BULLETIN OF MARINE SCIENCE, 30(4): 909–912, 1980

GROWTH OF CAPTIVE HAWKSBILL TURTLES, *ERETMOCHELYS IMBRICATA*, IN WESTERN SAMOA

W. N. Witzell

ABSTRACT—Growth rates of captive hawksbill turtles were computed by the Von Bertalanffy growth equation. Carapace length plotted as a relationship against carapace width, plastron length, head width, and eye width illustrated isometric growth for body and allometric growth for head relationships. Better designed growth studies and uniform analysis of growth data are urged for population comparisons by analysis of covariance techniques.

Age and growth studies of the hawksbill turtle have been limited to sporadic measurements at known age over short time periods (Schmidt, 1916; Hornell, 1927; Deraniyagala, 1939; Caldwell, 1962; Harrisson, 1963; Kaufmann, 1967; 1972; 1975; Diamond, 1976). An incomplete attempt at morphometric analysis has been reported by Hughes (1974) for South African hawksbill populations at unknown age.

Although tagging is often the preferred method used for studying age and growth of marine animals, information derived from captive specimens in controlled experiments can offer some insight into the growth and maturation of hawksbill turtles, though caution must be used when drawing definitive analogous conclusions with wild turtle populations. This study of hawksbill growth in captivity was incidental to an ongoing conservation program (Witzell, 1972; 1974) and not a primary research objective. Therefore, this growth study does not closely resemble wild growth conditions and the sample size is somewhat inadequate.

MATERIALS AND METHODS

A group of 95 neonate hawksbill turtles, incubated in a transplanted nest, were placed in one of several concrete rearing tanks, approximately 1.22 × 1.22 × 0.30 m, for growth studies. For the first 18 weeks six turtles were selected at random every week and measured. When the turtles reached 32 weeks of age, six were selected and placed in one of two concrete tanks, approximately 3.66 × 3.66 × 0.46 m, for monthly measurements until 84 weeks old. Two turtles, which best exemplified the mean growth rate of the siblings, were then selected for continued measurements until they reached 128 weeks of age.

The tanks were located in a metal-roofed shed with no walls. These tanks were drained daily, swept clean and refilled with fresh sea water from a portable gasoline powered pump; once a week they were scrubbed with a commercial antiseptic.

The turtles were fed varying amounts of food, averaging approximately 5% of their body weight, at irregular intervals three to four times per week. To further simulate natural feeding conditions, the turtles were never fed to satiation. The diet consisted of various species of fish, jelly fish, razor clams, and sea urchins. A marine angiosperm, *Syringodium isoetifolium*, was frequently added to the tanks, though very little was seen consumed.

Maximum straight line measurements in centimeters of five body parameters were taken using calipers. Although the individual measurements should be plotted in the following analysis, they were irretrievably lost and the mean values of these measurements are plotted instead. Measurements of two adult male hawksbills of unknown age were also plotted with the captive data.

RESULTS AND DISCUSSION

The mean carapace lengths of the turtles reared in captivity are plotted by weekly increments (Figure 1). A Von Bertalanffy growth curve was fitted by computer as described by Fabens (1965), omitting the first 52 weeks of data.

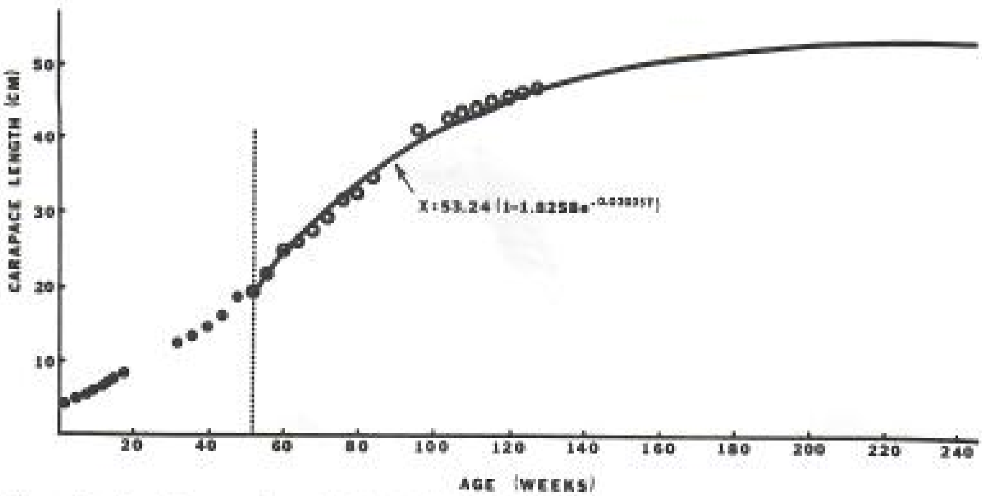

Figure 1. Growth curve of captive hawksbills plotted in weekly increments.

