

Research Report

4 May 2019

**EFFECTS OF CLIMATE VARIABILITY ON THE SOMATIC GROWTH OF  
WOODLAND BOX TURTLES: INSIGHTS FROM LONG-TERM GROWTH  
CHRONOLOGIES DERIVED FROM TREE-RING ANALYSIS**

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**1) Summary of how the Lucille F. Stickel Box Turtle Research Award funds were spent**

- Radio transmitters (\$180 each): \$971.64
- Rechargeable batteries and charger: \$20
- PC-7 epoxy: \$8.36

Total: \$1000

**2) Summary of work carried out:**

The near-term goal of our project is to identify climate-related, temporal sources of growth variation in woodland box turtle populations in the Piedmont region of the Carolinas. Project objectives are to 1) determine the accuracy of cross-dating in local woodland box turtle populations, 2) reconstruct annually resolved growth histories of individuals, 3) identify specific seasonal climate variables for which local populations are most sensitive, and 4) determine how climatic conditions experienced early in life affect growth or climate sensitivity later in life. We are in year 2 of this project and are progressing toward objective 1. In the first year of the project, we attached radio transmitters to 86 woodland box turtles and photographed their scutes. So far in the second year, we have attached radio transmitters to and photographed 9 more woodland box turtles. We have radio telemetered each turtle and photographed their scutes at least twice per month to determine the timing of growth ring formation. Using these photographs, we are attempting to cross-date their growth rings.

Tracking and measuring of radio-tagged individuals have produced a wealth of data for our concurrent project investigating the impact of urbanization on the persistence of box turtles.

The specific tasks carried out so far are below.

- Field data collection 2018
  - Attached radio transmitters to 86 woodland box turtles from 10 study sites in York County, SC
  - Obtained data on body size, mass, and sex for each turtle
  - Photographed the scutes on the carapace and plastron of each turtle
  - Marked each turtle by scute notching
  - Marked the most recent visible growth ring on one scute on each turtle with nail polish
  - Tracked each tagged turtle twice per month
  - An additional 26 turtles were measured, weighed, and photographed
  - Collected 28 woodland box turtle shells (deceased) for growth ring analysis
- Field data collection 2019 (ongoing)
  - Continue tracking tagged turtles
  - Have been collecting the same data as the previous year
- Analysis (ongoing)
  - The photographs taken in spring 2019 will be compared to the photographs from the previous year to identify the most recent growth rings
  - Currently the applicability of cross-dating methods is being assessed

### **3) Preliminary Results and Discussion**

- Several box turtles examined exhibited synchronous patterns of wide and narrow growth rings, which were visualized via a line plot of standardized growth ring series (Figure 1). However, there were considerable mismatches among individuals. Accordingly, we will continue to monitor growth ring formation (Figure 2) for the next few years to verify the applicability of cross-dating to turtles and confirm our preliminary results.
- Preliminary results were presented by graduate students Ashley Graham and Jack Nguyen at the Southeast Partners in Amphibian and Reptile Conservation annual meeting in February 2019 and the North American Box Turtle Committee meeting in May 2019.
- Male and female box turtle abundance decreased significantly as impervious surface cover increased (Figure 3).
- Male body condition decreased significantly as impervious surface cover increased (Figure 4). Female body condition did not significantly decrease.
- The observed population decline is probably not due to food availability, because body condition did not significantly decrease in females. Body condition determines the ability of females to reproduce in a given season, and is mainly driven by food availability.

