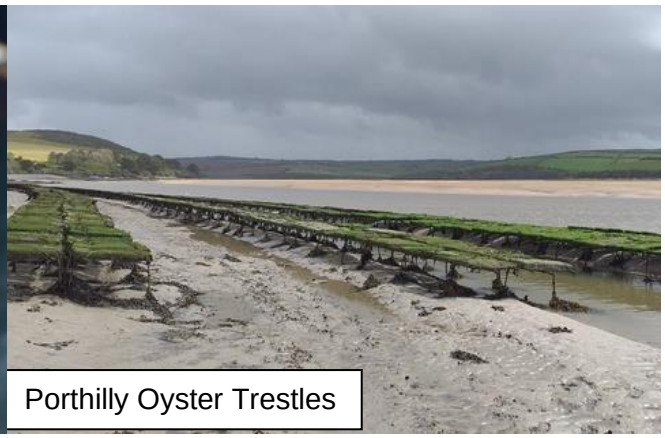
Developing an Assurance Scheme for Shellfish and Human Health (DASSHH)

One of the key issues constraining sustainable growth and economic viability of the UK shellfish aquaculture sector is water quality, particularly the limited availability of high quality shellfish waters. Poor and unpredictable water quality can have a detrimental impact on bivalve production (mussels and oysters). This affects a business' ability to sell their product and can render some sites uneconomic. This is because water quality affects the incidence of microbial contamination in harvested shellfish. There is a complex monitoring and testing system in place (via the Official Control Regulations) to assess and manage the risk of this contamination to human health. This involves the routine monitoring of the faecal indicator organism *Escherichia coli* (hereafter referred to as *E.coli*), which is used to grade production beds and determine the required harvesting protocols.

How a site is classified can affect business flexibility, operating costs, and even the ability to trade. The DASSHH project, facilitated by Seafish on behalf of the Shellfish Stakeholder Working Group (SSWG[1]), looked at innovative ways to better assess the factors that could influence water quality so that shellfish farmers could manage harvesting operation to avoid high-risk periods.

Mussel rope



Porthilly Oyster Trestles

Project Objectives

The DASSHH project sought to develop an innovative risk-based approach to enable the production of high quality bivalves that fully meets consumer safety and regulatory requirements, while recognising the variable water quality in the UK. The project aims included:

- Improving our understanding of the sources of microbial contamination and how uptake by shellfish varies with a range of potentially predictive environmental factors, so that producers can more accurately predict, manage, and intervene to reduce the risk of harvesting contaminated product.

[1] SSWG, facilitated by Seafish and chaired by the Shellfish Association of Great Britain (SAGB), brings together shellfish producers, regulators and researchers to work collaboratively to identify, discuss and find solutions to issues affecting UK shellfish production.

- Developing a framework for a risk-based adaptive management system that:
    - Complements the current retrospective classification system, by guiding the management action that should be taken when poor water quality is predicted;
    - Enables regulators and industry to cooperate in exploring potential flexible approaches to the application of the regulatory framework, with the aim of minimising the incorrect downgrading of shellfish beds, whilst ensuring the required standards for public health are maintained.

The DASSHH project took place at Porthilly Shellfish, located in the Camel Estuary (Cornwall), with Bangor University and the UK Centre of Ecology & Hydrology contracted to undertake the work.

DASSHH findings

Various factors influence the relationship between water quality and the microbial loading of shellfish flesh. There is good evidence to indicate that elevated *E.coli* levels in shellfish may be linked to environmental influences such as high rainfall and tidal water movements. Other important determinants include catchment characteristics such as land use (e.g. occurrence of livestock agriculture) and the presence of pollution sources such as storm overflows (also referred to as combined sewer overflows or CSOs).

DASSHH successfully developed models that enabled the real-time prediction for *E.coli* levels in mussels and oysters. Based on simple and readily available environmental data, such as rainfall, river flow and seawater temperature, potential contamination events were predicted with a 90% accuracy at the Class A threshold, rising to 98% accuracy for the Class C threshold. However, this level of reliability was only achieved by using an alternative approved test method (pour plate) rather than the reference test method (Most Probable Number or MPN) used by the UK shellfish monitoring programme.

The pour plate method consistently yielded less variable *E.coli* results than were obtained by MPN, particularly for the upper range of *E.coli* concentrations. This suggests that the MPN test method has a greater potential to generate outlier results which hamper predictive modelling and may also potentially influence official monitoring results. Whilst the research was not originally focused on assessing the different test methods the findings from the DASSHH research have some immediate benefits to the farmed shellfish industry. The results suggest that using a different test method could mean less variability in the test results and could in turn reduce the number of site closures and the need for resampling whilst still maintaining hygiene and health standards. This could be particularly beneficial for producers exporting to Europe.

Next Steps

The DASSHH findings contribute to the growing evidence base supporting an adaptive risk-based management approach to shellfish production. Transferring the DASSHH model from the Camel Estuary to other catchments is entirely feasible and could be linked to ongoing environmental monitoring programmes such as those of the Environment Agency and the Met Office. As the data from these monitoring programmes is increasingly being made available in close to real-time, the potential to develop a water quality forecast system for the industry is closer than ever to being realised. However, there is uncertainty about how such an approach could be aligned with the current regulatory system.

While we use *E.coli* as an indicator of potential contamination, it is not without its problems because it does not always reliably detect norovirus contamination. Because *E.coli* can be derived from animals as well as humans, high levels in shellfish do not always indicate the presence of norovirus. Additionally, it takes longer for viruses to be removed from the shellfish than *E.coli* during the purification process. These challenges mean contaminated bivalves could still reach the market even when they follow all the correct processes. This is a recognised weakness in the current system. This also means that an assurance scheme based only on environmental factors will encounter similar issues.

Improving our understanding of the source of norovirus, via wastewater surveillance, would be a valuable additional component for the predictive models. Seafish is working with Wessex Water, Othniel Oysters Ltd and Bangor University, to investigate if there is a correlation between levels of norovirus in wastewater and shellfish contamination. This project builds on the DASSHH research by incorporating results from a water quality prediction and alert system, alongside the environmental indicators. This should improve the predictive capability of the risk models and support the future management of shellfish production areas.