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Summer 2020 Seed Mussel Stock Assessment Report

July/August 2020

Document version control:

Version	Issue date	Modifier	Note	Issued to
1.0	02/09/2020	AB	First Draft	DAERA
1.1	10/09/2020	AB	Slight amendment after consultation	DAERA

Document title:	Outer Ards Seed Mussel Stock Assessment: July-August 2020
Status:	Version: V1.1
Date:	2020
Reference:	Seed/OA/01/20
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Executive summary

The Summer 2020 seed mussel survey was undertaken by the Agri-Food and Biosciences Institute (AFBI) within July and August 2020. Four areas were investigated at this time, namely Craigbrain, Skullmartin, Burial Island and The Feathers. Surveys undertaken within these areas included:

- RoxAnn acoustic surveys,
- Dredge surveys,
- Towed epibenthic video sledge surveys

This report details the methodologies used within these surveys and the subsequent results. The main findings are summarised below, and are discussed in detail within sections 1 – 4 of this report.

Introduction

The Summer 2020 seed mussel stock assessment survey was undertaken by AFBI on the 18th to the 20th and the 28th and 29th of July 2020 onboard the DAERA Fisheries Protection Vessel (FPV) Queen of Ulster and the 20th and 13th of August 2020 onboard the AFBI Research Vessel (RV) Corystes. The purpose of the Summer 2020 seed mussel stock assessment survey was to undertake acoustic, dredge and video surveys within the areas of Burial Island and The Feathers which had been fished in 2019, to monitor the development of the area of Skullmartin which was found to contain small quantities of seed mussel in 2017, 2018 and 2019, and also to investigate the historic seed bed at Craigbrain.

Results and Discussion

Following acoustic and ground truthing surveys (dredge and towed video) seed mussel beds were identified within the area of Burial Island (Figure 33) and the area of The Feathers (Figure 36). In order to determine the stock of seed mussels present within these areas, calculations as per Strong and Service (2011) were applied. From this it was determined that the Burial Island Seed Fishery Area, as shown within Figure 33, contains approximately **400** tonnes of seed mussel and The Feathers Seed Fishery Area, as shown within Figure 37 (and map 1 below), contains approximately **800** tonnes of seed mussel.

As can be seen from Figure 34, two out of the four dredge tows undertaken within the area of

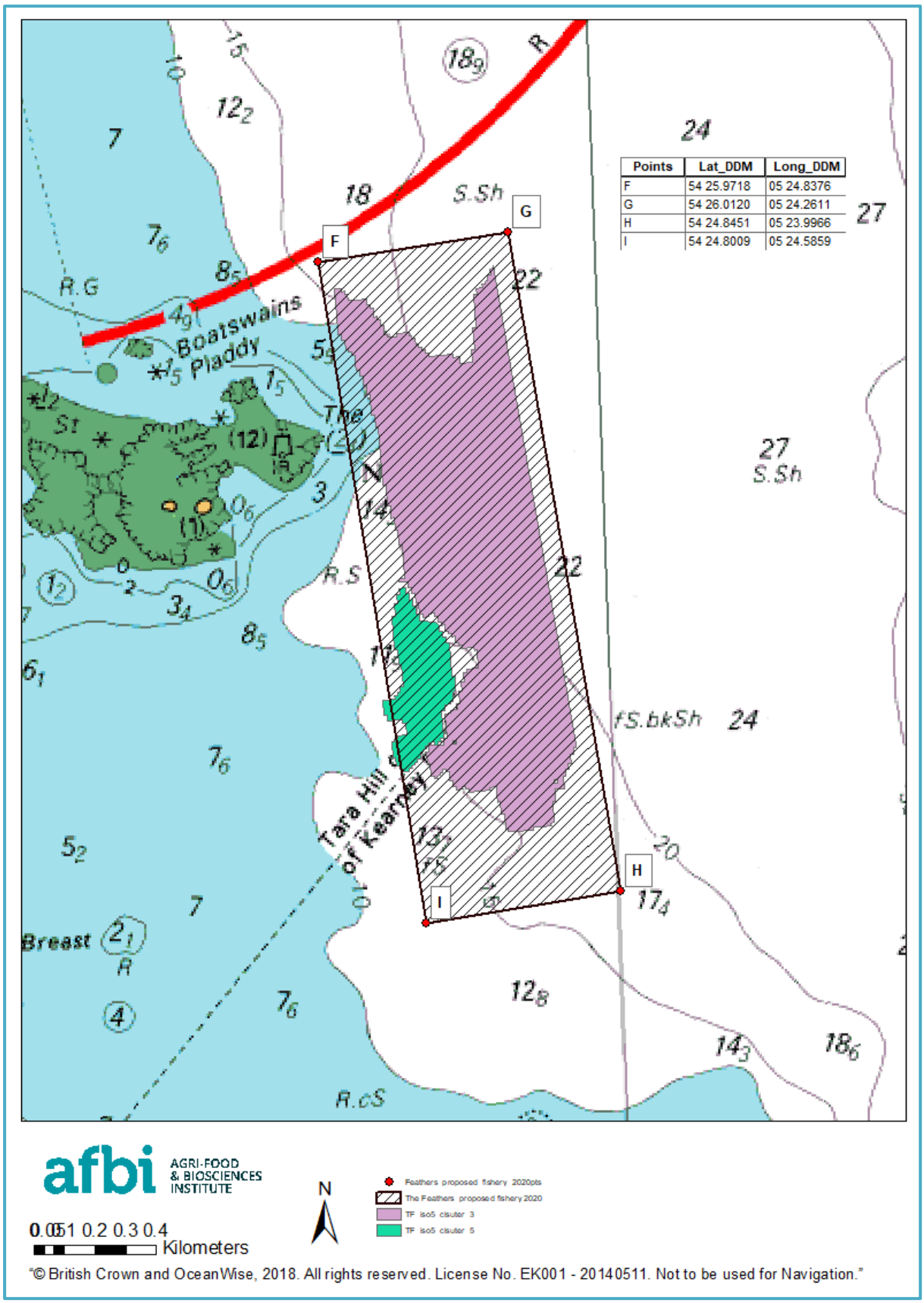
Burial Island that were found to contain mussels fell within the 80 m buffer which has been applied since the 2015 Seed mussel stock Assessments to allow protection of the adjacent Modiolus modiolus beds and one dredge was within 20m of this buffer. The calculations to estimate the tonnage of mussels within Burial Island therefore include the area within the buffer and will be an overestimation of what is present within the potential fishery box shown in Figure 33.

The actual tonnages present within the potential Fishery box shown within Figure 33 will be less than 400 tonnes.

It is therefore recommend that only the seed mussel bed within the area of The Feathers be opened to fishing on the next suitable tide.

It should be noted that the values stated above are <u>estimates</u>. These approximate tonnages come with the following caveats;

1. **The calculations as per Strong and Service (2011) utilise percentage waste which is based on the weight of the mussels subtracted from the total weight of the sample. If very small mussels are present within the beds the overall biomass of these mussels will be small in relation to the weight of the sample waste i.e. everything that wasn't mussels (predominately pebbles and cobbles). Therefore the waste on the beds may be an overestimation, which will in turn reduce the tonnage of mussels produced by the calculation**



Map 1: RoxAnn cluster map (from roughness and hardness values) from the AFBI July 2020 survey of The Feathers showing only those clusters within which mussels were found. The proposed fishery area is shown by the black hashed area on the map.

1. Introduction

The Summer 2020 seed mussel stock assessment survey was undertaken by the Agri-Food and Biosciences Institute (AFBI) on 18th to the 20th and the 28th and 29th of July 2020 onboard the DAERA Fisheries Protection Vessel (FPV) Queen of Ulster and the 20th and 13th of August 2020 onboard the AFBI Research Vessel (RV) Corystes. The current seed mussel stock assessment methodology has two stages. The first stage uses acoustic surveying and dredge tows to determine whether 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 Summer 2020 seed mussel stock assessment survey was to undertake acoustic, dredge and video surveys within the areas of Burial Island and The Feathers which had been fished in 2019, to monitor the development of the area of Skullmartin which was found to contain small quantities of seed mussel in 2017, 2018 and 2019, and also to investigate the historic seed bed at Craigbrain. The areas covered within the Summer 2020 survey are shown in Figure 1. The results of all of these surveys are detailed within the paragraphs below.

All care was taken to avoid the area of Burial Island previously identified as *Modiolus modiolus* habitat.

2. Materials and Methods

- *Survey methods*

RoxAnn acoustic ground discrimination system (AGDS) data were collected aboard the DAERA FPV Queen of Ulster from the 18th to the 20th of July 2020, using a 200 kHz transducer. Data were collected at a save rate of 1s. Track spacing was approximately 100 m for all four areas investigated.

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, 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 28th and 29th of July 2020, with three 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.

Towed Video Survey

The video survey was undertaken onboard the AFBI RV Corystes on the 13th of August 2020. Camera footage of the seabed was collected with a towed epibenthic video sledge equipped with an Tritech Image Scaling System video camera (image scaling not active), coupled with halogen lights and four point lasers for scaling (5 cm between paired lasers; 70 cm between outside lasers) (Figure 3). The video sledge was operated in accordance with AFBI SOP MARISM043 and was towed at a speed of approximately 0.8-1.1 knots. The camera provides a large and stable field of view which (under perfect conditions) can display a clear and unambiguous picture of the seabed for the assessment of seed mussel presence. All of the footage has been interpreted following NMBAQC Guidelines (Turner *et al* 2016) by experienced AFBI staff members who have undertaken video surveys of the seed mussel beds within previous years.

- *Laboratory Analysis*

Samples collected during the dredge and grab 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)

3. Results

Craigbrain

The processed RoxAnn cluster map for Craigbrain is shown in Figure 4. As can be seen from Figure 4, five distinct clusters were identified for this area. The dredge survey was then planned to provide representative sampling of all five of these clusters (Figure 5).

Six dredge tows were undertaken on the 29th of July 2020 within the area of the historic Craigbrain seed mussel bed (Figure 6). No seed mussel was found within any of these tows (Table 1).

Skullmartin

The processed RoxAnn cluster map for Skullmartin is shown in Figure 7. As can be seen from Figure 7, five distinct clusters were identified for this area. The dredge survey was then planned to provide representative sampling of all five of these clusters (Figure 8).

Thirteen dredge tows were undertaken on the 29th of July 2020 within the area of Skullmartin known to have previously yielded seed mussels (Figure 9). Mussels (accounting for greater than 10% of dredge contents) were found within five of these tows (Figures 9, 10 and 11, and Tables 1, 2 and 3).

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. The size class distributions for mussels within the dredge Tows are shown within Figure 11.

The video survey for this area was planned based on the findings of the RoxAnn, and dredge surveys. Figure 12 shows the location of the two video tows undertaken within the area of Skullmartin. Figure 13 shows the percentage mussel coverage identified along these tows. Percentage cover of blue mussels (*M. edulis*) was determined as per Turner *et al* (2016) (shown in Figure 14).

Burial Island

The processed RoxAnn cluster map for Burial Island 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 (Figure 16).

Twelve dredge tows were undertaken on the 28th of July 2020 within the area of Burial Island known to have previously yielded seed mussels (Figure 17). Mussels (accounting for greater than 10% of dredge contents) were found within four of these tows (Figures 17, 18 and 19 and Tables 1, 4 and 5).

The summary results from the mussel sample processing for the dredge tows undertaken within the area of Burial Island are shown in Tables 4 and 5. The size class distributions for mussels within the dredge Tows are shown within Figure 19.

The video survey for this area was planned based on the findings of the RoxAnn, and dredge surveys. Figure 20 shows the location of the video tows undertaken within the area of Burial Island. Figure 21 shows the percentage mussel coverage identified along these tows. Percentage cover of blue mussels (*M. edulis*) was determined as per Turner *et al* (2016) (shown in Figure 14).

The Feathers

The processed RoxAnn cluster map for The Feathers is shown in Figure 22. As can be seen from Figure 22, five distinct clusters were identified for this area. The dredge survey was then planned to provide representative sampling of all five of these clusters (Figure 23).

Sixteen dredge tows were undertaken on the 28th of July 2020 within the area of The Feathers known to have previously yielded seed mussels (Figure 24). Mussels (accounting for greater than 10% of dredge contents) were found within four of these tows (Figures 24, 25 and 26 and Tables 1, 6 and 7).

The summary results from the mussel sample processing for the dredge tows undertaken within the area of The Feathers are shown in Tables 6 and 7. The size class distributions for mussels within the dredge Tows are shown within Figure 26.

The video survey for this area was planned based on the findings of the RoxAnn, and dredge surveys. Figure 27 shows the location of the video tows undertaken within the area of The Feathers. Figure 28 shows percentage coverage of mussels identified along this tow. Percentage cover of blue mussels (*M. edulis*) was determined as per Turner *et al* (2016) (shown in Figure 14).

4. Discussion

Craigbrain

No seed musssels were found within this site. **AFBI would therefore recommend that further exploratory surveys are conducted within this area in Spring/Summer 2021 to look for new settlement.**

Skullmartin

Following acoustic and ground truthing surveys (dredge and towed video) undertaken between July and August 2020 an area of seed mussels was identified within the area of Skullmartin (Figure 29). A proportion of the areas identified as Cluster 2, 3 and 4 were found to correspond to seed mussels (Figure 30).

From the Towed video footage it could be seen that coverage of mussels within this area was very sporadic and this was substantiated by the dredge survey results as the percentage waste within the majority of samples was high.

As this is a sign of the reestablishment of this once large seed mussel bed (in 2006 approximately 3,900 tonnes of mussels were harvested from Skullmartin (McQuaid *et al* 2007)) we would not recommend opening this bed at this time. We propose to undertake further acoustic, dredge and video surveys during 2021 to monitor the development of the seed mussel bed within this area.

Burial Island

Following acoustic and ground truthing surveys (dredge and towed video) undertaken between July and August 2020 an area of seed mussels was identified within the area of Burial Island (Figure 31). A proportion of the areas identified as Cluster 3 and 4 were found to correspond to seed mussels (Figure 32). In order to determine the stock of seed mussels present within the Burial Island area, the following calculations, as per Strong and Service (2011) were applied:

Stock Assessment Calculations

1) Tow length was calculated from start and stop positions.
2) Tow area was calculated from dredge mouth width x tow length.
3) Dredge percentage 'fill' was assessed in situ – this was converted to a weight based on the volume held within a full dredge.

4) The mussel biomass (as determined from samples processed in the laboratory) is multiplied by the dredge fill. This mussel dredge biomass is then divided by the tow area (to give a biomass per m^2) and multiplied by the acoustic area (classified mussel strata) to give a tonnage.
5) As step 4 uses biomass from highly cleaned and sorted mussels, a site waste value has been included to better represent the actual weights likely to be recovered by industry.

All tonnages were adjusted according to published dredge efficiency values (Dolmer *et al.*, 1999).

It has been well document from previous surveys that the outer portion of Cluster 3 does not contain blue mussels but the horse mussel *Modiolus modiolus*. Mussel tonnages were calculated for the area of Clusters 3 and 4 determined to contain mussels and a mussel Fishery box was assigned to this region (Figure 33).

It should be noted that the seaward edge of the Fishery area has been constrained by an 80 m buffer applied since the 2015 Seed mussel stock Assessments to allow protection of the adjacent *M. modiolus* beds. As can be seen from Figure 34 two out of the four dredge tows undertaken on the 28th of July that contained mussels fell within this buffer area and one was within 20m of the buffer. The calculations to estimate the tonnage of mussels within Burial Island therefore include the area within the buffer and will be an overestimation of what is present within the potential fishery box shown in Figure 33.

Based on the information collected during the Summer 2020 (July and August) surveys (utilising the calculations, as per Strong and Service, 2011) we have approximated that The Burial Island Seed Fishery Area, as shown within Figure 33, contains approximately 400 tonnes of seed mussel. However it should be noted that this estimate includes the area of Clusters 3 and 4 excluded from the potential fishery box. The actual tonnages present within the fishery box shown within Figure 33 will be less than 400 tonnes.

The Feathers

Following acoustic and ground truthing surveys (dredge and towed video) undertaken between July and August 2020 an area of seed mussels was identified within the area of The Feathers (Figure 35). A proportion of the areas identified as Cluster 3 and 5 were found to correspond to seed mussels (Figure 36). **It is believed that Cluster 3 contains the more dense areas**

of seed mussel. In order to determine the stock of seed mussels present within The Feathers area, the calculations outlined above, as per Strong and Service (2011), were applied. All tonnages were adjusted according to published dredge efficiency values (Dolmer *et al.*, 1999). Mussel tonnages were calculated for the area of Clusters 3 and 5 determined to contain mussels and a mussel Fishery box was assigned to this region (Figure 37).

Based on the information collected during the Summer 2020 (July and August) surveys (utilising the calculations, as per Strong and Service, 2011) we have approximated that The Feathers Seed Fishery Area, as shown within Figure 37, contains approximately 800 tonnes of seed mussel and would therefore recommend that this area be opened to fishing on the next suitable tide.

It should be noted that the values stated above are estimates. These approximate tonnages come with the following caveats;

1. **The calculations as per Strong and Service (2011) utilise percentage waste which is based on the weight of the mussels subtracted from the total weight of the sample. If very small mussels are present within the beds the overall biomass of these mussels will be small in relation to the weight of the sample waste i.e. everything that wasn't mussels (predominately pebbles and cobbles). Therefore the waste on the beds may be an overestimation, which will in turn reduce the tonnage of mussels produced by the calculation.**

Tables

Table 1: Dredge information from the 28th and 29th of July 2020 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 9: Craigbrain, Figure 9: Skullmartin, Figure 17: Burial Island and Figure 24: The Feathers).

