Marine Turtle Newsletter

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Editor: N. Mrosovsky* Editorial Advisor: Archie Carr

EDITORIAL

Editorials in the last two Newsletters have discussed our ignorance of turtle biology. We return to this theme again. Working independently in different parts of the world, George Balazs and Colin Limpus have been studying the growth rates of immature green turtles in natural conditions in the sea. Preliminary accounts of their findings suggest that green turtles, and some other species, may often take more than 30 years to mature! On the other hand George Hughes has suggested, on the basis of marking hatchlings with notches, that loggerhead turtles may mature in 4-6 years (Marine Turtle Newsletter No. 8, July 1978, p. 2). A difference between 4 and more than 30 years has enormous implications for management programmes.

If maturation is more than 30 years ... and it seems to us that measuring carapace lengths is a more reliable way of estimating maturation than finding nesting notched turtles which could perhaps have received their notch in some natural way ... there still remain many questions to be answered. Are slow growth rates characteristic of all species and populations of sea turtles? For instance, what about ridleys? It may take the ridley arribadas in Mexico many years to recover from the extensive harvesting they are being subjected to at present (Marine Turtle Newsletter No. 7, April 1978).

It is also notable if a slow maturing animal is so prodigal with its egg production, because delayed reproduction and slow development are usually associated with high parental investment and low infant mortality (Daly, M. and Wilson, M. 1978, Sex, Evolution and Behavior, Duxbury Press, Mass. USA, p. 125). But perhaps there is some error in reasoning and marine turtles have some unusual form of growth curve, with a rapid spurt prior to first laying? We hope the important findings reported below by Balazs and by Limpus will be scrutinized and debated as much as possible.

N.M.

GROWTH, FOOD SOURCES AND MIGRATIONS OF IMMATURE HAWAIIAN *CHELONIA*

Major components of the life history study of Hawaiian *Chelonia* currently underway include the determination of growth rates, food sources and migrations of immature individuals as they naturally occur in shallow-water feeding pastures. Knowledge of these aspects, particularly growth and the resultant age at sexual maturity, is

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* Address all correspondence to: N. Mrosovsky, Departments of Zoology and Psychology
University of Toronto
Toronto, Ontario M5S 1A1, Canada

widely lacking for marine turtle populations due to the difficulties of capturing and tagging sufficient numbers of animals directly from the sea. Most research activities have instead focused on the colonial nesting beaches where large numbers of turtles are periodically accessible for observation and tagging. This has resulted in considerable insight into the reproductive ecology of the adult female, a critically important but nevertheless limited segment of the turtle's life history. The need to determine the rates of growth and migrations of immature marine turtles was emphasized as early as 1916 by Dr. J. Schmidt who pioneered such work in the Virgin Islands.

At select sites throughout the 2600 km Hawaiian Archipelago, immature green turtles are being sampled by the use of SCUBA, long-handled scoop nets and carefully monitored large-mesh tangle nets. Additionally, the unique land basking habit exhibited by some members of this population in the remote Northwestern Hawaiian Islands provides further access to immature turtles at their feeding pastures. A total of 375 individuals has now been measured and tagged using these capture techniques. Since October 1976 this has involved the use of tags specially manufactured from Inconel 625, an alloy that has thus far exhibited no corrosion and therefore appears to be far superior to the Monel tags previously used (see also Marine Turtle Newsletters No. 1, August 1976 and No. 2, January 1977). Food sources are being determined by the retrieval of mouth contents from turtles captured while actively feeding, and through the extraction of stomach contents using a flexible plastic tube inserted down the esophagus.

Recoveries of tagged turtles to date have demonstrated significant differences in the rates of growth between certain feeding pastures. At the southeast end of the archipelago off the Kau coast of the Island of Hawaii (19°10'N, 155°30'W), 4 recoveries of turtles 48 to 55 cm in carapace length have resulted in growth rates of .38-.52 cm per month (mean .44) over periods of 7 to 17 months in the wild. The major food source at this location has been found to be the red alga, *Pterocladia capillacea*. At French Frigate Shoals (23°45'N, 166°10'W) situated in the middle of the archipelago, 17 recoveries have been made of turtles 37 to 55 cm in carapace length. Growth rates of .01-.13 cm per month (mean .08) have been recorded over periods of 3 to 26 months in the wild. Food sources found to be utilized at this location consist mainly of green algae of the genera *Caulerpa* and *Codium*. At the northwest end of the archipelago, 9 recoveries have been made at Kure (28°25'N, 178°20'W) and Midway (28°13'N, 177°21'W). Turtles 40 to 59 cm in carapace length exhibited growth rates of .03-.21 cm per month (mean .10) over periods of 7 to 37 months in the wild. In addition to *Caulerpa* and *Codium*, turtles at these two locations have been found to feed on the invertebrates *Velella*, *Janthina*, and *Physalia* whenever such drift material is present.

