Seed Mussel Bed Post Fishery Survey 2020

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BIM Ireland's Seafood Development Agency

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As part of the 2020 seed mussel survey campaign, BIM was tasked to assess the potential remaining seed mussel biomass post fishery on both beds situated in the Rusk Channel and in the South Shear outside Rosslare, Co. Wexford.

Background

In late July 2020, following a preliminary seed mussel survey carried out in the Rusk Channel off the Wexford coast, a seed mussel settlement covering approximately 41 hectares was identified by BIM as part of its annual seed mussel survey effort. Another settlement was discovered earlier in July in the South Shear outside Rosslare Europort, estimated to extend to 52 hectares (http://www.bim.ie/our-publications/aquaculture/). On both sites, the survey was carried out using a side-scan sonar (van Overmeeren et al. 2009) and a 1-meter survey dredge for ground-truthing. To identify seed mussel bed acoustic signature, a catalogue of the side-scan sonar features was established by the BIM inshore survey team (BIM 2016), inspired by the Habitat Signature catalogue established by the MESH project in 2007 (Van Lancker et al. 2007).

In the Rusk Channel, the settlement appeared to be divided into three sub-beds with variable densities, while the Rosslare bed comprised one large area with a mixture of seed sizes. Prior to the fishery opening, a biomass survey was carried out on both sites. Random sampling of 32 (Rusk Channel) and 44 (Rosslare) points were generated on ArcGIS using X Tools Pro, resulting in 36 grab samples in the Rusk Channel and 42 in Rosslare. Using this data, it was estimated that approximately 3,500 tonnes of seed mussel were available in the Rusk Channel, while around 2,700 tonnes was potentially available in Rosslare. The Inverted Distance Weight (IDW) method was used to assess the potential biomass and generate density maps of the mussel settlement (Hervas et al. 2008; Jaya 2014). Following the publication of the biomass reports, and a recommendation to the Minister by the BGMCF, the fishery was opened on September 9th by the S.I. 338 of 2020 (Department Of Agriculture 2020). BIM observed no vessels fishing on the Rusk Channel settlement by September 30th, indicating that fishing activity at this location was likely over. No more seed mussel fishing activities were observed in Rosslare on the following suitable tide.

The post fishery survey was carried out over two days on October 7th and 8th in the Rusk Channel, and on October 15th in Rosslare.

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Method

To compare pre-and post-fishing data, the post fishery survey was confined to the settlement area identified during the initial side-scan sonar survey in July (Fig.1).

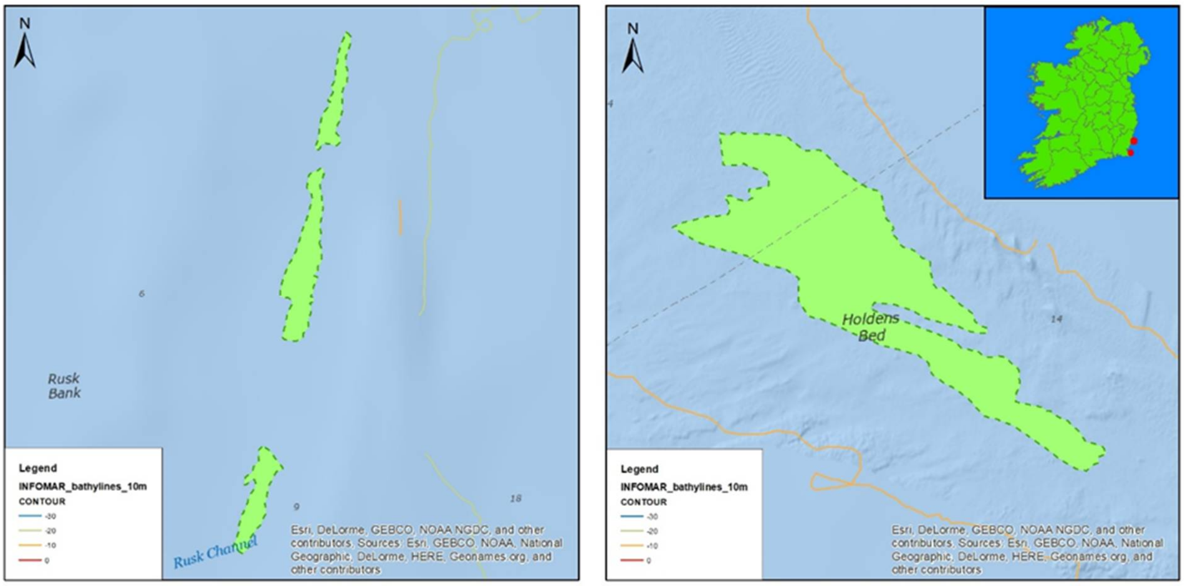

Fig. 1: Seed Mussel Beds extent 2020

Grab data collection

Using X Tools 18.1 software on ArcGIS 10.6.1, random points were generated within the seed mussel bed borders. The random point generator tool was set for 40 points with a minimum distance of 20 meters between each point in the Rusk Channel, and 30 points with 30 meters minimum distance in Rosslare. Also, extra points were manually selected in areas where limited sampling points were auto-generated. Those points were transferred on the survey vessel plotter in KML format (compatible with Time Zero plotter software). Using a Day grab with a footprint of $0.1m^{-2}$, each location was sampled within 20 meters of the generated points due to sea conditions (drift due to wind and tide). Unsuccessful grabs (jammed, open by stones, empty) were repeated on the location until a representative amount of substrate was collected (maximum of three attempts per location).

Each sample was then cleaned through a 1000 µm stainless steel mesh sieve. The survey aimed to collect mussel biomass; therefore, fine sediment, mud, and excessive coarse sediment was noted and then discarded. For each sample, the grab deployment location was recorded on seabed touchdown using a handheld GPS with 3 meters accuracy. The date, the time, depth in meters under the survey vessel, the tidal stage (speed and direction), the wind and sea conditions and a succinct description of the grab content were also recorded electronically. The grab can only be deployed while the drifting speed is inferior to 2 knots and the sea conditions are relatively calm (wave height <0.5 m). Samples were processed once back onshore on the same day.

Each sample was weighed on an electronic scale (precision 10 grams). The mussels were then separated and weighed. The waste amount was calculated by subtracting the sample weight by the mussel weight, and a waste percentage was then generated. Samples were then categorised as follows:

- weight >250 g: seed mussel
- weight <250 g: signs of seed mussel
- no mussel: shells and stones (including gravel, coarse sand, shell ashes)

The grab data was then transferred as a point shapefile into ArcGIS, including the position in latitude and longitude (WGS84), depth, category, total weight, the weight of mussel and weight of waste. The created shapefile was used to extrapolate mussel densities across the settlement.

Biomass estimation

As for previous biomass surveys in 2020, the IDW method was used (search radius for interpolation setting: 3 points). The created IDW raster was then reclassified following the range of mussel weight found throughout the samples. Polygons were created from the reclassified raster and area for each class was calculated in meter squared (m^{-2}) using the calculate geometry tool in the attribute table. The number of grabs and average weight per classes was extracted using the summary tool. An Excel table was then created with the extracted data, and calculated values were converted into industry relatable units (metric tonnes and hectares).

Acoustic data

The settlement area was also re-surveyed using side-scan sonar. Data was collected in 400 kHz with a swath of 2 x 100 meters. To ensure position accuracy, tow fish layback was applied to the data prior to recording. The most suitable towing speed is situated between 2 and 4 knots. The side-scan sonar data was then directly processed onboard using SonarWiz 6. The native Edgetech data format (.jsf) was imported with extra gains (Auto JSF Scalar, TVG set at 40dB/100m and ADC Gain from JSF sonar packet) for better definition. The data was cleaned firstly by setting the bottom track on each survey track. This removed part of the nadir (space between the two transducers on the tow fish) and makes the port and starboard signal as seamless as possible. Empirical Gain Normalisation (ENG) was applied to the first processed track; this action removed interferences and increased textures details. This treatment was then applied to the other tracks. The created mosaic was exported as a georeferenced image (GeoTIFF) with a resolution set at 0.2 meter per pixel for best texture detail renderer. This image was imported into ArcGIS where features were extracted by hand based on expert judgment (Brown et al. 2011; Diesing et al. 2014, 2020; Van Lancker et al. 2007).

Ground truthing

A 1 meter wide dredge equipped with chain belly (36 mm diameter) and a top diamond mesh (70 mm inner mesh measurement) was used to ground-truth features marked on the side-scan sonar data. The dredge was towed through the mark for an average distance of 100 meters. The towing speed was between 1 and 2.5 knots. Start and end coordinates (WGS84) were recorded along with the average depth, date, time, weather condition, tide speed and direction, location, category (seed, signs, shells and stones, other species), towing speed and a description of the content of the dredge. The data was plotted on ArcGIS, and the towing distance was calculated using the calculate geometry tool.

Biometrics

Three subsamples of 100 individuals were set aside either from dredge sampling or pooling the mussel samples from the grabs. The shell length (anterior to posterior) was measured on each mussel using an electronic calliper. Summary statistics (Excel) were then run on each subsample to determine the mean, the smallest, and the largest range. The measurements of the three subsamples were pooled to assess the cohort range distribution using a histogram.

Day grab on the survey vessel deck

Results

Rusk Channel

Grab data collection

Relatively calm sea conditions allowed BIM to collect 17 grabs on the first day and 16 on the second. A total of 8 grabs did not return any seed mussel (Fig.2).

