

Ground Vibration Simulator for Investigating Vibration Effects on the Development of Turtle Eggs

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[Research Experience](#)

Dr. Christina Davy's research group at Carleton University has extensive experience with ex situ incubation of turtle eggs. They are beginning to explore the effects of industrial vibrations on developing turtle eggs.

The project team is made up of 4th year Computer Systems and Electrical Engineering students at Carleton University. Throughout their degree programs, the students have gained experience in software and hardware design and development, electronics design, power engineering, simulation, and testing. These skills are crucial in the development of a device that can simulate ground vibrations, with a user interface for the research lab to easily customize the vibration parameters.

This collaborative project will move that research forward by integrating the team's engineering skills into the project.

[Summary of the proposed research](#)

Many human activities create measurable ground vibrations that may affect nearby species. These activities include roadways, railways, construction, and power generation. Turtles can be found nesting in these locations, where the vibrations could physically interfere with turtle development, if they are strong enough. They could also affect turtle behaviour and therefore influence hatch timing, because developing turtles synchronize their hatching through mechanical cues (vibrations from movement of neighbouring embryos, detected through the eggshell) and potentially also through vocalizations.

This project is particularly relevant to the Ottawa area, because the dense road networks, railways, ongoing construction activity and hydroelectric power stations all produce vibrations that travel through the ground. The eggs of turtles nesting in the Ottawa area are likely to be exposed to at least one of these sources of industrial vibration, but it is unclear whether these have any effect on developing eggs or whether they may pose a threat. This study aims to fill that knowledge gap.

The Davy Lab is partnering with the Faculty of Engineering and Design at Carleton University to develop a device that can simulate ecologically relevant ground vibrations while incubating various local species of turtle. The simulation device is the subject of a Fourth Year Project required by students in the Bachelor of Engineering program (the application team). Once the device is developed, the plans for it will be made open source, allowing members of the OFNC and the wider scientific community to recreate and use the device for further research in ground vibration effects on turtle eggs or other species.

The device will use motors to induce vibration in an egg incubation tub. The tub will move up and down at a chosen displacement and frequency. Sensors will be included that can monitor the vibration of the tub, and environmental parameters such as temperature and humidity. A user interface will enable the research group to customize the displacement and frequency being used, the experiment time, and to track parameters throughout the experiment duration. Further, the device will be designed to operate for the duration of the eggs' incubation (up to 95 days).

The first target ground vibration is that of roadways and railways, particularly highways where traffic is consistent for long periods in the day. These vibrations have a displacement between 0.16 – 0.8 mm, and a frequency between 10 – 20 Hz. If effects from these vibrations are found, lower displacements at similar frequencies will be analyzed.

The development of the device will conclude on April 12th, 2023. All devices and documentation will be handed over to the Davy lab to begin research in the summer of 2023.

Turtle eggs used in these experiments will be collected under research authorizations from the Ontario Ministry of Natural Resources and Forestry and the Ministry of Environment, Conservation and Parks. All egg collection and work with hatchlings is approved by the Ontario Wildlife Animal Care Committee (ACC) and the Carleton University ACC.

Proposed Budget

The proposed budget for the development of a single simulation device is \$860, with additional devices for the system estimated to cost \$650 each. The Davy Lab would like to construct five devices to achieve their research goals. This would have a total cost of \$3,450. The Faculty of Engineering at Carleton University can provide up to \$500 toward the project, and the Davy lab have provided \$1000. We are requesting \$2000 from the OFNC to cover further development and construction costs.