



REPORT

ON THE 2004 LEATHERBACK PROGRAM

AT TORTUGUERO, COSTA RICA

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and
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EXECUTIVE SUMMARY

Monitoring and Research Activities Conducted

1. A total of 26 track surveys were conducted between the Tortuguero rivermouth and Jalova lagoon between February and July 2004.
2. Peak nesting was recorded on 4 and 22 April when a total of 11 fresh leatherback nests were recorded.
3. The Research Coordinator (RC) and the Research Assistants (RAs) conducted a total of 29 additional track surveys between the Tortuguero and Parismina rivermouths between 15 March and 7 June 2004. Poaching was estimated to a minimum of 13.1 % of leatherback nests and 15.5 % of green turtle nests.
4. Comparison of the leatherback nesting estimates obtained from track surveys conducted either by the track surveyor (419 nests) or by the RC and RAs (388 nests) between Tortuguero river mouth and Jalova lagoon between 15 March-7 June revealed that the two methods produced similar results.
5. Sixtynine leatherback turtle encounters were recorded during 795 hours of night patrols between 8 March and 7 June, 2004. 18 were newly tagged females, 35 had tags from previous years and/or other nesting beaches, and 16 were renesters. Also, one leatherback was observed on the beach during a track survey, and local police reported tag numbers for a nesting leatherback. In addition, 32 green turtles (24 newly tagged and eight renesters), two hawksbills (one newly tagged and one previously tagged) and one previously tagged loggerhead turtle were encountered.
6. A total of 67 % of female leatherback turtles bore tags from previous years or other nesting beaches. Previously tagged leatherbacks (n = 36) were originally tagged on the beaches of Tortuguero (n = 14), Pacuare/Mondonguillo (n = 15), Lagunas de Urpiano/Matina (n = 3), Parismina (n = 1) and Panama (n = 3).
7. A total of 28 % of newly tagged leatherback turtles (n = 18) showed evidence of old tag holes or notches when they were encountered for the first time.
8. A total of 85.9 % of encountered leatherback turtles laid eggs in the open beach zone (n = 61) and 14.1 % did not lay eggs (n = 10).
9. Mean carapace length (CCL_{min}) for leatherback turtles with a complete caudal projection (n = 46) was 152.5 cm and for turtles with an incomplete caudal projection (n = 6) was 144.6 cm. Mean clutch size was 78 normal and 25 yolkless eggs for females with complete caudal projection (n = 28) and 84 normal and 27 yolkless eggs for females with incomplete caudal projection (n = 5).
10. Mean carapace length (CCL_{min}) was 105.9 cm for green turtles (n=22), 84.7 cm for hawksbill turtles (n = 2) and 101.4 cm for loggerhead turtles (n = 1). Mean clutch size for green turtles was 105 normal eggs (n = 14).
11. Precision of the CCL_{min} measurement during the same encounter was 0.3 cm for leatherback (n = 67), green (n = 19) and hawksbill turtles (n = 2) and 0.5 cm for loggerhead turtles (n = 1).
12. Precision of the CCL_{min} measurement for leatherback turtles measured during more than one encounter was 0.9 cm for two encounters (n = 8), 1.3 cm for three encounters (n = 2) and 1.0 cm for four encounters (n = 1).
13. A total of 18 leatherback nests were marked for monitoring. All three marker tapes were lost for one nest and it was excluded from further analysis.

14. Overall hatching success for monitored leatherback nests was 13.8 % and overall emerging success was 13.2 % (n = 17).
15. Mean distance between the sand surface and the top egg at the time of excavation for undisturbed nests (n=3) varied between 64 – 71 cm with a mean of 67 cm. The mean distance from the sand surface to the bottom of the egg chamber varied between 84 – 86 cm, with a mean of 85 cm.
16. The incubation period for leatherback nests for which emergence was observed (n=2) ranged from 66-73 days with a mean of 70 days.
17. No deformed embryos or eggs containing twin embryos were encountered during excavations of marked leatherback nests.
18. Rainfall was heaviest in May (858.6 mm) and July was the month with least rain 324.0 mm).
19. Mean monthly sand temperatures were similar for all depths in all zones from January to June, ranging between 24.8 - 30°C. Temperatures recorded in the open zone were lower than normal, possibly due to heavy rainfall and high tides.
20. A total of 67,669 visitors paid to enter Tortuguero National Park in 2003.
21. The visitation at the CCC Natural History and Visitors' Center increased in 2004 and in the first eight months of the year 23,587 tourists had visited the centre, an average of 97 visitors/day. March 2004 was the month with the highest visitation since the Center opened.
22. Hotels and cabinas increased their capacity in 2004 to a total of 599 rooms and 1,365 beds.
23. The number of artificial lights in Tortuguero village continues to increase but the Costa Rican Electricity Institute (ICE) again undertook an initiative to limit light pollution by shading or painting the bulbs of some of the street lights.
24. One dead leatherback was encountered on the beach during the 2004 Leatherback Program; the cause of death could not be determined. In addition 25 green turtles were found, all of which had been killed by jaguars.
25. A series of environmental education activities covering a variety of different subjects were conducted with students in grades 4 – 9 in the Tortuguero school and high school. Students from the high school regularly accompanied RAs on night beach patrols.
26. Three satellite transmitters were attached to leatherback turtles; two in Tortuguero and one in Gandoca. The data from these transmitters provide valuable information on the migration routes of female leatherbacks during the internesting interval and after they leave the nesting beaches at the conclusion of their nesting period.