Tow_No	Date	Location	Depth start	Depth end	Tow Length (m)	Est % fill	Mussel >10%	Sample description
1	28/07/2020	The Feathers	15	18.3	304.9	<5%	N	empty apart from a few pieces of kelp and stones
2	28/07/2020	The Feathers	11.9	15	311.9	<5%	N	Kelp and small cobbles
3	28/07/2020	The Feathers	15.6	16.4	249.6	<10%	N	Shell gravel and starfish
4	28/07/2020	The Feathers	10.5	9.1	276.9	<5%	N	Kelp, small cobbles and shell gravel
5	28/07/2020	The Feathers	14.7	15.1	278.8	80-90%	Y	Mussel, shell gravel and mud
6	28/07/2020	The Feathers	16.6	17.3	374.9	40%	Y	Mussels with Kelp
7	28/07/2020	The Feathers	23	23.6	355.1	<5%	N	S.Latissima and crabs
8	28/07/2020	The Feathers	22.2	22.4	328.3	<10%	N	Dead shell, Kelp and sm
9	28/07/2020	The Feathers	24	24.8	339.8	5%	N	Kelp, shell gravel and cobbles
10	28/07/2020	The Feathers	18.5	22.4	270.1	50-60%	Y	Mussels and shell gravel
11	28/07/2020	The Feathers	22.6	25.9	308.7	5-10%	N	Dead shell and shell gravel
12	28/07/2020	The Feathers	17.2	15.2	356.5	70%	Y	Mussels and shell gravel
13	28/07/2020	The Feathers	19.8	21.7	409.5	<5%	N	Dead shells and kelp
14	28/07/2020	The Feathers	25	26.4	400.0	<10%	N	Cobbles and dead shell
15	28/07/2020	The Feathers	17.8	18.5	317.1	5%	N	Kelp and cobbles
16	28/07/2020	The Feathers	21.3	23.2	380.0	<5%	N	empty apart from a few pieces of kelp
17	28/07/2020	Burial Island	19.9	20.2	394.4	<5%	N	Urchins and cobbles
18	28/07/2020	Burial Island	14.43	14.47	338.7	30%	N	Cobbles, pebbles and shell gravel
19	28/07/2020	Burial Island	20.6	21.4	415.2	80%	Y	Mussel and shell gravel
20	28/07/2020	Burial Island	20.3	19.3	396.4	10%	N	Stones and shell gravel
21	28/07/2020	Burial Island	13.4	14.4	356.6	<5%	N	Shell gravel and sand
22	28/07/2020	Burial Island	20.4	21.6	328.1	50%	Y	Mussels
23	28/07/2020	Burial Island	22.3	23.4	349.0	80-90%	Y	Mussels and brittle stars
24	28/07/2020	Burial Island	24	24.7	317.2	80-90%	Y	Mussels and brittle stars

Tow_No	Date	Location	Depth start	Depth end	Tow Length (m)	Est % fill	Mussel >10%	Sample description
25	28/07/2020	Burial Island	19.7	20.7	320.0	<5%	N	Dredge almost empty
26	28/07/2020	Burial Island	25.1	24.8	301.3	30%	N	shell gravel and dead modiouls shell
27	28/07/2020	Burial Island	25.3	17.9	278.1	30%	N	Shell gravel and dead shells
28	28/07/2020	Burial Island	21.2	20.9	322.9	10-20%	N	Dead shells and shell gravel
29	28/07/2020	Burial Island	17.6	19	152.8	<5%	N	Flustra
30	28/07/2020	Burial Island	24.2	25.7	306.0	50%	N	shell gravel and dead shell with coarse sand
31	28/07/2020	Burial Island	19.4	23.4	351.0	<5%	N	Kelp and dead shell
32	29/07/2020	Skullmartin	19.6	18	286.4	10%	N	shell gravel and coarse sand
33	29/07/2020	Skullmartin	20.4	19.3	319.6	20%	N	Shell gravel, dead shell and coarse sand
34	29/07/2020	Skullmartin	18.5	19.3	345.6	60%	N	gravel, shell gravel and dead sheels
35	29/07/2020	Skullmartin	20	19.3	364.1	10%	Y	shell gravel and mussels
36	29/07/2020	Skullmartin	20.8	23.3	356.4	NA	NA	Dredge door open
37	29/07/2020	Skullmartin	22.2	23.4	401.9	40%	Y	mussels and some shell debris
38	29/07/2020	Skullmartin	18.9	17.8	292.6	30%	N	shell gravel, dead shells
39	29/07/2020	Skullmartin	23	23.5	302.6	90%	Y	mussel, shell gravel and coarse sand
40	29/07/2020	Skullmartin	24.5	24.8	350.0	10%	N	large cobbles some adult mussel
41	29/07/2020	Skullmartin	23.1	26.6	323.1	15%	Y	mussel
42	29/07/2020	Skullmartin	25.1	27.6	351.2	60%	Y	cobbles mussel and shell gravel
43	29/07/2020	Skullmartin	28.2	31.2	389.2	50%	N	Shell gravel, cobbles, gravel
44	29/07/2020	Skullmartin	16.4	18.7	356.6	<5%	N	shell gravel
45	29/07/2020	Craigbrain	22.2	21.6	287.8	40%	N	cobbles and shell gravel
46	29/07/2020	Craigbrain	19.6	19.2	298.9	40%	N	cobbles and shell gravel
47	29/07/2020	Craigbrain	21.3	21.1	251.9	60%	N	coarse sand/gravel
48	29/07/2020	Craigbrain	22.7	20.6	283.4		N	cobbles and coarse sand/gravel
49	29/07/2020	Craigbrain	24.4	23.3	248.5	60%	N	brittle stars and modiolus shells
50	29/07/2020	Craigbrain	23	21.7	289.9	25%	N	cobbles and shell gravel

Table 2: Mussel sample processing summary data: Skullmartin 29th July 2020 dredge survey

Tow No.	Total sample weight (kg)	Shellfish weight (kg)	% Waste	Pieces per kilo
Tow 35	7.20	0.73	89.83	596
Tow 37	8.06	5.45	32.33	164
Tow 39	11.57	4.66	59.72	108
Tow 41	7.75	3.28	57.63	179
Tow 42	13.18	3.47	73.65	178

Table 3: Mussel length measurement summary data: Skullmartin 29th July 2020 dredge survey

Tow No.	Mussel length measurements (mm)				
	Median	**Mean**	**SD**	**min**	**max**
Tow 35	17.33	22.78	11.15	10.27	42.79
Tow 37	43.71	43.46	4.45	33.06	53.62
Tow 39	50.40	50.85	4.23	41.91	58.93
Tow 41	44.35	44.11	4.86	33.21	57.95
Tow 42	43.20	43.15	4.09	31.96	51.64

SD= Standard Deviation from the mean

Table 4: Mussel sample processing summary data: Burial Island 28th July 2020 dredge survey

Tow no.	Total sample weight (kg)	Shellfish weight (kg)	% Waste	Pieces per kilo
Tow 19	12.62	3.99	68.41	211
Tow 22	10.90	3.12	71.37	421
Tow 23	9.34	3.32	64.41	91
Tow 24	14.12	2.90	79.48	206

Table 5: Mussel length measurement summary data: Burial Island 28th July 2020 dredge survey

Tow No.	Mussel length measurements (mm)				
	Median	**Mean**	**SD**	**min**	**max**
Tow 19	43.05	42.04	6.62	11.70	51.87
Tow 22	21.24	31.31	17.17	10.11	58.95
Tow 23	54.45	50.65	14.78	10.52	69.84
Tow 24	38.50	37.13	22.10	12.16	69.74

SD= Standard Deviation from the mean

Table 6: Mussel sample processing summary data: The Feathers 28th July 2020 dredge survey

Tow no.	Total sample weight (kg)	Shellfish weight (kg)	% Waste	Pieces per kilo
Tow 5	17.73	6.14	65.39	198.04
Tow 6	8.77	3.71	57.65	301.72
Tow 10	9.75	2.85	70.73	1504.20
Tow 12	14.51	5.77	60.21	654.31

Table 7: Mussel length measurement summary data: The Feathers 28th July 2020 dredge survey

Tow No.	Mussel length measurements (mm)				
	Median	**Mean**	**SD**	**min**	**max**
Tow 5	41.77	41.85	8.58	11.95	55.31
Tow 6	39.39	36.54	11.61	11.97	53.71
Tow 10	18.02	19.56	8.43	11.15	46.34
Tow 12	19.36	23.12	10.78	12.84	54.46

SD= Standard Deviation from the mean

Figures

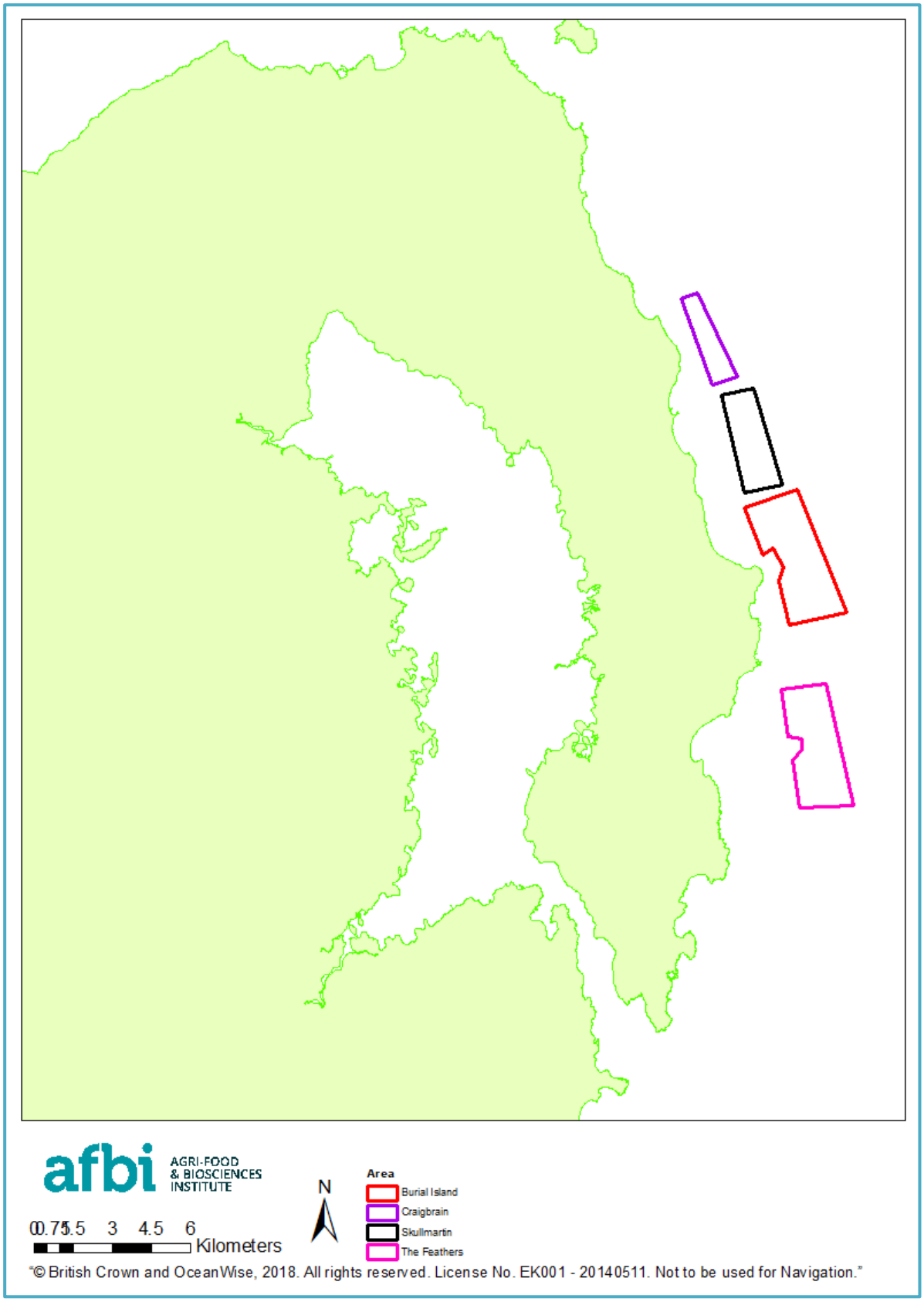


Figure 1: Locations of areas surveyed during the summer 2020 seed mussel survey.

Figure 2: Photograph showing the dredge used during the Summer 2020 survey.

Figure 3: Photographs showing the AFBI camera sledge used during the Summer 2020 surveys.

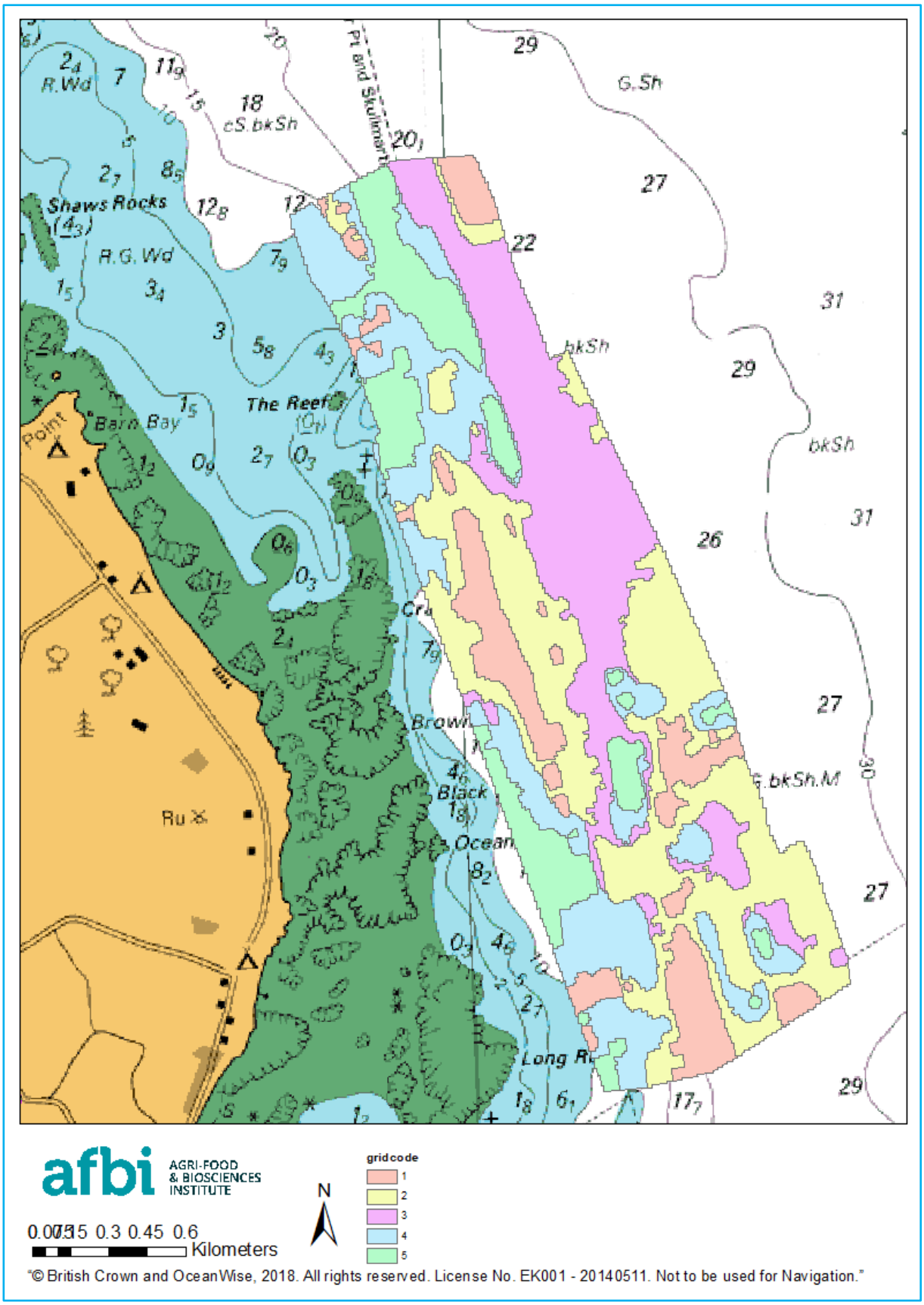


Figure 4: RoxAnn cluster map (from roughness and hardness values) from the July 2020 survey of Craigbrain.

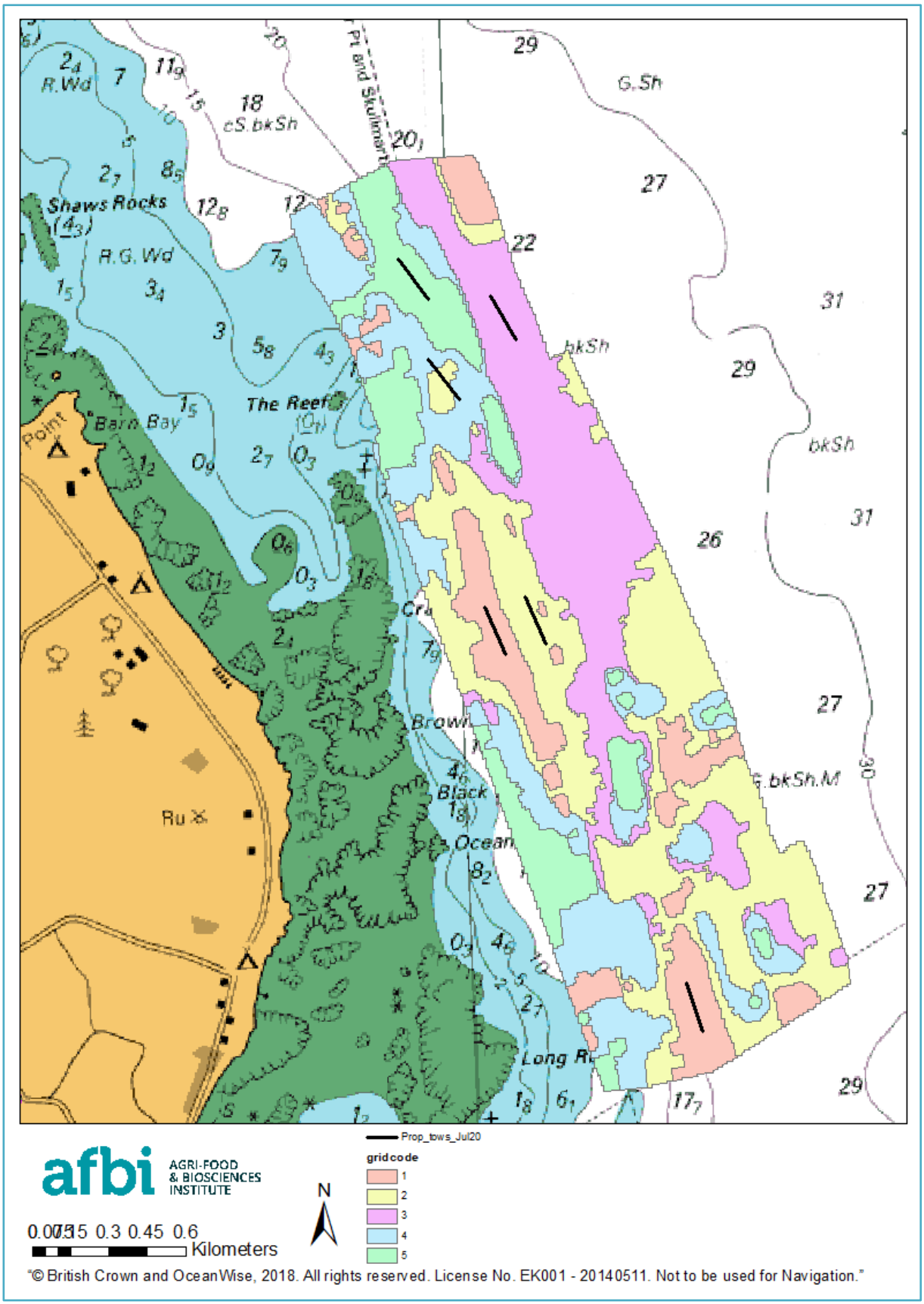


Figure 5: RoxAnn cluster map (from roughness and hardness values) from the July 2020 survey of Craigbrain overlaid with the proposed dredge tows.

