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The Relationship Between Pond Bottom Type and Growth Rate of Western Painted Turtles *Chrysemys picta belli* in Iowa, a Preliminary Report[1]

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ANTHONY J. QUINN & JAMES L. CHRISTIANSEN. The Relationship Between Pond Bottom Type and Growth Rate of Western Painted Turtles *Chrysemys picta belli* in Iowa, a Preliminary Report. *Proc. Iowa Acad. Sci.* 78(3-4):67-69, 1972.

SYNOPSIS. Several populations of western painted turtles (*Chrysemys picta belli*) were sampled during 1970 to determine the possible relationship between turtle growth rate and type of pond substrate. The populations sampled were selected because they existed in lentic habitats that had either highly organic, mud substrates or relatively inorganic, sand substrates. Age determinations based on plastral annuli showed turtles from highly organic substrates to grow more rapidly than those from substrates with less apparent organic matter. Females attained greater size than males in both habitat extremes.

INDEX DESCRIPTORS: *Chrysemys picta belli*, growth rate, bottom type.

During 1970 the authors undertook a study of the relationship between lentic substrates and growth rates of western painted turtles (*Chrysemys picta belli*) in Iowa. Previous studies of turtle growth demonstrate that growth rates vary from one geographic locality to another and from one individual to another in the same geographic locality (See Cagle, 1946 and Gibbons, 1967). Cagle (1946) suggested that average size of *Pseudemys scripta* varied from one population to another in Illinois because of population age and varying ecological factors such as water temperature and availability of food. He observed that juvenile growth was very great and that it was probably limited by ecological factors. Gibbons (1967) suggested that growth rate of painted turtles in Michigan, probably *C. picta marginata*, was limited by the quality rather than the quantity of food consumed, primarily by the amount of animal protein in the diet. Lagler (1943) and Knight and Gibbons (1968) found that plants and insects made up most of the diet of painted turtles in Michigan. They and others, also found large amounts of unidentified detritus in the stomachs of turtles but no correlation between either the amount of decayed detritus in the stomachs or in the habitat and turtle growth rates was found. The present study is designed to test the hypothesis that turtles from ponds with highly organic substrates possibly providing among other things a more nutritive detritus, may grow more rapidly than those from ponds with relatively little bottom organic matter.

METHODS

Bodies of water were chosen for sampling on the basis of amount of organic matter apparent in the bottom substrates. The substrates were either light colored sand with relatively little organic matter or dark colored mud mixed with considerable decaying organic matter. The sand habitats were abandoned gravel pits or strip mines. Bottom samples could easily be distinguished by settling rate. When mixed with an equal volume of water in a tall half-quart jar the solid material from sand habitats settled in ten minutes or less, leaving a slightly turbid decantate. Mud samples took more than one hour to settle when mixed in this way. Hach Kit tests were made for nitrates, nitrites, and phosphates as indicators of decaying organic matter. Secchi disk readings were taken to measure turbidity.

Localities with sand substrates from which turtles were taken were:

1. Three sand-bottomed ponds, south end Lake Aquabi, 6.5 mi. south Indianola, Warren Co., Iowa (7 specimens).
2. Four ponds, Banner Mines, ⅛ mi. east U.S. 65, 5½ mi. north Indianola, Warren Co., Iowa (11 specimens).
3. Three ponds, Monaghan Farm, ½ mi. north Iowa Hwy. 2, ¾ mi. east Missouri River, Fremont Co., Iowa (31 specimens).

Bodies of water with highly organic substrates were mud-bottomed ponds, swamps, or ditches. Bubbles of hydrogen sulphide were usually released when the substrates were disturbed, indicating a high degree of decay. Localities with organic substrates from which turtles were collected were as follows:

1. Two ponds, 4 mi. southwest Cummings exit from I. 35, Madison Co., Iowa (5 specimens).
2. Ditch, Riverton Game Area, 2¾ mi. west Riverton, Fremont Co., Iowa (14 specimens).
3. Ditch entering Missouri River, sampled ½ mi. south Iowa Hwy. 2, 1/8-1/4 mi. east Missouri River, Fremont Co., Iowa (3 specimens).

No ponds with intermediate conditions were used in the study. Only lentic habitats were used although a small sample was taken from a stagnant estuary not far from its junction with the Missouri River. All localities sampled were from southern Iowa.

Turtles were collected in hoopnet traps modified from the form described by Legler (1960). Canned sardines were used as bait. All specimens were preserved with the shell and most skeletal elements stored dry. Skins were fixed in 10% formalin and stored in alcohol. Internal organs were stored in 10% formalin for studies of stomach contents, parasites, and reproduction. Where possible, oviducal eggs were removed and hatched and the hatching records were retained. Complete locality data and dates of collection and sacrifice were attached to the specimens. All specimens are

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available for examination in the Drake Research Collection.

