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Recruitment and Remigration in a Green Turtle Nesting Colony*

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ABSTRACT

Tabulation of length-frequencies in the sample of turtles measured at the breeding ground of the Green Turtle, Chelonia mydas, at Tortuguero, Costa Rica, during the exceptionally heavy nesting season of 1969, reveals a disproportionately large number of females 36 inches (91·44 cm) long or less. Moreover, a disproportionately large number of these were untagged on arrival. The inference is that they were probably nesting for the first time. This is not self-evident, because each year some turtles are missed by the tagging crew, and therefore turn up without tags on subsequent nesting emergences. Recognizing true neophyte nesters is important to the study of the colony, because (1) *growth is very slow after maturity is reached (only about 1/10 inch = 2·54 mm per year);* (2) *heavy nesting at the Tortuguero feeding ground reduces the average age of the female contingent of the colony; and, therefore,* (3) *the spread in length-frequency becomes increasingly dependent upon variation in maturation-size, rather than on differences in age. It now seems evident that this increase in neophyte recruitment was a factor in the increase in nesting activity during 1969.*

An abrupt decrease in the number of arrivals of female Green Turtles (*Chelonia mydas*) on the nesting ground at Tortuguero, Costa Rica, in 1968 (Carr, 1969) was followed by an exceptionally heavy nesting year in 1969. Two factors probably involved in the resurgence were an unexplained extensive shift from a three-year to a two-year breeding cycle by members of the group that had come ashore in 1967 (Carr & Carr, in press), and an increase in the proportion of neophyte nesters that appeared on the beach in 1969.

The total number of tagged Green Turtles (remigrants) that returned in 1969 was 97, or 8·07 per cent of the total number of females recorded on the study beach for the year. The corresponding percentage for 1968, a poor year, was 15·81. To use this figure in calculating recruitment for the season one should compare it with the number of known new arrivals. This is not possible, however, because most first-time nesters cannot be distinguished as such. Untagged arrivals include not only neophytes but also remigrants that are not recognizable because they were not tagged during any previous visit to the beach.

In most cases there is no means of distinguishing between these two classes of untagged turtles. The distinction cannot be made on the basis of size. The growth of a female Caribbean Green Turtle after she reaches maturity is exceedingly slow (Carr & Goodman, in press), perhaps only about a tenth-of-an-inch (2·54 mm) a year; and it seems clear that either genetic factors or ecologic conditions on the reproductive range, or both, are important in producing the spread in size-range in the breeding colony. Nevertheless some growth does occur, and there must therefore be detectable correlation between small size and recency of emergence from the adolescent backlog of the stock. That this is actually the case can be seen in Tables I and II, which show that of 434 remigrant turtles measured over the 12-year period from 1958 through 1969, only eight, or 1·84 per cent, were 36 inches (91·44 cm) long or less. Above this length and up to about 39 inches (99·06 cm), there is a gradual increase in the proportion of tagged remigrants. The proportion of nesting females 36 inches

TABLE I

Comparative Frequency of Three Length-groups of Green Turtles Arriving with, and without, Tags at Tortuguero, Costa Rica

	No.	More than 39·5 in* (per cent)	Less than 39·25 in* (per cent)	Less than 36 in* (per cent)
Untagged 1956–69	4145	49·54	50·46	5·69
Tagged 1958–69	434	58·76	41·24	1·84

* 1 in = 2·54 cm.

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TABLE II

Length-frequency of Remigrant Green Turtles Measured at Tortuguero, Costa Rica, 1958–69

Year:	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	Totals No.	Totals Per cent
Length (inches)*														
48														
47														
46										1			1	·23
45				1	1		1					1	4	·92
44					1	1			1	2	2	4	11	2·53
43		1		1	2	3	2	5	1	3	3	5	26	5·99
42		1	2	4	2	5	10	4	2	7	4	8	49	11·29
41		1	3	2	7	7	5	13	1	21	4	14	78	17·97
40	1		1	2	4	12	12	10	4	15	6	19	86	19·81
39	1	2	2	4	10	11	8	16	2	13	12	16	97	22·35
38	2	1	4	1	3	6	7	3	6	4	4	13	54	12·44
37		1		2	1	3	1	3	1	1	2	5	20	4·60
36			1		1	1		1		1	1	1	7	1·61
35														
34										1			1	·23
Yearly Total:	4	7	13	17	32	49	46	55	18	69	38	86	434	

