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J H Brown , Solway Marine Oysters – September 2010

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Innovative shellfish system for high energy conditions

Monitoring project

Janet H Brown and Solway Marine Oysters

June 2007 – September 2010

A collaborative project was set up to monitor the performance of a new oyster growing system in a high energy environment, the Solway coastline, to investigate the performance of the system and to monitor any environmental changes that might be associated with its placement. The project has suffered from serious losses of experimental trials with oyster bags being lost from lines during storms on the two occasions when new trials were set up, but there has been considerable development in fixing techniques and how best to manage the system under the conditions. The growth data that is available is limited because of loss of bags and labels but are presented here as indication of what may be possible. Solway Marine Oysters have learnt a great deal about how to manage the system and there are indications from the data that regular sorting and redistribution of the oysters to optimize their stocking at each stage can produce significantly better growth. The oysters produced are of good shape and free of any epibionts. A measurable change in the sediment and fauna associated with the location of the line was detected but whether this was due to the presence of the fixing posts, the growing bags themselves or other changes is not certain. The changes in the fauna were most likely related to the slight changes in the sediment present. The value of the training opportunity to one of the Solway Marine Oysters staff is acknowledged and there is an ongoing cooperation between the company and BST Ltd to further improve the operation of the system.

Innovative shellfish system for high energy conditions – monitoring project

Solway Marine Oysters and Janet H Brown, Institute of Aquaculture, University of Stirling

Final Report

The project was set up to monitor growth of oysters in an extremely exposed area, the coast of the Solway Firth using technology untested in such conditions or even within the United Kingdom as a whole. It was hoped that results from this long term programme would provide useful information on the value of this technique under a wide range of environments and also provide invaluable data for the development of shellfish culture in areas such as the Solway Firth that are sites of special interest from a conservation view point.

The novel system is an Australian developed system called the BST system. Before the start of this project trials had been carried out at the site and appeared to show good growth but the aim of the project was to obtain data that would allow comparison with growth data from other systems and in other conditions.

The project, by establishing a long term monitoring of environmental parameters also had the potential to gather essential data for providing information to Natural England (NE).

Since the BST system was totally untested in such an exposed area, to the extent that the developers themselves were uncertain as to how it would perform, as part of this project funds were requested for one of the farm operatives to receive "hands on" experience with the system in Australia. The aim of this was to provide practical experience of working with the system where it is already well established to provide a much better grounding to ensure the best out of the system was achieved. Janet Morgan went to Australia in 2007 and her report of her visit is included as part of this final report.

Thus the objectives of the project were

- to establish and run a monitoring system for an innovative shellfish growing system on the Solway to determine how well this novel system of growing oysters could perform in a highly exposed but productive area also relatively untested for shellfish culture.
- To gain information on the impacts of such a system in an area with high value from a conservation viewpoint.
- For one of the farm operators to receive hands-on training in using the system in an established location i.e. Australia to get the very best out of the new system.

Background to the project

In Europe the traditional culture method for *Crassostrea gigas* has been either bottom culture or bags on trestle. There are potential environmental disadvantages to bottom culture and this is not used in Scotland at all and bags and trestles can be costly in time. Bags need regular turning to prevent build up of algae and sediment that could affect oyster feeding and ideally they also benefit from regular grading as growth can be uneven in the flat bags. On exposed beaches such as the West coast of Cumbria bags and trestles could not possibly survive the first storm; they require sheltered conditions.

There was therefore the need to investigate another means of farming oysters. The Australians have developed a number of systems and the one chosen for the Solway was the BST system. The system is marketed as 'The adjustable longline oyster farming system' ‘allowing the farmer to manage the oysters more efficiently and economically than traditional methods’. The BST system involves suspending cylindrical mesh bags on a highly tensioned wire supported by wooden posts (*fig.* 1). The bags come in varying mesh sizes depending upon the size of the stock to be held (*fig.* 2). The wire can be raised to different heights using plastic risers on the posts and so the farmer can control (to a degree) the hours of immersion the stock receives and so can potentially control the growth rates of a stock to meet market demand. It is also possible to manage growth characteristics according to the height of the line. The BST training DVD explains how there can be better growth of shell at longer immersion, i.e. using lower fixing while to harden the oysters for market they advise growing with greater emersion at a greater suspension height.) Growth rate in *C. gigas* has been shown to be inversely proportional to emersion time and greater emersion also increases shell growth in relation to tissue mass (Spencer *et al.* 1978, Moroney and Walker 1999). The baskets are connected to the tensioned wire by plastic arms that allow the baskets to move with the water flow to potentially endure greater wave exposure than traditional methods and so allow a wider range of sites to be exploited and so can reduce fouling and therefore investment of time and labour. The oysters are also free to move within the rigid shape of the bags which is thought to prevent misshapen oysters. This system has been used in Franklin harbour, Cowell, south-east Australia by its developer, Ashley Turner for over 19 years with considerable success. BST suggest that their system cuts down management tasks by 80%. At the start of this project the sytem was virtually untested in the U.K. on any large scale apart from one instalment in Lough Swilly, County Donegal, Ireland. Since the project started there has been more interest and the system is being used at a number of farms. One large user in the south of England has reverted from the long line system to bag and trestles.

