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Outer Ards Seed mussel Stock Assessment survey

Spring 2017

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Introduction

The Spring 2017 seed mussel stock assessment survey was undertaken by the Agri-Food and Biosciences Institute on the 7th, 8th, 21st and 22nd of February 2017 and the 24th of March 2017 onboard the DAERA Fisheries Protection Vessel (FPV) Queen of Ulster. The current seed mussel stock assessment methodology has two stages. The first stage uses acoustic and dredge tows. If there are any significant amounts of juvenile *Mytilus edulis* present, a second towed camera stage is undertaken to build on the initial ground truthing. The purpose of the Spring 2017 seed mussel stock assessment survey was to undertake acoustic and dredge surveys within areas previously identified as seed mussel beds and also to investigate three additional areas identified as potential see beds for the presence of seed mussels. The areas covered within the Spring 2017 survey are shown in Figure 1, and were the previously fished areas of Burial Island, Skullmartin and the Feathers and three new potential areas, Plough rock, South Point and Drumfad. The results of all of these surveys are detailed within the paragraphs below.

All care was taken to avoid areas within Burial Island determined to contain live *Modiolus modiolus* within previously AFBI surveys.

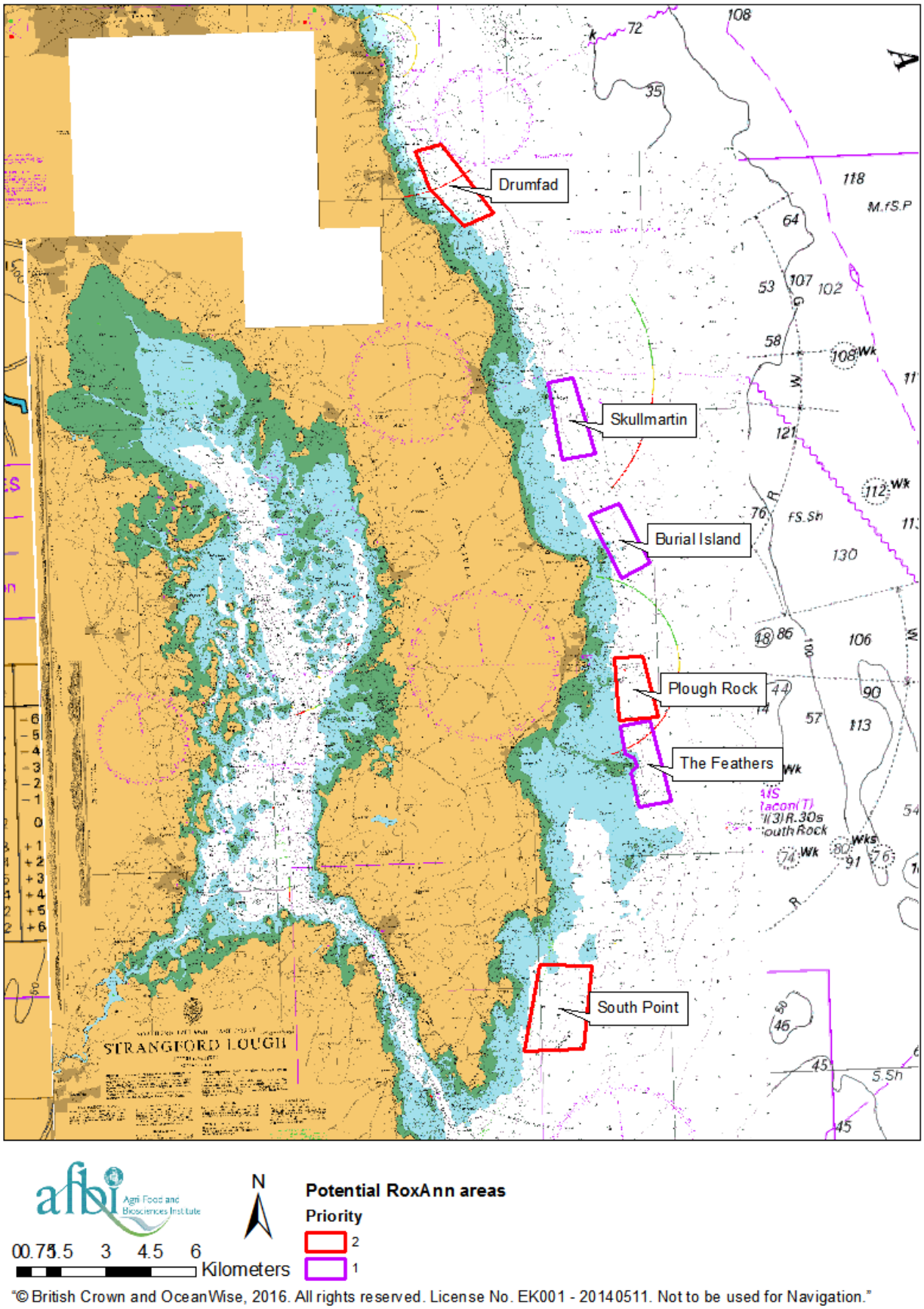


Figure 1: Survey locations for the spring 2017 seed mussel stock assessment.

Materials and Methods

- *Survey methods*

RoxAnn acoustic ground discrimination system (AGDS) data were collected aboard the DAERA FPV Queen of Ulster on the 7th, 8th and 22nd of February 2017, using a 200 kHz transducer. Data were collected at a save rate of 1s. Track spacing was approximately 100 m for Skulmartin, Burial Island and the Feathers and approximately 200 m for Drumfad, Plough Rock and South Point.

The following data processing was completed for the RoxAnn data obtained:

1. Data artefacts removed (caused by bubbles beneath transducer) and data from all turns at the end of survey lines.
2. E1 ("roughness") and E2 ("hardness") standardised by dividing each value by the 95th percentile of the range of values. Additionally a variability index, which shows how variable particular seabed areas are, was calculated by measuring the variability between sequential E1 and E2 datapoints. This was generated by square-rooting the absolute value of the next data point minus the current data point for each of E1 and E2, then adding these together. This provides a measure of along-track data variability for E1 and E2. These data were then plotted in ArcGIS as a point shapefile in UTM Zone 30N projection.
3. E1 (standardised) and E2 (standardised) were interpolated using ArcGIS 10.3 Spatial Analyst using a smooth circular search neighbourhood of 100 m for Skullmartin, Burial Island and The Feathers and 250 m for Drumfad, Plough Rock, and South Point, with inverse distance weighting method (to the power of 2), with a resulting grid cell size of 10 m^2 The resulting grids were clipped by an extent mask to constrain the final grids to the limits of the survey lines.

The clipped and interpolated E1 and E2 grids were then subjected to IsoCluster unsupervised image classification, with a number of classes trialled. The minimum class size (number of cells) used in the IsoCluster routine was 2. The addition of the depth grid was also trialled in the classification (i.e. E1, E2 and depth, or E1 and E2). The classified raster grid was then converted to a shapefile for calculation of areas.

The dredge surveys were undertaken onboard the DAERA FPV Queen of Ulster on the 21st of February and the 24th of March 2017, with two AFBI staff members onboard collecting samples and directing sampling effort.

Dredging was conducted using a custom oyster dredge measuring 1.5m x 0.5m (Figure 2). Dredge sampling was in accordance with AFBI Standard Operating Procedures (SOP) "Collection and recording of Benthic dredge samples". Samples collected were logged into the AFBI laboratory upon return as per SOP MARISM015 and processed in accordance with SOP MARISM019 and SOP MARISM020.

- *Laboratory Analysis*

Samples collected during the dredge surveys were processed as per SOP MARISM019 and MARISM020 the main elements of which are summarised very briefly below:

1) Whole sample weighed
2) Mussel removed from the sample and weighed
3) Waste calculated from above values
4) Mussels in 1 kg were counted
5) Sixty mussels selected for length analysis (more if two or more size classes were present)

Figure 2: Photograph showing the mussel dredge used during the Spring 2017 survey.

Results

1. Previous seed bed sites

Skullmartin

The processed RoxAnn cluster map for Skullmartin is shown in Figure 3. As can be seen from Figure 3, five distinct clusters were identified for this area. The dredge survey was then planned to provide representative sampling of all five of these clusters.

Nine dredge tows were undertaken on the 24th of March 2017 within the area of Skullmartin known to have previously yielded seed mussels (Figure 4). Mussels (accounting for greater than 10% of dredge contents) were found within two of these tows (Figures 4, 5 and 6, and Tables 1 - 3).

- *Shellfish Processing*

The summary results from the mussel sample processing for the dredge tows undertaken within the area of Skullmartin are shown in Tables 2 and 3 and the size class distributions for mussels within each of the dredges are shown within Figure 6. As can be seen from Figure 6 the majority of the mussels found within Tow 17 were within the 20.1 – 25.0 mm size class, whilst the majority of mussels measured within Tow 18 were within the 30.1 – 35.0 mm, 35.1 - 40.0 mm and 40.1 – 45.0 mm size classes. As can be seen from Table 2 the percentage waste (by weight) contained within these samples was high.

Burial Island

The processed RoxAnn cluster map for Burial Island is shown in Figure 7. As can be seen from Figure 7, four distinct clusters were identified for this area. The dredge survey was then planned to provide representative sampling of all four of these clusters.

Eleven dredge tows were undertaken on the 21st of February 2017 within the area of Burial Island known to have previously yielded seed mussels (Figure 8). Mussels (accounting for greater than 10% of dredge contents) were found within six of these tows (Figures 8, 9 and 10, and Tables 4 - 6).

- *Shellfish Processing*

The summary results from the mussel sample processing for the dredge tows undertaken within the area of Burial Island are shown in Tables 5 and 6 and the size class distributions

for mussels within each of the dredges are shown within Figure 10. As can be seen from Figure 10 both seed mussel (mussels < 40 mm in length) and adult mussels (mussels > 40 mm in length) were found within this area. As can be seen from Table 5 the percentage waste (by weight) contained within these samples ranged from 21% to 58%.

The Feathers

The processed RoxAnn cluster map for The Feathers is shown in Figure 11. As can be seen from Figure 11, five distinct clusters were identified for this area. The dredge survey was then planned to provide representative sampling of all five of these clusters.

Ten dredge tows were undertaken on the 21st of February 2017 within the area of The Feathers known to have previously yielded seed mussels (Figure 12). Mussels (accounting for greater than 10% of dredge contents) were found within five of these tows (Figures 12, 13 and 14 and 9 Tables 4, 7 and 8).

- *Shellfish Processing*

The summary results from the mussel sample processing for the dredge tows undertaken within the area of The Feathers are shown in Tables 7 and 8 and the size class distributions for mussels within each of the dredges are shown within Figure 14. As can be seen from Figure 14 the majority of the mussels found within this area were seed mussel within the size classes 15.1-20 mm and 20.1-25.0 mm. Some adult mussels (mussels > 40 mm in length) were found within Tows 4 and 5 in The Feathers. As can be seen from Table 7 the percentage waste (by weight) contained within these samples ranged from 19% to 93%.

2. Potential new areas

Drumfad

The processed RoxAnn cluster map for the area identified for the purpose of this report as Dumfad is shown in Figure 15. As can be seen from Figure 15, five distinct clusters were identified for this area. The dredge survey was then planned to provide representative sampling of all five of these clusters.

Eight dredge tows were undertaken on the 24th of March 2017 within the area of Dumfad (Figure 16). Mussels were not found within any of these dredge tows (Figure 17).

