MASTS Renewable Energy Forum Small Grant 2017

Progress report for grant MESG16: Exposure of Early Life Stage Marine Invertebrates to Playbacks of Marine Renewable Energy Installation Vibrations

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Aims and Objectives

The Marine Strategy Framework Directive (MSFD) recognizes noise as a major pollutant, and in order for the UK and other EU member states to achieve 'Good Environmental Status' (GES) of their territorial waters by 2020 (a requirement of the MSFD), GES descriptor 11 of the MSFD states that 'Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.' (Council directive, 2008/56/EC). As the effects of underwater noise on many marine invertebrates, particularly their early life history stages are as yet unknown, it is unclear whether or not offshore activities are meeting GES descriptor 11.

Marine Renewable Energy Installations (MREI) such as windfarms produce high-amplitude impulsive pile-driving noise during construction and also produce lower-amplitude low frequency noise over the longer term of their operational phase.

This project aims to assess the effects of windfarm associated sediment vibrations on the early life stage development of two commercially important marine invertebrates, *Nephrops norvegicus* (L.) and *Buccinum undatum* (L.). These species have been chosen as they form an important part of UK shellfish landings and also remain relatively stationary during their early life history stages. The entirety of *B.undatum* embryonic and larval development occurs over a period of 5 months within stationary egg-capsules attached to the substrate. Berried female *N.norvegicus* remain relatively stationary in sub-surface burrow systems whilst brooding the eggs for approx. 6 months prior to the onset of hatching. This means that the early life-history stages of both these species could be exposed to potentially damaging MREI associated pile-driving and operational vibrations for large proportions of their early development.

The MASTS small grant MESG16 has allowed the purchase of a Brunell Eyecam Plus digital microscope camera, which has already been purchased in preparation for the forthcoming experiments. The Eyecam will

allow high quality microscopy images of developing *B.undatum* and *N.norvegicus* embryos to be captured. This will enable assessments of maturity stage, survival and morphological changes to be made.

Timeline

The proposed experiments are constrained by the natural breeding cycles and development rates of *B.undatum* and *N.norvegicus*, and are scheduled to run as follows:

November 2017 – February 2018: *B.undatum* experiment

February 2018 – May 2018: *N.norvegicus* experiment

Proposed Methodology

Vibrator tables situated underneath experimental aquaria will be used in the St Abbs Marine Station laboratory to produce playbacks of pile-driving vibrations. The development of embryonic *N. norvegicus* and *B. undatum* that are exposed to these vibrations will be compared to control groups.

A layer of sediment (20cm height) will be placed on the base of experimental aquaria.

For *B. undatum*: Egg masses will be placed on sediment surface
For *N. norvegicus*: Berried females will be allowed to form burrows within the substrate

Noise/vibration playbacks will be characterised in terms of sound pressure and particle motion using hydrophones and particle motions accelerometers respectively (already available at Edinburgh Napier).

Experimental aquaria will be supplied with seawater from the Marine Station's continuous seawater pump system. Parameters such as temperature, light and flow will be controlled between all experimental aquaria.

At regular intervals throughout embryonic development, egg samples will be taken from the experimental chamber and developmental rate/morphological abnormalities/mortalities will be assessed using Brunel Eyecam Plus. In addition, the levels of a range of stress indicators will be quantified in the Edinburgh Napier laboratories, including lipid peroxidation and heat shock proteins. Finally, the effect of MREI associated sediment vibrations on the egg respiration rate will be assessed at St Abbs Marine Station, using a Unisense Microchamber respiration system.

Conclusion

Thanks is given to the MASTS Small Grant Scheme and we look forward to sharing our results in a comprehensive report in 2018.