Activity and Movements of Stinkpot Turtles at Brewster Lake

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Introduction

Life-history and ecology of stinkpot turtles (*Sternotherus odoratus*) is poorly understood. There have been no comprehensive and detailed studies of activity and movements of stinkpots, and therefore we have no idea of how home ranges vary among years and between sexes. Differences in energy allocation to eggs and finding mates exist between the sexes, although how these differences are manifested in movement patterns is unknown. How variations in weather and temperature patterns over time influence activity and movements are unknown. The purpose of our studies in 2004 and 2005, as funded by PCCI, was to determine patterns of activity and movements in stinkpot turtles at Brewster Lake.

Materials and Methods

We studied activity and movements of musk turtles on Brewster Lake on the Pierce Cedar Creek Institute property from May--August of 2005. Using nearly 200 wire-stemmed nylon flags, and anchored Styrofoam floats, we marked the boundaries of the lake and obtained GPS locations on each flag or float. We then constructed a map using the ArcMap software program on a PC. We baited hoop nets to trap stinkpots and attached transmitters with unique frequencies to the rear, dorsal scutes using super glue and epoxy. Transmitter placement minimized hindrance to turtle movement. Five to seven days per week, we determined each turtle's location in the lake three times daily between 0800-1000, 1300-1500, and 1800-2000 using a handheld radio-receiver. We marked locations on a map of the lake and transferred them to an electronic map on

ArcView GIS v3.2. Using ArcView, we then measured the total distance moved by each turtle by measuring the distances between successive daily locations. Every seven to ten days, we performed a diurnal tracking regimen in which we monitored the turtles' locations for twenty-four hours, tracking at 0900, 1300, 1700, 2100, 0100, 0500, and 0900. This gave us seven locations and six distance segments for each turtle. We determined the total distance moved by each turtle by adding the six segments.

Initially we applied fifteen transmitters to fifteen turtles. However, our number of subjects studied varied throughout the summer due to transmitter failures. At any one time, we tracked between one and twelve turtles. On July 16, we applied three new transmitters to three new turtles. The final transmitter of the original fifteen failed on August 3. The three remaining, newer transmitters carried the study through the middle of August, with some additional tracking being done in September. To gather information on thermal temperature data, we used transmitters with thermal capabilities. We also placed data loggers to 10 and 50 cm depth at four locations around the lake to record water temperatures continuously from May through September.

Results

Total daily distances moved (TDDM) based on three radiolocations / day are shown in Fig. 1. On average, turtles rarely moved in excess of 50 m per day. Upon visual inspection, we found no obvious repeatable seasonal trends in the 2004 and 2005 data except for possible mid-summer peaks in activity. When TDDM values were averaged per turtle, we found no year, gender, or year x gender effects ($F_{3,17} = 1.80$, $P > 0.05$) and mean TDDM was less than 30 m per day in both years of the study. Total daily distance moved based on 24-h monitoring also indicated that there were no obvious seasonal

trends (Fig. 2). However, the greater number of radio-locations collected per day resulted in mean TDDM values that could exceed 100—200 m, indicating that monitoring turtles three times per day underestimates TDDM. When TDDM was determined for each turtle, we found that turtles averaged between 74 and 101 meters, which exceed those values reported on a three times per day monitoring regimen. Our data from 24-h monitoring in both years (Fig. 3) indicate that musk turtles are active during all hours of the day with possible peaks between 2100 and 0100 in both 2004 and 2005.

Turtles favored areas adjacent to the littoral zones in water that was from 50--100 cm deep (Fig. 6). Discrete clusters of data points indicate that individual turtles favored multiple activity centers in the lake. Minimum convex polygon method (MCP) determines the entire area contained by all peripheral points. With duration of monitoring included in the model as a covariate, we found significant differences in home range size ($F_{4,12} = 6.4$, $P = 0.005$, $R^2 = 0.68$) with significant annual effects ($F_{1,12} = 14.9$, $P = 0.002$)(2004 > 2005; Fig. 4). Gender and year x gender effects were not significant. Similarly, for range length (RL), our ANCOVA model was significant ($F_{4,12} = 4.62$, $P = 0.017$) with significant annual effects ($F_{1,12} = 6.79$, $P = 0.023$)(2004 > 2005; Fig. 5), and duration of study had significant effects on our data ($F_{1,12}=9.78$, $P=0.0087$).

