Los Angeles County Museum

CONTRIBUTIONS IN SCIENCE

ıBER 62 DECEMBER 7, 1962

CARAPACE LENGTH—BODY WEIGHT RELATIONSHIP AND SIZE AND SEX RATIO OF THE NORTHEASTERN PACIFIC GREEN SEA TURTLE, *CHELONIA MYDAS CARRINEGRA*

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David K. Caldwell

Editor

CARAPACE LENGTH—BODY WEIGHT RELATIONSHIP AND SIZE AND SEX RATIO OF THE NORTHEASTERN PACIFIC GREEN SEA TURTLE, *CHELONIA MYDAS CARRINEGRA*

By DAVID K. CALDWELL[1]

ABSTRACT: Empirical data are presented for the carapace length—body weight relationships of juvenile and presumably-adult northeastern Pacific green sea turtles, *Chelonia mydas carrinegra* Caldwell, of both sexes from the central Gulf of California. A formula for calculating length or weight when only the other is known is included. The sex ratio and relationship of size to sex in these turtles is discussed.

In a forthcoming paper (Caldwell, *In press*), I have given a brief history of the fishery for the green sea turtle, *Chelonia mydas carrinegra* Caldwell, in Baja California, Mexico, and have discussed the present status of the fishery for this and other species of sea turtles in that region.

As a contribution toward the establishment of modern fisheries practices for sea turtles in Baja California and the Gulf of California, I have gathered data on the relationship of carapace length to body weight for green turtles taken from the central Gulf and landed at the village of Bahia de Los Angeles, on the central Gulf shore of Baja California. With such information, which apparently represents the subspecies as a whole, one of these figures can be estimated with some accuracy when the other is known.

Although equations were prepared for males and females taken separately, as well as in combination, they are not included here as the results for all three calculations are so similar. When the empirical body weight values for the two sexes were graphed versus carapace length, they were found to overlap completely. The data for the separate sexes are included in Tables 1 and 2. Although graphically it was found that after the attainment of a carapace length of about 30 inches there was a *tendency*, when using each turtle as a point on the graph, for males to weigh less than females (for example, a 29¾-inch female weighed 61 kilograms, while a male of the same length weighed only 49 kilograms), such was not the case when the means of body weights at each carapace length were compared. Individual variation within a sex overshadows intersexual variation to such a degree that for fishery purposes in particular, and biological purposes in general, for a number of individuals there is a smooth curve. That there is a *tendency* for males to be lighter than females beginning at a carapace length of about 30 inches seems to be related to the phenomenon that I have noted elsewhere (Caldwell, 1962) in which sexual dimorphism begins to become especially evident at this size, with the female becoming somewhat deeper bodied, the posterior portion of the carapace of the male becoming proportionately more pointed and the length of the male

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tail greatly increasing relative to that of the female. As noted above, the variation in other dimensions overshadows this difference in shell outline. The increasingly longer and heavier tail of the maturing male certainly also contributes to this sex's keeping pace with the somewhat broader and deeper bodied females in the character of body weight.

Considering the variation just noted, the combined data for 323 green turtles landed at Bahia de Los Angeles were therefore used to describe the relationship between carapace length in inches and body weight in kilograms[2]. This relationship is expressed by the equation:

$$\log W = -2.14 + 2.60 \log L$$

where L is carapace length and W is body weight.

In instances where it is not practical to use the equation, the approximate body weight for a known carapace length can be determined from Tables 1 or 2 if the sex is known, or from Table 3 if it is not. Conversely, using the same tables, an approximate carapace length can be determined when the body weight is known.

For comparison, in Table 4 the actual length-weight data for selected lengths, from Table 3, are compared with the theoretical weights calculated with the above equation. As would be expected, the calculated weights are more accurate for that part of the sample most strongly represented, or the middle weights, and the calculated weights for the larger turtles are somewhat low.

SIZE AND SEX RATIO OF THE GREEN TURTLE

Males of *Chelonia mydas carrinegra* apparently are smaller (35½ inches in carapace length being the largest seen) than the females (38½ inches the largest seen), and occur in relatively fewer numbers. Although less desirable for food when captured, all are landed in the fishery and in four samples the number of females was considerably greater than the number of males, in all seasons of the year (Table 5). Señor Antero Diaz, the turtle broker at Bahia de Los Angeles, in addition stated that the fishermen felt that there was some degree of segregation of the sexes, as they often caught mostly one or the other in a given limited area.

