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THE NESTING DYNAMICS OF SEA TURTLES AT KARACHI COAST

Fehmida Firdous[1], Solaha Rahman[2] and Sohail Barkati[2]

[1]*Sindh Wildlife Department, Karachi, Pakistan.*
[2]*Department of Zoology, University of Karachi, Karachi, Pakistan.*
e-mail: sohailbarkati@yahoo.com

ABSTRACT

Extensive ground surveys and patrolling trips were made along the sandy beaches of Karachi coast, Sindh for a period of 19 years (1979 – 1997) to study nesting grounds, nesting frequency and nesting season of green turtle (*Chelonia mydas*) and olive ridley (*Lepeidochelys olivacea*). The number of nests made in a month by green turtle ranged from 13 (May) to 197 (September) whereas that of Olive ridley varied from 1 (March & May) to 19 (August).

The nests of olive ridley are shallower than those of green turtle. Nesting of green turtle occurred throughout the year with peak in September (20.82 %). Nesting of olive ridley was observed during June to August with peak in August (49.7 %). Nesting was inversely proportional to tidal level and water temperature.

Intensity of nest forming in green turtles was markedly less during the first six months of the year compared to last six months. Arribada or mass nesting was not observed on the coast of Sindh.

Key words: Green turtle, olive ridley, nesting frequency, nesting season

INTRODUCTION

Marine turtles are universally acknowledged as endangered species (Groombridge, 1982) due to overexploitation, poaching and habitat destruction particularly on nesting and feeding grounds. Industrial debris, beach development activities and intensive illumination due to construction of highways were also proved to be detrimental to the habitat of turtles.

Information on nesting grounds of marine turtles in different parts of the world are contained in many publications (FAO, 1968, 1973; Hughes, 1971; Frazier 1972, 1975a; Salm, 1975a; Schulz, 1975; Servan, 1976; Ghalib and Zaidi, 1976; Ross, 1979; Stancyk *et al*., 1980; Lutz and Musick, 1997).

Hawkesbay and Sandspit beaches along the coast of Karachi, Sindh, Pakistan are world known nesting grounds of green turtles (Kabraji and Firdous, 1984). Hirth (1971) categorized Hawkesbay as a major nesting site in the eastern hemisphere of the world. Of the seven or eight marine turtle species in the world (Lutz and Musick, 1997), only two i.e. green turtle (*Chelonia mydas*) and olive ridley (*Lepidochelys olivacea*) are seen nesting at Hawkesbay and Sandspit beaches of Karachi, Sind. Although knowledge about nesting of sea turtles on Sindh coast is contained in many papers, most of these are either based on indirect observations, survey reports or preliminary remarks. Ghalib and Zaidi (1976), however, provided some information on breeding season, nesting behavior, predation etc. of the green turtle.

The present communication, first of a comprehensive study on turtles, deals with the nesting grounds, nesting season and nesting frequency of green and olive ridley turtles from the Karachi coast.

MATERIALS AND METHODS

Extensive survey trips were made during the course of the present study for a period of 19 years (1979 to 1997) along the Sindh coast of Pakistan. The sites of intensive investigation were Hawkesbay and Sandspit. Although surveys were mostly conducted using a four wheel drive to visit and monitor the study sites, facilities of motor boat and helicopter were sometime used. While collecting data special attention was focused on the nests, nesting turtles, hatchlings, turtle tracks etc. A vernier caliper and a flexible tape were used to measure the dimension of the flat and curved surface of the shell, respectively. Similarly, the diameter and circumference of the eggs were measured.

RESULTS

Study Area: The two study sites, Sandspit (24 47 – 24 52 N) and Hawkesbay (66 50 – 66 59 E), are about 5 and 7 km, respectively, long sandy beaches located southwest of Karachi. It is thus a 20 km long sandy beach including a strip of about 8 km in between the two beaches. The temperatures at Sandspit and Hawkesbay are relatively higher than the adjoining sites. Sea water temperature, up to 10 meter depth, ranged from 21^{o}C in February to 30^{o}C in

June/July. The tidal pattern is semi-diurnal type with two high and two low tides per day. Tidal range is between 1.41 and 2.43 m. Humidity is relatively higher in the early morning and it decreases as the day proceeds. Noise pollution created by boats during fishing operation at night disturbs the nesting turtles as well as their egg laying sequence.

