Home Range Estimates and Habitat Preferences of Spotted Turtles (*Clemmys guttata*) Assessed Through the Utilization of Radio Telemetry, GPS, and GIS Technology

Frank W. Smith[1,2], Jeremy A. Feinberg[2,3], and Timothy M. Green[2]

[1]University of Rhode Island, Department of Biological Sciences

[2]Brookhaven National Laboratory, Environmental and Waste Management Services Division

[3]U.S. Fish and Wildlife Service, Long Island National Wildlife Refuge Complex

Abstract

Beginning in the fall of 2003, a behavioral ecology study of the spotted turtle, *Clemmys guttata*, implementing radio telemetry was initiated at Brookhaven National Laboratory (BNL). Both hatchery-raised (headstarted) and native spotted turtles were radio tracked in order to discern anomalous behavior in hatchery-raised turtles and the applicability of the raise-and-release method in reestablishing viable spotted turtle populations in native habitats. Individuals from the study group were monitored regularly, habitat data gathered and positional data logged utilizing GPS technology. The GPS points gathered were used to map hypothetical home ranges for each turtle using GIS technology. No significant difference was found between the summer 2004 headstarted turtle home range sizes and the summer 2005 headstarted turtle home range sizes (Student *t*-test, $\alpha = 0.05$, $p = 0.3073$). Also, no significant difference was found between the combined 2004 and 2005 headstarted turtle home range sizes and the combined 2004 and 2005 native turtle home range sizes (Student *t*-test, $\alpha = 0.05$, $p = 0.6088$). Because the spotted turtle is considered a species of special concern in New York State, the results of this study are relevant to conservation policy.

Introduction

The spotted turtle, *Clemmys guttata*, is a relatively small North American semi-aquatic turtle found from Ontario to Florida along the East Coast, and west through New York, Pennsylvania, Ohio, Michigan, Indiana, and Illinois. This species has carapace length of up to 12.5 cm. and is easily distinguished from other turtles sharing the same range by conspicuous yellow markings on the carapace, legs and head. The presence of a yellow or tan throat is another unique characteristic of the spotted turtle differentiating it from similar species [1].

Spotted turtles typically reside in shallow vernal pools, marshes, bogs, swamps, or permanent bodies of water, however *C. guttata may* leave their aquatic habitats throughout the year and move upland to hibernate, aestivate, nest, and to migrate to more productive aquatic environments [1]. These seasonal activities are all reflected in the home range size of individual turtles. Therefore, turtles in marginal environments should exhibit larger home ranges than turtles in more pristine habitats [2].

Although once abundant in New York State, the spotted turtle is currently recognized as a Species of Special Concern. Presently, biologists are observing an alarming trend toward population decline across the entire range of this species [3]. Many suspected anthropogenic catalysts have been cited as primary antagonists provoking this trend; including: habitat loss, alteration, and fragmentation, road mortalities, and pet trade collection. Also, habitat succession has been proposed to be a natural agent playing an integral role in this species-encompassing trend [3].

The focus of this project was to evaluate the efficacy of the raise-and-release method (headstarting) in augmenting senescent turtle populations. Although headstarting is not a novel conservation technique, little is known about the long-term effectiveness of this practice as it pertains to *C. guttata.*

Thirty spotted turtles were donated from the Cold Spring Harbor Fish Hatchery and Aquarium to Brookhaven National Laboratory for this study. Of the thirty-headstarted turtles released, nine were fitted with radio transmitters. In conjunction with this sample population, two native spotted turtles were also fitted with radio transmitters. Home range size, macro and microhabitat preference, and aestivation, hibernation, and migratory behavior were all criteria analyzed to elucidate the extent to which the headstarted turtles have acclimated to their new home at BNL. Because of the status of the spotted turtle in New York and the state of the species in general, the potential ramifications of this project in regards to conservation policy are extensive.

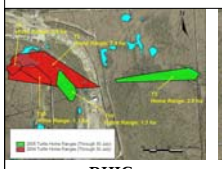
Materials and Methods

Eleven turtles (nine headstarted and two natives) were fitted with radio transmitters for this study. L.L. Electronics 4g LF series transmitters were adhered to the caudal section of the carapace using either epoxy or black electrical tape. Morphological measurements were taken prior to release. These measurements included weight, plastron length, plastron width, and carapace length.

Weather permitting, turtles were tracked daily, Monday through Friday, with occasional weekend data collection. Daily locations of turtles were determined utilizing a Communications Specialists Model R1000 telemetry receiver and an AF Antronics Model F150-3FB antenna. Once discovered, the precise location of a turtle was marked with florescent flagging tape. Turtle ID#, date of discovery, time of discovery, and temperature were logged on the flagging tape with black permanent marker. Turtle ID#, date of observation, time of observation, location, macrohabitat, microhabitat, and percent cloud cover were logged in a field journal. Wind speed, temperature, and relative humidity measurements were taken with a Forestry Suppliers *Kestrel 4000* personal weather station. Water temperature was taken when applicable using a standard thermometer.