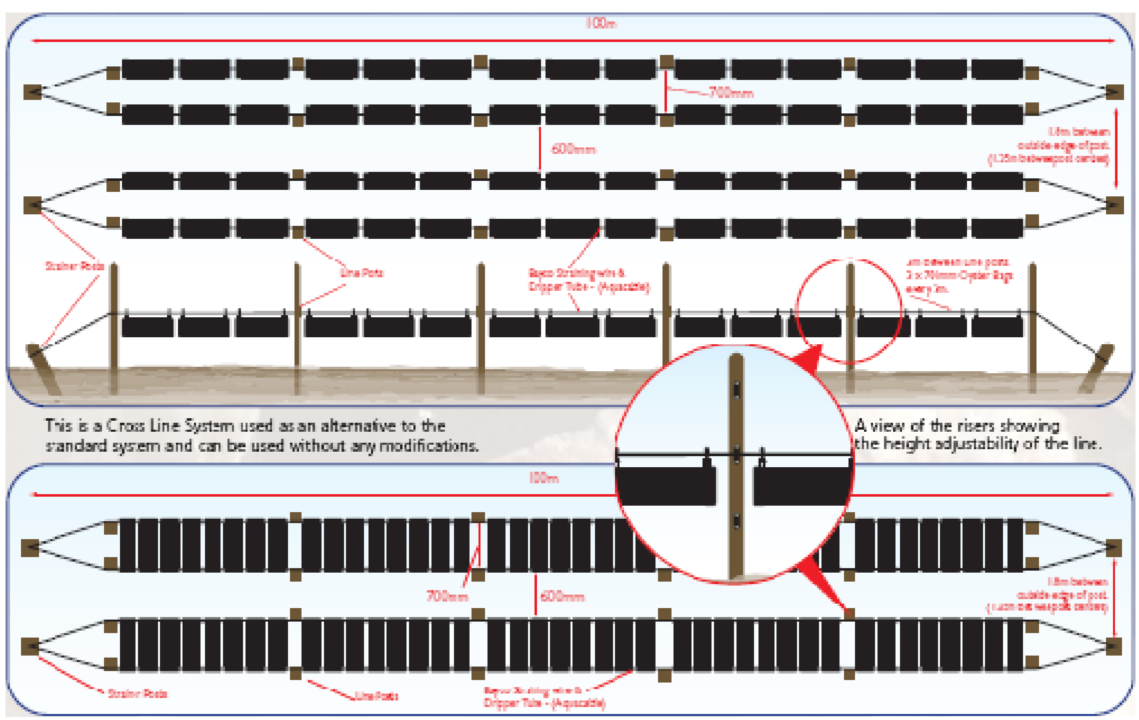


Fig 1. Diagram to show deployment of BST system (source BST training DVD)

Figure 2 – BST bags on lines.

The Solway Firth forms part of the border between England and Scotland, between Cumbria and Dumfries and Galloway. It stretches from St. Bees Head in Cumbria to the Mull of Galloway. The inner Solway has been recognised by the EC as an area of high nature conservation importance since 2000 (Poseidon, 2007). It is currently designated a Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC) and a Special Protection Area (SPA). The reasons for these designations vary from particular habitats, for instance sand banks covered by sea water at all times to 'biogenic reefs' formed by aggregations of the tube worm *Sabellaria alveolata* (Joint Nature Conservation Committee, 2007, Habitats Directive, 1992). The *S. alveolata* reefs are listed under ANNEX II of the EU Habitats Directive (1992) and so when planning any development in this area it has to be shown that the activity will not cause deleterious effects. The designations indicate that it is an area with a particularly rich ecosystem and in terms of other U.K. coastline is worth protecting. This however, does not indicate a completely untouched environment. On the contrary, the Solway Firth's fishery has been exploited since the Mesolithic era and at its height in 1896 supported 51 shrimp trawlers, 30 whammel boats, 13 herring boats and 24 small boats, and so is no stranger to human interaction (Hawkins, 2006). Since this time, the fishery has declined to a mere 3 shrimp trawlers and 1 whammel boat. The cockle and mussel beds were also mismanaged to the extent that harvesting had to be prohibited until they recovered. (Scottish Executive, 2001, Solway Firth Partnership, 2000).

The project area is Dubmill Scar near Silloth on the English side of the Solway. This particular area is known to have the species *S. alveolata,* which forms the protected biogenic reefs although it is hard to define what constitutes a biogenic reef (Hendrick and Foster-Smith, 2006). The implementation or construction of anything in such an area is inevitably going to be controversial and many groups with vested interests within this area have already voiced their concerns. To deal with such matters, the Solway Firth Partnership was formed in 1994 to provide organisations, agencies and companies with a forum to work together for the benefit of the Solway Firth. They have since identified that aquaculture could bring potential benefits and impacts to the area and have commissioned 'An Aquaculture Strategy for the Solway Firth'. In the draft of this report, it is acknowledged that there is a need for 'best practice operational procedures to be developed in relation to each site and where appropriate impact reduction techniques applied'(Poseidon, 2005). For these measures to be enforced the impacts of a particular farm in a particular place must firstly be understood in order that they can be recognised and then mitigated accordingly.

The impacts of intertidal shellfish farming have been found to be low. Even where a farm has a considerable production over a number of years, the immediate environment has suffered almost no deleterious effects and remained in the same state as control sited further from the site (Crawford, 2001, Crawford *et al.* 2003, McKinnon, 2003). There are currently no models that have been constructed to specifically simulate the effects of a shellfish farm in the intertidal zone. This maybe as a result of the perceived low impact nature of shellfish farming as the stock need no extra input of feed and a comparatively small amount of husbandry to maintain them, so essentially the farm would not be loading the environment with unwanted nutrients. This general assumption has yet to be disproved, however as there is not an abundance of data upon the environmental impacts of shellfish farming in the intertidal zone it leaves the subject open for debate. Organisations such as Natural England have a duty to raise concerns where they feel the environment may be under threat and can recommend that projects such as oyster longlines should not be implemented if they cannot show that they will not adversely impact upon the environment. To bring perspective and reality to a debate on the relative impacts of shellfish farming inter-tidally, a monitoring programme would need to be undertaken to highlight any changes in the immediate and surrounding area.

It is also important that the system is economically as well as environmentally sustainable and so the farm should also be judged upon its production performance. This will involve the implementation of a growth monitoring plan. Measuring the growth of oysters has been carried out in a number of different ways; some are down to practical necessity (i.e. weighing thousands of spat) and others are more concerned with monitoring growth rate more accurately (i.e. measuring annual growth rings/ shell accretion).

Pictured above: the line with bags suspended

Monitoring programme

The site was initially surveyed on the evening of the 17/05/2007 at low water by MSc student Chris Clayburn. Twenty one stations were sampled over the longline site plus two control sites 100m north and south from the site, as displayed in figure 3. The sample stations were paced out at approximately 20 metres from each other and their position recorded using a handheld GPS with an accuracy of 2m, allowing 30 seconds for the system to settle (see appendix). The following sample methods were used at each station

Carbon and Nitrogen

In the first year one sample for carbon and nitrogen was collected using a 9 x 2.5cm universal sample tube at each station. The sediment was taken from the top 5cm of sediment and the tube sealed and labelled accordingly. All samples were frozen within 24 hours at -20°C for subsequent analysis. The samples were thawed until they could be extracted from the sample tube and then dried at 100°C for 24 hours. The dry sediment was then ground with a mortar and pestle to gain a fine consistency from which a sample of 15-20mg was weighed to the nearest four decimal grams. The samples were placed in a Perkin Elmer Series 3 CHNS/O analyser to measure for total carbon and nitrogen for each sample. The process was then repeated but before C/N analysis a sample from each station was placed in a 600°C furnace to burn off the organic carbon in the sample. These samples were then weighed and processed in the CHNS/O analyser as before to produce measures for inorganic carbon. The inorganic carbon readings were then subtracted from their corresponding total carbon readings to give a value for organic carbon present at each station.

In subsequent years Carbon Nitrogen samples were taken using the same methodology but at the sites sampled as shown in the results. In 2008 an onshore wind during sampling caused the tide to advance exceptionally quickly so there was reduced time available for sample collection.

