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# GROWTH CURVE FOR CAPTIVE -REARED GREEN SEA TURTLES, *CHELONIA MYDAS*

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ABSTRACT

Growth of the captive- reared green sea turtle, *Chelonia mydas*, fits a logistic by weight growth equation reaching an asymptotic weight at approximately 12.5 years with an average weight of 156 kg. The relationship of weight to carapace length and width is inter-dependent with age and size of the turtle. Mean age at sexual maturity for the captive green turtle is estimated at 16 years, and it is projected that 96% of a captive population would begin nesting at 25 years of age. Although growth of mature green turtles reaches an asymptote at 12.5 years, captive, mature green turtles continue to increase in weight at a rate of 3 kg/yr.

## INTRODUCTION

Cayman Turtle Farm, Cayman Islands, British West Indies, has cultured the green sea turtle *Chelonia mydas* for 25 years. During this period of time, culture techniques have been refined and improved to obtain optimum growth and health of the herd based upon physical and economic parameters. Since 1980, a proportion of the production of the Farm has been released into the waters surrounding the Cayman Islands. Ongoing tag and recapture programmes of the Farm monitor the success of the release programme. An important aspect of this works lies in the comparison of the growth of the released turtles with those maintained in captivity.

Several investigators have fitted data collected from natural populations to various growth equations (Frazer & Ehrhart, 1985; Bjorndal & Bolten, 1988; Frazer & Ladner, 1986). Growth rates and patterns from these investigations are based upon time interval growth data, since the absolute age of the turtles are unknown. In most instances, the size range of the turtles surveyed for any study area is restricted due to the use of the area by the population, i.e. as a feeding ground or breeding area. A complete growth model from hatching to adult for a sea turtle natural population is therefore not available.

Most commonly, growth data from natural populations has been fitted to either logistic or von Bertalanffy growth equations and on the basis of carapace length as compared to weight of the turtle. The age of sexual maturity for any sea turtle species is not clearly defined. Estimates range from 15-50 years for the green sea turtle and various factors appear to influence the projected age at sexual maturity (Groombridge, 1982).

## METHODS AND MATERIALS

Turtles at Cayman Turtle Farm, CTF, are maintained in tanks or an excavated pond (Wood, 1991). The turtles are moved through a series of tank sizes and stocking densities to facilitate feeding and handling. Tank size and stocking density increase with the size of the turtle. Hatchlings are kept in small, rectangular tanks with an approximate volume of 600 litres, while the older turtles are kept in circular tanks ranging in volume from 3,000 to 130,000 litres. Tanks are constructed of concrete block or fibreglass walls with concrete bottoms. Unfiltered sea water is pumped continuously into the tanks at an approximate exchange rate of one volume per 20 minutes. Average daily water temperature ranges from 27°C in January to 30°C in July.

Turtles are fed a floating, pelleted diet. Until the turtles are approximately one year old, they are fed a modified trout chow (Ralston Purina, St. Louis, MO) containing 40% crude protein, 8.0% crude fat and less than 5.0% crude fibre. Older turtles, including the breeding herd, are fed turtle chow (Ralston Purina, St. Louis, MO) containing 35% crude protein, 3.5% crude fat, and less than 5.0% crude fibre. Feed conversion varies from 1.2 to 6.5 units of diet as fed to unit of body weight gain, increasing with the size of the turtle. The hatchlings are fed *ad libitum* while the growing stock over one year of age is fed a regulated daily ration decreasing from 2.0% body weight per day to 0.4% as the turtles grow.

The majority of the size data represented in this paper is the accumulation of stock records collected by CTF personnel under working conditions. The English measuring system is routinely used in the CTF operation. Consequently, in describing the methodology, the English units will be used as applicable. In analysis of the data, data are converted into metric units for presentation. Breeders are weighed individually in February with a commercial, crane mounted scale weighing to within one pound. The curved carapace length, CCL, (from the leading edge of the nuchal scute to the notch between the two supracaudals) and curved carapace width, CCW, (as measured at the widest part of the carapace from the edge of the marginals) are measured with a fibreglass sewing tape to the nearest 0.5 inch.