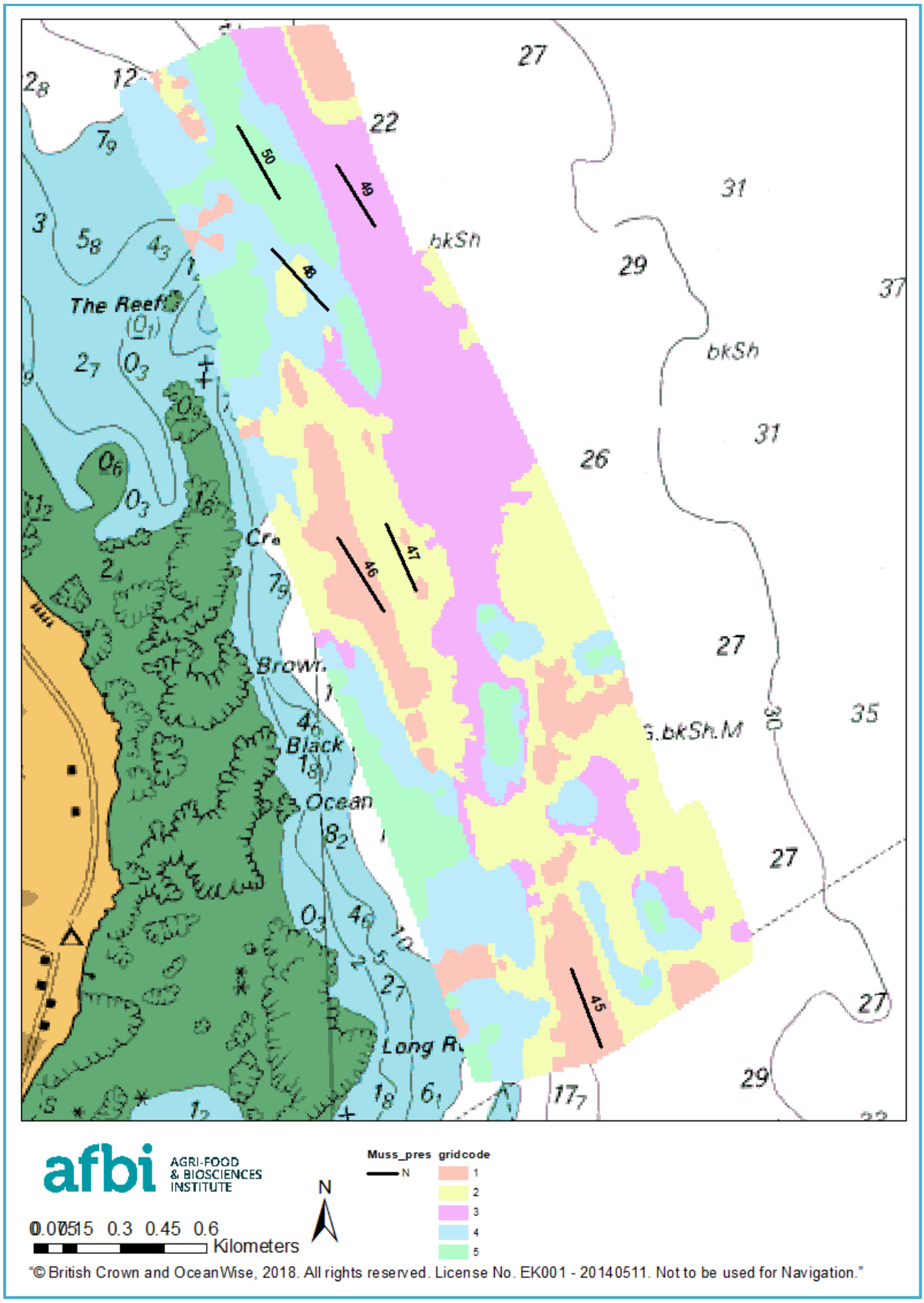


Figure 6: RoxAnn cluster map (from roughness and hardness values) from the July 2020 survey of Craigbrain overlaid with the dredge tows undertaken on the 29th of July 2020. Dredges within which mussels were found are coloured red.

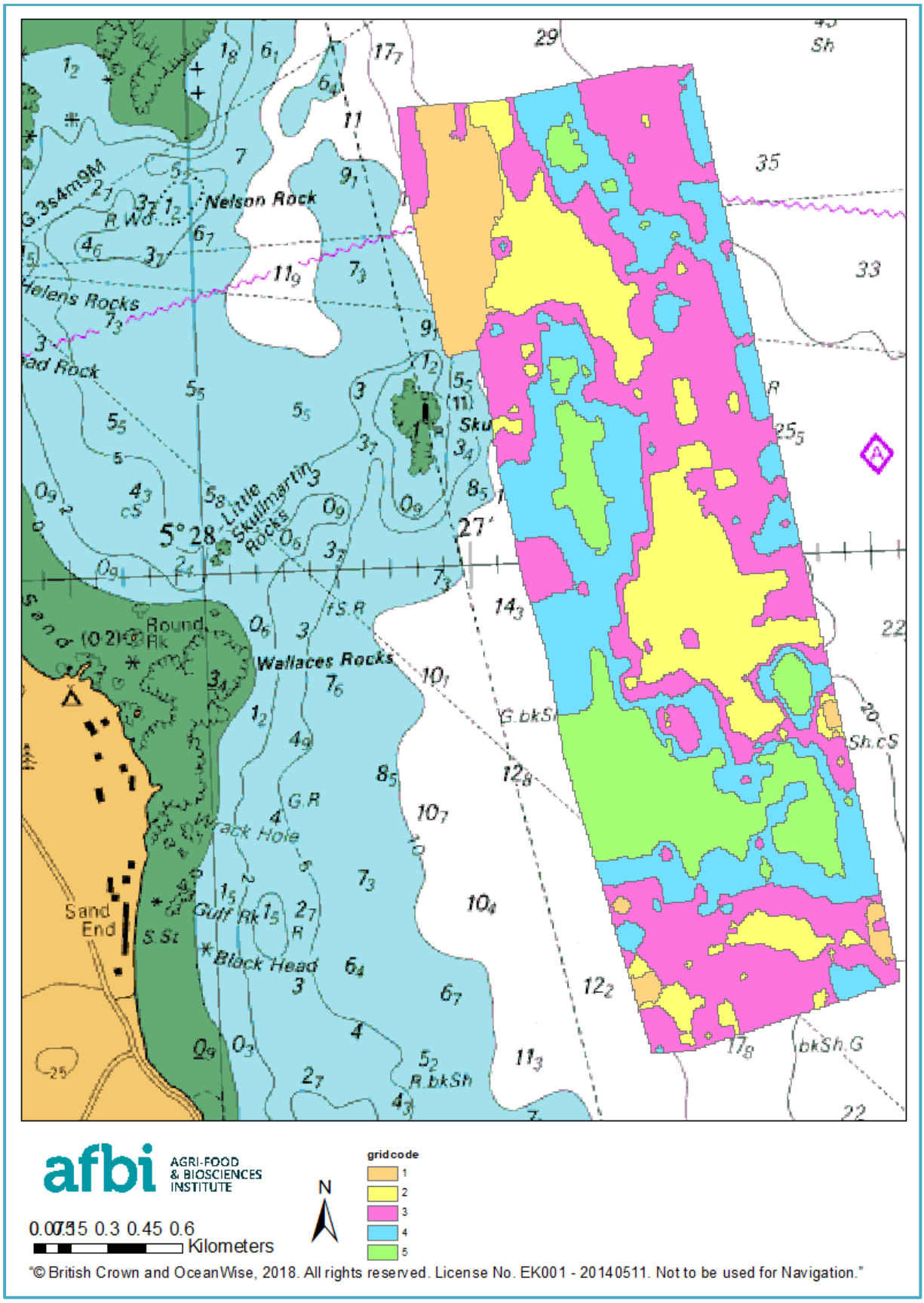


Figure 7: RoxAnn cluster map (from roughness and hardness values) from the July 2020 survey of Skullmartin.

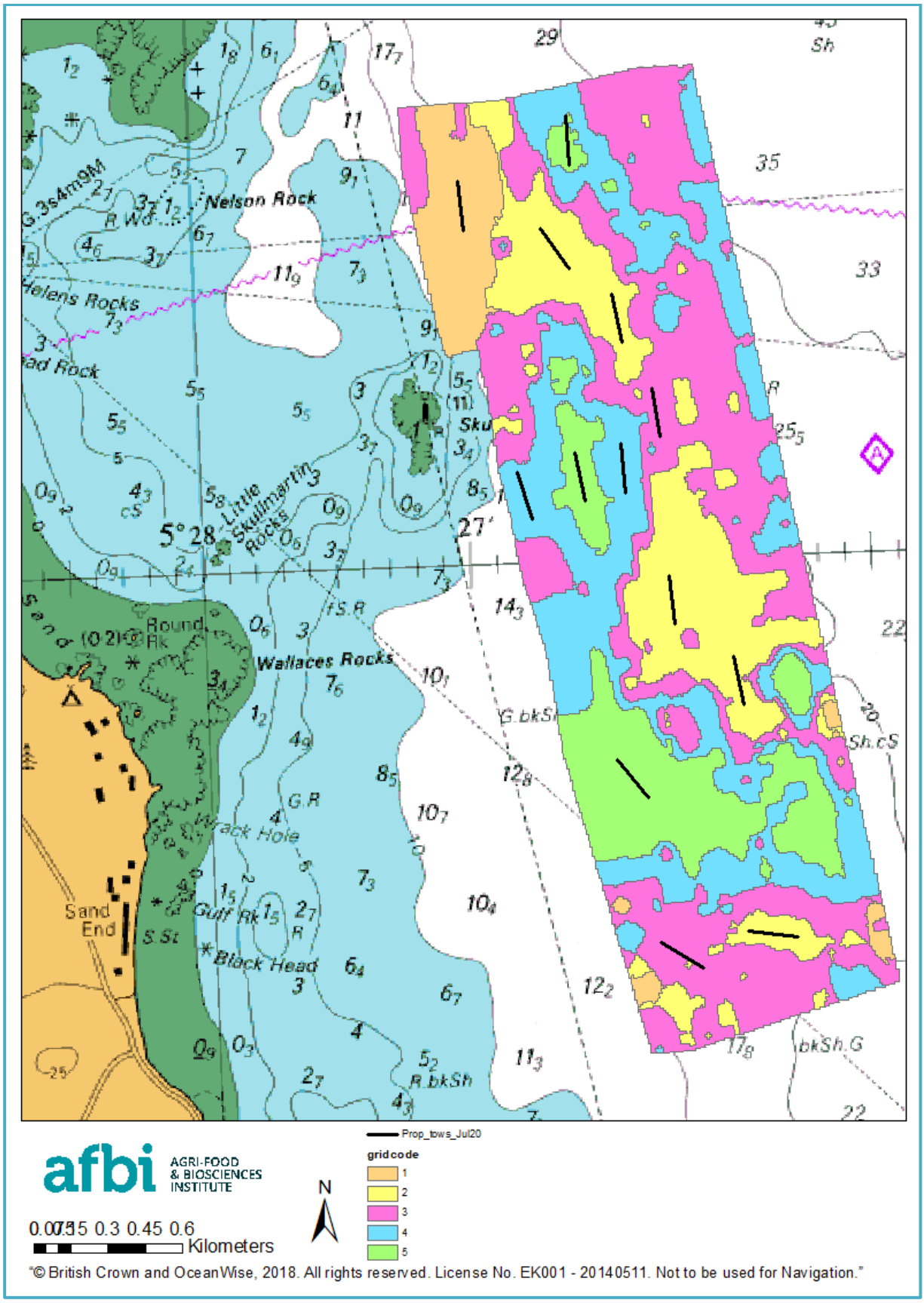


Figure 8: RoxAnn cluster map (from roughness and hardness values) from the July 2020 survey of Skullmartin overlaid with the proposed dredge tows.

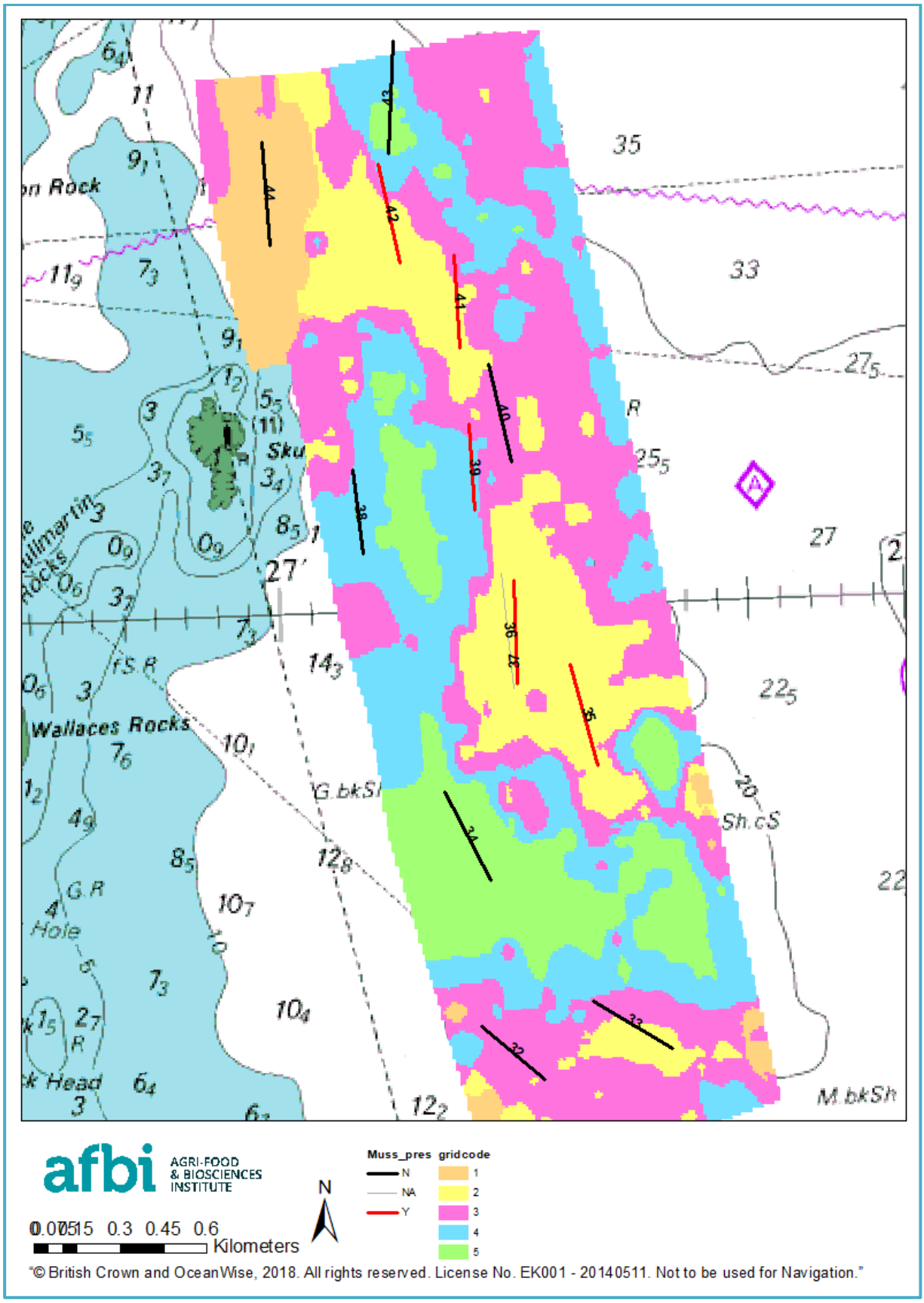


Figure 9: RoxAnn cluster map (from roughness and hardness values) from the July 2020 survey of Skullmartin overlaid with the dredge tows undertaken on the 29th of July 2020. Dredges within which mussels were found are coloured red.

Figure 10: Photographs showing the contents of the dredge tows which yielded mussels undertaken within the area of Skullmartin during the July 2020 seed mussel survey.

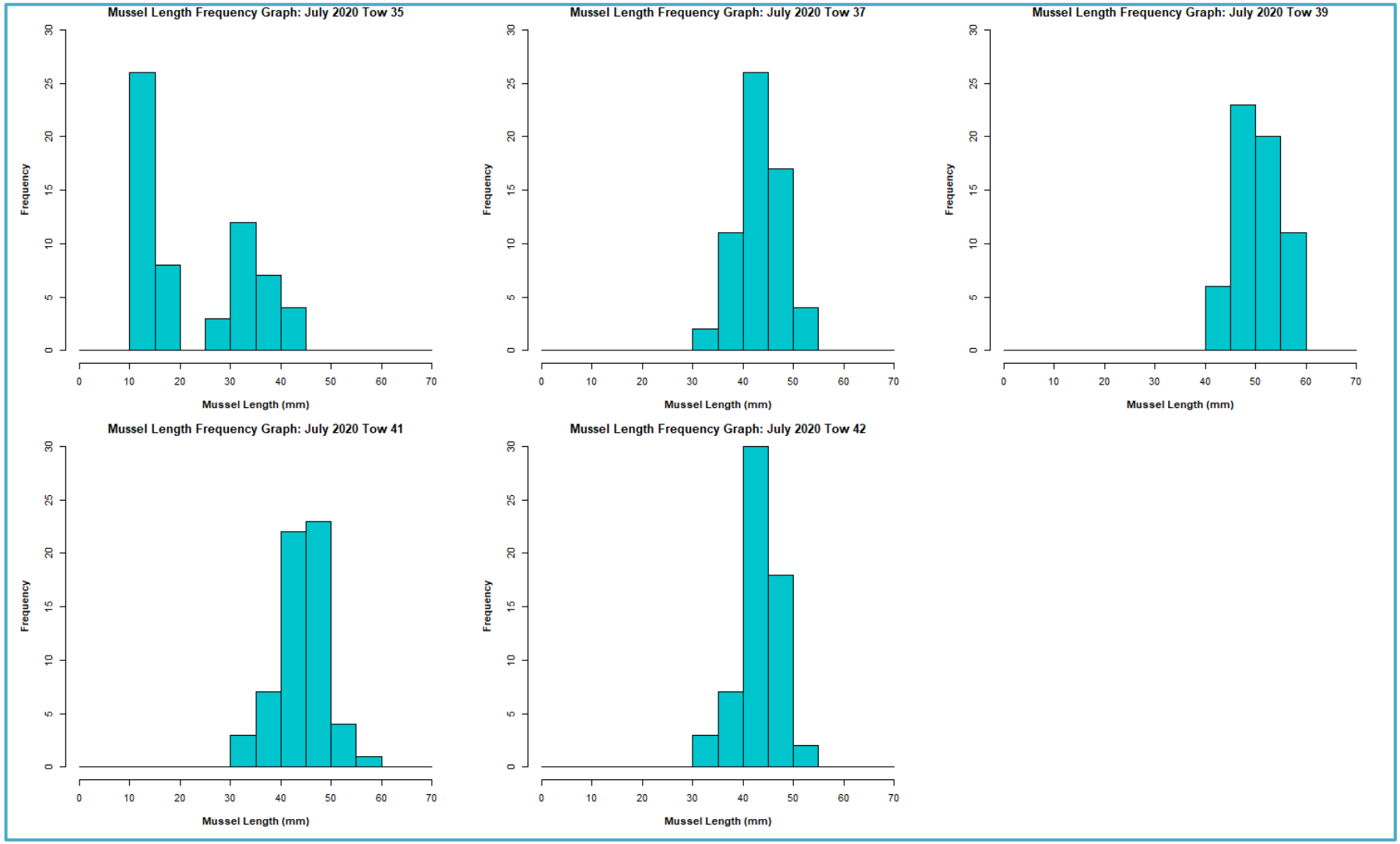


Figure 11: Length class distribution histogram for mussels found within dredge Tows undertaken within the area of Skullmartin during the July 2020 seed mussel survey.