Particle Size Analysis (PSA)

A particle size analysis sample was taken using an 8cm diameter plastic corer extracting a 10cm profile of sediment from each station. This was place into a plastic bag, labelled and sealed with a cable tie. The samples were frozen within 24 hours at -20°C for processing later. The bags were thawed for 5 hours after which their contents were poured into metal dishes labelled and lined with foil. They were then dried in an oven at 100°C for 24 hours. A representative 25g sample was carefully weighed from each sample to the nearest four decimal places. This sample was then placed into a beaker with 250ml of water and 10ml of aqueous sodium hexametaphosphate $(NaPO_3)_6$ to aid particle separation, stirred mechanically for 5 minutes left overnight and then stirred again for another 5 minutes. The sample was then poured onto a 63µm sieve, held over a tray and water puddled in the sieve. The sieve and its contents were then dried for 45 minutes in a 100°C oven and then weighed again. After recording the weight the sample was placed on the top sieve of a Fritsch Analysette 3 Spartan sieving machine to separate out the different particle sizes into 9 different fractions (200mm, 100mm, 500µm, 250µm, 180µm, 125µm, 90µm, 63µm and particles <63µ). The individual contents of each sieve were then weighed, recorded and analysed.

Fauna

Fauna samples were collected using the same technique as used in PSA. The plastic bags containing the fauna samples were transferred to sturdy plastic tubs within 24 hours of collection and fixed using 80% formalin. The samples were poured and washed through 2mm sieve inside a fume cupboard. The contents of the sieve were transferred to a white tray and any fauna were collected into a vial and preserved in 70% alcohol. The vial contents were inspected under a microscope and identified (Hayward and Ryland, 1995, Hayward, Nelson-Smith and Shields, 1996) and the identity recorded down to species level. The complete data lists are given in Appendix 1.

Farm management

The farm management techniques were developed in accordance to the manufacturers' (BST Longlines Ltd.) recommendations.

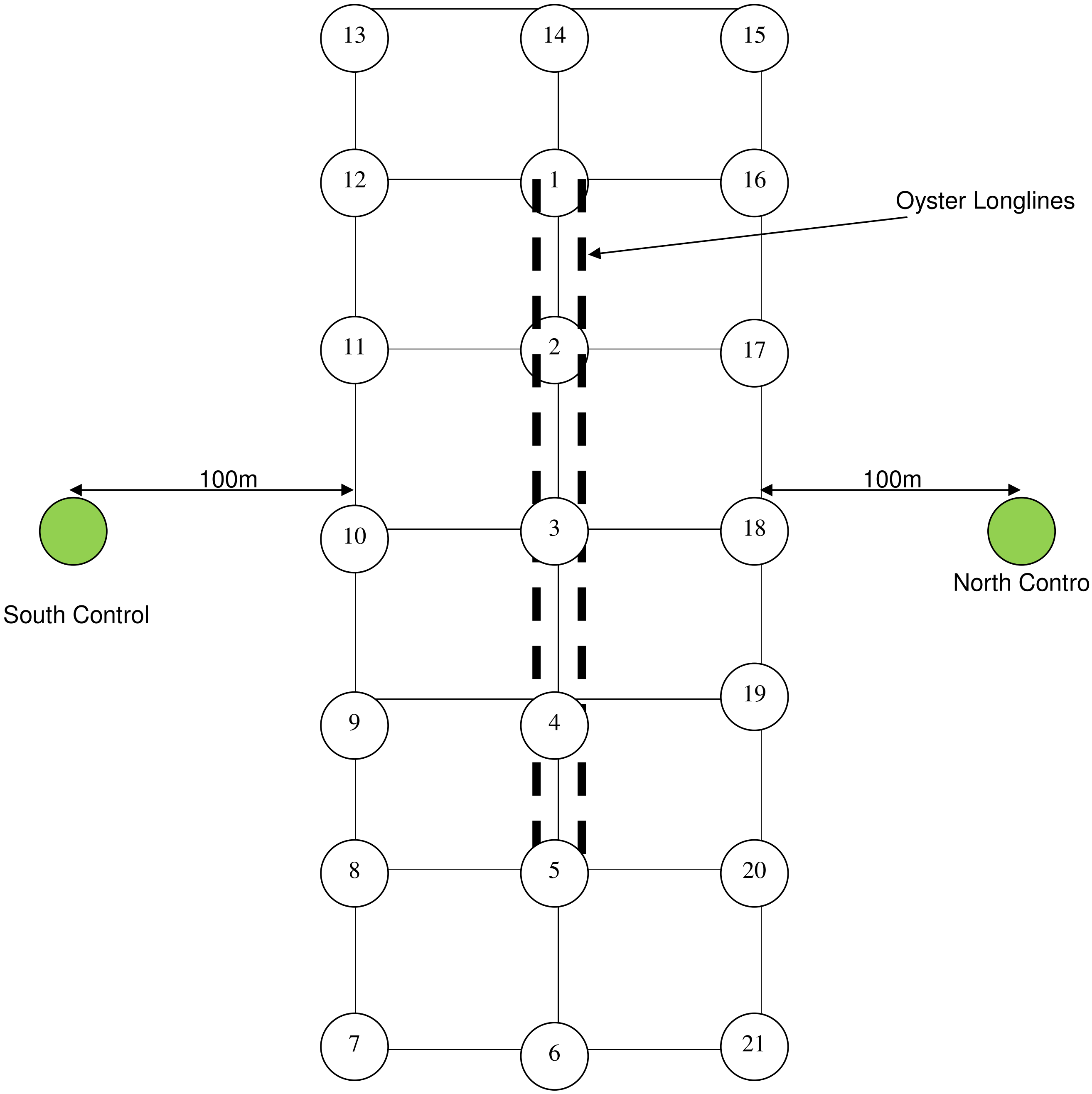
BST suggests stocking baskets with 600 oysters of 8-12mm to initially gauge an optimum stocking density. The initial project order from Solway Marine oysters was 11,000 spat from the Seasalter oyster hatchery and nursery on Walney Island. This number would not allow for a comprehensive span of the various oyster densities that BST recommends at increments of +/-50 oysters per bag and for a reasonable number of replicate populations for statistical analysis. Therefore a larger variation between populations was made to hopefully 'cast the net wider' to highlight any differences between population density and also allow for the same number of replicates to be tested at two different heights on the longlines. For the initial trial set up by MSc student Chris Clayburn it was decided to test 3 replicates of 500, 600 and 700 oysters per basket on the lowest line and the same replicated on the line above at the time of first deployment.

Severe storms immediately after deploying this trial meant results are not easily interpretable but marked the start of concerted efforts to improve fixing methods. Solway Marine Oysters have been assisted in this considerably by BST who are developing systems on similarly exposed sites in the Bass Strait in Tasmania so over the years of the project fixing systems have improved although each new trial established during the course of this project has been adversely affected by storm losses. While many of the bags are recovered labels have been lost and simple systems for labelling bags that are reliable over a suitable period of time have taken some time to be developed.