Plough Rock

The processed RoxAnn cluster map for the area identified for the purpose of this report as Plough Rock is shown in Figure 18. As can be seen from Figure 18, five distinct clusters were identified for this area. The dredge survey was then planned to provide representative sampling of all five of these clusters.

Seven dredge tows were undertaken on the 21st of February 2017 within the area of Plough rock (Figure 19). Mussels were not found within any of these dredge tows (Figure 20).

South Point

The processed RoxAnn cluster map for the area identified for the purpose of this report as South Point is shown in Figure 21. As can be seen from Figure 21, five distinct clusters were identified for this area. The dredge survey was then planned to provide representative sampling of all five of these clusters.

Eleven dredge tows were undertaken on the 24th of March 2017 within the area of South Point (Figure 22). Mussels were not found within any of these dredge tows (Figure 23).

Table 1: Dredge information from the 24th of March 2017 Outer Ards dredge survey. Only the dredge Tows whose contents were composed of greater than 10% mussels are shown as red lines on the corresponding maps (Figure 4: Skullmartin, Figure 16: Drumfad, and Figure 22: South Point).

Tow No.	Date	Location	Depth start (m)	Depth end (m)	Sample description	% fill	Mussels present
1	24/03/2017	South Point	15.3	19.2	*Halichondria panicea* and *Echinus esculentus*.	<1%	N
2	24/03/2017	South Point	17.7	20.3	*E. esculentus*, *Asterias rubens*, shell and Polyplacophora	<1%	N
3	24/03/2017	South Point	14.7	14.2	*Laminaria digitata*, *A. rubens*, *Crossaster papposus*.	1%	N
4	24/03/2017	South Point	16.2	18.9	Cobbles, *A. rubens*, brittle stars	1%	N
5	24/03/2017	South Point	21.6	20.8	Cobbles, brittle stars, *Actinia equina*.	<1%	N
6	24/03/2017	South Point	23.6	23.9	One cobble	<1%	N
7	24/03/2017	South Point	22.4	23.6	Pebbles, brittle stars, *Ascidiella aspersa*, *Alcyonium digitatum*, small boulder	2%	N
8	24/03/2017	South Point	21.6	22	Pebbles, *Pecten maximus*, brittle stars, *C. papposus*, *A. rubens*, *Pomatoceros lamarcki*, *Inachus sp*.	1%	N
9	24/03/2017	South Point	17.3	17.6	Pebbles and cobbles, *Henricia oculata*, *E. esculentus*, *H. panicea*, brittle stars, *C. papposus*, *A. rubens*, *Marthasterias glacialis*, bryozoans, *P. lamarcki* and *Balanus balanus*.	10%	N
10	24/03/2017	South Point	-	26.2	Broken shell, gravel and cobbles. *A. rubens, Corystes cassivelaunus, Astarte sulcata*.	5%	N
11	24/03/2017	South Point	26.9	24.6	Cobbles, broken shell and gravel. *E. esculentus*, *M. glacialis, A. rubens, H. oculata, P. maximus, A. sulcata*, *P. lamarcki*, brittle stars.	5%	N
12	24/03/2017	Skullmartin	16.8	15.7	Broken shell, cobbles, *Arctica islandica*, *Ammodytes tobianus*, *Pagurus bernhardus*, bryozoans, gravel, *A sulcata*.	<1%	N
13	24/03/2017	Skullmartin	18.6	19.6	Dead shell, gravel, cobbles and pebbles. *Liocarcinus depurator*, *P. bernhardus*, *Inachus sp., A. rubens, H. oculata, L. digitata, P. maximus*, bryozoans, *Buccinum undatum*.	15%	N
14	24/03/2017	Skullmartin	17.9	20.6	Dead shell, gravel, pebbles, *C. papposus*, *P. bernhardus*, *B. undatum*, *P. maximus*, *B. balanus*, *A. rubens*, bryozoans, *Macropodia sp.*, *L. depurator*, *Inachus sp*.	20%	N
15	24/03/2017	Skullmartin	19.5	19.1	Broken shell, gravel, pebbles, *L. depurator*, *C. cassivelaunus, Cancer pagurus*, *P. bernhardus*, *A. rubens, A. sulcata*, *C. papposus, A. tobianus*.	20%	N
16	24/03/2017	Skullmartin	16.5	16.4	*L. digitata* and shell. *Zeus faber*, *P. maximus, P. bernhardus*, *A. tobianus*.	1%	N
17	24/03/2017	Skullmartin	23	23.6	Broken shell, gravel, *M. edulis*. *L. digitata*, *C. papposus*, *P. bernhardus*, *B. undatum*.	33%	Y
18	24/03/2017	Skullmartin	22.7	21.9	*M. edulis*, broken shell, gravel. *Psammechinus*, bryozoans, *P. bernhardus*, *B. undatum*, *Eledone cirrhosa*.	25%	Y
19	24/03/2017	Skullmartin	25.5	24.3	Cobbles, *L. digitata*, *M. edulis*. *A. tobianus*, *P. bernhardus, A. rubens*, *P. maximus*, *B. balanus*.	5%	Y
20	24/03/2017	Skullmartin	24	25.9	Cobbles, *E. esculentus* and *L. digitata. C. papposus*.	<1%	N

Tow No.	Date	Location	Depth start (m)	Depth end (m)	Sample description	% fill	Mussels present
21	24/03/2017	Drumfad	20.6	22.2	Cobbles. C. papposus, *P. maximus*, *P. lamarcki*, *Inachus sp*.	1%	N
22	24/03/2017	Drumfad	16.1		Cobbles, bryozoans, *P. maximus*.	<1%	N
23	24/03/2017	Drumfad	21.8	19.9	Cobbles, *P. maximus, E. esculentus*, one *Modiolus modiolus* (photos), brittle stars.	2%	N
24	24/03/2017	Drumfad	20.8	21	Gravel, pebbles, some cobbles. *Anseropoda placenta*, brittle stars, bryozoans, *P. bernhardus*, *A. sulcata*, *L. depurator, C. papposus*, *E. esculentus*, *B. balanus*, *Inachus sp*.	10%	N
25	24/03/2017	Drumfad	18.8	19.3	Gravel, broken shell, cobbles. *E. cirrhosa*, *C. papposus*, *P. maximus*, *B. balanus*, *P. bernhardus*, brittle stars, *B. undatum*.	20%	N
26	24/03/2017	Drumfad	21.4	21	Pebbles and gravel, few cobbles. *P. bernhardus*, *B. undatum*, *C. papposus*, brittle stars, *E. esculentus*, *B. balanus*, *Turritella communis*, *E. cirrhosa*, *A. sulcata*.	5%	N
27	24/03/2017	Drumfad	16.8	16.7	Mud, gravel. Polychaeta, *A. sulcata, P. maximus*, brittle stars.	<1%	N
28	24/03/2017	Drumfad	14.2	14	Cobbles, gravel, dead shell. *P. maximus, A. rubens*, brittle stars, bryozoans.	1%	N
29	24/03/2017	Drumfad	19.5	20.1	Cobbles, pebbles, gravel. *Callionymus lyra*, *L. digitata, A. sulcata*, bryozoans, *B. undatum*, brittle stars, *E. esculentus, P. miliaris, A. rubens*.	15%	N

Table 2: Mussel sample processing summary data: Skullmartin 24/03/17

Tow No.	Total sample weight (kg)	Shellfish weight (kg)	% Waste	Pieces per kilo
Tow 17	11.12	0.79	92.91048	1490
Tow 18	14.75	3.85	73.87589	365

Table 3: Mussel length measurement summary data: Skullmartin 24/03/17

Tow No.	Mussel length measurements (mm)				
	Median	**Mean**	**SD**	**min**	**max**
Tow 17	22.89	22.32	3.27	13.08	30.30
Tow 18	35.57	35.22	6.63	16.27	45.65

SD= Standard Deviation from the mean

Table 4: Dredge information from the 21st of February 2017 Outer Ards dredge survey. Only the dredge Tows whose contents were composed of greater than 10% mussels are shown as red lines on the corresponding maps (Figure 8: Burial Island, Figure 12: The Feathers, and Figure 19: Plough Rock).

Tow No.	Date	Location	Depth start (m)	Depth end (m)	Sample description	% fill	Mussels present
1	21/02/2017	Feathers	19	16.7	Gravel, *Asterias rubens*, *Liocarcinus depurator*, *Necora puber*, brittle stars, *Buccinum undatum*, *Mytilus edulis*.	5%	Y
2	21/02/2017	Feathers	15.4	17.8	*Pleuronectes platessa*, *Echinus esculentus*, some cobbles, *M. edulis*.	<1%	N
3	21/02/2017	Feathers	23.4	19.2	*Pecten maximus*, *Echinus esculentus*, *Alcyonium digitatum*, *Callionymus lyra*, *Laminaria saccharina*. *Mytilus edulis* attached to gravel.	<1%	N
4	21/02/2017	Feathers	21.1	19.4	*M. edulis*, *L. Saccharina, N. puber*, B. *undatum*, L. *depurator*, *Gammarus* sp.	40%	Y
5	21/02/2017	Feathers	15.2	16.7	*L. saccharina* and *M. edulis*. *Pagurus bernhardus*, *Callionymus lyra*, *Macropodia sp*.	1%	Y
6	21/02/2017	Feathers	19.9	21.8	*M. edulis* and *A. rubens* (> 10). Gravel and cobbles. *Corystes cassivelaunus*, *Macropodia sp*., *L. depurator*, *B. undatum*, *Crossaster papposus*, *Astarte sulcata*, *Arctica islandica*.	25%	Y
7	21/02/2017	Feathers	24.4	25	*M. edulis, A. rubens*, *Marthasterias glacialis*.	<1%	N
8	21/02/2017	Feathers	23.1	24.4	*M. edulis,* cobbles, Polychaeta, *A. rubens*, brittle stars, *Gammarus* sp., *L. depurator*, *Inachus phalangium*.	33%	Y
9	21/02/2017	Feathers	20	19.6	Cobble with *M. edulis* attached. Broken shell and *L. Saccharina*. *P. bernhardus*, *L. depurator*.	<1%	N
10	21/02/2017	Feathers	23.7	23.3	*L. saccharina* and broken shell. *L. depurator*, brittle stars.	<1%	N
11	21/02/2017	Plough Rock	19.2	19.7	*L. digitata* and some shell. *P. bernhardus*, *L. depurator*, polychaeta	<1%	N
12	21/02/2017	Plough Rock	22.8	21.9	*L. Saccharina* and *digitata*, some shell. *Zeus faber*, *Ammodytes tobianus*, *P. bernhardus*, *L. depurator* and *Hyas araneus*.	<1%	N
13	21/02/2017	Plough Rock	20.5	19.8	Some broken shell. *P. bernhardus*, *L. depurator*.	0%	N
14	21/02/2017	Plough Rock	19.9	19.4	Shell, *Chorda filum*. *L. depurator*, *Sepiola atlantica*, B*alanus balanus*, *Pomatoceros lamarcki*, *Turritella communis*, brittle stars	<1%	N
15	21/02/2017	Plough Rock	21.2	20	*L. digitata* and broken shell. *Z. faber, P. maximus*, *A. digitatum*, *Ascidiella aspersa*, *P. bernhardus.*	<1%	N
16	21/02/2017	Plough Rock	26.1	25.7	*L. saccharina* and *L. digitata*, broken shell. *Aphrodita aculeata*, *P. bernhardus*, *L. depurator*, *A. rubens*.	1%	N
17	21/02/2017	Plough Rock	23.8	23.7	*L. Digitata* and broken shell, *C. lyra*, *P. bernhardus*, *L. depurator*, brittle stars.	1%	N
18	21/02/2017	Burial Island	17.1	16.4	*M. edulis*. Bryozoans, *A. sulcata*, *Chondrus crispus*.	2%	Y
19	21/02/2017	Burial Island	21.3	21.5	*M. edulis*, broken shell, dead *Modiolus modiolus* shell. *N. puber*, *E. esculentus*, brittle stars, *L. depurator*, *B. undatum*, *A. rubens*.	40%	Y
20	21/02/2017	Burial Island	20.8	21.7	Brittle stars, dead *M. modiolus* shells, *M. edulis*. Polychaeta, *P. bernhardus*, *A. sulcata*, *M. modiolus*, *B. undatum, A. rubens, E. esculentus*, Polyplacophora.	33%	Y
21	21/02/2017	Burial Island	-	16.2	*M. edulis*, some broken shell. *E. esculentus*, *L. digitata*, *N. puber*, *Cancer pagurus, A.*	75%	Y

