

Effects of Prescribed Fire on the Eastern Box Turtle (*Terrapene carolina carolina*)

Christopher A.F. Howey^{1,*} and Willem M. Roosenburg¹

Abstract - While conducting an on-going project investigating the effects of prescribed fire on reptile communities, 31 *Terrapene carolina carolina* (Eastern Box Turtle) were captured in burned and unburned study sites; some with extensive injuries that were likely caused by a recent prescribed burn. In order to determine if the disturbance had any negative effects on the turtles, we recorded morphometrics, mass, sex, and injuries for each one captured. Twenty percent of box turtles in the burned area exhibited injuries caused by the fire. Turtles in burned sites were similar in length but weighed significantly less ($df = 1$, $F = 5.255$, $P = 0.0329$) and had a poorer body-condition index than turtles in unburned sites. Additionally, one injured box turtle was encountered 32 times in a burned site. On average, this individual moved 22.5 m/day within a 3.77 ha home range. Over the course of 1 year, the turtle grew 1.3 mm and gained 27 g. The injuries to the carapace of this individual never fully healed during that year, and the scutes did not grow back; however, regeneration of the carapace may require a longer period of time. These scant data suggest that Eastern Box Turtles may not respond favorably to prescribed fire, and indicate that additional studies are needed to increase knowledge of the effects of prescribed fire on this species.

Introduction

Prescribed burning has become a popular tool in forestry management used to create a more open, early successional habitat; however, it is unclear how most reptiles respond to this landscape disturbance. *Terrapene* spp. (box turtles) reportedly suffer high rates of mortality and/or extensive injuries as a result of the direct effects of fire (Allard 1949, Babbitt and Babbitt 1951, Bigham et al. 1964, Dolbeer 1969). Due to the slow movements of box turtles and their tendency to take shelter in leaf litter, box turtles may not be able to avoid a fire as it passes through the landscape. If box turtles survive the fire, they are sometimes left with extensive injuries that may lead to the partial or complete loss of the epidermal layer (scutes) of the shell (Babbitt and Babbitt 1951, Rose 1986). Regeneration of the scutes has been documented in a few instances (Rose 1986), but it is unclear if this phenomenon is common, how these animals will cope with the changed landscape, and if the health of the animal will improve or deteriorate in these altered environments.

Methods

Terrapene carolina carolina L. (Eastern Box Turtle) were captured in burned and unburned sites between 2010 and 2011 as part of a larger study. The burned

¹Ohio Center for Ecology and Evolutionary Studies, Department of Biological Sciences, Ohio University, Athens, OH 45701. *Corresponding author - chris.howey@gmail.com.

sites had been recently subjected to a prescribed fire (September 2010), and were located in the Franklin Burn Unit at Land-Between-the-Lakes National Recreational Area, KY. Morphometrics, mass, sex, and the presence of injuries were recorded for each captured turtle. Additionally, each captured turtle was uniquely marked (Cagle 1939) prior to its release.

One severely injured, adult male Eastern Box Turtle was recaptured multiple times over the course of a year in a burn site (Fig. 1). Upon each encounter with the turtle, GPS coordinates, morphometrics, mass, and condition of the injuries to the carapace were recorded. These data were used to determine if there was a change in morphometrics, mass, or condition of injuries over the course of the year. GPS coordinates were analyzed with Home Range Tools 1.0 extension in ArcGIS 9.3 (Rodgers et al. 2007) to determine movement rates and home-range size based on a 95% Kernal estimate.

Results and Discussion

In total, 31 Eastern Box Turtles were captured in burned and unburned study sites—20 turtles in burned sites and 11 in unburned sites. All turtles captured in