Nesting & Feeding grounds: Both species of turtles, green and olive ridley, nest on most sandy coves and stretches of gently sloping beaches of Hawkesbay and Sandspit. The nesting sites on the beach may be located through large number of tracks and nest pits. The turtles were found nesting all along the 20 km strip of Sandspit continuing into Hawkesbay.

The beach platform is high enough to keep turtles above high tide mark for nesting all the year round save that of monsoon period (May - August) when it is inundated by high tide. The area behind Sandpit is marshy and low-lying with mangrove forests where turtles and hatchlings may get stranded sometimes when they lose orientation due to bright transport lights coming from Karachi city.

Nesting Process:

i. Green Turtle (*Chelonia mydas*): Nesting occurs at night after sun set. Female turtles emerge from sea usually from 10 p.m. to 2 a.m. However, in the peak nesting season, August to November (Table I), turtles are seen nesting on the beach as early as 8 p.m. In winter months (December, January) occasional turtles were observed in early morning between 4 and 6 a.m. and completed nesting even after sunrise. This unusual nesting was observed only four times during the whole study period from 1979 to 1997. Very few turtles were observed busy in covering the nest even at sunrise probably came late for nesting at night.

Green turtles forward their body while coming up on the beach, spent some time in the shallow water, touch the sand with their plastron and move their heads up and down from time to time to inspect the surroundings. If there is no disturbance, the turtles approach the water mark and climb straight on the soft, dry sandy beach with several throaty noises.

They progress by advancing both their front flippers together and literally dragging themselves forward; the hind flippers also help to push them forward. The whole body is not raised from the ground, the simultaneous pulling and pushing of both flippers help the turtles to make a series of these movements and then take rest with their belly on the sand.

Digging of body pit is done with the help of front and back flippers and plastron rests on the sand. The flippers sweep the sand far to the rear. The turtles move a little bit forward and make the pit bigger gradually and slowly. Turtles during digging take rest repeatedly and put their head on the sand and rise after sometime, take a deep breath and resume digging.

The body pit is roughly ovoid in shape and 30 to 40 cm deep. As the excavation of body pit is completed, the fore- flippers stop to move and the hind- flippers scrape and push the sand backward for 5-10 minutes. The hind flippers dug a deep hole, the egg pit, measuring 40 to 60 cm from the body pit and about one meter from the surface of the sand above the ground. The egg pit is a deep narrow cylindrical cavity, wider at the bottom and oval in the horizontal section.

The weight of eggs ranged from 46 to 61 g (average 53.2 g). Minimum and maximum number of eggs laid per nest is 7 and 194, respectively with an average of 86 eggs per clutch.

The process of nesting is completed in 3 to 5 hours.

ii. Olive ridley (*Lepidochelys olivacea*): The nesting process of olive ridley is little different from the green turtle.

The olive ridley moves its limbs faster on land and also during digging. Ridley is not as shy as green turtle. They do not seem to be much bothered by lights, dogs and picnickers.

The olive ridley was always found nesting after dark i.e. from 8 p.m. to just before sunrise.

The most obvious distinguishing feature of olive ridley nesting is its behaviour after laying the eggs. The turtle pound down the sand over the nest with up and down and side to side movements of the plastron.

The nest olive ridley is shallower than that of green turtle, only 30-40 cm deep owing to the smaller size of flippers and shallowness of body pit (15 cm deep). The nest hole is as deep as the length of hind flippers, about 40 cm (Kabraji and Firdous, 1984).

The digging movement including flicking back of sand with hind flipper is similar as described for the green turtle. During laying eggs, the turtles breathe heavily, shed tears and occasionally raise their heads with a great sigh,

Of the sea turtles, ridleys lay the smallest eggs, with weight ranges from 30 to 40 gm (average 35 gm). Average number of eggs laid per nest is 186 with a minimum of 45 (average 110 eggs per clutch).

The most remarkable feature of nesting is the thumping action during covering of the pit. After sand has been pulled into the egg containing cavity by alternate movement of hind flippers they commence pounding in order to compact the sand that is pushed over the nest's hole by the hind flippers between the series of strokes.