A point near the asymptote should equal the minimum size of reproductively mature turtles, assuming that hawksbills essentially stop growing after reaching sexual maturity as occurs in other marine turtle species (Carr and Goodman, 1970; Hughes, 1974). The growth curve presented here indicates that these turtles mature at about 50 cm and 3.5 years old. However, the minimum nesting size reported for Samoan hawksbills is 60 cm (Witzell and Banner, 1980), which indicates that the Samoan turtles either grow faster in their natural habitat or mature at considerably older ages; neither of which intuitively appear correct. This seemingly low value for minimum reproductive size derived from the Von Bertalanffy curve could be caused by several factors, the lack of sufficient data over a longer time span being the most critical. The last few points, which strongly influence the asymptote of the growth curve, could reflect premature slowing of the turtles growth rate due to some metabolic deficiency as a result of their being

Table 1. Size at maturity for various hawksbill turtle populations

	Minimum Nesting Size (cm)	Maximum Nesting Size (cm)	Average Nesting Size (cm)	Sample Size
South Yemen Hirth & Carr (1970)	63.5	72.4	69.4	15
Sudan Hirth & Latif (1980)	53.3	73.7	66.0	42
Western Samoa Witzell & Banner	60.0	73.5	68.6	7
Solomon Islands McKeown (1977)	69.5	89.0	82.7	40
Costa Rica Carr, Hirth & Ogren (1966)	74.9	91.4	83.1	62
Guyana Prichard (1969)	80.0	88.9	83.8	23

Table 2. Morphometric relationships between four body parameters and carapace length (CL), the data also plotted as a percentage of carapace length

	Relationship to Carapace Length	Coefficient of Determination
Carapace Width	$Y = 1.473 + 0.724X$	0.99
% CL	$Y = 81.191 - 0.092X$	0.58
Plastron Length	$Y = 1.446 + 0.693X$	0.99
% CL	$Y = 81.133 - 0.148X$	0.92
Head Width	$Y = 0.775 + 0.135X$	0.99
% CL	$Y = 40.418 - 6.565 \log_e X$	0.86
Eye Width	$Y = 0.404 + 0.035X$	0.97
% CL	$Y = 14.871 - 2.702 \log_e X$	0.90

held in captivity. Another factor could be the differences in growth rates which vary between siblings and possibly sexes, thereby reaching maturity at different sizes.

The literature reports the possible ecological reasons for the varying average sizes at maturity between different nesting populations of green and loggerhead turtles (Carr and Goodman, 1970; Hughes, 1974). Similar differences in the average and minimum nesting sizes also seem to exist between different nesting populations of hawksbills (Table 1). However, more extensive studies are needed at all known hawksbill rookeries before definitive comparative statements can be made between the various nesting populations.

The relationship between carapace length and four other body measurements at known age were plotted and yielded linear relationships (Table 2). Weight, because of its extreme variability, is an unreliable parameter and not utilized in this paper.

Literature Cited

Caldwell, D. K. 1962. Growth measurements of young captive Atlantic sea turtles in temperate waters. Contrib. Sci. Los Ang. Cty. Mus. 50: 8 pp.

Carr, A., and D. Goodman. 1970. Ecologic implications of size and growth in *Chelonia*. Copeia 1970: 783–786.

———, H. Hirth, and L. Ogren. 1966. The ecology and migrations of sea turtles. 6. The hawksbill turtle in the Caribbean Sea. Am. Mus. Novit. (2248): 29 pp.

Deraniyagala, P. E. P. 1939. The tetrapod reptiles of Ceylon. Colombo, Colombo Museum. 412 pp.

Diamond, A. W. 1976. Breeding biology and conservation of hawksbill turtles, *Eretmochelys imbricata* L., on Cousin Island, Seychelles. Biol. Conserv. 9: 199–215.

Fabens, A. J. 1965. Properties and fitting of the Von Bertalanffy growth curve. Growth (29): 265–289.

Harrisson, T. 1963. Notes on marine turtles: 13—growth rate of the hawksbill. Sarawak Mus. J. 11: 302–303.

