Dietary Shift in the Turtle Pseudemys scripta (Schoepff) from Youth to Maturity

Article *in* Copeia · December 1969

DOI: 10.2307/1441797

2 authors, including:

David B. Clark
University of Missouri - St. Louis
142 PUBLICATIONS **11,344** CITATIONS

SEE PROFILE

Dietary Shift in the Turtle *Pseudemys scripta* (Schoepff) From Youth to Maturity

David B. Clark and J. Whitfield Gibbons

A dietary change occurs from youth to maturity in the turtle *Pseudemys scripta* in South Carolina. Juveniles in their first year of growth were primarily carnivorous whereas adults were largely herbivorous. The shift from a carnivorous to a herbivorous diet occurred over the course of one summer. A positive correlation between the calcium content of the shell and size of the turtle is demonstrated. The food of juveniles contained a significantly higher percentage of calcium than the food of the adults.

Introduction

THE yellow-bellied turtle, *Pseudemys scripta* (Schoepff), is common throughout much of the southeastern U. S. (Carr, 1952), frequently being the most abundant chelonian resident of lentic waters. Investigations of the feeding habits of *P. scripta* show it to be omnivorous with varying amounts of carnivorousness (Cagle, 1950; Marchand, 1942). Marchand noted that animal food made up 52% of the stomach contents in 10 immature specimens, while in 12 mature animals, animal food accounted for only 9%. He theorized that this shift was due to smaller turtles being able to fulfill a dietary preference for animal matter more easily than adults by eating a variety of small forms not so readily available to the larger turtles. Dietary changes from youth to maturity have also been observed in *Chrysemys picta* (Marchand, op. cit.), *Graptemys pseudogeographica* (Pope, 1939) and the *Sternothaerus carinatus* complex (Tinkle, 1958).

However, no previous study has indicated the size and age at which dietary changes occur in turtles nor has any study provided data to explain this phenomenon. The objectives of this study were to determine the diet of *P. scripta* at various ages to establish the age at which dietary changes occur and to determine possible reasons for these changes.

Materials and Methods

P. scripta populations from two adjacent farm ponds on the U. S. Atomic Energy Commission's Savannah River Plant near Aiken, South Carolina, provided the data for this research. The lakes, known locally as "Twin Ponds," were named "Debby's Pond" and "Gus' Pond" to distinguish between them for this study.

The lakes are of similar size. Debby's Pond is an estimated 2–3 acres; Gus' Pond is slightly smaller. Debby's Pond averages about 30 cm in depth in the shallow areas and 4½ m at the deepest point. The only vascular aquatic plant on which any of the turtles fed was *Eleocharis acicularis*. These plants are abundant near the edges and out to about 1.5 m in depth. Deeper parts of the pond lacked bottom vegetation. Although Gus' Pond is similar in depth, the water in it is more turbid and bottom vegetation is limited to the very shallow regions. Both lakes are dystrophic, having a total alkalinity of only 2.2 ppm and an extraordinarily low calcium content of less than 0.2 ppm. Photosynthesis and respiration are not measurable by the light and dark bottle method (C. E. Boyd, unpubl. data).

Most of the turtles were collected in baited swim-in traps (Gibbons, 1968) or by hand. The traps were baited with pieces of largemouth bass (*Micropterus salmoides*), enclosed in glass bottles with holes punched in the top; this prevented the captured turtles from eating the bait. The swim-in traps were not effective in catching one or two-year turtles; most of these were collected with dipnets or by hand from a boat. A basking trap constructed of hardware cloth with several ramps leading to a collection container was also used. This method yielded a few small turtles.

