

ENVIRONMENTAL STUDIES PROGRAM: Ongoing Studies

Region: National

Planning Area(s): All Applicable Areas

Title: Effects of Pile Driving Sounds on Auditory and Non-Auditory Tissues of Fish

BOEM Cost: \$939,354

Period of Performance: FY 2008-2012

Conducting Organization(s): University of Maryland, Department of Biology (M08PC20010)

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Description:

Background: This study investigates the effects of high intensity sounds produced from pile driving activities on the non-auditory tissues of fish species. The effects of sound have been studied for marine mammals, but little information exists about the effects on fish. Using a newly designed acoustic wave tube, fish are exposed in the laboratory to actual pile driving signals that have acoustic parameters very similar to those that a fish is likely to be exposed to in the field as a result of any pile driving activity. The experiments examine a variety of exposure parameters including, but not limited to, signal spectrum, number of pile driving strikes, time between strikes, accumulation of effects, etc. Both short-term and long-term effects of exposure are examined. Experiments include several different species, representing different fish morphologies and behaviors. The results of this quantitative study will provide the first comprehensive understanding of the effects on fish tissues of pile driving. Results will be applicable to pile driving activities such as construction of offshore wind facilities.

These experiments will provide the first highly controlled and quantified effect of any impulsive sound on fish. The advantage of laboratory work is that the stimulus to which the fish are exposed can be controlled and measured. Additionally, the specially designed apparatus allows the measurement of the ratio of pressure to particle motion of the stimulus, which is critical to understanding the effects of sound on fish.

Objectives: The objective of the study is to evaluate the effects of impulsive pile driving sounds on the body tissues of exposed fish, taking into account the species, size, post-exposure intervals and sound variables.

Methods: Experimental fish will be placed in a unique laboratory device called a High Intensity Controlled Impedance – Fluid-filled wave Tube (HICI-FT) and exposed to pile driving sounds. Post-exposure, pathological and histopathological examinations of fish tissues are examined to determine the effects of sound exposure. Examinations evaluate

damage to the swim bladder, internal bleeding, and effects at the cellular and subcellular levels to all organ systems. Species chosen reflect diversity in terms of anatomy and function, for example, fish with and without swim bladders and fish with different mechanisms for filling the bladder. An advisory group is engaged to ensure that the experimental design is sound and statistically valid.

Importance to BOEM: With our mandate to oversee renewable energy development, the Bureau needs to evaluate the possible adverse environmental impacts of noise on marine organisms. Pile driving and other activities for the construction of renewable energy facilities will generate considerable noise, the intensity and duration of which may cause damage to fish in the same area. While we have considerable knowledge already on the effects of noise on marine mammals, we are lacking the equivalent information on fish. This study will provide us with essential information on such adverse impacts and it is fundamental research that needs to be conducted before more focused research can follow.

Current Status: Experiments are complete. The final report is in preparation

Final Report Due: September 30, 2012

Publications: Casper, B.M, Popper, A.N., Matthews, F., Carlson, T.J., and Halvosen, M.B. *in press*. Recovery of Barotrauma Injuries in Chinook Salmon, *Oncorhynchus tshawytscha* From Exposure to Pile Driving Sound.

Affiliated Web Sites: <http://www.life.umd.edu/biology/popperlab/>

Revised Date: May 15, 2012

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<http://www.boem.gov/Environmental-Stewardship/Data-and-Information-Systems.aspx>