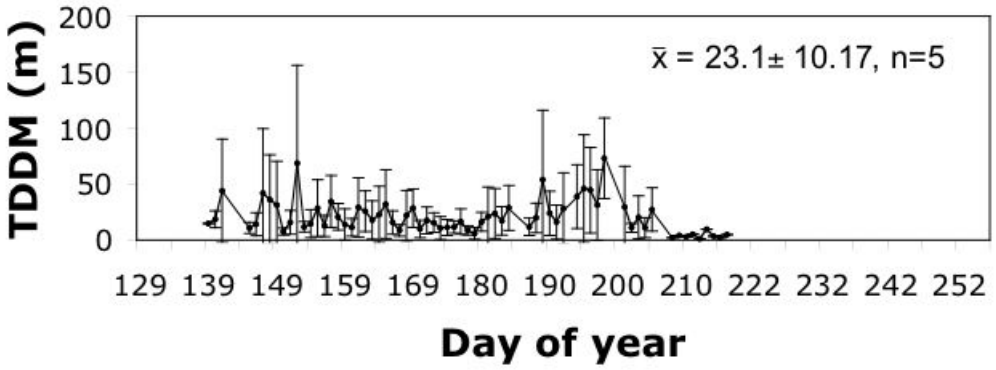
Analyses of covariance of home range size estimates based on the fixed kernel method were not significant for 95, 75, or 50 % probabilities because individual turtles had clusters of movement data points as opposed to random or uniform distributions. Therefore, the use of the fixed kernel method of home range size seemed most appropriate as it estimates home range size in terms of point densities.

Discussion

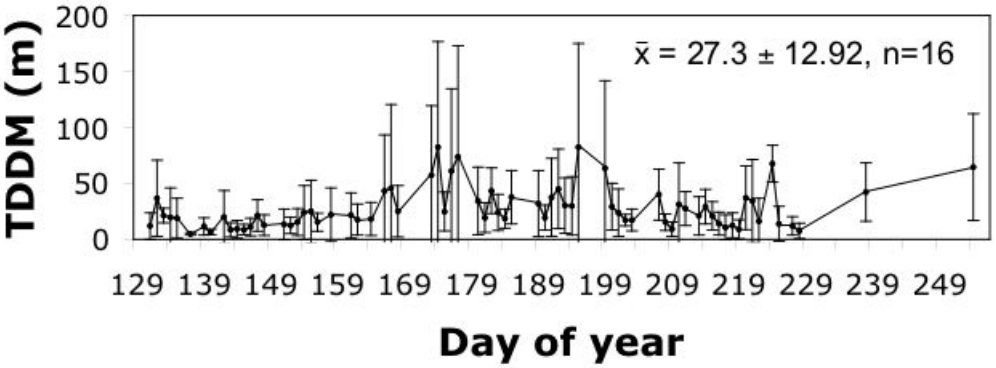
Despite some problems with technology, we were able to determine meaningful patterns of activity and movements in stinkpot turtles. We were able to corroborate our 2004 data which indicated that stinkpot turtles are active nearly 24 hrs / day and not just at night as was previously believed. We also found that daily movement patterns are variable and do not seem to depend on gender or weather patterns. However, we still have a considerable amount of data analyses to perform, and we may find that water temperature patterns influence daily distances moved. We have yet to determine how well our 3 radiolocations / day and 24-hour monitoring sampling regimens correlate with one another.

As with the daily distances moved data, our home range estimates are the first for this species that are based on radiotelemetry data. One significant result was that home range size may vary based on minimum convex polygon methods because the distribution of activity centers can vary. However, when analyzing clusters of points, we found little variation in kernel methods.

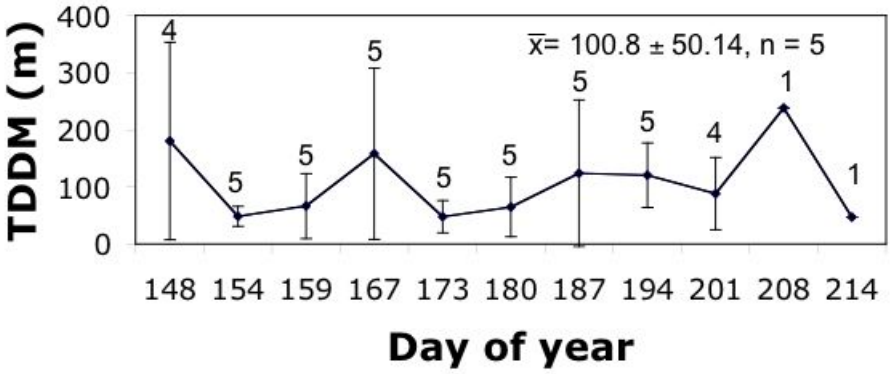
A.