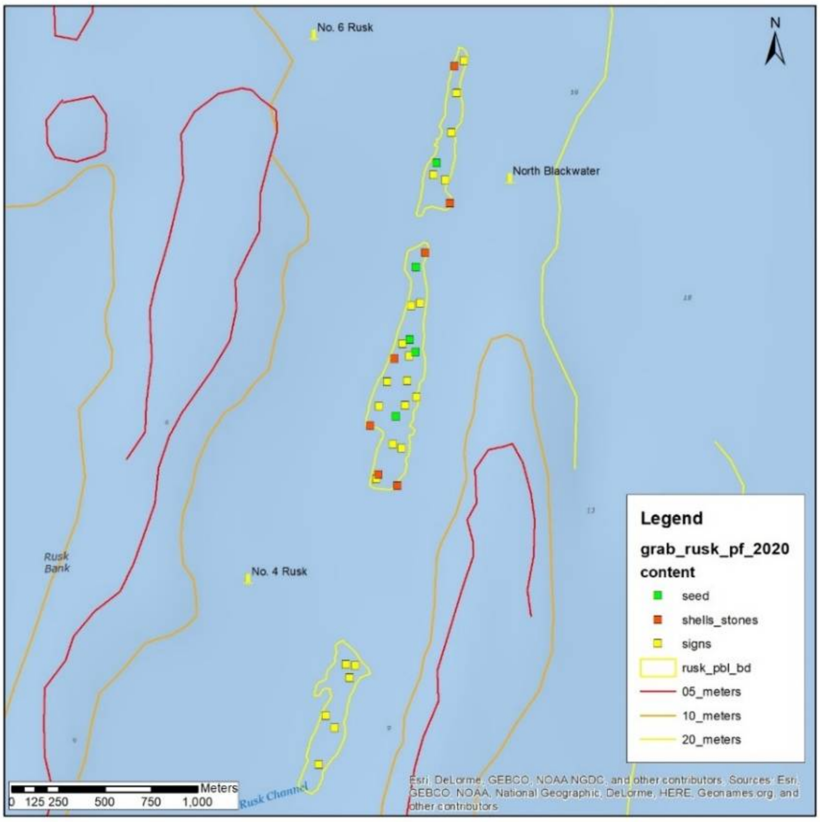

Fig.2: Grabs distribution and category

Out of the 32 grab samples, 74% grabs presented low amounts of seed: <150 grams of seed mussel per grabs (Fig.2 and 3). However, significant amounts of clean seed were found in the central bed. The southern patch which returned a high density of smaller seed prior to the fishery showed only low amounts of remaining biomass, indicating a higher fishing effort than the two northern patches (Fig.2 and 3). The average total weight recorded throughout the grabs (Limited to those containing mussels) was 759.89 grams (Max. 1,504 g; Min.: 70 g). The average weight of mussel recorded across the sample was 124.89 grams (Fig 4. Max.: 541 g, Min.:13 g).

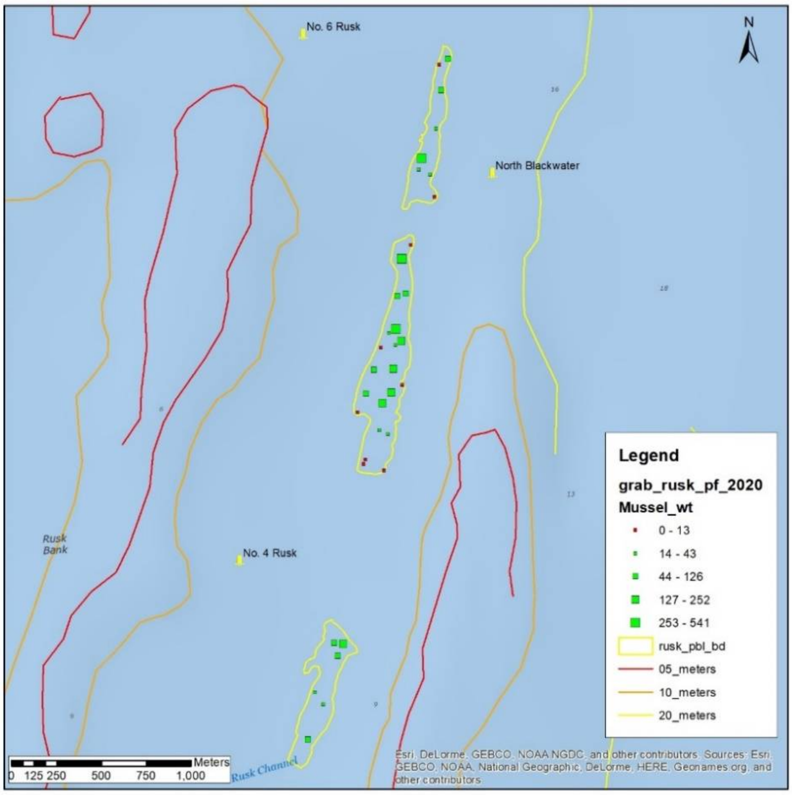

Fig.3: Seed mussel weight per grabs

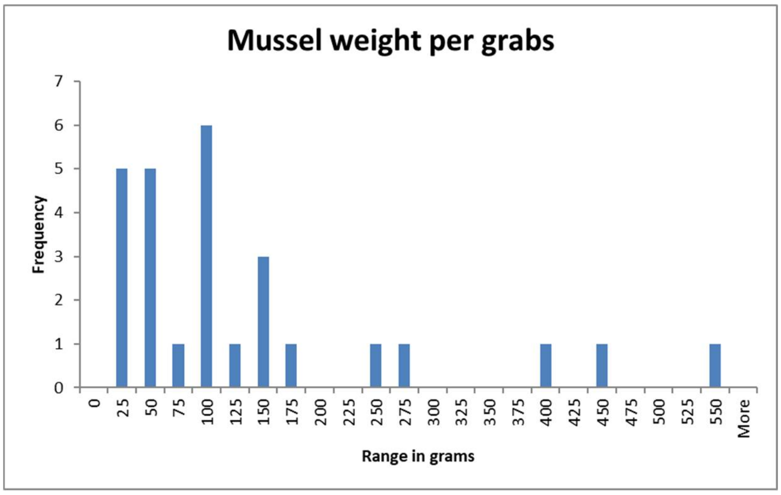

Fig.4: Range distribution of mussel weight (g) per grabs

The grab content, limited to those containing mussels, was characterised by a high level of waste (80% in average) mainly composed of small gravel, coarse sediment, and broken shell (due to fishing activity and/or predation). The average waste per grab was 635 grams (Max.: 1,332 g; Min.: 45 g). Highest waste levels were concentrated in the central patch. The south patch showed low levels of waste which correlates with pre-fishery levels (Fig.5).

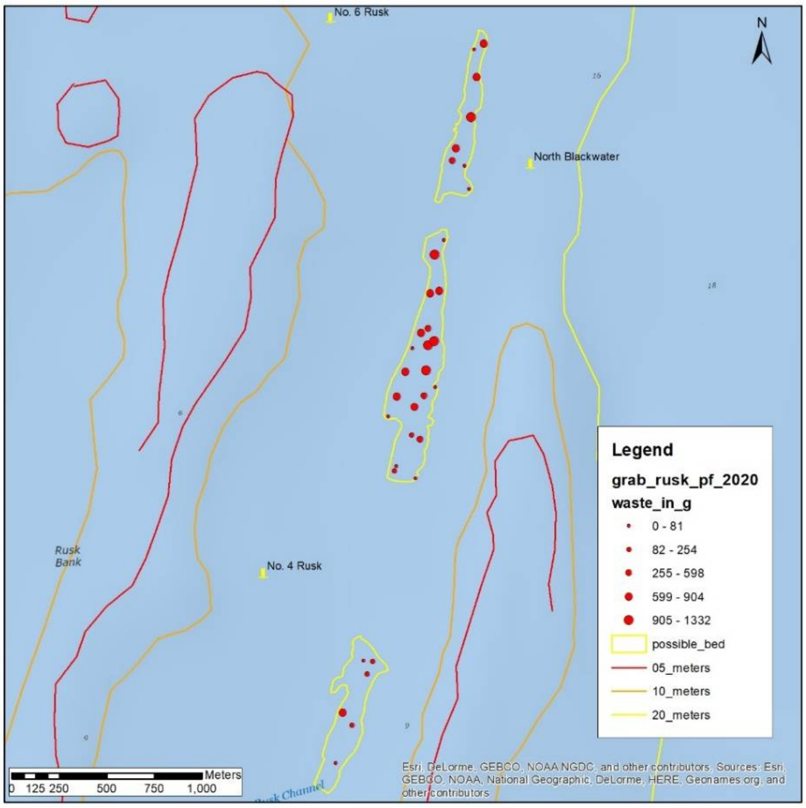

Fig.5: Waste amount distribution per grabs

Biomass estimation

The IDW interpolation method using a scale representing the data recorded showed significantly greater mussel density on the north side of the central bed and on the north patch (Fig.6). However, density levels are low in comparison to pre-fishery (see Pre and Post fishing Comparison). The potential remaining mussel biomass was approximately 417 tonnes (Table1), mainly distributed on the northern part of the central patch. The south patch appears nearly fully depleted. Some mussel seems to remain in the lower part of the north patch.

The amount of waste bycatch highlighted above would likely be an impediment for the industry to collect the remaining seed.

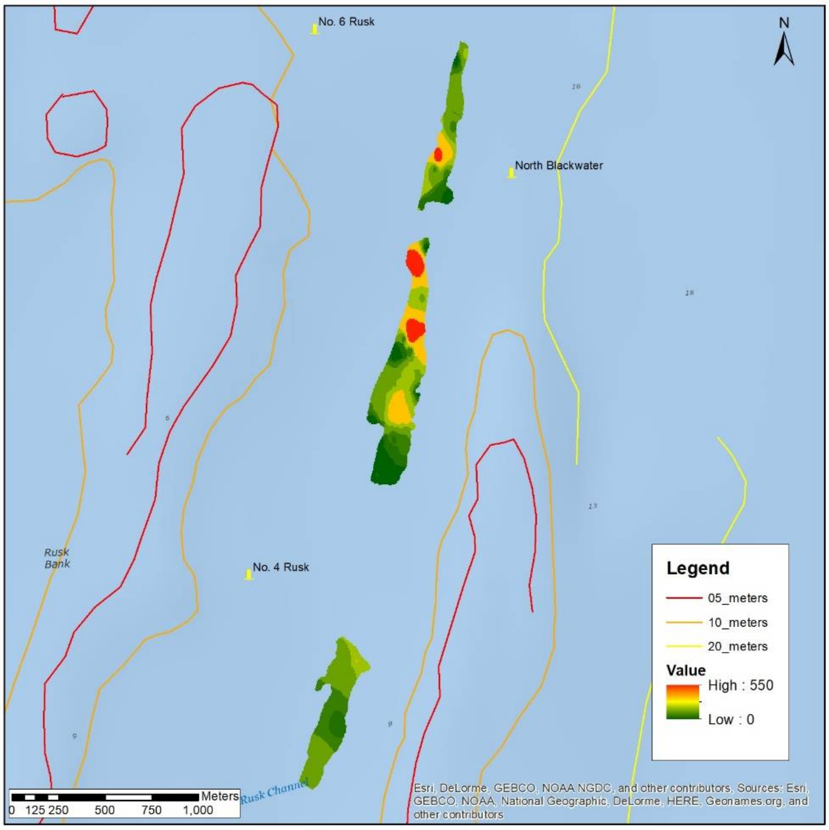

Fig.6: IDW interpolation density map

Density Classes in g	Areas in hectares	N samples	Mean Wt. per 0.1 m⁻² in Kg	Tonnes/Area
0	3.69	6	0.00	0.00
13 to 25	3.77	3	0.02	6.16
25 to 50	5.69	7	0.03	18.05
50 to 75	7.32	1	0.07	47.61
75 to 100	6.72	6	0.08	56.03
100 to 150	6.51	4	0.13	86.31
150 to 200	2.46	1	0.15	37.22
200 to 250	1.92	1	0.24	45.97
250 to 300	1.09	1	0.25	27.42
300 to 400	1.74	1	0.38	66.06
400 to 550	0.54	2	0.49	26.72
Total area	***41.48***		***Total tonnage***	***417.56***