Periodically, tanks of turtles are weighed to assess the growth of the herd. Any given tank will hold turtles from one age class. As hatching occurs from June through November, the age range within a tank may vary within 6 months. However, 70-80% of the turtles are within two months of age, and the age of each age class is based on the month of hatch of the majority of the group. Turtles within the tank are weighed several at a time and total weight for the tank is used to obtain an average weight per turtle. Farm weight data from May 1985 through October 1990 were used for turtles ranging in age from 5 months to 63 months, as feeding and stocking parameters were constant during this time period.

Weights of turtles less than five months were based on individual weights of hatchlings, weighed to the nearest 0.1 g.

For comparison of straight line versus curved carapace measurements, straight line carapace length, SCL, (from the leading edge of the nuchal scute to the notch between the supracaudals) and the straight line carapace width, SCW, (as measured at the widest part of the carapace from the edge of the marginals) were measured with callipers to the nearest 1/8 inch.

Individual weights (to the nearest ounce) and SCL, CCL, SCW, and CCW (to the nearest 1/8 inch) were measured for turtles from 5 age classes for the comparison of weight versus length/width measurements within age classes. With repetitive measurements, accuracy of the measurements was estimated to be ±4% (2% error in callipers or scales and 2% error in reproducibility).

Size data are fitted to two growth equations commonly used to describe animal growth (Kaufman, 1981) and which appear to represent empirical data for the green sea turtle. The logistic growth equation is of the general form (Mead & Curnow, 1983):

$$Y = A/(1+Be^{-kt}) \qquad (1)$$

The von Bertalanffy growth equation is of the general form (Fabens, 1965):

$$Y = A(1-Be^{-kt}) \qquad (2)$$

In both equations $Y$ represents size; $A$, size at the asymptotic value; $B$, parameter related to size at birth; $e$, base of natural logarithm; $k$, constant rate of growth; $t$, time.

Statistical procedures were done on an IBM compatible computer utilising a commercially available software package (Statgraphics, Statistical Graphics Corporation, Rockville, MD). Nonlinear regression analysis is based upon the procedure developed by Marquardt (1963) to determine the estimate that minimises the residual sum of squares.

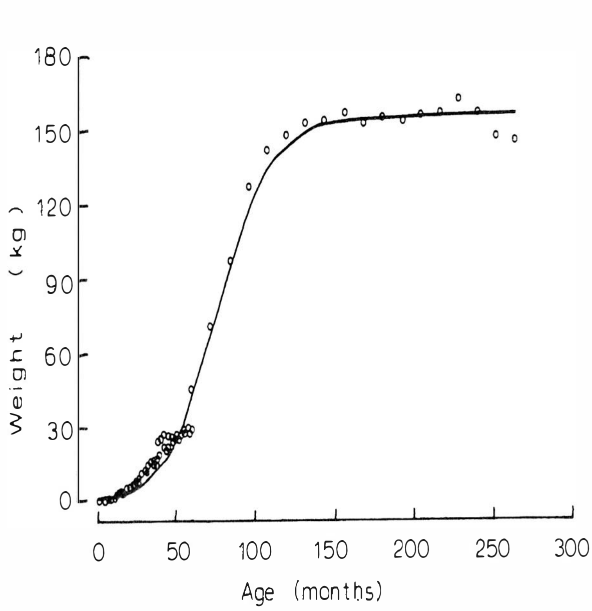


Fig. 1. Logistic by weight growth curve for the captive reared green sea turtle. Circles represent average weight (kg) for each age class (total $N$ for all age classes=127,782). Solid line represents fitted non-linear regression line.

| Source | *SS* | df | *MS* | *F* |
|---|---|---|---|---|
| *Logistic:* | | | | |
| Mode | 1377450.96 | 3 | 125816.99 | 4750.65 * |
| Error | 1694.99 | 64 | 26.48 | |
| Total | 379145.95 | 67 | | |
| *von Bertalanffy:* | | | | |
| Model | 359561.93 | 3 | 119853.98 | 391.68 * |
| Error | 19584.02 | 64 | 306.00 | |
| Total | 379145.95 | 67 | | |

TABLE 1. Analysis of variance for the non-linear regression of logistic and von Bertalanffy growth equations for the green sea turtle (*$P$<.001).

| Variable | Weight (kg) | CCL (cm) | CCW (cm) |
|---|---|---|---|
| Average | 3.02 | 29.1 | 24.9 |
| SD | 0.92 | 3.2 | 2.9 |
| Range | 0.7-6.3 | 18-38 | 13-36 |
| Coeff. of Var. | 30.6 | 11.1 | 11.6 |

TABLE 2. Size data for 1202, 14 month old green sea turtles.