Tow No.	Date	Location	Depth start (m)	Depth end (m)	Sample description	% fill	Mussels present
					rubens, C. papposus, B. undatum, polychaeta		
22	21/02/2017	Burial Island	23.3	24.4	*M. edulis*, brittle stars and *M. modiolus* shells. Quite muddy. *E. esculentus*, *B. undatum*, *A. sulcata*, bryozoans.	66%	Y
23	21/02/2017	Burial Island	23.8	24.5	*M. edulis*. Brittle stars, *B. undatum*, *A. sulcata* and *A. rubens*.	50%	Y
24	21/02/2017	Burial Island	25.9	24.9	Brittle stars and dead *M. modiolus* shell, gravel. *Scorpaena porcus*, *C. papposus*, *M. edulis*, *A rubens*, *Agonus cataphractus*.	35%	N
25	21/02/2017	Burial Island	24.7	28.2	*C. filum*, cobbles, broken shell, *L. digitata. A. rubens*, *C. papposus*, *E. esculentus*, *Psammechinus miliaris*.	<1%	N
26	21/02/2017	Burial Island	25.4	24.8	Broken shell, gravel. *Psammechinus miliaris*, *A. rubens*, *P. maximus*, brittle stars, *E. esculentus*, *A. sulcata*, *A. digitatum*.	5%	N
27	21/02/2017	Burial Island	20.2	25.1	Broken shell. *A. tobianus*, *P. bernhardus, M. edulis*.	<1%	N
28	21/02/2017	Burial Island	18.5	21	Completely empty	0%	N

Table 5: Mussel sample processing summary data: Burial Island 21/02/17

Tow no.	Total sample weight (kg)	Shellfish weight (kg)	% Waste	Pieces per kilo
Tow 18	5.54	2.78	49.74	165
Tow 19	13.25	9.89	25.38	144
Tow 20	15.04	6.31	58.06	156
Tow 21	15.21	11.17	26.53	206
Tow 22	11.02	8.67	21.29	124
Tow 23	8.90	6.17	30.73	216

Table 6: Mussel length measurement summary data: Burial Island 21/02/17

Tow No.	Mussel length measurements (mm)				
	Median	**Mean**	**SD**	**min**	**max**
Tow 18	48.45	43.38	13.01	17.85	58.84
Tow 19	49.40	45.02	12.68	15.84	59.73
Tow 20	46.49	46.87	3.85	39.29	55.94
Tow 21	44.67	37.17	15.39	12.82	62.73
Tow 22	48.20	47.74	4.56	34.66	58.92
Tow 23	39.56	36.67	15.83	15.46	58.21

SD= Standard Deviation from the mean

Table 7: Mussel sample processing summary data: The Feathers 21/02/17

Tow No.	Total sample weight (kg)	Shellfish weight (kg)	% Waste	Pieces per kilo
Tow 1	11.82	0.75	93.69	1952
Tow 4	12.80	7.60	40.64	655
Tow 5	1.31	1.06	19.30	200
Tow 6	11.42	3.09	72.96	2587
Tow 8	11.05	3.63	67.17	2490

Table 8: Mussel length measurement summary data: The Feathers 21/02/17

Tow No.	Mussel length measurements				
	Median	**Mean**	**SD**	**min**	**max**
Tow 1	19.17	18.62	3.72	8.68	27.74
Tow 4	20.40	24.59	11.91	12.41	54.07
Tow 5	44.39	37.17	15.14	14.40	59.89
Tow 6	17.35	17.29	3.34	9.73	23.77
Tow 8	18.00	18.58	2.75	12.92	27.23

SD= Standard Deviation from the mean

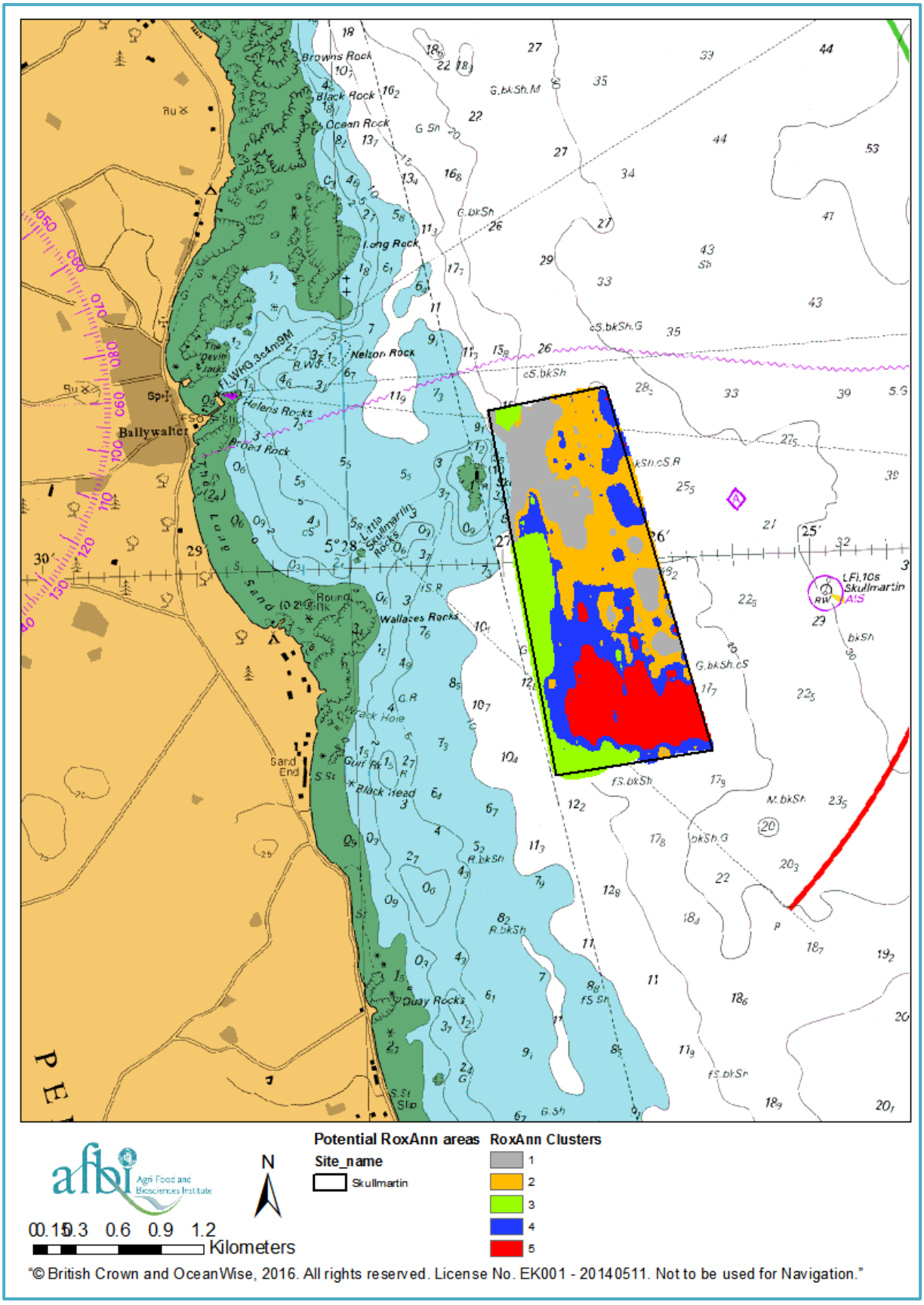


Figure 3: RoxAnn cluster map (from roughness and hardness values) from the February 2017 survey of Skullmartin.

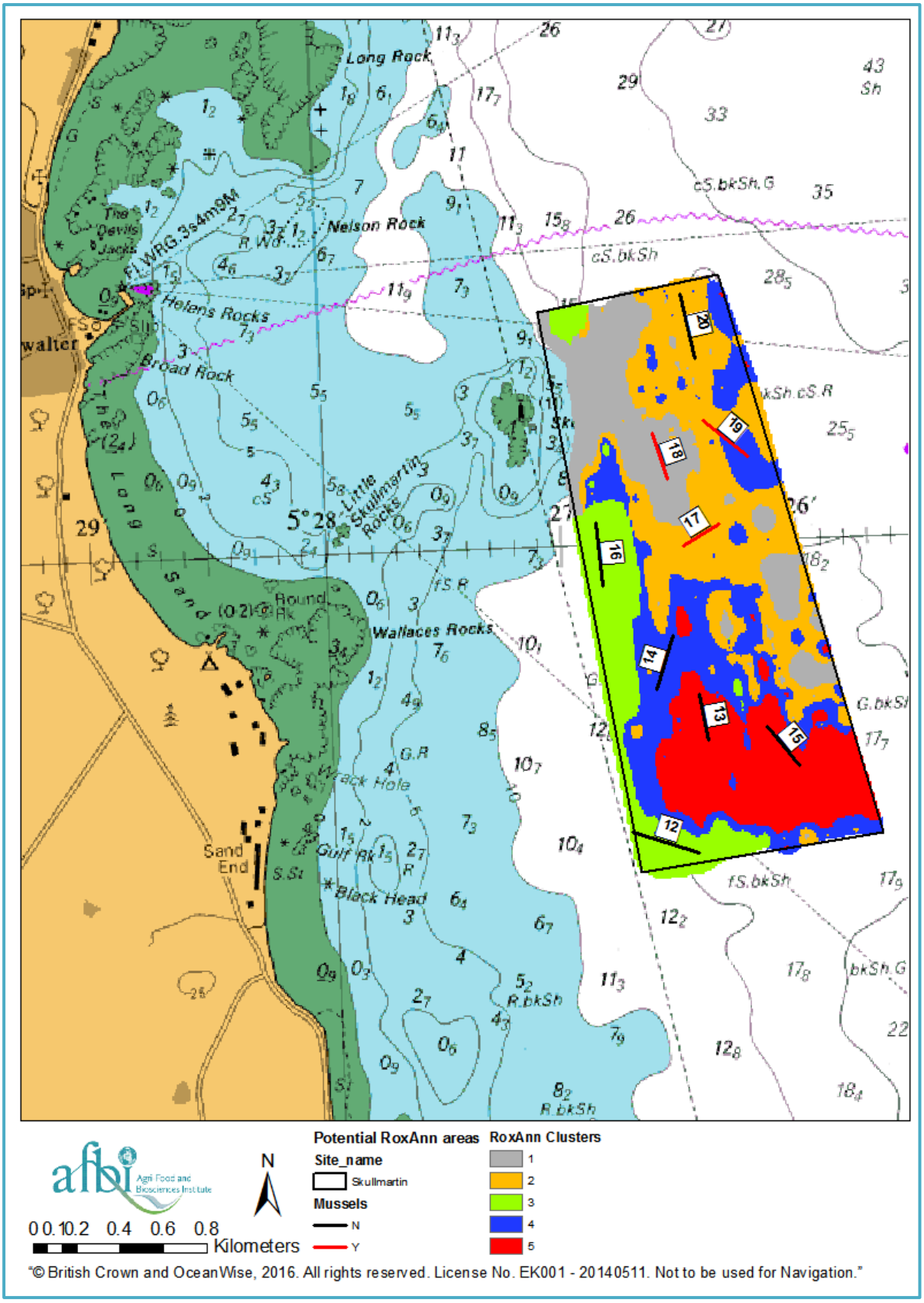


Figure 4: RoxAnn cluster map (from roughness and hardness values) from the February 2017 survey of Skullmartin overlaid with the dredge tows undertaken on the 24th of March 2017. Dredges within which mussels were found are coloured red.