Table 1: IDW biomass interpolation

Acoustic survey

The results from the acoustic survey showed that most of the features observed in July have disappeared. However, some seem to have remained within the July settlement boundaries and extend to 9.58 hectares (Fig. 7). There appeared to be a limited correlation between these areas and the IDW interpolation, a possible reason for this is that a greater level of surveying should have been undertaken in these locations, however, due to limited time and requirements to survey large areas in advance of a potential fishery, this was not achievable.

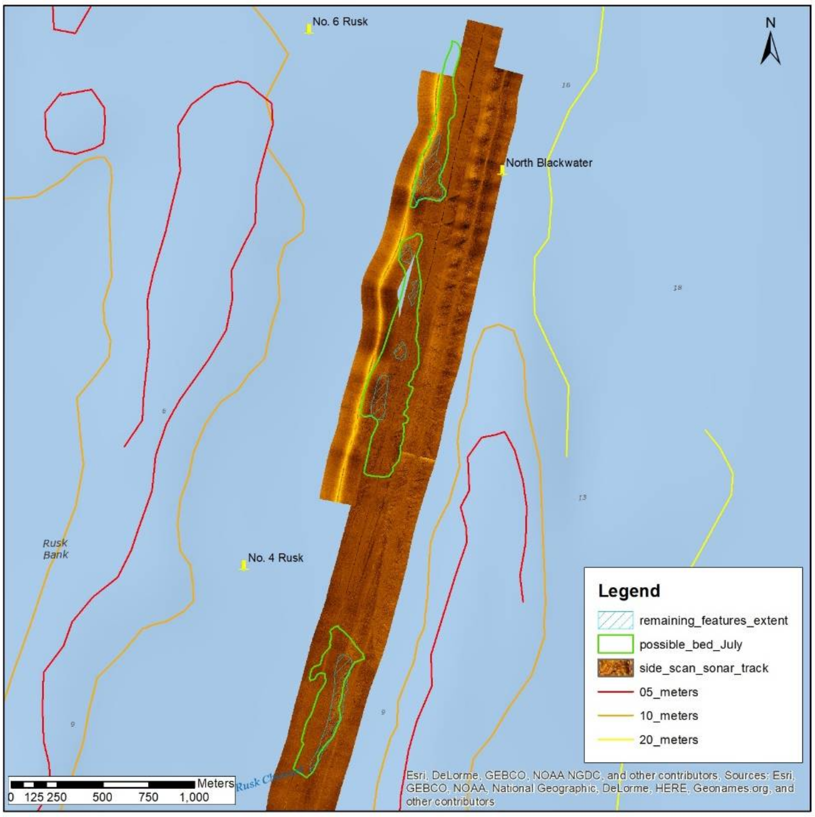

Fig.7: Post fishery acoustic survey extent

Biometrics

The remaining mussels' mean size was 32.24 mm (minimum:17.92 mm, maximum: 44.03 mm). The main population, representing 65% of the 300 individuals measured, was between 28 and 36 mm throughout the surveyed area (Fig.8). The post fishery population range was less evenly distributed than the original biomass survey, during which no size range was represented by greater than 40 individual mussels. In comparison, the post fishery population biometric data shows that the 32 to 34 mm class, was composed of 64 individuals or 21% of the measured samples.

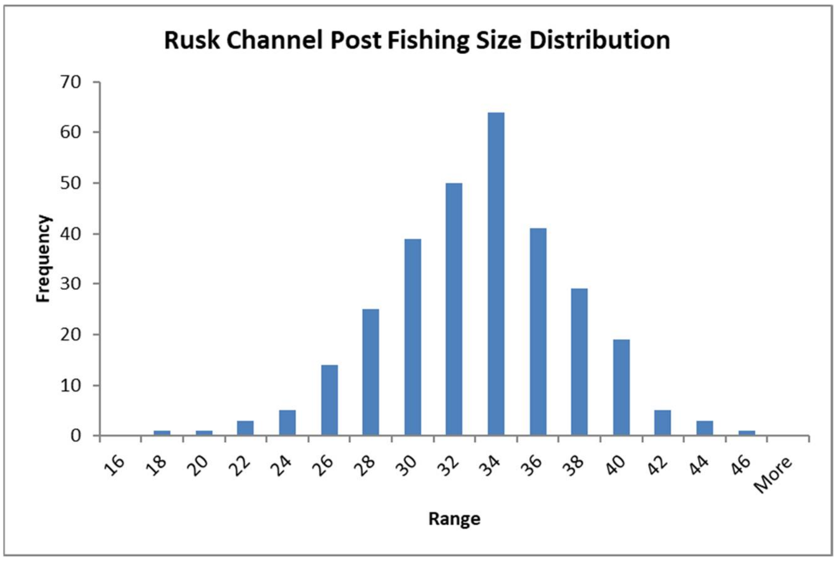

Fig.8: Size range distribution in the Rusk Channel post fishing

Content of survey dredge from the Rusk Channel

Rosslare

Grab data collection

Despite fresh easterly conditions at the start of this survey, 31 grabs were successfully taken within the Rosslare bed's known boundaries, over the two slack tides on October 15th. Ten grabs needed to be retaken due to the high concentration of stones in the area, which resulted in the grab being jammed open. A total of 7 grabs showed no mussels.

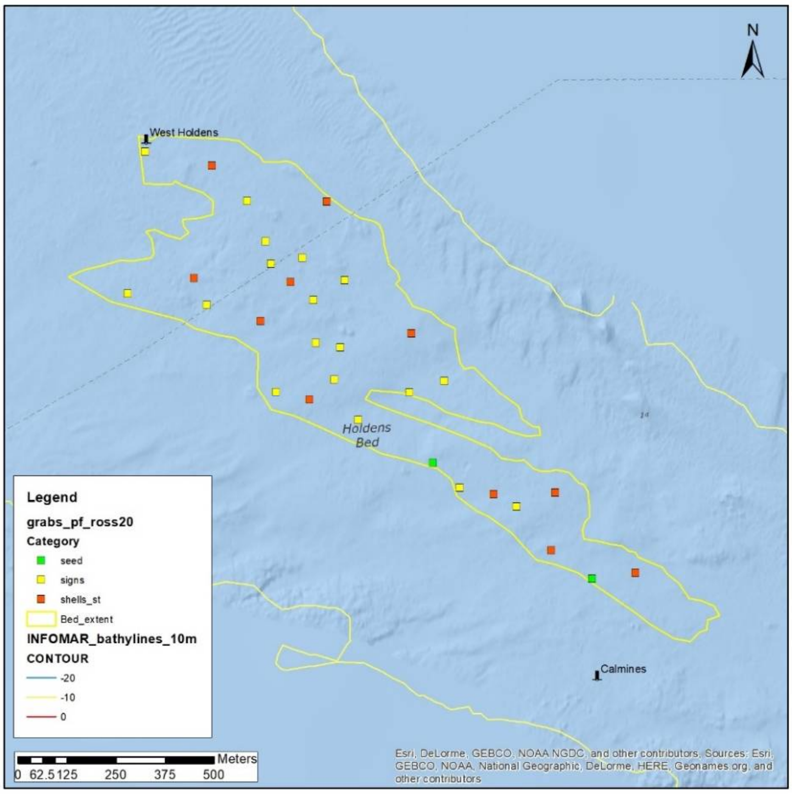

Fig.9: Grabs distribution and category

Out of the 24 grab samples, 92% of grabs presented low amounts of seed: <150 grams of seed mussel per grabs (Fig.9 and 10). A significant amount of seed was found in one grab collected on the bed's southeast border (the largest square in Fig.10). The sample was very clean and returned 2,015 g of mussels with only 137 g of waste. However, the two other grabs in the vicinity did not show any presence of mussel. Due to weather conditions and associated time limitation, no additional samples were taken in the proximity of the high content grab; nevertheless, acoustic data was collected in the area. The average total weight recorded throughout the grabs was 600.96 grams (Max: 2,152 g; Min: 152 g). The average weight of mussel recorded across the sample was 140 grams (Max: 2,015 g; Min:5 g), which is slightly higher than the Rusk Channel samples. This value is probably due to the contribution of several high content grabs and the size range of the seed (see Biometrics for Rosslare).