Analysis of variance utilises the least squares approach to estimate the regression and ANOVA. The Student-Newman-Keuls method was used for multi-range tests.

## RESULTS

Fig. 1 shows the growth curve generated using a logistic by weight equation with the equation:

$$Y = 156/(1+105e^{-0.060t}) \qquad (3)$$

Table 1 compares the ANOVA for the regression of the data utilising both the logistic and von Bertalanffy equation as both equations have been used in analysis of growth data for sea turtle populations. Each point in Fig. 1 at any given age represents average weight for turtles of that age. Sample size ranges from 8 to 8505 per age class with an average sample size for age class of 1907±2212. No data are presented for the variance in weight within each age class as the majority of the data presented represents group weights as previously explained.

To appreciate the variance that is encountered among turtles of the same age, Table 2 presents data for a group of 14 month old turtles. Individuals of this particular group of turtles are within 30 days of the same age. The coefficient of variation clearly indicates that variability within weights (cv = 30.6) is substantially greater than that within lengths (cv = 11.1).

Table 3 presents weight, SCL, CCL, SCW, and CCW for groups of different age turtles. For the five age groups of immature turtles each sample represents a known age group. For the sample of mature turtles, the sample includes known age, as well as unknown age, turtles, but all are sexually mature.

| | Weight (kg) | CCL (cm) | CCW (cm) | SCL (cm) | SCW (cm) |
|---|---|---|---|---|---|
| Age = 8 months. $N$ = 2 5 | | | | | |
| Mean | 1.63 | 23.3 | 20.1 | 22.4 | 18.8 |
| SD | 0.33 | 1.5 | 1.3 | 1.4 | 1.5 |
| Range | 1.08-2.22 | 21.0-26.0 | 17.8-22.2 | 19.7-25.4 | 16.2-21.9 |
| Coeff. of Var. | 20.2 | 6.3 | 6.4 | 6.5 | 8.0 |
| Age = 20 months. $N$ = 20 | | | | | |
| Mean | 5.9 | 36.4 | 31.4 | 34.9 | 28.8 |
| SD | 1.76 | 3.6 | 2.7 | 3.3 | 2.5 |
| Range | 3.61-10.31 | 31.4-44.1 | 26.7-36.8 | 29.5-42.2 | 24.4-3 .3 |
| Coeff. of Var. | 29.9 | 10.0 | 8.6 | 9.5 | 8.7 |
| Age = 32 months. $N$ = 20 | | | | | |
| Mean | 8.68 | 42.1 | 36.3 | 40.1 | 32.8 |
| SD | 2.37 | 4.3 | 3.4 | 4.1 | 3.7 |
| Range | 5.09-13.66 | 33.7-50.2 | 21.4-43.2 | 32.1-47.3 | 26.4-39.1 |
| Coeff. of Var. | 27.3 | 10.1 | 9.2 | 10.2 | 11.2 |
| Age = 44 months. $N$ = 20 | | | | | |
| Mean | 24.6 | 59.5 | 52.3 | 55.7 | 44.1 |
| SD | 10.0 | 7.3 | 6.5 | 7.2 | 5.7 |
| Range | 12.7-46.8 | 48.6-73.4 | 43.5-63.8 | 43.2-68.3 | 34.3-54.3 |
| Coeff. of Var. | 40.6 | 12.3 | 12.5 | 13.0 | 13.0 |
| Age = 56 months. $N$ = 20 | | | | | |
| Mean | 26.7 | 60.6 | 53.5 | 55.4 | 45.6 |
| SD | 12.4 | 9.0 | 8.4 | 8.0 | 7.2 |
| Range | 11.4-52.3 | 46.0-77.8 | 40.9-68.9 | 41.9-69.9 | 33.7-57.9 |
| Coeff. of Var. | 46.3 | 14.9 | 15.7 | 14.5 | 15.8 |
| Mature Breeders. $N$ = 219 | | | | | |
| Mean | 146.2 | 102.6 | 90.6 | 96.2 | 72.5 |
| SD | 25.6 | 5.5 | 6.4 | 4.6 | 4.2 |
| Range | 8.7-227.7 | 86.4-114.3 | 74.9-106.7 | 81.3-105.4 | 61.0-82.5 |
| Coeff.of Var. | 17.5 | 5.3 | 7.1 | 4.8 | 5.8 |