The nesting process is completed in about one to one and a half hours.

Nesting Season

i. Green Turtle: Although nesting was seen all the year round, the period of maximum nesting was August to November (post monsoon) with peak in September (21%) when 197 nests were transplanted (Table I). During the period August to November the temperature was moderate (25-30 ^{o}C), the tidal action was also normal (between 1.32 and 1.91m) being the post monsoon season. Whereas nesting was extremely poor in monsoon season (May to July) with lowest in May (1.33 %). The rate of nesting decreased from December to February presumably due to the decrease in temperature.

ii. Olive Ridley: Unlike green turtle, nesting and egg laying of olive ridley was found during few months only (Table 1). Larger number of nests were recorded during the months of July and August (Table 1). It means that the nesting of this species begins during the monsoon period and ends post monsoon. They were seldom seen nesting in other months of the year. Total number of olive ridleys observed at Sandspit and Hawkesbay for nesting was far lesser than the green turtle. Maximum percentage of nesting was 49.7% during August and minimum (0.15%) during March, May and June.

No mass nesting or arribadas were observed on Karachi coast or reported on any other nesting beaches along Baluchistan coast. Turtles were very rarely seen coming for nesting in numbers greater than five. Moderate temperature and tidal action seemed to favour nesting (data available with the first author).

Nesting Frequency

i. Green Turtle: Turtles were divided into following three size groups (measured as curved carapace length):

I, 86.00-96.49 cm; II, 96.50-106.99 cm; III, 107.00-117.49 cm

Turtles of size group I were seen nesting throughout the study period (1983 – 1996) but more so from August to November. Maximum number of nests of green turtle at Sandspit were formed in October 1995 when 53 females of size group II came ashore for nesting (Table 2). Size group II dominated the three size groups whereas the size group III showed the lowest number.

Frequency of nesting for each size group is minimum during the months of April and May as these are the months of onset of monsoon and high temperature which are not preferred by nesting females. Similar was the case for nesting of green turtles at Hawkesbay (Table 3). Turtles of size group I were found nesting all the year round with maximum frequency from August to November. Minimum nesting frequency was observed from March to May.

Number of nesting females were more at Sandspit than at Hawkesbay.

ii. Olive ridley: Olive ridley turtles were divided into following three size groups:

I, 71.0-74.9 cm; II, 75.0-78.9 cm; III, 79.0-82.9 cm.

Tables IV & V show annual variations during each month in the number of olive ridley turtles of following three size groups (measured as curved carapace length) nested at Sandspit and Hawkesbay, respectively during the period from 1983-1996:

Unlike green turtles the nesting frequency of olive ridley was observed only during the month of July &August and a little bit in September. Olive ridley was found only once during other months of the year. For instance, in March 1995 an olive ridley of size group II laid eggs at Sandspit. In May 1985 a ridley of size group I laid 129 eggs at Sandspit. Peak nesting frequency was observed in the months of July, August & September when maximum number of turtles made nests mostly at Sandspit.

Seasonal and Annual variations in Nesting

i. Green Turtle: Annual changes in the number of nests formed by green turtle (*Chelonia mydas*) at Karachi coast (both sites combined) from 1979 to 1997 are given in Fig. 1. Values of Coefficient of Variation over years (C.V.) are given in Fig. 3.

Minimum number of nests (227) in the study period were formed in May (C.V., over years 184.6 %; Fig. 3) whereas maximum number of nests (3549) were formed in September (C.V., over years 40.1 %).

The number of nests formed by turtles and transplanted to the enclosures were markedly less during the first six months of each year compared to the last six months (Fig. 1)