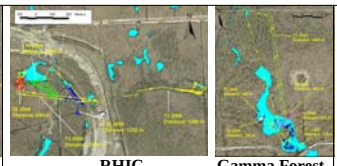
A GPS point was taken to mark the precise daily locations of each turtle, using a Garmin *rino* 110 personal navigator. Arcview v. 3.3 was used to analyze spatial data and estimate the minimum convex polygon (MCP) and line distance for each turtle. This GIS program was also used to overlay the MCP home range maps onto aerial photos.

Results



RHIC Gamma Forest

Fig. 1 A comparison of SULI 2004 and SULI 2005 home range estimates.



RHIC Gamma Forest

Fig. 2 A comparison of SULI 2004 and SULI 2005 line distances.

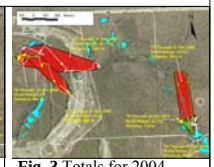


Fig. 3 Totals for 2004.

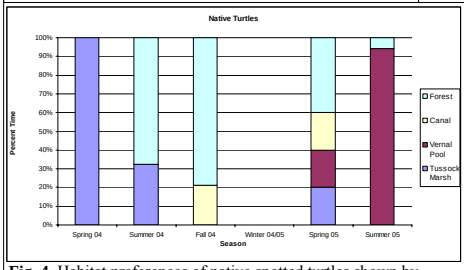


Fig. 4 Habitat preferences of native spotted turtles shown by percent time spent in each habitat (N = 2).

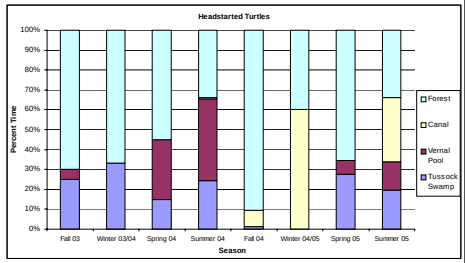


Fig. 5 Habitat preferences of headstarted spotted turtles shown by percent time spent in each habitat (N = 9).

ID#	Native (N)/ Headstarted (H)	Weight (g)	Carapace (mm)	Plastron Length (mm)	Plastron Width (mm)	Dates Monitored	Days Tracked (d)	Average Distance Per Movement Summer 04 (m)	Average Distance Per Movement Summer 05 (m)	Home Range Summer 04 (Hectares)	Home Range Summer 05 (Hectares)	Fate
1	H	67	73.8	66.6	44.5	10/14/03-12/22/03	6	-	-	-	-	Unknown-Transmitter Failure
2	H	68	71.1	61.6	40.3	10/14/03-07/29/05	123	85	44	0.4	0.2	Active
3	H	83	81.7	69.2	44.9	10/14/03-07/29/05	110	372	114	7.4	2.5	Active
4	H	64	74	64	43.4	10/14/03-04/07/04	10	-	-	-	-	Unknown-Transmitter Failure
5	H	56	67.7	59.1	39.5	10/14/03-04/19/04	9	-	-	-	-	Unknown-Transmitter Failure
6	H	63	72.5	64.1	41.4	10/14/03-04/07/04	9	-	-	-	-	Unknown-Transmitter Failure
7	N	195	103.6	93	64.2	05/05/04-10/31/04	56	426	-	5.5	-	Unknown-Transmitter Failure
8	H	74	77.6	67.4	43.3	06/10/04-07/08/05	63	27	24	0.04	0.1	Lost to Predation
9	H	56	71	60.6	39.2	06/10/04-04/07/05	58	146	-	0.5	-	Lost to Predation
10	H	62	74	63.9	41.7	06/10/04-07/29/05	104	292	86	1.1	1.3	Active
11	N	75	78	75	46	05/13/05-07/29/05	40	-	77	-	0.8	Active

Table 1. A compilation of data for all spotted turtles tracked during the duration of this study.

*Morphological data was taken prior to release of the animal after first being fitted with a transmitter.

Discussion and Conclusion

On initial inspection, it appeared that the home range sizes of the headstarted turtles had dropped significantly when comparing the summer 2004 home range sizes to the summer 2005 home range sizes, yet statistical analysis suggests that there is no significant difference between the two years (Student *t*-test, $\alpha = 0.05$, $p = 0.3073$). Also, no significant difference was found between the home range sizes of native turtles and headstarted turtles (Student *t*-test, $\alpha = 0.05$, $p = 0.6088$). Although useful, due to the small sample size this information may not be reflective of the actual degree of acclimation currently maintained by the headstarted turtle population. The documentation of mating behavior or nesting would be the ultimate indication that headstarted turtles are able to adjust to a natural environment. More research is required to definitively elucidate the value of headstarting programs in augmenting senescent or extirpated turtle populations.

References

[1] Ernst, C. H., Lovich, J. E., and Barbour, R.W., *Turtles of the US and Canada*. Washington D.C.: Smithsonian Institute Press (1994).

[2] "Spotted Turtles *Clemmys guttata* Identification, Status, Ecology, and Conservation in the Midwest." Center for Reptile and Amphibian Conservation and Management. http://herpcenter.ipfw.edu

[3] Graham, T.E., "Habitat Use and Population Parameters of the Spotted Turtle, *Clemmys guttata*, a Species of Special Concern in Massachusetts," in Chelonian Conservation and Biology, Vol. 1(3): 207-214.

Acknowledgements

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