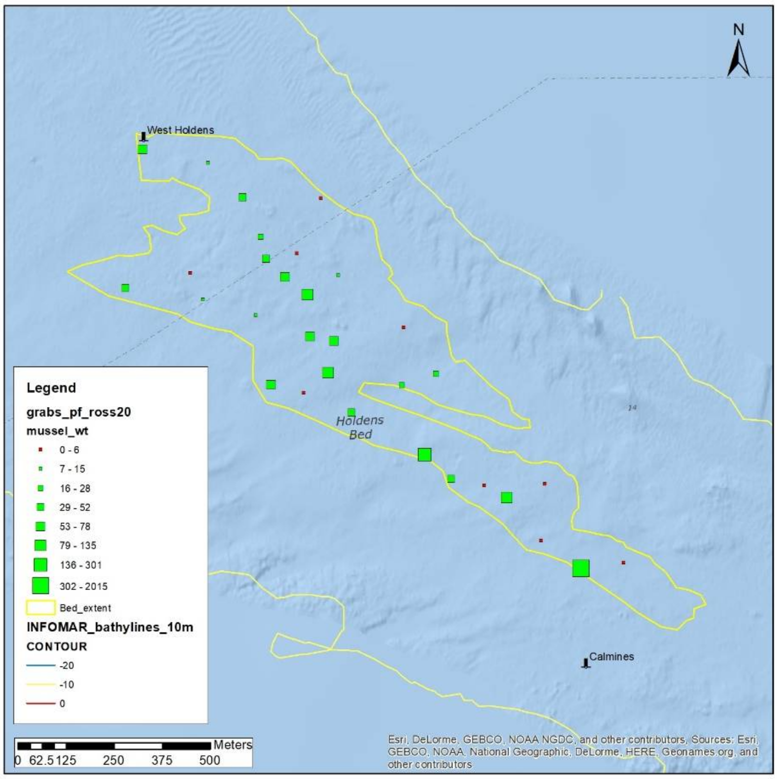

Fig.10: Seed mussel weight per grabs

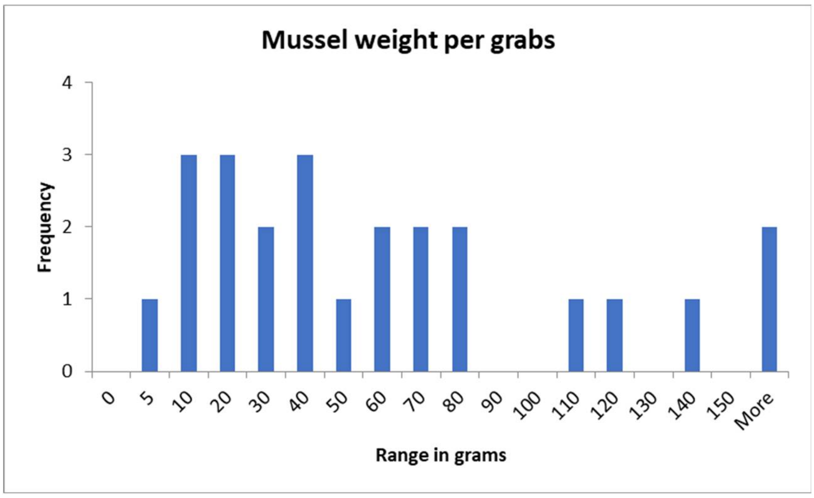

Fig.11: Range distribution of mussel weight (g) per grabs

Again, the grab contents, limited to those containing mussels, contained high waste levels (83% on average). The waste was mainly composed of small gravel, coarse sediment, and broken shell (due to fishing activity and/or predation). The average waste per grab was 492.71 grams (Max.: 1,775 g; Min.: 84 g). The waste appears to be concentrated along the southern border of the bed. On average, the Rosslare bed's remaining biomass presented less waste than in the Rusk Channel bed.

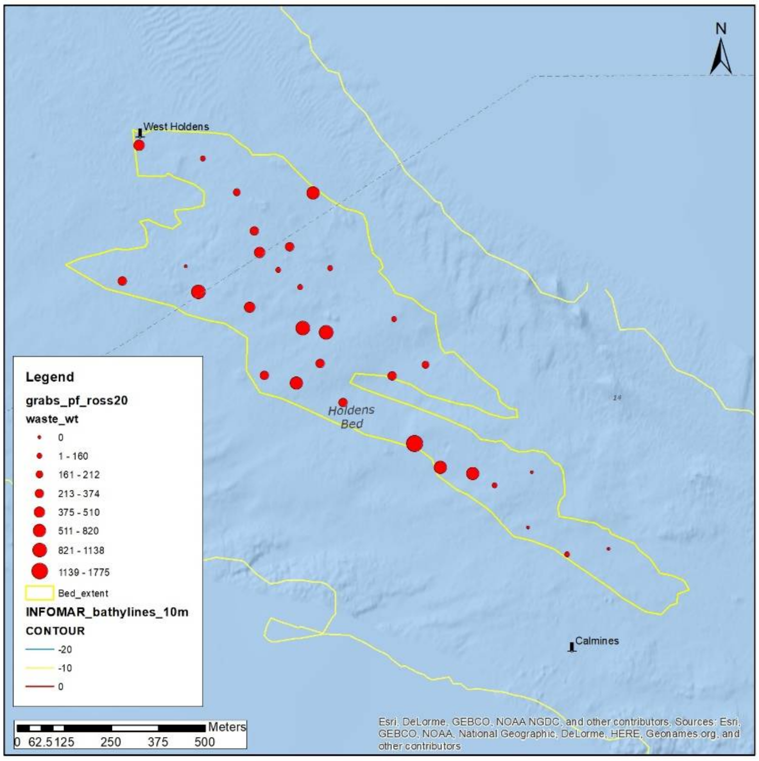

Fig.12: Waste amount distribution

Biomass estimation

Considering the range of the data, the large grab containing 2,015 grams of seed had to be considered as an outlier; therefore, it was not included in the IDW interpolation for Rosslare. Biomass estimation calculated, including the aforementioned grab, showed unrealistic levels of remaining mussels, not supported by side-scan analysis.

Again, interpolation using data fitting scale was used to calculate possible biomass distributions within the borders of the beds delineated in July. As in the Rusk Channel bed, potential remaining biomass levels are low; yet possible significant levels could remain in the centre south of the settlement (Fig.12). The south end of the bed appears to be depleted; however, considering the quantity of mussels found in the isolated grab in the area, more investigation would be needed to confirm this estimation fully. The north and northeast parts show near to full depletion. The remaining biomass could represent 195.1 tonnes (Table 2), mainly distributed along the southern border.

Again, the distribution throughout the bed and the level of waste, would make the fishing of remaining biomass unviable for commercial purposes.

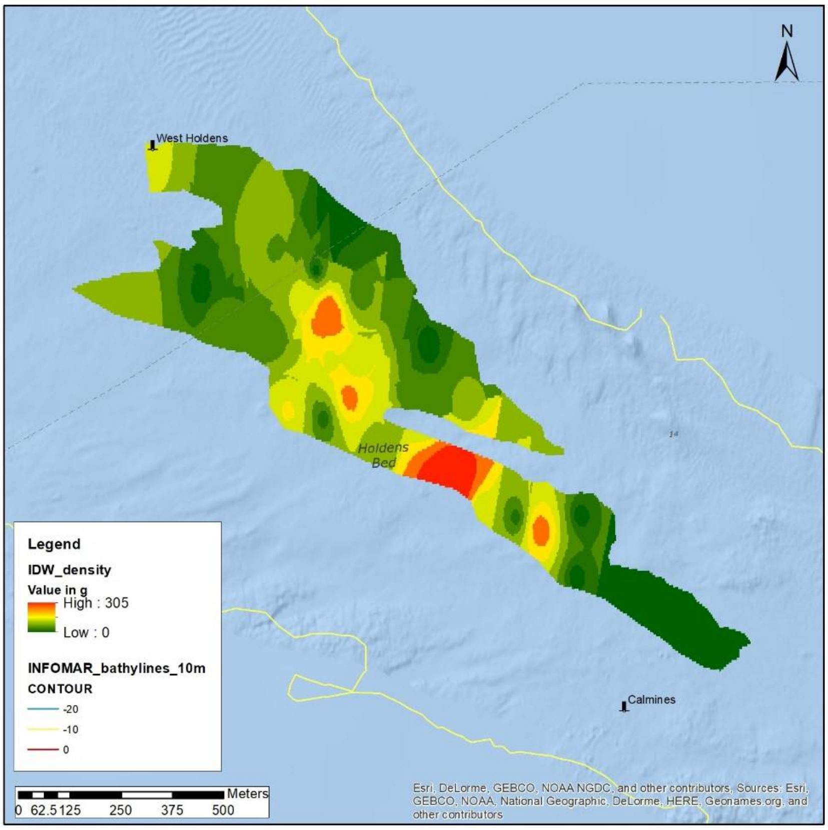

Fig.12: IDW biomass density interpolation

Density Classes in g	Areas in hectares	N samples	Mean Wt. per 0.1 m^{-2} in Kg	Tonnes/Area
0	6.73	7	0.00	0.00
3 to 10	6.17	2	0.01	3.40
10 to 25	13.30	6	0.02	20.17
25 to 50	13.24	5	0.04	48.71
50 to 75	6.89	5	0.06	43.81
75 to 100	3.20	1	0.08	24.98
100 to 150	1.60	3	0.12	19.26
150 to 305	1.18	1	0.30	35.39
Total area	***52.30***		***Total tonnage***	***195.71***

Table 2: IDW biomass interpolation

Acoustic survey

The acoustic survey showed that most seed mussel structures have disappeared as for the Rusk Channel bed. Nevertheless, a stripe appears to remain in the southeast. This correlates with the grab data collected from the area (see Grab Data Collection). As mentioned above, further investigation would have needed to be carried out to have a more accurate idea of the remaining biomass levels. Indeed, this possible area does not relate to the IDW interpolation estimation (Fig.13). In total, the two possible remaining areas represent approximately 3.29 hectares.