1 inch = 2·54 cm.

g or smaller appears, therefore, to be a reliable lex either to reproductive success that occurred ng a season one maturation period before the ent season, or to survival since that season.

t is thus of interest to compare some of the so-led 'good years' at Tortuguero ('good' in the semi-ective opinion of the tagging crew, the local idents, and the turtle industry), such as 1969, with d' years such as 1966, which was in most respects the worst on record. Some relevant data appear in Table III.

The fact that in the same year in which there is an increased representation of turtles 36 inches or less in length, a less well-marked but significant increase also occurs in lengths up to 39·25 inches (99·7 cm) (*see* Table III), tends to confirm that additional recruitment by length-groups up to about 39·25 inches occurs. Above this figure the percentage falls off, but there is no reason to suppose that some recruits as big as any of the oldest members of the population do

TABLE III

nparative Frequency of Three Length-groups of agged Green Turtles, by year, during 1956–69 *at Tortuguero, Costa Rica*

Year	Number	*More than* 39·5 *in** (per cent)	*Less than* 39·25 *in** (per cent)	*Less than* 36 *in** (per cent)
1956	114	44·74	55·26	3·50
1957	247	51·46	48·54	5·30
1958	133	53·39	46·61	3·00
1959	189	44·45	55·55	8·94
1960	389	57·61	42·39	4·91
1961	383	40·74	59·26	9·13
1962	308	44·81	55·19	9·73
1963	513	51·88	48·12	4·67
1964	334	57·49	42·51	2·69
1965	259	55·99	44·01	4·60
1966	58	51·73	48·27	5·17
1967	283	48·06	51·94	5·64
1968	213	53·53	46·47	1·83
1969	731	44·33	55·67	7·79

1 in = 2·54 cm.

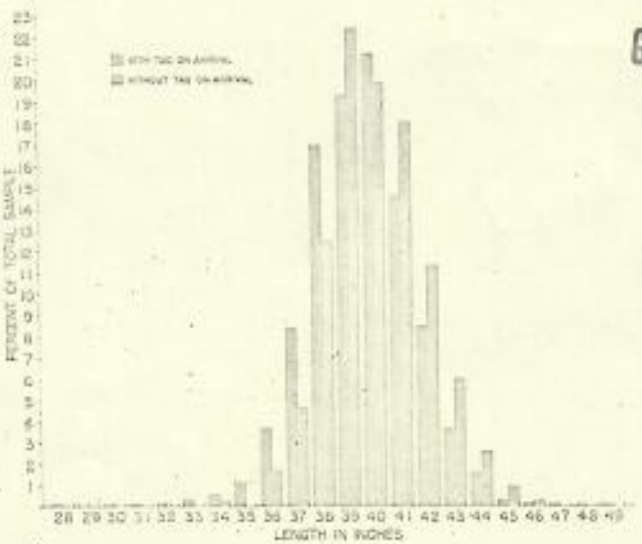

Fig. 1. Histogram of shell-length percentages of 434 *remigrant and* 4,155 *untagged Green Turtles, Tortuguero, Costa Rica,* 1956–69. 1 *inch* = 2·54 *cm.*

not appear. The population thus includes two kinds of big turtles: some that grew big after reaching sexual maturity, and some that have reached maturity at a large size, and so come to the nesting beach as cryptic neophytes.

