STATE WILDLIFE GRANT PROJECT REPORT—INDIANA
Assessing Juvenile Survival in Eastern Hellbenders

Juvenile hellbenders being raised and conditioned at Purdue University's Aquaculture Research Laboratory. (Photo by Erin Kenison)

CURRENT STATUS

Third year of a four-year project

FUNDING SOURCES AND PARTNERS

State Wildlife Grant Program (T7R15)
Purdue University

PROJECT PERSONNEL

Dr. Rod N. Williams, Principal Investigator, Purdue University
Emily McCallen, Doctoral student (2013–present), Purdue University
Erin Kenison, Doctoral student (2014–present), Purdue University
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TECHNICIANS

Nick Burgmeier (2015–2016)
Veronica Yager (2016)
Cullen Harris (2016)
Helen Sung (2016)
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BACKGROUND AND OBJECTIVES

The Eastern hellbender (*Cryptobranchus alleganiensis alleganiensis*) is a large aquatic salamander that historically occurred throughout much of the eastern United States. These giant salamanders are important indicators of water quality and ecosystem health. Because they remain aquatic all their life and breathe through skinfolds on the sides of their bodies, they are constantly exposed to potential risks in the aquatic

environment. As a result, they may alert us to contaminants or dangers that could affect humans.

During the past few decades, hellbender populations have exhibited range-wide declines. They are now listed as threatened or endangered in nearly every state in which they occur. Factors such as habitat degradation, pollution, collection for scientific investigations or the pet trade, and being killed by anglers have reduced hellbender populations; however, the ultimate cause of declines remains unknown.

In the Midwest, hellbender population declines have been particularly pronounced. Populations in Ohio and Missouri continue to be at risk. Hellbenders have been extirpated in Illinois. In Indiana, they have been reduced to a 112-kilometer stretch of the Blue River in the southern part of the state. Hellbender density in the Blue River is far lower than studied hellbender populations outside of Indiana. Moreover, there has been no record of larvae or juveniles for the past two decades in the Blue River despite extensive surveys. Indiana's Eastern hellbender population is skewed toward older adults that are likely approaching the end of their 30-year life span. With continued decline in population sizes and no indication of successful reproduction, hellbenders in southern Indiana are extremely vulnerable to extirpation.

In order to reverse the risk of local and statewide extirpation, it is crucial to concentrate efforts on improving larval survival and juvenile success in the wild. We plan to advance captive rearing methods in the laboratory to better prepare young larvae for reintroduction as sub-adults to the Blue River. We will be investigating larval responses to a variety of natural conditions in a controlled environment. It is also essential to explicitly evaluate the habitat requirements of Indiana's hellbenders and assess potential release sites to maximize the survival of reintroduced sub-adults. Habitat evaluation and assessment will be achieved through ecological niche modeling. We ultimately hope to influence rearing methods, release techniques, and management decisions to preserve future hellbender populations.

METHODS

We have an active head-starting program at Purdue University's Aquaculture Facility. We use eggs collected from the wild and plan to rear larvae for two years before reintroduction. During this time, our work will be directed at creating an artificial stream in which larvae can experience water current, monitoring larval responses to changes in environmental conditions and predator cues, and introducing larvae to natural and artificial habitat structures so they can be conditioned to use ideal habitat when released. Before release, we will develop an ecological niche model to help determine optimal sites for young hellbenders.

Ecological niche modeling is a process that relates patterns of known species occurrence to environmental covariates and results in a predictive map of habitat suitability covering a continuous area of interest. Because hellbenders require large boulders for protection, the substrate of the Blue River will be classified using side-scan sonar. The resulting substrate map will be used to derive the primary predictor variables for the hellbender niche model.

Ph.D. student Erin Kenison (front) and master's student Brianna Osinski (back) conduct a swim performance trial on a juvenile Eastern hellbender. (Photo by Veronica Yager)

We will also include the presence of river otters and crayfish within the model—these two species respectively represent the main predator and food resource for local hellbenders. The data collected from the Blue River watershed will be used to create an explicit map of adult Eastern hellbender habitat suitability in Indiana, and we will use data collected throughout the species' range to gain insight into habitat requirements of Eastern hellbender larvae. We will use radio telemetry to track individuals released back into the Blue River to better understand juvenile habitat use, movement and survival after laboratory conditioning.

PROGRESS TO DATE

Data for a multi-species ecological niche model were collected during 2014 with 14 sites surveyed for crayfish and Eastern hellbenders and 35 sites surveyed multiple times for river otter latrines. During

summer 2015, multi-pass sonar imagery was collected and processed for 35 river kilometers. The goal was to create a substrate map for use in ecological niche modeling. The data are currently being analyzed using semi-automated classification techniques. In order to verify the sonar data, we have connected an underwater video camera equipped with GPS to our kayaks to film the river bottom. Once we have confirmed the accuracy of the sonar data, the rest of the Blue River will be imaged during spring 2017 during high water. These data will be used to identify priority areas for release of captive-reared juvenile hellbenders.

We continued to enhance our captive-rearing program and conditioning of captive-reared hellbenders. We have set up six large raceway tanks at Purdue's aquaculture facility with a variety of stone substrate and rock-slab cover objects. We introduced 20 two-year-old hellbenders to each tank in May and manipulated water flow in three of the six tanks to expose larvae to water current. Water-current velocities in treatment tanks mimic flow rates in riffle and run river sections where hellbenders are naturally found. This experiment is designed to introduce hellbenders to more-natural conditions than those in standard aquarium tanks. The hope is that they will become better acclimated to and more prepared for a riverine system before release.

We are interested in comparing hellbender behavior and morphology between tanks with and without environmental conditioning. We are specifically interested in how the presence or absence of water current influences growth rates, size differences, and refuge use (i.e., probability of being inside or outside of cover objects).

The results from this study show that water current has no effect on growth rates. However, we have found that individuals in the tanks with flows mimicking the Blue River develop longer, leaner bodies and make fewer attempts to move upstream than the individuals in the low-flow tanks. This could be important for the survival of these individuals as those not exposed to flow might be more likely to be affected by flood events and predators.

We continued to search for hellbender nest sites and signs of reproduction throughout the 2016 breeding season. We observed one male guarding a natural nest rock and one male guarding an artificial nest box. Unfortunately, no nests were found. We will continue to monitor these sites to see if these individuals are potentially late breeders. We collected a nest of 156 eggs in 2015, 149 of which hatched. We currently have 120 healthy larvae.

Our planned release of 80 of the 120 juveniles in 2016 has been delayed due to unexpectedly slow growth rates and high water throughout much of the field season. The release has been rescheduled to 2017. We plan to release 80 individuals that will be surgically implanted with radio transmitters within the priority habitat identified by our ecological niche model. All of the release sites have been selected. We will use the data collected from radio-tracking to estimate the survivorship of juvenile hellbenders reared within different environments and assess their movement patterns and how they use their habitat.

We will use data obtained from this project to fulfill two doctoral degree requirements for Purdue University and to provide useful information for other groups, agencies and scientists working with hellbenders. This project encompasses innovative ways to understand and protect an endangered species. It may influence future rearing and management decisions for Eastern and Ozark hellbender conservation throughout the nation.

COST: $423,164 FOR THE COMPLETE FOUR-YEAR PROJECT