Solway Marine Oysters now use a failsafe system using cable ties to each end of the bag to effectively dampen any excess movement on the lines. However, BST did advise in 2009 that the direction the line being used in the project was being struck by the prevailing tide at an adverse angle and that this was causing the additional stress on the bags causing them to be more likely to be forced off the line. So from 2009 this line was abandoned and a new one established at a different orientation. The direction of this line is such that if one drew a line between stations 8 and 4 on figure 3 this would give the orientation of the new line. With this new orientation Solway Marine Oysters have found that no bags have been lost and there has been significantly less wear and tear on bags, fixings and line wear.

The change of location meant effectively that the sampling programme stopped but there was still three years worth of data.

Figure 3



Monitoring Growth

To determine an effective monitoring programme for oyster growth, the circumstances and end goal must be considered. The circumstances here are that there is no laboratory or suitable substitute near by and the logistics of transporting the oysters to be processed and then returned are probably too great to be considered. Also the benefits of obtaining accurate data on individuals are again negligible (Quayle and Newkirk, 1989). The end goal is to obtain accurate growth data and so weighing alone may not suffice as this may be skewed by variations in water retention and sexual stage (Lawrence and Scott, 1982). In addition one of the promoted advantages of the BST system is that growth of the oysters should be more uniform than in traditional bags since the movement of the bags on the line means that oysters should not get trapped in one position causing them to grow in one dimension more than another.

Thus it was decided that the best method to monitor oyster growth on the site was to both weigh and measure three dimensions of the oyster. This is a feasible task for this situation and should have provided a good data set to analyse. There are a number of other methods to test the physiological condition of oysters to quantify weight more accurately by measuring dry ash weight: total dry weight (Lucas and Beninger, 1985), however, measuring the shell dimensions has proven valuable data for assessing shell growth and should more than suffice for assessing the BST system and location (Brown and Hartwick, 1988).

In the initial trial the oysters were weighed to the nearest two decimal places in 7 batches of exactly 200 and then divided by their number to find an average individual weight. They had been graded and counted a few hours earlier by the Seasalter oyster hatchery so variation in weight was minimal. Seventy oysters were measured to the nearest millimetre recording their shell height, width and depth using callipers initially.

After the initial weighing for setting up the trials oysters were weighed individually on a top balance and measured using a measuring board to the nearest millimetre. Samples for weighing and measuring were taken randomly as representative of the contents of each basket.

Results

Monitoring of growth

The initial trial was set up in June 2007 with replicate bags containing 500, 600 and 700 spat. The same weekend severe storms swept 25 of the bags including some of the experimental bags to sea but growth measurements from the 4 remaining bags in October appeared to show good growth but without the possibility of comparing different stocking densities as had been the plan.

In October a new trial was set up with new spat but a storm in October 2008 caused loss of 38 bags including the bags that were ready for monitoring so there is no data from that particular trial. The results that are present follow the performance of the initial 4 bags salvaged from 2007 through various restocking and grading exercises. Results are therefore just indicative of growth and performance and with loss of labels are not fully reliable. However, the process itself has led to improve monitoring systems and labelling practices within Solway Marine Oysters so will have improved knowledge and understanding of the performance of the system. So in practical terms the results are useful but are somewhat empirical. They are not robust enough for detailed analysis.

The results do demonstrate unsurprisingly that there are optimal stocking densities at different sizes of oysters and there can be dramatic improvements in growth with sorting. However, over stocking does not seem to impair survival. With the loss of bags and labels it is not possible to draw any robust conclusions from the data available. Full results are given in the table below.

	weight (g)	sd	length (mm)	sd	width (mm)	sd	height (mm)	sd	linitial stock	survival %	
Initial data	1.26	0.04	18.8	2.5	10.7	2.0	6.4	1.3			
Results at October 2007											
Bag 1	5.49	1.04	34.7	4.7	24.1	3.1	11.7	1.9	500	72.4	
bag 2	4.93	1.36	32.1	4.6	22.8	4.7	10.7	1.4	600	50.7	
bag 3	5.54	1.37	35.1	4.2	21.7	3.7	12.9	3.0	600	99.3	
bag 4	5.29	1.30	32.7	5.6	23.5	3.2	12.0	4.3	600	95.7	
Results from June 2008											
bag 1	7.57	2.59	40.7	6.4	28.5	5.1	13.0	2.4	600	97.3	
bag 2	7.71	2.60	nm		nm		nm		nm	97.2	
bag 3	7.81	1.93	nm		nm		nm		nm	91.7	
bag 4	8.31	2.70	nm		nm		nm		nm	98.0	
Results from June 2009					(Labels lost in storms)						
Bag A?	15.65	2.80	46.4	3.8	47.1	5.6	18.9	2.5	300	93.3	
BagB?	12.70	3.60	46.4	3.3	16.4	3.4	31.4	5.6	300		
Bag?	18.11	4.24	48.8	4.7	18.5	3.3	30.0	7.0			
Bag?	11.52	5.70	51.4	11.4	13.8	4.5	29.2	7.8	600	93.2	
Results from 26th September 2010									number at count		
Bag A	34.60	11.43	74.0	11.1	39.0	5.9	22.0	2.7	210		
Bag ?	38.50	10.15	70.0	8.0	47.4	9.3	24.6	3.4	200.0		
Bag L	43.46	9.90	73.0	10.2	46.4	5.1	25.9	3.6	300.0	Bags had been split in May	
Bag A(1)	13.19	5.10	54.1	8.8	30.2	5.5	18.5	3.6	1360.0		
Bag A (2)	31.54	11.82	75.3	11.0	41.9	7.9	26.3	14.7	229.0	Split from A in May	
Bag 4	46.55	11.29	74.4	7.7	49.2	10.7	31.3	7.2	300.0	repacked in May 2010	
Bag N	17.85	7.60	58.9	10.1					700.0	98.4	

Table 1: Growth data of sampled oysters.

Carbon and Nitrogen

The results for total carbon and total nitrogen are both at low levels and in particular for nitrogen.

2008 data

	1	2	3	4	5	6	7	8	9	10	11	12	13
%TC	1.25	1.19	1.3	1.7	1.83								
%TN	0.05	0.04	0.1	0.1	0.17								

2009 data

%TC	1.18	2.18	1.9	1.95	1.27	1.26	2.59	1.47	0.9	1.62	1.01	1.18	1.71
%TN	0.04	0.04	0.09	0.1	0.07	0.11	0.18	0.13	0.1	0.1	0.05	0.14	0.13

PSA results

The results from Particle size analysis do show a change over the period of the study. From initial results in 2007 the results were typical of an exposed beach with particles being at the larger end of the scale. There was a gradual change in that while site 1 remained basically coarse in the first year and is much the same as it was in 2007, sites 3-5 become much finer in the second year. In 2009 3, 4 and 5 were slightly less fine but site 1 is very much more sorted. However, the fact that the fine sediments have doubled and in some cases trebled in the outlying sites indicates it is a current effect rather than due to the presence of the line itself. Sites 9, 10 and 11 is a lot finer while 8 is slightly less fine.

