ECOLOGY AND POPULATION GENETICS OF EASTERN BOX TURTLES IN INDIANA

Eastern box turtles can sometimes be found crossing grassy lawns. Credit: Ethan Estabrook

Current Status

Fourth year of five-year project

Funding Source

State Wildlife Grants (T07R09), Purdue University, DNR Nongame Fund

Project Personnel

Principal investigator, Dr. Rod N. Williams
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Technicians:

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Background

Eastern box turtles are long-lived reptiles that are native to forested regions across the eastern United States. Their numbers are declining across the country, most likely because of habitat loss, collection from the wild for sale as pets, disease, and mortality on roadways. Some habitat alterations, such as timber harvests, are a common and sustainable type of habitat management

Steve Kimble draws a blood sample from an Eastern box turtle for DNA. Credit: Sarabeth Klueh

but these activities may affect forest animals in different ways. It is unclear if box turtles will be affected (either positively or negatively) by these types of activities.

Objectives

The purpose of this project is to use genetic tools and radio telemetry methods to clarify the ecology and population organization of Eastern box turtles in Indiana for use in conservation programs. In general, we are interested in the impacts of timber harvesting on Eastern box turtles movement, home-range size, and over-winter use. We are also interested in using molecular methods to assess the genetic health of Indiana box turtle populations relative to that of others across the species' range.

Methods

To understand how much turtles move during their daily activities and lives, we glued tiny radio transmitters to about 40 box turtles in Morgan-Monroe and Yellowwood State Forests. Many highly skilled people spent all summer and fall from 2007 to 2010 hiking in the woods, finding each turtle three times a week with radio receivers and making maps of each turtle's movements. These movements were studied in the periods before and immediately after timber harvests in order to help biologists understand how box turtles respond in the wild. Any changes in movement patterns in response to timber harvests might have effects on mating, foraging and health.

While it is important to study how turtles respond to timber harvests during summer months, it is equally important during winter months when box turtles are hibernating. Turtles were monitored during winter months using very small temperature-dataloggers that were affixed to their shells. Dataloggers were also used to monitor ambient temperatures in the turtle's habitats from many locations in the forest. These dataloggers recorded temperatures every 45 minutes and provided critical information on the thermal environment in timber harvest openings versus that of uncut areas of the forest.

Spending so much time in the woods means we saw lots of other box turtles. From every box turtle we found

A hatchling Eastern box turtle that is barely larger than a quarter. At his stage in their life they are soft and very vulnerable to predation. Credit: Steve Kimble

we took a small blood sample and took it to a lab for DNA analysis. Just like the DNA fingerprinting used to uniquely identify humans for parentage or forensic purposes, each turtle has a unique DNA fingerprint. More-similar fingerprints are found among more-related turtles, and less-related turtles have less-similar fingerprints, so we can make a family tree showing how the turtles captured are related. To be able to compare the turtles at Morgan-Monroe and Yellowwood State Forests to other populations, in 2010 and 2011 we collected samples from at least 25 individuals from populations all across Indiana and most of the species' range.

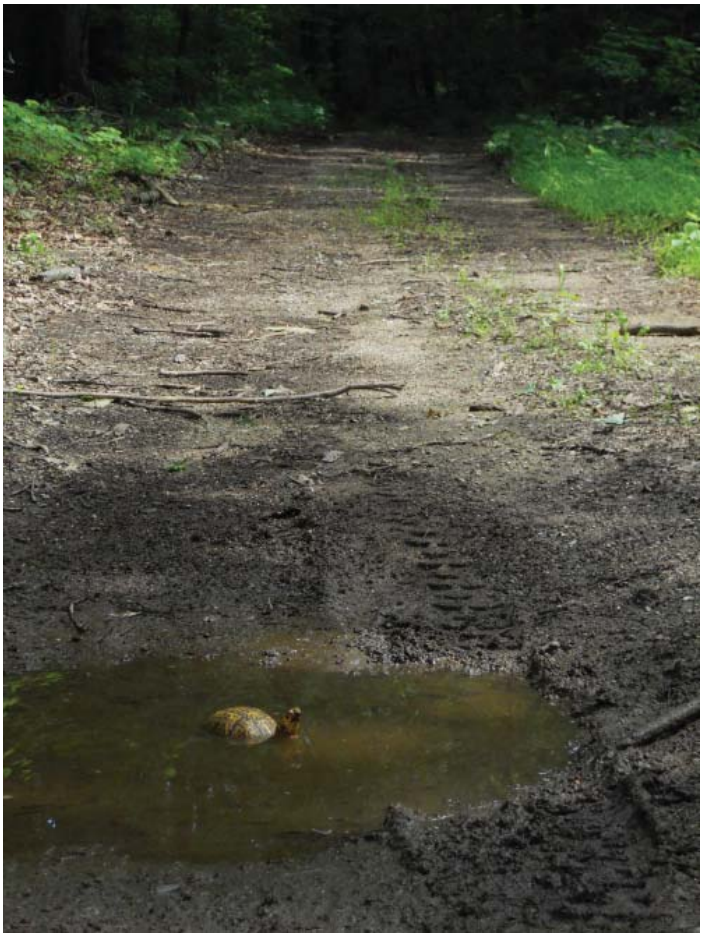
In our laboratory we can also get a good picture of the genetic characteristics of the whole box turtle population. To accomplish this we use DNA markers that were developed for the first time in our lab specifically for use with Eastern box turtles. All this may sound simple but is costly in money, skilled labor, and time. While it takes all summer to track the turtles, it takes all winter, while the turtles are hibernating, to complete the genetic analyses.