Figure 5: Photographs showing the contents of the dredge tows which yielded mussels undertaken within the area of Skullmartin during the March 2017 seed mussel survey.

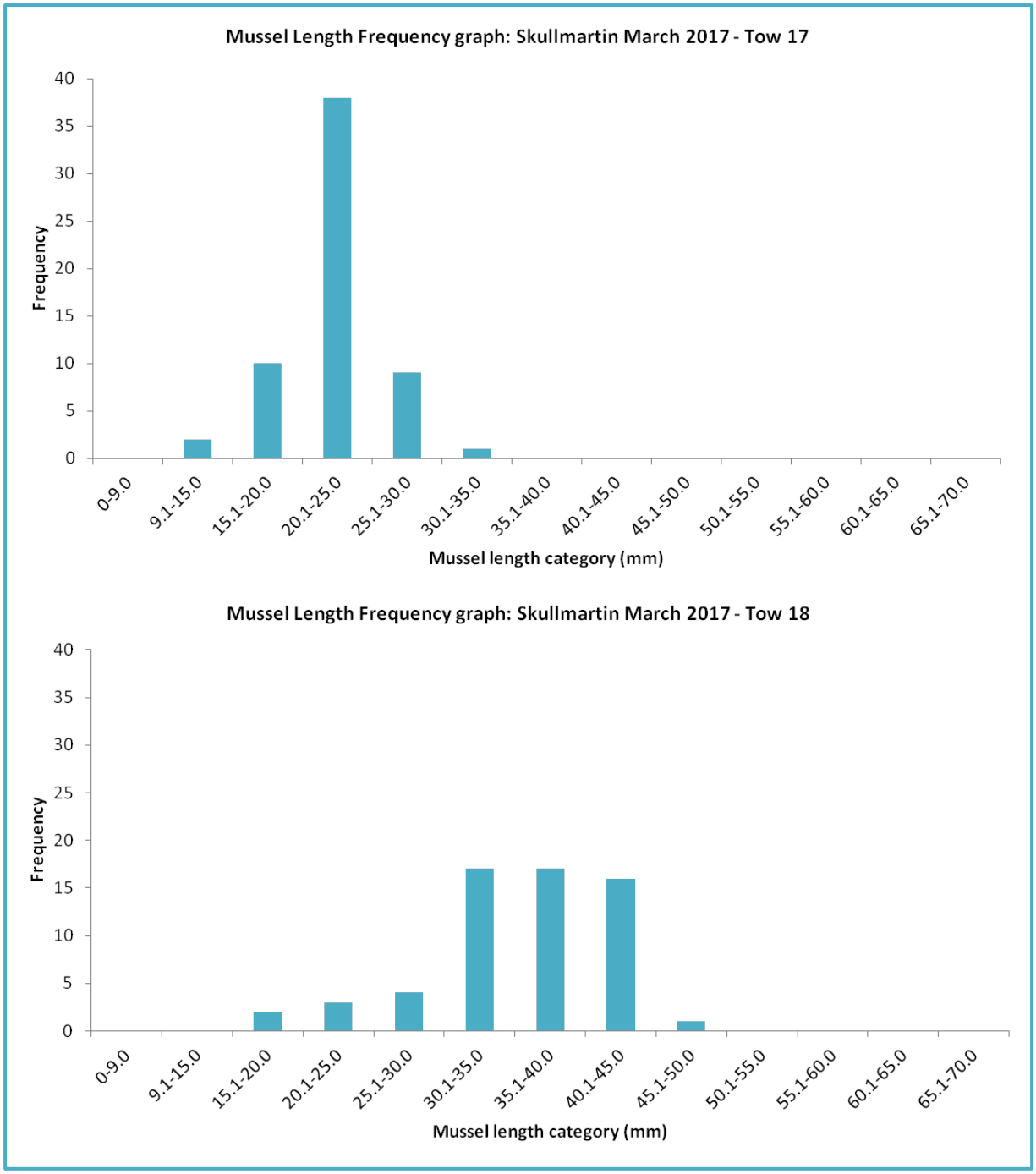


Figure 6: Length class distribution histograms for mussels found within dredge Tows undertaken within the area of Skullmartin during the March 2017 seed mussel survey.

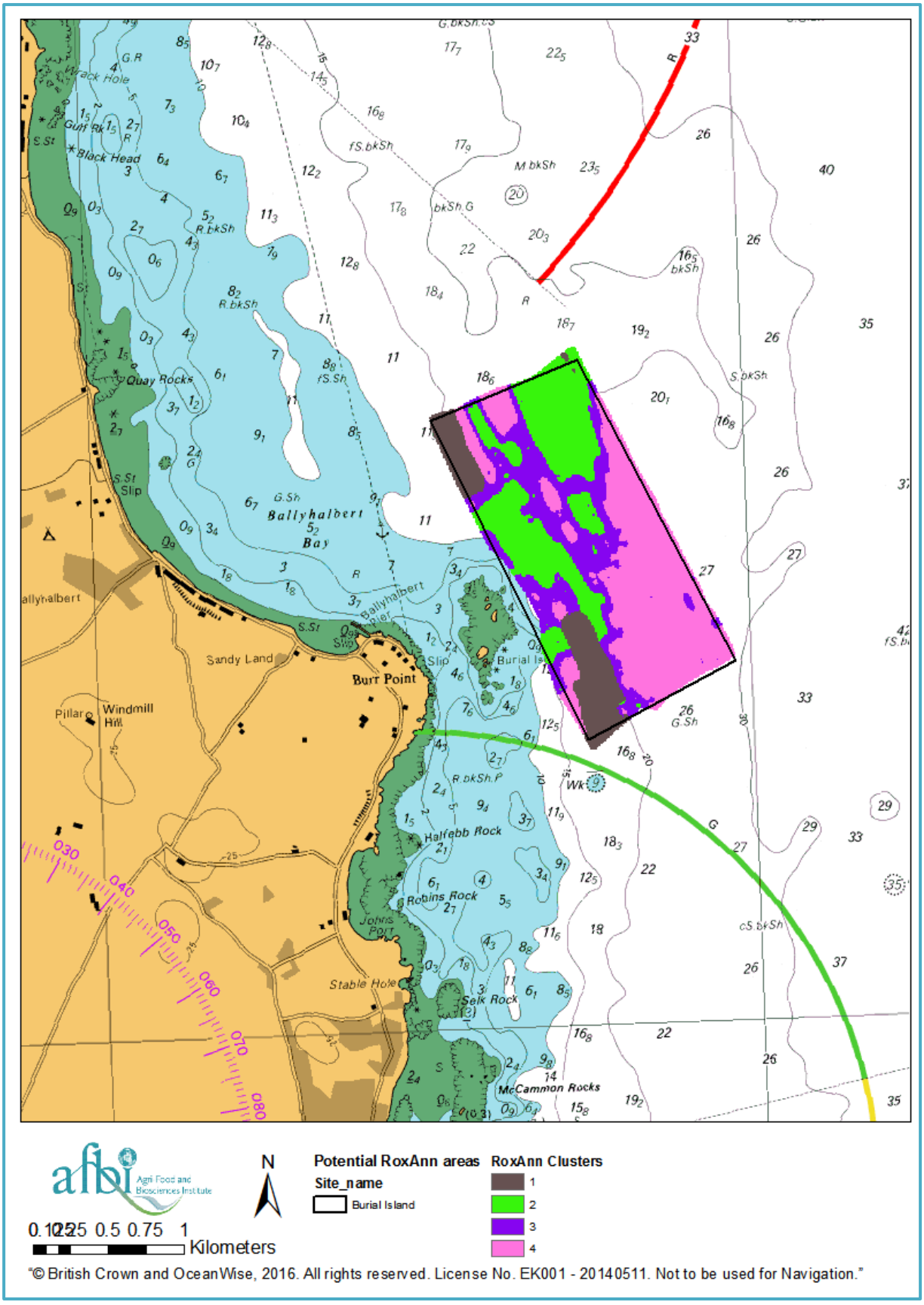


Figure 7: RoxAnn cluster map (from roughness and hardness values) from the February 2017 survey of Burial Island.

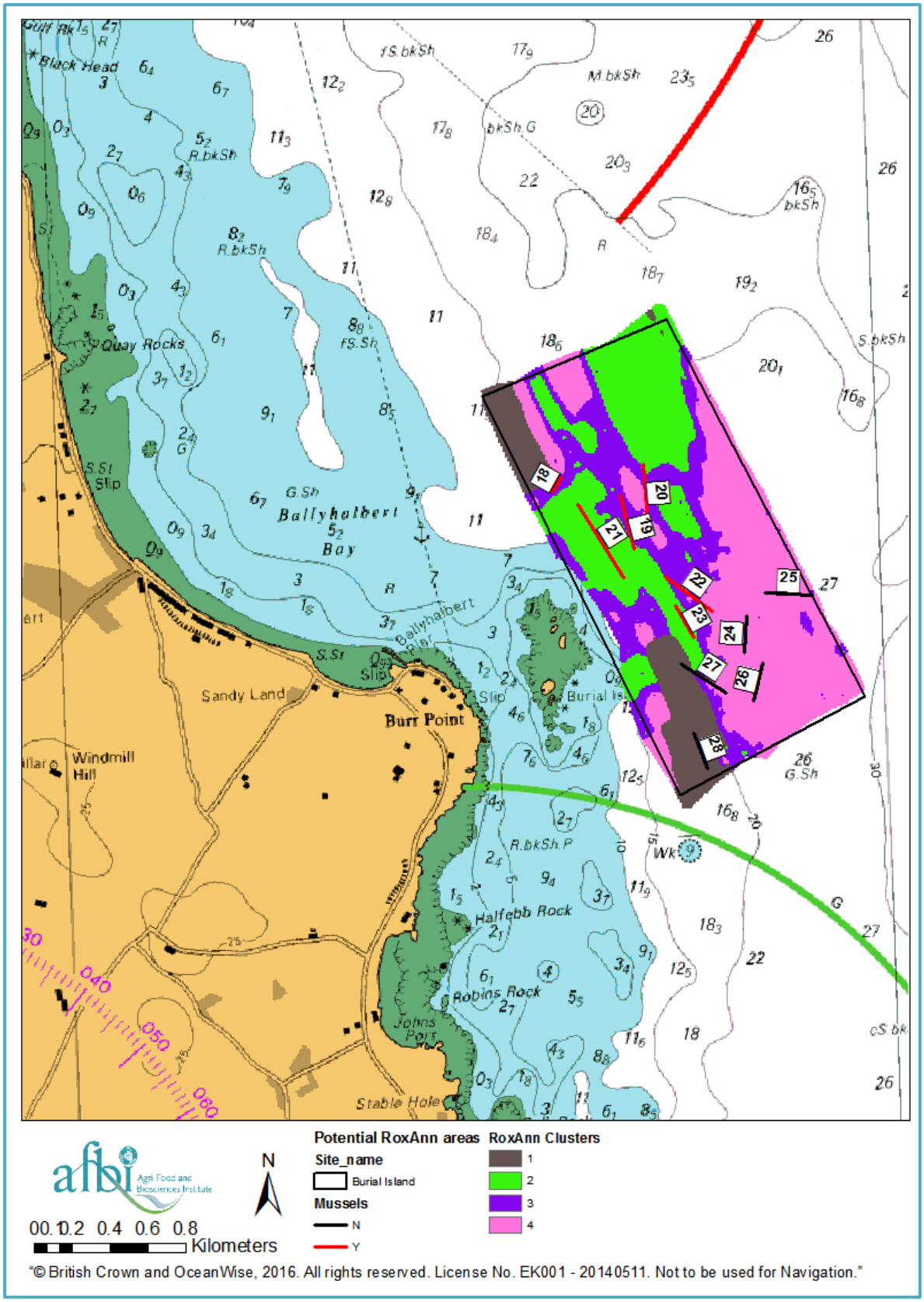


Figure 8: RoxAnn cluster map (from roughness and hardness values) from the February 2017 survey of Burial Island overlaid with the dredge tows undertaken on the 21st of February 2017. Dredges within which mussels were found are coloured red.