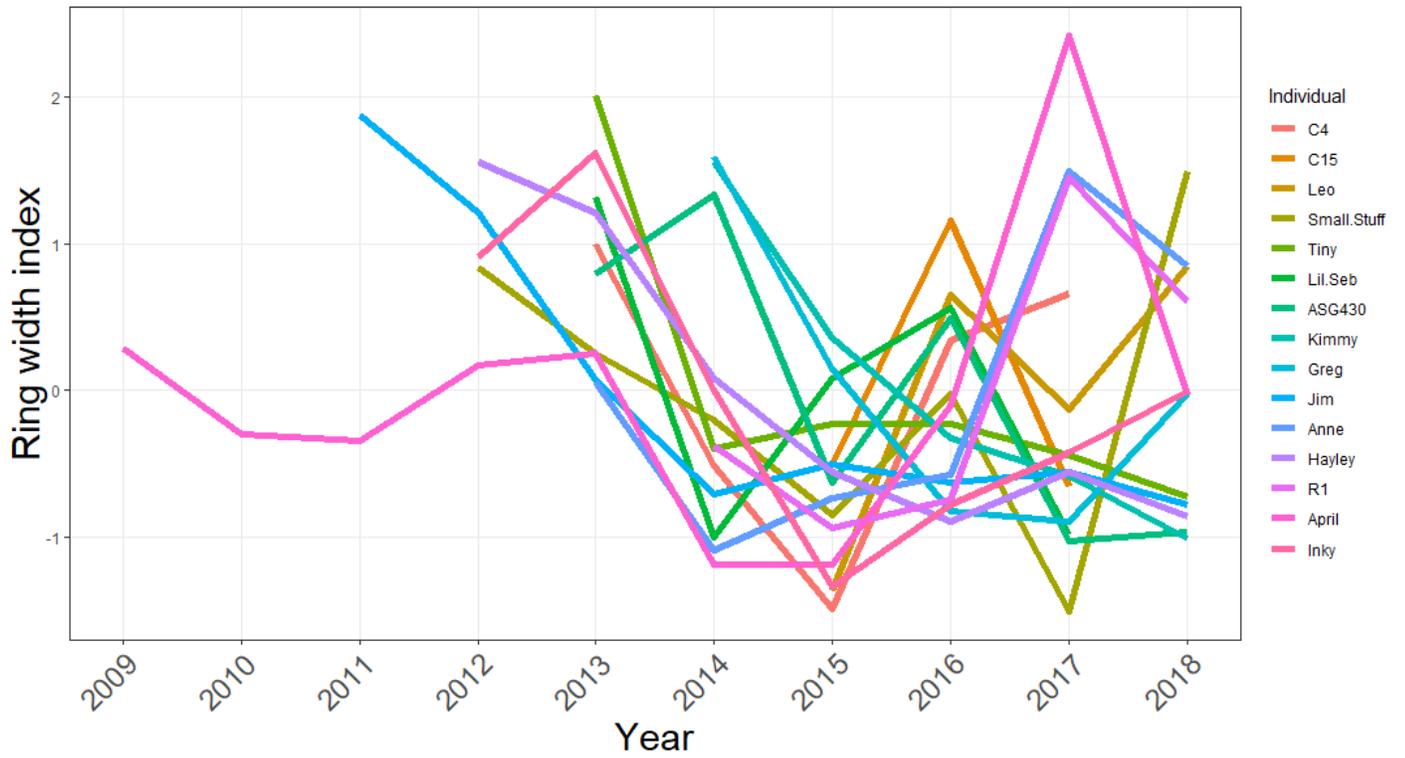


Figure 1. Standardized series of growth ring widths from 15 woodland box turtles. These individuals have a known date of formation for their most recent growth ring. Although there are mismatches between some individuals, there may be a synchronous pattern that can be determined via cross dating.

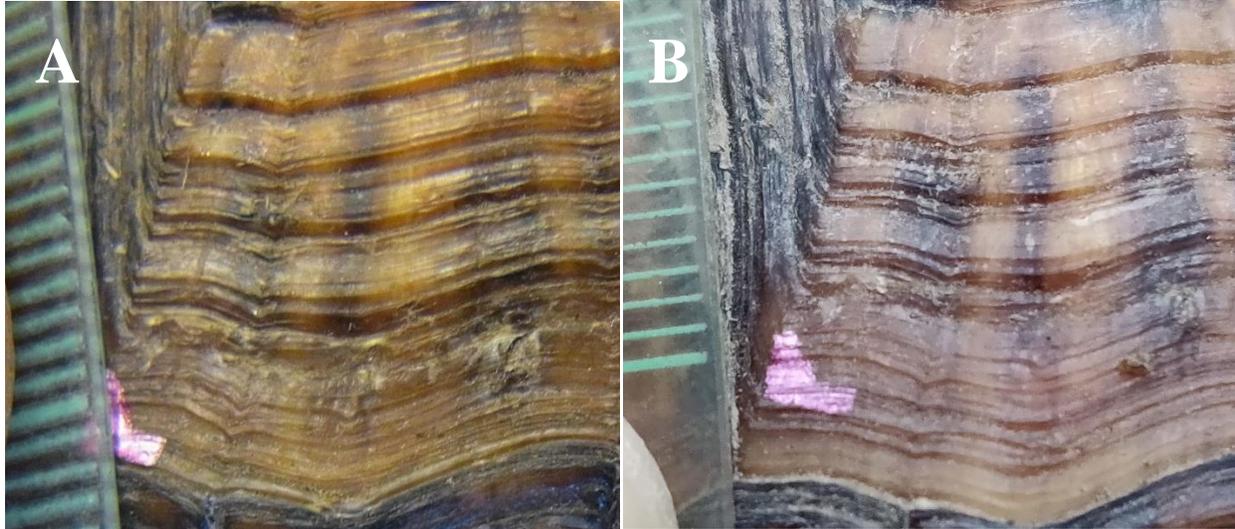


Figure 2. New growth was assessed by painting the bottom edge of the scute with nail polish at the initial capture of each turtle. On repeated captures, new growth is shown below the nail polish. A) A turtle marked in June 2018. B) The same turtle in May 2019, with new growth below the June 2018 mark.