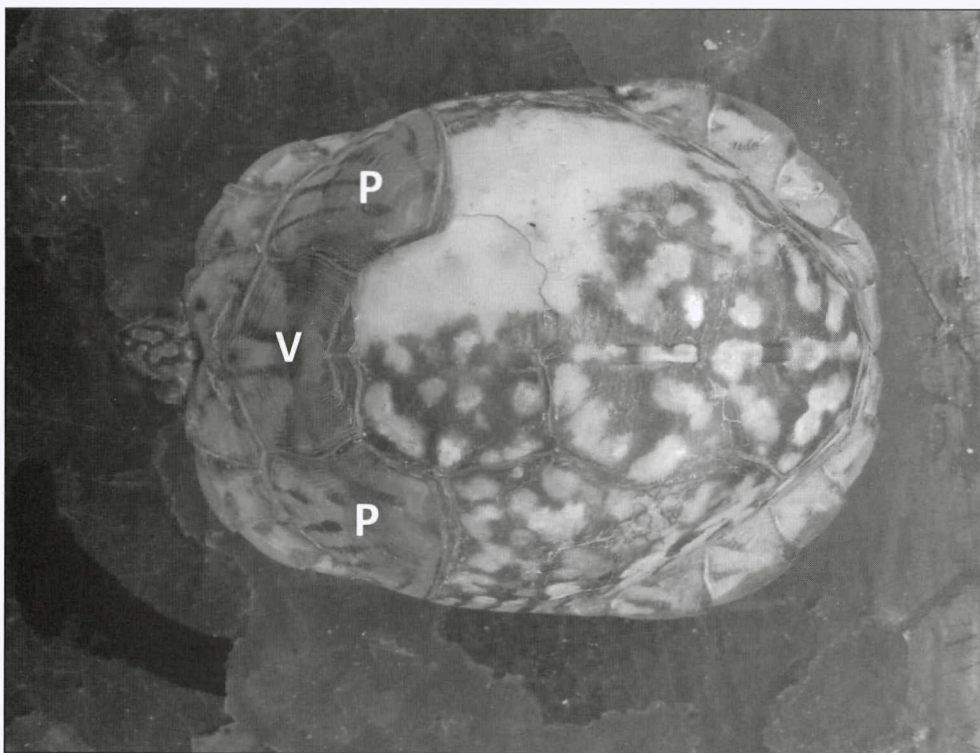


Figure 1. Eastern Box Turtle with injuries from a prescribed fire. The front vertebral (denoted by “V”) and right and left pleural scutes (denoted by “P”) are discolored and weakly attached to the carapace. All other vertebral and pleural scutes have fallen off of the carapace. Marginal scutes (surrounding the perimeter of the carapace) and plastron appear to be unaffected.

unburned sites were uninjured; however, 20% of turtles captured in burned sites exhibited injuries that were presumably caused by fire. Injuries mostly consisted of damaged or missing pleural and vertebral scutes (Fig. 1); these scutes would be the most vulnerable if the animal were buried in the leaf litter at the time of the fire. Mean carapace length was 127.1 mm and 130.4 mm for uninjured and injured turtles respectively; however, mean mass was greater for uninjured compared to injured turtles (405.8 and 385.5 g, respectively). All turtles in burned sites (injured and uninjured) had a significantly lower body mass (mean = 373.3 g) than those found in unburned areas (mean = 448.0 g) when carapace length was used as a covariate ($df = 1$, $F = 5.255$, $P = 0.0329$). In addition to the lower body mass, turtles that were found in burned sites also had a lower body condition index (Fig. 2), which may suggest poorer health of these animals. It is possible that the warmer ground temperatures and higher total radiation of the burn sites (C.A.F. Howey, unpubl. data) led to greater body water loss; and thus, lower body mass for turtles in burned areas. Additionally, the loss of the outer dermal layer of the shell (i.e., scutes) may exaggerate this loss of body water and lead to a lower mass and poorer body condition. Degraded habitat may also contribute to a diminished body condition, but data on habitat use was not recorded for box turtles during this project. We hope that the scant data presented here may

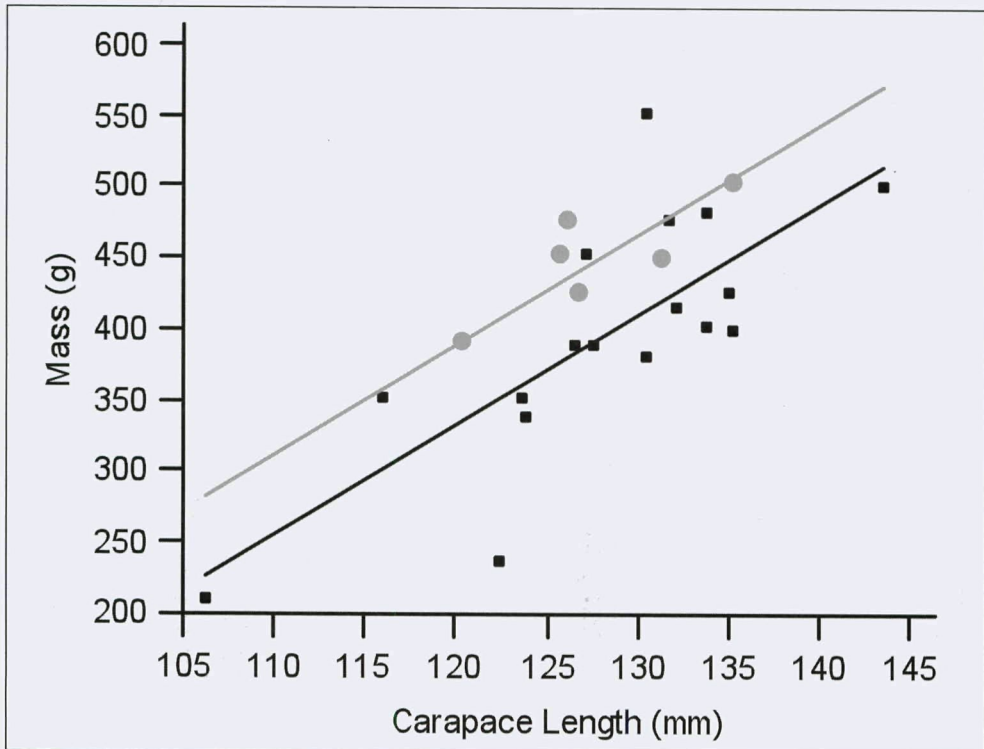


Figure 2. Body condition index of Eastern Box Turtles is determined by the residuals from the mean (regression line). Black squares denote turtles from burn sites. Gray circles denote turtles from unburned sites.

spur future work examining the effect of such injuries and the effect of a changed landscape on the Eastern Box Turtle. It appears that surviving a prescribed burn is only the first challenge for Eastern Box Turtles; maintaining a healthy body condition may also be difficult in these disturbed landscapes.