TDDM (m)
200
150
100
50
0
x̄ = 23.1± 10.17, n=5
129 139 149 159 169 180 190 200 210 222 232 242 252
Day of year

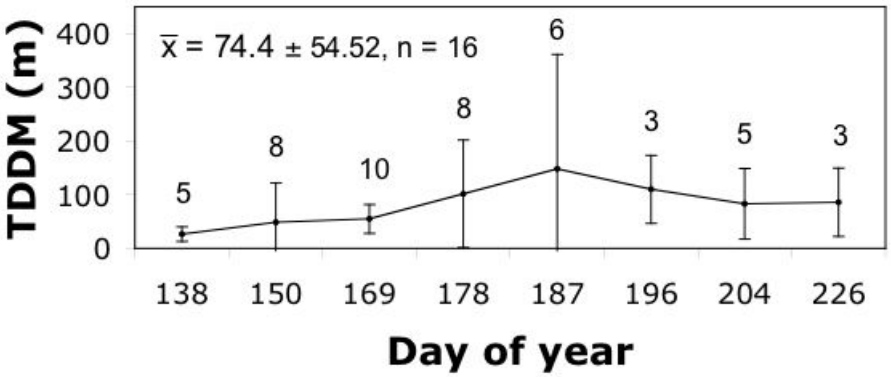
B.


TDDM (m)
200
150
100
50
0
x̄ = 27.3 ± 12.92, n=16
129 139 149 159 169 179 189 199 209 219 229 239 249
Day of year

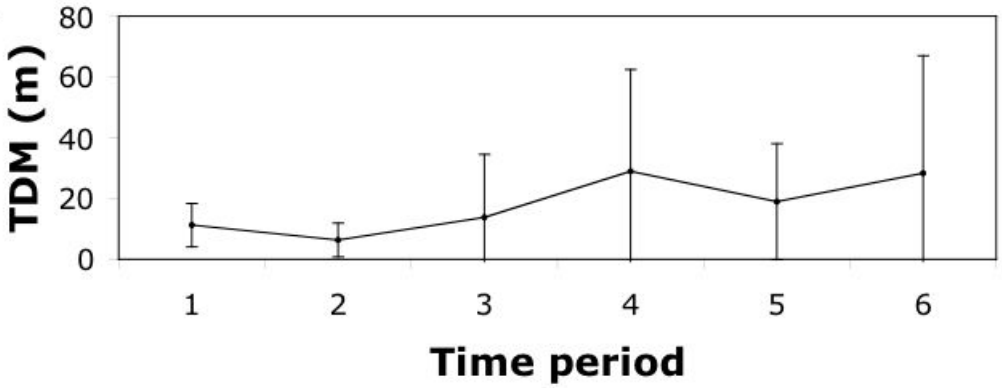
A.


TDDM (m)
400
300
200
100
0
x̄= 100.8 ± 50.14, n = 5
4
5
5
5
5
5
5
4
1
1
148 154 159 167 173 180 187 194 201 208 214
Day of year

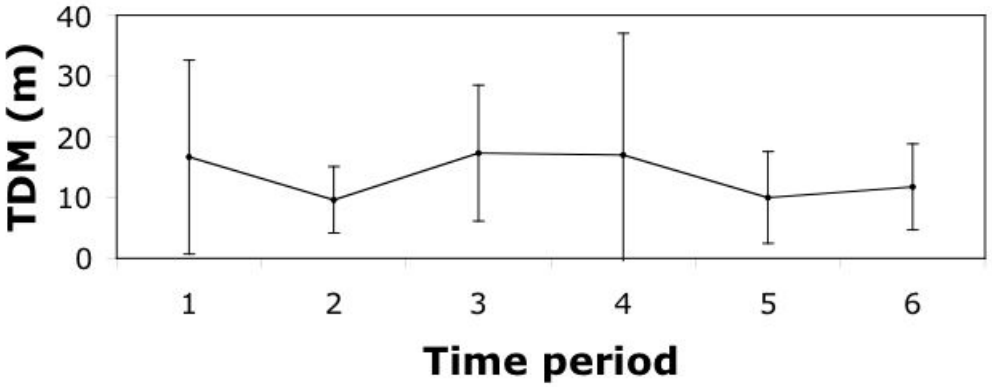
B.