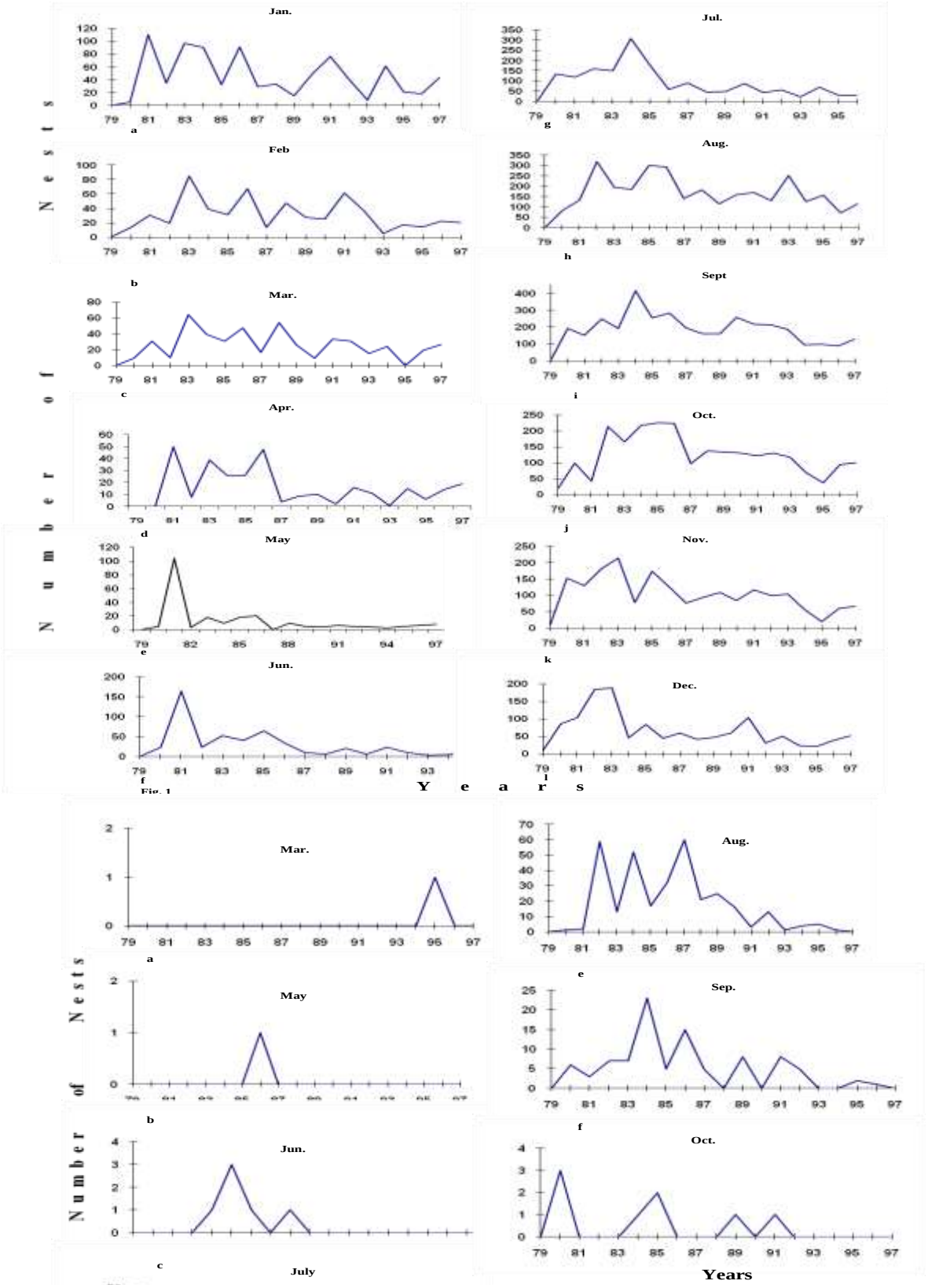

Fig. 1. Annual changes in the number of nests of green turtle (*Chelonia mydas*) from Karachi coast (both sites combined) during the study period (1979-1997).

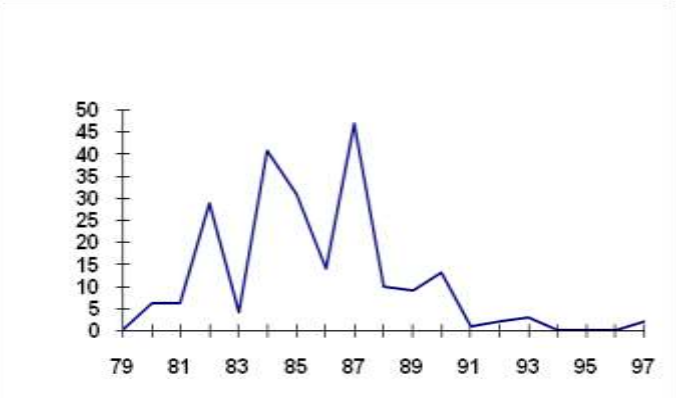

Fig. 2. Annual changes in the number of nests of olive ridley turtle (*Lepidochelys olivacea*) from Karachi coast (both sites combined) during the study period (1979-1997).