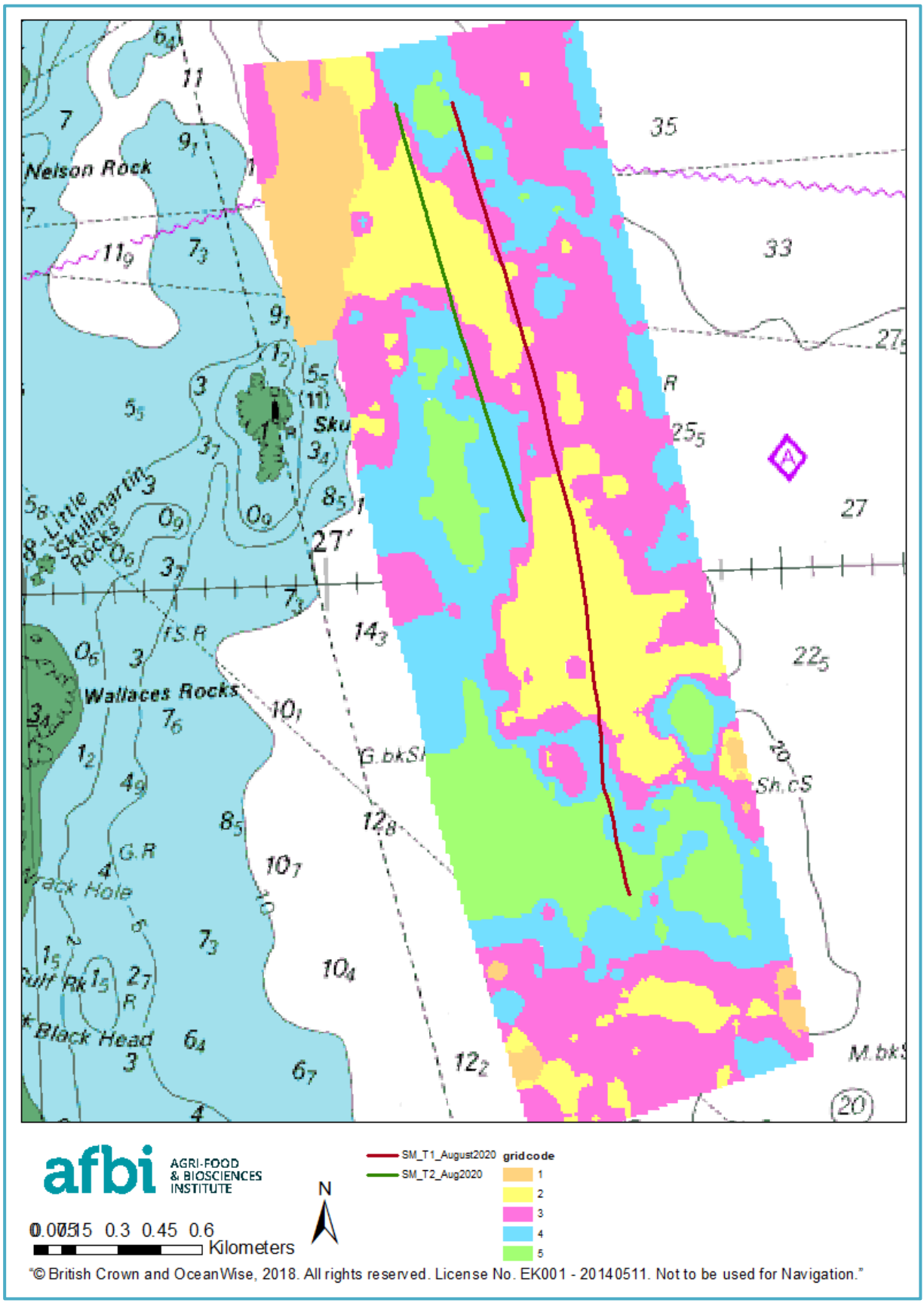


Figure 12: Location of video tows undertaken within the area of Skullmartin during theSummer 2020 seed mussel survey.

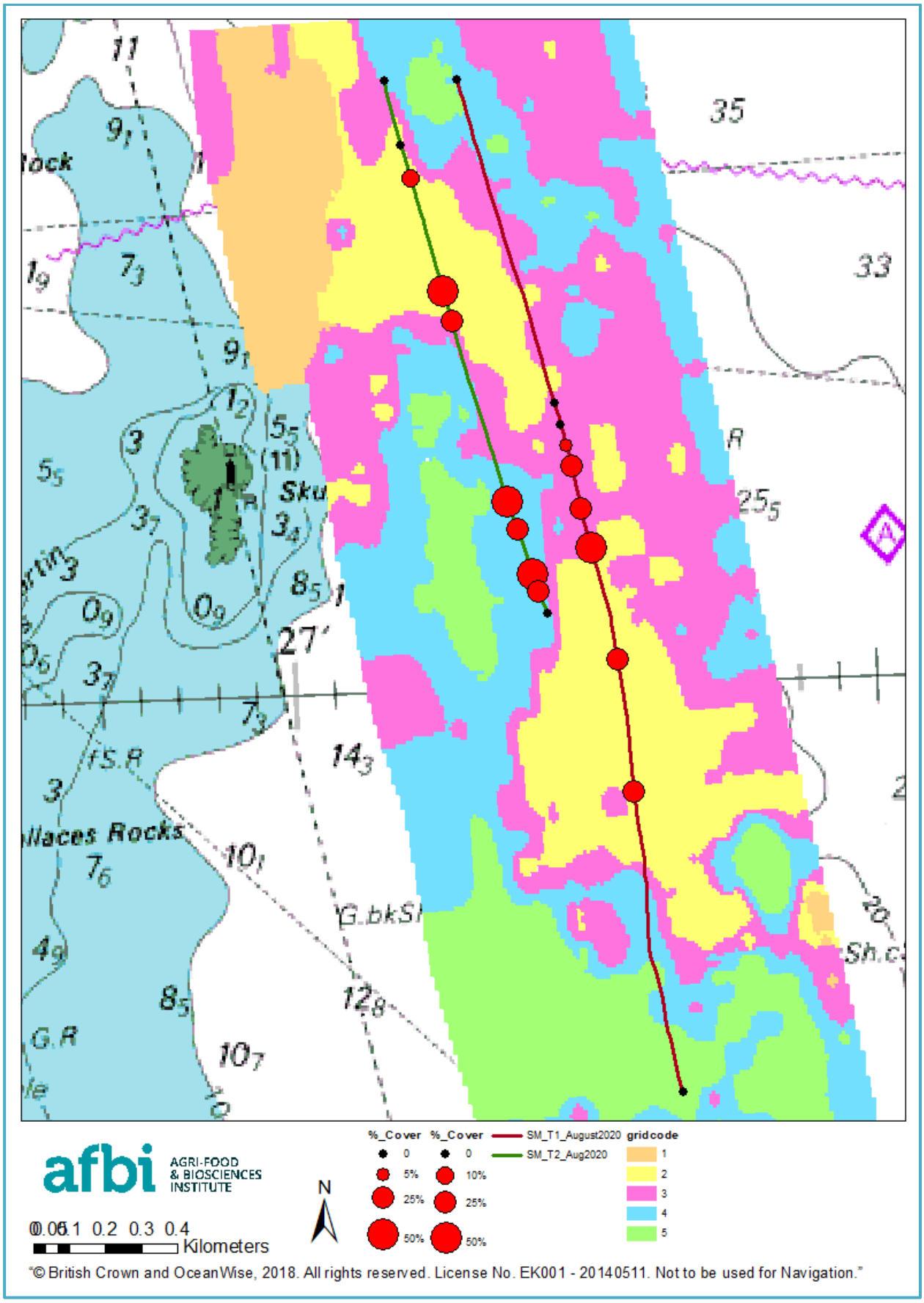


Figure 13: Location of video tows undertaken within the area of Skullmartin during the Summer 2020 seed mussel survey showing percentage coverage of mussels.

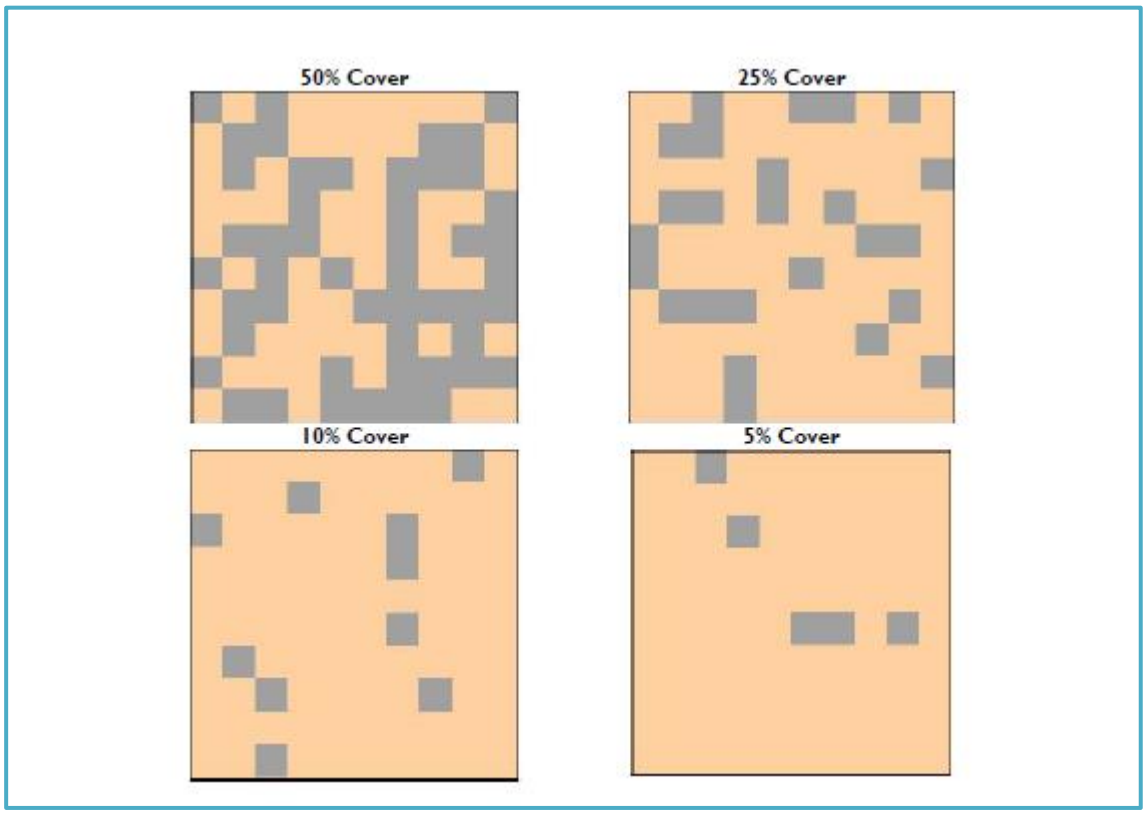


Figure 14: Graphical illustrations to assist with estimation of percentage cover, as taken from Turner et al (2016) Figure 2.

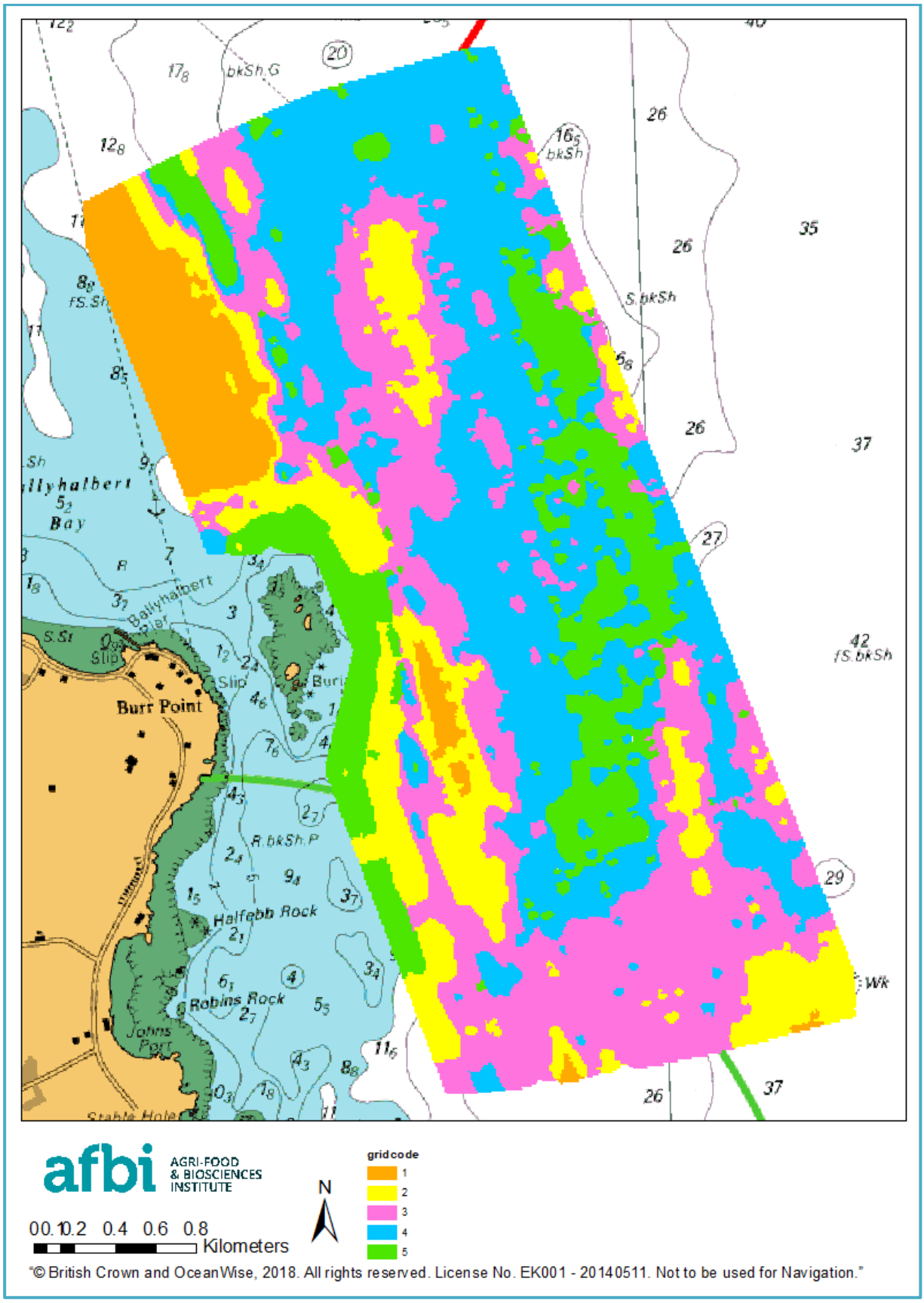


Figure 15: RoxAnn cluster map (from roughness and hardness values) from the July 2020 survey of Burial Island.

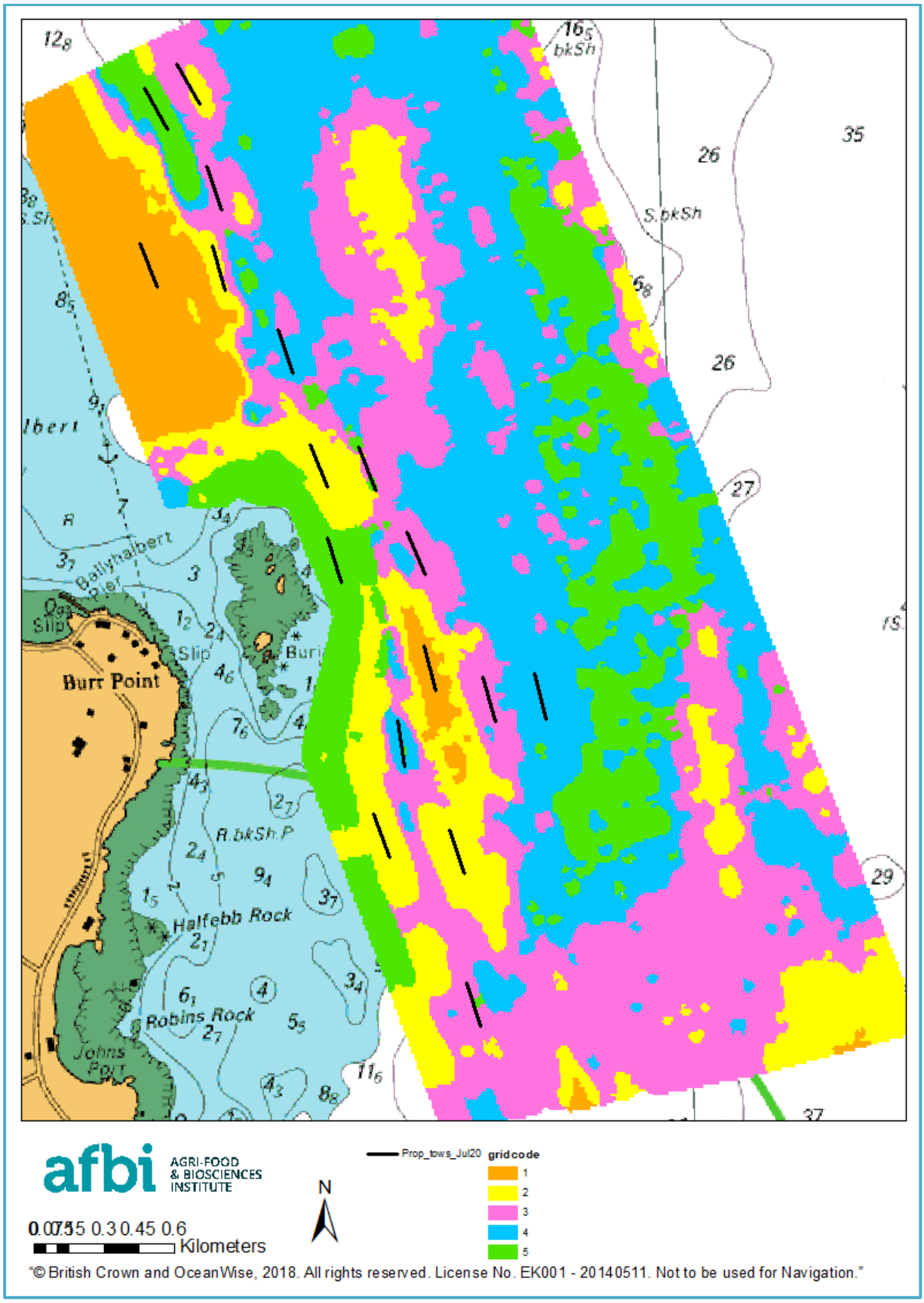


Figure 16: Rox Ann cluster map (from roughness and hardness values) from the July 2020 survey of Burial Island overlaid with the proposed dredge tows.