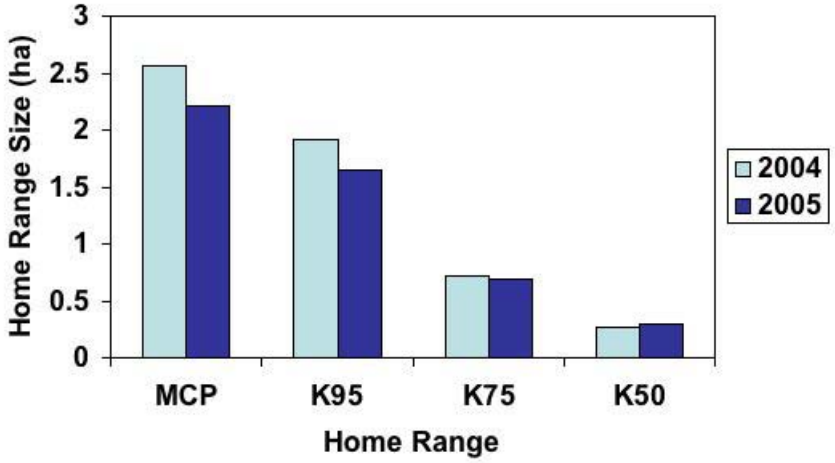

TDDM (m)
400
300
200
100
0
x̄ = 74.4 ± 54.52, n = 16
5
8
10
8
6
3
5
3
138 150 169 178 187 196 204 226
Day of year

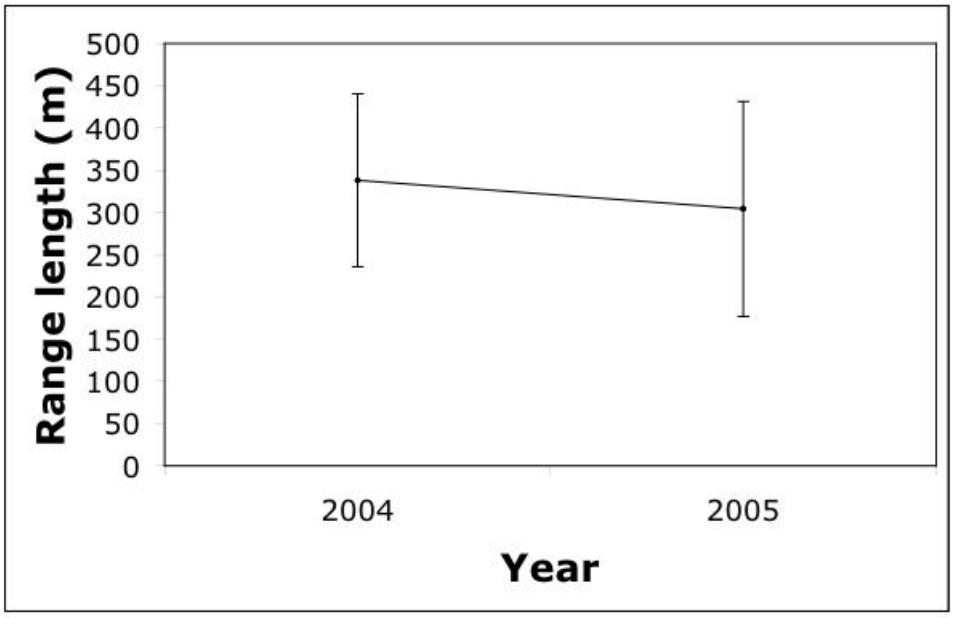
A.


TDM (m)
80
60
40
20
0
1
2
3
4
5
6
Time period

B.