TABLE 3. Weight. CCL. CCW. SCL. and SCW for six age classes of green turtles.

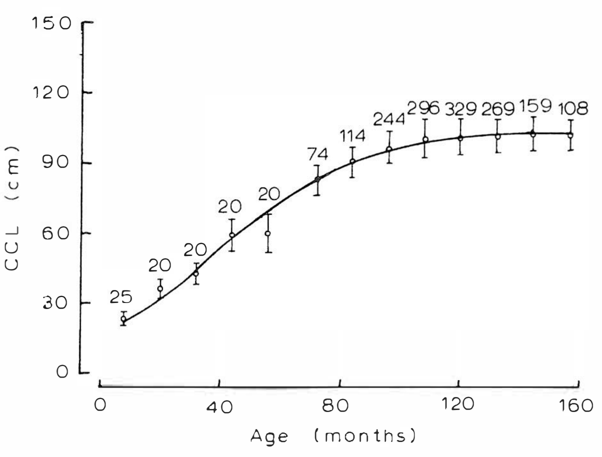


Fig. 2. Logistic by length growth curve for the captive green sea turtle. Mean curved carapace length. CCL (cm). ±SD represented by circles with bars for turtles within an age class. Number of turtles in each age class given above mean (total $N$ for all age classes=1.698). Solid line represents fitted non-linear regression line.

Within each sample group. the greatest variability for the size measurement occurs in weight with measurement of carapace size, SCL, CCL, SCW, and CCW, showing similar variability.

The relationships between the different carapace measurements and weight are expressed as ratios in Table 4. An analysis of variance among age classes shows a significant difference ($P<.001$) for each relationship. except CCW to CCL. A Student-Newman-Keuls analysis is used to determine significant differences between means as noted in Table 4. The most obvious correlation is noted in the ratio of weight to either length or width. which increases with increasing size and age.

Using available size measurements for the five groups of immature turtles represented in Table 3 and for older turtles of known age. the CCL and weight can be fitted to a logistic growth equation. as shown in Fig. 2. which includes individual data points. The length data fits the logistic by length equation:

$$Y = 104/(1+52.8e^{-0.064t}) \quad (4)$$

| | Ratio SCL/CCL | Weight/CCL | CCW/CCL | SCW/CCW | Weight/CCW |
|---|---|---|---|---|---|
| Age Class | | | | | |
| 8 months | .962 ± .029$^{c}$ | .069 ± .010$^{a}$ | .862 ± .020$^{a}$ | .938 ± .036$^{d}$ | .081 ± .011$^{a}$ |
| 20 months | .956 ± .023$^{c}$ | .159 ± .030$^{a,b}$ | .864 ± .024$^{a}$ | .917 ± .038$^{c,d}$ | .185 ± .038$^{a,b}$ |
| 32 months | .951 ± .021$^{c}$ | .203 ± .037$^{b}$ | .864 ± .037$^{a}$ | .903 ± .045$^{c}$ | .235 ± .046$^{b}$ |
| 44 months | .934 ± .031$^{b}$ | .401 ± .113$^{c}$ | .878 ± .019$^{a}$ | .843 ± .045$^{b}$ | .456 ± .127$^{c}$ |
| 56 months | .914 ± .037$^{a}$ | .424 ± .131$^{c}$ | .883 ± .041$^{a}$ | .855 ± .076$^{b}$ | .479 ± .144$^{c}$ |
| Breeders | .938 ± .018$^{b}$ | 1.42 ± 0.20$^{d}$ | .883 ± .040$^{a}$ | .802 ± .039$^{a}$ | 1.61 ± 0.24$^{d}$ |

