Nesting of the Leatherback Turtle (*Dermochelys coriacea*) in Tongaland, KwaZulu-Natal, South Africa, 1963–1995

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ABSTRACT. – A modest nesting population of leatherback turtles has been vigorously protected and studied on the Tongaland coast of KwaZulu-Natal, South Africa, for 32 years from 1963 to 1995. The number of nesting females has grown significantly from about 20 nesting females per season to over 100 per season. Of 1329 females tagged, 1017 (76.5%) have never been identified again, though many untagged turtles have calluses suggesting high tag loss. Remigration rates averaged 30.5% for 1964–84, and 33.7% for 1984–95. The longest observed reproductive lifetime was 18 years and many females were recorded nesting over a period of more than 9 years. Re-nesting occurred most frequently at two year intervals (44.8%) and often at three year intervals (29.2%). However, most females appear capable of changing their remigration intervals quite frequently, even nesting occasionally in consecutive years (1.9%). Mean carapace length of the nesting females has decreased from 162.2 cm in 1964–68 to 159.6 cm in 1994–95. Long distance recoveries of females have been relatively few in number, and none have been recorded nesting elsewhere. This nesting population is now the focus for a successful tourism activity.

KEY WORDS. – Reptilia; Testudines; Dermochelyidae; Dermochelys coriacea; sea turtle; nesting; remigration; conservation; South Africa

Leatherbacks in South African waters were first recorded by Smith (1849) and thereafter until 1963 only occasional records indicated their presence (e.g., Hewitt, 1937). In 1963, however, the first indication of regular nesting by *Dermochelys* in South Africa was recorded by staff of the Natal Parks Board on the coast of northeast KwaZulu-Natal by McAllister et al. (1965). Since then a regular annual protection and monitoring program has been carried out by staff of the Natal Parks Board. A review of the first decade of study was published in two monographs by Hughes (1974a; 1974b).

The sea turtle nesting beaches in South Africa south of the Mozambique border, where nesting also occurs, stretch almost continuously for 200 km (Fig. 1). The beaches are mainly silica sand beaches rising steeply and reaching heights of 100 m above sea level. Within 20–50 m of the highwater mark, dunes are covered with forest. On the primary dunes sand stabilization is accelerated by *Scaevola* spp. (see Hughes, 1974b). The coastline is high energy with the dominant wave direction coming from the southeast. The coast is a series of long (4–5 km) slightly curving bays punctuated by occasional rocky headlands of dune rock. Sub-tidal rocky formations are found near the shoreline with intermittent, obstruction-free approaches to the beach characterized by strong rip-currents.

In 1979 after many years of campaigning, the first section of the coast from Cape Vidal to just north of Sodwana Bay was declared as the St. Lucia Marine Reserve. Six years later in 1986, the remainder of the northern coast was proclaimed as the Maputaland Marine Reserve. The combined protected area covers 150 km of sandy beaches along which leatherbacks nest fairly evenly at specified sites normally associated with rip-currents.

Nesting seasons vary little for leatherbacks – the first females arriving in late October and the last departing in mid-February. The beaches are shared by a significant nesting population of loggerhead turtles *Caretta caretta* (over 400 females per season). There is no apparent competition for nesting sites between the two species, nor is there any conflict with the non-breeding green and hawksbill turtles found offshore. Olive ridleys occur rarely offshore.

METHODS

Patrol Area. — The monitoring of the protection program has now continued for 32 seasons without interruption. Methods as described by Hughes (1974a; 1974b) have remained virtually unchanged. The original protection site was ca. 56 km in length and by the third year the patrol routine had become fairly established. From the station at Bhanga Nek, two-person foot patrols go out each night at 1930 h, each patrol covering 8 km out and 8 km return to camp. These patrols, which cover the main loggerhead beaches, are normally led by a student. At regular intervals, some 10 km apart, camps are established from which guards, drawn from the local community, patrol each night and each morning. These local staff are trained to tag and measure turtles. At least one full vehicle patrol, covering the entire 56 km area, is carried out each night and varies according to the tides.