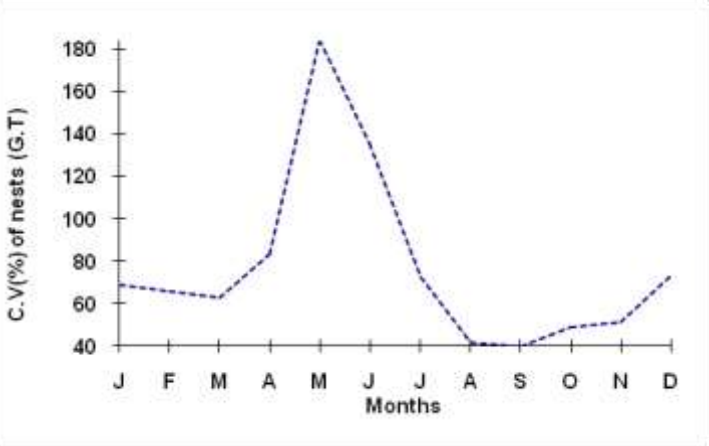

Fig. 3. Seasonal variation in coefficient of variation of number of nests formed by green turtle (*Chelonia mydas*) at Karachi coast (both sites combined) during the study period (1979-1997).

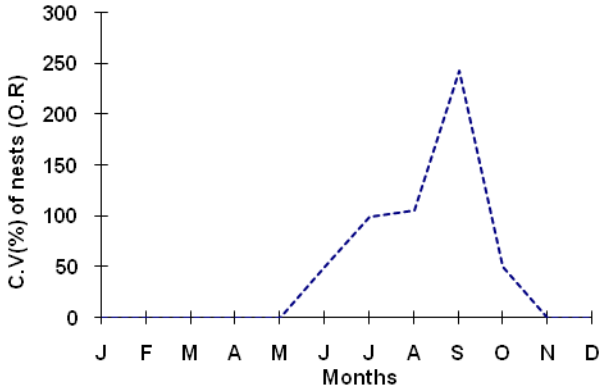

Fig. 4. Seasonal variation in coefficient of variation of number of nests formed by olive ridley turtle (*Lepidochelys olivacea*) at Karachi coast (both sites combined) during the study period (1979-1997).

Table 1 Seasonal variations in the number of nests made and eggs laid during various calendar months by the two species of the turtle at Sandspit & Hawkes Bay (combined); the figures are averages of the study period (October 1979 to December 1997). G.T.; Green Turtle (*Chelonia mydas*), O.R.; Olive Ridley (*Lepidochelys olivacea*).

S.No.	Months	No. of Nests						No. of Eggs	
		G.T			O.R			G.T	O.R
		Average	S.D.	% Nesting	Average	S.D.	% Nesting		
1	January	48	33	5	-	-	-	3752	-
2	February	32	21	3.34	-	-	-	2621	-
3	March	27	17	2.86	1	-	0.15	2137	119
4	April	18	15	1.78	-	-	-	1411	-
5	May	13	24	1.33	1	-	-	1072	137
6	June	28	38	3	2	1	0.15	2496	173
7	July	99	72	10.5	15	15	33.33	8780	1676
8	August	174	73	18.38	19	20	49.7	15096	2340
9	September	197	79	20.82	7	17	14.53	17142	867
10	October	126	62	14	2	1	1.22	10914	177
11	November	103	53	11.51	-	-	-	8618	-
12	December	67	49	7.48	-	-	-	5486	-

In the first half of the year the number of nests formed varied from a minimum of 1 (March, 1995 and April, 1993) to a maximum of 308 (July, 1985). In the second half the minimum number of nests (11) were formed transplanted during December 1979 and maximum (416) during the month of September 1984 (Fig. 1).