TABLE 4. Relationship of carapace measurements and weights among age classes. Means ±SD that are significantly different ($P$<0.05) for a given relationship have different superscripts (ANOVA, Student-Newman-Keuls multiple range test).

| | Weight (kg) | CCL (cm) | CCW (cm) |
|---|---|---|---|
| Mean | 151 | 101 | 86 |
| SD | 32 | 7.4 | 6.4 |
| Minimum | 80 | 81 | 69 |
| Maximum | 232 | 119 | 102 |

TABLE 5. Size of 80 captive reared green sea turtles for the first nesting season.

The weight data for the same turtles fit the logistic by weight equation:

$$Y = 157/(1+119e^{-0.064t}) \qquad (5)$$

Table 5 shows the average size at which 80 females began nesting. The range is considerable, varying from 84 to 232 kg and 82 to 119 cm (CCL). Comparing the size of these females in years prior to and following first nesting in Table 6, there is a continued pattern of growth following maturity, although at a much lesser rate, in keeping with the growth curve of Fig. 1. The percentage change in length after maturity is less than the percentage change in weight after maturity. Assuming a linear relationship for the narrow range prior to and following maturity, the percent change in weight is 4.7%/yr and 1.3%/yr prior to and after first nesting, respectively. This compares to 1.7%/yr and 0.3%/yr for percent change in length. Table 7 shows a similar pattern of increased size for 1647 female seasons for CTF's stock of females which were obtained as mature adults. The linear regression of weight versus subsequent season following first observed nesting shows an increase in weight of 3.1±0.2 kg/yr and an increase in length of 0.42±0.05 cm/yr. Respective coefficients of correlation are .957 and .917 for weight or length linear regression versus year, respectively.

There is no significant difference among ages for size at sexual maturity ($F$=1.024, $P$ = 0.42 and $F$=0.884, $P$ =0.51, respectively for weight and CCL) for the 59 known age females nesting for the first time. For these 59 known age

| Season | $N$ | Weight (kg) | SD (kg) | CCL (cm) | SD (cm) |
|---|---|---|---|---|---|
| 0 | 136 | 143 | 31$^{a}$ | 104.1 | 7.6$^{a}$ |
| 1 | 145 | 139 | 35$^{a}$ | 104.8 | 8.3$^{a}$ |
| 2 | 141 | 142 | 37$^{a}$ | 104.8 | 8.6$^{a}$ |
| 3 | 140 | 145 | 37$^{a}$ | 105.2 | 8.6$^{a}$ |
| 4 | 138 | 147 | 37$^{a,b}$ | 105.3 | 8.8$^{a}$ |
| 5 | 133 | 147 | 37$^{a,b}$ | 105.6 | 8.3$^{a}$ |
| 6 | 129 | 151 | 38$^{a,b}$ | 105.6 | 8.4$^{a}$ |
| 7 | 125 | 152 | 37$^{a,b}$ | 105.6 | 8.0$^{a}$ |
| 8 | 101 | 153 | 40$^{a,b}$ | 106.4 | 8.6$^{a,b}$ |
| 9 | 96 | 157 | 40$^{a,b,c}$ | 106.5 | 8.5$^{a,b}$ |
| 10 | 88 | 161 | 42$^{a,b,c}$ | 106.7 | 8.6$^{a,b}$ |
| 11 | 76 | 161 | 41$^{a,b,c}$ | 107.0 | 8.6$^{a,b}$ |
| 12 | 58 | 164 | 41$^{a,b,c}$ | 107.3 | 9.4$^{a,b}$ |
| 13 | 46 | 170 | 44$^{b,c,d}$ | 107.7 | 9.3$^{a,b}$ |
| 14 | 38 | 178 | 45$^{c,d,e}$ | 108.8 | 9.3$^{a,b,c}$ |
| 15 | 27 | 188 | 46$^{d,e}$ | 111.3 | 10.1$^{b,c}$ |
| 16 | 20 | 188 | 45$^{d,e}$ | 111.5 | 10.5$^{b,c}$ |
| 17 | 10 | 193 | 51$^{e}$ | 112.4 | 11.1$^{c}$ |