Figure 4: Complete PSA results for all sites, 2007

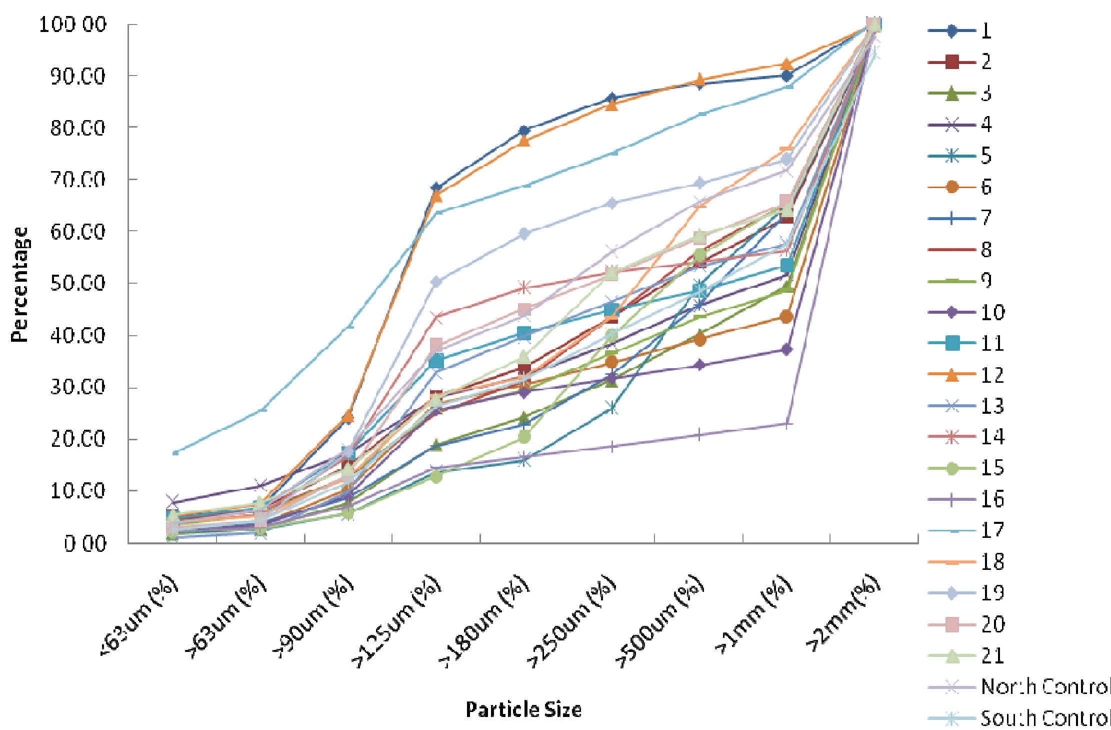


Figure 5: PSA results for 2008

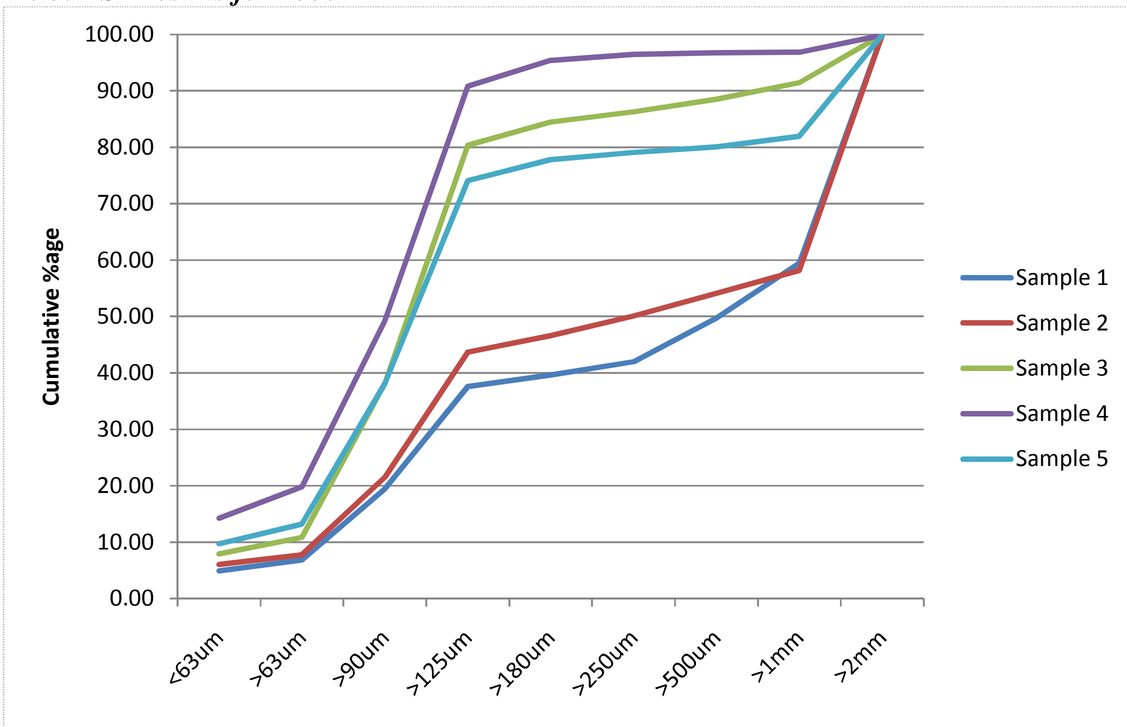