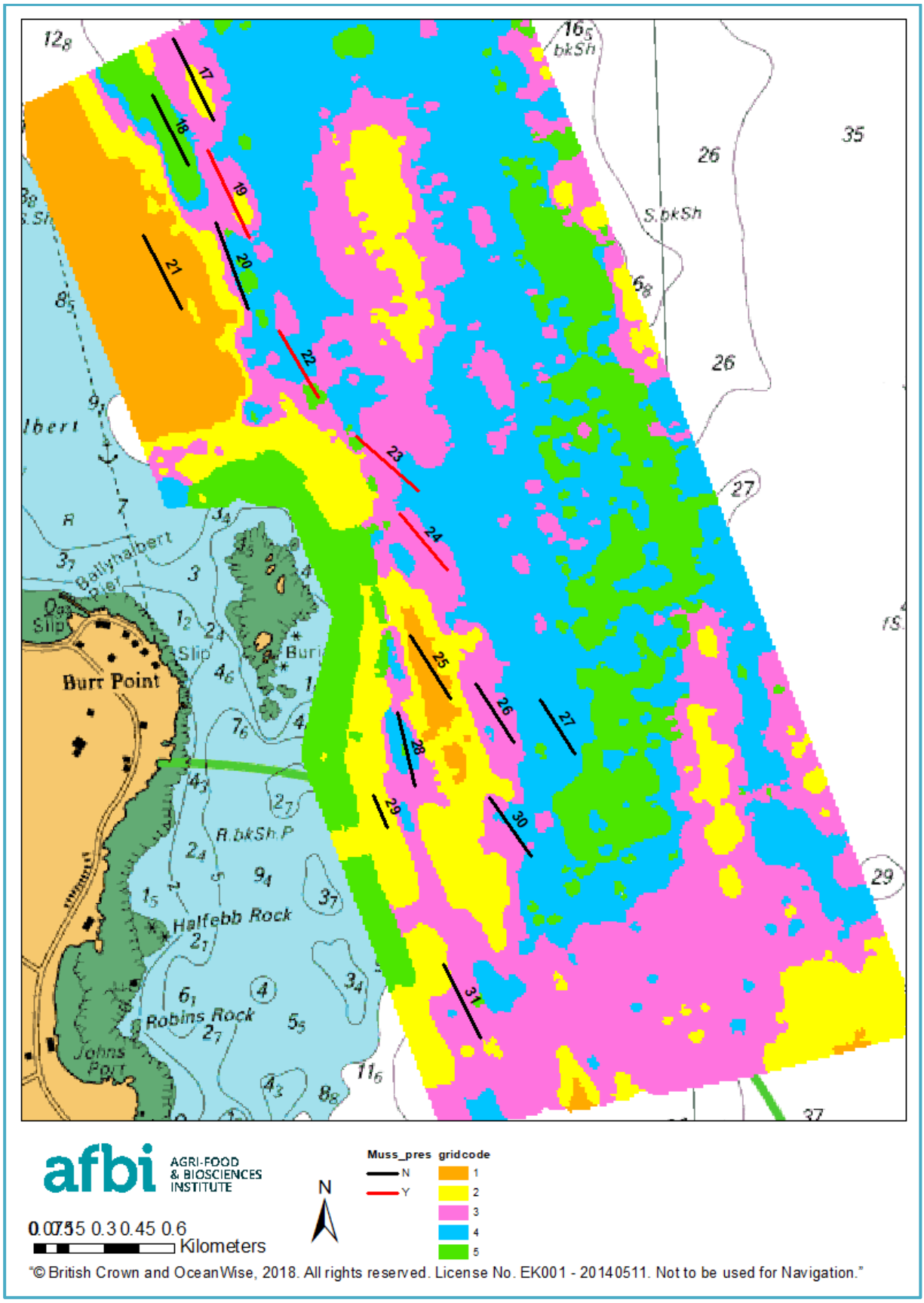


Figure 17: Rox Ann cluster map (from roughness and hardness values) from the July 2020 survey of Burial Island overlaid with the dredge tows undertaken on the 28th of July 2020. Dredges within which mussels were found are coloured red.

Figure 18: Photographs showing the contents of the dredge tows which yielded mussels undertaken within the area of Burial Island during the July 2020 seed mussel survey.

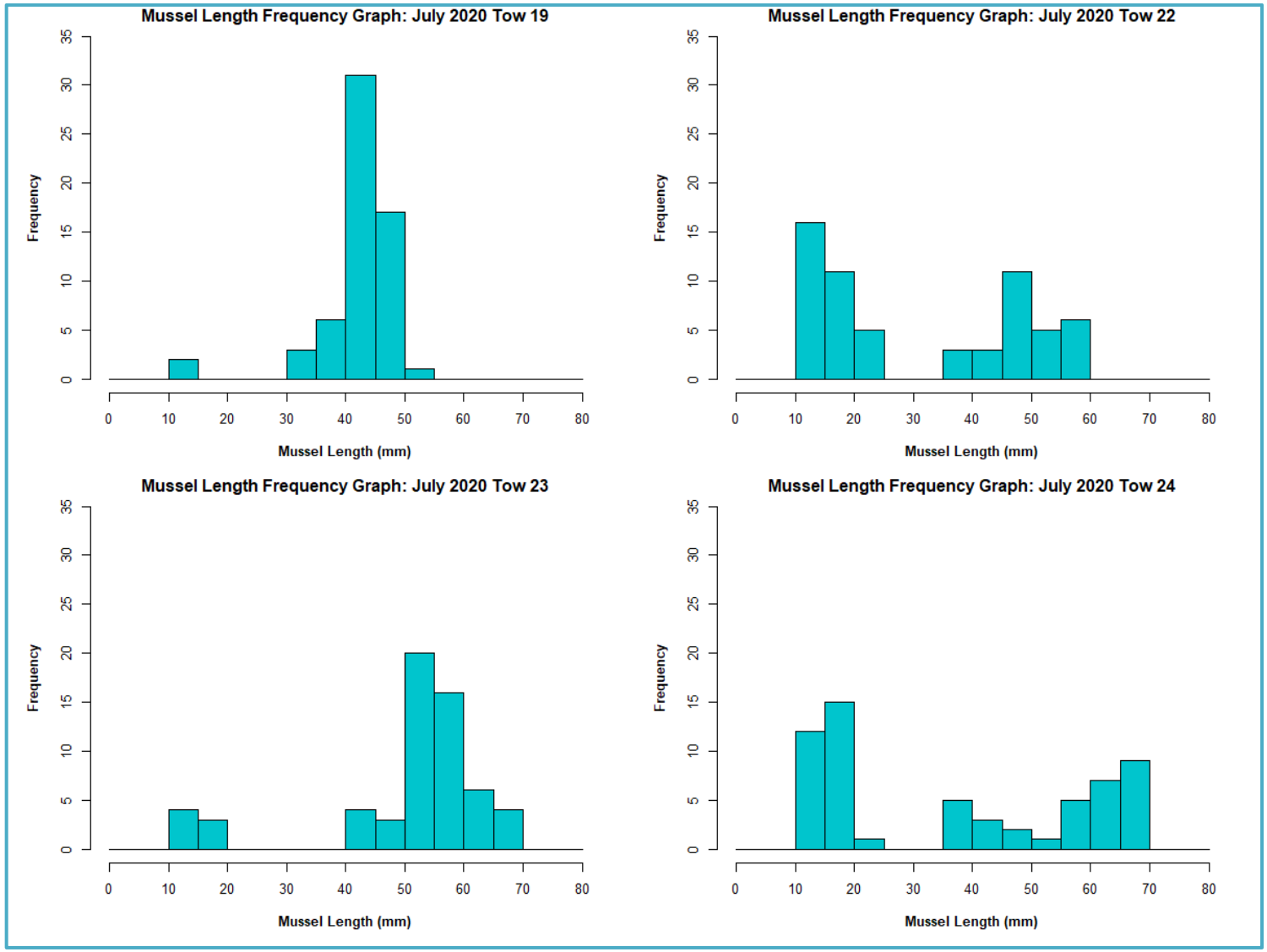


Figure 19: Length class distribution histogram for mussels found within dredge Tows undertaken within the area of Burial Island during the July 2020 seed mussel survey.

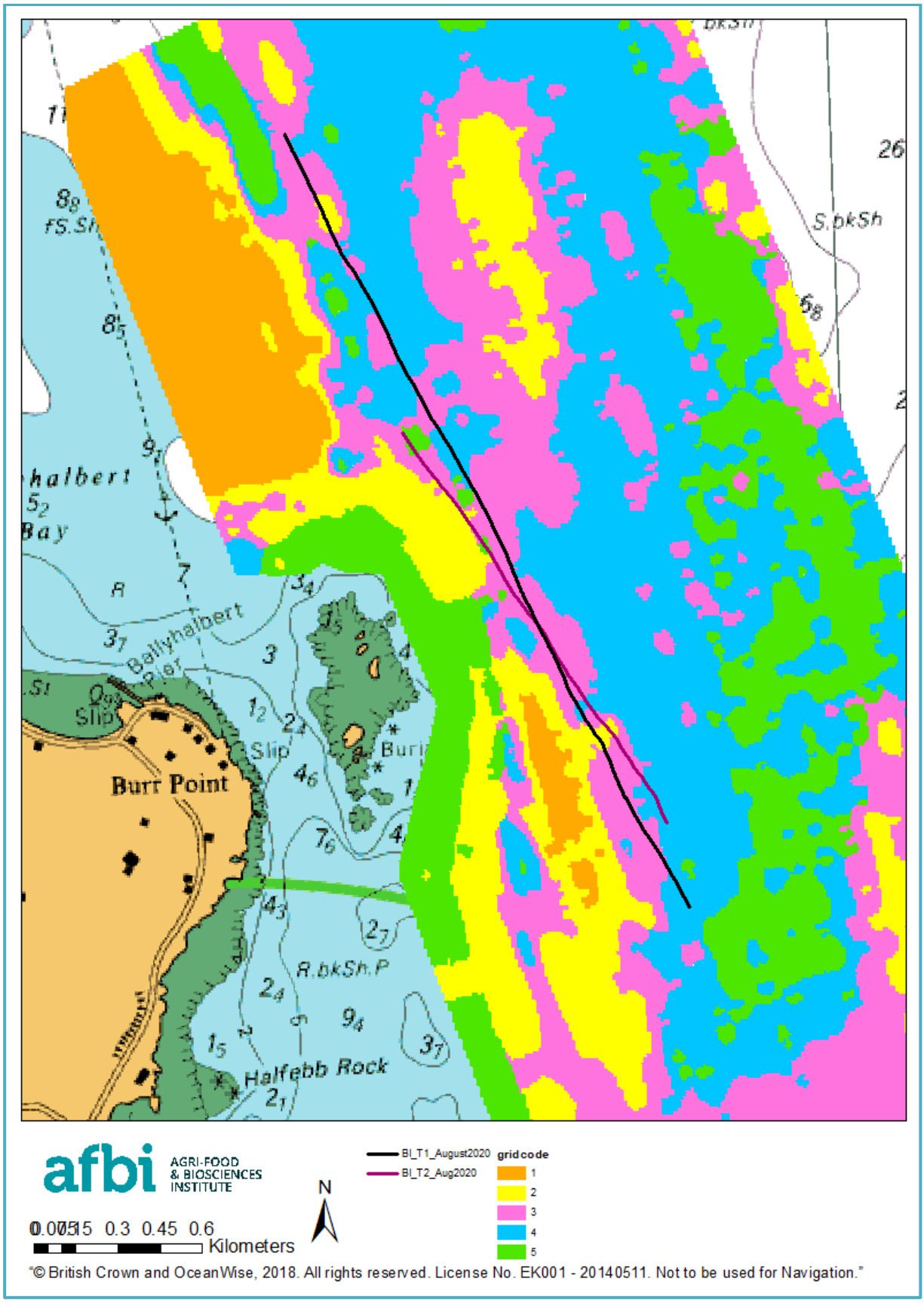


Figure 20: Location of video tows undertaken within the area of Burial Island during the Summer 2020 seed mussel survey.

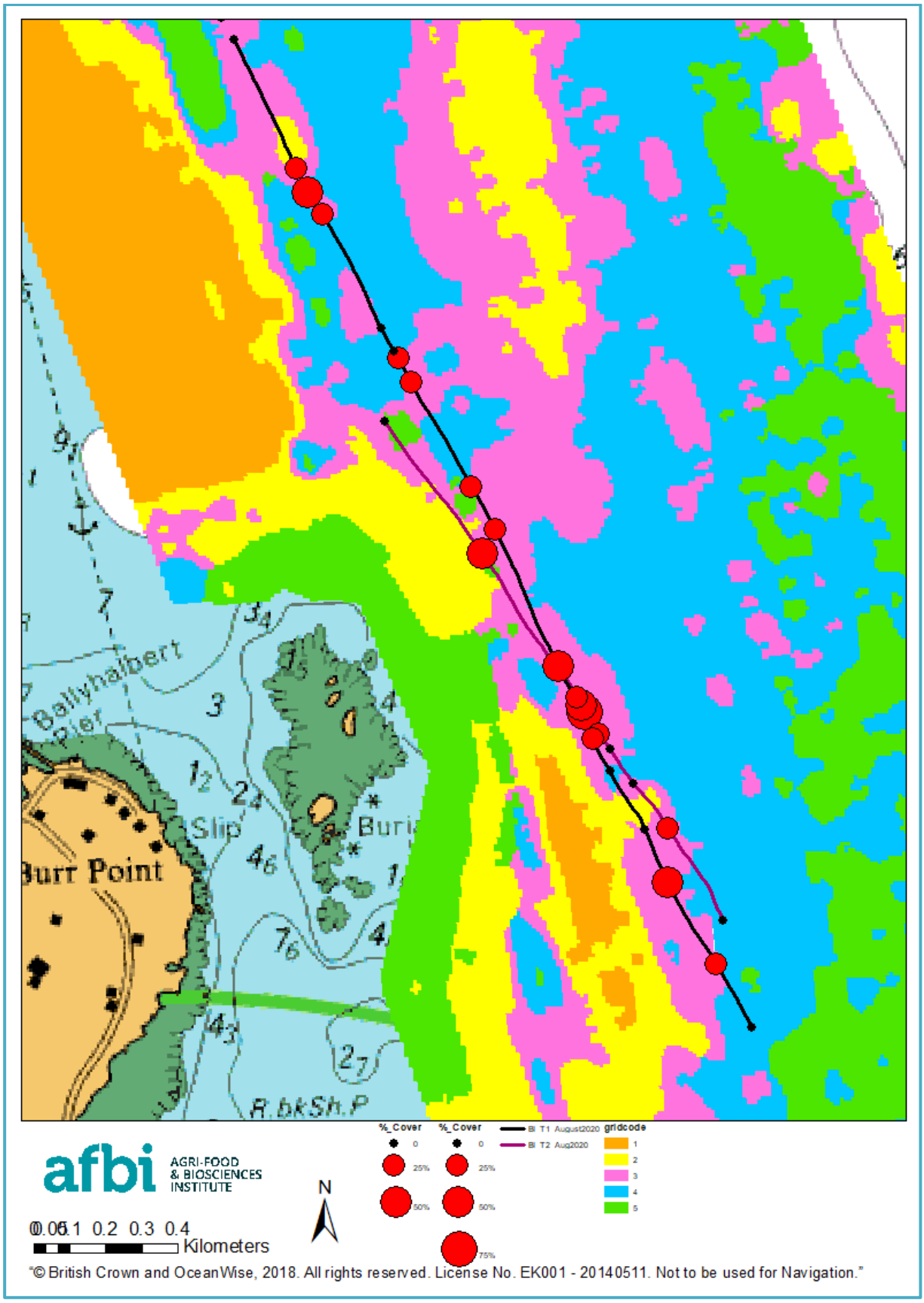


Figure 21: Location of video tows undertaken within the area of Burial Island during the Summer 2020 seed mussel survey showing percentage coverage of mussels.

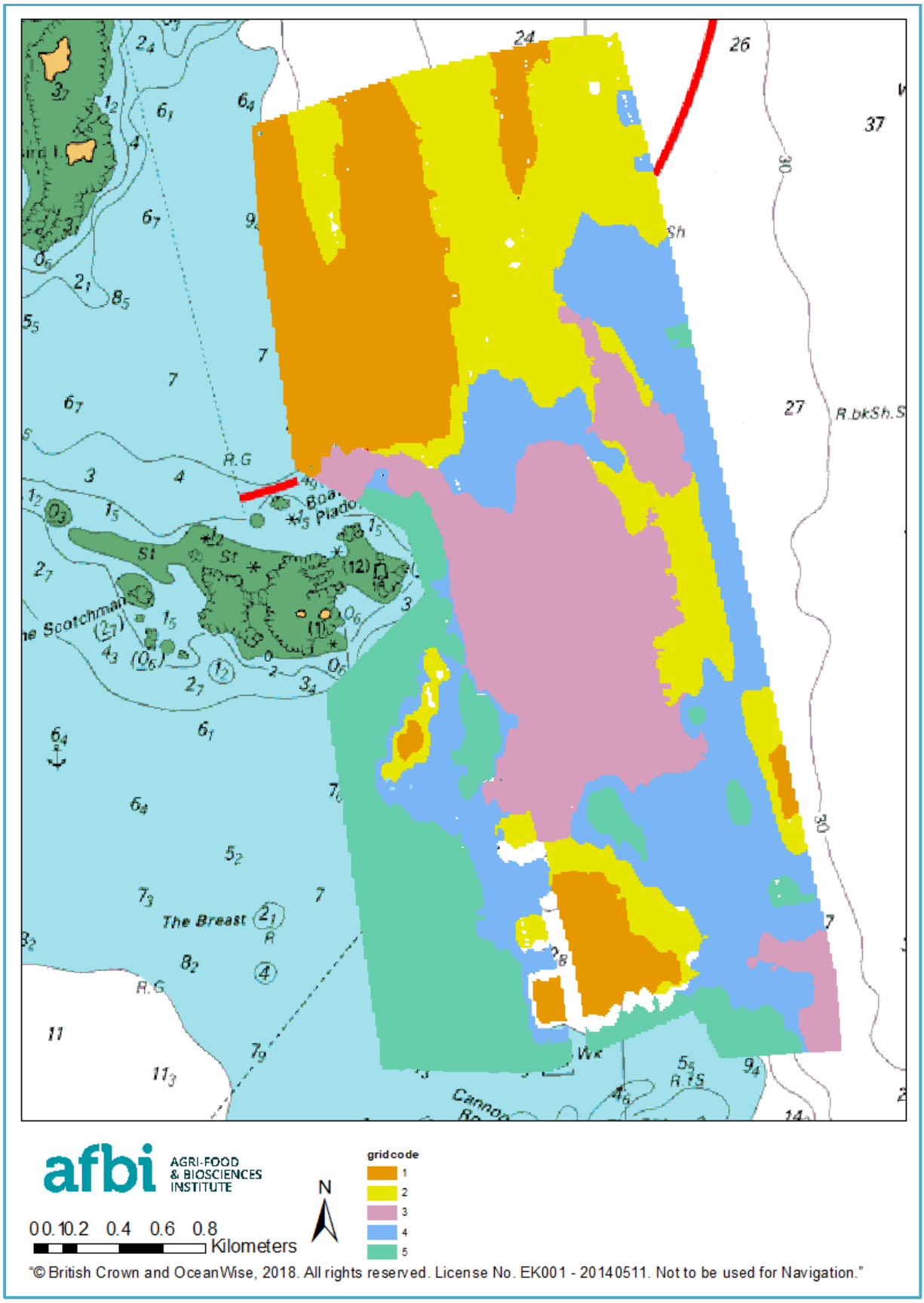


Figure 22: Rox Ann cluster map (from roughness and hardness values) from the July 2020 survey of The Feathers.

