Dr. Jeanine Refsnider, Associate Professor in the Department of Environmental Sciences at the University of Toledo completed an Ohio Water Resources Center funded project via 104(b) USGS. The project, "**Effects of Harmful Algal Blooms on Stress and Immune Function in Freshwater Amphibians and Reptiles**", aims to determine whether wildlife health can be used as an early indicator of microcystin pollution.

Figure 1. MS student, Jessica Garcia (University of Toledo) is sampling turtles during her fieldwork.

Harmful algal blooms (HABs) occur almost every year in the Western Basin of Lake Erie, and are a major contributor to the decline in quality of Ohio's water resources. Although the algal toxin microcystin is harmful to humans and pets if ingested or inhaled, almost nothing is known about its effects on the aquatic wildlife living in water bodies affected by HABs. Dr. Refsnider's lab is taking a first step towards understanding how HABs affect aquatic wildlife by studying physiological stress and immune function in several common species of reptiles and amphibians (Figure 1). The goal of the funded project was to compare stress levels and immune function in turtles, snakes, and frogs exposed to microcystin from HABs to control, unexposed animals.

Dr. Refsnider's results demonstrate that aquatic wildlife exposed to harmful algal blooms demonstrate several sublethal effects. The laboratory results showed that tadpoles exposed to microcystin for 7 days exhibited increased dilation of the intestines compared to control tadpoles, potentially indicating an inflammatory response (Figure 2). Field studies consisted of sampling wild songbirds, painted turtles and northern watersnakes during a HAB event in Grand Lake St. Mary's and a control site at Ottawa National Wildlife Refuge. Songbirds and snakes from the microcystin-exposed site had higher baseline stress levels than unexposed individuals. Microcystin-exposed turtles exhibited depressed immune functioning measured by bactericidal capacity compared to control turtles. On the other hand, exposed watersnakes exhibited higher physiological stress levels and increased bactericidal capacity when exposed to microcystin. Overall, we have found that even when HABs do not cause direct mortality of exposed wildlife, they can act as a physiological stressor across several different taxa, which may lead to other sublethal effects such as organ damage and depressed immune functioning in some groups. Therefore, the health of aquatic wildlife does appear to be a useful indicator of water quality and of the health of aquatic systems.

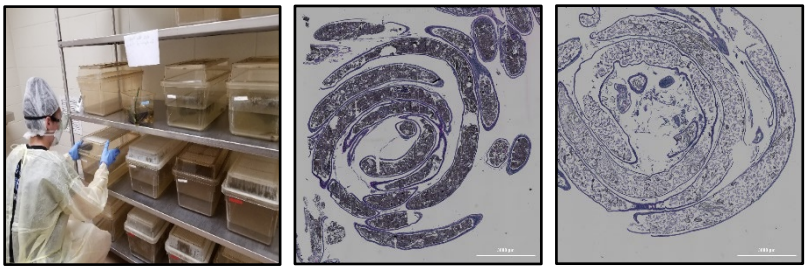

Figure 2. Controlled laboratory experiment exposing bullfrog tadpoles to microcystin (left). Cross-sections of tadpole intestines show that tadpoles exposed to microcystin (right) exhibited increased dilation compared to control animals (center), potentially indicating an inflammatory response to microcystin (histology photos by R. Su).

<u>Researcher Profile:</u> Dr. Refsnider's received her Ph.D. in Ecology and Evolutionary Biology from Iowa State University in 2012. After finishing her Ph.D., she was a postdoc in biology at the University of California, Berkeley. Dr. Refsnider is interested in exploring the mechanisms underlying species' responses to rapid environmental change and their potential to affect species persistence. Her research combines observational and experimental studies in the field and in the lab, and incorporates technological advances in field data collection and genomic techniques.