If the growth rates thus far recorded remain constant throughout adolescence, a 35 cm turtle would require the following time periods to reach 91 cm, the mean size of sexually mature females in the Hawaiian population: Island of Hawaii - 10 years 7 months; French Frigate Shoals - 58 years 4 months; Kure/Midway - 46 years 7 months. Juveniles smaller than 35 cm are rarely seen in the Hawaiian Archipelago, therefore it has not been possible to estimate the age of this size category by tag and recapture experiments. Growth rates of these smaller turtles could, however, be more rapid if the food sources exploited are exclusively animal in origin as is thought to be the case during the period of open-ocean existence.

It is important to note that in those feeding pastures where slower growth occurs, the use of body weight as an index of growth has proved to be unreliable for most of the recoveries that have been made. This is undoubtedly due to differences in the amount of food material in the gastro-intestinal tract, a component that can comprise up to 18% of the body weight of immature turtles.

All recoveries, with the exception of two, have been made in the same feeding pasture where the original tagging took place. At French Frigate Shoals, recoveries have indicated that no movement takes place between feeding sites separated by as short a distance as 8 km. Furthermore, at Kure a turtle was recovered resting under the same coral ledge where it had been captured 13 months earlier. The two long-distance recoveries consisted of a 1540 km movement from Midway to Wake (19°18'N, 166°36'E), and a 2240 km movement from Midway to Hilo Bay on the Island of Hawaii. Both of these recoveries were reported by fishermen and did not include measurement data for determinations of growth.

Investigations of both immature and adult Hawaiian green turtles in their feeding pastures are presently being conducted with financial support from the Sea Grant College Program and the Marine Affairs Coordinator, State of Hawaii. Future support has been requested from the World Wildlife Fund in order to place continuing and greater emphasis on the important aspect of natural growth.

G.H. Balazs
Hawaii Institute of Marine Biology
P.O. Box 1346, Kaneohe
Hawaii 96744, U.S.A.

NOTES ON GROWTH RATES OF WILD TURTLES

My growth data is derived from a study of wild turtle populations that has just entered its 5th consecutive year and based on two adjacent coral reefs of the southern Great Barrier Reef, i.e. Heron Island Reef and Wistari Reef (approx. 23.5° S). These reefs are the year round feeding grounds of large numbers of greens and loggerheads and a small number of hawksbills. Each spring there is an influx of migrant adult greens and loggerheads on to these reefs, aggregating for mating and subsequent nesting on nearby islands. These migrant turtles are also feeding on these reefs. While the immature turtles are definitely residents to the area, the residency status of many of the adults is uncertain. See Table 1 for size range and diets of these turtles.

Table 1: Size range and observed diet of turtles resident on the coral reefs of the southern Great Barrier Reef. Midline curved carapace length (CCL) is used as the standard measurement.

Species	CCL range (cm)	Observed diet
Chelonia mydas	38 - 120 immature to mature adults	algae, occasional jellyfish
Caretta caretta	70 - 110 immature to mature adults	molluscs, occasional fish, crab, jelly-fish

Table 1 (cont'd)

Species	CCL range (cm)	Observed diet
Eretmochelys imbricata	35 - 87 immature to mature adults	ascidians (and other encrusting animals), algae

Recaptures of these turtles during our successive trips to the area have provided growth measurements on over 100 green turtles, several hundred loggerheads and 4 hawksbills. The intervals between captures vary from a few months up to 4.25 years.

The overall impressions gained from these growth measurements are:

1. Green turtles above 38 cm inhabiting southern Great Barrier Reef feeding grounds grow slowly - usually between 0.5 and 2 cm per year. Maximum recorded is 3.24 cm/yr. Immature green turtles, 60 - 90 cm CCL gave a mean growth rate of 1.3 cm/yr (Table 2).
2. Mature male and female green turtles breeding in the southern Great Barrier Reef are growing very slowly - of the order of only a few millimetres per year (Tables 2 and 3).