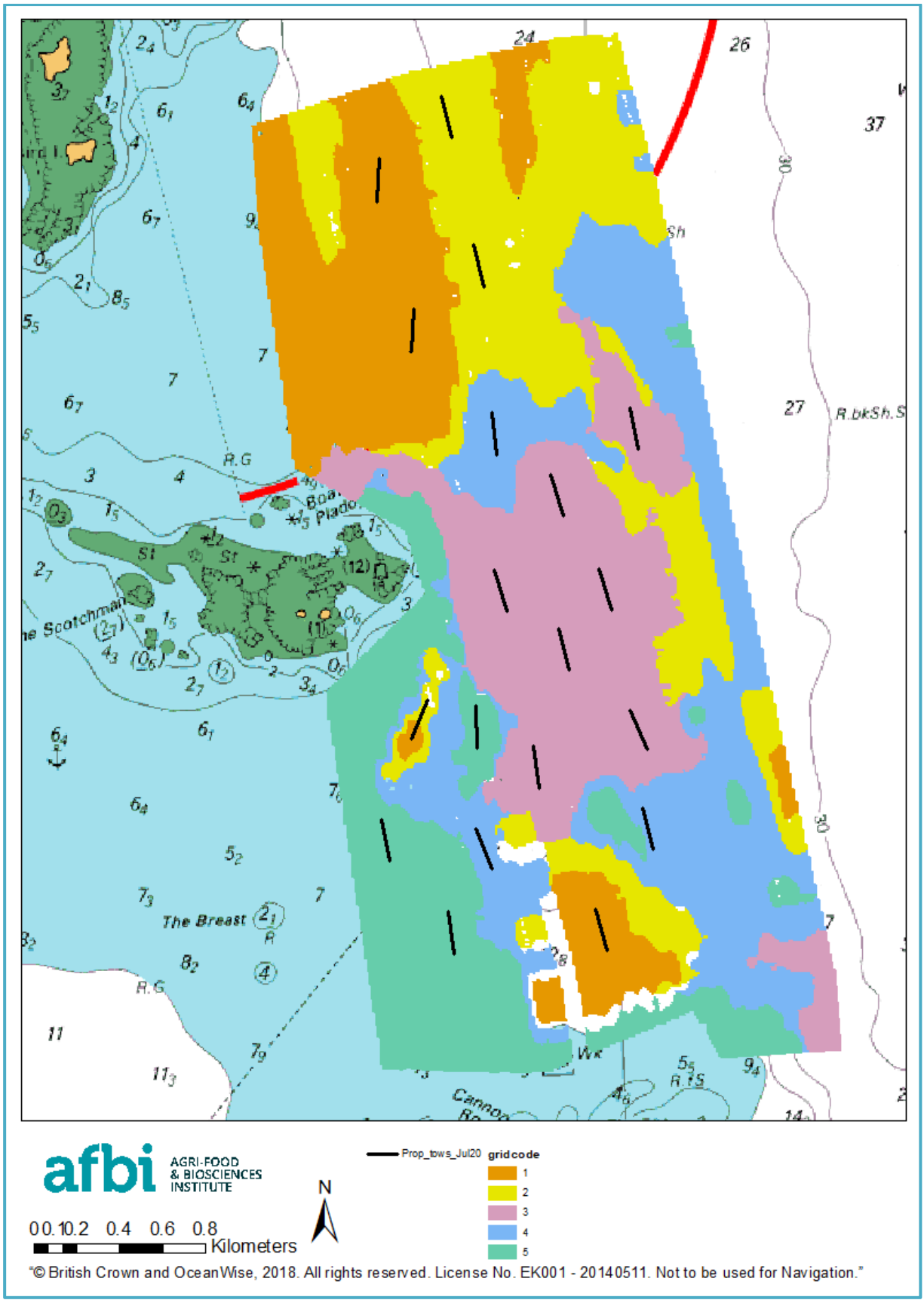


Figure 23: Rox Ann cluster map (from roughness and hardness values) from the July 2020 survey of The Feathers overlaid with the proposed dredge tows.

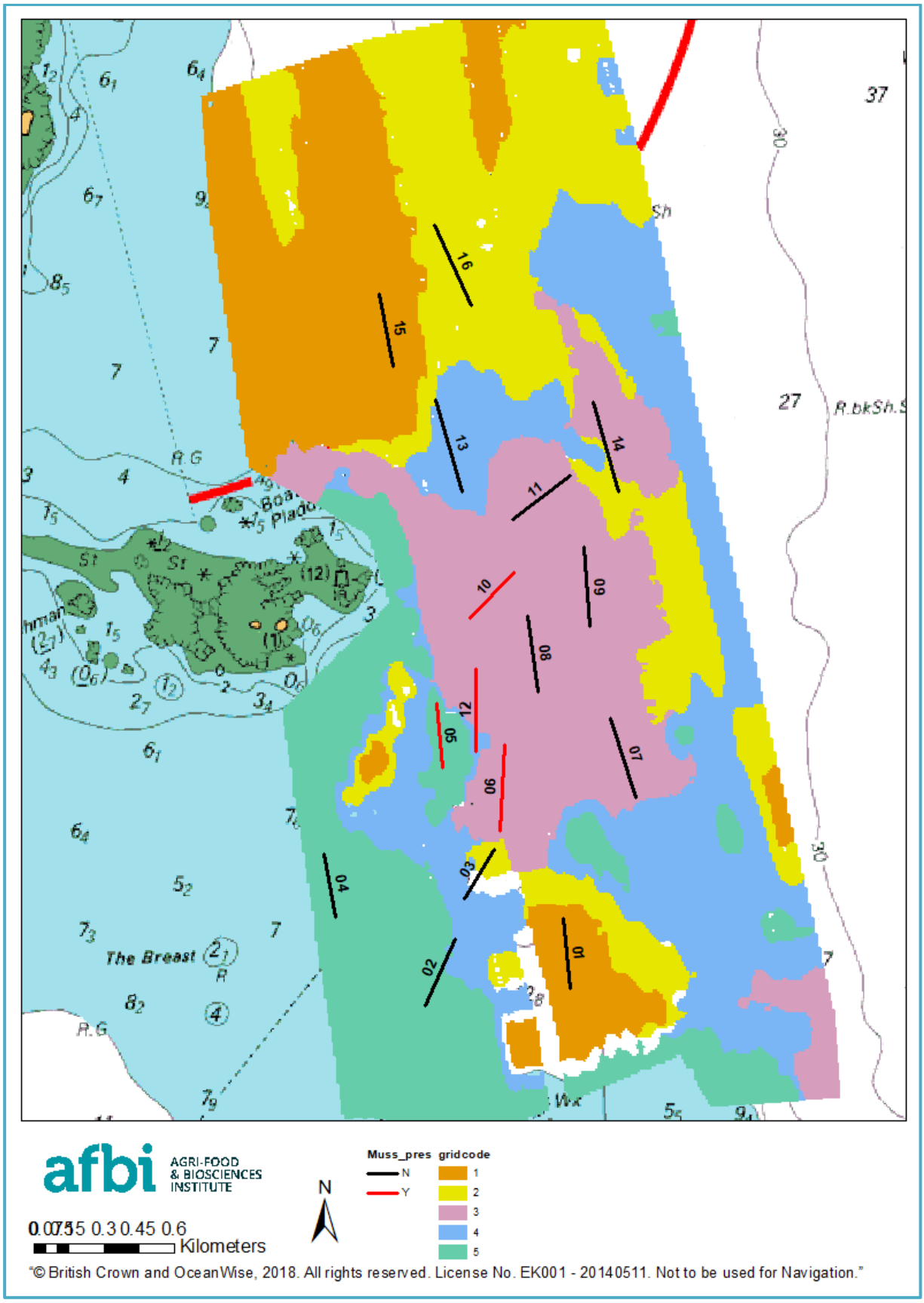


Figure 24: Rox Ann cluster map (from roughness and hardness values) from the July 2020 survey of The Feathers overlaid with the dredge tows undertaken on the 28th of July 2020. Dredges within which mussels were found are coloured red.

Figure 25: Photographs showing the contents of the dredge tows which yielded mussels undertaken within the area of The Feathers during the July 2020 seed mussel survey.

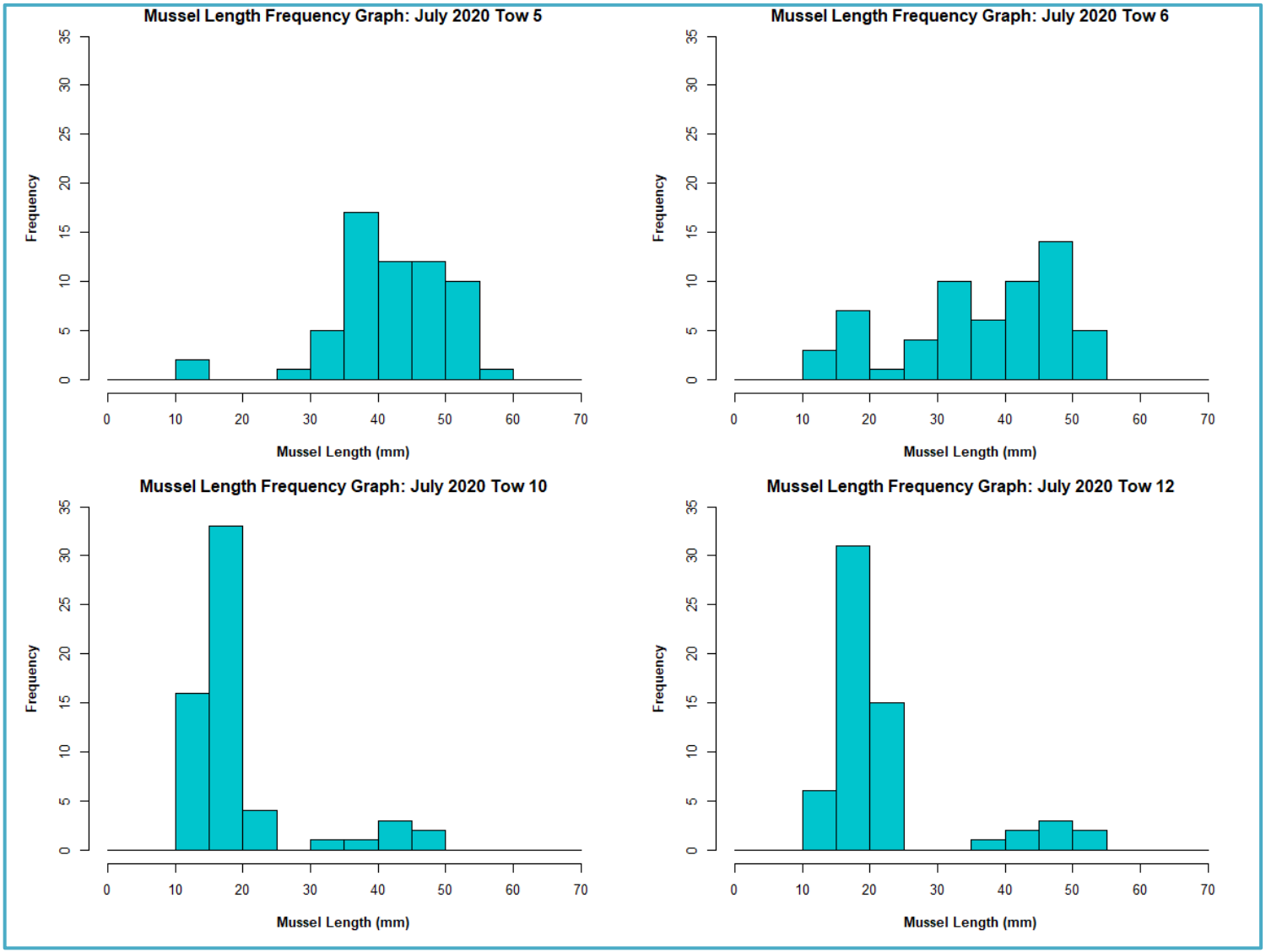


Figure 26: Length class distribution histogram for mussels found within dredge Tows undertaken within the area of The Feathers during the July 2020 seed mussel survey.

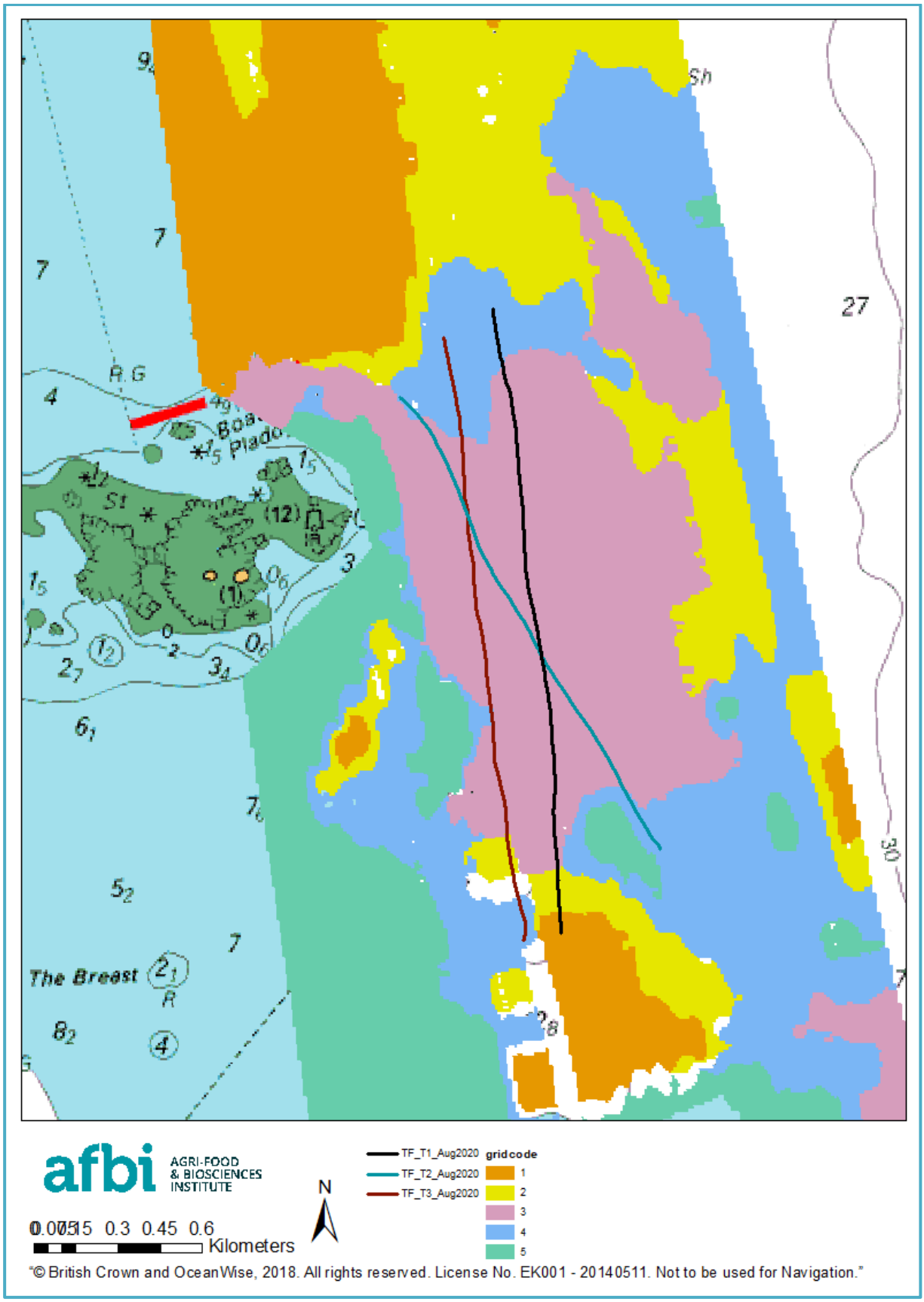


Figure 27: Location of video tows undertaken within the area of The Feathers during the Summer 2020 seed mussel survey.

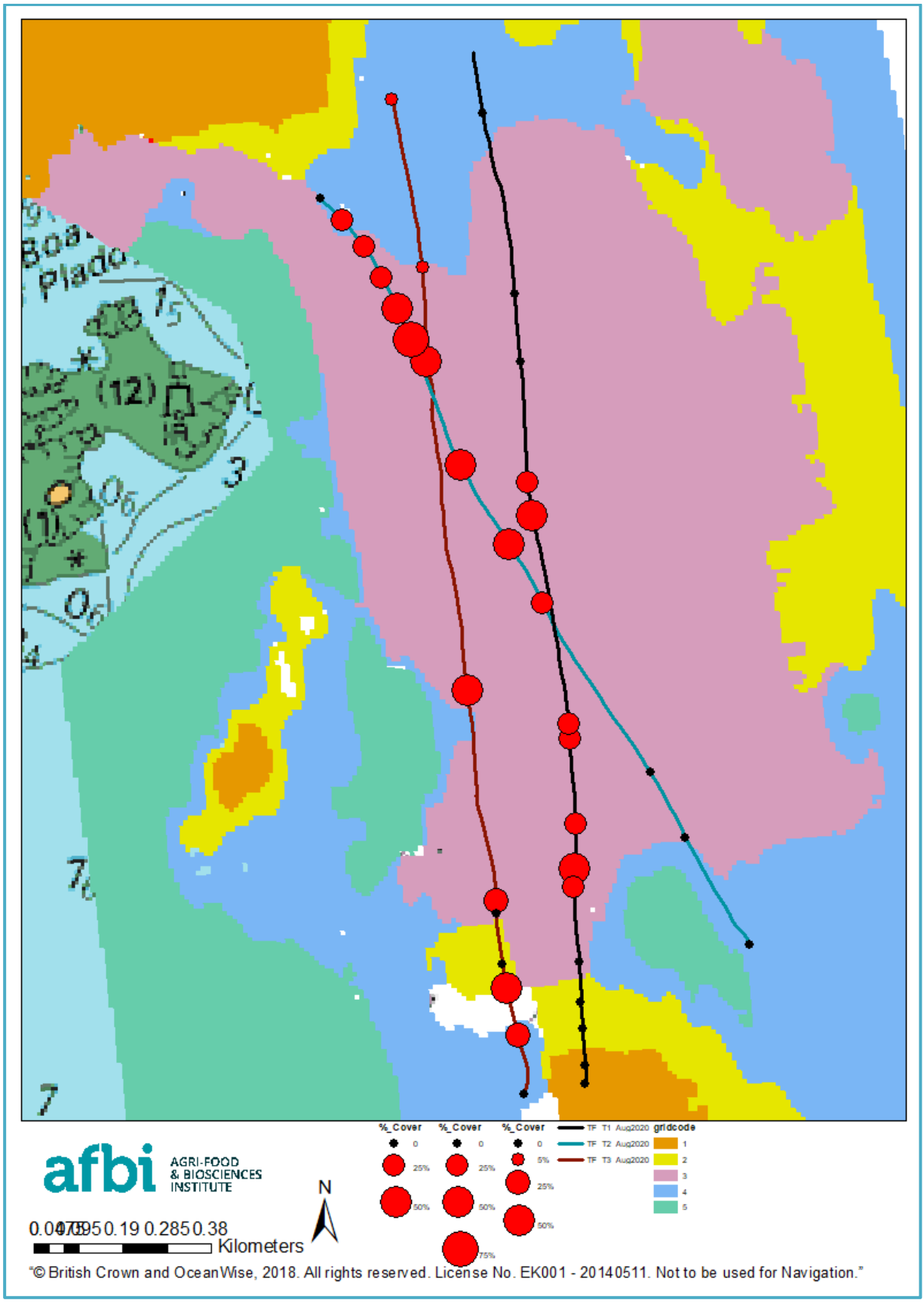


Figure 28: Location of video tows undertaken within the area of The Feathers during the Summer 2020 seed mussel survey showing coverage of mussels.