Figure 1. The sea turtle nesting beaches of Tongaland, KwaZulu-Natal, South Africa.

Since the 1983–84 season an additional 93 km of beach has been patrolled, but in a more irregular and erratic manner (Fig. 1). The methods used are regularly reviewed and are included in the St. Lucia Marine Reserve Management Plan (Natal Parks Board, 1985).

Measurements. — Hughes (1974a) reported on carapace length (CL) measurements taken by both straightline and over-the-curve methods, but since then overthe-curve measurements of leatherbacks have been taken for convenience. This is fairly standard practice on leatherback nesting beaches (see e.g., Pritchard, 1971). Length measurements are recorded to the nearest 5 mm from the center of the notch on the anterior of the carapace along the central ridge to the tip of pointed posterior end of the carapace.

Tags. — Hughes (1974a; 1974b) described the different types of tags used on leatherbacks between 1963 and 1974. Monel tags (Kentucky Band and Tag) were used from 1969 up until 1984 when Titanium tags (Stockbrands, Australia) have been in use whenever possible. Due to poor service from Stockbrands, it has occasionally proved necessary to use a mixture of Monel and Titanium tags.

As a result of extremely poor tag recoveries, damage caused by tags to the carapace during digging, and indications that the tags were eroding out of the foreflippers, by 1974 the preferred tag site had been changed from the trailing edge of the foreflipper to the inner side of the hindflipper and this site has been in use for the past 20 years (see Hughes, 1982). Tag sites are carefully checked for indications of tag loss and where found are recorded as calluses (fibrotic tag scars).

Records. — Every nesting female encountered by patrols is measured and tagged or her identity, if previously tagged, recorded. The beach within the survey area is marked by poles 400 m apart and emergences are recorded to within 400 m. Nests are recorded but are not marked or interfered with in any way. There is no necessity for nest protection at present.

An annual report (see e.g., Hughes and Llewellyn, 1995) on the turtle protection program is prepared each year and all results are recorded in the Natal Parks Board Yearbooks (see e.g., Natal Parks Board, 1994).

RESULTS

In general there have been no significant changes observed in the leatherback population nesting in South Africa and color descriptions etc., as reported by Hughes (1974) remain valid. The additional 20 years of monitoring have produced additional data worth recording.

Population Size. — The results of the 32 years of monitoring are shown in Fig. 2, demonstrating a gentle but steady increase in the numbers of leatherback females nesting within the 56 km survey area. Table 1 records these data along with figures of females recorded in the extended protected area with the highest number ever recorded in a single season being 124 individually recognized females – either new, with calluses, or recoveries from previous seasons during 1994–95.

Within the survey area the average number of females handled each year during the first ten years of study (1976–85) was 24 and in the last ten years (1986– 95) was 86, a very rewarding 258% increase. The overall average for the extended protected area (including the 56 km study area) for the last ten years is 113 nesting females with the highest number of females accounted for being 164 in 1994–95.

Carapace Length. — Hughes (1974a) provided detailed measurements of leatherback females which did not indicate any significant differences between the Tongaland population and other known populations. This has not changed, but a sample of the mean carapace length of every measured female from the first five years of study (1963–67) (CL = 162.2 cm, n = 41) has been compared with the mean carapace length of females measured in the 1994–95 season (CL = 159.6 cm, n =156) (Fig. 3). There is a significant difference between the two samples with the mean carapace length having become smaller, suggesting the presence – as could be expected – of many more younger and smaller females in the more recent sample.



Figure 2. Tongaland leatherback nesting population numbers and remigrations. Data are from the 56 km of Maputaland Marine Reserve protected area only. The curves represent computer-generated "best lines of fit."

Table 1. A summary of leatherback nestings and remigrations in Tongaland, 1963–95. Data are from the 56 km of Maputaland Marine Reserve protected area only. Data on calluses are very dubious because of difficulty of scar recognition.