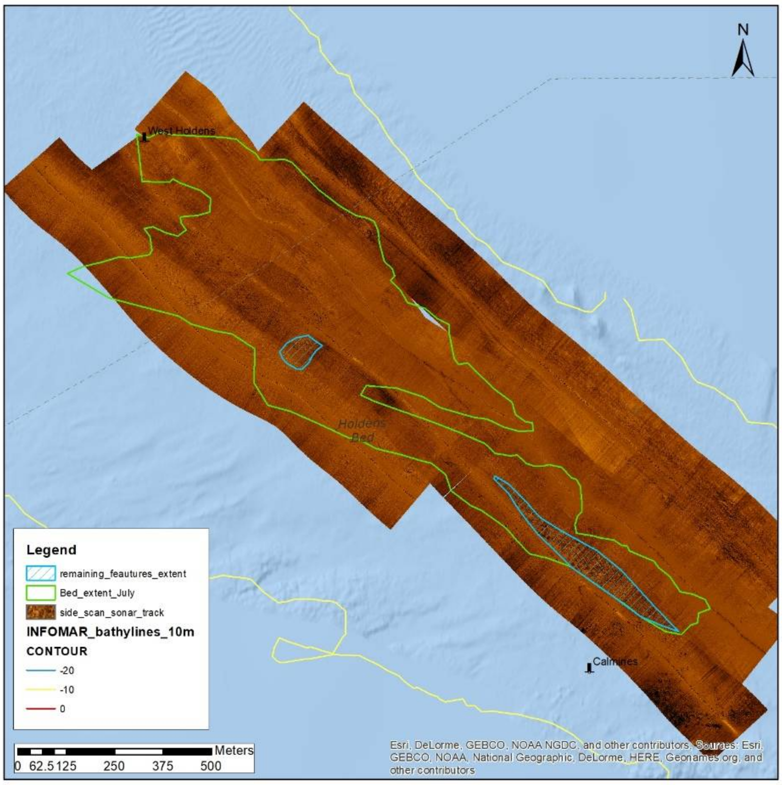

Fig.13: Post fishery acoustic survey extent

Biometrics

The average seed size observed during the post fishery survey in Rosslare was 37.77 mm (minimum: 19.08 mm; maximum: 53.87). The most represented class range was between 40 and 46 mm, accounting for 39% of the mussels measured. As for the pre-fishing survey, the data indicates two-distinct population sizes, likely corresponding to two different settlement times (Fig.14). The larger class range (36 to 50 mm) is the most common within the samples (62%) while the second class (20 to 34 mm) represents 22% of all measured individuals.

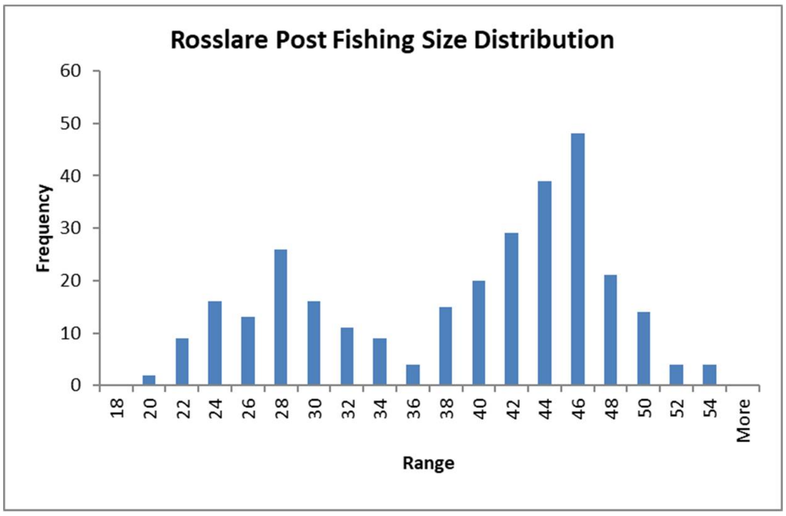

Fig.14: Size distribution on the Rosslare Bed post-fishing

Broken shell from the Rosslare bed

Comparative analysis

Biomass

Overall, the Rusk Channel bed and the Rosslare bed were predicted to yield approximately 6,300 tonnes (3,588.49 tonnes for the Rusk Channel and 2,737.99 tonnes for Rosslare). The post fishery survey data indicates approximately 613 tonnes left across both locations. This would correspond to less than 10% of the initially predicted biomass (11.62% in the Rusk and 7.15% Rosslare).

By comparing the IDW interpolations pre- and post-fishing for each site, we can observe variations in biomass density s, noticeably in areas with pre-fishing high-density such as the south patch and the southern end of the central patch in the Rusk Channel (Fig.15). In Rosslare, the highest variations are observed in the central part of the bed and close to the southern border (Fig.16), yet it must be noted that the post fishery biomass estimation at this location did not take account of the outlier sample discussed above. The areas presenting lower variations could correspond to less fishing effort; however, this could only be confirmed by overlaying VMS data from the fleet, which was not possible at the time of this report.

It is expected that by carrying out more extensive post fishing surveys and by concentrating grab samples in areas presenting relevant acoustic features, the precision of biomass estimates would be enhanced.

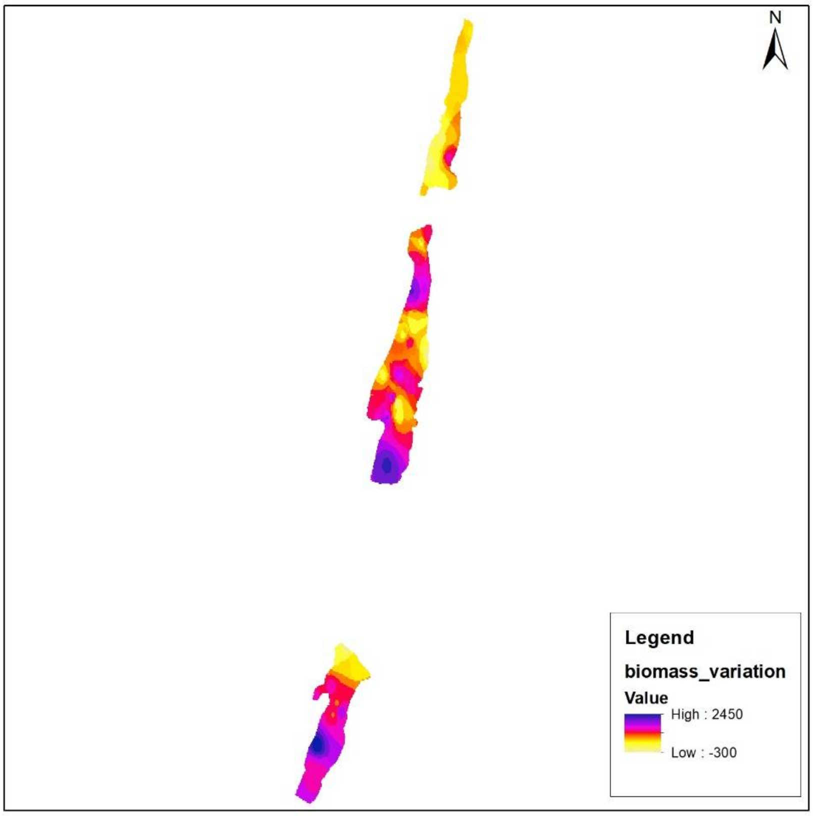

Fig.15: Estimated biomass variations pre-and post-fishing in the Rusk Channel

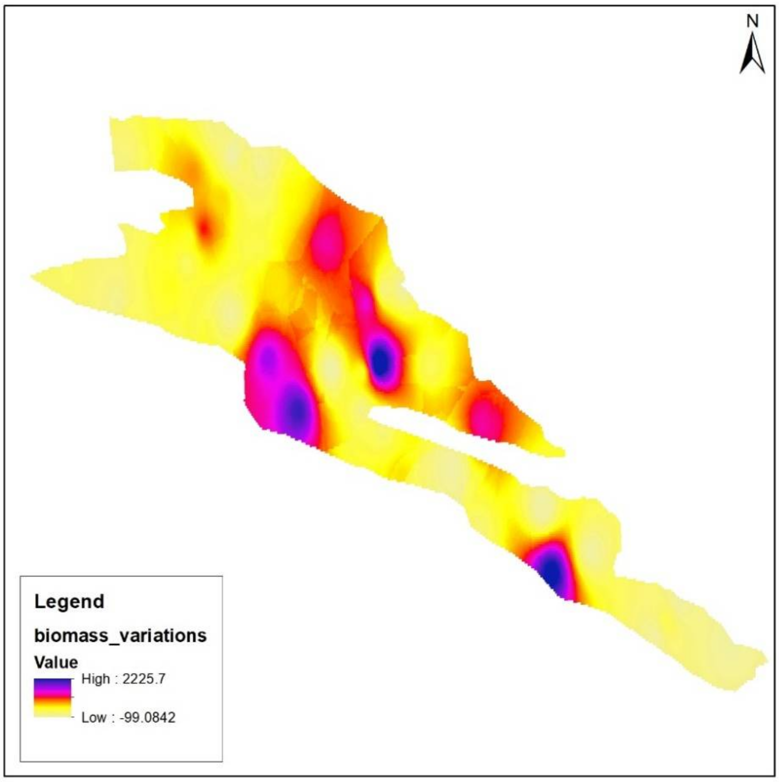

Fig.16: Estimated biomass variations pre-and post-fishing in Rosslare

Biometrics

It appears that there was significant growth between the two sampling periods at both locations. In Rosslare, the minimum mussel size has increased by more than 3 mm and the median size by more than 10 mm. Yet, the maximum size was similar pre- and post-fishing with only a regression of 1.1 mm. The increase is most noticeable in the Rusk Channel, with the minimum size gaining more than 12 mm and the median size increasing by more than 13 mm, while the maximum increased by more than 11 mm (Table 3).

	Pre-fishing WX	*Pre-fishing CH*	*Post fishing WX*	*Post fishing CH*
Mean	32.61	19.08	37.77	32.24
Standard Error	0.5748	0.3674	0.5051	0.2532
Median	27.905	18.685	40.825	32.365
Standard Deviation	10.1195	6.3642	8.7484	4.3862
Range	39.55	27.02	34.79	26.11
Minimum	15.41	5.38	19.08	17.92
Maximum	54.96	32.4	53.87	44.03
Count	310	300	300	300

Table 3: Summary statistics for pre and post fishing biometrics in Rosslare(WX) and the Rusk Channel(CH)

There was a slight decrease in the size range post-fishing at both locations; this is likely due to the reduction of growth of the larger individuals and the development of the smaller individuals. The increase of the mean size for both locations post fishing is more than 5 mm for Rosslare and 13 mm for the Rusk Channel, which again partially correlates to the above hypothesis(Table 3 and Fig.17). The removal of most of the biomass could, also, have played a role in reducing the size range, but this could only be confirmed with data from multiple years.