Traps were checked daily and specimens removed and brought at once to the laboratory. Body weight and plastron and carapace length were taken before the turtles were killed for dissection. The contents of the

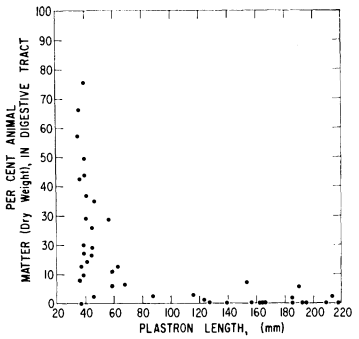

Fig. 1. Relationship between degree of carnivorousness and body size of *Pseudemys scripta* from a population on the Savannah River Plant in South Carolina.

stomach, small intestine and colon were analyzed separately and separated into plant and animal portions. The wet weight of each portion was recorded. Dry weight was taken after each sample had been oven-dried at 60° C.

An analysis of the amount of calcium in the shell and in the contents of the digestive tract was made to determine if a relationship existed between calcium concentration and diet. The shells of 23 turtles were oven-dried at 60° C for one week. Two 0.2 g pieces of shell were removed from the carapace, two others from the plastron. No particular area of the shell was selected although the yolk scar area in juveniles was avoided. Each 0.2 g sample was digested by immersion in 10 ml of 70% perchloric acid ($HClO_4$) and 10 ml of hydrogen peroxide (H_2O_2) prior to autoclaving for 30 min. Calcium concentrations were determined on an Atomic Absorbtion Spectrophotometer. Samples from the digestive tract were treated similarly.

Discussion of Results

A definite shift in diet occurs from young to older turtles (Fig. 1), the juveniles being more variable in their diet and more carnivorous. This carnivorousness extends into the second year (the 25 turtles below 64 mm in plastron length were either in their first or second growing season). The diet of first year turtles apparently changed over the course of a summer (Fig. 2; $r = .46$ with 20 df), thus accounting for much of the variability of the juvenile diet. Decreasing carnivorousness apparently occurs during the first year of growth. Not enough second-year turtles were collected to run similar analyses.

The reason for the decreasing carnivorousness during the summer is presently unknown. Insect food material may have been less abundant in the latter part of the summer, or more difficult to obtain. The lack of carnivorousness in the adults even in early summer, indicates an apparent preference for plant material under the particular conditions.

The evidence indicates that very young turtles are active carnivores in the early summer as they subsist on animal food (which must be pursued) rather than on the avail-

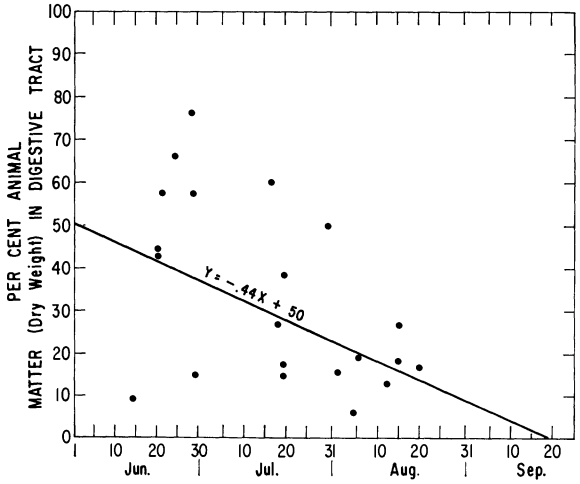

Fig. 2. Seasonal change in degree of carnivorousness by first year *Pseudemys scripta* from a population on the Savannah River Plant in South Carolina.

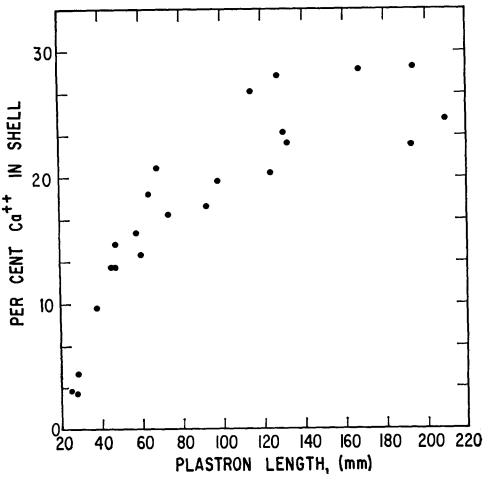

Fig. 3. Relationship between amount of calcium in shell and body size of *Pseudemys scripta* from a population on the Savannah River Plant in South Carolina.