Season	Total Turtles	New Turtles	Percent New	Tagged Remigrants	Turtles with Calluses	Percent with Calluses	Percent Total Remigrations
1963-64	18	18	100.0	0	0	0.0	0.0
1964-65	13	12	92.3	1	0	0.0	77
1965-66	27	25	92.6	2	0	0.0	7.4
1966-67	5	3	60.0	1	1	20.0	40.0
1967-68	18	18	100.0	0	0	0.0	0.0
1968-69	19	14	73.7	5	0	0.0	26.3
1969-70	28	17	60.7	6	5	17.9	39.3
1970-71	17	12	70.6	3	2	11.8	29.4
1971-72	39	33	84.6	3	3	7.7	15.4
1972-73	21	17	81.0	1	3	14.3	19.0
1973-74	54	46	85.2	7	1	1.9	14.8
1974-75	63	55	87.2	6	2	3.2	12.7
1975-76	65	46	70.8	16	3	4.6	29.2
1976-77	58	33	56.8	20	5	8.6	43.1
1977-78	70	34	48.6	35	1	1.4	51.4
1978-79	63	35	55.6	25	3	4.8	44.4
1979-80	79	45	57.0	30	4	5.1	43.0
1980-81	83	46	55.4	30	7	8.4	44.6
1981-82	65	31	47.7	28	6	9.2	52.3
1982-83	65	38	58.5	26	1	1.5	41.5
1983-84	56	29	51.8	24	3	5.4	48.2
			 Titanium Ta 	gs Introduced -			1012
1984-85	67	35	52.2	28	4	6.0	47.8
1985-86	64	36	56.3	21	7	10.9	43.8
1986-87	86	67	78.0	16	3	3.5	22.1
1987-88	89	56	62.9	23	10	11.2	37.1
1988-89	88	69	78.4	16	3	3.4	21.6
1989-90	83	57	68.7	19	7	8.7	31.3
1990-91	80	58	72.5	15	7	8.8	27.5
1991-92	77	44	57.1	26	7	9.1	42.9
1992-93	116	82	70.7	29	5	4.3	29.3
1993-94	57	35	61.4	18	4	7.0	38.6
1994-95	124	98	79.0	34	2	1.6	29.0



Figure 3. Tongaland leatherback carapace lengths for 1964-68 (mean = 162.2 ± 6.8 cm) and 1994-95 (mean = 159.6 ± 9.4 cm).

Nesting. — Information on nesting behavior, migrations, etc., still depend on the success of the external tag. There is no doubt that the change from Monel to Titanium tags in 1984 has improved the quantity of data collected and the change from foreflipper to hindflipper tagging has also improved the flow of information (see Hughes, 1982) (Fig. 1, Table 1).

(1) Nesting Lifetimes. After 32 years of study the data collected remain insufficient to indicate the full nesting lifetime of a leatherback female. A total of 1329 females has been tagged between the 1969-70 and 1993-94 seasons of which 1017 (76.5%) have not been observed again. We know that a percentage (certainly an underestimation) of 8-10% of females encountered each year bear calluses indicating that they have been tagged before but the vast majority of females appear to nest once and are never encountered again. It could be argued that they shed their tags but this is not proven as each female is inspected with care for tag scars. Certainly some scars are missed but never 76.5% every season. Observed remigration rates averaged 30.5% for the 1964-84 seasons before the introduction of Titanium tags, and 33.7% for the 1984-95 seasons.

There is no doubt that each female has the potential to nest many times over many years. Only two females have been recorded nesting in 7 different seasons. The longest recorded nesting lifetime is by female C52/53 (later K018) who spread her nesting endeavors over an 18 year period. The number of females recorded nesting for periods exceeding 9 years (n = 29) is illustrated in Fig. 4.

(2) Remigration Intervals. In 1982 Hughes questioned the assumption that regular nesting cycles were typical of sea turtles and suggested that although regular cycles were certainly exhibited by some, this could not be assumed to apply to every female. Table 2 shows the recorded remigration intervals of 123 leatherback females between 1969-70 and the 1993-94 seasons. It is clear that irregular intervals between nesting seasons are more frequent than regular intervals. The problem with nesting turtles moving north of the protected area to Mozambique (P. Lombard, pers. comm.), and thus being missed every few years, would certainly confuse the records but there can be no doubt that females are capable of varying their nesting intervals. The remigration intervals (n = 513) recorded from 1969–70 to 1993–94 are shown in Fig. 5. Two year intervals dominate (44.8%) with three year intervals the next most frequent (29.2%). A small number of females (1.9%) have nested in consecutive seasons.

