Fire effects on box turtle spatial ecology using opportunistic capture

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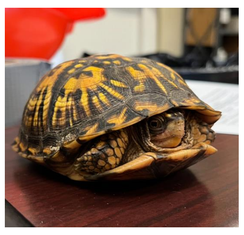
Abstract



Turtle grazing habits and habitat use are most likely affected by fire, as burns both destroy and facilitate vegetation growth. Fire history and opportunistic turtle capture data collected by the Environmental Protection Division at Brookhaven National Laboratory were used with the ArcGIS® mapping program and RStudio® statistical analysis program to analyze and visualize trends. More turtles were observed and captured around frequently burned habitats than around infrequently burned habitats. More turtles were observed and captured around habitats that had been burned between 11-15 years prior to turtle capture than habitats burned more recently. There was no significant difference in turtle mass between habitats with different burn histories. While these findings could lead to further standardized studies, the opportunistic nature of the data harbors numerous biases and our ability to correct those biases were limited. This study is consistent with Brookhaven National Lab's mission to protect the natural environment and her ecosystems.

Introduction

Long term forest mismanagement has been found to increase both the frequency and severity of unintentional forest fires which destroy both developed and undeveloped areas, decreasing resource availability, air quality, ecosystem quality, and the overall safety of humans and wildlife alike[1]. With a recent rise in prescribed fire management to combat these consequences of past mismanagement, discussion has continued to assess the impacts the strategy has on the local wildlife. One notable species, the Eastern Box Turtle, has been largely used for mortality assessments due to the inefficiency of their stress response to escape instances of fire[2]. Box turtles also act as an indicator species for the health of an ecosystem due to their susceptibility to diseases, limited habitat range, and long life spans[3],[4].This species is crucial to the balance of the ecosystems they inhabit through their predatory and herbivorous behaviors, necessitating an understanding of how prescribed burns could affect their ecology for a wider understanding of ecosystem stability.

Goal
- What is the relationship between the ecology of the eastern box turtle and fire?

Objective
- To observe and model the trends between fire history and eastern box turtle observations/captures.

Hypotheses
1. We hypothesize that a greater number of box turtle home ranges will overlap with less frequently burned areas than with more frequently burned areas
2. We hypothesize that a greater number of box turtle home ranges will overlap with areas burned 11-15 years prior than with more recently burned areas.
3. We hypothesize that turtles whose home ranges overlap with less frequently burned areas will weigh more on average than turtles whose home ranges overlap with more frequently burned areas
4. We hypothesize that turtles whose home ranges overlap with areas burned 11-15 years prior will weigh more on average than turtles whose home ranges overlap with more recently burned area

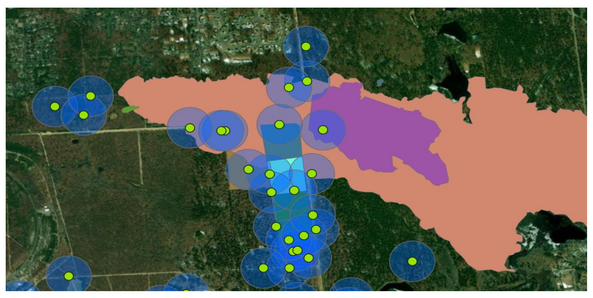
Methods

Site Description:
- Brookhaven National Lab, Upton NY, burn plots and other burned areas within the central pine barrens were used for mapping and analysis.

Turtle Processing
- Record date, time, and location of capture with age, sex, and shell measurements of the individual.
- Notch turtle with unique notch combination on the marginal scutes (scales) of the shell (Fig 1).
- Safely release turtle at the point of capture.

Mapping:
- Plot fire history data and create a 148.84 m buffer around each coordinate to predict a possible home range of 6.96 ha[5] (Map 1).
- Assign each coordinate entry a habitat, state of habitat, and time since last fire disturbance based on overlapping area and time of capture.

Statistical Analysis (for statistical significance)
- A t-test was performed on turtle mass data in relation to habitat type.
- A Kruskal-wallis test was preformed on turtle mass data in relation to time since most recent burn.



Map 1. Locations of burn plots and burned areas ("Habitats") represented by polygons. Coordinates where turtles were found represented by points with 6.96 ha projected home ranges represented by semi-transparent radii.

Figure 1. One observer takes measurements of the individual while another observer records additional capture data.

Results

Turtle Capture Trends (Figures 2 and 3):
- A greater number of turtles were found per year per hectare near frequently burned areas than near infrequently burned areas (Fig. 2).
- A greater number of turtles were found per year per hectare near areas burned within 11-15 years prior to capture than near areas burned within 0-10 years prior (Fig. 3).

Turtle Mass Trends (Figures 4 and 5):
- There was no significant difference in average mass between individuals found near frequently burned areas and individuals found near infrequently burned areas (Fig. 4).
- There was no significant difference in average mass between individuals found near areas burned 11-15 years prior and individuals found near areas burned within 0-10 years prior (Fig. 5).

