NORA 4 Online
Reconnecting across Europe

4th Conference
23rd – 25th November 2021

ABSTRACTS

STUDENT SESSION

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Partners
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| 10:15  | Talks Session                              | Hannah Farley<br>The role and optimization of the microbiome in molluscan larval development  
Monica Fabra<br>Development of a non-destructive technique for the monitoring of oyster gametogenesis and sex differentiation  
Charlie Mountain<br>Trial of intertidal and subtidal structures to mitigate saltmarsh erosion and increase bivalve settlement rates within the Hamble estuary  
Brecht Stechele<br>Comparing life history traits and resistance to changing environments of two oyster species (*Ostrea edulis* and *Crassostrea gigas*) through Dynamic Energy Budget theory  
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| 12:00  | Close of meeting                           |                                                                                   |
The role and optimization of the microbiome in molluscan larval development

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Microbiomes are known to play a range of beneficial roles in the health of host animals, including bivalve species such as the native and Pacific oysters. As sessile filter feeding organisms, oysters have a particularly close relationship with their environment, and are constantly exposed to an assortment of microbes. This project will study if and how microbes influence development and survival of oyster larvae, as well as how the microbiome may be influenced by environmental interactions within a hatchery setting.

This project has a number of objectives to elucidate the impact of microbes on culture systems. This includes the characterization of the European flat oyster microbiome throughout a natural spawning event, and the microbiome of C. gigas and O. edulis throughout hatchery production. Characterisation of hatchery environmental samples will also provide insights into sources of microbial contamination, a major limiting factor for efficient hatchery output. These studies will elucidate both what a normal microbiome looks like, and also what happens when the larval culture system is not performing optimally.

Analysis will be completed using ONT metabarcoding MinION platforms. This broad-scale data will then allow for hypothesis driven manipulation experiments to investigate if and how the microbiome can be influenced to increase hatchery output. These studies have the potential to improve seedstock output from hatcheries for contributions towards food sustainability goals and ecological restoration activities.

Project supervisors:
Dr Tim Bean, Dr Tim Regan, Dr Mick Watson, Dr Frederico Batista and Dr David Bass
Development of a non-destructive technique for the monitoring of oyster gametogenesis and sex differentiation

Monica Fabra¹, Tim Bean², Gordon Watson¹, Joanne Preston¹
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Reflecting the global decline of oyster reefs, the current distribution of the European native oyster, Ostrea edulis (Linnaeus, 1758), across the UK and Europe represents only a small fraction of the historic distribution. Several hatcheries are being established across Europe to assist in restoring O. edulis populations, providing oyster seed. However, the hatchery production of native oysters is still prone to failure due to O. edulis complex lifecycle and the knowledge gaps surrounding its gametogenesis and sex differentiation. It is currently difficult to control and manipulate spawning, fertilisation, and sex ratio in a controlled environment, this frequently leading to disproportionate gametic contribution. Techniques used to monitor the development of oyster gonads and the effectiveness of broodstock conditioning protocols usually require destructive sampling of gonad tissue for histological analysis involving the sacrifice of large numbers of oysters, which is undesirable for many restoration projects with limited broodstock. This research investigated the suitability of two non-destructive sampling techniques for the long-term monitoring of oyster gametogenesis, and the effects of frequent gonadal sampling on oyster health and survival. Forty oysters were kept separately in flow-through tanks for one month. The shell of sixteen oysters was drilled at the beginning of the experiment using a pillar drill, eight of which was subjected to weekly gonadal sampling using a biopsy needle. Other sixteen oysters were anaesthetised weekly using magnesium chloride, eight of which was subjected to weekly sampling of gonad smears. Eight oysters were used as a control, neither anaesthetised nor sampled. Mortality, growth and filtration rate were monitored weekly. The use of anaesthetic (magnesium chloride) as a non-sacrificial method to sample oyster gonads cannot be considered efficient for frequent sampling, causing high oyster mortality (25% after only three weeks) and low filtration rate. Contrarily, the drilling of oyster shells caused low oyster mortality (0% in five weeks), and after only two weeks, 50% of the drilled holes was completely sealed. The high filtration rate of oysters subjected to the drilling may be associated to the production of new shell. The novel non-destructive approach involving the shell drilling may finally allow to monitor the gametogenesis and sex differentiation of individual oysters throughout the whole reproductive season, without sacrificing any broodstock.
Trial of intertidal and subtidal structures to mitigate saltmarsh erosion and increase bivalve settlement rates within the Hamble estuary