(3) *Predation*. The removal of feral dogs in the 1960s reduced nest predation to near zero and it is only now during the 1995–96 season that side-striped jackals (*Canis adjustus*) appear to have learned to rob nests. Dozens of nests have been dug up by jackal, some waiting next to the nesting female until she has completed her laying before digging up the eggs.

Migration. — Table 3 lists all recoveries of leatherbacks away from the nesting beaches since the beginning of the program in 1963. There are no very long distance recoveries nor can any deductions regarding post- or pre-



Figure 4. Observed nesting lifetimes of Tongaland female leatherbacks expressed as the interval between the earliest and latest observations of each nesting individual. Data are presented only for those animals exceeding 9 years reproductive observations.



Figure 5. Frequency of observed remigration intervals of Tongaland female leatherbacks.

nesting behavioral movements be derived from these data. The recovery of a female leatherback from Madagascar is the most interesting recovery, being the first from that area, although there have been numerous recoveries from Madagascar of loggerhead *Caretta caretta* females tagged in Tongaland (see Hughes, 1989). There are no records of any leatherback tagged in southeast Africa nesting anywhere else in the world.

Table	e 2. Mu	ltiple	remigration	intervals	recorded	for	123	leather-
hack	females	in T	ongaland.					

Intervals (Years)	\overline{n}	Intervals (Years)	n	Intervals (Years)	п
2.1	1	3.2	8	4.2.2	1
3.3	23	3.2.1	2	4.2.3.3	1
2.2.1.1	1	3.2.2	1	4.2.4	1
2,2.2	6	3.2.2.2	1	4.3	1
2.2.2.1.2.2	1	3.2.2.2.2	1	4.3.4	1
2.2.2.2	2	3.2.2.5	1	4.4.4	1
2.2.3	1	3.2.3	2	5.2	1
2.2.3.2	1	3.2.3.2	1	5.2.5.3	1
2.2.3.3.2.5	1	3.2.4	1	5.3	1
2.2.4	1	3.3	7	5.6	1
2.3	12	3.3.2	3	5.9	1
2,3.2	4	3.3.3	1	6.2	1
2.3.3	1	3.3.3.3	1	6.4	2
2.4	2	3.3.6	1	7.2.1.3.2	1
2.4.2	1	3.4	1	7.3	1
2.4.3	1	3.4.5.3	1	9.3	1
2.4.5.2	1	3.5	2		
2.5	2	3.5.5	1		
2.5.3	1	3.6	1		
2.6	1	3.6.3	1		
28.2.3	1				

DISCUSSION

Prior to 1963, loggerhead turtles were killed on the beaches and probably the majority of nests robbed. There are no records of leatherback females being killed. With the almost total elimination of nest predation by people, the past 32 years of protection has seen significant improvements in the survival of the leatherback population of Tongaland. The steady increase in the numbers of nesting females over this time has been a most rewarding result of the protection efforts and has shown that it is possible to effect recovery of even very reduced populations. It is worth remembering that in the 1966–67 season only 5 nesting females were seen during the entire season.

Although most of the fundamental nesting behavior recorded between 1963 and 1973 and published by Hughes (1974a; 1974b) has been confirmed in the next 23 years thereafter, the growing body of data is gradually and steadily increasing our knowledge of this magnificent animal.

Formal relations with the Mozambique Department of Fauna Bravia has resulted in the extension of the monitoring program into southern Mozambique and some protection is now being offered the animals nesting north of the border. This protection is expected to improve as it is our belief that during the years of civil war virtually every animal that nested was killed.

Table 3. International and national tag returns of Tongaland leatherbacks away from nesting grounds.