Table 2: Measured growth rates of green turtles captured in southern Great Barrier Reef feeding grounds compared with growth rate of nesting females from Tortuguero and Heron Island.

Curved carapace length (cm)	Growth rate (cm/yr) $\bar{x}$	SD	range	n	Reference
Immatures 40 - 50	-	-	0 to 1.54	4	Limpus & Walter (MS)
" 50 - 60	-	-	0.95	1	
" 60 - 70	1.432	1.957	0 to 3.24	14	
" 70 - 80	1.42	0.653	0.6 to 2.25	15	
" 80 - 90	1.098	0.993	-0.6 to 2.86	11	
Mature males 90 - 102	0.14	0.1132	-0.3 to 2.6	12	Limpus (unpublished data)
Nesting females (Tortuguero)	0.4	-	-	-	Carr & Goodman (1970)
Nesting females (Heron Island)	<1 cm in 4 to 5 yrs	-	-	-	Bustard (1974)

3. Based on these growth rates it would appear that a green turtle living in the southern Great Barrier Reef could not reach maturity in less than 30 years. If green turtles, before they commence breeding, grow to an adult size beyond which little growth occurs then an average-sized nesting green turtle from Heron Island (CCL = 107 cm) could be more than 50 years old before she commences laying.

Table 3: Some of the largest growth increments recorded from turtles in the southern Great Barrier Reef feeding grounds.

	Initial CCL (cm)	Growth increment (cm)	Interval between captures (yr)
Loggerheads:			
Sub adult	76	5.5	4
"	80	6.5	4
"	80.5	3.5	4
" ♂	88	2.5	4
Adult ♂	90.5	1.0	3 10/12
" ♂	100.5	0	3 6/12
" ♀	99.5	1	4 } also observed nesting in another area
" ♀	99	1.5	10 }
Greens: (see also Table 2)			
Sub adult	77	6	4 3/12
♂	99	1	3 10/12
Hawksbills:			
♀	81	6.5	4
Sub adult	67	2.5	1 5/12

4. Growth rates from the numerous loggerhead and the few hawksbill recaptures show these to be growing at a similar rate to that of green turtles of the same size.
5. Growth rates of wild turtles are very much less than those of captive reared turtles.

If the age of maturity for a sea turtle is 30 years plus, then a number of our management practices may need revision. For example it may take several decades before the effect of over harvesting of turtle eggs is seen on the numbers of nesting females at a rookery. Attempts to restock rookeries by releasing hatchlings should not be regarded as failures if turtles haven't returned to nest in less than 20 years. Similarly success of releasing programs may not be measurable in only a few years.

Bustard, R. 1972. Australian Sea Turtles. William Collins Sons and Co., London.

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

Limpus, C.J. and D.G. Walter. Manuscript. Growth rates of immature wild green turtles, *Chelonia mydas* (L.): a preliminary report.

Colin Limpus
National Parks & Wildlife Service of Queensland
P.O. Box 190
Brisbane North Quay 4000, Australia

RECENT PAPERS

Reference	Address of Author
A team of workers from Indonesia have produced a report "Studi habitat dan populasi penyu belimbing (*Dermochelys coriacea*) di propinsi Bengkulu", published by Departemenen Pertanian, Bogor, 46 pp. (habitat, lists of vegetation, maps, egg sizes and some other morphological data for leatherback populations in the Bengkulu area. Text in Indonesian).	Ir. I. Njoman S. Nuitja Faculty of Fisheries, BAU I.M.T.S.G. Bogor Indonesia
Licht, P., Farmer, S.W. and Papkoff, H. 1978. Biological activity of hybrid combinations of ovine and sea turtle LH subunits. General and Comparative Endocrinology 35: 289-294. (analysis of differences between turtle and mammalian luteinizing hormone).	Paul Licht Department of Zoology University of California Berkeley, California 94720 U.S.A.
Limpus, C.L. 1978. The Reef. In: Exploration North, edited by H.J. Lavery, Richmond Hill Press, Victoria, Australia, pp. 187-222. (popular account of Great Barrier Reef turtles, their feeding, interactions with other species and habitat).	Colin Limpus National Parks & Wildlife Service of Queensland P.O. Box 190 Brisbane North Quay 4000 Australia
Owens, D.W. and Ralph, C.L. 1978. The pineal-paraphyseal complex of sea turtles. 1. Light microscopic description. Journal of Morphology, 158 (2): 169-179. (sea turtle pineal is very large; morphology and speculations on function).	David W. Owens Department of Biology Texas A & M University College Station, Texas 77840 U.S.A.