Figure 6: PSA results for 2009 sampling sites 1-5

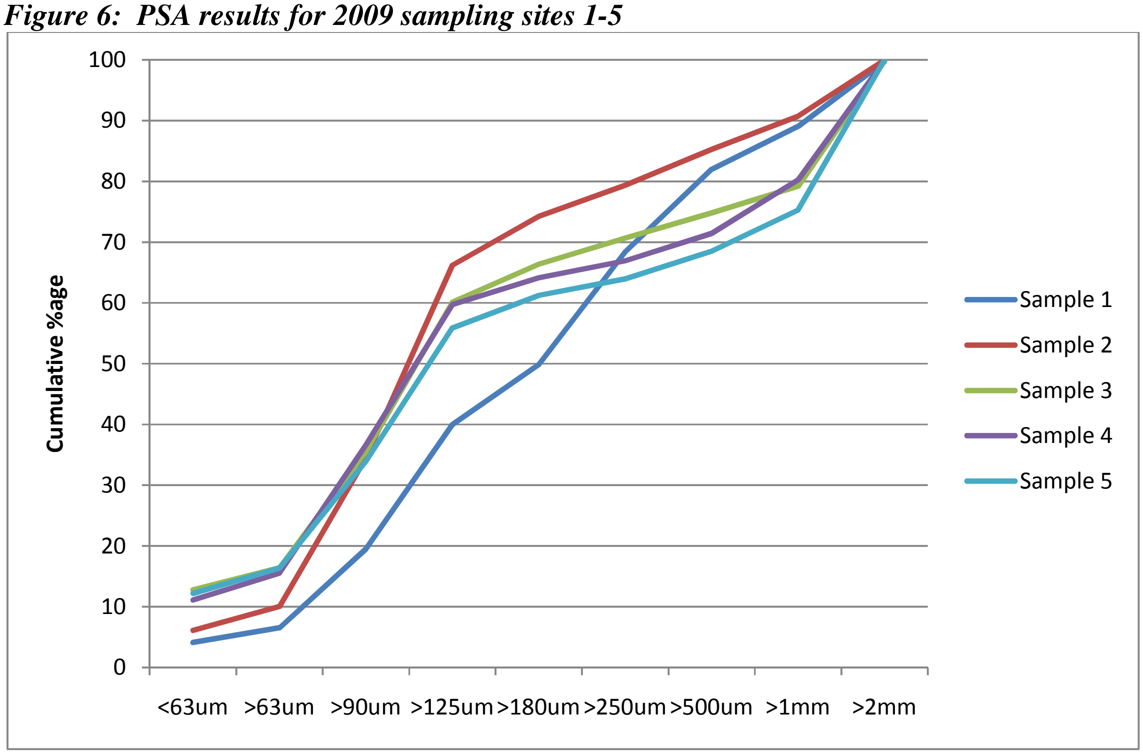


Figure 6: PSA results for sites 8-12 2009

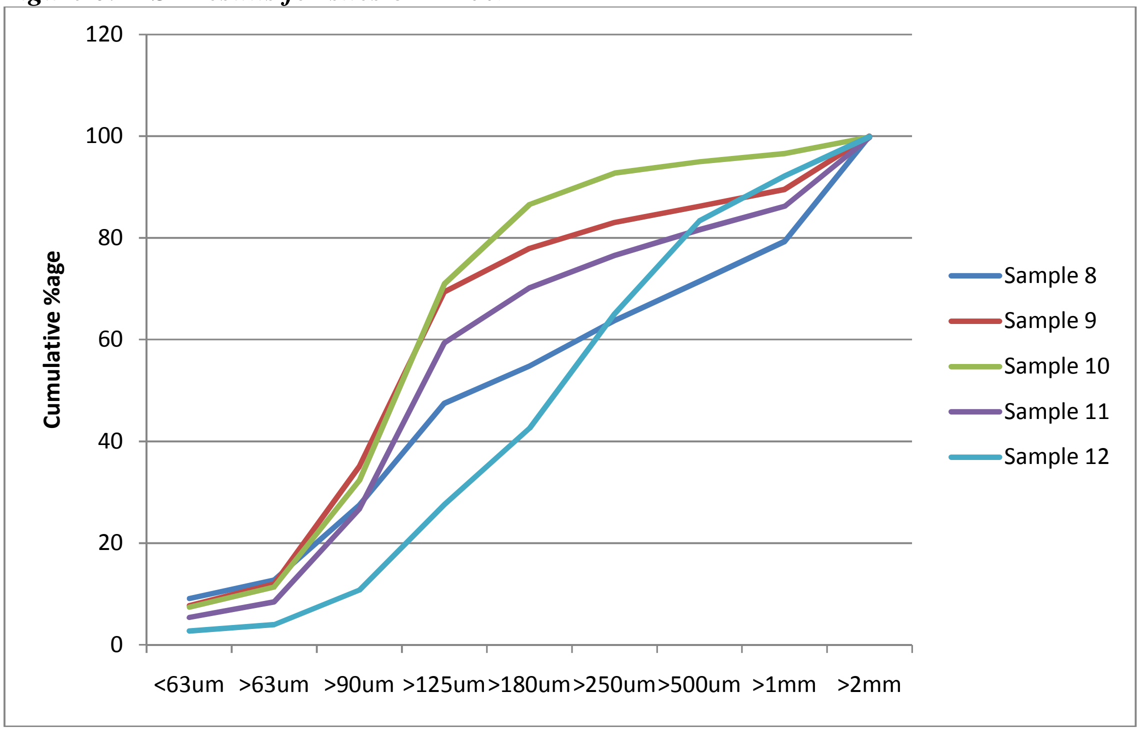
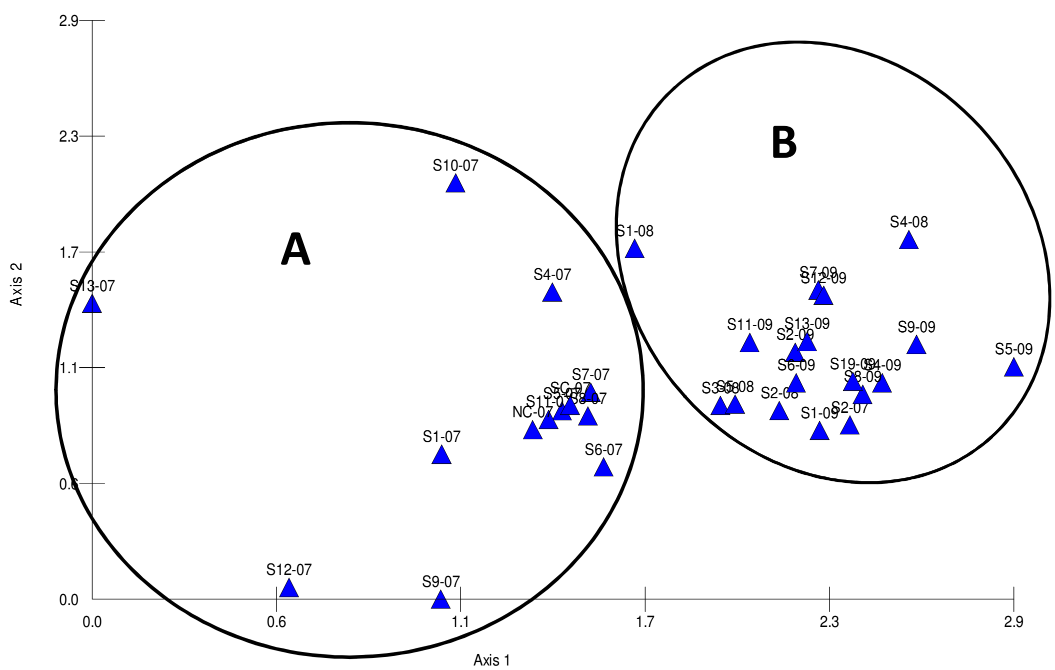