Tag No.	Date Tagged	Date Recovered	Locality	Coordinates	Distance (km)	Notes
B235/B236	7 Dec 1971	10 Dec 1972	Beira, Mozambique	19°50'S, 34°55'E	1000	Netted at sea
R470	11 Feb 1984	7 Feb 1992	Richards Bay, South Africa	28°50'S, 32°08'E	250	
\$470	1986-87 season	28 Oct 1989	Inhassoro, Mozambique	21°40'S, 35°10'E	820	Netted 8 km offshore
1576	8 Dec 1988	22 Oct 1991	Battery Beach, Durban, South Africa	29°55'S, 31°00'E	400	Caught in shark nets
X387	16 Dec 1989	28 Feb 1993	Fenérife, Madagascar	17°20'S, 49°15'E	2600	
AA583	16 Jan 1992	Apr 1992	Sinkwazi, South Africa	29°18'S, 31°25'E	320	

What is more, a lucrative tourist industry is developing around the nesting turtles, thereby creating employment and revenue-earning opportunities for the local community. The Natal Parks Board runs nightly guided tours in open vehicles from Sodwana Bay, guided trails are carried out from a private sector resort at Rocktail Bay, and guided trails on foot are also carried out from the KwaDapha Community Resort near Bhanga Nek using local AmaThonga guides trained by the Board. Our sister organization, the KwaZulu Department of Nature Conservation, also guides groups of visitors on foot. The demand for these tours – both on foot and by vehicle – is growing exponentially and they are enormously valuable for environmental education as well as for gaining support for sea turtle conservation.

As a result of their very existence, the leatherbacks are now providing benefits in a far more sustainable manner than when conservation authorities first stopped the exploitation of eggs in 1963.

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LITERATURE CITED

- HEWITT, J. (Ed.). 1937. A guide to the vertebrate fauna of the Eastern Cape Province, South Africa. 2. Reptiles, Amphibians and Freshwater Fishes. Grahamstown, Albany Museum.
- HUGHES, G.R. 1974a. The sea turtles of South East Africa. I. Status, morphology and distributions. Inv. Rept. Oceanographic Research Institute, Durban 35:1-146.
- HUGHES, G.R. 1974b. The sea turtles of South East Africa. II. The biology of the Tongaland loggerhead turtle (*Caretta* caretta) L. with comments on the leatherback turtle (*Dermochelys coriacea*) L. and the green turtle (*Chelonia* mydas) L. in the study region. Inv. Rept. Oceanographic Research Institute, Durban 36:1-96.
- HUGHES, G.R. 1982. Nesting cycles in sea turtles typical or atypical? In: Bjorndal, K.A. (Ed.). Biology and Conservation of Sea Turtles. Proc. World Conf. on Sea Turtle Conservation. Washington DC: Smithsonian Inst. Press, pp. 81-89.
- HUGHES, G.R. 1989. Sea turtles. In: Payne, A.I.I., and Crawford, R.J.M. (Eds.). Oceans of Life off Southern Africa. Vlaeberg, Cape Town, pp. 230-243.
- HUGHES, G.R., AND LLEWELLYN, J. 1995. The Tongaland Sea Turtle Project, 1 April 1994 - 31 March 1995. Natal Parks Board Int. Rept., 5 pp.
- MCALLISTER, H.J., BASS, A.J., AND VAN SCHOOR, H.J. 1965. Marine turtles on the coast of Tongaland, Natal. Lammergeyer 3(2):10-40.
- NATAL PARKS BOARD, 1985. St. Lucia Marine Reserve Management Plan. Natal Parks Board, Pietermaritzburg, 50 pp.
- NATAL PARKS BOARD. 1994. Yearbook 1993/94. Natal Parks Board, Pietermaritzburg, 1096 pp.
- PRITCHARD, P.C.H. 1971. The leatherback or leathery turtle, *Dermochelys coriacea*. IUCN Monographs, Marine Turtle Series, No. 2, 30 pp.
- SMITH, A. 1849. Appendix to Illustrations of the Zoology of South Africa. Reptiles. London, 28 pp.

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