All carapace and plastral lengths were determined to the nearest mm. Age was determined by counts of annuli of the right abdominal scute as described by Sexton (1959). Mean plastral length was determined for hatchlings from three clutches of eggs removed from females collected during the study. These data were used in calculation of growth rate by the following formula:

$$\text{growth rate} = \frac{\text{Plastral length - mean hatchling plastral length}}{\text{age}}$$

RESULTS

The following results are based on examination of 71 turtles from the two environmental extremes described in the previous section; 31 were males and 40 were females.

The relationship between age and plastral length for turtles from the two habitats is shown in Figure 1. Turtles from bodies of water with highly organic (mud) substrate grow considerably more rapidly than those from ponds with relatively inorganic (sand) substrate. No turtles beyond age six from sandy habitats had grown as rapidly as those of the same age from mud habitats. It should be noted that specimens more than ten years old could not be aged accurately, and therefore are excluded from Figure 1.

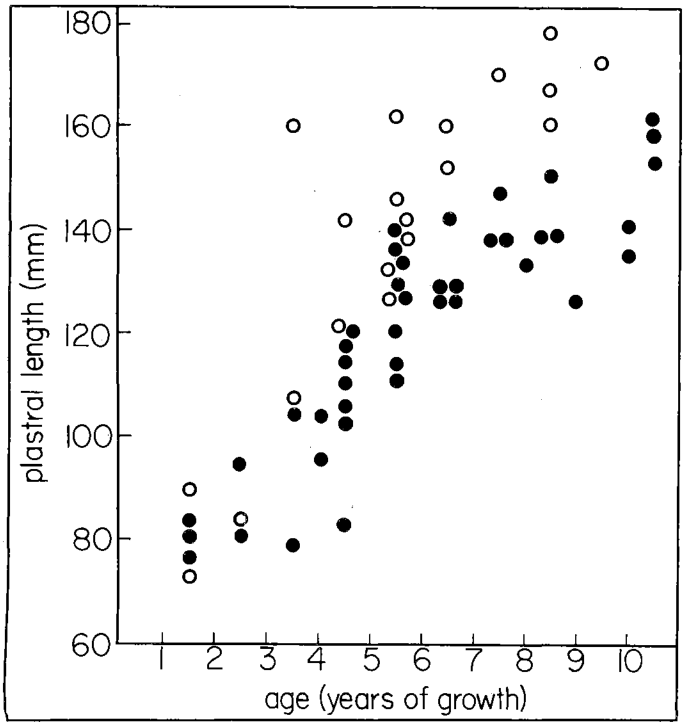

Fig. 1. Growth rates of western painted turtles (*Chrysemys picta belli*) from southern Iowa. Open circles represent specimens from lentic habitats with highly organic substrates; closed circles represent specimens from relatively inorganic substrates.

Many of the largest and oldest specimens are represented in Figure 2. This figure shows that the five largest females from mud substrates were all larger than the five largest females collected from sand substrates. Although three of the five largest males from mud habitats were larger than those from sand habitats, some overlap occurred. It is our opinion that this overlap resulted from sampling error because of the small sample size (10 individuals) from which the five largest males from mud habitats were selected. Figure 2 supports the observation of Gibbons (1967) that females attain larger sizes than males and show that this is true for both habitat extremes considered in the present study. A faster rate of growth has been observed for females than for males of several other turtle species (Cagle, 1946, for *Pseudemys scripta*, e.g.). The fact that both males and females are included in Figure 1 is partly responsible for the overlap in growth rates seen for years four and five.

