

ABSTRACT OF THE THESIS

Behavioral Thermoregulation and Energy

Budget of the Eastern Box Turtle,

Terrapene carolina carolina (Linne)

by PAUL MICHAEL RUSSO, Ph.D.

Thesis director: Professor Paul G. Pearson

The Energy Budget at 25°C

Under controlled environmental conditions in the laboratory, the rates of ingestion, egestion, and production were monitored for the semi-terrestrial eastern box turtle, Terrapene c. carolina, at 25°C. The amount of energy expended during respiration and locomotion, and body heat produced per day by an individual turtle were estimated.

Results indicate that: (1) the average ingestion rate is 12.47 ± 1.54 cal/gm/day, (2) the average egestion rate is 3.30 ± 0.48 cal/gm/day, and (3) the average production rate is 1.10 ± 0.81 cal/gm/day. The average turtle basal heat production is 2.5 kcal/day. The percentage of ingestion allocated to egestion and production is similar in all individuals.

The Annual Behavioral Thermoregulation Cycle

Thermistors were placed through the carapace of adult eastern box turtles and the measurements correlated with rectal temperatures in both shielded and unshielded

solar environments. Box turtles with thermistors implanted inside their carapace were released at Hutcheson Memorial Forest during the summer and winter of 1967 and the summer of 1968. Temperature readings of the turtles and of shielded and unshielded ambient air and the soil surface were taken approximately every minute for successive 24-hour periods. Behavioral observations were taken for the active periods of the day.

During the summer, spring, and fall, the turtle's body temperature was similar to that of the surrounding air. In the summer a body temperature of 26-28°C was maintained by early emergence at sunrise, retreat into dense vegetation during the heat of the day, and by selection of microhabitat when a choice existed; a daily temperature cycle resulted from such behavior. The early spring and fall were periods of greatest activity and maximal exposure to solar radiation. The mean body temperatures were 8.97°C and 17.11°C, respectively.

As the monitored turtles entered hibernation, temperature of the turtle, the burrow, the soil surface, and the ambient air were recorded to the end of hibernation. The winter temperatures of the box turtles were just above freezing (1.47°C).

The data indicate that box turtles behaviorally thermoregulate during the warmer months by changing their microenvironment, thus maintaining their body temperature within the individual's thermal tolerances.

The Interrelationship of the Energy
Budget at 25°C and Thermoregulation

The close approximation of the summer turtle temperature to 25°C permitted calculation of the energy flow through a box turtle population (3,783 kcal/ha/summer). Box turtle energy flow for each season and for the year (929 kcal/turtle) was also estimated. The box turtle was estimated to influence only 0.04 percent of the fixed energy in its community and was thus considered an insignificant part of the community with respect to energy flow. The turtle's energy requirements were similar to those reported for other reptiles. Calculations indicate that man's annual energy expenditure is approximately five orders of magnitude greater than the turtle's annual energy expenditure.