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[2]Because of circumstances at the time, carapace lengths were measured to the nearest ¼ inch in a straight line (not over the curve of the shell) from the anterior midline to the greatest posterior projection of the shell, in the manner described by Carr and Caldwell (1956: 4). Weights were taken to the nearest kilogram on a set of beam scales. Although the scales were somewhat corroded from the sea air, they were consistent in their accuracy over a 17-month period and recorded my own known weight with sufficient accuracy to make the results useful and within the expected range of variation in weight of turtles of a given length. I have remarked elsewhere (Caldwell, 1962) that the resulting weights were remarkably consistent with those of Atlantic turtles taken on scales in better condition that were calibrated in pounds. For purposes of conversion, one kilogram may be reckoned as equaling 2.2 pounds, and one inch may be considered as equaling 2.54 centimeters.

ACKNOWLEDGMENTS

I would particularly like to emphasize the great amount of help given this study by the cooperation of Señor Antero Diaz, the leading turtle dealer at Bahia de Los Angeles, and his associates. Señor Diaz was most generous in allowing me to examine his turtles, and most patient in answering my many questions. Señor Eriberto Arce of Ensenada also generously allowed me to examine his turtles, from both the Gulf and the outer coast of Baja California, and spent much time in answering my questions.

Dr. Carl L. Hubbs kindly offered certain data on Gulf green turtles, but as I felt that they duplicated my own previous findings, which I feel are sufficient, I have not attempted to include them here.

To my wife, Melba C. Caldwell, I offer my sincere thanks for her critical reading of the manuscript and for many hours spent with me in the field helping to obtain and record data. Clyde A. Wilson, Jr. II and Frank F. Wilson also aided in this latter endeavor.

Support for the field work on this project was received in part from the Los Angeles County Museum and the Museum Associates and from funds made available to the Museum from the American Foundation for Oceanography.

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TABLE 1

Empirical values for the carapace length-body weight relationship of 55 male northeastern Pacific green sea turtles, *Chelonia mydas carrinegra,* from the central Gulf of California and landed at Bahia de Los Angeles, Baja California, Mexico.

Carapace Length (inches)[1]	Mean Weight (kilograms)	Range of Weights (kilograms)	Number of Specimens
23	26.5	23-30	2
24½	27.5	26-29	2
25	29.0	....	1
25¼	37.5	37-38	2
25½	34.0	29-39	3
26	34.0	....	1
26½	34.7	32-37	3
26¾	35.0	....	1
27	39.3	38-42	3
27¼	43.0	....	1
27½	37.0	34-39	4
27¾	41.0	....	1
28¼	40.0	....	1
28¾	44.5	41-48	2
29	49.0	45-54	3
29¼	43.3	43-44	3
29½	52.0	....	1
29¾	48.9	41-55	7
30	48.5	47-50	2
30¼	55.3	53-59	4
30½	58.0	....	1
30¾	47.0	....	1
31½	62.0	....	1
31¾	57.5	52-63	2
32	60.0	....	1
32¼	72.0	....	1
35½	76.0	....	1

[1]Measured to the nearest ¼ inch in accord with Carr and Caldwell (1956: 4).

TABLE 2

Empirical values for the carapace length-body weight relationship of 217 female northeastern Pacific green sea turtles, *Chelonia mydas carrinegra*, from the central Gulf of California and landed at Bahia de Los Angeles, Baja California, Mexico.

Carapace Length (inches)[1]	Mean Weight (kilograms)	Range of Weights (kilograms)	Number of Specimens
23	25.9	20-29	9
23¼	26.9	22-31	8
23½	28.0	26-30	2
23¾	28.4	24-32	8
24	27.8	21-31	5
24¼	28.4	23-31	7
24½	28.9	25-33	12
24¾	29.0	26-32	4
25	32.3	31-35	3
25¼	33.5	29-38	6
25½	32.7	29-36	7
25¾	33.2	31-36	6
26	35.9	31-40	10
26¼	37.5	31-43	13
26½	34.4	31-42	7
26¾	39.2	36-41	5
27	39.2	32-46	9
27¼	40.3	34-50	7
27½	39.0	34-43	9
27¾	38.8	34-42	5
28	43.4	39-49	9
28¼	44.9	38-52	10
28½	48.7	44-54	3
28¾	47.2	40-54	5
29	42.0	40-45	3
29¼	49.3	43-53	3
29½	51.8	46-58	4
29¾	57.5	54-61	2
30	50.5	49-52	2
30½	56.5	48-65	2
30¾	57.0	51-63	2
31	52.2	50-57	4
31¼	52.5	49-56	2
31½	56.5	54-59	2
31¾	58.0	56-60	2
32¼	60.0	....	1
32¾	70.0	....	1
33¼	69.0	66-72	2
33½	69.0	....	1
33¾	73.5	72-75	2
34¼	65.0	....	1
34¾	75.0	....	1
35	74.0	....	1
35½	89.5	80-99	2
35¾	90.3	81-100	4
36¼	85.0	....	1
37	92.0	....	1
37½	112.0	....	1
38½	124.0	....	1

[1]Measured to the nearest ¼ inch in accord with Carr and Caldwell (1956: 4).

