

## **SWEEP WORKSHOP** **7<sup>TH</sup> September 2009**

Notes of the meeting held at the offices of Eastern Sea Fisheries Joint Committee (ESFJC), 6<sup>th</sup> North Lynn Business Village, Bergen Way, King's Lynn, Norfolk PE30 2JG. Held at 1030 hours

### **Present:**

Mike Best	Environment Agency
Daryl Burdon	University of Hull
Ruth Callaway	Swansea University
Phil Coates	SWSFC
Veronique Creach	Cefas
Eileen Daly	Environment Agency
Conor Donnelly	Natural England
Angus Garbutt	CEH
Helgi Gudmundsson	Environment Agency
Andrew Harwood	ESFJC
Ron Jessop	ESFJC
Katherine Kennedy	Cefas
Matt Mander	ESFJC
Ian Mears	Environment Agency
David Sivyver	Cefas
Judith Stoutt	ESFJC
Duncan Vaughan	ESFJC
Chris Vincent	UEA
Keith Weston	Natural England
Andrew Wither	Natural England
Will Wright	KESFC
Jessica Woo	ESFJC
Mick Yates	ESFJC Member / ex CEH

Matt Mander welcomed everyone to the meeting, and hoped that by everyone having gathered together it would be an opportunity for all involved to combine their knowledge, which would hopefully result in a better understanding of how the Wash operates.

### ***The Role of Eastern Sea Fisheries Joint Committee / Current Research***

Ron Jessop began by advising members of the history, role and resources of ESFJC. Followed by advice that under the Marine Bill ESFJC would become an IFCA (Inshore Fisheries and Conservation Authority), and as such would have greater environmental responsibilities.

Those present were also advised that cockle surveys formed a large part of the core work carried out by the research team. 1,314 sample stations covering 21 beds, were visited, on which a combination of day grabs and foot surveys would take place. At each station cockle samples are taken, with each cockle being measured, its age class assessed and the information entered on to GIS in order to calculate available stock. Additional information is also collected at each site, namely sediment type, and presence of macoma/arenicola/lanice.

Mussel surveys take place over 20 beds, with surveys being carried out over low water. During the survey the beds are assessed for coverage, density, size and frequency of stocks. In addition to the 20 public beds, the several fishery (lays) provided the mainstay of mussel landings as well as contributing to the stocks on the public beds.

During the course of carrying out surveys the research team had noted a high level of unexplained cockle mortality that could not be explained through natural ridging/starvation. Initially 1-2% of the cockles on the bed in question had been seen to be coming to the surface and gaping. Over the previous 3-4 months the small numbers of cockles had added up to a substantial amount, estimated to be a loss of approximately 14,000 tonnes. It was questioned whether the losses had occurred on a particular sediment type, as sandy sediments would usually be on higher ground.

It was felt that a combination of effects could be causing stress in the cockles. Historically a good spatfall would be expected every 6-7 years. However, there had been a good spatfall in 2004 followed by another in 2006. Generally it would take 3-4 years to reach a commercially viable size so spatfalls so close together would result in juvenile stock amongst adult stock, which would make fishing difficult (the committee's policy was not to open a bed if it contained more than 70% juvenile stock). Consequently most of the 2004 stock was lost due to ridging out in 2007. It had also been observed that cockles, mussels and Razor shell had all reached peak levels in 2008, raising the question of whether the Wash had reached carrying capacity for bivalves in specific areas.

In an effort to establish the 'food' levels in the water the ESFJC research team had begun a Wash Productivity Study involving the monitoring of Chlorophyll-a levels.

Would the 2006 year class cockles which died have spawned?: Normally spawning would take place from two year old onwards, however, it would be hard to comment on whether they had spawned until the spat had had time to settle. It was however, believed that they had spawned, which had further weakened the cockles.

What age do cockles reach?: Generally 3-4 year old cockles make up the commercial fishery. In lower densities cockles reach up to 7 years old, however on higher grounds it can be 5 years before a cockle reaches a commercial size.

Is there information regarding the economic value of the cockle mortality?: The tonnage of cockles involved would suggest a value of approximately £5m. The industry would not have been affected yet as only one third of the adult stock is used to make up the available TAC. Ultimately the TAC had not been reduced noticeably as a new ground had been found which had not previously been included in total stock assessments. Obviously it may be more noticeable in future years. It was also noted that an accurate value is hard to predict as it depends on the price of cockles at the time of landing.

What environmental factors have been considered?: Questions were raised as to whether factors such as water quality entering the Wash from the rivers, sea temperature changes and climate change impacts on phytoplankton levels had been considered. These are all areas that will have to be considered in the ongoing investigations.

Were mussel stocks affected as well as cockles?: There seemed to be a slow trickling decline but the available dataset was not strong enough to support any definitive conclusions. There has generally been good mussel meat quality, however during the previous 2 years this appears to have declined. The mussels appeared to be surviving but were not of the same quality.

