first labial even with middle of naris; median loreal longer than anterior, about equal to posterior. In these and in other morphological features the specimen agrees well with near-topotypic examples (Nos. 19515-6, 1-3 mi. W. La Joya, Veracruz) and all differ consistently from *C. rozellae*. Yet in pattern No. 36130 is very distinctive, being uniform dark above except for a wide bluish line extending from the rostral through most of the length of the tail. The stripe occupies the middorsal scale row or its equivalent and, in the lumbar region, the edges of the adjacent rows; it gradually becomes narrower and less distinct distally on the tail.

Thamnophis sumichrasti fulvus (Bocourt)

A single adult female (No. 33665) from the region of Soconusco, Chiapas, collected 1944-49 by Eizi Matuda, completely lacks stripes and has only small flecks evident on either side of the middorsal line. This represents the first definite record of this subspecies from Mexico, although it has previously been thought to occur.

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Observations on the Feeding Habits and Growth of Immature Diamondback Terrapins

By J. FRANCES ALLEN AND ROBERT A. LITTLEFORD

Studies on the general biology and culture of the diamondback terrapin are in no sense new, since as early as 1906 Coker described in some detail the biology, feeding habits, and reproduction of this species. Additional information has been reported by Hildebrand (1929, 1932) and Hildebrand and Hatsel (1926).

As a result of the work noted above, the general features of the life cycle, growth, and feeding habits of this reptile are well known. However, no detailed studies of any particular phase of the biology of the diamondback terrapin are available. In order to fill some of the gaps in our specific knowledge, the present investigation of the feeding habits and growth of newly hatched terrapins was initiated.

The specimens used in this study were obtained from Beaufort, North Carolina, and represented a portion of a shipment of newly hatched terrapins delivered to the University for release in suitable habitats. A total of 875 individuals were observed during the period of this investigation. Unfortunately, many of these individuals were hybrids between *Malaclemys c. centrata* and *M. c. concentrica* (Hay 1905, Hildebrand 1933), thus the data presented cannot be said to apply specifically to either subspecies.

Rearing of diamondback terrapins under laboratory conditions poses problems with respect to sanitation, water supply, methods of feeding, and avoidance of the development of "soft shells." After considerable trial and error, during which all methods suggested by previous investigators were tried, the authors adopted a relatively simple plan for rearing the terrapins.

The terrapins were divided into groups of 20 and each group was

placed in a glass aquarium of 6 gallon capacity, which was equipped with a turtle adapter made of slate. Each aquarium measured 17½ by 9½ inches inside and was 9½ inches in heighth. Water having a salinity range of between 12 and 18 parts per thousand was collected from nearby areas of Chesapeake Bay and added to the aquaria. The water level in the aquaria was maintained so that approximately one-third of the sloping slate surface was covered at all times. The aquaria were cleaned weekly and each time a new supply of water was added. No attempt was made to provide facilities for hibernation, as one of the objectives of the study was to determine the extent of feeding and growth in a non-hibernating population. All experimental animals were kept in the laboratory, where the temperature range was between 20° and 26° C. inclusive.

The individual terrapins were marked for identification by the use of red nail polish, rather than paint, applied to selected plates of the carapace. This system afforded an identification which remained permanent for at least six months, was easily replaced, and did not result in injury to the animal or loss of the identification by obliteration (Cagle 1939, Hildebrand and Hatsel 1926).

The terrapins were fed three times a week and at each feeding were removed from the aquaria and placed in pans with water and food. After feeding, the terrapins were washed thoroughly and returned to the aquaria. All food was chopped as fine as possible and a sufficient quantity was available at each feeding so that some was left after all specimens had finished. This method had the advantage of allowing the smaller and apparently weaker specimens, that normally would be forced away from the food, an opportunity to feed.

The use of 2 inch square pieces of copper screen in the aquaria to prevent "sore tail" and "soft shell" diseases as recommended by Hildebrand and Prytherch (1947) was found to be totally ineffective. However, copper pennies served the same purpose very effectively, and it was observed that as the terrapins increased in size many of them would carry the pennies around the aquarium in their mouths. The method of rearing terrapins as described above proved highly effective in that cleanliness was easily maintained and disease was observed in less than 2% of the population.

OBSERVATIONS

Of the 875 terrapins started initially, 752 survived until the end of the first year. The remaining 123 died either because of a failure to feed or, in the case of 68 individuals, a failure to feed combined with the effects of a two day period when the temperature in the laboratory rose to 32° Centigrade. It is of interest to note that this high temperature did not have a lethal effect upon the terrapins that had been feeding.