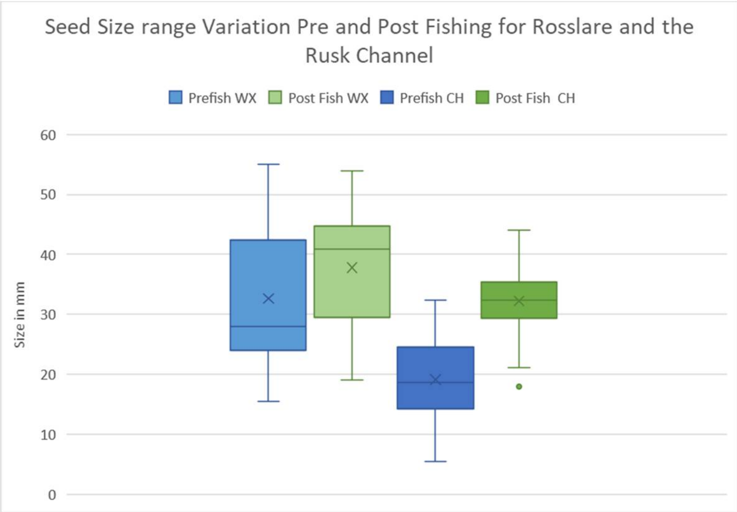

Fig.17: Size variations at both locations pre and post fishing.

Size distribution pattern remains similar for Rosslare pre and post-fishing, with an understandable slight shift to larger individuals. This also highlights the growth of the mussels in this bed (Fig.18). Despite the removal of most of the biomass, the two distinct cohorts observed pre-fishing are still noticeable, which could indicate that the industry did not preferentially target one population.

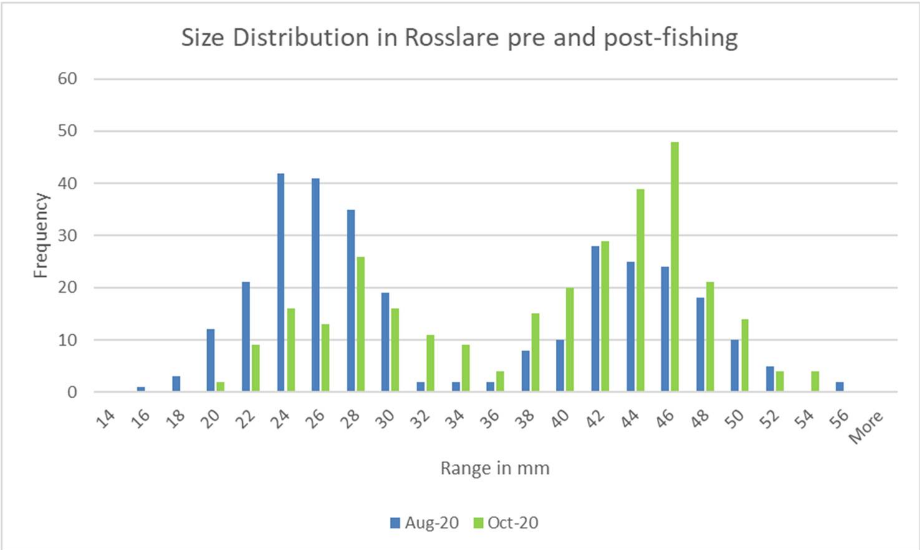

Fig.18: Seed mussel size distribution in Rosslare pre and post-fishing

In the Rusk Channel (Fig.19), the population size pre-fishing was evenly distributed throughout the range; it was not the case post-fishing. As mentioned above, the post-fishing biometrics showed that the 30 to 32 mm class dominated the population distribution (21% of all samples measured). This is a significant difference in the distribution pattern that also indicates a high growth rate, from the end of August to the start of October, the seed mussel nearly doubled in size. The most common cohort pre-fishing was between 16 and 18 mm. At in October, it was the 30 to 32 mm cohort which indicates a 14 mm increase. This growth rate is similar to that reported in the literature for suspended culture (Pérez-Camacho et al. 1995).

This high growth rate could be associated with the type of seed mussel found in the Rusk Channel. Unlike the seed in Rosslare, the seed in the Rusk likely settled in spring and was characterised by a light shell typical of young mussels and usually indicates a high growth rate (Aldrich and Crowley 1986). It is possible that the overwintered mussel in Rosslare dedicated more energy to produce gonads, rather than supporting growth; however, this hypothesis would require further investigation.

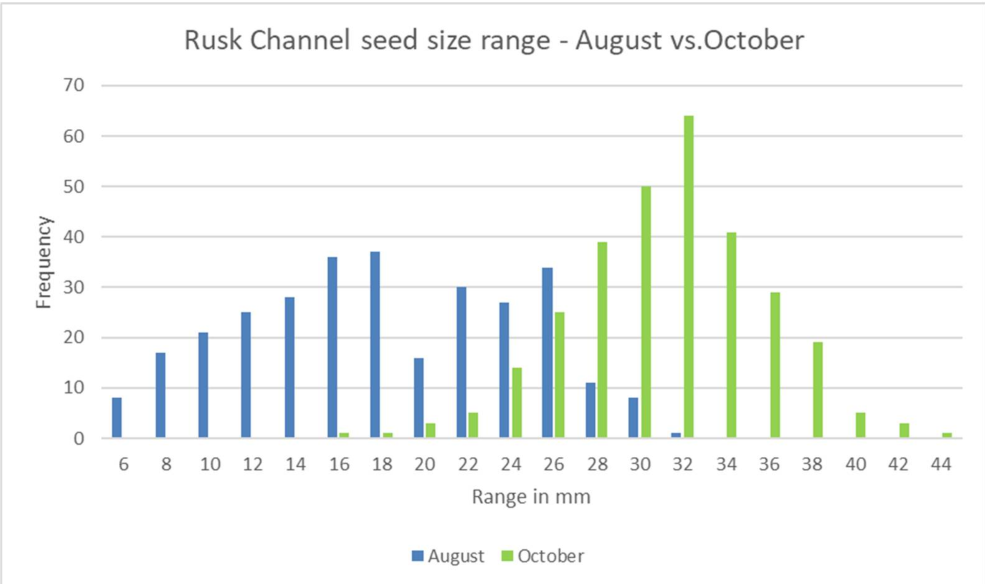

Fig.19: Seed mussel size distribution in the Rusk Channel pre and post-fishing

Acoustic survey

This section highlights the differences between the features on the seabed pre and post-fishing. As mentioned above, most of the identified seed mussel features observed on both beds before the fishery was not seen during the post-fishery acoustic survey.

For the Rusk Channel, three locations were selected on the original survey data and replicated on the post-fishery data (Fig.20). Although the side-scan sonar track did not follow the same pattern pre and post fishing, the relevant ground (i.e., the seed mussel settlement) was covered.

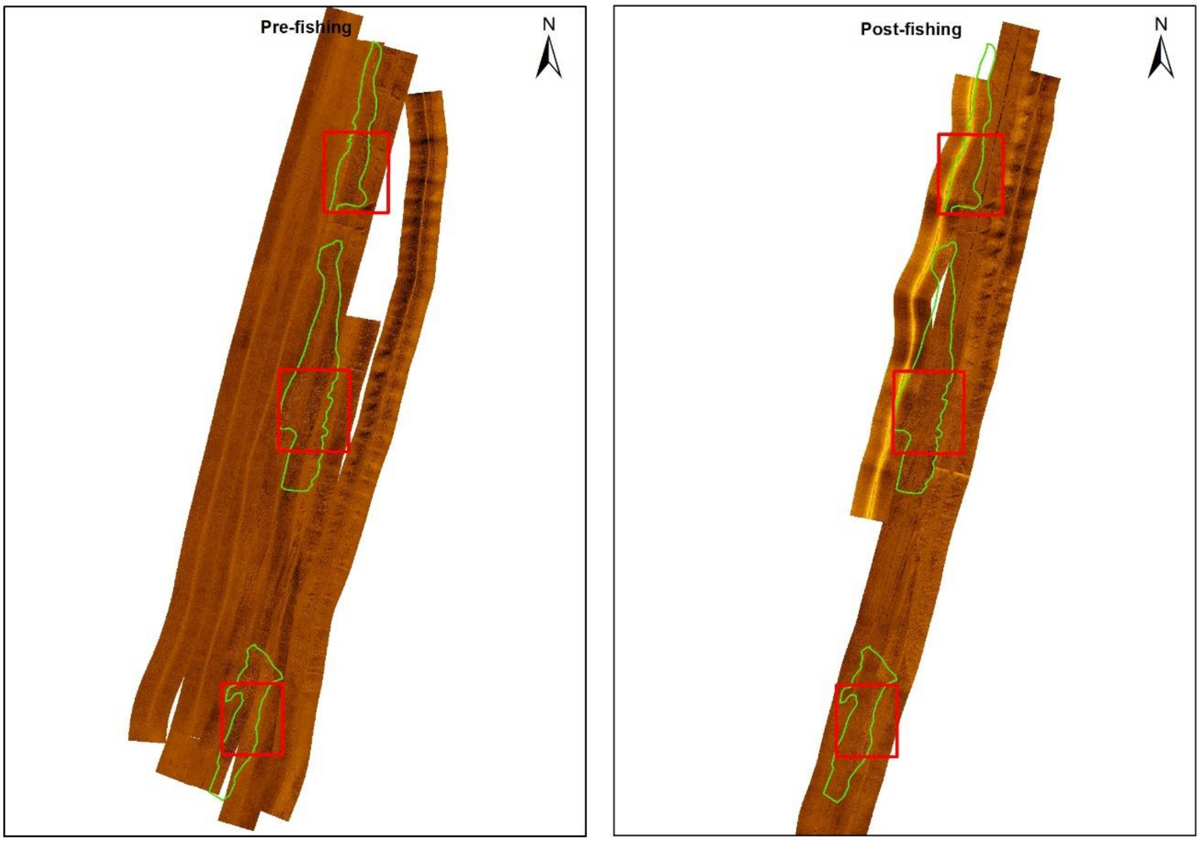

Fig.20: Selected areas on the acoustic data in the Rusk Channel

At Rosslare, only two locations were shortlisted for more detailed assessment as the settlement was not as spread like the one in the Rusk Channel (Fig.21). Within those locations, three small areas showing distinctive differences were selected.