### ***Application of Environmental Monitoring Data in Shellfish Studies and Management: The Burry Inlet***

Exceptional rates of ongoing cockle mortalities have been identified in the Burry Inlet, resulting in investigations into potential causative agents and monitoring in the area. Ruth Callaway presented the available data on the cockle situation during the past decade, up to the present time.

The area had been a prolific cockle fishery for a number of years, managed by the South Wales Sea Fisheries Committee (SWSFC). 50 licences were available for the fishery with the method of fishing limited to handworking only. Over the past few years many suggestions had been given for the mortalities and subsequently declining stocks. Initially the decline had been a trickle with small

number of cockles coming to the surface and dying, similar to the situation noted in the Wash. However, this was ongoing in the Burry Inlet since 2003 significantly affecting the fishery and stakeholders. It was estimated there had been a loss of approximately £20 million to the industry since 2003. The reduction in stock levels had also affected the level of spatfall in subsequent years. Since 2004 there had been no cockles older than 2 years. Despite spat levels being average to high this had not translated into a sustainable adult cockle stock.

What age are the stock taken?: Under normal circumstances it would depend on the size limitations, typically stock taken would consist of 20% 1-year-olds and 80% 2-year-olds, however the management of the fishery had been adjusted by the situation of the fishery, therefore no size limitations were in place.

As the study unfolded it was apparent the existing data could not identify a cause for the mortality. Consequently a research project had been set up, a stakeholder group was formed led by the Environment Agency taking into account all interested parties. Initially, numerous potential causes for the decline had been highlighted and the project aimed to investigate whether there was evidence supporting potential theories. Several work packages on cockle health and the environment of the Burry Inlet were devised. Information was also gathered to ascertain whether other animals inhabiting the area were being affected.

During April-July (2009) work began on investigating factor, this allowed them to rule in/out factors which might affect mortality. The process began by allocating a Reference Site. The Dee Estuary was used as the Reference Site with the Burry Inlet being classed as the Investigation Site.

Water analyses were carried out as well as collecting information on:

- Temperature/sediment/oxygen (data probes)
- Benthos samples
- Cockle population/densities/reburying capacity/size structure/productivity
- Reproductive condition of cockles

During this process unusual mortality was encountered at the Reference Site, with barnacles appearing on the cockles. It was undetermined whether these had appeared after mortality or whether they contributed to the mortality.

The loss of cockles on a weekly basis had a distinctive pattern, in that the younger cockles were growing but those 1-2 years old were steadily declining.

Despite the project groundwork the funding had not been secured for the project to go ahead. It was estimated that £1/2m would be required to complete the 2 year project.

Did the weekly mortality indicate any pattern related to the tides?: It had been noticed that there was greater mortality during neap tides than there was during spring tides.

There had also been expressed belief that the mortality was related to changes in the sewage system (which had been altered in the late 1990s), as there were a lot of storm overflows that were thought to cause a problem during neap tides, where water would not have been treated before entering the rivers. Ammonia levels had been assessed, 50 samples had been taken and in some cases above toxic threshold levels had been identified, it was hoped that four more estuaries could be sampled in the same way to see if this was a normal phenomena.

As above threshold levels of ammonia would also affect other organisms in general, it did not explain why only cockles of 1-2 years old were being affected.

How to Combine the available resources / knowledge / effort?

With the possibility that the mortalities in the Dee could have a similar cause to those in the Wash it seemed sensible to co-ordinate research information, particularly as Wales were looking at a whole package of potential causes whilst ESFJC were just beginning to look at a couple of key factors. It was also suggested that there might be a need to combine information on mortalities, as they are more geographically widespread than the two situations being discussed, it was suggested this could be done through Sea Fisheries Committees.

It was felt important to carefully describe a mortality event including distinguishing characteristics as this could quickly rule out some reasons for the event.

Co-ordinating information would enable methodology, data and experiences to be easily shared. As the Thames region had not encountered any unexplained mortality it was suggested this could be used as a reference site. It appears that some event this year had clearly impacted widely on cockle beds, with most areas having recorded mortalities rather than a steady trickle of deaths. It was noted, however, that the Thames might not have identified any mortalities as yet because it operates a dredge fishery with fishing not taking place over low waters when evidence of a slow mortality would be apparent.

A similar case had been recorded in France, after investigation this was thought to be a combination effect of rainfall and phosphate run off killing the cockles.

*Could it be a virus?:* The possibility of the cause being a virus was raised. ESFJC had had some cockles tested in May (2009); half of the samples were found to be infected with parasites (commonly found in cockles), whilst the other half were not. One theory was that the parasite may have been transferred to the Wash from the Burry Inlet via relaid stocks or other vectors. It was hoped Cefas (Weymouth) would be able to provide advice.