As both Table I and Fig. 1 show, the average size of the remigrants is greater than that of the untagged group. This is expected, because the turtles that arrive with tags are, on the average, older than the untagged group. What is not explained, however, is that the peak in length-frequency distribution for the older group should be about 39 inches, whereas the peak-length for the younger untagged turtles is about 40 inches (101·6 cm). A possible explanation may be that 40 inches is the modal length at which a West-Caribbean Green Turtle matures. The untagged group may thus comprise some 40-inch turtles that have just come in to nest for the first time, and others that grew to that length after a previous visit to the beach that was missed by the tagging crew; and this reinforcement in that size-group may be the factor that makes it the mode for the untagged component of the population. It is nevertheless not immediately clear how this interplay could produce a modal length frequency greater than that of the certainly older remigrant group with a larger average size, even granting the increased attrition that must attend the greater age. An explanation may emerge when an analysis of attrition rates, as shown by histories of individual year-groups, is made.

References

Carr, Archie (1969). Sea turtle resources of the Caribbean and Gulf of Mexico. *IUCN Bull.*, 2(10), pp. 74–75, 83.

Carr, Archie & Goodman, Donald (in press). Ecologic implications of size and growth in *Chelonia*. Copeia 6.

Carr, Archie & Carr, Marjorie H., (in press). Mating reproductive periodicity in *Chelonia*. *Ecology*.

Endangered North American Molluses

A series of scientific papers, collectively entitled 'Symposium on the Rare and Endangered Molluses of North America', was presented on 16 July 1968 in Corpus Christi, Texas, during the thirty-fourth annual meeting of the American Malacological Union. The object of the symposium was to designate for the first time those species of North American molluses which are in danger of extinction, and to provide authoritative information on the circumstances and extent of their peril.

Papers on the freshwater molluses were presented by Dr D. H. Stansbery, Dr A. H. Clarke, Dr W. H. Heard, H. D. Athearn, Dr D. W. Taylor, and Dr H. D. Murray. Papers on terrestrial molluses were read by Dr W. J. Clench, Dr Dee S. Dundee, and A. G. Smith. Papers on marine molluses were contributed by Dr R. T. Abbott, Dr J. Rosewater, Dr A. Myra Keen, and Dr W. K. Emerson. A paper on brackish-water molluses was also presented by Dr J. P. E. Morrison. The collected manuscripts, together with introductory and summary material, comprise the first synopsis of the subject. It is scheduled to be published during 1970 in the international journal *Malacologia*, which is produced by the Institute of Malacology, University of Michigan, Ann Arbor, Michigan, USA.

The contributors have documented the existence of a crisis situation: *more than 400 species and subspecies of North American molluses are in imminent danger of extinction.* At least 1,000 others will also soon be in danger if present trends continue. Furthermore, numerous species have recently become extinct, or are on the threshold of extinction, which were not even suspected of being imperilled.

In general, those species whose survival is most in jeopardy are restricted to small geographical areas that are undergoing urbanization, industrialization, or other ecological disruption. The survival status of freshwater molluses is particularly precarious, especially in the southeastern and south-central parts of the continent. Approximately 185 freshwater species and subspecies have now been listed as rare and endangered. Of the nine species that are thought to have become extinct in recent decades, eight are species of *Dromus* (Unionidae). Those species are restricted to riffles (wide stretches of shallow water in rivers where the flow is rapid and the surface irregular) in large rivers of the Ohio–Mississippi drainage system, and most such habitats have now been flooded by dams.

Some 45 terrestrial species and subspecies of North American molluses, about half of them in the East and the other half in the West, are in immediate danger. A much larger number, especially in the arid West, are extremely localized and therefore in great potential peril.

Well over 100 species and subspecies of highly localized endemic brackish-water molluses, particularly among the Hydrobiidae, are also endangered, and many are becoming extinct even before they have been described and named. Numerous local populations of marine molluses are also being obliterated through pollution or over-collecting, but nearly all of the species, as such, are still secure.

The purpose of the forthcoming publication is to direct public attention towards the species listed therein and to stimulate additional research and corrective action wherever possible. All interested individuals and appropriate government agencies are urged to do whatever they can to ensure the survival of the fascinating, unique, and irreplaceable molluscan fauna of North America.

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