Charlie Mountain¹, Joanne Preston¹, Gordon Watson¹, Federica Raggazola¹, Tim Sykes²
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² Environment Agency, Solent & South Downs Area, Hampshire, UK

The value of habitats such as saltmarsh and oyster reefs can be derived from services such as coastal protection, blue carbon, and biodiversity enhancement to species upon which humans depend. It has been observed outside of the UK that fish and invertebrate production can be enhanced by each of these habitats, and that sediment stability can be enhanced by restored oyster reefs, thereby mitigating shoreline erosion. Yet a combined approach to restoring and monitoring both of these habitats is yet to be investigated in the UK, particularly the Solent, where small scale restoration of both salt marsh and oyster habitats is well underway and gaining traction. The project aims to trial structures designed for saltmarsh and bivalve restoration in the intertidal, monitoring the effect on biodiversity and sedimentation, as well as effect of tidal height on Ostrea edulis settlement, and eventually develop a framework for future integrated restoration practice. Two main experiments will be conducted to test the ability of these structures to restore coastal habitats, observing the saltmarsh and ecosystem response to structures placed at immediate shoreline edge, and O. edulis/general bivalve settlement on cultch at varying heights along the intertidal. Settlement experiments will involve monitoring of; reef areal dimensions, reef height, live oyster density, bivalve size-frequency distribution. Whilst the saltmarsh experiment metrics monitored are more extensive; biodiversity of saltmarsh, invertebrate, fish, and water bird species, shoreline change, wave attenuation, water quality, carbon system, and sediment analysis. Universal environmental variables temperature, salinity and dissolved oxygen will be monitored for all experiments, and ancillary metrics involving oyster condition will be monitored post restoration only, to be referred to for context of the performance of the restoration. As of yet we have conducted deployment of both saltmarsh and oyster related structures, and have collected baseline data for the metrics outlined in the methods. Drone flyovers of sites have also been conducted. The discussion will include the following, once appropriate data has been collected; influence of structures on biodiversity and shoreline in terms of loss/gain/height profile, sediment changes induced by structures and wave attenuating properties of structures, optimal tidal height to encourage native oyster settlement, the importance of stakeholder engagement and implications for future trials/larger scale integrated projects.
Comparing life history traits and resistance to changing environments of two oyster species (*Ostrea edulis* and *Crassostrea gigas*) through Dynamic Energy Budget theory

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To predict the response of the European flat oysters (*Ostrea edulis*) and Pacific cupped oyster (*Crassostrea gigas*) populations to environmental changes, it is key to understand their life history traits. The Dynamic Energy Budget (DEB) theory is a mechanistic framework that enables the research in the bioenergetics of development, growth, and reproduction from fertilization to death of living organisms. This study parameterizes the DEB parameters for the European flat oyster, based on a comprehensive dataset, while DEB parameters for the Pacific cupped oyster were extracted from literature. The DEB parameters for both species were validated using growth rates from laboratory experiments at different temperatures and food levels as well as with collected aquaculture data from the Limfjord, Denmark and the German Bight. DEB parameters and the Arrhenius temperature parameters were compared to get insight in the life history traits of both species. Increasing sea temperatures will be beneficial for both oysters. Lower assimilation rates and high energy allocation to soma explain *O. edulis*’ slow growth and low reproductive output. *C. gigas*’ high assimilation rate, low investment in soma and extremely low reserve mobility explains the species’ fast growth, high tolerance to starvation and high reproductive output. The reproductive strategies of both oysters are considerably different. Flat oysters are especially susceptible to unfavorable environmental conditions during the brooding period while Pacific oysters’ large investment in reproduction make it well adapted to highly diverse environments. Based on the life history traits, aquaculture, and restoration of *O. edulis* should be done in environments with suitable and stable conditions, while *C. gigas* is more adapted to dynamic environments. Climate change might reduce the suitability of dynamic coastal habitats for *O. edulis*. 
What happens next? Three (and a bit...) years on

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\textsuperscript{2} School of Applied Sciences, Edinburgh Napier University, Edinburgh, UK

It’s exciting to be nearing the end of the doctorate after three and a half years of lab work, field work, public engagement, and a pandemic to boot. In this short talk Hannah will give an overview of the focus of her work and speak about her experiences throughout her PhD from grant applications to job applications. From designing science communication outputs to the process of publication and a short stop at what she’d wished she’d known back when she’d started.