February 2017 seed mussel survey: Burial Island Tow 20 (photographed in the laboratory)

February 2017 seed mussel survey: Burial Island Tow 21 (photographed in the laboratory)

Figure 9: Photographs showing the contents of the dredge tows which yielded mussels undertaken within the area of Burial Island during the February 2017 seed mussel survey. Due to equipment failure on the day of survey only two out of the six dredge tows that yielded mussels are represented above.

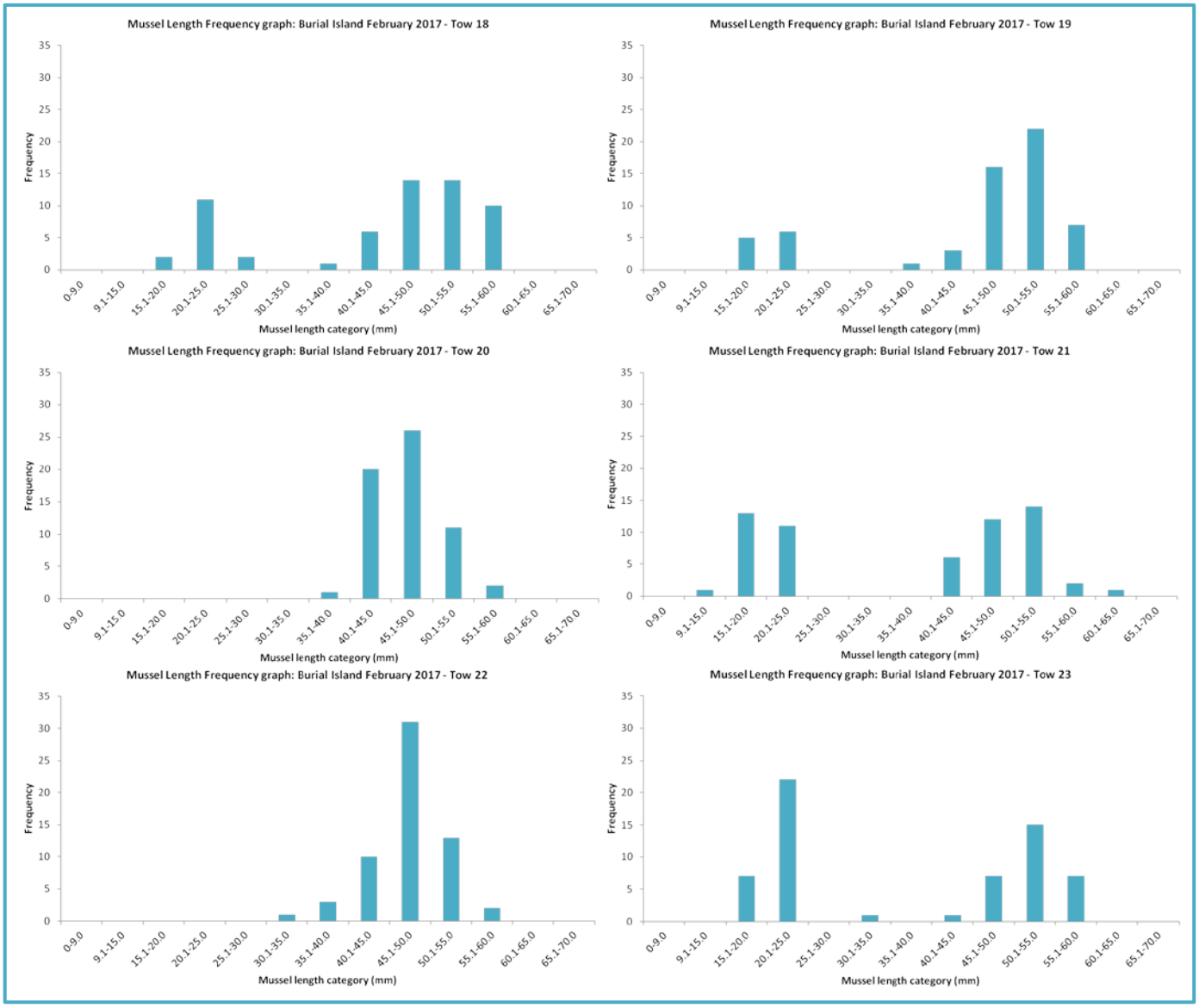


Figure 10: Length class distribution histograms for mussels found within dredge Tows undertaken within the area of Burial Island during the February 2017 seed mussel survey.

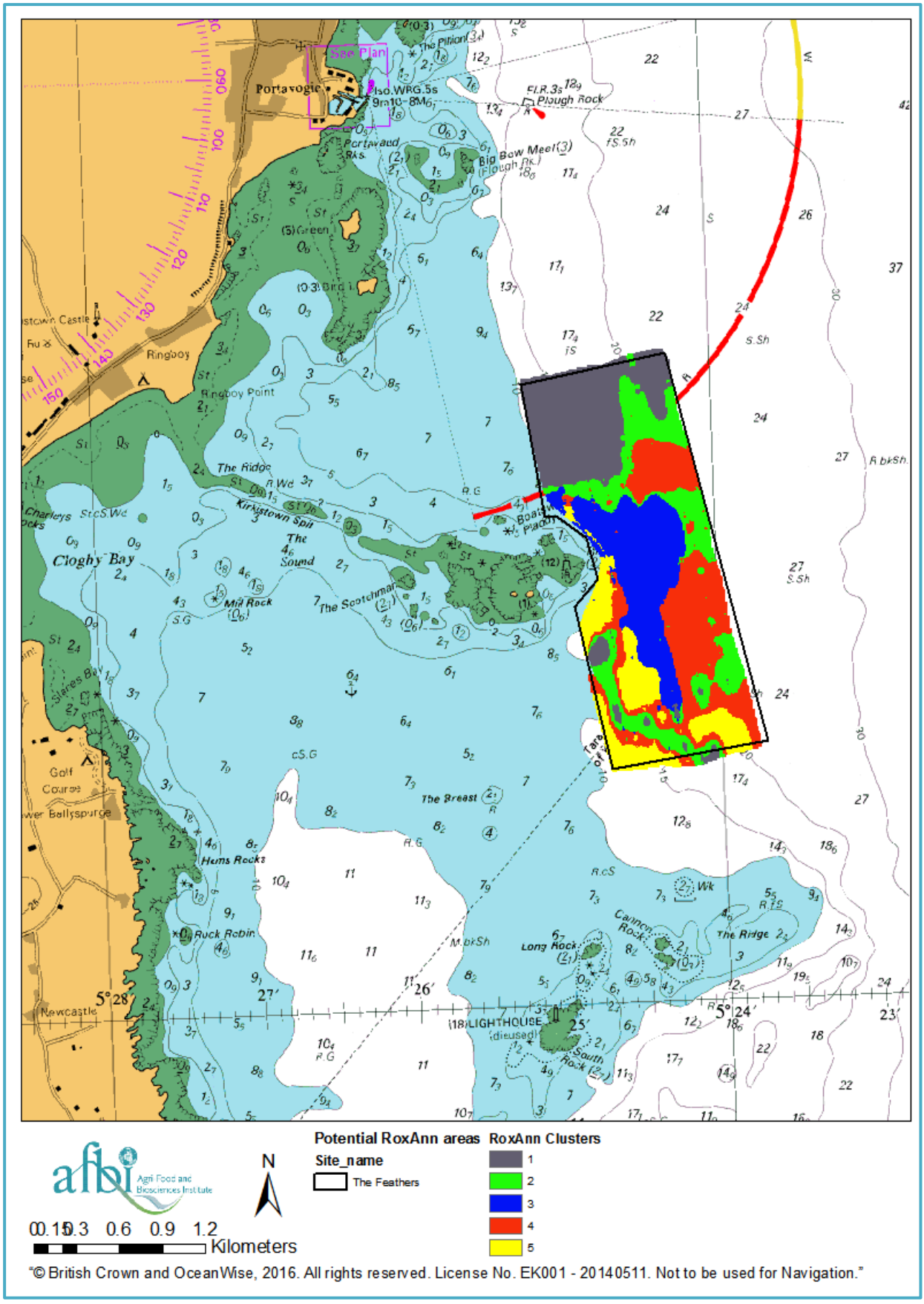


Figure 11: RoxAnn cluster map (from roughness and hardness values) from the February 2017 survey of The Feathers.