### *Water Movements and Hydrodynamic Controls*

There is a clear requirement for a greater understanding of water movements and controls on primary production in The Wash and as such ESF have been trying to identify a method for conducting this work with other organisations. Having liaised with the University of East Anglia it appeared possible that an International Incoming Fellowship (IIF) award might provide a means of approaching this work. This would involve a student from an international country coming to work and undertake research in Europe for 1 to 2 years with a view to developing mutually beneficial research. Fortuitously an Egyptian scientist had applied to the UEA to undertake a project and was well suited to the task and an application for IIF funding was put forward with the UEA, Cefas (Lowestoft) and ESF working together.

Objectives of the project would be:

- Understanding water movements through a detailed 3D hydrodynamic model
- Integration of hydrodynamic modelling with ecosystem models
- Inclusion of important ecological beds
- Handling of flooding and drying on beds
- Investigating likely impacts of production of the Wash resulting from reduction of nutrients under Water Framework Directive.

The project would be using the General Estuarine Transport Model (GETM) methodology, with all parties providing information Free of Charge, and cooperating toward a common goal.

It was advised that as there was only a 6 metre difference between low and high tide it would be necessary to provide a precise (centimetres) elevation model to identify localised processes. It was also advised that it would be important to clearly identify spatial scales used in the modelling process and that these would influence the performance of the model and further data analyses.

Encouragingly the EA had just completed a three-year monitoring programme that would contribute significantly to the modelling process. The EA also suggested that they might have access to

Light Detection and Ranging (LIDAR) data from previous work that would help toward the provision of a more accurate elevation model on which subsequent modelling would be based. Cefas may also be able to access historical models that could be useful in this work. This included past studies of Wash mussels included an overlay of Wash sediments. There may also be useful information on sediment types as well as aerial photography and channel movement information.

It was advised that the Met Office has developed models capable of producing outputs that include spatial estimates of marine productivity and chlorophyll-a levels. It was thought these could be computed for the whole of the coast. However, resolution and detail within localised areas may be lacking but could help towards our understanding of more general areas.

It was questioned whether a model of the Wash could be useful in explaining the mortality of the cockles. It was advised that this might be plausible with the provision of sufficient information pertaining to the parameters that influence the mortality of cockles. However, the hydrodynamic model and integration with ecological models would provide a good starting point.

It was suggested that whilst the result of this application was awaited an additional student application case should also be put forward, although the processes of proceeding with this needs to be clarified.

The matter of funding a CASE PhD studentship to run alongside the project was considered. Costs for such a studentship would be relatively economical and if spread between organisations in theory could be found. It was acknowledged that it might be difficult to get funding for a PhD due to the competitive nature of the process. Cefas are conducting a large amount of work on the influence of climate variability. However there is a lack of understanding in relation to shellfisheries and environmental variation. If the project could be geared generally in this direction it may be possible to get funding from their climate change budget.

Ultimately it was agreed that if the application was successful and the project could go ahead, all present would be willing to support the project.

### *Nutrient inputs and productivity*

The Wash is considered to be 'high profile' at present, with the Water Framework Directive (WFD) currently focussing on the outer Wash. Chlorophyll-a and phytoplankton measurements were being studied on a monthly basis from 5 sites in the outer Wash by the EA. The EA were also collecting data on water chemistry (nutrients) although this was mainly during the winter months. Wave Rider buoys would have a larger amount of historical data although the timeframe for the data may not be ideal, it would be monthly rather than weekly. Essentially the data would relate to winter months as information was not gathered after the spring bloom.

Cefas have a high resolution buoy checking nutrient / chlorophyll etc collecting data, this had been deployed in January 15 miles out to sea.

It was questioned whether Cefas and EA could put their resources together and devise a programme, with ESFJC collecting samples. The problem with this would be paying for the samples to be analysed.

Andrew Harwood expanded on the research being carried out using water quality data sondes (part funded by Natural England) in the Wash. He advised there was one static buoy located in the mid Wash collecting data relating to turbidity, chlorophyll-a, temperature and salinity. A further data sonde was being used for spot monitoring and it was envisaged that water samples would be collected and analysed (with the help of Cefas) to enable accurate calibration of the equipment. These water samples would also be tested for common nutrient parameters contributing to a dataset for both this work and that conducted by Cefas as part of routine monitoring. Currently the research team are conducting some high-resolution studies over relatively small areas, with effort being concentrated in the western Wash where the main mortality had taken place. They were also looking at what was

coming from the rivers and the influence that mussel lays had on the relative abundance of chlorophyll-a (as a proxy for phytoplankton and organic plant matter) in the water column. It was hoped that a greater understanding of nutrient cycling and its influence on available food resources could be gained through this and other work. In addition the chlorophyll-a signatures of waters are based on the total photosynthetic pigment abundance and it is important that we try to understand what this is composed of (e.g. phytoplankton communities and plant detritus).