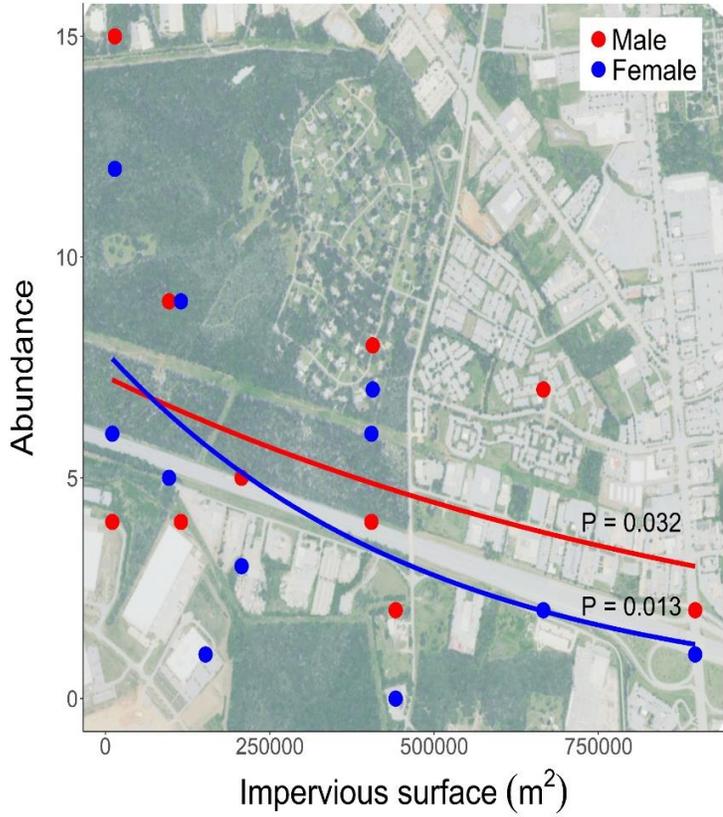


Figure 3. Abundance of male and female eastern box turtles at 10 study sites in York County, assessed via visual surveys versus impervious surface cover within a 2.5 km buffer around the centroid of turtle captures at each site.

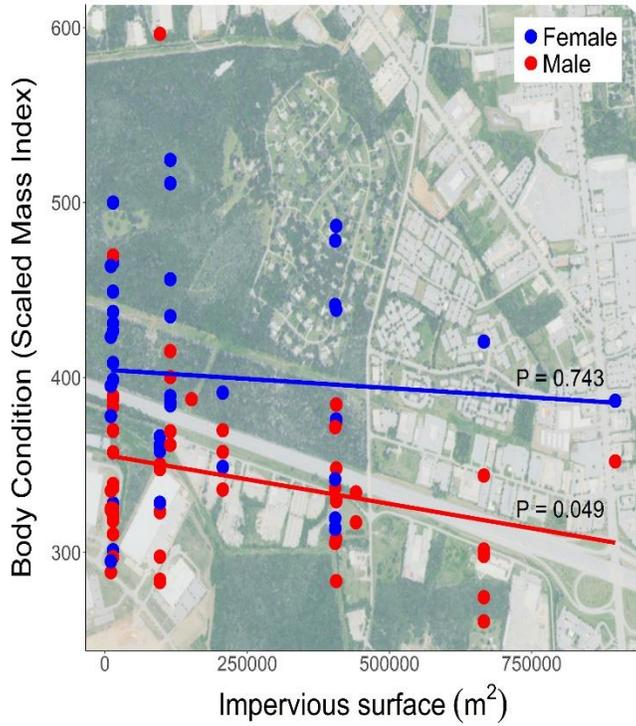


Figure 4. Body condition of male and female eastern box turtles at 10 study sites in York County versus impervious surface cover within a 2.5 km buffer around the centroid of turtle captures at each site.