TABLE 7. Comparison of weights for captive wild females following first observed nesting season=0 in captivity. Means with different superscripts are significantly different ($P$<0.05).

| Season | $N$ | Weight (kg) | SD (kg) | CCL (cm) | SD (cm) |
|---|---|---|---|---|---|
| -7 | 3 | 95 | $27^{a}$ | 87.2 | $8.9^{a}$ |
| -6 | 3 | 118 | $24^{a,b}$ | 93.6 | $7.0^{a,b,c}$ |
| -5 | 4 | 101 | $44^{a}$ | 88.9 | $14.2^{a,b}$ |
| -4 | 9 | 118 | $38^{a,b}$ | 94.8 | $10.9^{b,c,d}$ |
| -3 | 18 | 125 | $33^{a,b,c}$ | 95.9 | $9.0^{b,c,d,e}$ |
| -2 | 38 | 127 | $32^{a,b,c,d}$ | 96.5 | $7.9^{c,d,e}$ |
| -1 | 61 | 139 | $31^{b,c,d,e}$ | 99.2 | $7.5^{c,d,e}$ |
| 0 | 80 | 152 | $32^{b,c,d,e}$ | 110.8 | $7.4^{c,d,e}$ |
| 1 | 74 | 144 | $27^{b,c,d,e}$ | 101.4 | $6.6^{c,d,e}$ |
| 2 | 68 | 152 | $31^{b,c,d,e}$ | 101.8 | $6.8^{c,d,e}$ |
| 3 | 61 | 155 | $32^{b,c,d,e}$ | 103.0 | $6.6^{c,d}$ |
| 4 | 55 | 158 | $31^{b,c,d,e}$ | 104.0 | $6.1^{e}$ |
| 5 | 49 | 162 | $32^{c,d,e}$ | 104.5 | $6.8^{e}$ |
| 6 | 46 | 165 | $34^{c,d,e}$ | 104.5 | $6.9^{e}$ |
| 7 | 44 | 163 | $33^{c,d,e}$ | 104.7 | $6.9^{e}$ |
| 8 | 43 | 166 | $35^{c,d,e}$ | 105.0 | $6.6^{e}$ |
| 9 | 43 | 172 | $36^{e}$ | 105.2 | $6.7^{e}$ |
| 10 | 37 | 174 | $36^{e}$ | 105.4 | $6.6^{e}$ |
| 11 | 23 | 169 | $34^{d,e}$ | 103.8 | $5.8^{e}$ |
| 12 | 13 | 173 | $43^{e}$ | 104.1 | $6.5^{e}$ |
| 13 | 6 | 169 | $37^{d,e}$ | 104.6 | $5.6^{e}$ |

TABLE 6. Comparison of weights and CCLs for farmed reared turtles prior to and following first nesting season. Season designated as year preceding or following first nesting season=0. Means with different superscripts are significantly different ($P<0.05$).

females, the average age of first nesting was 10.0±1.5 yr. Herd management at CTF resulted in the culling of all non-nesting females of known age in 1980. Since then additional turtles have been added to the breeding herd. To estimate average age of sexual maturity for captive reared turtles, the percentage of females nesting from a known age class can be calculated and accumulated as shown in Table 8. The coefficient of correlation for the linear regression of percentage mature turtles within an age class versus age is .971. The linear model, $y = a + bx$, yields a value of $a = 34\pm6$ and $b = 5.2\pm0.5$ for $y$ = percentage of females nesting from a known age class and $x$ = age of class (in years). Consequently, at 16 years of age, 50% of the females should begin nesting and at 25 years of age, 96% of the population should begin nesting.

| Age (yr) | No. in Age Class | No. Nesting | % Age Class Nesting | Cumulative % Nesting |
|---|---|---|---|---|
| 8 | 202 | 7 | 3.5 | 3.5 |
| 9 | 192 | 17 | 8.9 | 12.4 |
| 10 | 182 | 18 | 9.9 | 22.3 |
| 11 | 161 | 9 | 5.6 | 27.9 |
| 12 | 96 | 3 | 3.1 | 31.0 |
| 13 | 54 | 0 | 0.0 | 31.0 |
| 14 | 26 | 2 | 7.7 | 38.7 |
| 15 | 21 | 1 | 4.8 | 43.5 |

TABLE 8. Age at first nesting for 57 farmed reared green sea turtles relative to total no. in respective age class.

