Factors Affecting the Home Range of Eastern Box Turtles at Brookhaven National Laboratory

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Abstract

Widespread among the many acres of Brookhaven National Laboratory (BNL), the Eastern Box turtle (*Terrapene carolina carolina*) finds its niche in the dense understory of the Pine Barrens ecosystem. Box turtles move within a central home range, which varies among individual turtles and amount of habitat present. Disturbances, such as roadways, buildings, removal of forest, and change in ground cover impact turtle movement and behavior. Specifically, with the recent addition of a 200 acre solar farm on the property, it is being questioned whether the turtles will be disturbed and change their home range. Understanding the home range of each turtle gives better insight as to whether they will move nearer to or away from the solar farm. Twenty-eight turtles were found as part of the study. Each turtle was weighed, measured, and notched on three scutes around the rim of the carapace. After collecting the initial data, radio transmitters were attached to the lower portion of the carapace. Six turtles were chosen to be part of the radio telemetry study. Each transmitter has a unique frequency, which helps to identify the turtles in their specific home ranges. The turtles were tracked once daily to observe the distance traveled and vegetation they prefer to burrow or forage in. Their locations were recorded using a Global Positioning System and represented visually using Geospatial Information Systems mapping technology. Each turtle had a unique movement pattern, but they all stayed within a 0.3 – 1.7 hectare area. The turtles with frequencies 149.843 MHz, 149.802 MHz, 149.852MHz remained in a close home range and preferred the pitch pine/white oak habitat with a huckleberry/blueberry dominated understory. Transmitters with frequencies 149.833 MHz, 149.813 MHz, 149.822 MHz, all female, had greater movement going deep in the forest or walking across the dirt roads. These turtles moved from areas of no vegetation to dense barberry and blueberry thickets. Females typically have a greater range of movement than males, which explains their varied habitat preference. The more significant changes in movement indicate the possibility of disturbances caused by roads fragmenting the forest or by human activity. Turtles 802 and 822 are closest to the solar farm and are slowly moving away from the site. Future studies will investigate whether the Eastern Box turtles with transmitters, as well as others, will travel into the solar array area using the wildlife friendly fencing.

Introduction

The Eastern Box Turtle is common in the woodlands of the Northeast United States. Their preference of habitat includes densely forested areas with sources of moisture close by and a large enough space to extend their desired home range. Box turtle habitat includes deciduous or mixed forest, early successional habitat, fields, and shallow wetlands (Erb, 2011).

The Pine Barrens ecosystem at Brookhaven National Laboratory is prime habitat for turtles. The native vegetation provides the perfect habitat for turtles to forage, nest and burrow. Turtles make use of both the dense understory and areas where there are openings in the overstory. Typical trees include pitch pine, white oak, scarlet oak and red maple. Understory plants are mainly from the heath family and include huckleberry, blueberry, and cranberry.

Box Turtle movement depends on a variety of factors. They move to obtain food and water, locate mates or nesting sites, thermoregulate body temperature, hibernate, and explore new habitat (Dodd, 2001). Movements may be direct paths to specific resources, such as blueberry or huckleberry. Also, type of understory vegetation can affect the box turtles microhabitat selection. The turtles have been observed moving more frequently in areas of dense ground cover. The varied Pine Barrens groundcover gives turtles the option to select habitat based on need for regulating body temperature or foraging.

Although threatened by natural occurrences in the environment and anthropogenic effects, the eastern box turtle population remains stable on Long Island. Threats include vehicular traffic, fragmentation, habitat loss, degradation due to development, and natural disturbances (Erb, 2011). Specifically at BNL box turtles face the task of surviving in their natural habitat while encountering disturbances, such as the construction of the solar farm.

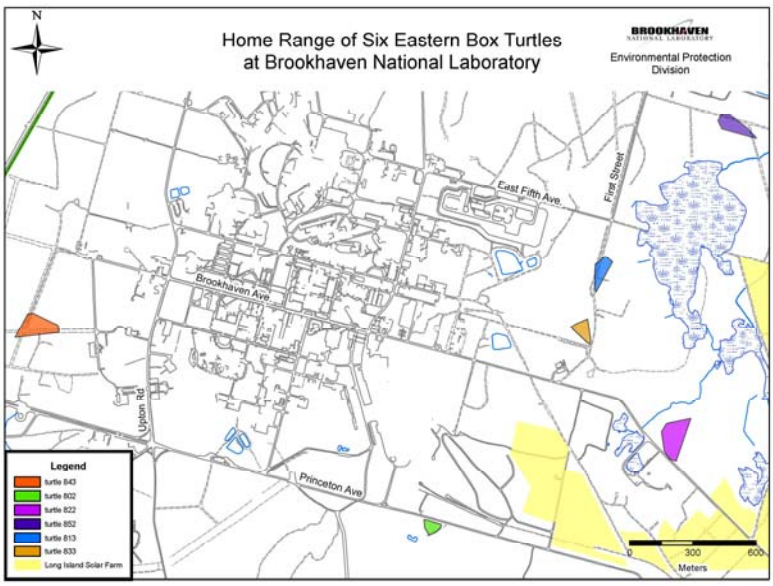
Methods and Materials

The goal of this study was to capture six turtles near the Long Island Solar Farm to monitor using radio telemetry for six weeks. The turtles were weighed, length and width of the carapace and plastron were measured , and sex/age were determined. Using the master notch list provided, a unique notch ID was given. Notches were filed into three scutes around the carapace.