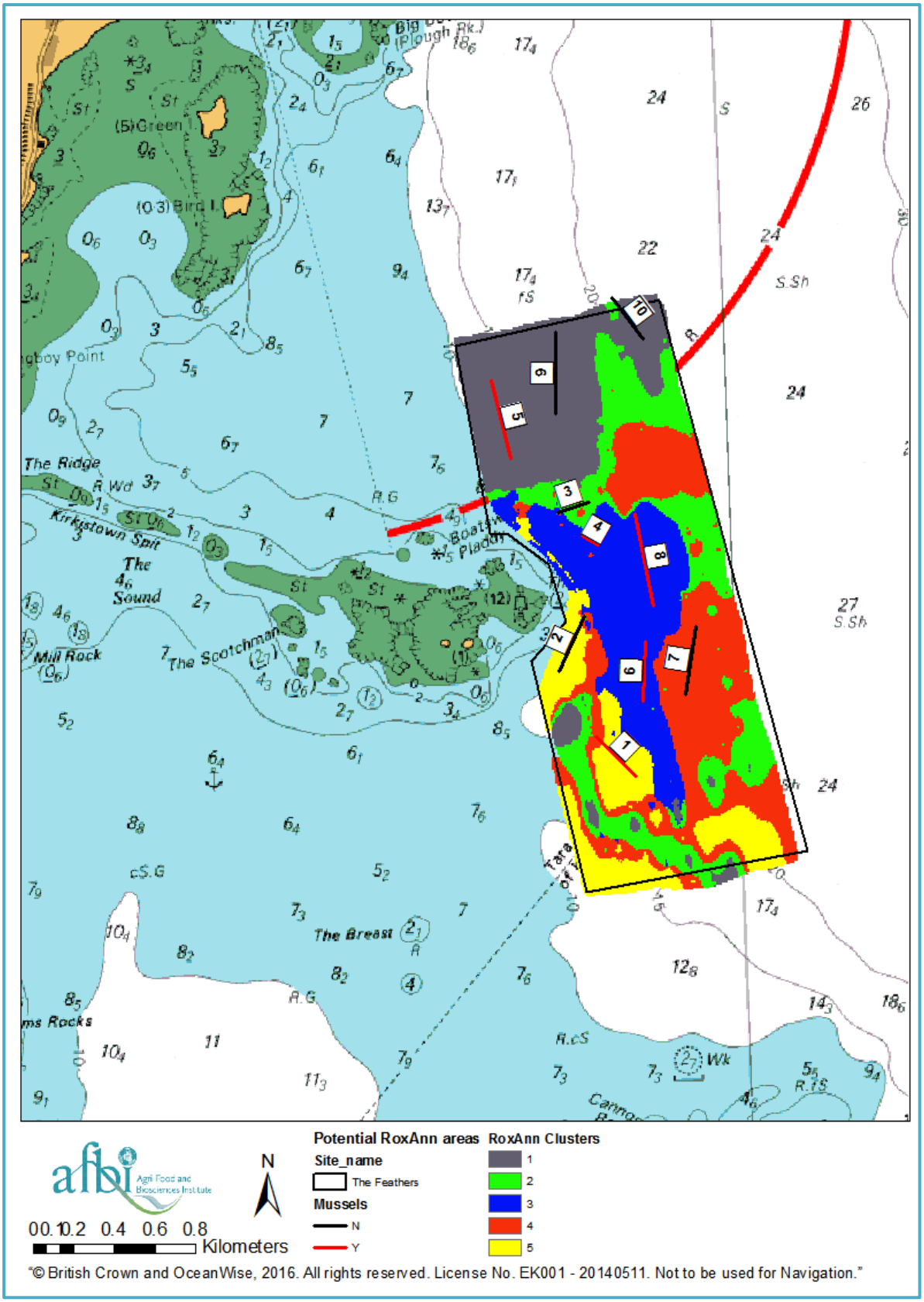


Figure 12: RoxAnn cluster map (from roughness and hardness values) from the February 2017 survey of The Feathers overlaid with the dredge tows undertaken on the 21st of February 2017. Dredges within which mussels were found are coloured red.

Figure 13a: Photographs showing the contents of the dredge tows which yielded mussels undertaken within the area of The Feathers during the February 2017 seed mussel survey.

Figure 13b: Photographs showing the contents of the dredge tows which yielded mussels undertaken within the area of The Feathers during the February 2017 seed mussel survey.

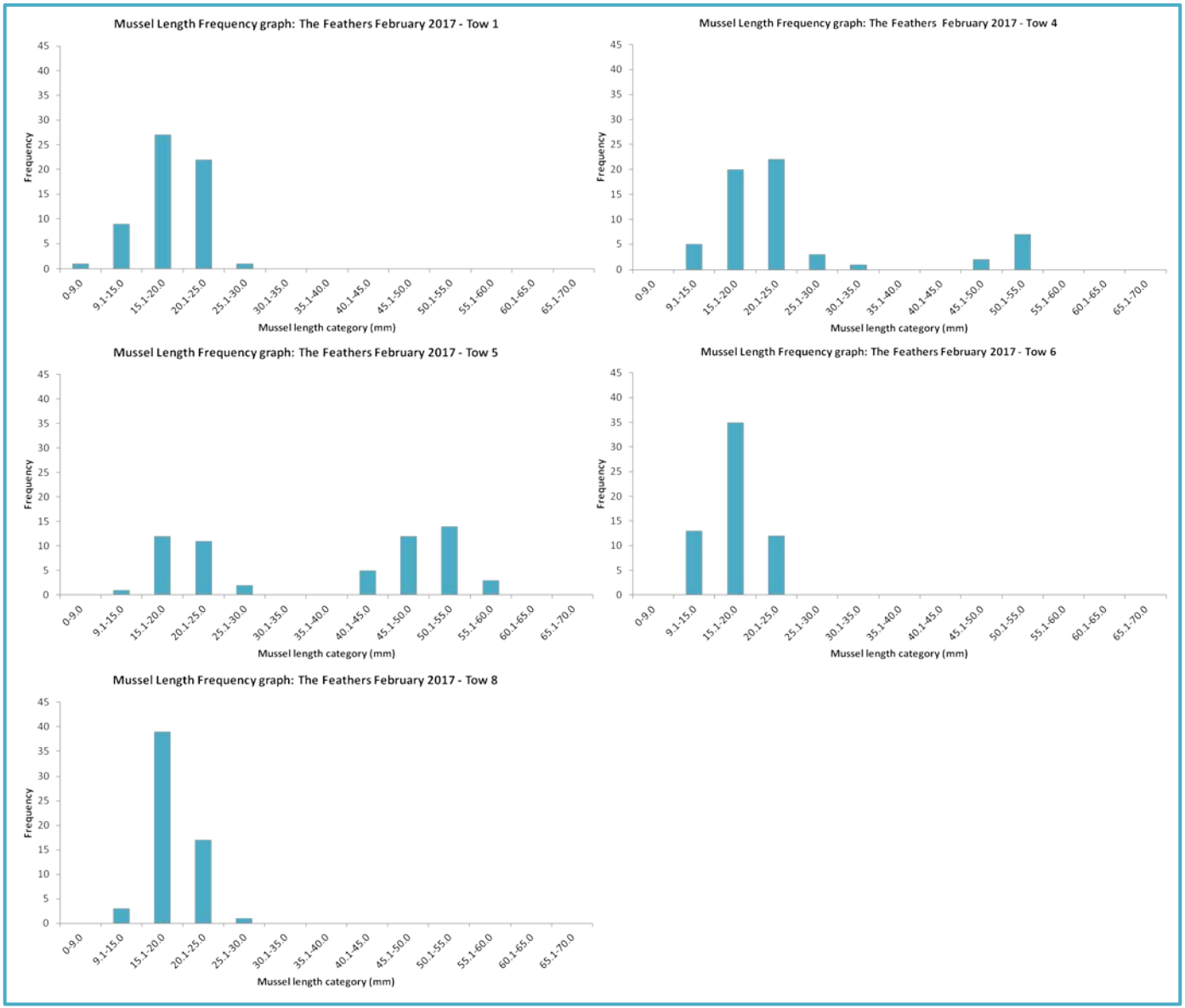


Figure 14: Length class distribution histograms for mussels found within dredge Tows undertaken within the area of The Feathers during the February 2017 seed mussel survey.

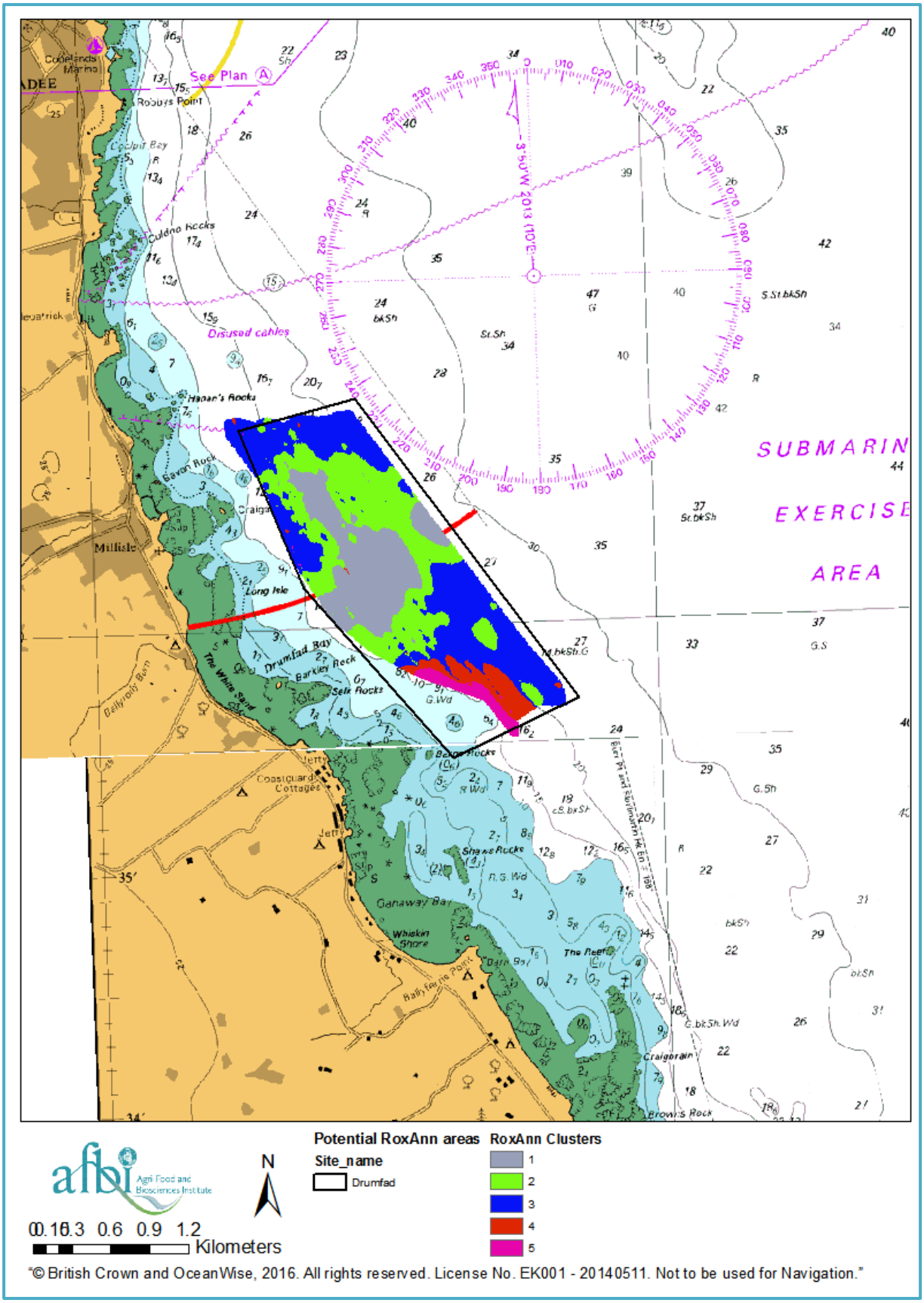


Figure 15: RoxAnn cluster map (from roughness and hardness values) from the February 2017 survey of the area identified for the purpose of this report as Drumfad.