The selected areas were picked due to their distinct feature variations pre and post-fishing. It is worth noting that those variations were not observed all over the marked settlement, but it was clearer to use areas with high feature differences for the purpose of this document.

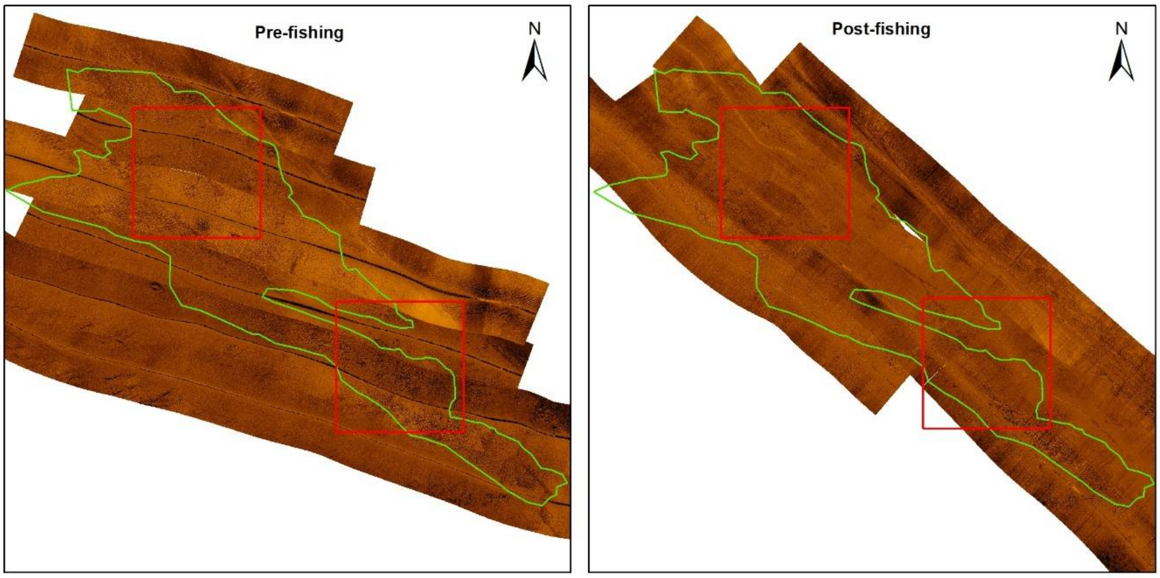

Fig.21: Selected areas on the acoustic data in Rosslare

Rusk Channel

In the Rusk Channel, starting with the south end of the settlement (Fig.22), the difference is noticeable.

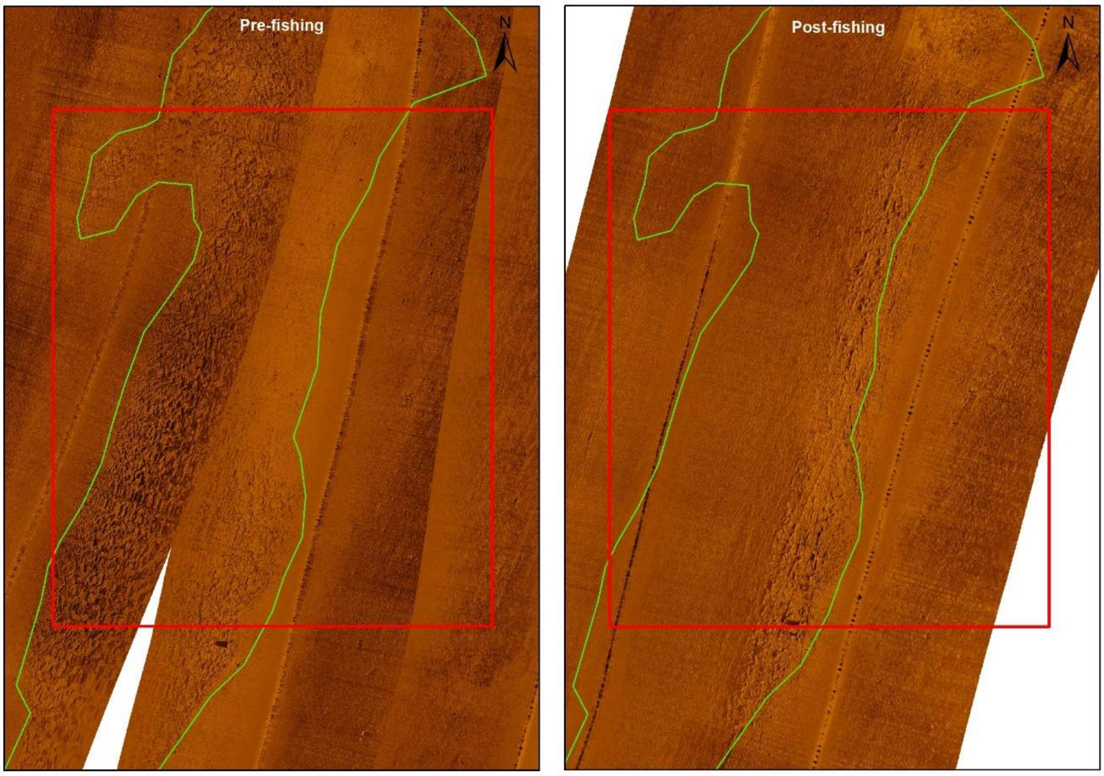

Fig.22: Rusk Channel Settlement Southern Part pre and post-fishing acoustics

Indeed, this area corresponds to one of the highest biomass variations highlighted previously. The "crumble-top" texture clearly visible on the left map is absent on the right map. However, it seems that some texture remains, especially along the eastern border where some dredge marks are also visible (right map). Nevertheless, the biological data collected at proximity only shows limited amounts of biomass. The remaining features in the Rusk Channel represent 23% of the area of the original settlement.

In the centre of the settlement, again a location with a high variation of biomass, the darker features from the pre-fishing survey, corresponding to shadows made by rises from the seabed, have disappeared and dredge marks are again clearly visible (Fig. 23). Some texture appears to remain on the western side, but again the grab data collected at this location shows low biomass.

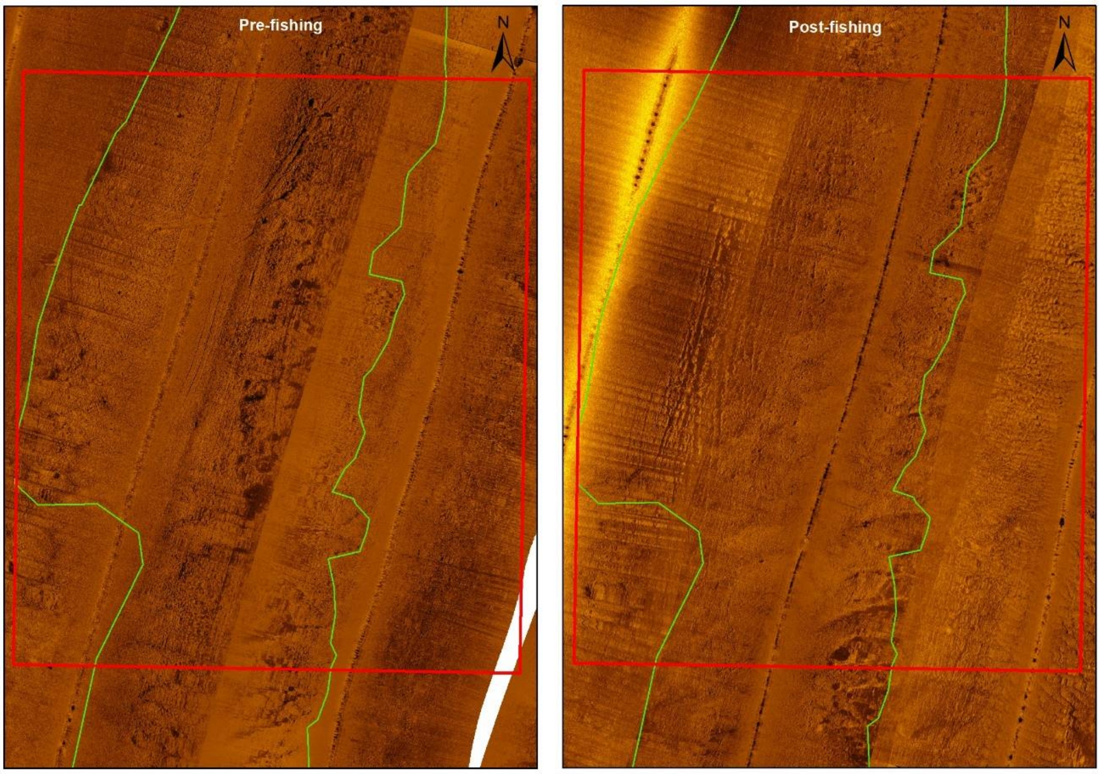

Fig.23: Rusk Channel Settlement Central part pre and post-fishing acoustics

The northern patch still shows significant features post fishing (Fig.24). This is partially confirmed by the biomass variation analysis where the northern part displays low variations pre and post-fishing. The biological data collected at this location also indicates a larger amount of biomass remaining in this area.