Overall results of annual changes in number of nests formed indicate that data is more consistent during the months of August, September and November; the consistency of data is at maximum as evidenced by the low value of Coefficient of Variation (40.1 – 51.4 %) as compared to other months (62.9 – 184.6 %).

Seasonal changes in the number of nests of green turtle at Karachi coast (both sites combined) are shown in Fig. 1 for the period from 1980 to 1997. The number of nests formed during this period ranged from a minimum of 1 (April, 1993) to a maximum of 104 (May, 1981). Two peaks, a minor and a major were observed each year. The minor peak seemed to occur during first six months i.e. January to June of every year (Fig. 1; a-f) and the major peak during the last six months (July to December) indicating that maximum nesting occurred during this period. More precisely, September is the peak month for nesting during the whole season almost every year throughout the study period.

The number of nests formed during peak nesting month (September) varied from a minimum of 90 (1996) to a maximum of 416 (1984; Fig. 1 c). The minimum nesting was observed during the months of April and May every year; no nesting was observed in May 1997.

ii. Olive Ridley: Annual and seasonal changes in the nests formed by olive ridley (*Lepidochelys olivacea*) at Karachi coast (both sites combined) during the period from 1980 to 1987 are given in Figs. 2 and 4.

A total of 654 nests were seen and transplanted to the protected enclosures during the study period with a minimum of 6 nests during the month of March (showing the lowest Coefficient of Variation i.e. C.V. (50.0 %), indicating the highest consistency of data during this month. A maximum of 325 nests were formed during the month of August with 105.2 % C.V. indicating relatively less consistency in the data during this month (Fig. 4). The data is least consistent in September with the highest C.V. (242.8). July to September is the peak season of olive ridley nesting at Karachi coast (Fig. 2 d, e & f). Occasional nesting may be observed in July and October. Not a single turtle was observed nesting in January, February, April, November and December during the nineteen years of study period.

Table 2. Annual variations in the number of green turtles (*Chelonia mydas*) of three size groups (measured as curved carapace length,CCL) from Sandspit, Karachi: size groups I, 86.00-96.49; II, 96.50-106.99; III, 107.00-117.49 cm.

S.No.	Year	January			February			March			April			May			June			July			August			September			October			November			December		
		I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
1	1983	2	1	-	-	-	-	1	-	-	-	2	1	-	-	-	7	6	2	3	4	-	10	8	-	-	1	-	4	5	1	3	9	2	1	2	-
2	1984	1	1	-	-	-	-	1	1	-	1	-	-	-	-	-	6	-	-	6	5	-	6	8	1	5	9	1	6	6	-	7	8	1	1	-	-
3	1985	1	3	-	1	1	-	-	1	-	1	-	-	3	1	-	3	-	1	1	4	1	6	9	-	5	11	-	9	13	2	2	13	4	2	10	-
4	1986	1	3	-	-	2	-	1	6	-	1	3	1	-	-	-	2	6	2	5	14	-	4	12	-	5	35	4	5	15	6	5	6	-	-	1	-
5	1987	-	-	-	1	1	-	1	1	-	-	1	-	-	-	-	1	-	-	4	14	1	10	27	2	10	10	2	9	15	-	1	11	-	-	4	-
6	1988	-	7	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	2	16	1	2	9	2	5	12	2	-	3	1	2	3	-	-	3	-
7	1989	-	2	-	-	-	-	-	-	2	1	-	-	1	-	-	1	2	-	2	13	1	3	6	1	10	27	2	3	16	-	4	16	1	1	3	-
8	1990	-	7	-	-	4	1	2	-	1	-	-	-	-	-	-	-	-	-	1	3	-	6	14	1	9	31	4	1	8	-	4	10	3	-	9	-
9	1991	-	3	2	-	-	-	2	1	-	3	3	1	-	-	-	6	-	-	1	13	1	3	12	1	3	13	1	-	12	1	2	16	2	2	11	1
10	1992	2	5	1	1	-	-	2	2	-	1	1	-	-	-	-	1	-	-	1	2	1	2	2	3	4	18	2	2	7	1	-	8	1	1	5	-
11	1993	-	2	-	-	1	-	-	-	1	-	-	-	-	1	-	-	5	1	9	17	3	10	22	3	8	14	1	1	3	-	4	8	-	3	16	-
12	1994	1	-	1	1	-	-	4	-	-	3	1	1	-	-	-	-	-	-	-	7	-	1	3	-	-	1	-	1	4	1	3	7	-	-	-	-
13	1995	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	1	1	1	-	3	13	-	9	18	5	19	53	4	2	16	1	3	7	1
14	1996	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	1	1	-	1	6	1	9	11	4	1	9	-	1	21	4	8	14	3	-	19	1