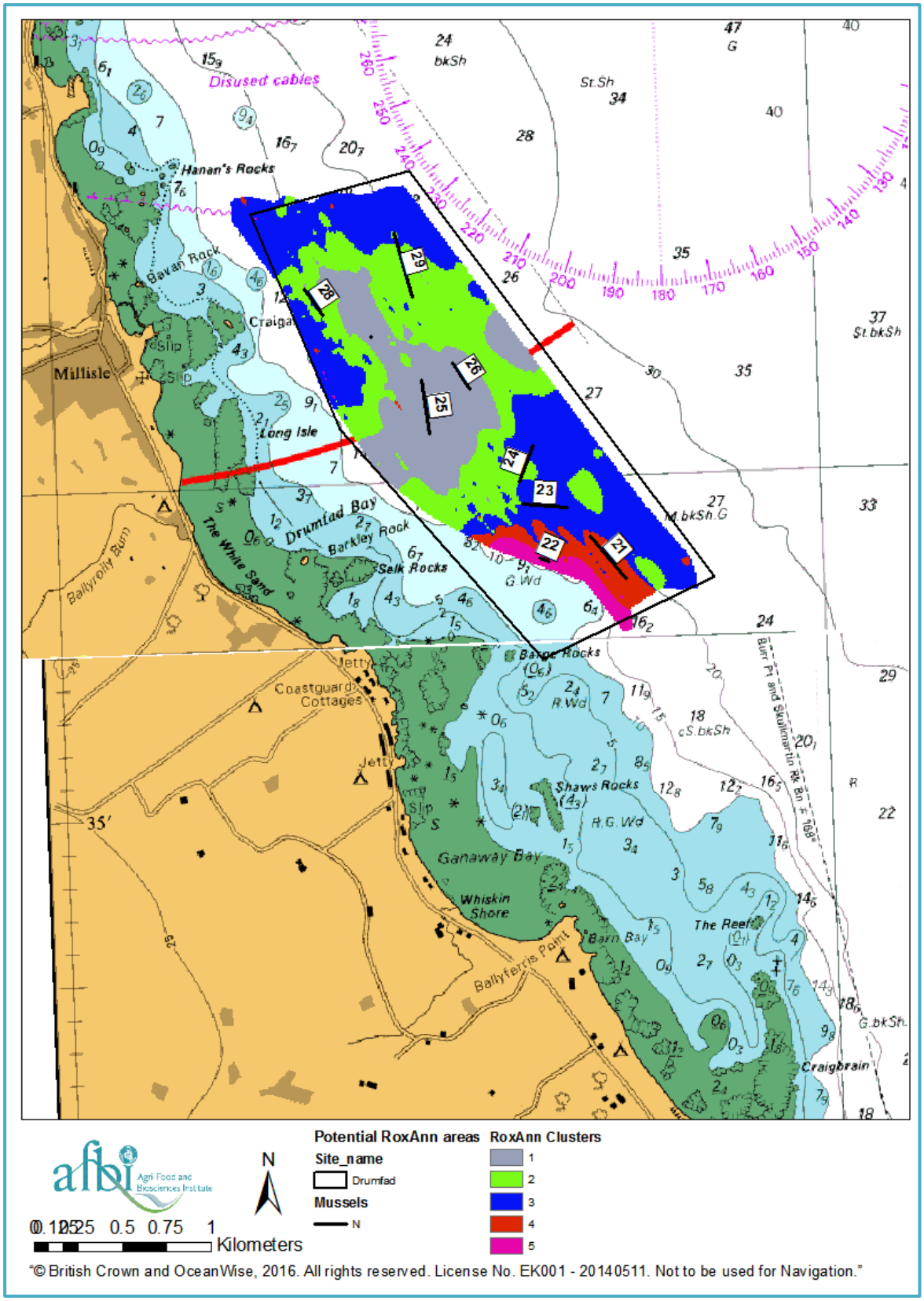


Figure 16: RoxAnn cluster map (from roughness and hardness values) from the February 2017 survey of the area identified for the purpose of this report as Drumfad overlaid with the dredge tows undertaken on the 24th of March 2017. Dredges within which mussels were found are coloured red.

Figure 17a: Photographs showing the contents of the dredge tows undertaken within the area identified for the purpose of this report as Drumfad during the March 2017 seed mussel survey.

Figure 17b: Photographs showing the contents of the dredge tows undertaken within the area identified for the purpose of this report as Drumfad during the March 2017 seed mussel survey.

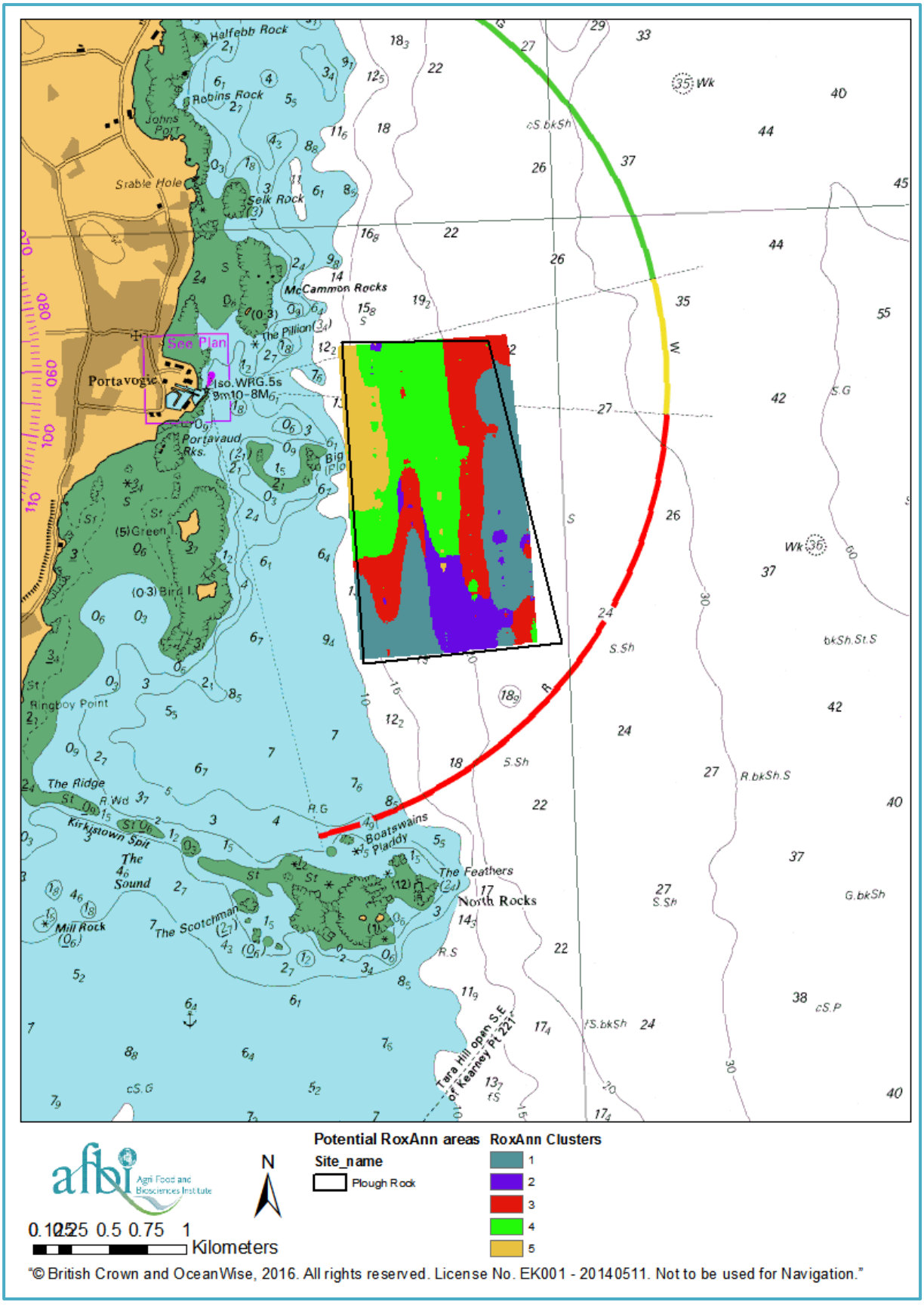


Figure 18: RoxAnn cluster map (from roughness and hardness values) from the February 2017 survey of the area identified for the purpose of this report as Plough Rock.

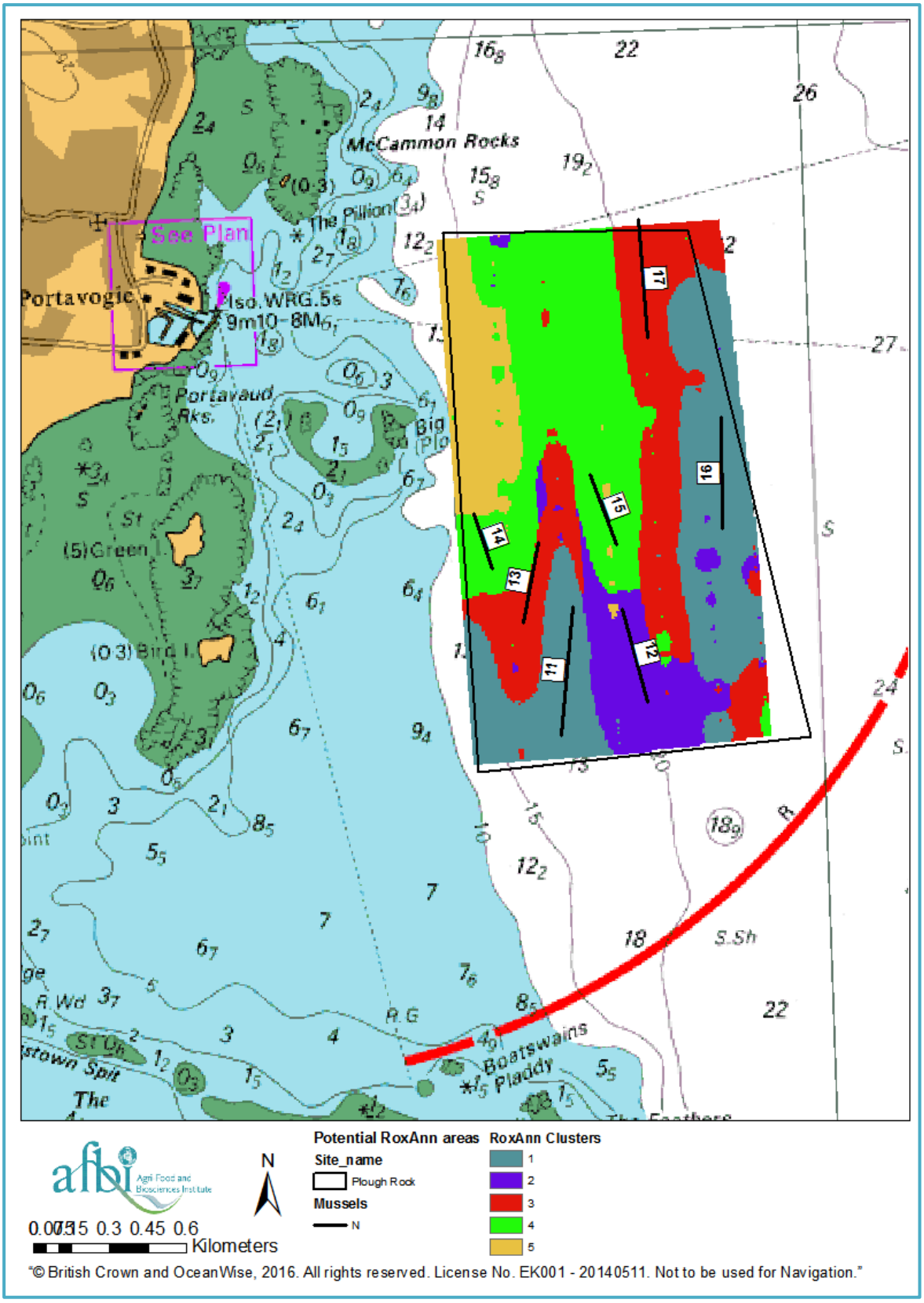
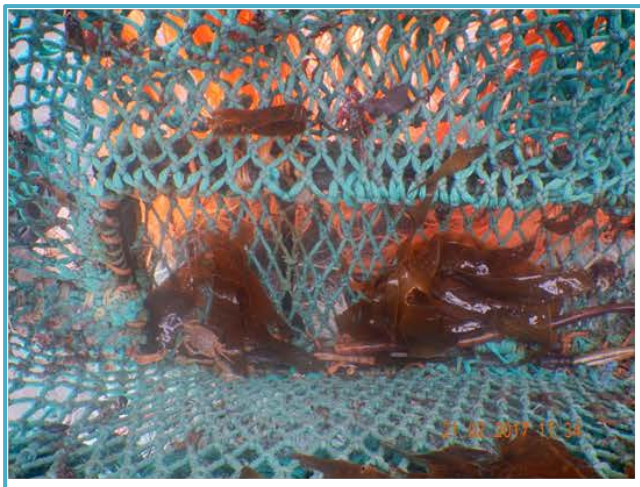


Figure 19: RoxAnn cluster map (from roughness and hardness values) from the February 2017 survey of the area identified for the purpose of this report as Plough Rock overlaid with the dredge tows undertaken on the 21st of February 2017. Dredges within which mussels were found are coloured red.