In order to determine food preferences of the terrapin, the following items were offered: crabs, oysters, clams, marsh snails, mussels, fresh fish, canned fish such as tuna and salmon, liver, and beef. At the outset, the terrapins accepted all of these items without any discrimination. After three weeks of feeding, however, the tuna and salmon were refused and the terrapins would go without eating rather than consume these items. Liver, likewise, proved to be unacceptable to the majority of the terrapins and the few that fed on this material showed a rather lethargic type of

behavior. On the other hand, liver could be substituted once every one or two months in any of the diets and was accepted by the terrapins.

As compared to the aforementioned foods, all terrapins showed a definite preference for fresh fish, crabs or crab meat, various shellfish, snails, and beef. Of these foods, shellfish and snails were preferred over fish, crabs, and beef. This observation supports the brief data of Coker (1906) who noted that fragments of *Littorina irrorata* and other gastropods were found in greatest abundance in the stomachs of 14 young terrapins captured in Beaufort Harbor. From these data, Coker concluded that *Littorina irrorata* was one of the chief sources of food of young terrapins under natural conditions. Contrary to the statement of Hildebrand and Prytherch (1947) that beef does not produce rapid growth and healthy animals, the 75 terrapins that were reared exclusively on a beef diet for three years showed the same rate of growth and at the same time appeared as healthy as, and more alert than, those reared on a mixed diet.

The observations on feeding of newly hatched terrapins show that they are rather indiscriminate in their initial feeding habits with respect to animal sources of food. After three weeks of feeding, however, they become more selective in their choice of food and will refuse items that are unpalatable. Moreover, food preferences are developed, and once these preferences become firmly established, it is extremely difficult to break the feeding pattern. The terrapins reared on a beef diet (raw steak and lean beef chopped fine), for example, consistently refused to accept any other type of food. Of the 875 terrapins observed, only 123 or 14.06% failed to feed. This indicates that the majority of newly hatched terrapins are able to feed without undergoing a period of hibernation.

In order to investigate the rate of growth of young terrapins, 200 individuals were reared on a mixed diet consisting of fresh fish; clams, *Mya arenaria, Tagelus plebeius,* and *Venus mercenaria*; oysters, *Crassostrea virginica*; and snails, *Littorina irrorata,* and *Melampus b. lineatus.* A definite feeding routine was established in which fish, clams, oysters, and snails were fed regularly in that order. At the end of the first year, the number of terrapins was reduced to 100 because of the increase in size that had take place. At the end of the second year, the terrapins were released, as plans for moving the laboratory to another building would have resulted in an interruption of the observations. Significantly, no deaths occurred in this population.

The general summary of the data with respect to the increment of length and of weight is presented in Table I. Length was determined by measuring the plastron to the nearest tenth of a millimeter by the use of vernier calipers. All weights were made on an analytical balance. Since the young terrapins arrived initially in late September, all measurements and weights were made on October 1 of each year.

TABLE I. Length and Weight Increments of Diamondback Terrapins Through Two Years of Age

Year	Number of Terrapins	Length in MM. Range	Length in MM. Average	Weight in Grams Range	Weight in Grams Average
Initial	200	27.1–32.8	30.65	4.40– 7.85	6.485
End of 1st yr.	200	59.5–65.5	61.93	75.20– 95.80	81.83
End of 2nd yr.	100	68.5–95.7	89.63	134.60–153.70	143.08

The data presented in Table I show that the average initial length of the terrapins was 30.65 mm. At the end of the first year of growth, the length range extended from 59.5 through 65.5 mm., with an average length of 61.93 mm. An average increment of length of 31.28 mm. is reported for the first year's growth. These results compare with those reported by Hildebrand and his associates for growth of young terrapins reared under different conditions and are slightly higher than those reported by Coker (1906) from measurements of captured individuals. Growth during the second year was somewhat less than that in the first year, in that the average length of the terrapins at this time was 89.63 mm., an average increase of 27.70 mm. in length as compared to 31.28 mm. for the first year of growth.

Increase in weight, as would be expected, showed the same trend as that of length. By the end of the first year, an average weight increase of 74.345 grams was observed. This may be compared to an average increase of 61.25 grams during the second year of growth.

In conclusion, it may be pointed out that, under clean conditions, terrapins will grow as rapidly and survive as well under laboratory conditions as under natural conditions. The young terrapins are indiscriminate in their initial feeding habits, but rapidly develop food preferences that are difficult to break. Reared on a diet of fresh fish, shellfish, and snails, individuals in the laboratory showed growth just as rapid as that taking place under natural circumstances.

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