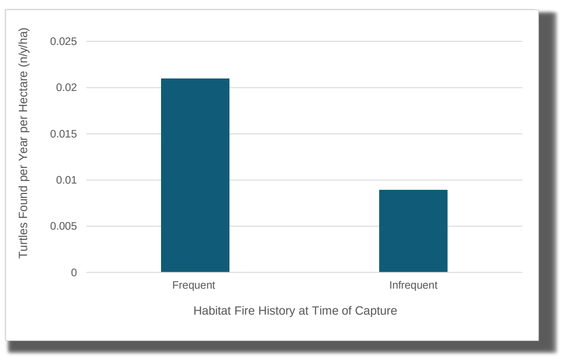


Figure 2. Turtles found per year per ha near frequently burned areas and infrequently burned areas. A greater number of turtles were found per year per hectare near frequently burned areas (~0.021 n/y/ha) than near infrequently burned areas (~0.009 n/y/ha).

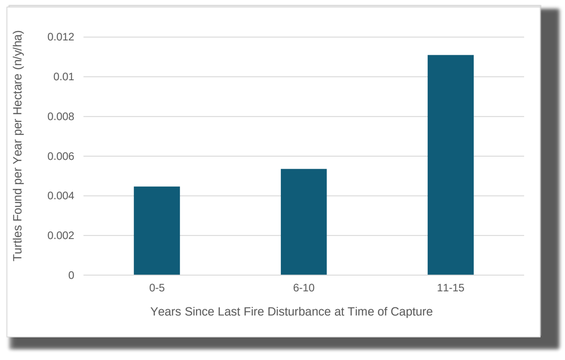


Figure 3. Turtles found per year per ha near areas burned between 0-5, 6-10, and 11-15 years prior to capture. A greater number of turtles were found per year per hectare near areas burned between 11-15 years prior to capture (~0.011 n/y/ha) than near areas burned between 0-5 and 6-10 years prior to capture (~0.004 n/y/ha and ~0.005 n/y/ha respectively).

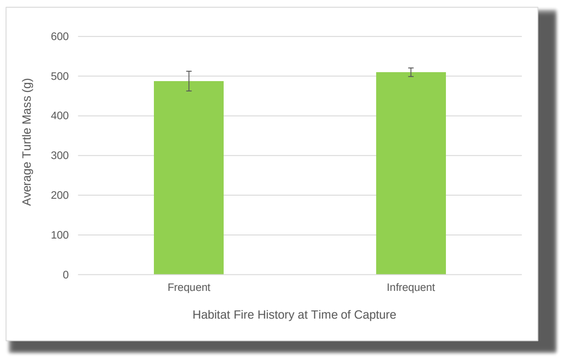


Figure 4. Average mass of turtles found near frequently burned areas and infrequently burned areas. No significant difference in mass was found between fire histories. P-value = 0.4549, failed to reject the null hypothesis.

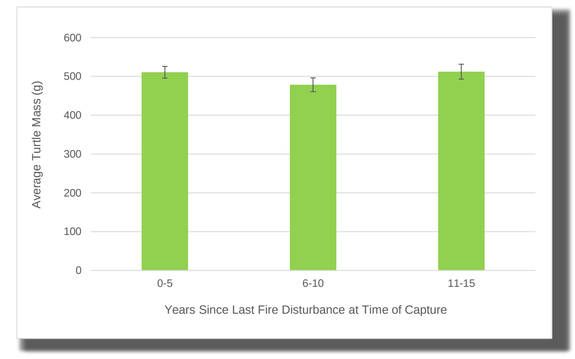


Figure 5. Average mass of turtles found near areas burned between 0-5, 6-10, and 11-15 years prior to capture. No significant difference in average mass was found between fire histories. P-value = 0.2974, failed to reject the null hypothesis.

Discussion

Turtle Abundance Implications:
- Both Frequently burned habitats and habitats burned 11-15 years ago could lack oppressive overstory, allowing greater thermoregulation and grazing opportunities[6].
- Vegetation present in more recently burned habitats are most likely too small to provide ample cover or ample food resources crucial to box turtle ecology[3],[4].

Turtle Mass Implications:
- Turtle health may not correlate with fire history due to refugia present within the box-turtles' overlapping home ranges[7],[8].
- Gravid individuals and seasonal diets could skew data[9].

Opportunistic Data Issues:
- Lack of standardization = frequent censorship
- Long-term collection = inconsistent methods and values/format
- Human error inevitable
- Exhaustive standardization attempts unable to fully correct inconsistencies

Conclusion:
- Findings could lead to further, more consistent, and more standardized studies.
- Better standardization of opportunistic data (exact instances of available habitat area, probability of human presence in habitat areas, etc.).

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