Once the six turtles were identified, a radio telemetry transmitter was attached to the back scales. Each of the transmitters had a different frequency, which would be the determining factor in telling each turtle apart in their specific locations. The frequencies, given by the Advanced Telemetry Systems, ended in the digits: 813, 833, 802, 843, 842, 822.

The selected box turtles were released after being assigned a frequency and tracking began immediately. Tracking took place once daily and radio telemetry equipment was used to pick up the specific frequencies. The antennae picked up the frequency, which became louder when in close proximity to the turtles and was held horizontally to obtain the clearest signal. At each point of capture, a GPS point was logged to be used for GIS analysis.

GIS analysis included creating the path of movement for each turtle and a minimum convex polygon to show estimated home range. Using an added program in ArcInfo 9.2, Hawth's Tools, lines were drawn to connect each point based on date. In order to find the estimated home range, minimum convex polygons were drawn around the paths.



Results

Factors that played a role in movement were dirt and paved roads, fencing, the solar farm construction site, buildings, and vegetation density and type. Due to the factors effecting movement, the home ranges sizes were impacted. Turtles with frequencies 833, 802, 813 remained in a close home range. On the other hand, Transmitters 822, 843, 852 had greater movement going deep in the forest or walking across the dirt roads. Their home ranges had a larger area. According to GIS calculation, all of the turtles stayed between a 0.3 - 1.7 hectare area (see table 1).

Large home ranges were observed in areas where habitat was expansive. Areas with fragmentation, road barriers, and buildings forced turtles to have fewer options for movement. Turtle 843 experienced fragmentation due to the intersection of roads that divided the forest into four quarters. This turtle frequently crossed into each of the four sections every week. Roads also acted as a barrier to turtles 822, 802, and 833. These specific turtles never crossed the roads near their selected forest habitat.

Vegetation preferences were evident for each of the six box turtles (see table 2). The most preferred habitat was the Pitch Pine/White Oak forest. The understory in this type of forest consisted of low blueberry and huckleberry bushes. Each turtle was often found with food residue on their mouths indicating that they were in good foraging habitat.

In regards to movement near the solar farm, turtles 822, 802, and 852 were observed closely. Each turtle exhibited some movement in the direction of the solar farm, but not significant enough to suggest if they were being effected by the placement of the farm. Turtle 822 was in closest proximity (290m) to the construction site, but moved north and south instead of east to move closer to the fencing.

	833	813	852	822	802	843
sex	F	F	M	F	F	M
min dist (m)	3.01	1.12	1.65	3.67	2.36	1.12
max dist (m)	103.47	76.62	195.79	79.40	78.52	140.43
mean	33.09	28.65	43.08	32.54	30.53	45.34
SD	28.28	20.73	43.13	24.18	22.52	34.40
Area (ha)	0.568	0.721	0.925	1.67	0.364	1.42

Table 1: Length of movement for each box turtle and home range area

	Pitch/ white oak	Pitch/mixed oak/heath	Scarlet Oak/ Heath	Red Maple/ Scarlet Oak/ Heath	Red Maple/ Heath	Planted White Pine	Grass	Successional	Road
813			■			■	■		
822		■	■	■	■				
833	■		■			■	■		
852	■	■							
802	■						■		
843	■	■						■	■

Table 2: Habitat preferences

Discussion and Conclusions

Radio telemetry was successfully used to help determine an approximate home range area that can be used to predict future movements and turtle behavior. Each turtle's path illustrated that movement largely depends on the type of habitat present and the individual turtle's behavior.

Vegetation proved to be a major factor affecting turtle home range. The overstory provides shade and openings give turtles a chance to bask in the sun. Ground cover is used for foraging, shelter, and daily movement. Leaf litter provides a place for turtles to burrow in order to regulate their body temperature. Density of the understory also impacted the turtle's daily movement. Box turtles rely on their microhabitat for thermoregulation and controlling water loss (McKnight, 2011).

Roads were also assessed during the study to determine whether they act as barriers to turtle movement. Each turtle's home range included at least one road. Frequencies 813, 822, and 802 had one road as a possible barrier. Frequencies 843, 852, and 833 had two roads. The amount of roads in the habitat did not prove to be a major factor in turtle movement. Box turtles move to find what they need to survive and by studying their movements it is apparent that if they found a suitable habitat, they did not need to travel far.

Another potential obstruction to box turtles at Brookhaven National Laboratory is the solar farm. The closest turtle to the construction site is 822. After observing the other turtle's behavior, it is possible that turtle 822 had suitable habitat and had no need to move closer to the solar farm. Once construction is complete and grasses grow under the panels, the turtles may choose to move into the area. The habitat must contain food, moisture, and areas to burrow in order to be worth moving in through the wildlife friendly fencing.

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