Table 3. Annual variations in the number of green turtles (*Chelonia mydas*) of three size groups (measured as curved carapace length,CCL) from Hawkes Bay, Karachi: size groups I, 86.00-96.49; II, 96.50-106.99; III, 107.00-117.49 cm.

S.No.	Year	January			February			March			April			May			June			July			August			September			October			November			December		
		I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
1	1983	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	3	2	-	-	-	-	2	5	-	2	1	-	-	2	-	3	9	1	1	8	-
2	1984	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2	-	-	1	-	-	-	2	-	-	1	-	2	6	-	-	1	-	-	-	-
3	1985	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	8	13	1	-	5	6	1	2	2	-	2	2	1	5	7	3	1	1	-
4	1986	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	2	-	-	-	16	-	4	10	1	-	13	1	1	7	1	1	1	-
5	1987	-	-	-	-	-	1	1	1	-	-	-	-	-	-	1	3	1	-	1	-	-	2	11	3	5	18	2	3	2	-	3	6	1	4	10	2
6	1988	4	7	-	-	1	-	-	1	-	2	-	-	-	-	2	7	1	2	8	4	2	2	8	1	2	9	3	-	3	1	1	5	-	3	6	-
7	1989	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	1	1	-	5	-	-	1	4	1	1	12	3	5	17	1	1	3	-	-	9	1
8	1990	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	6	-	-	3	10	-	5	19	1	1	9	3	-	5	-	1	5	-
9	1991	1	17	-	1	2	-	-	1	-	-	1	-	-	-	-	3	9	-	-	-	-	-	-	-	-	11	4	1	13	2	-	1	-	-	4	-
10	1992	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	1	4	-	-	5	-	1	8	2	2	6	1	-	3	-
11	1993	-	1	1	-	1	-	-	-	-	-	-	-	1	-	-	-	-	4	18	3	-	6	7	-	5	18	1	3	3	2	1	4	1	2	3	-
12	1994	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	7	-	-	2	-
13	1995	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	1	1	-	26	55	8	14	32	8	11	33	4	10	31	2	-	3	-
14	1996	5	12	-	1	-	-	-	-	-	-	-	-	1	-	-	-	1	19	1	-	4	9	3	9	42	4	13	95	5	7	54	14	2	13	4

Table 4. Analysis of variance of evaluated traits in soybean (maturity group IV) in normal and stress sites

Source of variation	df	MS											
		Number of node per plant		Number of sub branch		Number of pod per plant		Number of seed per plant		100-seed weight per plant		Seed yield	
		N	S	N	S	N	S	N	S	N	S	N	S
Block	2	1.63	2.90	0.11	0.09	1.63	1.49	0.50	3.53	0.41	0.15	4658.27	58140.62
Soybean cultivars (maturity group IV)	3	29.95**	43.34**	0.91^{ns}	0.15^{ns}	85.86**	30.73**	216.73**	257.43**	0.48^{ns}	0.66^{ns}	1043828.00**	906858.96**
Error	6	1.09	0.88	0.28	0.19	0.83	0.16	6.01	2.23	0.76	0.46	70847.99	29278.70
Coefficient of variation (%)	-	9.57	8.94	10.86	10.43	8.97	10.06	6.07	7.83	7.98	6.38	9.40	10.78

Source of variation	df	Ms									
		Biological yield		Harvest index		Pod dry weight per plant		Seed dry weight per plant		Total dry weight	
		N	S	N	S	N	S	N	S	N	S
Block	2	90452.72	58616.81	1.01	1.71	0.16	0.24	1.13	0.04	3.50	0.80
Soybean cultivars (maturity group IV)	3	2841074.29**	802799.27**	10.64^{ns}	9.92**	1.77**	0.85**	13.69**	3.39**	24.65^{ns}	13.49*
Error	6	30145.23	51965.69	2.89	0.81	0.07	0.05	0.14	0.06	7.68	1.69
Coefficient of variation (%)	-	10.47	9.61	9.08	7.17	8.59	9.65	10.85	9.80	9.47	9.40

-ns, * and **: Non significant, significant at 5 and 1% levels of probability, respectively.

