Home Office

NON-TECHNICAL SUMMARY

Impacts of renewable energy systems on farmed finfish

Project duration

Years **5**
Months **0**

Project purpose

- (a) Basic research
- (b) Translational or applied research with one of the following aims:
  - (iii) Improvement of the welfare of animals or of the production conditions for animals reared for agricultural purposes.
- (d) Protection of the natural environment in the interests of the health or welfare of man or animals.

Key words

Stressor, Noise, Fish, Growth, Welfare

Retrospective assessment

> The Secretary of State has determined that a retrospective assessment of this licence is not required.

Objectives and benefits

Description of the project's objectives, for example the scientific unknowns or clinical or scientific needs it's addressing.

What is the aim of this project?

There is a recognised need to increase aquaculture production to meet food security demands; this coincides with the increasing demand to expand renewable energy systems. Co-location of fish-farms with wind-farms and/or wave energy converters at sea could address both requirements, limit the impacted areas of the marine environment, and optimise the use of space, installations and associated infrastructures. Nevertheless, there is a risk that the wind/wave energy systems may impact on the fish being farmed alongside. The cultured stocks will be exposed to potential stressors associated with energy production such as human disturbance, (moving) shade, noise, vibration and electro-magnetic fields. The objective of this laboratory-based research is to evaluate whether these stressors could affect the productivity and welfare of farmed fish. The research ultimately aims to evaluate whether fish-farm and wind/wave energy-farm co-location is viable.

Potential benefits likely to derive from the project, for example how science might be advanced or how humans, animals or the environment might benefit - these could be short-term benefits within the duration of the project or long-term benefits that accrue after the project has finished.

What are the potential benefits that will derive from this project?

This research will help to understand the potential impacts of stressors associated with wind/wave energy production on finfish being farmed alongside. It is well known that stressors affect fish physiology, behaviour and welfare but, because co-location is a novel approach, information on responses to the specific stressors and their combination is lacking. Our research will build upon the existing information by providing new focussed data on stress indicators, such as stress hormones, growth, food conversion efficiency and behaviour (e.g. feeding, shoaling, distribution, activity). Ultimately, the research will clarify the magnitude of any impacts on fish productivity and welfare, and aid decision-making in relation to co-location and multi-use platforms.

Species and numbers of animals expected to be used

What types and approximate numbers of animals will you use over the course of this project?

Finfish species of importance to European marine aquaculture and widely used in applied laboratory experiments, e.g. European sea-bass (Dicentrarchus labrax), Atlantic salmon (Salmo salar), gilthead seabream (Sparus aurata). The approximate number of fish used will be 5000 over a 5-year period.

Predicted harms

Typical procedures done to animals, for example injections or surgical procedures, including duration of the experiment and number of procedures.

In the context of what you propose to do to the animals, what are the expected adverse effects and the likely/expected level of severity? What will happen to the animals at the end?

The main focus of the project is to expose fish within a controlled laboratory environment to standardised stressors that simulate those associated with wind/wave energy farms such as noise, vibration and electro-magnetic fields. The treatment stressors will be applied over a maximum period of

8 weeks, at a periodicity representative of co-location. The anticipated adverse effects are restricted to minor disturbance of physiology and behaviour which, given the study duration, the fish may habituate to. However, because there is potential for cumulative effects, the severity has been categorised as moderate, which will be adhered to through monitoring and intervention if necessary. Laboratory control fish may be used, which will be held under standard husbandry conditions, not exposed to stress and would therefore be classed as sub-threshold. All fish will be euthanised humanely at the end of the experiment

Application of the three Rs

1. Replacement

State why you need to use animals and why you cannot use non-animal alternatives.

The primary aim is to assess the impacts of offshore wind farm/wave energy converter stressors on fish productivity and welfare and as such non-animal alternatives are not relevant. However, non-protected aquatic invertebrates may be used in prior experiments to assess and enhance the experimental set-up and parameters.

2. Reduction

Explain how you will assure the use of minimum numbers of animals.

The number of animals used will depend upon the number of replicate tanks and the number of individual fish per tank. To produce relevant data, we will need to use fish densities representative of commercial aquaculture practices. Numbers can be reduced by use of smaller tanks or by reducing water volume, so animal husbandry experts will advise on fish social and spatial needs.

Statisticians will advise on the number of replicates required to achieve meaningful results (e.g. by power analysis), based upon measurements to be taken of individual fish and the whole tank population. Marking will be considered as a mean to track the performance of individual fish, and thereby maintain data quality while reducing numbers.

3. Refinement

Explain the choice of species and why the animal model(s) you will use are the most refined, having regard to the objectives. Explain the general measures you will take to minimise welfare costs (harms) to the animals.

Our establishment has significant expertise in working with fish. The species proposed for use represent common European net-pen (cage) farmed fish; farmed stocks will be sourced and acclimated to our laboratory environment.

A literature review is being written to define the relevant stressors and the means of applying them.

The individual procedures, which the fish will be exposed to, are classed as mild but the overall severity is categorised as moderate due to the potential for a cumulative effect. The exposure period will be limited to a maximum of 8 weeks, and fish will be regularly monitored throughout - for both welfare and for data collection. Quantification of behaviour is non-invasive and can be used to assess welfare in real-time.

In the unlikely event that observed effects become more adverse than anticipated (and indicative that co-location is not viable), prompt action will be taken (for individuals or tank groups as appropriate). We believe we have a strong institutional culture of care and have review processes to identify where continual improvements in care can be made.

Finally, as mentioned above, a prior study using non-vertebrate animals may be undertaken to refine the experimental set-up and ensure logistics/equipment are fit for purpose prior to using fish.