Figure 7: DCA plot of species data for years 2007-2009



This is a detrended correspondence analysis (DCA) plot of the species data for 2007, 2008 and 2009. It shows that there is a difference in community between the baseline (pre-development data) in 2007 and 2008, and this change continues in 2009. So clearly there has been a change in benthic community from pre- and post-development. This ties in closely with the PSA results and as there is no specific evidence from species indicative of environmental disturbance or nutrient impact, the community simply reflects this change in sediment. Whether the sediment is as a direct result of the oyster production is difficult to say, but there is clearly no nutrient deposition impact on the sediments (as of 2009) from the oyster production.

DCA is a numerical method which can compare community structure using all of the species data together rather than selecting particular indicator species. It is essentially a statistical measure to look at change in community structure, in this case over time. The ordination scatter plot above can be interpreted by considering the proximity of each point to each other, where the positions of the points on the plot are dependent on their species composition. Therefore the more similar the composition the closer the points are. Therefore those points arranged in groups (see the ovals) represent particular species assemblages, where group A consists only of 2007 stations and group B contains only 2008/09 stations; which indicates that there was a community change between these dates.

The results from the PSA analysis and the changes in community structure essentially say the same thing. Over the period of the project there has been a change in both the nature of the sediment and in the composition of the community over the location of the shellfish line. There is an increase in the proportion of fine sediment in the area under the line and the extent of this fine material does increase from 2008 to 2009 and it is to some extent mirrored in site 12 in year 2009 which is the sample parallel to sample site 1 where the sediments were markedly better sorted. The species and abundance at each sampled site are given in Appendix 1.

The change in community structure could be as a result of this change in sediment characteristics. All the communities sampled are characteristic of clean conditions

Conclusions

The project has provided the opportunity for practical training for one of the operatives of Solway Marine Oysters to get hands on experience in using this novel system. Its initial setting up has been studied but because of the problems with working in such a high energy system results from growth trials are not conclusive with bags being lost and also labels. However, the developments possible through this work are paying dividends and the benefits of careful stock management are evident.

There is evidence that the operation of the system does not have an adverse impact on the fauna or sediments and as such suggests it is highly suitable for deployment in all environments.

Solway Marine Oysters have also been able to develop their own improvements and one of their innovations was featured in The Grower since it could be of useful application for other shellfish farmers (see Appendix 2).

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Acknowledgements

This work has been funded through a grant from Seafish with matched in-kind contribution from Solway Marine Oysters and this assistance from Seafish is gratefully acknowledged. The initial setting up of the project with the monitoring sites was established by MSc student Chris Clayburn whose work has also been used in the preparation of this report and is likewise gratefully acknowledged. Solway Marine Oysters are particularly grateful for the ongoing support from Mr Ashley Turner of BST Ltd without whose help they would not have been able to make the progress they have.

SEAfish Sponsored Training visit to Australia

Janet Morgan
18th June-11th September 2007

College attended; Cowell Area School of Aquaculture,
http://acacia.cowellas.sa.edu.au/cms/content/view/18/29/

Vision statement "to be a leading provider in the education of young people specialising in aquaculture and the environment"

The course in aquaculture was set up based on an idea from oyster growers in the area wanting suitably trained young people for employment in their business. Part of the course is to be seconded to a local business to gain "hands on" experience.

I was resident at the school from 18th June to 11th September 2007 and had practicals (day release from college) in 2 oyster farms. One was the school's own farm where they used the BST system and the other was the Turner farm where they also used this system as we use on the Solway. However, the Turner farm was in the process of being taken over by Aquafood so I was not able to start work there until 1st August.

While I had gone to Australia to learn about the BST system, at the college only roughly 10% of the bags were actual BST bags. The bulk of the growing bags at Aquafood were normal flat (pillow) bags as used on trestles converted to suspended use). At the college 25% of the bags used were BST (*as shown below left),* 50% poche bags and 25% Aquapurse. *Picturd below right: Oyster lines at Franklin Harbour, Cowell, one of the college sites.*


Areas in which I obtained most experience were the **grading system.** This was a fully automated computer controlled system on the Aquafood farm,as illustrated below and diagram attached (fig 1). This is the sort of system that we are never likely to be able to use on our farm and in fact the Aquafood farm shipped oysters from their farm in Coffin Bay and Ceduna up to the grading machine approximately 200kms away. This machine could grade 300 oysters per minute doing 30-60 tonnes per day.

In contrast on the college farm we hand graded, sorting them to
5 dozen per bag extra large oysters
7 dozen per bag large
10 dozen per bag small.

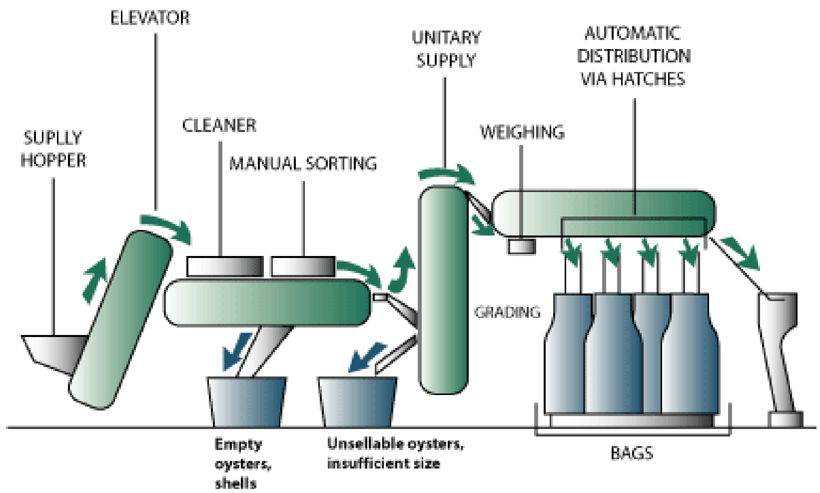
The grading is an integral part of their management which they do by use of zonation. They stock by colour zones, Red A-F, Orange zone A-F and White Zone A-F. This relates to time of stocking and size, they coloured the poles and moved oysters between the zones.

All the oysters for both farms were supplied from a hatchery in Tasmania. I also had experience of grading spat in Aquafood.

Course work
As part of the lessons at college I worked on testing water quality in ponds, cleaning out barramundi ponds and also yabby and rainbow trout growing facilities. There were also some marine studies and boat handling.