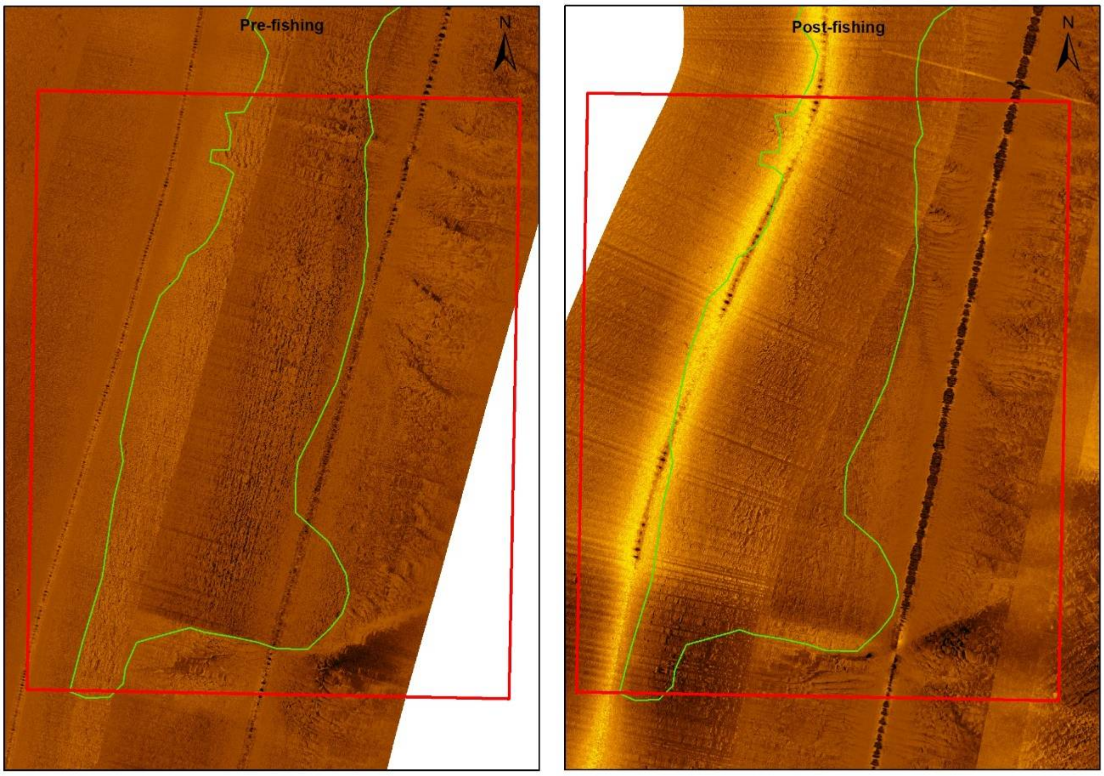

Fig.24: Rusk Channel Settlement Northern part pre and post-fishing acoustics

Rosslare

The feature variation on the Rosslare beds appear even more apparent (Fig. 25).

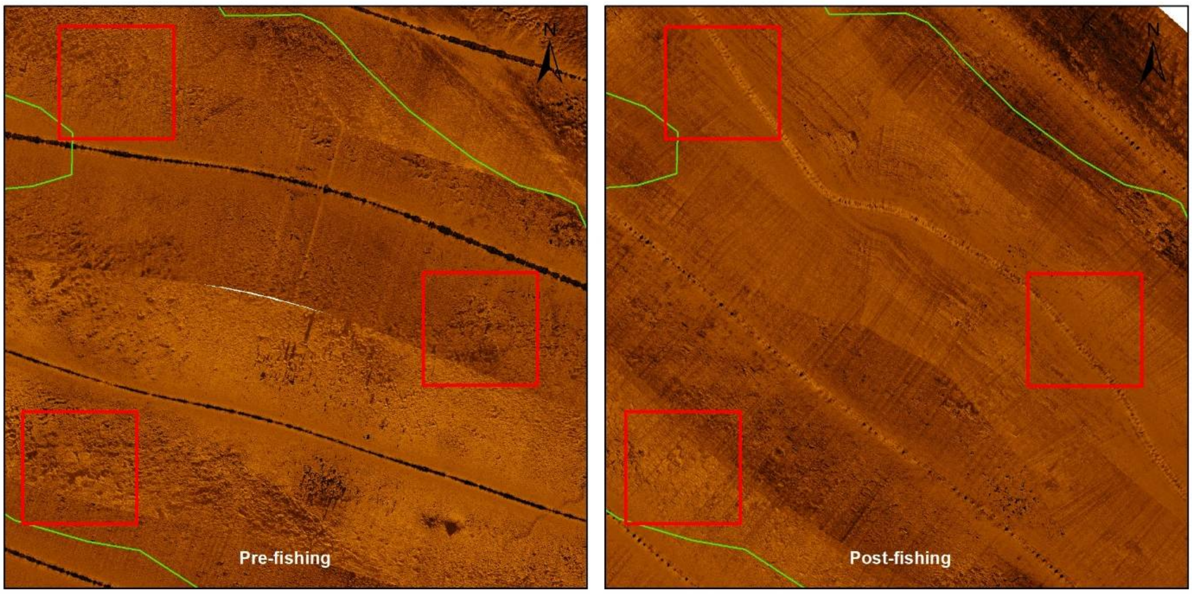

Fig.25: Rosslare Settlement Western Side Acoustics

The remaining features in Rosslare represent a little more than 3% of the original bed's footprint. In the three sub-selected areas, the features have disappeared (Fig. 25). However, we can see remaining stones and boulders across the data, mainly in the southwestern square, with their shadows creating darker marks on the acoustic data.

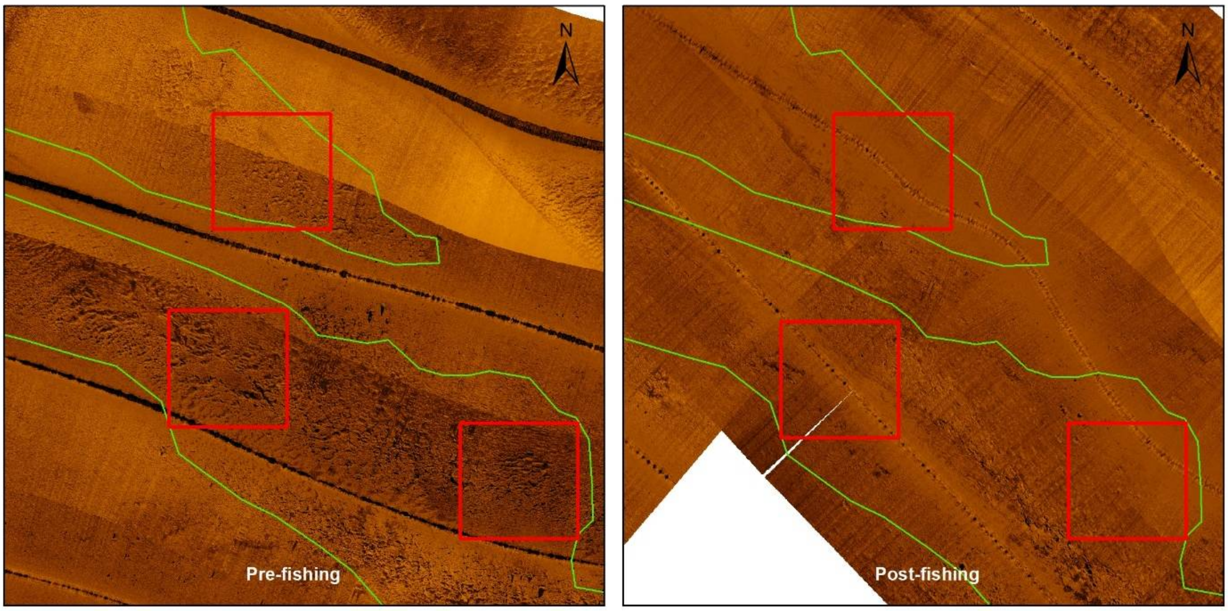

Fig.26: Rosslare Settlement Eastern Side Acoustics

Figure 26 shows the same situation, with the three sub-selected areas on the eastern side. The typical seed mussel feature is not visible post-fishing. It is particularly evident on the southern half of the maps. Some features appear to be still visible on the southeast part, creating a strip; however, only limited biological data was collected in the location.

As for the Rusk Channel, this variation is also partially confirmed by the collected biological data post-fishery, which only showed a low amount of remaining biomass. Yet, the biomass variation analysis only showed limited variations. This problem could be resolved by increasing sampling in areas presenting the remaining features and producing a more accurate biomass distribution estimation.

Conclusion

It is the first time that a detailed post-fishery survey was carried out on the subtidal seed mussel beds in the Southeast Irish Sea. To standardise practices for this survey, it was decided to stay within the pre-established borders of the known settlement and replicate the pre-fishing survey method. Despite the short weather window to carry out this survey, valuable data was gathered in following categories: possible remaining biomass, distribution, population size variations, levels and content of post-fishery bycatch and the condition of the seabed.

The Rusk Channel bed and the Rosslare bed showed low levels of biomass remaining, estimated at approximately 417 and 195 tonnes respectively using the IDW interpolation method. This quantity corresponds to less than 10% of the original estimation across both locations. Significant growth was observed on both beds, which had mussels remaining. Most pre-fishing acoustic features have disappeared although some remain.

Some survey methodology needs improvement, mainly to refine the IDW biomass estimation distribution. This can only be achieved by collecting more biological samples and by using the acoustic data to strategically sample in portions of the beds where features are prominent. It would require a more significant time commitment and a greater number of personnel to process the samples. It was not feasible in 2020 due to social distancing requirements and logistics challenges associated with the Covid-19 pandemic.

Although some biomass remains on the seabed, it cannot be concluded that this biomass will survive the weather and predation challenges over the winter months and then produce viable larvae that could potentially feed new settlements. Unfished intertidal seed mussel beds have shown a very high level of overwintering depletion, up to 50% of their original distribution for the first year and another 30% on the second year (Steenbergen et al. 2005). Though subtidal beds are less impacted by bird predation due to diving depth limitations, starfish such as *Asteria rubens* are the primary threat observed earlier in 2020 on an overwinter patch along the Long Bank on the Wexford coast (see http://www.bim.ie/media/bim/content/publications/aquaculture/BIM-preliminary-smsp-wexf-July-2020.pdf).

Subsequently, it is more likely that the transplanted seed mussel will have better chances to produce viable larvae to fuel future recruitment. This could be further supported by implementing predator removal and growth management measures on the growing plots to improve growth and survivability; this would, of course, not be possible on wild beds. Considering the possible larvae distribution in this locality (BIM 2019), the nature of the seabed (Guinan et al. 2020), it is yet to be proven that the subtidal seed mussel beds, in this part of the Irish sea, can stabilise and provide stable biogenic reefs.

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