ASSESSMENT OF THE ROLE OF INTERSTATE HIGHWAYS AS BARRIERS TO GENE FLOW AND METAPOPULATION PERSISTENCE IN MAMMALS FROM INDIANA

Tricia Tsai getting a fox squirrel out of a trap.

Current Status

Second year of a five-year project

Funding Sources and/or Partners

State Wildlife Grants, Purdue University, Nongame Fund

Project Personnel

Gene Rhodes (principal investigator), Pat Zollner (co-principal investigator), Cecilia Hennessy (Ph.D. graduate research assistant), Matt Beard (Ph.D. graduate research assistant), Valerie Clarkston (field technician), Jamie MacNeil (field technician), Matt Wieczorek (GIS technician), Tricia Tsai (Ph.D. graduate research assistant)

Background and Objectives

The main goal of this project is to determine whether interstate highways in Indiana are restricting the movements of wild animal species of various sizes, which may result in declines of these species due to losses in genetic diversity. We will investigate the ability of six mammal species to cross the interstate by analyzing genetic information and movement patterns of wild populations.

Methods

We have been trapping six common species of mammals, including raccoons, opossums, gray squirrels, fox squirrels, chipmunks and white-footed mice, from forests on opposite sides of interstate highways in Indiana. While these species are common, we hope the results that we

Deployed trailer with tower and automated telemetry receiving unit.

Technician Jamie MacNeil weighing an opossum in the trap.

Tower for telemetry receiving unit being assembled for deployment.

obtain will be transferable to less common species, especially threatened or endangered wildlife. For sampling, we have selected forests that are separated by the interstate, but that otherwise have good habitat for these species. These are so-called "paired" sites, because each site actually has two parts–one on either side of the interstate.

We set trapping grids in these habitats to catch the mammals that inhabit the forest close to the interstate. We use box traps, which are like wire cages, to trap the animals. The animal is drawn into the trap by bait in the back of the trap, and it steps on a treadle that shuts the door.

Each animal is handled carefully to reduce the stress of its experience as much as possible. We marked the animals with numbered ear tags, and we took a small genetic sample from each animal, usually a tiny piece of the tip of the ear. Collars containing radio telemetry transmitters were attached to 10 adult chipmunks, gray squirrels, fox squirrels, raccoons within each trapping grid.

All animals are released at the trap location, which we record to help us determine the spatial arrangement of the animals in the forest.

We take the tissue samples back to the wildlife genetics research lab at Purdue University to extract DNA and determine the genetic characteristics of each individual. Combining the genetic information with location data will help us to determine the effect the interstate has on the local populations by allowing us to look for evidence of genetic exchange between populations on either side of the road.

Animals that are related share a lot of the same DNA, and the more related they are, the more DNA they have in common. Therefore, a population of animals is likely

Demonstrating the prehensile tail of an opossum to Matt Beard.

to share DNA at a relatively high rate because there will be a lot of relatives living near each other. Populations on either side of an interstate can be compared for evidence of gene sharing and relatedness. Using this information, we can determine if the interstate is separating two populations or if the animals on either side are actually one population. If the animals on the two sides of the interstate are two populations, then the interstate may be creating a barrier to animal movements. This effect may be more evident in species that are more reluctant to cross over roads or to use culverts to cross under roads (such as chipmunks and squirrels) than species that are not as reluctant (such as raccoons and opossums). However, if the animals from either side of the interstate are determined to be one population, then the animals are successfully crossing the interstate and gene flow is occurring.

Detailed data on the movement patterns of animals help us understand the day-to-day response of these animals to highways. That understanding of those daily movement responses, in combination with the genetic data, are critical to building computer models that we will use to predict the consequences of interstate highways in Indiana on the long-term persistence of viable populations of wildlife. The radio telemetry collars provide us detailed data on the movement patterns of the 40 animals we are tracking at each grid. Animal locations are estimated using four automated telemetry receivers and towers that are mounted on trailers. This system allows us to estimate the location of each collared animal within a grid once every couple of minutes.

Every two or three weeks we move the four trailers between grids so we collect movement data at all of our study sites. Back in the lab we analyze the recorded movements of the animals to determine if there are consistent patterns in how frequently these animals turn or move slowly or quickly. We compare the movement patterns of these animals when they are close to highways to times when they are not. We then use those movement patterns to create virtual animals inside the computer. By simulating the movements of thousands of virtual animals we estimate the strength of the barrier effects of different highways for different species. Then we compare the predictions of the computer models with the genetic data to investigate the details of how highways restrict the movement of different wild animal species.

Progress

This past year, we trapped three paired sites in southern Indiana, which included portions of Hoosier National Forest, Harrison-Crawford State Forest and Clark County State Forest, as well as a few parcels of private land with permission from the landowners. The lab analysis has begun, but the majority of the genetic work will be completed in the next few months. Radio-telemetry collars have been placed on the target wildlife species at the three paired sites in southern Indiana, and the trailers with the towers and the automated receiving units have been deployed.

The future of this project includes another field season of trapping the same six species, in three more paired sites along interstates in Indiana. This will take place spring 2010, as spring is the best time to capture squirrels and chipmunks, simply because there is less natural food available for them at that time of year. We expect to have useful information to share with our funding partners by 2012.

Graduate research assistant Cecilia Hennessy with a sedated raccoon.

Taking a tissue sample from a sedated raccoon's ear.

Cost: $1,042,067 for the complete five-year study