PROJECT TITLE: Accurate Age Estimation of Multiple Freshwater Fish Species Using Deep Learning of Otolith Images

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The black basses (Centrarchidae: *Micropterus*) are a diverse group of economically important freshwater fishes that are highly sought-after as food sources and for recreational angling. According to 2018 estimates, anglers created \$129 billion in national economic output. However, freshwater fisheries are vulnerable to climate change and habitat alterations. Quantifying growth, survival, and reproduction rates in freshwater fishes is increasingly needed to prevent population declines. By collecting age data on individuals and pairing it with sizerelated variables, survival probability can ultimately be predicted. The most accurate and precise method for measuring age is by analyzing otoliths, which are calcium carbonate structures located in the fluid-filled sacs of the inner ear of bony fishes. Throughout seasonal transitions, otoliths acquire bands of different densities of calcium carbonate, which causes levels of transparency to form. These different transparencies will create rings that can be analyzed to determine the age of the fish. Current analysis methods are time-consuming and inherently subjective, and, to a degree, uncertain due to the nature of manual counting. To combat this, we are developing a new method for easily, efficiently, and reliably obtaining age data on these species, which would have significant impacts in the future of Black Bass research.

Our goal is to create a supervised deep learning algorithm that will accept microscope images of otoliths as inputs and output an age estimate. Deep learning, a subfield of machine learning, utilizes convoluted neural networks (convNETs) to analyze visual imagery through a series of tensor manipulations that make the images easier to process without losing critical features. We have created a small convNET that was implemented using standard software packages Keras with Tensorflow run on Python. We are continuing to work to solve engineering problems in order to begin training the network.