February 2017 seed mussel survey Plough Rock Tow 11

February 2017 seed mussel survey Plough Rock Tow 12

February 2017 seed mussel survey Plough Rock Tow 14

February 2017 seed mussel survey Plough Rock Tow 15

February 2017 seed mussel survey Plough Rock Tow 16

Figure 20: Photographs showing the contents of the dredge tows undertaken within the area identified for the purpose of this report as Plough rock during the February 2017 seed mussel survey. Due to equipment failure on the day of survey only five out of the seven dredge tows are represented above.

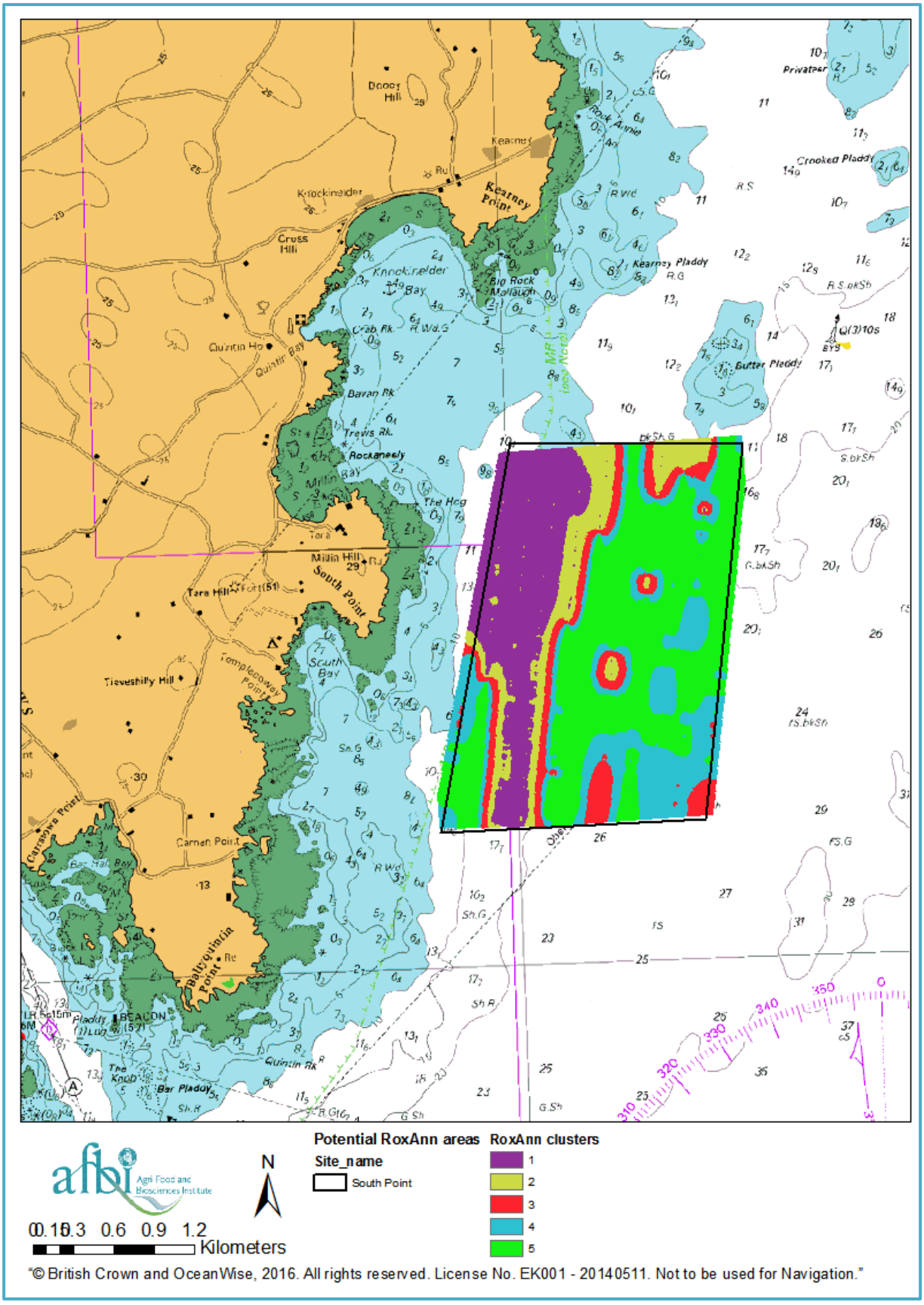


Figure 21: RoxAnn cluster map (from roughness and hardness values) from the February 2017 survey of the area identified for the purpose of this report as South Point.

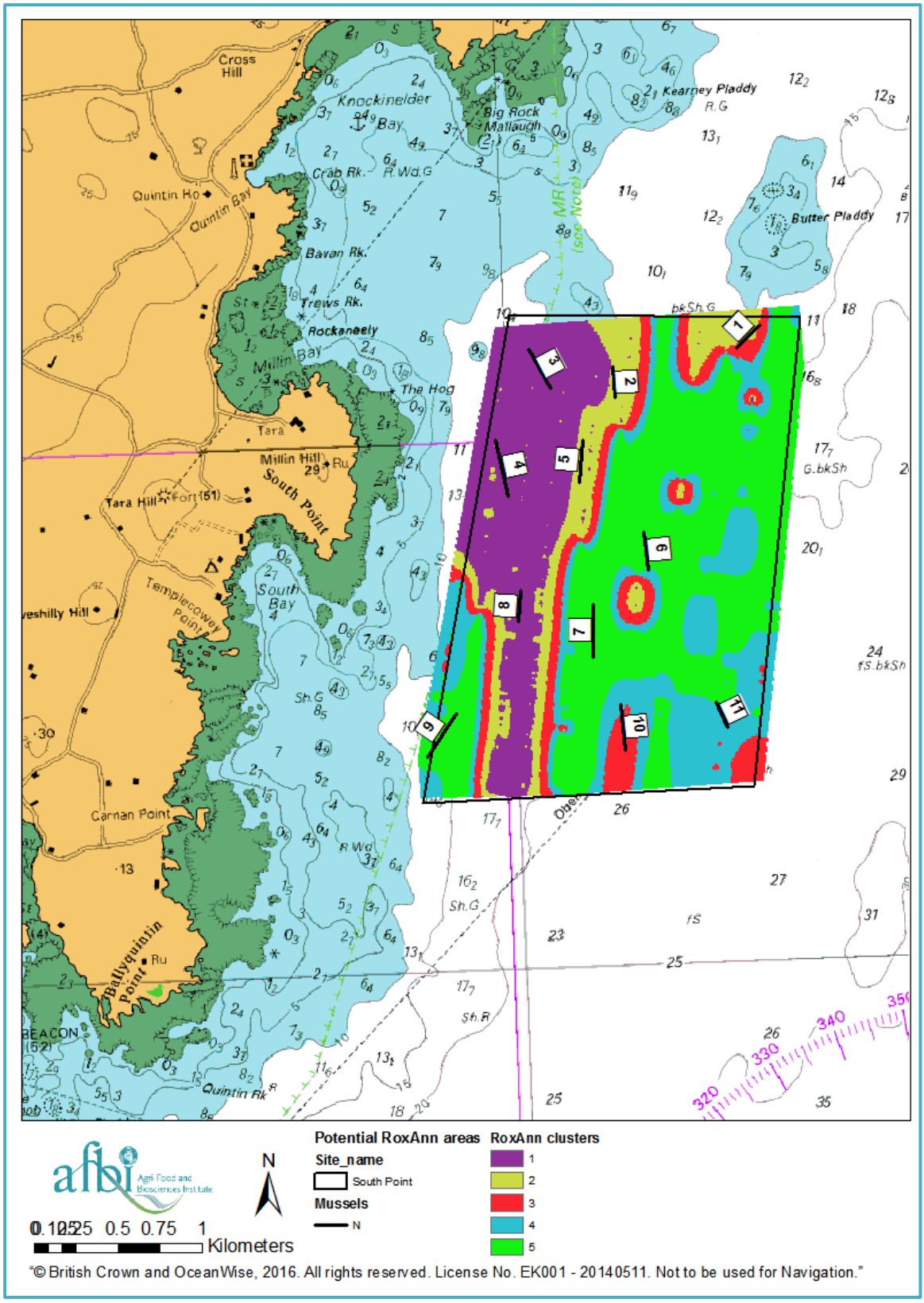


Figure 22: RoxAnn cluster map (from roughness and hardness values) from the February 2017 survey of the area identified for the purpose of this report as South Point overlaid with the dredge tows undertaken on the 24th of March 2017. Dredges within which mussels were found are coloured red.

Figure 23: Photographs showing the contents of the dredge tows undertaken within the area identified for the purpose of this report as South Point during the March 2017 seed mussel survey. Due to equipment failure on the day of survey only eight out of the eleven dredge tows are represented above.

Discussion

1. Previous seed bed sites

Skullmartin

The mussels found within this area appeared to be from two cohorts (Figure 6 and Table 3). The percentage waste by weight within the samples was high, with mussels representing less than 30% of the total sample weight (Table 2). We would therefore not recommend opening this area to fishing at this time.

We propose to undertake further acoustic, dredge and video surveys during June and July 2017 to monitor the development of the seed mussels within this area. At this time if a significant seed bed is discovered then an assessment of the tonnages within this area will undertaken and the bed boundaries defined.

Burial Island

The mussels found within this area also appeared to be from two cohorts, some small newly settled seed and some larger mussels from an earlier settlement (Figure 10 and Table 5). Due to the proximity of the historic seed bed within this area to an area identified as a *Modiolus modiolus* bed we would recommend undertaking more detailed surveys before this bed could be opened.

We propose to undertake further acoustic, dredge and video surveys during June and July 2017 to determine the boundaries of this bed and undertake an assessment of the tonnages within this area.

The Feathers

The majority of the mussels found within this area were small newly settled seed mussels (Figure 14 and Table 8). The percentage waste by weight was greater than 40% in all but one of the dredge Tows (Table 7). We would therefore not recommend opening this area to fishing at this time.

We propose to undertake further acoustic, dredge and video surveys during June and July 2017 to monitor the development of the seed mussels within this area, determine the boundaries of the bed and to provide an estimation of the tonnages of seed mussels within the area.

2. Potential new areas

Seed mussels were not found within any of the additional areas sampled during the Spring 2017 seed mussel surveys. The priority within the next sampling period will be the areas where seed mussels have been located. It is proposed that following the Autumn fishery further surveys will be undertaken to investigate other potential seed mussel settlement areas.