Cefas have a flow through fluorometer to study phytoplankton, this provides measurements pertaining to the size, numbers, composition and pigments present in the water.

What growth measurements were generally taken from cockles & mussels?: currently there was nothing in place when sampling cockles other than comparing year classes, up to the present time no other detail of growth rates was looked at.

It was hoped to further establish what the bivalves actually feed on, whether they were competing with others and whether this changes with age. It was thought that changes in condition are likely to be more significant than those in growth rate. The mortalities in the Burry Inlet differed to those in The Wash because meat yields (condition) were still good in contrast to the reductions seen in localised areas of The Wash. Thus, metabolic stress might not be at the route of the Burry Inlet mortalities but could be an underlying agent in The Wash. It is envisaged that further studies may be carried out to assess localised growth potential under various conditions and therefore what threshold levels for metabolic stress and mortality would be.

Anecdotal information from shellfish farmers has also suggested the mortalities might be related to the presence of large numbers of razor shells (*Ensis directus*). When there were large numbers of razor shells there was a smaller yield of cockles. Cefas has previously carried out surveys of the razor shells and it was agreed that they would enquire as to whether there was any evidence of die-offs related to large numbers of razors.

It was thought that the key to the problem might potentially be to gain a more in depth understanding the hydrology of The Wash.

NEXT GOAL : To generate a testable hypothesis

Questions were raised as to why the EA nutrient sampling was only applied to winter months and not the summer. This was explained as being based on what the EA had to regulate, with funding cuts it had been necessary to look at what information was required to pass the regulation. It was thought the winter nutrients gave an idea of the maximum capacity for the summer. EA spot sampling and normal water sampling data should be available, although this will be looked into.

### ***Impacts of Environmental Variations***

There was concern in the Burry Inlet that improving water quality had resulting in the carrying capacity declining due to the lack of food coming in. This was not thought to have been as great as was originally expected.

The question of what happens to the composition of nutrients etc once they have passed through the treatment works, compared to arriving in its raw form was raised. The bulk of ammonia would go through the treatment work and become nitrate, losing 10/15% of the nitrogen.

What about temperature / climate change? The effect in the Wash happened so quickly it seemed unlikely to be due to climate change unless it was a build up of stress over a period of time finally causing the mortality. It was hard to imagine temperature was a factor as the ecology of the cockles is very robust. They are known to survive in frozen areas as well as at high temperatures making it difficult to relate mortality to temperature. The succession of mild winters meaning the water

temperature dropped less may have had an affect. It was thought possible that the shellfish shut down as a certain water temperature which may not have happened if the temperature did not drop that low. This would mean the cockles with their high metabolism would still be feeding and therefore taking the food earlier than they would be during cold winters.

Other environmental issues to consider:

- Historical flow data for rivers (from EA)

### ***Changes in Ecosystem Structure and Functioning***

Was there anything that needed to be taken into consideration as the project moved forward?:

If there are continued changes in growth/meat yield of the shellfish and productivity continued to decrease it would be necessary to leave more of the stock for birds - under the new environmental requirements. It was acknowledge it would be necessary to assess the impact of the amount of shellfish was taken by birds. This had not been looked into previously as over the last few years the cockle and mussel stocks had reached a high level.

Plankton in general could be looked into in more detail, including how efficiently energy is getting through to cockles and other species and whether this has changed historically. Work on trophic change was considered very contemporary and The Wash would provide an interesting location for further studies.

The Wash could be viewed as a wider study concept. A similar study had been done elsewhere that could be built on. It was agreed that this could be something Cefas could help ESFJC promote.

### ***SUMMARY***

Suggestions were made for progression of the project at a local level (although it was noted that it was more likely to be worthwhile to work with multi agencies at a higher level).

- Start collecting data for different regions and compare the need to collect information in the same format.
- Use institutes closest to the sites, students could be encouraged to study related projects - this would reduce the cost of sample analysis (£25 to outside body / £5 to a student). This would involve working out what needs to be studied in advance by talking to the modellers.
- Need to assess what information is missing – an individual project could aim to collate available information from all organisations and gaps could be identified.
- Need an authority with the respect of all the diverse interested groups to take the lead and keep the communication and momentum going. It was suggested the regional Wash lead at EA - Sue Hogarth - should be contacted (EA interest may increase under the WFD).

What is the best way to get access to data held by the EA?

In theory there are three databases, however in practice data is held locally or is in the process of being checked prior to going onto the national system.

Would it be beneficial to have all the data on mortalities over the last few years put together?: This would be cockle mortalities with accurate data around them over the last 2/3 years. This might show up some similarities.

Everyone was thanked for attending. In order to ensure progress each party would be contacted on an individual basis and where possible assistance requested.