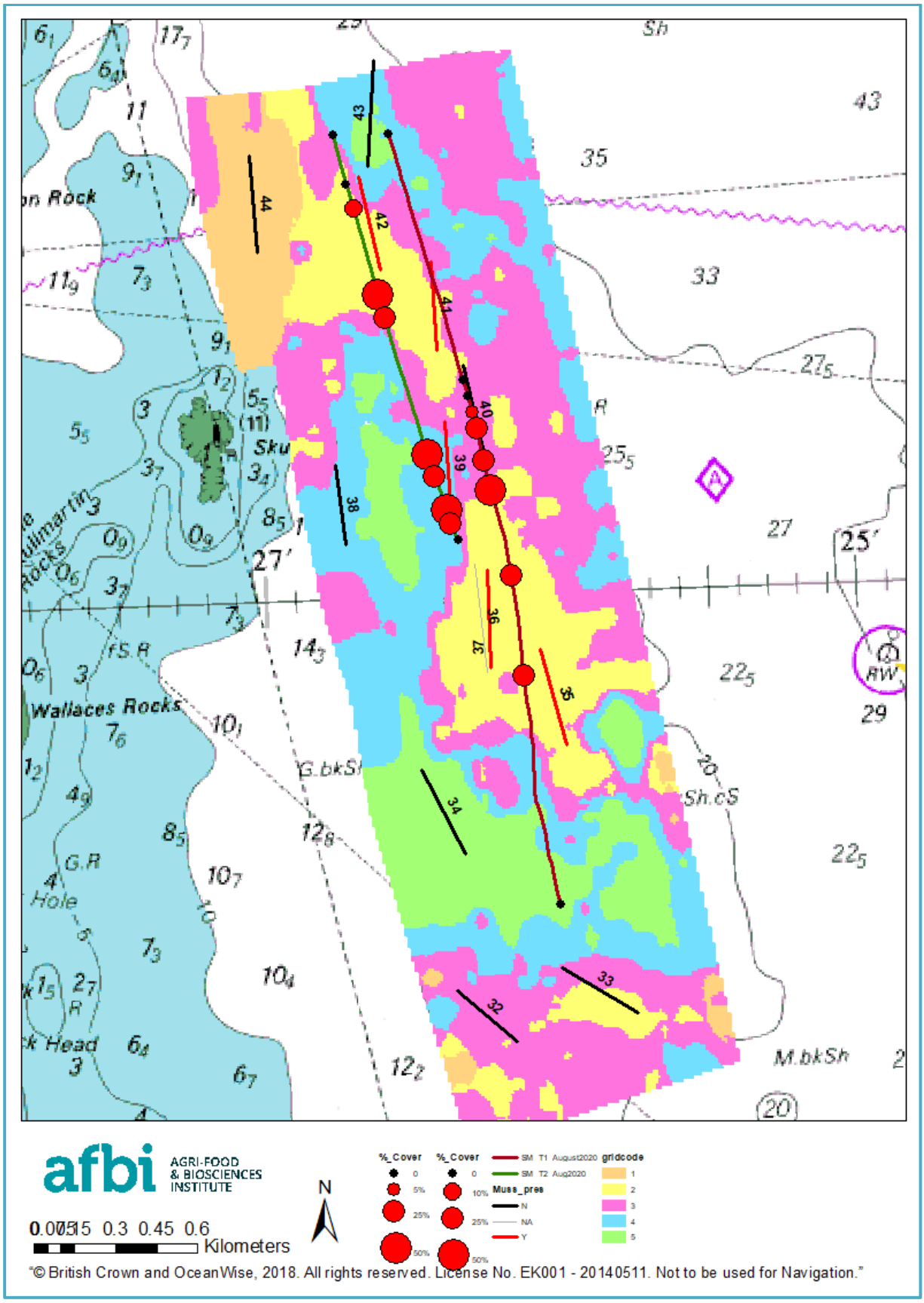


Figure 29: RoxAnn cluster map (from roughness and hardness values) from the AFBI July 2020 survey of Skullmartin, overlaid with the dredges undertaken on the 29th of July 2020 and the video tows undertaken on the 13th of August 2020.

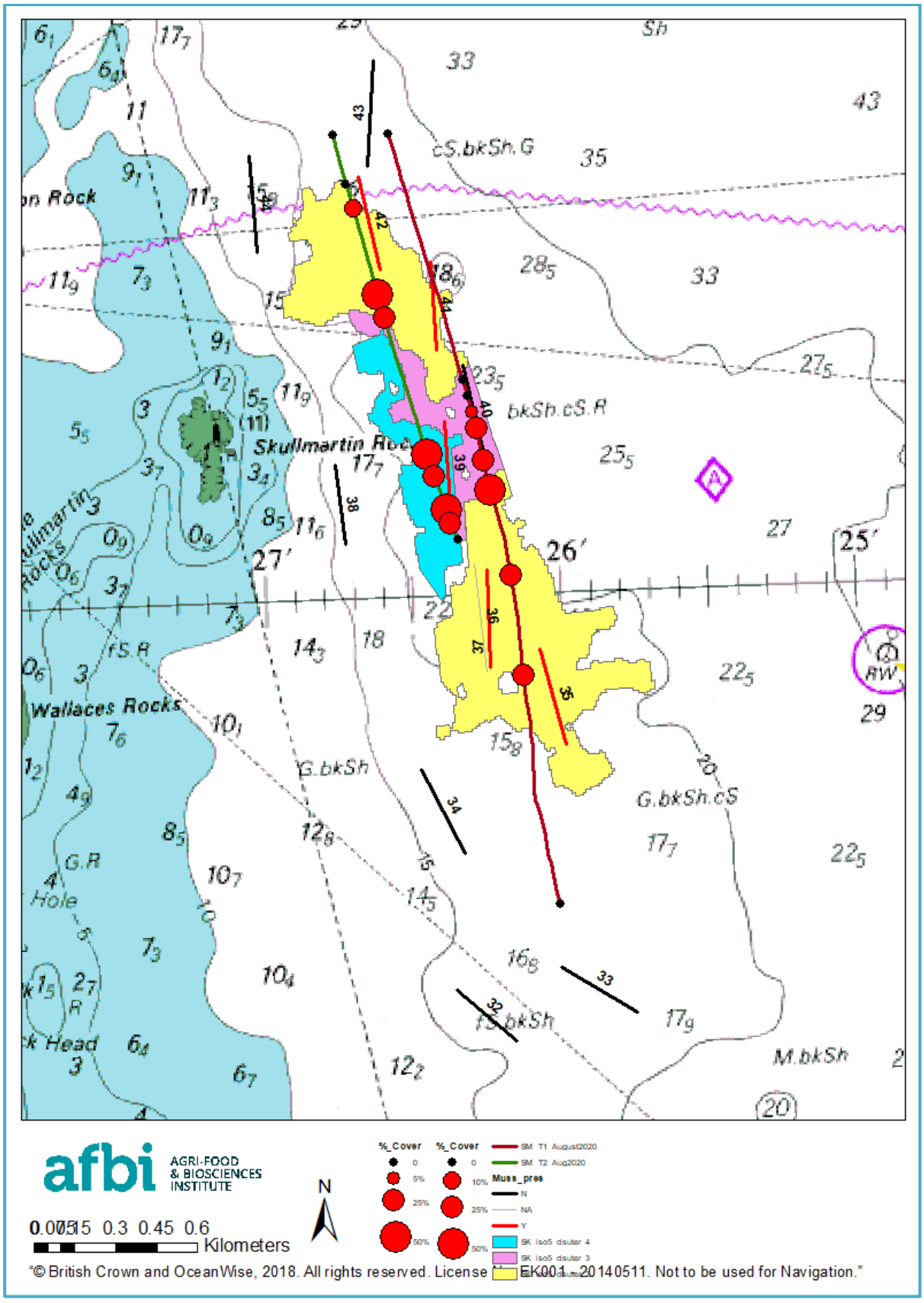


Figure 30: RoxAnn cluster map (from roughness and hardness values) from the AFBI July 2020 survey of Skullmartin showing only those clusters within which mussels were found, overlaid with the dredges undertaken on the 29th of July 2020 and the video tows undertaken on the 13th of August 2020.

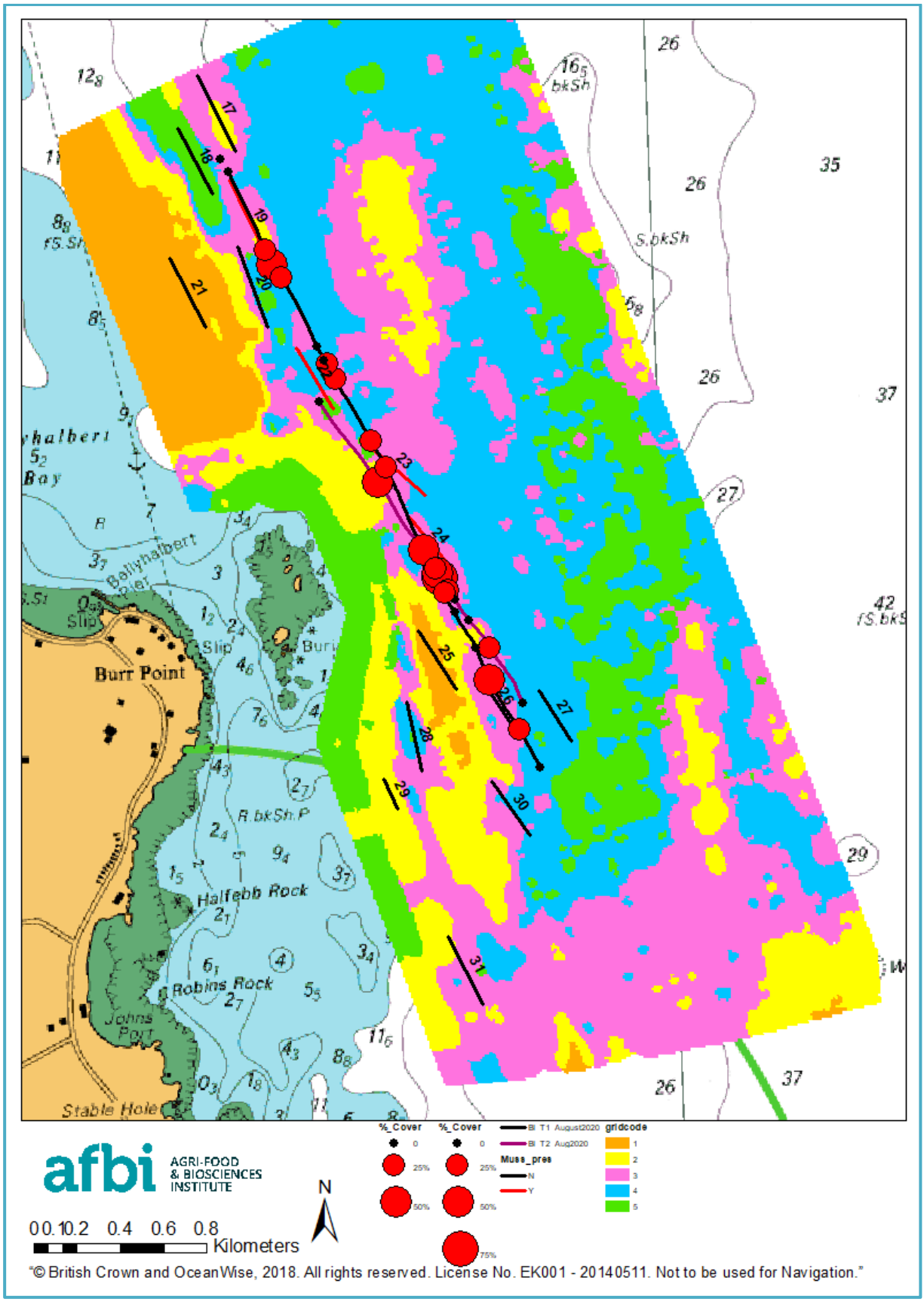


Figure 31: RoxAnn cluster map (from roughness and hardness values) from the AFBI July 2020 survey of Burial Island, overlaid with the dredges undertaken on the 28th of July 2020 and the video tows undertaken on the 13th of August 2020.

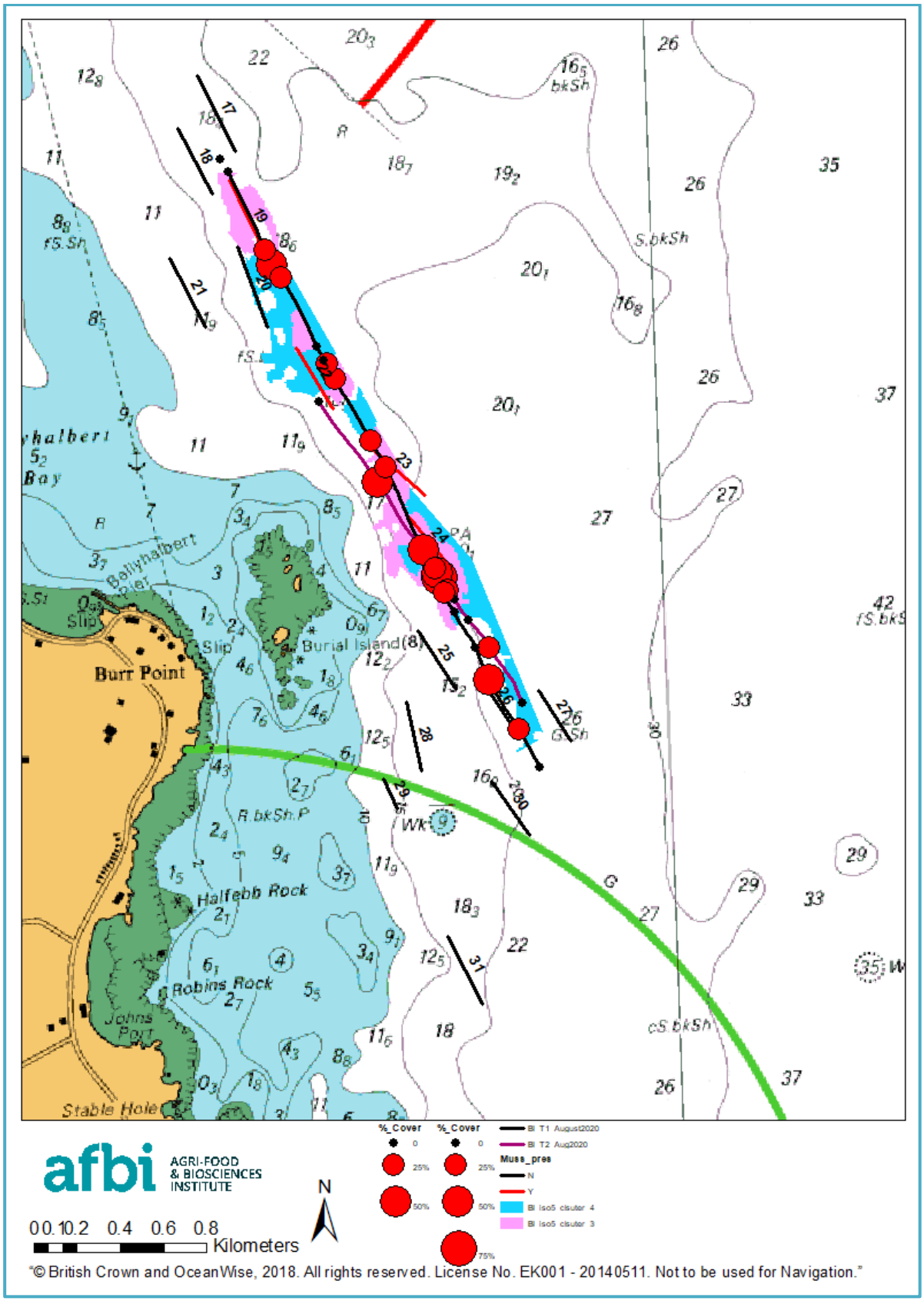


Figure 32: RoxAnn cluster map (from roughness and hardness values) from AFBI July 2020 survey of Burial Island showing only those clusters within which mussels were found, overlaid with the dredges undertaken on the 28th of July 2020 and the video tows undertaken on the 13th of August 2020.

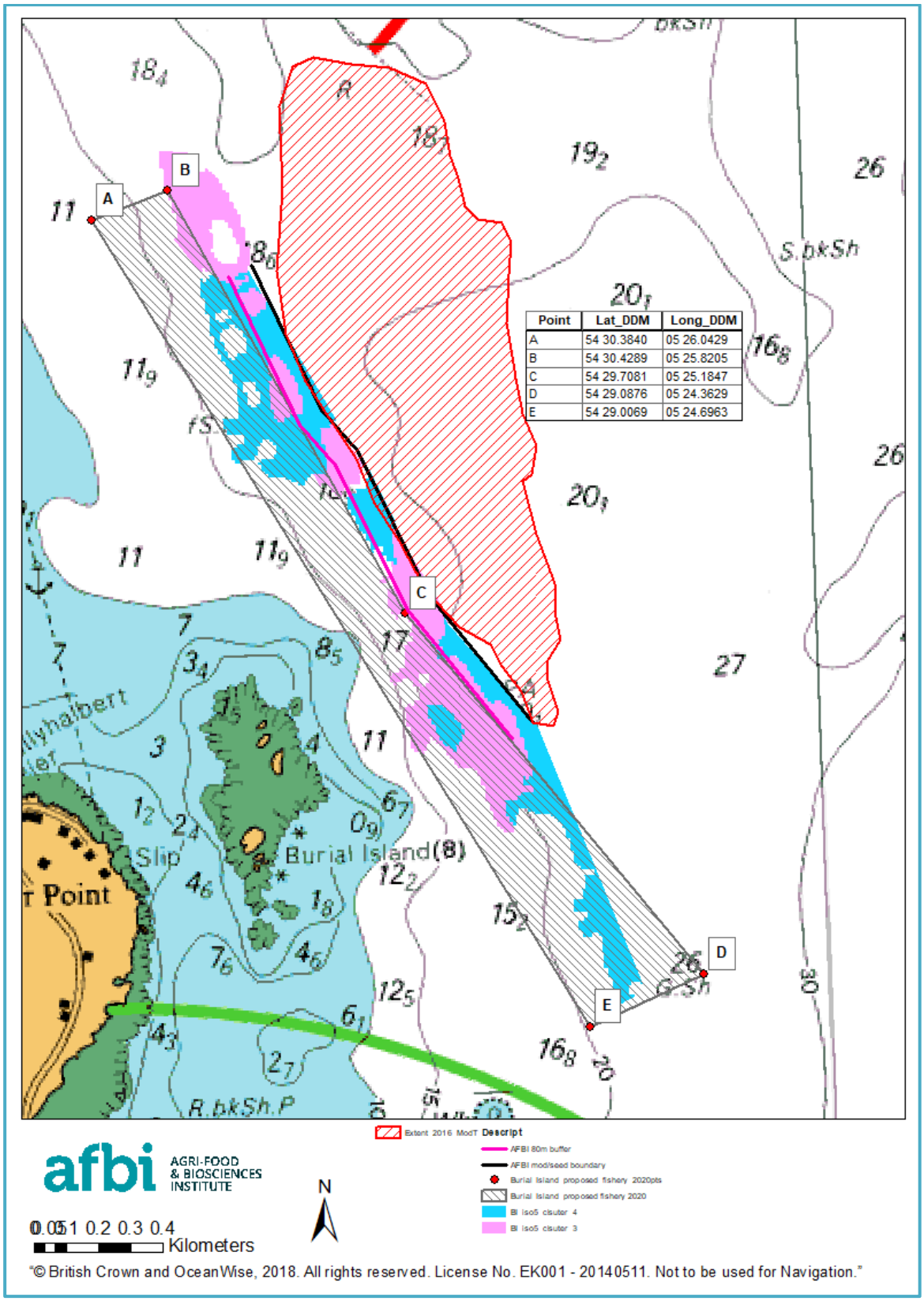


Figure 33: RoxAnn cluster map (from roughness and hardness values) from the AFBI July 2020 survey of Burial Island, highlighting the area of Cluster 4 (blue area on map) Cluster 3 (pink area on map) that represents seed mussel. The potential fishery area is shown by the grey hashed area on the map. The red hashed area indicates the area previously identified as *M. modiolus* bed.

