Bachelor or Master thesis BIOVIT 2022/23

Topic/Title (Norwegian)

Fisk velferd/ Hvordan påvirket lyd forurensing oppdrettslaks?

Topic/Title (English)

Fish welfare/ How is sound pollution affecting farmed salmon

Supervisors

Main supervisor: Dr. Marco A Vindas.
Co-supervisors: Dr. Frode Oppedal (Institute of Marine Research) and Dr. Luke Barret (University of Melbourne)
Faculty of Veterinary medicine, Norwegian University of Life Sciences (NMBU)

Summary:

Project background: Hearing is a key sense in the lives of fish. It enables detection of information from all three dimensions, and is important in many aspects including communication, mating, and detecting food and predators. Much is known about the hearing capabilities of fish through several decades of fundamental research yet key knowledge gaps remain regarding how environmental noise affects fish. Furthermore, much of the current information that exists also relates to wild fish. For farmed fish, many of the purposes of detecting sound for life in the wild no longer apply, yet sound, particularly as a disturbance, may nevertheless be important in their production and welfare status. Farmed fish are also subject to a completely different 'soundscape' to wild fish as they exist in different industrial settings throughout their lives; first in land-based hatcheries in tanks, followed by sea-cages in the ocean for the grow-out period. These settings will expose them to noises and vibrations generated by machinery, boats and other equipment, either consistently through time, or sporadically.

The primary hearing range of salmon is between 100 and 300 Hz. However, farmed salmon may have a decreased hearing capabilities compared to wild salmon. The possibility exists that decreased

hearing sensitivity could prove beneficial to farmed salmon in production settings by buffering the effects of sudden loud or startling noise and thereby reducing stressful responses to disturbing noise levels. The behavioral and physiological responses of individual fish to sound stimuli can be tested and correlated to the level of vaterite deformity in their otoliths. This will enable for the first time an understanding of the effect of this deformity on the ability of farmed fish to cope with sounds in their farming environments. Existing knowledge of salmon farming soundscapes and the effects of potentially harmful sound on farmed salmon is still lacking. However, there is a potential for damaging human-related noise to modify fish behavior, increase stress, and even cause death or physical injury in farmed salmon.

In this project we aim to address key knowledge gaps related on the effects of sounds in aquaculture environments on farmed Atlantic salmon.

Hypotheses:

We hypothesize that:

1- **Different sounds will cause significant differences in stress reactivity**
2- **Teaching fish to expect certain sounds will increase their welfare**

Aim of the project: to understand how sound is affecting the behavioral and physiological responses of farmed salmon throughout their life, from freshwater tank facilities to saltwater seacages.

Project plan and implementation: this project is in collaboration with the institute of Marine Research in Bergen and the University of Melbourne. We have so far measured different sound sources at several commercial farms (both fresh and seawater facilities) and are currently conducting the first experiment in which we expose salmon to a potentially stressful sound source and assess their behavior and physiological responses for one month. There is a possibility for 1 to 2 master projects in which students will have to opportunity to join on-going sound measuring, sample collection and/or experimental studies activities. In addition, video analysis for fish behavior and sample analysis will also be part of the work.

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Materials and methods

Animals: Atlantic salmon (*Salmo salar*)

Methods:

Experimental design: the student will learn how to plan and conduct fish experiments to assess different behavioral outputs associated with cognition, stress and pain.

Tissue sampling: the student will learn how to plan and conduct sampling for biological samples. This will include brain, otholits and blood plasma samples.

Immunohistochemistry (IHC): the student will learn to process samples (embed brain samples for tissue slicing onto glass slides) for the application of IHC labelling antibodies used to assess neuronal activity.

Microscopy: The student will learn how to use different types of microscopes, including dissection and fluorescent microscopes. This will allow to conduct microdissections and evaluate IHC results.

High performance liquid chromatography (HPLC): The student will learn how to use the HPLC system to measure neurotransmitter signaling, specifically dopamine, serotonin, and noradrenaline. This will be done in microdissected tissue from specific brain areas of interest

Bachelor or Master thesis BIOVIT 2022/23

Quantitative Polymerase Chain Reaction (qPCR): The student will learn this regular laboratory technique of molecular biology which monitors the amplification of a targeted DNA molecule during the PCR (i.e., in real time), which provides information on specific gene expression levels in a tissue.

Blood sampling: The student will learn how to collect blood in a small fish for analysis.

ELISA: The student will learn how to perform immunoassays (using antibodies) that measure analytes such as the stress hormone cortisol, in a tissue or blood samples.

Behavioral analysis: The student will learn how to analyze fish behavior from video recordings.

Statistical analysis: The student will receive training on how to analyze and run statistics on the collected data.

Implementation

- The student will be supervised by experts in their field all along the project.
- Dr Marco A Vindas is localized in the new vet building at NMBU which facilitates communication, particularly in the coordination and supervision of laboratory techniques. In addition, Frode Oppedal is located at the Matre research station (1:30 north of Bergen). The state-of-the-art facilities at Matre are ideal for conducting salmon studies in both fresh- and saltwater. Furthermore, many commercial farms are located close to Bergen which has allowed for easy access for the collection of sound associated with aquaculture facilities. Finally, even though Luke Barret is located in Melbourne Australia, he is often in Norway where he is involved in several projects, so he will also be readily available for the student. The collaborating team in this project will provide a unique opportunity for the student to interact with many scientist and commercial salmon farmers.
- The student will have the possibility to travel and stay in Matre if they wish to have hands on experience on sound experiments, sound measurement collections and sampling activities
- All the techniques in this project are already established and regularly used in our lab.
- Our group has ample experience with the supervision of students. We have a very international environment which allows for a varied exciting environment were students flourish and thrive.

Subject area

Neurobiology, behavior, fish welfare, farmed salmon, sound

Thesis

Master thesis of 30 or 60 credits to be written in English or Norwegian

Project/company

Salmon Soundscape project

Please contact

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