

Environment Agency Wales update to the Welsh Assembly Petitions Committee on the outcome of the Burry Inlet Cockle Mortality Investigation Report 2009-20011, dated 17 January 2012

Following the recent completion of the investigations into the mass mortalities of cockles in the Burry Inlet, we are now able to provide the following summary of the report's main findings, conclusions and recommendations. We have also outlined how the information will be used to improve the management of the fishery to better serve the needs of the community and the environment on which it depends.

Project Background and History

The Burry Inlet is a large estuarine complex located in South Wales between the north coast of the Gower Peninsula and the south-east coast of Carmarthenshire. Chronic mass mortalities of cockles (*Cerastoderma edule*) in the Burry Inlet have been observed annually since 2002. In 2008, the Welsh Government asked Environment Agency Wales to co-ordinate and facilitate an investigation into the cockle mortalities. This was developed, in collaboration with Hull, Bangor and Swansea Universities, Centre for Environment, Fisheries & Aquaculture Science (CRFAS) and the Countryside Council for Wales.

The original two-year programme was extended by one year to undertake more integrated data analyses. The study aimed to understand the causes and consequences of cockle mortalities in relation to their fisheries and to inform future management of the cockle beds. It also addressed the socio-economic and environmental sustainability of the cockle fishery. The study reviewed existing literature and undertook a detailed field sampling and laboratory programme during March to July 2009 at two sites in the Burry Inlet and a comparison site in the Dee Estuary. The study was comprehensive, including the health of the cockles and the other estuarine fauna, the nature of their populations, the types and quality of the sediments and the water quality.

Although the study focused on the Burry Inlet, its fishery and cockle population, the methods used and findings will be very relevant to other similar areas, species and fisheries that may be experiencing similar problems. The overall study provides an understanding of the populations in relation to both the functioning ecology and human activities in the area.

The technical report is divided into four main sections, in addition to references and appendices:

1. Scientific Reviews (Water Quality, Physical Characteristics of the estuaries and the cockle beds, Ecology and Dynamics of cockles, other bivalves and the other sand flat fauna, Cockle Individuals and Health);
2. Scientific Investigation undertaken in 2009 (Water Quality, Ecology and Dynamics, Cockle Individuals and Health, Combined Data Analysis);
3. Fisheries Management;
4. Conclusions and Recommendations.

The project began by bringing together the local community, policy makers and scientists to systematically map out all possible causes of cockle mortalities in a typical estuarine area such as the Burry Inlet. This produced a set of questions which could be tested through scientific investigation to confirm or eliminate possible causes of cockle deaths. Hence the research objectively tested:

- Whether the mortalities were as evident as the anecdotal evidence suggested and, if so, whether similar patterns of mortality could be seen in other species in the estuary. Were they related to water or sediment characteristics and thus related to 'external' factors such as pollution:
- Were they caused by 'internal' cockle factors such as abnormal growth, early spawning or pressures from overcrowding, or:
- Were they caused by, or reflected in, the physiological health of the organisms and their parasite levels.

We know that typically first-year cockles always suffer much higher mortality rates than older cockles, and most populations experience occasional mass mortalities. There is little analytical work on these mass mortalities and hence the research aimed to determine if possible whether the observed patterns were normal or abnormal for cockle populations.

Summary of Main Findings

The report is clear that there is no evidence that pollution in the water or sediment is related to the mortalities. The study suggests that the nutrient and organic conditions in the Burry Inlet are producing good growth of young cockles. With time, it is expected one of two alternatives may arise – either this new state stabilises and becomes typical for the area, or the population gradually regains its former characteristics with an increasing number of older individuals surviving to rebuild the typical age structure as suggested by more recent stock survey results.

The investigations found no single cause of the mortalities but the report makes clear there may be several, possibly interacting causes

and that the cause(s) of the initial mass mortality may differ from the cause(s) of the continuing mortalities.

The report concludes that the Burry Inlet cockle populations have gone from an apparently stable population, composed of several age classes and supporting a lucrative fishery, to one in which high recruitment produces a first-year cohort which has good growth, and gives an early and successful reproduction (spawning) but is then followed by death. The analyses indicate correlations between the mortalities and overcrowding, parasite load, energy imbalance, and/or condition loss together with a lesser influence of sedimentation. The investigation has been unable to determine the relative influences of each of these factors on total mortality or whether some are causes or merely symptoms of the problems observed.

The study, using field observations and laboratory analyses, has produced a large amount of data, information and understanding about the cockle mortalities. More robust modelling of the data collected, supported by field- and laboratory-based experiments is needed so that future management options may be more effectively focussed.

Areas of uncertainty that remain include:

- the effects of population density on cockle physiology, energy budgets, and their micro-habitat;
- the role of parasites in cockle health and mortality;
- longer-term patterns of behaviour -- future monitoring of the cockle population may highlight trends not observed during this short-term study;

Further investigations are also recommended in support of future fisheries management:

- investigate the options for dividing the Burry Inlet into management areas as this would allow each area to be managed separately (rotational harvest and bed closure) while still allowing for the management of the whole estuary;
- redesign the stock survey methodology to provide higher accuracy of overall biomass estimates. This will allow a better apportioning of the available stock to better balance the demands of the fishery and ecology;
- model the options for cockle size limits to optimise both stock sustainability and the economic return from the fishery;

- determine whether there are biosecurity issues with the movement of cockles into and out of the Burry Inlet and whether this could have contributed to genetic and health changes.