## DISCUSSION

For the captive green sea turtle, the logistic growth equation best describes the growth of the animal. The logistic curve is sigmoid in shape and represents growth from a very small initial stage, in which growth is proportional to size, to later stages when size approaches an asymptote. In examining the curve of Fig. 1 as described by Equation (3), the following points must be kept clearly in mind. First, the average size of groups of turtles of the same age are used for generating the curve. As Table 2 indicates the variability in these values is considerable with an expected coefficient of variation greater than 30 for weight size data. Practical experience at CTF has shown that smaller turtles will demonstrate the same percentage weight gain as larger turtles. Consequently, the relative size of the turtle is not expected to change the shape of the curve, but whether the individual lies above or below the average.

Secondly, the size data for turtles 63 months and younger are based on stock tank weighings, and for turtles 72 months and older are based on average weights of turtles that have been separated for inclusion in the breeding herd. The effect of this management strategy on the growth rate of the turtles is not defined.

Thirdly, the generated growth curve is based on culture conditions, with regulated diets, controlled water quality and obviously restricted range movements. Although the growth curve is beneficial in economic forecasting for CTF, its application to natural conditions remains comparatively limited. As CTF releases both hatchling and yearling turtles each year, the pattern of growth observed from recaptures can be compared with what is expected if the turtles had been maintained in captivity.

For herd assessment, weight data is the most beneficial and easiest obtained. However, Table 3 clearly indicates that for monitoring the growth of individuals within a population over a period of time, length or width data would be preferable as the variability within the measurement is considerably less. Bjorndal & Bolten (1988), elaborated on this in their assessment of growth rates of immature green turtles in the southern Bahamas. Practically, curved carapace measurements are the easier to obtain. Length measurements are preferable over width measurements as the points of reference for taking length are more clearly defined than for width.

The relationship of carapace measurements to each other remain reasonably constant for immature turtles, suggesting that conversion from one measure to another would be valid in relation to the expected error in measurement. The relationship of weight to carapace size, however, increases with increasing age or size. A ratio of weight to carapace size has been used at CTF in previous years to assess the development of the breeding herd.

Both fitted logistic by weight equations (3) and (5) and the fitted logistic by length equation (4) over-estimate the size of the green turtle at hatch. The calculated weights and length are 1.47 kg, 1.31 kg, and 16.6 cm (CCL), respectively. Observed weight and length for green hatchlings average 0. 027 kg and 5. 27 cm (SCL) . At 14 months, the calculated weights and length are 3.37 kg, 3.17 kg, and 26.4 cm (CCL), respectively, compared to 3.02 kg and 29.1 cm (CCL) as recorded from Table 2 . Consequently for the first few months of the growth curve, fit is extremely poor. In comparison, the fitted von Bertalanffy equation for the data as presented in Table 1, shows an even poorer fit at $t$=0, with $A$ = -26.7 kg calculated weight at birth.

The data in Tables 6 and 7 suggest that the green sea turtle continues to increase in size following maturity. However, in observing individual turtles in subsequent years, the individual's weight will fluctuate as much as 13%. Consequently, several years are needed to observe this continued growth for mature turtles. There is also no significant difference in weight or CCL ($P$<.05) between nesting and non-nesting seasons. Although the green sea turtle may lay an egg mass totalling 25% of her body weight, this difference is not detected in her weight as measured in February for nesting in May through August under farm conditions.

Since the culling of known age potential breeders in 1980, additional turtles have been selected from CTF stock for addition to the breeding herd. Presently, 28 females, ages 12-18 years, average age 15 years, form part of this group. Another 29 females, less than 7 years of age, have also been set aside, with additional turtles to be selected each year. Of the 28 females of potential nesting status, 10 have begun nesting. Based on Table 8, 12 of these turtles should have begun nesting. Future seasons will continue to update the reliability of the projections.

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