Outputs
The most important part of attending the course is putting into practice what I learnt in Australia. The value of grading and keeping control of year classes is probably the most important lesson I learnt and using colour tags for different year classes would be one of the easiest management changes we could introduce.

Where I felt I did not benefit was the course was very much run for hired hands so it was involved with the actual practical aspects. What I needed was more of the management techniques themselves that are more relevant to actually running a farm.



http://www.meleagrine.com/anglais/presentation.htm

Following the training opportunity I have been working with my father Wilf Morgan and have set up the depuration shed. I also undertook the training in depuration run at Loch Fyne Oysters in 2009 by Seafish. The training in Australia provided a very useful background for this course also in addition to what I have been able to put in pratcie in Solway Marine oysters. I still have hopes that I will in addition be able to utilise also what I learnt about fish husbandry as our business develops.

Appendix 1 Species and their abundance at the sampling sites 2007-2009

Station Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	North Control	South Control
Identified Species																							
Molluscs																							
Mytilus Edulis	9	13	0	212	147	273	85	179	2	167	56	0	2	2	15	9	17	5	123	23	2	41	17
Littorina saxatilis	1			1						2			2			1	2		1	1	2		
Littorina littorea													1										
Annelids																							
Capitella capitata	1					2			1						2	1			1				
Eumida sanguinea	1							1	1												1		
Scoloplos armiger		1																					
Eteone picta		1				1																	
Nereis diversicolor				2						2					1		2		1	1			
Nephtys caeca				1									1	1									
Lanice conchilega					3	3	1		1		3	2	1		1			2		2		4	1
Tubifex costatus													1	1									
Tubificoides benedeni															1								
Eteone foliosa																	1						
Nephtys hombergi														1	1			1					
Crustacean																							
Liocarcinus marmoreus										1													
Pandalus montagui										4							1						
Total Number of Species	4	3	0	4	2	4	2	2	4	5	2	1	6	4	6	3	5	3	4	4	3	2	2
Total Abundance	12	15	0	216	150	279	86	180	5	176	59	2	8	5	21	11	23	8	126	27	5	45	18

2008 data

Species	1	2	3	4	5
Nematoda	1				
Harmothoe sp. (juvenile)	2				
Eteone longa agg.		1			1
Hediste diversicolor			1	8	1
Nephtys kersivalensis	1				
Polydora cornuta			1		
Pygospio elegans		19	8	1	2
Scalibregma inflatum					1
Lanice conchilega	3	2	4		2
Gastropoda (juvenile)	2				
Mytilus edulis	154	177	241	1	119
Mytilus edulis (juvenile)			1		
Total Number of Species	5	4	5	3	6
Total Abundance	163	199	255	10	126

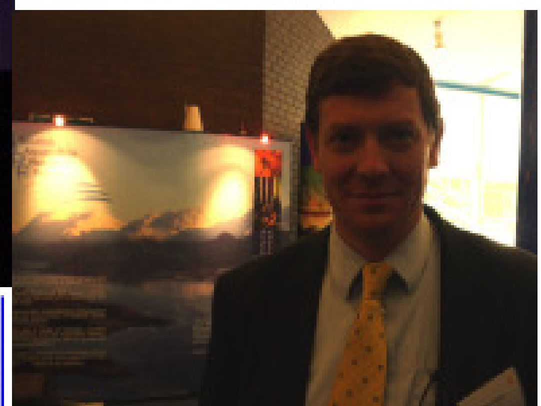
2009 data

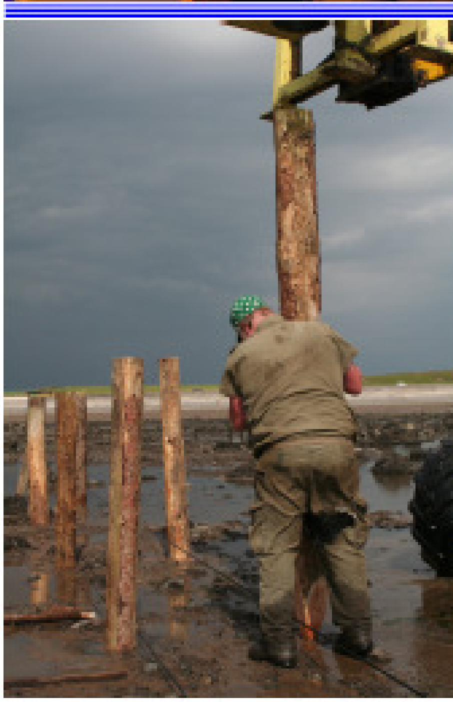
Species	1	2	3	4	5	6	7	8	9	10	11	12	13
Nemertea				1								1	
Nematoda	1	1							1				
Pholoe baltica					1								
Eteone longa agg.	2	1		1		2		1	1	2			
Anaitides mucosa							1						
Glycera tridactyla											1		
Hediste diversicolor	1	7		1	2				5	1		7	2
Nereididae *(juvenile)*						1							
Scoloplos armiger				1	4				1				
Pygospio elegans	1	1	1	2		1	2	12	8	15	2	3	9
Capitella sp.	2	1											
Ampharete grubei									1				
Tubificoides benedii							1						
Limnodriloides sp.			1										
Crangon crangon					1								
Mytilus edulis	10	90		27	28	66	77	43	121	162	190	99	166
Mytilus edulis (juvenile)									3				1
Total Number of Species	6	6	2	6	5	4	4	3	8	4	3	4	4
Total Abundance	17	101	2	33	36	70	81	56	141	180	193	110	178

Appendix 2: Reproduction of Page 2 from the Grower August 2009

Sustainability Conference held in Edinburgh

Pictured left; David Kay of University of Aberystwyth talking on identifying risk factors in shellfish harvesting areas and the subsequent regulatory and policy implications *and below* Dr Mark James, FRM, Conference organiser. For full report of the conference held in April see full report on the facing page from Dr Alison Morgan.





Bouchot poles to install? Here's how.....

Wilf Morgan of Solway Marine Oysters grows oysters using the Boddington's system which suspends bags on high tensile plastic cable. The posts supporting them have therefore to be up to the job particularly on the highly exposed Solway coastline. Wilf has developed a method of inserting his posts into the hard substrate of the Solway coast, - the scar ground. He has worked with Mark Bingham of Bingham Engineering Ltd, Pontefract, a company specialising in mining equipment. This idea is Wilf's which he took to the company. Mark Bingham commented "Wilf came to me with his idea and with photos; Wilf has basically done our research and development for us – we are always looking for new uses for our heavy duty equipment."

Wilf's view is "This solves a major problem for us and we are really pleased with the results."

Sea Fish Industry Authority

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supporting the seafood industry for a sustainable, profitable future