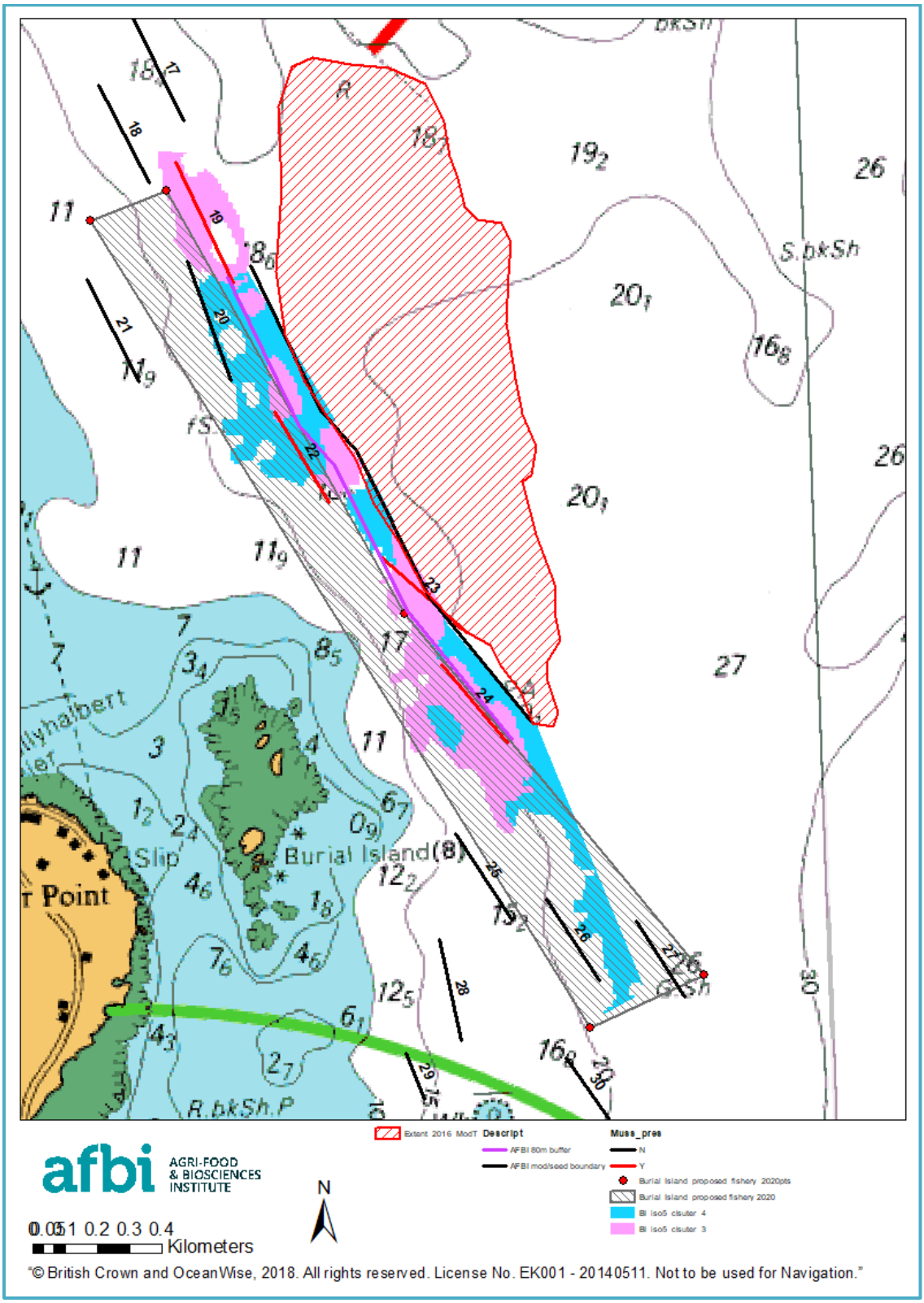


Figure 34: RoxAnn cluster map (from roughness and hardness values) from the AFBI July 2020 survey of Burial Island, highlighting the area of Cluster 4 (blue area on map) Cluster 3 (pink area on map) that represents seed mussel. The potential fishery area is shown by the grey hashed area on the map. The red hashed area indicates the area previously identified as *M. modiolus* bed and the purple line highlights the 80m buffer applied to protect this bed. Dredged tows undertaken on the 28th of July which contained mussels are shown in red on the map.

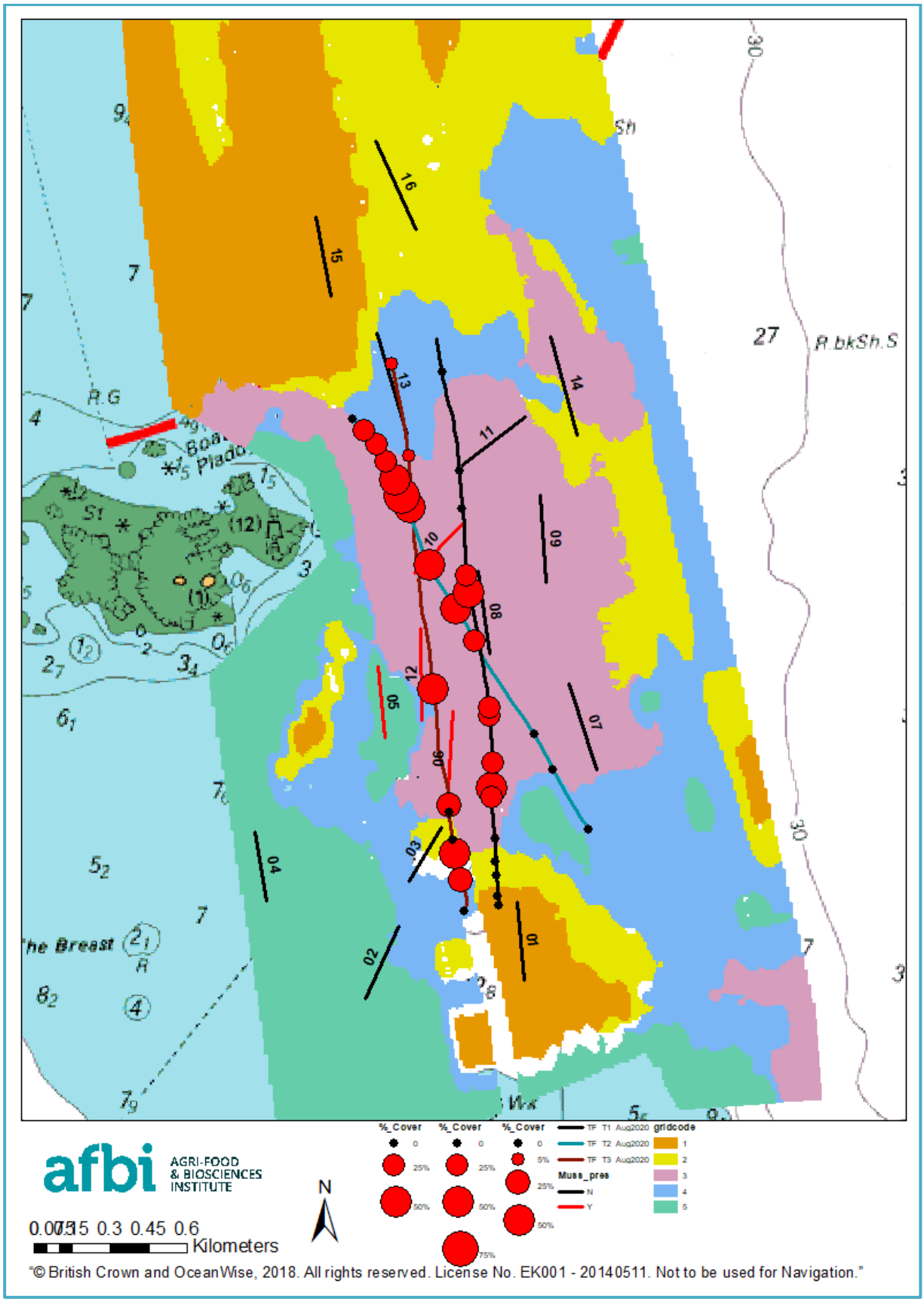


Figure 35: RoxAnn cluster map (from roughness and hardness values) from the AFBI July 2020 survey of The Feathers, overlaid with the dredges undertaken on the 28th of July 2020 and the video tows undertaken on the 13th of August 2020.

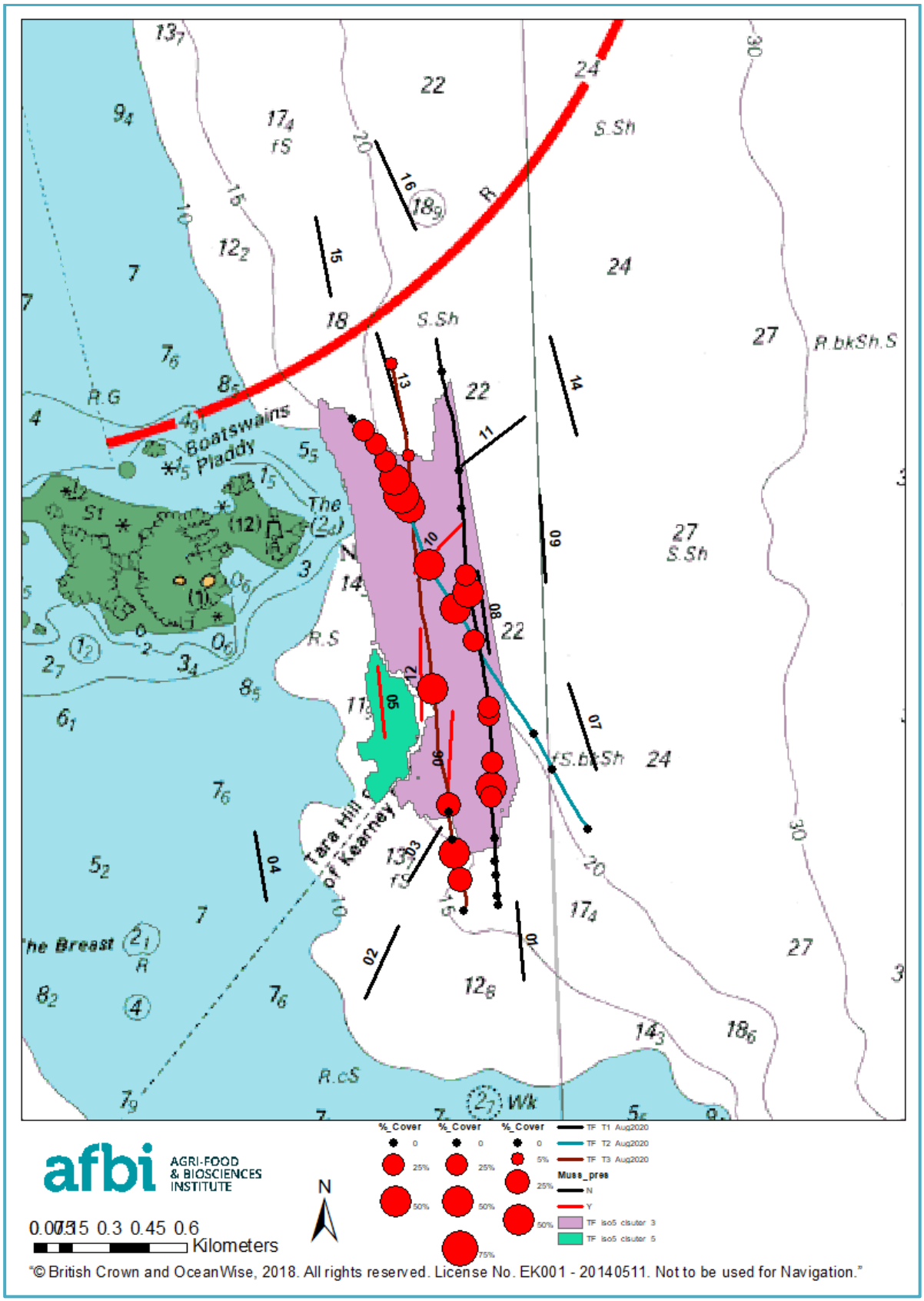


Figure 36: RoxAnn cluster map (from roughness and hardness values) from AFBI July 2019 survey of The Feathers showing only those clusters within which mussels were found overlaid with the dredges undertaken on the 28th of July 2020 and the video tows undertaken on the 13th of August 2020.

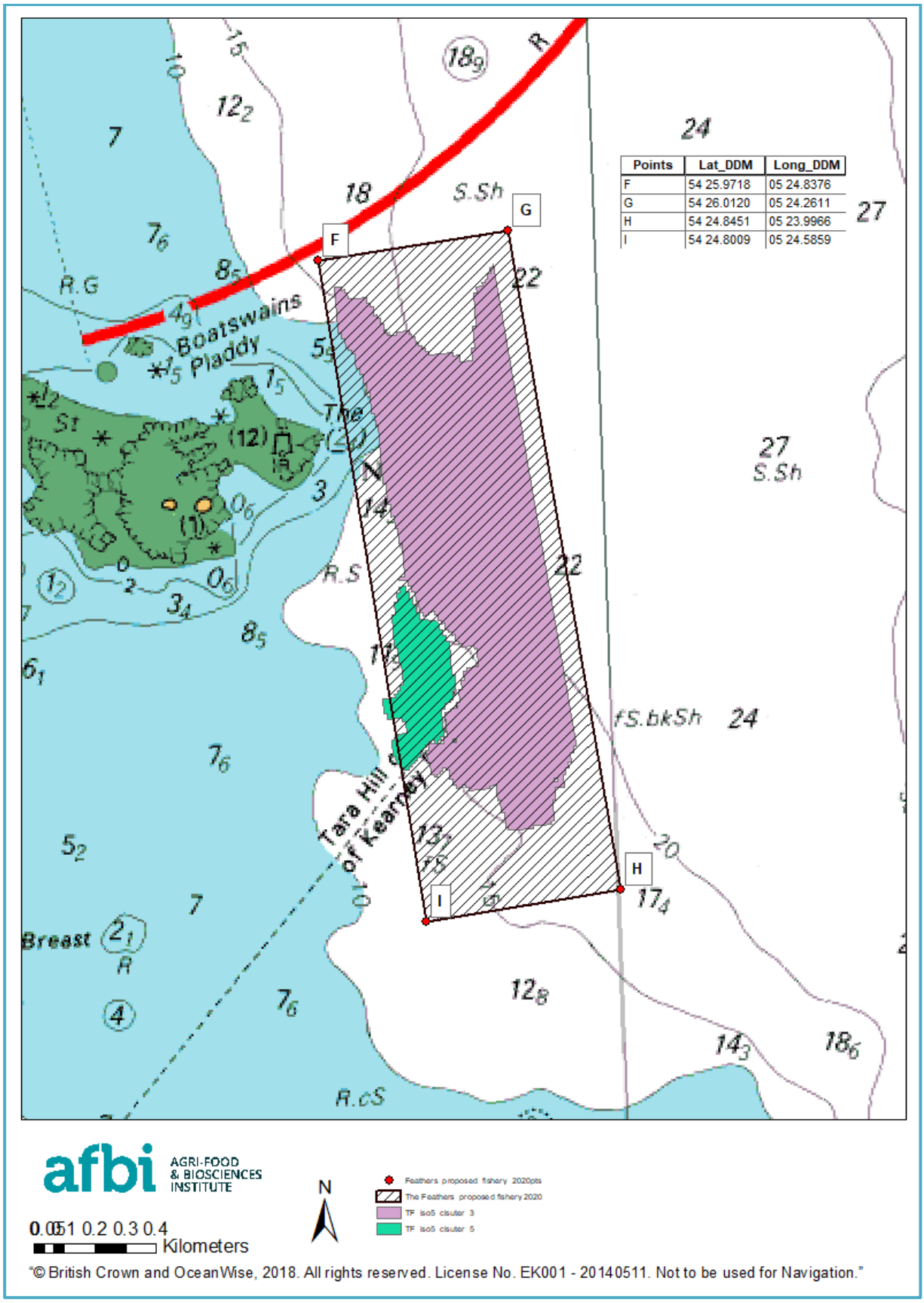


Figure 37: RoxAnn cluster map (from roughness and hardness values) from the AFBI July 2020 survey of The Feathers showing only those clusters within which mussels were found. The proposed fishery area is shown by the black hashed area on the map.

References

Dolmer, P., Kristensen, P.S., and Hoffmann, E. 1999. Dredging of blue mussels (*Mytilus edulis* L.) in a Danish sound: stock sizes and fishery-effects on mussel population dynamic. Fisheries Research, 40: 73-80.

McQuaid, N., Roberts, D., McMinn, C., Browne, L. and McDonough, N. 2017. A multi-disciplinary study of the blue mussel seed resource in the north Irish Sea and ongrowing strategies for the Northern Ireland Bottom mussel industry. Report to the Department of Agriculture and Rural Development for Northern Ireland. pp 155.

Strong, J.A. and Service, M. (2011) Using Optimum Allocation Analysis to Improve Seed Mussel Stock Assessments. *Journal of Shellfish Research* 30 (1): 1-6.

Turner, J. A., Hitchin, R., Verling, E., van Rein, H. 2016. Epibiota remote monitoring from digital imagery: Interpretation guidelines.