Hirth, H., and A. Carr. 1970. The green turtle in the Gulf of Aden and the Seychelles Islands. Verh. K. Ned. Akad. Wet. 58: 44 pp.

———, and E. Latif. 1980. A nesting colony of the hawksbill turtle *Eretmochelys imbricata* on Seil Ada Kebir Island, Suakin Archipelago, Sudan. Biol. Conserv. 17: 125–130.

Hornell, J. 1927. The turtle fisheries of the Seychelles Islands. London, HMSO. 55 pp.

Hughes, G. R. 1974. The sea turtles of south-east Africa. I. Status, morphology and distributions. Invest. Rep. Oceanogr. Res. Inst. 35: 144 pp.

Kaufmann, R. 1967. Wachstumsraten in Gefangenschaft gehaltener Meeresschildkroten. Mitt. Inst. Colombo-Aleman Invest. Cient. 1: 65–72.

———. 1972. Wachstumsraten in Gefangenschaft gehaltener Meeresschildkroten. II. Mitt. Inst. Colombo-Aleman Invest. Cient. 6: 105–112.

———. 1975. Observaciones sobre el crecimiento de tortugas marinas en cautividad. Caldasia 11: 139–150.
McKeown, A. 1977. Marine turtles of the Solomon Islands. Ministry of Natural Resources, Fisheries Division, Honiara. 50 pp.
Prichard, P. 1969. Sea turtles of the Guianas. Bull. Fla. St. Mus. 13: 85–140.
Schmidt, J. 1916. Marking experiments with turtles in the Danish West Indies. Meddr. Kommn. Havunders. (Ser. Fisk.) 5: 26 pp.
Witzell, W. N. 1972. To live or not to live. Int. Turtle Tortoise Soc. J. 6: 32–35.
———. 1974. The conservation of the hawksbill turtle in Western Samoa. South Pac. Bull. 24: 33–36.
———, and A. C. Banner. 1980. The hawksbill turtle, *Eretmochelys imbricata*, in Western Samoa. Bull. Mar. Sci. 30: 571–579.

DATE ACCEPTED: May 5, 1980.

ADDRESS: *Fisheries Division, Western Samoa.* PRESENT ADDRESS: *National Marine Fisheries Service, Southeast Fisheries Center, 75 Virginia Beach Drive, Miami, Florida 33149.*

BULLETIN OF MARINE SCIENCE, 30(4): 912–914, 1980

NEW RECORD OF *AEGA MONOPHTHALMA* JOHNSTON (ISOPODA: FLABELLIFERA: AEGIDAE) IN THE TROPICAL WESTERN ATLANTIC

Sara-Ann F. Treat

ABSTRACT—The isopod *Aega monophthalma* Johnston 1834 is reported for the first time from the tropical western Atlantic at Cay Sal Bank, Bahamas. The previously known distribution included the eastern and northern Atlantic.

An adult male specimen of *Aega monophthalma* Johnston 1834 was obtained from a depth of 460 m at Cay Sal Bank, Bahamas, in May 1978. Prior to 1900, this species had been reported from Iceland, the Shetland Islands, Britain and Norway (Barnard, 1914). In 1901 a juvenile male specimen was discovered in deep waters off the South African coast (Barnard, 1914); subsequently, the species was reported from Denmark and Sweden (Stephensen, 1948). The most recent reference to the species was that of Dollfus (1953) who listed *A. monophthalma* among the parasites of the arctic Atlantic cod *Gadus callarias* L. Other authors have stated that the cod and shark are the usual hosts of this ectoparasitic species (Schioedte and Meinert, 1879; Sars, 1899). No record of the occurrence of *A. monophthalma* in the tropical western Atlantic has been found, although Richardson (1904) did note sporadic records of similar northeastern Atlantic taxa from the eastern coast of the United States and as far south as the West Indies.

Aega monophthalma was discussed by Bate and Westwood (1868) and was included in the review of the family Cymothoidae by Schioedte and Meinert (1879). The species was also included in Sars' (1899) account of the Crustacea of Norway. Barnard (1914) described the South African specimen in detail: Stephensen (1948) gave a brief description in his review of Danish fauna. Barnard's description was particularly detailed because ". . . the discovery of this northern form off the South African coast bears on the interesting question of Bipolarity" (Barnard, 1914, p. 365). The mouthparts, second pereopod, and partial ventral view of the cephalon (showing first and second antennae, and frontal lamina)