Progress

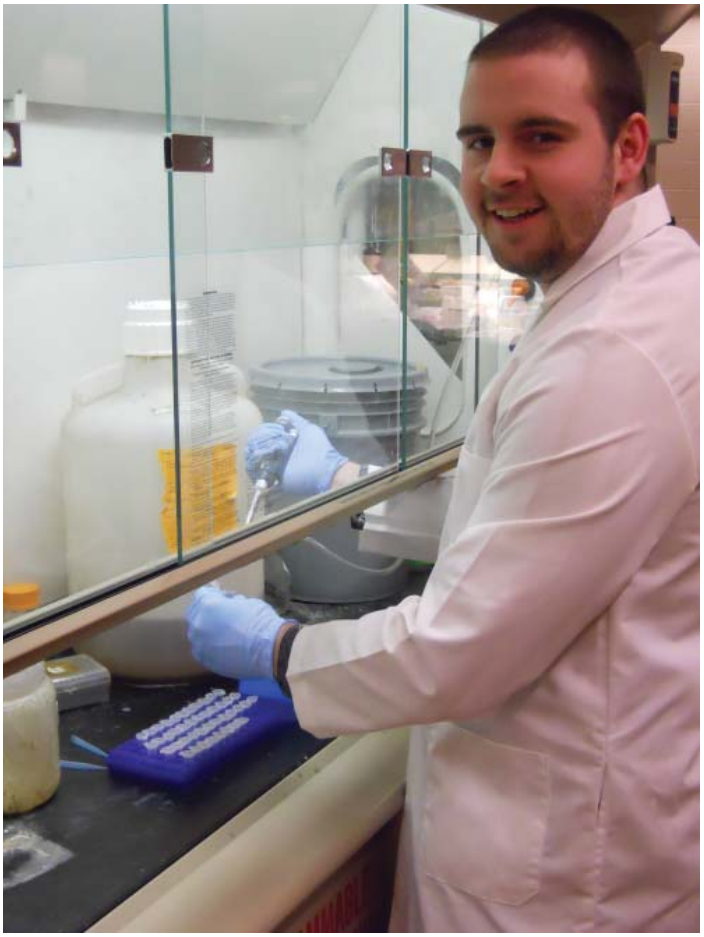
The radio telemetry portion of the project is complete. We tracked more than 40 turtles throughout the 2009–10 field season and have now collected two years of post-harvest movement data. Preliminary analyses of pre-harvest versus post-harvest movements suggest that Eastern box turtles tend to avoid the centers of large timber harvests but gravitate toward the edges of harvest openings during summer. During winter, when Eastern box turtles are hibernating, they choose one spot in which to burrow to escape the cold. The deeper they go, the more moderate the temperature.

Eastern box turtles in Indiana may hibernate for five to seven months of the year; that means they spend nearly half their life underground. We found that turtles prefer to over-winter at temperatures of approximately 38 F and at an average depth of 4 inches. Although most turtles hibernated in the forest, we recorded one turtle that hibernated in a timber harvest cut.

Previously it was thought that over-wintering turtles would not use timber harvests because of the absence



Eastern box turtles will sometimes soak in puddles in roads where they are hard to see. Please drive carefully. Credit: Steve Kimble



Purdue undergraduate student Ethan Estabrook extracts DNA from blood samples. Credit: Evan Alexander

of a tree canopy and the lack of a leaf-litter floor mat to buffer them from extreme cold. We found that the timber harvests were colder all winter, but if turtles burrowed deeply enough, warmer temperatures could be reached and maintained. We also found that the timber harvests warmed more quickly during spring when turtles emerge from hibernation, possibly allowing those turtles that over-wintered close to the harvest edge to emerge sooner and start feeding.

More than 1,000 box turtles have now been sampled range-wide. Most of these are from Indiana, while the remaining samples represent populations across most of the box turtle range: north into Michigan, east into New York, south into Georgia and west into Illinois. Most of the laboratory work has been completed, and the computer analyses have begun. So far we have found that a population of box turtles, as defined by their genetics, is very large, spanning several states in the Midwest. This is probably because box turtles are mostly forest-dwellers and can therefore move around freely.

However, from the study of the radio-tracked turtles at Morgan-Monroe and Yellowwood we know that most adult Eastern box turtles do not move around much, keeping to a small home range. A typical home range is about the size of 10 football fields, and they appear to keep the same home range for years. We also have found that there are rare individuals, always male, who seem to have a different lifestyle. They do not maintain a typical home range but rather seem to be on some sort of journey. One individual travelled nearly five miles in a nearly straight line one summer, a distance the length of 75 football fields placed end-to-end. It may be that these individuals are the ones that make box turtle genetic populations so large. Recent analyses reveal that Eastern box turtles have good genetic diversity within Indiana and across their range. We are currently trying to identify potential barriers to gene flow. Preliminary analyses suggest that the Appalachian Mountains of the eastern U.S. may limit box turtle dispersal to some degree.

By the completion of this project, it will have helped train two graduate students and at least 12 undergraduate students and technicians, relayed important findings to the public through numerous outreach presentations and publications, and it will have provided valuable information for the protection of the Eastern box turtle in Indiana and across its range.

Cost: $683,694 for the complete five-year project