RESEARCH BRIEF

Direct and Indirect Effects of Fire on Eastern Box Turtles

Katie A. Harris, Joseph D. Clark, R. Dwayne Elmore, Craig A. Harper
Journal of Wildlife Management 84(7):1384–1395; 2020

MANAGEMENT IMPLICATIONS

- Eastern box turtles are susceptible to prescribed fires, particularly during the growing season.
- Box turtles have behavioral and physical traits that offer protection from direct fire effects.
- Unburned microsites within burn units offer important refugia for slow moving reptiles.

In this study, researchers evaluated the direct (mortality, physical injury) and indirect effects (changes in movements and space use) of prescribed fires on eastern box turtles (*Terrapene carolina carolina*, box turtles) in various vegetation types in eastern Tennessee, USA. Box turtle populations may be negatively affected by disturbance events such as fire as a result of life-history characteristics (e.g., late reproductive age, slow growth, small clutch size), limited mobility, and site fidelity. However, prescribed fire may benefit box turtle populations by providing improved conditions for foraging, nesting, and thermoregulation, as shown for other reptile species. Indirect effects such as these are highly influenced by fire intensity, seasonality, and frequency.

Field experiments were conducted at three sites which included areas dominated by shortleaf pine-oak woodlands, early-successional plant communities, and closed- canopy deciduous forests; all of which had experienced routine prescribed fire for at least the previous 12 years. In all, effects from 17 different prescribed fires were assessed, 11 of which occurred during the early growing season (April-May), one in the summer season (June-Aug.), four in the late growing season (Sept.-Oct.), and one in the dormant season (Nov.-March).

Adult box turtles were captured at the study sites during a two-year period using opportunistic finds, active searches, and wildlife detector dogs. Capture location, body mass, sex, and additional physical characteristics including existing injuries were recorded. A small radio transmitter was affixed to each turtle's shell (and later removed) to monitor movement before, during, and after the prescribed fires. Turtles located within a prescribed fire unit prior to ignition were considered to have experienced a fire, and those that did not were considered the control group. During fire events, observers walked firebreaks to estimate number of marked and unmarked turtles leaving burn units. Fire intensity was assessed using heat-sensitive paint applied to ceramic tiles deployed near each turtle located within fire units prior to ignition.

The locations of radio-marked turtles were identified within four hours prior to each prescribed fire. The fate (fire-caused mortality or injury) of turtles that experienced a fire was compared to those that did not. Statistical models were assessed to determine how turtle fate varied among treatment sites, season of burn, turtle locations pre-fire relative to nearest firebreak, fire intensity, litter depth, burn size, and burn coverage. Turtle movements before and after fires were assessed to determine if fire affected

This eastern box turtle took refuge under a rock outcrop during a prescribed fire in eastern Tennessee. (Photo: Katie Harris-Stovall)

RESEARCH BRIEF

Effects of Fire on Eastern Box Turtles

space use (e.g., selection for or against recently burned areas and home range size).

During the study, 118 adult box turtles were captured and radio-marked, with similar numbers of males and females. In all, 11 turtle mortalities were recorded in the study, six of which (3 males, 3 females) were directly related to the prescribed fires. The remaining mortalities resulted from wildfires (3), vehicle strike (1), and unknown causes (1). Only one of the 33 marked turtles that experienced and survived prescribed fires was observed to be injured, though pre-existing shell injuries (thought to be fire related) were identified on 17 turtles (14%) during pre-fire assessments. Turtles avoided fire-caused mortality by occurring in unburned microsites, burrowing after ignition, or by moving to areas which did not burn (in or out of the burn unit). During prescribed fires, 24 box turtles were observed crossing fire breaks (apparently to avoid fire), and returned to burn units within a relatively short time period.

Because box turtles brumate (similar to hibernation in mammals) in underground burrows during much of the dormant season, it was not surprising that all fire-related mortality occurred during growing-season fires. Most mortalities occurred during early growing-season fires, and one occurred during late growing-season fires. Movement patterns and home ranges did not differ among treatments, suggesting that turtles did not exhibit selection for or against burned areas during the study period.

Statistical models showed fire intensity (indicated by temperature-sensitive tiles and influenced by litter depth) to be the dominant predictor of fire-caused turtle mortality. Burn size and turtle distance to a fire break were not predictors of survival, likely because unburned microsites within fire units were common and accessible. The authors suggest that alterations to fire regimes, such as increased fire frequency (to reduce fuel loads) and employing ignition patterns which result in slow-moving flames, can increase opportunities for turtles to escape to an unburned refuge.

These results indicate that turtles are susceptible to prescribed fire, particularly during the growing season, and that they possess behavioral and physical traits that may reduce direct effects from fire. Mortality was 2.5 times more likely during early growing-season fires compared to the late growing-season fires as a result of lethargy associated with recent hibernacula emergence, despite greater burn coverages during the late growing season. Turtles may remain lethargic for 1-2 weeks after hibernacula emergence, and because populations of turtles emerge over a 1-3 month period, managers should consider avoiding prescribed fires during April-May if turtles are of high concern.

Eastern box turtles can burrow in leaf litter (A) and coarse woody debris (B) or move to unburned areas within burn units (C) to avoid direct effects of low intensity prescribed fire. (Photos: Katie Harris-Stovall)

Watch a recorded webinar on this topic presented by Katie Harris-Stovall HERE. View all recorded webinars HERE.

This research brief was funded by The Joint Fire Science Program. www.firescience.gov