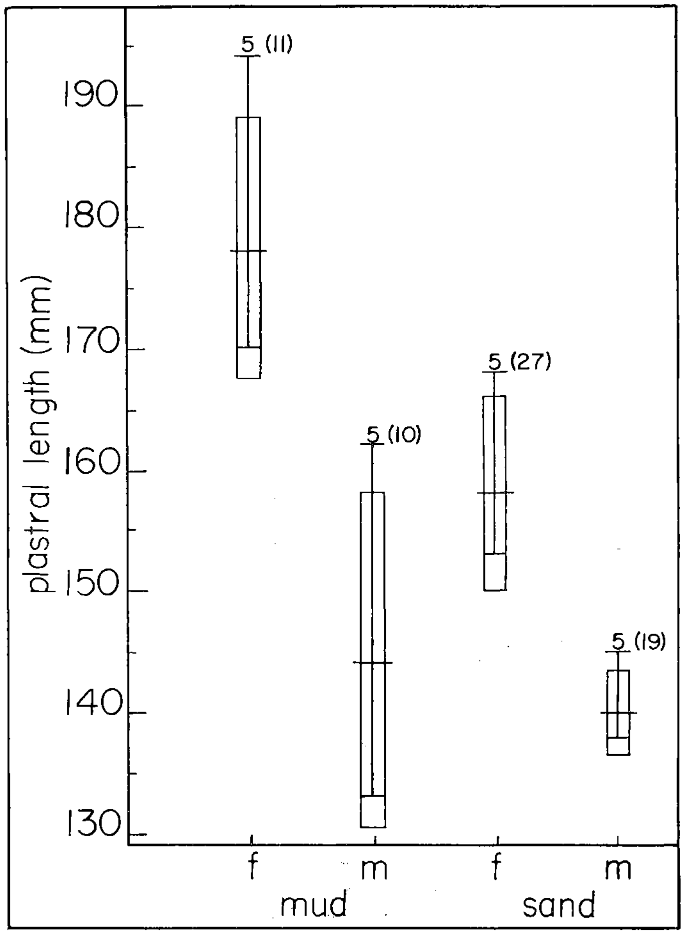

Fig. 2. Comparison of the five largest females (f) and the five largest males (m) from highly organic (mud) and relatively inorganic (sand) substrates. Numbers in parentheses show sample sizes from which the sets of five were selected. Vertical lines represent ranges, rectangles show 95% confidence limits, and horizontal lines in center of rectangles show means.

Gibbons (1967) showed that juvenile *C. picta* in southern Michigan grew more rapidly than adults. Our findings show this to be true in Iowa, and also indicate that growth rate slows as turtles age after they have attained maturity. Differences in growth rate for Iowa painted turtles of different ages are shown in Table 1. Age-correlated differences in growth rates are affected by the habitat extremes investigated. The data emphasize the importance of both age composition and habitat when comparing the size of turtles in different populations.

TABLE 1—GROWTH RATE OF PAINTED TURTLES (mm PER YEAR) FROM THE TWO HABITAT EXTREMES CONSIDERED IN THE STUDY. Rates were determined from turtles sacrificed in each age category; hence categories are not mutually exclusive.

		Age Categories *(Years of Growth)*			
Substrate		0.1-3.0 (n)	3.1-5.0 (n)	5.1-7.0(n)	7.1-10.5 (n)
Sand					
	Mean	26.4 (6)	18.4 (11)	17.1 (13)	13.3 (12)
	Range	22-2-29.3	11.5-22.7	15.5-19.1	11.0-16.2
Mud					
	Mean	32.7 (3)	27.3 (4)	21.0 (8)	16.7 (6)
	Range	23.4-43.1	21.2-38.5	18.5-24.8	14.7-19.3

No consistent differences in the concentration of several products of protein decomposition were observed. Concentrations of inorganic nitrates, nitrites, and phosphates varied only slightly and were not correlated with any other measurements. Secchi disk readings did vary consistently, however, and showed higher turbidity in water from mud habitats than from sand. Readings for water over mud substrates were 7-22 cm while those for water over sand substrates varied from 27 to 32 cm.

DISCUSSION

The fastest growth rates were found in populations from water with highly organic, mud, substrates and the slowest from ponds with relatively inorganic, sand substrates. Gibbons (1967) attributed growth rate differences in Michigan populations of painted turtles to diet, primarily the amount of animal matter consumed. He did not provide ecological reasons for these dietary differences. He suggested that dense vegetation might make it difficult for large turtles to locate animal food, thereby making consumption of less nutritive, plant food necessary, but major differences in the density of aquatic vegetation were not described among the areas where he found vastly different growth rates. In the present study, aquatic vegetation varied from one pond to another but the variation was not consistent with the observed differences in growth rate. We are inclined to tentatively accept the hypothesis that the amount of animal matter in the diet is a major factor in determining growth rate, pending further analysis of stomach contents.

Our observations of turtles searching for food both in the laboratory and in the field indicate that they spend much of their time eating benthic detritis. This material may be identified as to its plant or animal origin when it is removed from turtles' stomachs, but it should not be assumed that it was living at the time it was eaten. Bacterial decomposition of plant detritis may increase its nutritional value to turtles in the same way that bacterial action releases nutrients from plant material in ruminates. This hypothesis could be tested in the laboratory by feeding captive turtles varying amounts of fresh and decayed plant material, the latter allowed to decay under water.

That extensive decomposition of organic matter was taking place in the mud substrates we sampled was indicated by the bubbles of hydrogen sulphide released when the substrates were disturbed. Lack of correlation between available nitrogen and amount of apparent decaying organic matter might best be explained by assuming that the nitrogen was still bound to organic compounds rather than circulating as inorganic nitrates and nitrites. That the effect of a highly organic pond bottom on turtle growth might well function through increased production of certain aquatic insects with low dissolved oxygen requirements is understood. We wish only to point out that turtles feeding under these circumstances may also obtain a more nutritive detritus which may at least in part be responsible for a more rapid rate of growth.

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