TDM (m)
40
30
20
10
0
1
2
3
4
5
6
Time period


Home Range Size (ha)
3
2.5
2
1.5
1
0.5
0
MCP
K95
K75
K50
Home Range
2004
2005


Range length (m)
500
450
400
350
300
250
200
150
100
50
0
2004
2005
Year

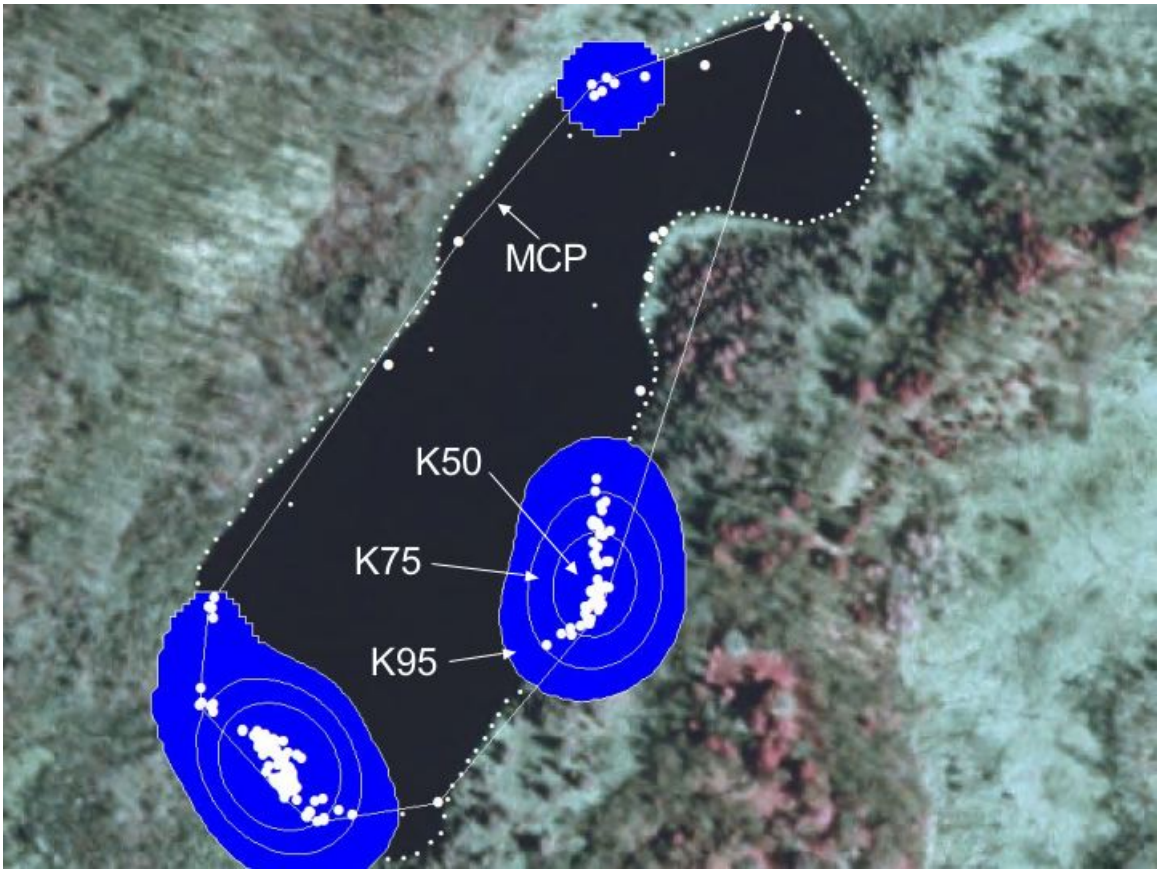

MCP
K50
K75
K95

Figure Legend

Figure 1. Total daily distances moved by all turtles during A) 2004 and B) 2005. Mean ± 1 SD for distance moved per turtle each day during each year are included as insets.

Figure 2. Total daily distances moved during 24 h monitoring in A) 2004 and B) 2005. Sample sizes are seen above and vertical lines are ± 1 SD. Mean (± 1 SD) daily distance moved are included as insets.

Figure 3. Total distance moved for each time period of 24 h monitoring in A) 2004 and B) 2005. Time period 1 corresponds to the time between 0900-1300; time 2 corresponds to 1300-1700; time 3 is 1700-2100; time 4 is 2100-0100; time 5 represents 0100-0500; and time period 6 corresponds to 0500-0900.

Figure 4. Histogram of minimal convex polygons (MCP) and kernel shapes (K95, K75, and K50) for the home ranges of turtles in both 2004 and 2005.

Figure 5. Average range lengths (meters) for turtles studied in 2004 and 2005.

Figure 6. Aerial Image of Brewster Lake shown with MCP and kernel regions.