One severely injured, adult male Eastern Box Turtle was encountered 32 times between 30 May 2011 and 8 June 2012. Over the course of the year, the turtle grew 1.3 mm and gained 27 g. The state of the injuries did not change over the year; scutes that were missing did not grow back, and scutes that were severely damaged still appeared damaged after one year (Fig. 1). Shell regeneration has been reported for box turtles (Rose 1986); however, this phenomenon may require more than one year. Over the course of the year, the turtle moved on average 22.5 m per day with a maximum movement of 60.8 m per day. The home range for the turtle was 3.77 ha, and over the course of the year the turtle was never found outside of a small valley. Although we did not record habitat characteristics associated with the valley, greater amounts of canopy cover and understory vegetation were observed in this area compared to surrounding habitat in the burned landscape. In comparison to other Eastern Box Turtle studies, the home range of this individual was equal to or smaller than previously reported home ranges (Hester et al. 2008, Madden 1975, Wilson 2001), but movement rates were less than the mean for turtles that occupy undisturbed, forested landscapes (40 m/day; Strang 1983). Interestingly, Iglay et al. (2007) found lower movement rates for Eastern Box Turtles in habitat disturbed by fragmentation, which were comparable to the movement rates for the individual in this study. It is possible that the lower movement rate for the injured turtle is the result of reduced-quality habitat rather than the result of its injuries, but this is purely speculation. Given these data, further work regarding the habitat use of Eastern Box Turtles in burned and unburned landscapes is warranted. If box turtles can survive the direct effects of prescribed fire, it is unclear if this altered landscape will provide favorable habitat characteristics for the species, how habitat changes will affect movement rates and home-range sizes, and ultimately energetic expenditures and fitness of Eastern Box Turtles.

Acknowledgments

This study was conducted in compliance with state (SC1211012) and federal (LBL10165) permits. The research was supported by funding from the National Fire Plan through the US Forest Service's Northern Research Station (10-CR-11242302-056). All interactions with animals were approved under the Ohio University IACUC L09-08. We thank M. Dickinson for assistance with this project and with obtaining funding for this project. I thank A. Schneider, E. Stulik, R. Everett, N. Becker, B. Johnson, and K. Heckler for assistance with data collection.

Literature Cited

Allard, H.A. 1949. The Eastern Box Turtle and its behavior. *Journal of the Tennessee Academy of Science* 24:146–152.

- Babbitt, L.H., and C.H. Babbitt. 1951. A herpetological study of burned-over areas in Dade County, Florida. *Copeia* 1951:79.
- Bigham, S.R., J.L. Hepworth, and R.P. Martin. 1964. A casualty count of wildlife following a fire. *Proceedings of the Oklahoma Academy of Science* 45:47–50.
- Cagle, F.R. 1939. A system of marking turtles for future identification. *Copeia* 1939:170–173.
- Dolbeer, R.A. 1969. Population density and home-range size of the Eastern Box Turtle (*Terrapene c. carolina*) in eastern Tennessee *ASB Bulletin*. 16:49.
- Hester, J.M., S.J. Price, and M.E. Dorcas. 2008. Effects of relocation on movements and home ranges of Eastern Box Turtles. *Journal of Wildlife Management* 72:772–777.
- Iglay, R. B., J.L. Bowman, and N.H. Nazdrowicz. 2007. Eastern Box Turtle (*Terrapene carolina carolina*) movements in fragmented landscape. *Journal of Herpetology* 41:102–106.
- Madden, R.C. 1975. Home range, movements, and orientation in the Eastern Box Turtle, *Terrapene carolina carolina*. Ph.D. Dissertation. The City University of New York. New York, NY.
- Rodgers, A.R., A.P. Carr, H.L. Beyer, L. Smith, and J.G. Kie. 2007. HRT: Home Range Tools for ArcGIS. Version 1.1. Ontario Ministry of Natural Resources, Centre for Northern Forest Ecosystem Research, Thunder Bay, ON, Canada
- Rose, F.L. 1986. Carapace regeneration in *Terrapene* (Chelonia: Testudinidae). *The Southwestern Naturalist* 31:131–134.
- Strang, C.A. 1983. Spatial and temporal activity patterns in two terrestrial turtles. *Journal of Herpetology* 17:43–47.
- Wilson, G.L. 2001. Reproductive ecology of the Eastern Box Turtle (*Terrapene carolina carolina*) in a mixed oak-pine woodland in the central Virginia Piedmont. *Virginia Journal of Science* 52:86–87.

Copyright of Northeastern Naturalist is the property of Humboldt Field Research Institute and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.