Conclusions

- During the period March to July 2009 there were high but uniform mortalities of end-of- 1st-year cockles in the Burry Inlet, i.e. there was no apparent episodic mass mortality. The mortalities were balanced by high recruitment
- There is documented evidence of a seasonally-reduced flesh condition, use of body reserves and energy, in the Burry Inlet cockles. These processes are part of the 'normal' cockle life cycle although cockles elsewhere usually survive spawning to live and spawn in successive years. In the Burry Inlet, however, these declines are correlated with spawning, after which the cockles showed increased mortalities.
- Spawning produced a high spatfall thus allowing the population to persist on an annual basis. The resulting high densities of 1-year cockles may be sufficient to cause problems linked to overcrowding, which in turn may affect the ability of the cockles to remain in the sediment.
- High levels of some internal parasites could have caused mortalities in the Burry Inlet but are unlikely to be a primary cause of death, i.e., the infections probably occur in already stressed individuals. Although these levels of parasitism may themselves stress the cockles, these are not sufficient alone to account for the mortalities. Data collected by Cefas throughout the 2000s on prevalence and intensity of parasite infections from the Burry Inlet cockle populations, however, indicate that their frequency was higher earlier in the decade than during this study. It is possible therefore, that parasites may have been more problematical prior to 2009 and less so during the recent intense field campaign.
- There was immunological evidence of stress but this occurred at all sites, both in the Dee and Burry Inlet and again the evidence was insufficient to indicate this as a cause of death. .
- Sediment changes leading to tidal elevation changes occur in all tidal flat systems. Accretion can potentially stress cockles by raising their position in the tidal range. This is considered unlikely in the Burry Inlet given cockles' normal environmental tolerances. Similarly, the remaining benthic community in the estuary (i.e., apart from cockles) did not show any adverse changes, again reinforcing the conclusions that physico-chemical factors were not the causal agents of the elevated mortalities seen in the cockle populations of the Burry Inlet.

- There were no gross changes of water and sediment quality in the Burry Inlet sufficient to stress the cockles. The Burry Inlet nutrient levels are typically in the mid-range shown for a large suite of UK estuaries, and it is of particular note that cockle mortalities were not regarded as being of concern during previous periods of elevated nutrient levels.
- With regard to contamination levels, the estuary shows higher metals concentrations than other estuaries around the UK, reflecting its industrial history. The levels are not, however, considered sufficient to cause any toxic effect in the cockles; for example, the levels of copper were shown to be significantly below the environmental quality standard (EQS, the level of a contaminant that can safely be allowed in the environment without causing ecological harm). It is also significant to note that copper levels were higher historically and yet abnormal cockle population mortalities were not recorded and the fishery was profitable.
- The study focussed on the causes of the mortality during 2009 hence it is not possible to make comparisons with "catastrophic" mortalities reported in 2005. The anecdotal evidence of the 2005 mortalities, using images made available by the cockle gatherers, suggest that the mortality level was indeed a lot higher, especially in 2005, than seen in 2009.
- Similarly, in assessing whether the mortalities are becoming less acute year on year, numbers published in the recent stock survey reports suggest that more cockles are surviving beyond the first year. It is not possible to say whether this is a trend although survey data show that the mortality levels are not increasing.

Consultation and Future Considerations

The authors of the report presented their draft findings to the Cockle Working (steering) Group and members of the Burry Inlet Management Advisory Group (BIMAG) in October 2011. These groups, which include industry representatives (both cockle gatherers and processors, who represent the petitioners) were given an opportunity to discuss and comment on the findings during the meeting and were personally invited by Professor Mike Elliott (the report's main Author) to submit their points or objections in writing so that they could be formally considered

The scientific authors of the report can only provide conclusions based on the data and analyses available. Environment Agency Wales and its partners and stakeholders are currently considering the detailed implications of the report, its conclusions and recommendations, and how these might influence future management approaches. Management approaches will be developed in consultation with the industry to maximise the chances of returning to an economically and ecologically sustainable fishery, although this desired outcome is by no means certain.

A number of ongoing independent investigations, notably the INTERREG funded SUSFISH (Shellfish Productivity in the Irish Sea) project, are likely to further our understanding and address some of the areas of uncertainty identified. Even so, if opportunities occur, further specifically targeted investigations (primarily modelling or experimental) will be proposed to directly improve the effectiveness of the management of the fishery.

Environment Agency Wales, as part of its two-year stewardship of the Burry Inlet Regulating Order on behalf of the Welsh Government, intends to produce a Management Plan by April 2012. This will draw on the best available scientific evidence, including the Burry Inlet Cockle Mortalities Investigation Report, to help recreate a thriving cockle fishery that supports, protects and enhances the needs of the local community and the environment on which it depends.