LA CUMBIA DE LA TORTUGA

(Folksong, 1978, from West Coast of Mexico. See Newsletter No. 7, April 1978, for background).

Corre, corre tortuguita
No te dejes agarrar
Porque ahi viene Antonia Suárez
Y pronto te va a destazar
La cumbia de la tortuga es
una cumbia muy sabrosa
No ven a Don Antonio lo bonito
que la goza
La cumbia de la tortuga
es una cumbia popular
La bailan en Puerto Angel
Y también en Michoacan

ASCENSION ISLAND: BRITISH JEOPARDIZE 45 YEARS OF CONSERVATION

Recently I returned from 16 months of fieldwork at Ascension Island. On Ascension, which is the type locality for *Chelonia mydas*, there nests a genetically isolated population of green turtles that is unique not only morphologically but also behaviorally. They are the largest green turtles in the world, commonly attaining weights of 450-500 pounds. Their round trip migration between feeding grounds on the coast of Brazil and their nesting grounds on Ascension, a total distance of over 4,000 km, is farther than that recorded for any other green turtle population.

For more than 50 years now, the turtles have enjoyed near-complete protection by the British government during their nesting at Ascension. The island is geographically remote, separated by 800 miles of water from the nearest point of land. Partly for logistic reasons, and partly for security reasons (much classified government work is carried out on Ascension) visitors have generally been denied access to the island. At the present time, the island is inhabited by approximately 1000 people, including British, Americans, Saint Helenians and South Africans.

However, I was recently appalled to learn that the British government is taking steps towards developing the island as a holiday resort area. The plans include construction of five hotels, with "about 1250 rooms available" (see The Islander, Ascension Island, #379, 27th October 1978). The hotels in this "tourist resort by the sea" would undoubtedly be located as near as possible to the island's picturesque beaches. Because only three miles of shoreline consist of beaches suitable for turtle nesting, I feel that this would spell disaster for the turtles. Nesting is very concentrated on these beaches, and even apparently slight disturbances near a beach can have a major impact. In all fairness, the British on the island have shown great concern for their turtles. However, even without the added burden of luxury beachfront hotels and a doubled or tripled human population, minor catastrophes have recently taken place. For example, I found the bodies of over 500 charred hatchling turtles which had wandered into the flames of a bonfire left unattended on the beach. Beach huts are located alongside two of the three major nesting beaches on the island. Lights from these buildings frequently frighten female turtles coming ashore to lay their eggs, and draw newly emerged hatchling turtles away from the sea. On one occasion, more than 100 hatchlings were stomped to death when they were attracted by lights, and mistakenly crawled into a beach hut while a dance was in progress.

While on Ascension, I became very concerned that too much sand is being dredged from prime nesting beaches. Scars remain on beaches even though years may have elapsed since dredging in a particular area has ceased. In addition, there has been a tendency to take sand at all times of the year, regardless of the nesting season. Frequently nests are exhumed inadvertantly when the sand is removed.

In sum, I am extremely concerned about the obvious disruption in the form of lights and general commotion which would be caused by the presence of large resort hotels closely adjacent to concentrated nesting beaches. I also feel certain that the beach sand would be used in the construction of the hotels, and I dread the impact that this is likely to have on the nesting beaches themselves.

It seems a shame that when the British government has done so much to protect these animals during the past 45 years, all their efforts should end in naught because of such an ill-conceived scheme as this. It is difficult to stop commercial development of an area once plans have progressed too far. I am hoping there remains a chance of halting the proposed development at Ascension now while it is still in the "pre-feasibility study" stage, and urge that anyone else with similar concerns write as soon as possible to the British authorities about the situation. Letters should be addressed to:

Foreign & Commonwealth Office
Downing Street
London SW1 A 2AL
U.K.

It would be appreciated if copies of letters could be sent either to Dr. N. Mrosovsky (address on front page of newsletter) or direct to me at the address below.

Jeanne A. Mortimer
Department of Zoology
University of Florida
Gainesville, Florida 32611
U.S.A.

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