able plant food. Adults, although generally herbivorous, are opportunistic carnivores, that is, they will eat animal food when it can be easily obtained. This was demonstrated both by the capture of adults in bait traps and by preliminary laboratory experiments which showed that adult *P. scripta* in captivity will unhesitatingly eat dead fish.

A possible explanation for the juvenile dietary shift during the summer is that easily obtained plant food satisfied all dietary requirements at the end of the summer whereas it did not at the beginning. This idea is substantiated by preliminary chemical analyses, which indicate that calcium levels in foods and shells may be related to dietary change. Calcium levels were significantly higher ($t = 2.1$; $df = 48$) in animal food ($\bar{x} = 4.8\%$ dry weight) taken from dissected turtles than in plant food ($\bar{x} = 0.7\%$). As *E. aciculatis* was the sole vascular plant ingested by the turtles, the latter determination agrees closely with the calcium value of 0.53% obtained for the plant species in a nearby aquatic area (C. E. Boyd, unpubl. data). Calcium levels in shells increased significantly with increasing size in the turtles (Fig. 3).

A relationship between low calcium shells in juveniles and high calcium shells in adults suggests an interesting hypothesis. During the first two years a turtle increases the calcium percentage in its shell. As increased calcium levels are equivalent to increased shell hardness, young turtles that receive the highest per cent calcium would have the hardest shells. Since the water in the Twin Ponds is low in calcium, an increase in body calcium could be accomplished most effectively by eating calcium-rich food. A calcium-rich carnivorous diet would thus be selectively advantageous.

As the carnivorous diet in juvenile *P. scripta* consists almost entirely of small insects, there is a point at which it is no longer energetically possible for larger turtles to satisfy their dietary requirements. Selection would thus favor a change to the more readily available but calcium-poor plant food.

Further study will be necessary to carefully define the relationships between calcium and diet in *P. scripta*. Also, the pattern shown by calcium may be followed by other dietary properties such as calories, proteins, vitamins or other minerals. Studies are presently in progress to determine if one or more of these features of diet may also be associated with the dietary shift.

Acknowledgments

We thank Gus Chelton, Debby Grosser, Jim McClearen and Larry Wright for field assistance. Dr. Michael Smith read the original manuscript. We particularly thank Dr. Claud E. Boyd for assistance in making the calcium analyses and for allowing us to refer to his data. This research was conducted under Atomic Energy Commission contract AT(38-1)-310 with the University of Georgia while the senior author was an undergraduate research trainee at the Savannah River Ecology Laboratory.

Literature Cited

Cagle, F. R. 1950. The life history of the slider turtle, *Pseudemys scripta troostii* (Holbrook). Ecol. Monogr. 20:32–54.

Carr, A. F. 1952. Handbook of turtles. Comstock Publ. Co., Ithaca, N. Y.

Gibbons, J. W. 1968. Population structure and survivorship in the painted turtle, *Chrysemys picta*. Copeia 1968(2):260–268.

Marchand, L. J. 1942. A contribution to a knowledge of the natural history of certain freshwater turtles. M. A. thesis. Univ. Fla. Gainesville, Fla.

Pope, C. H. 1939. Turtles of the United States and Canada. A. A. Knopf, New York.

Tinkle, D. W. 1958. The systematics and ecology of the *Sternothaerus carinatus* complex (Testudinata: Chelydridae). Tulane Stud. Zool. 6:1–56.

Savannah River Ecology Laboratory, SROO, P. O. Box A, Aiken, South Carolina 29801.