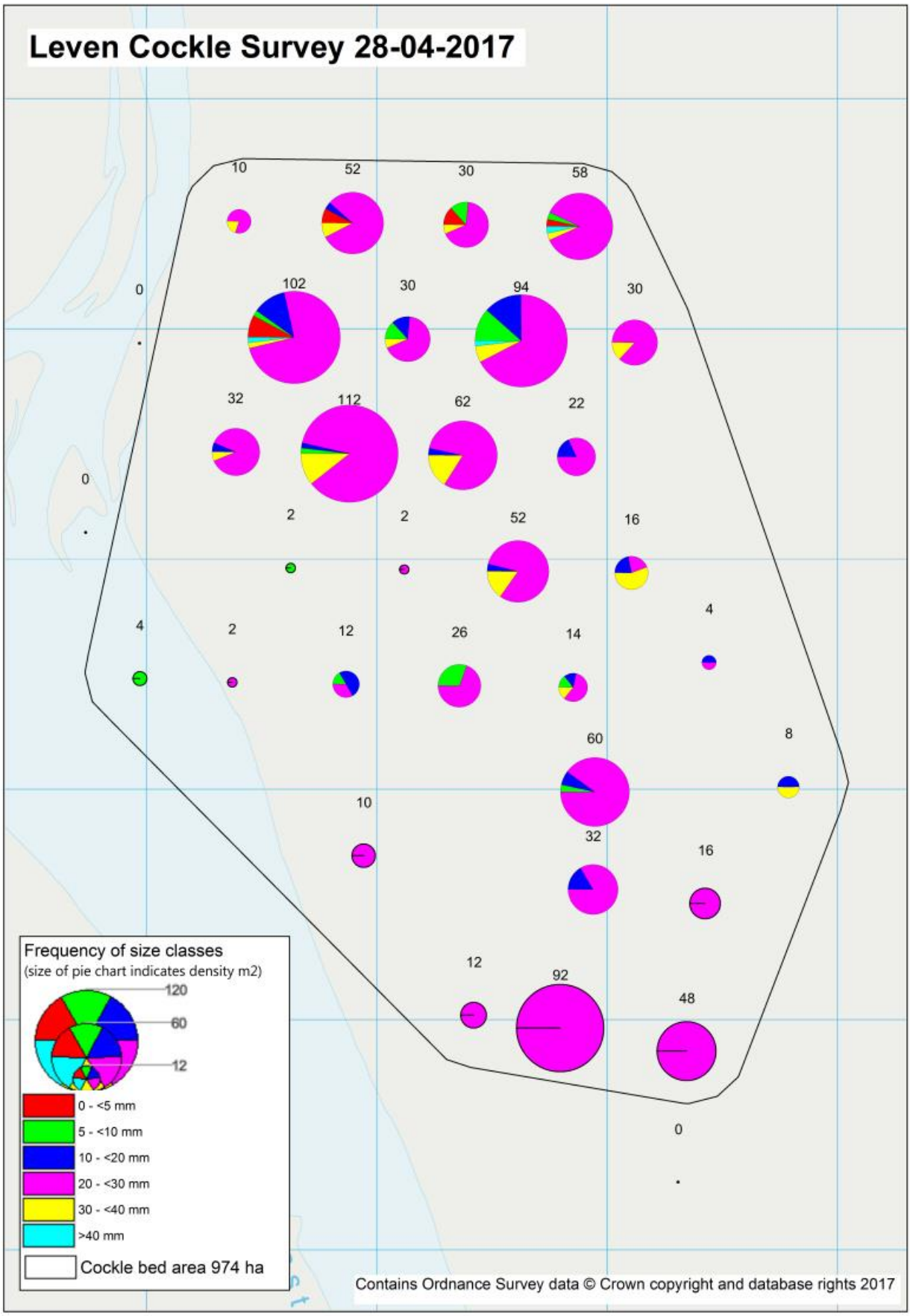
Leven Cockle Survey 28-04-2017
10
52
30
58
0
102
30
94
30
32
112
62
22
0
2
2
52
16
4
4
2
12
26
14
60
8
10
32
16
12
92
48
0
Frequency of size classes
(size of pie chart indicates density m2)
120
60
12
0 - <5 mm
5 - <10 mm
10 - <20 mm
20 - <30 mm
30 - <40 mm
>40 mm
Cockle bed area 974 ha
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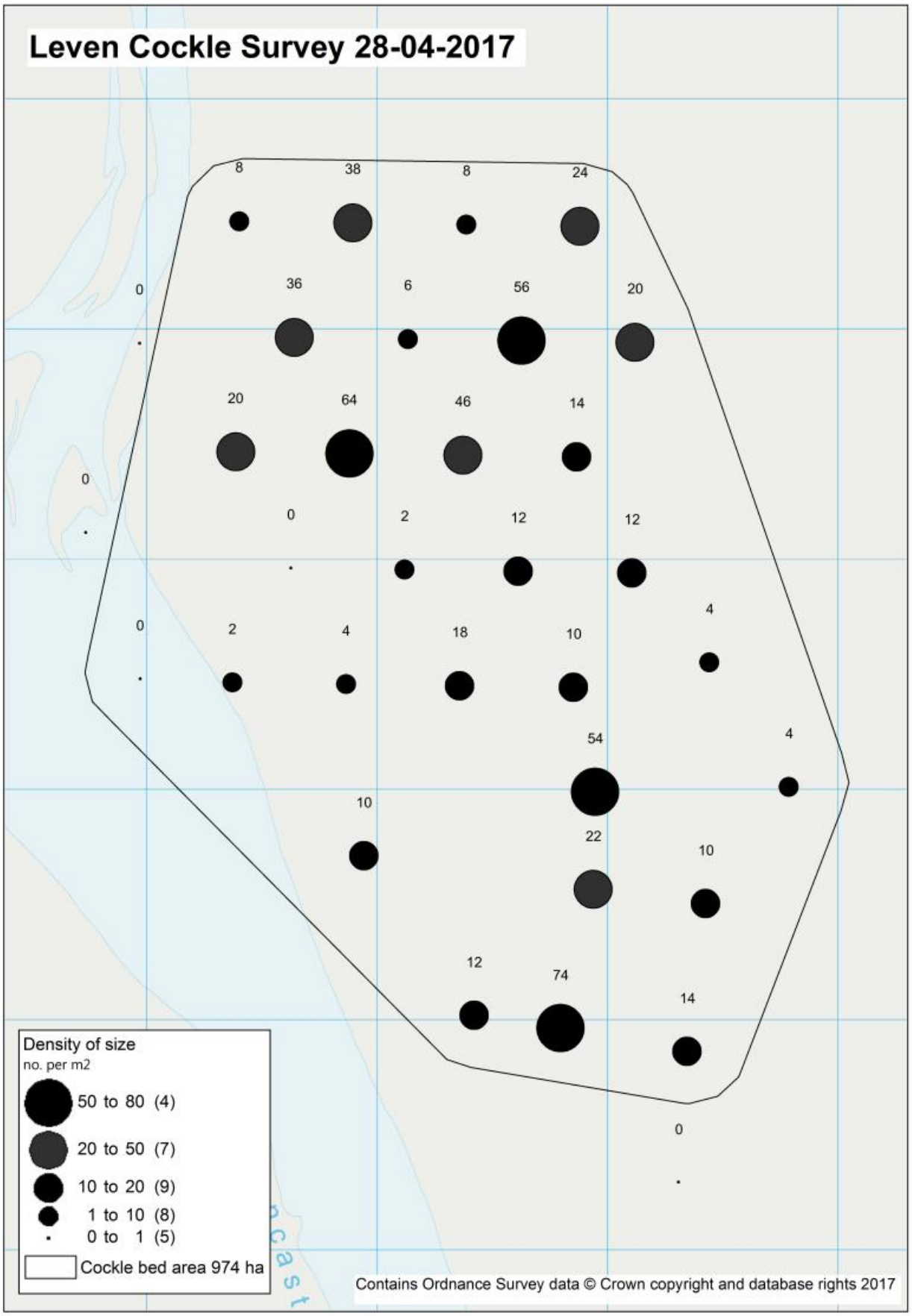
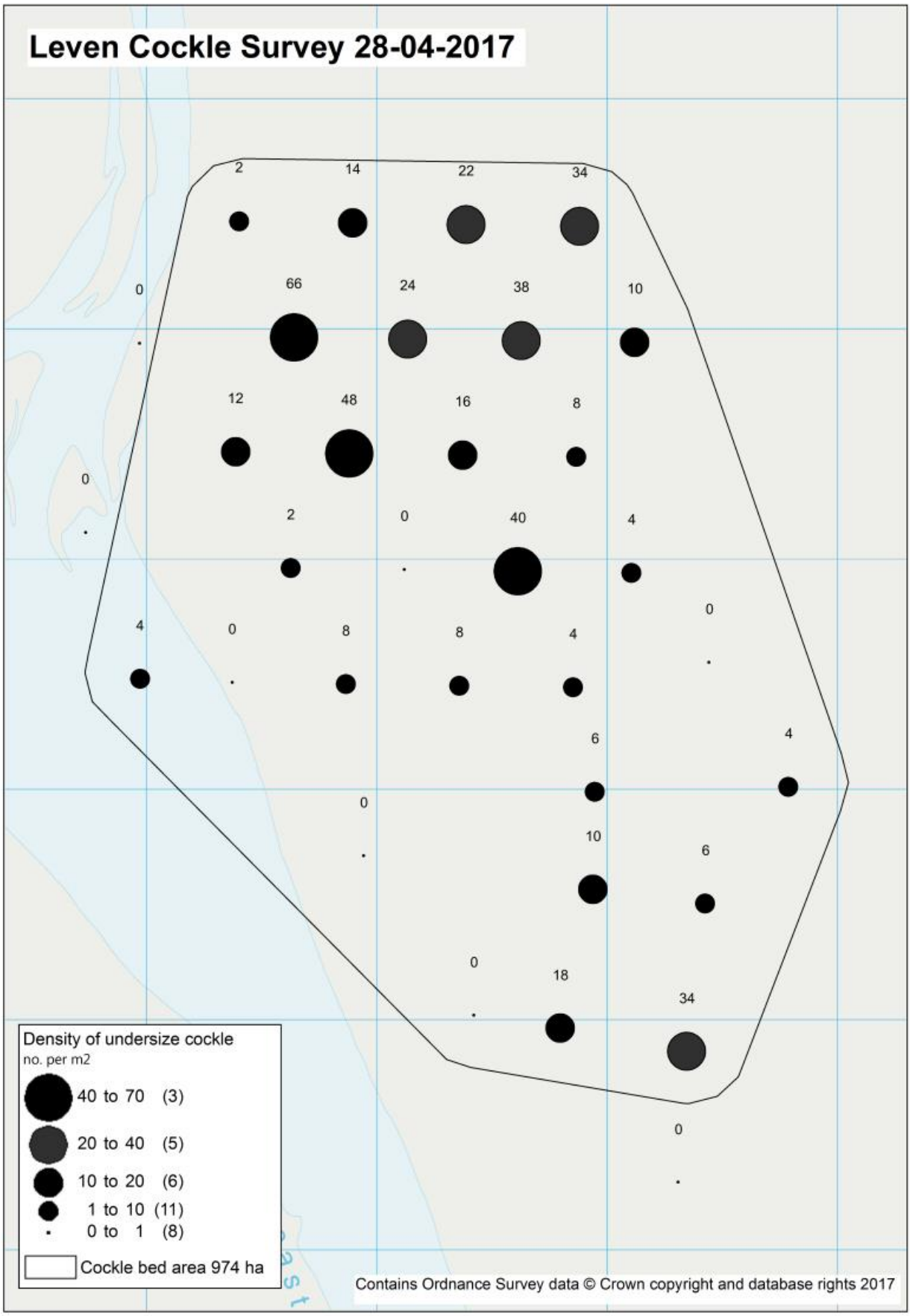

Leven Cockle Survey 28-04-2017
8
38
8
24
0
36
6
56
20
20
64
46
14
0
0
2
12
12
0
2
4
18
10
4
54
4
10
22
10
12
74
14
0
Density of size
no. per m2
50 to 80 (4)
20 to 50 (7)
10 to 20 (9)
1 to 10 (8)
0 to 1 (5)
Cockle bed area 974 ha
Contains Ordnance Survey data © Crown copyright and database rights 2017


Leven Cockle Survey 28-04-2017
2
14
22
34
0
66
24
38
10
12
48
16
8
0
2
0
40
4
4
0
8
8
4
0
6
4
0
10
6
0
18
34
0
Density of undersize cockle
no. per m2
40 to 70 (3)
20 to 40 (5)
10 to 20 (6)
1 to 10 (11)
0 to 1 (8)
Cockle bed area 974 ha
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vi. Aldingham

No reports of significant stock at present. Not scheduled in for survey at present.

vii. Newbiggin

No reports of significant stock at present. Not scheduled in for survey at present.

d) Solway

No indication from IFCOs patrols or industry that significant quantities of cockle present. Not scheduled in for survey at present.

Science Team. 31st July 2017