-N: normal condition S: stress condition

DISCUSSION

Details of nesting sites and seasons of marine turtles on the coast of Pakistan are contained in very few publications (Murray, 1884; Minton, 1966; Hirth, 1971; Ghalib and Zaidi, 1976; Frazier, 1980, Kabraji and Firdous, 1984; Firdous, 1985; Groombridge, 1985). According to Minton (1966) nesting occurs on Karachi coast from June through early November. Zwinenberg (1975) stated that green turtles visit the beaches of West Pakistan throughout the year. In a rather detailed study, Ghalib and Zaidi (1976) provided information about marine turtles from Karachi coast but unfortunately without naming the species. They reported breeding throughout the year with a peak from July to November. They found low rate of nesting during November to March. Groombridge (1985) mentioned that 5000 females nested at Hawkesbay and Sandspit annually. He, however, did not mention the year of his study. In the present study 1549 turtle nests were seen in 1985 at Hawkesbay and Sandspit.

In the present investigation based on of 19 years uninterrupted observations, nesting of green turtles at Sandspit and Hawkesbay was seen throughout the year with peak, precisely, in September. Furthermore, nesting frequency was regularly much less during the first half (January to June) of every year compared to second half (July to December). The lowest nesting month was April as was also reported by Ghalib and Zaidi (1976).

Nesting period of Olive ridley on Karachi coast was restricted to July to October. Previous records regarding nesting of Olive ridley at Sandspit and Hawkesbay showed that its nesting season is almost same as that of green turtle. The difference is that olive ridley are much less in number (Murray, 1884; Burton, 1918; Shockley 1949; Hatt, 1957; Minton, 1966; Mertens, 1969; Minton & Minton, 1973; Mohiuddin, 1975; Salm, 1975a, 1975b, 1976a, 1976b).

Mass nesting or 'arribazones', the most important group activity of olive ridley, has not been observed on Karachi beaches during the study period (1979-1997). Major Arribada nesting in Eastern Pacific are confined to the coast of Oaxaca, Mexico and Guanacaster, Costa Rica (Cornelius and Robinson, 1984). On the beaches of Costa Rica 400-600 thousand annual nesting of olive ridley constitute the second most critically important sea turtle habitat in the world. In Malaysia nesting of olive ridley occurs at flat beaches with hard packed, fine sand (Hendrickson, 1961) and in Surinam it nests on wide and highly crested beach (Zwinenberg, 1976) but on the beaches of Karachi olive ridley nests on flat and soft sandy beaches of Sandspit and Hawkesbay.

The average number of green turtle eggs per year during the study period varied from 62.2 to 104.7. which compared favourably with the figures reported in the literature from a number of other places: Bigisanti and Elanti, Surinam, 142.8 and 141.9, respectively (Pritchard, 1969; Rebel, 1974), Tortuguero, Costa Rica, 110.0 (Carr and Hirth, 1962; Rebel, 1974), Sarawak, 104.7 (Hendrickson, 1958; Pritchard, 1969; Rebel, 1974; Zwinenberg, 1975), South Yemen, 106 (Hirth and Carr, 1970; Rebel, 1974) and Ascension Island, 115.5 (Carr and Hirth, 1962; Pritchard, 1969; Rebel, 1974; Zwinenberg, 1975).

The number of olive ridley eggs per year during the study period varied from 45 to 186 with an average of 110 eggs per clutch. Reported figures of the same order from other regions of the world are: 101-140, Surinam (Schulz, 1975); 90-135, Sri Lanka (Deraniyagala, 1953); 93-113, Mexico (Casas-Andreu, 1974); 50-147 with an average of 108 eggs per clutch in Australia (Frauca, 1970).

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