TABLE 3

Empirical values for the carapace length-body weight relationship of 323[1] northeastern Pacific green sea turtles, *Chelonia mydas carrinegra,* from the central Gulf of California and landed at Bahia de Los Angeles, Baja California, Mexico.

Carapace Length (inches)[2]	Mean Weight (kilograms)	Range of Weights (kilograms)	Number of Specimens
18¼	9.0	....	1
18½	12.3	10-14	3
18¾	11.0	....	1
19¼	16.0	....	1
19½	14.5	14-15	2
19¾	14.5	14-15	2
20	15.2	14-18	3
20¼	18.7	16-20	3
20½	17.5	14-21	2
20¾	18.5	17-20	2
21	17.5	17-18	2
21¼	18.5	18-20	4
21½	19.5	19-20	2
21¾	18.5	16-21	4
22	22.3	19-24	3
22¼	20.5	19-22	2
22½	23.5	22-26	4
22¾	25.3	17-29	10
23	26.0	20-30	11
23¼	26.9	22-31	8
23½	28.0	26-30	2
23¾	28.4	24-32	8
24	27.8	21-31	5
24¼	28.4	23-31	7
24½	28.7	25-33	14
24¾	29.0	26-32	4
25	31.5	29-35	4
25¼	34.5	29-38	8
25½	33.1	29-39	10
25¾	33.2	31-36	6
26	35.7	31-40	11
26¼	37.5	31-43	13
26½	34.5	31-42	10
26¾	38.5	35-41	6
27	39.3	32-46	12
27¼	40.6	34-50	8
27½	38.4	34-43	13
27¾	37.5	34-42	6
28	43.4	39-49	9
28¼	44.5	38-52	11
28½	48.7	44-54	3
28¾	46.4	40-54	7
29	45.5	40-54	6
29¼	46.3	43-53	6
29½	51.8	46-52	5

Carapace Length (inches)[2]	Mean Weight (kilograms)	Range of Weights (kilograms)	Number of Specimens
29¾	50.8	41-61	9
30	47.0	47-52	4
30¼	55.3	53-59	4
30½	57.0	48-65	3
30¾	53.7	47-63	3
31	52.4	50-57	4
31¼	52.5	49-56	2
31½	58.3	54-62	3
31¾	57.8	52-63	4
32	60.0	....	1
32¼	66.0	60-72	2
32¾	70.0	....	1
33¼	69.0	66-72	2
33½	69.0	....	1
33¾	73.5	72-75	2
34¼	65.0	....	1
34¾	75.0	....	1
35	74.0	....	1
35½	85.0	76-99	3
35¾	90.3	81-100	4
36¼	85.0	....	1
37	92.0	....	1
37½	112.0	....	1
38½	124.0	....	1

[1]Includes 51 individuals less than 23 inches in carapace length of undetermined sex.
[2]Measured to the nearest ¼ inch in accord with Carr and Caldwell (1956: 4).

TABLE 4

Comparison of empirical and calculated weights of selected sizes of northeastern Pacific green sea turtles, *Chelonia mydas carrinegra,* from the central Gulf of California and landed at Bahia de Los Angeles, Baja California, Mexico. Sexes combined.

Carapace Length (inches)[1]	Mean, Empirical Weight (kilograms)	Range, Empirical Weight (kilograms)	Calculated[2] Weight (kilograms)
17½	...	....	12.3
18½	12.3	10-14	14.3
20½	17.5	14-21	18.6
23	26.0	20-30	25.1
24½	28.7	25-33	29.6
27	39.3	32-46	38.2
28¾	46.4	40-54	44.9
31¾	57.8	52-63	58.1
34¼	65.0	....	70.8
35¾	90.3	81-100	79.2
37	92.0	....	86.6
38½	124.0	....	95.9

[1]Measured to the nearest ¼ inch in accord with Carr and Caldwell (1956: 4).
[2]By means of formula given in text.