Conclusions

1. The presence of CCC personnel and park ranger patrols helped to reduce levels of poaching during the 2004 Leatherback Program.
2. Poaching continues to be higher outside Tortuguero National Park boundaries.
3. Low numbers of leatherback encounters may be a result of reduced patrolling effort combined with the leatherback turtles utilizing different nesting beaches, and not necessarily an indication of a declining population. To monitor the trend of the entire population it is necessary to continue cooperation between all leatherback turtle projects along the Caribbean coasts of Costa Rica and Panama.
4. Low hatching success in 2004 resulted from a loss of nests due to beach erosion, and reduced sand temperatures as a result of heavy rainfall and high tides.

5. Tourism in Tortuguero is increasing substantially each year, and the majority of the hotels and cabinas in the area are continuing to expand.
6. Jaguar predation of green turtles remains at a level that is unlikely to have any negative impacts on the nesting population.
7. Satellite telemetry is a useful tool to determine the precise migration routes of leatherback turtles nesting at Tortuguero and nearby nesting beaches.

Recommendations

1. Increased institutional presence by the Ministry of the Environment and Energy or other government institutions aimed at reducing poaching would be highly desirable during future leatherback nesting seasons.
2. Night patrols should be conducted from mid-March through mid-June during future leatherback nesting seasons.
3. During the training of RAs, emphasis should be placed on the importance of correctly identifying levels of poaching during track surveys.
4. Classification of the leatherback caudal projections as complete or incomplete should be continued.
5. A more detailed study of jaguar predation of green turtles would be desirable.
6. Care should be taken when placing the data loggers on the beach to ensure that they cannot easily be detected and removed by unauthorized people.
7. Discussions should be continued with the Costa Rican Electricity Institute (ICE) regarding the subject of the light pollution from the street lights in Tortuguero village.
8. In future years, a more structured schedule of environmental education activities that better compliment the students' curriculum would be advisable.
9. Further satellite telemetry studies would be highly desirable in future programs, to increase the knowledge about interesting areas and migratory routes. The same attachment protocol should be utilized, although modifications to the harness fabrication should be considered following the difficulties experienced in Gandoca.

1. INTRODUCTION

Sea turtle research and conservation was initiated in Tortuguero in 1955 (Carr *et al.* 1978). Caribbean Conservation Corporation (CCC) began an annual leatherback (*Dermochelys coriacea*) program in Tortuguero in 1995 (Campbell *et al.* 1996). The leatherback program is implemented in order to fulfill CCC's scientific mission in Tortuguero: "*CCC will provide the scientific information necessary to conserve the populations of sea turtles that nest at Tortuguero, Costa Rica, so that they fulfill their ecological roles*". CCC staff and Scientific Advisory Committee revised the monitoring protocol in preparation for the 1998 Leatherback Program. The 2004 Leatherback Program represents the tenth consecutive leatherback program and the seventh year of implementing the new monitoring protocol.

The objectives of this report are to summarize the results of the 2004 Leatherback Program and to provide recommendations for future sea turtle programs, conservation efforts and research activities in Tortuguero.

2. METHODS

2.1 Preparations

The Research Coordinator arrived in Tortuguero the first week of March to prepare for the 2004 Leatherback Program. The Research Assistants (RAs) arrived in Tortuguero on 8 March 2004. During the first two weeks of the 2004 Leatherback Program, RAs received training in sea turtle biology and conservation, and the Tortuguero monitoring protocol was explained in detail. RAs also received practical training in sea turtle tagging, nest marking and other data collection from the Research Coordinator (RC) and the Scientific Director. In addition to practise night patrols along beach sections close to the field station, training was also conducted between Jalova lagoon and mile 14 on 15-16 March 2004.

The positions of mile markers along the 22 miles (=36 km) of beach between the Tortuguero and Parismina river mouths were verified using a 300 feet fiberglass measuring tape. Mile markers were located every 1/8 of a mile between the Tortuguero river mouth (mile -3/8) and mile 5, and every 4/8 mile between mile 5 and the Parismina river mouth (mile 21 4/8). Three markers were put up in every location and the two markers nearest to the vegetation were painted white with the marker number in black.

2.2 Track Surveys

Track surveys between the Tortuguero river mouth and Jalova lagoon were conducted approximately weekly by CCC track surveyor Enrique Vargas. Track surveys started near Tortuguero river mouth at 5:00 am and were completed at Jalova lagoon at approximately 10:30 am. Only sea turtle tracks from the previous night were counted. Notes were also kept on the number of turtles depredated by jaguars or taken by poachers and the number of poached fresh nests. The total number of leatherback nests for all nights was extrapolated by applying a GAM model and integrating resulting values using Berkeley Madonna software (Troëng *et al.* 2004).

Track surveys were also conducted between the Tortuguero and Parismina river mouths, every 3 days from 15 March to 7 June by the RC and the RAs. The beach was divided into four sections: Tortuguero river mouth - CCC station (mile 2 5/8), CCC station-Juana López path (close to the mile 15 marker), Juana López path-Jalova lagoon (mile 18) and Jalova lagoon-Parismina river mouth (mile 21 4/8). All tracks since the previous survey were recorded in order to get a total count of all nests. Nests were marked by a line through the track and by putting two sticks in a cross formation over the nest. Notes were also kept on jaguar predation, turtles taken by poachers and the number of poached nests.

2.3 Tagging of Nesting Sea Turtles

Nightly tagging patrols were conducted 8 March-7 June 2004 (with the exception of 10-11, 14, 27 March, 1, 13, 17, 19, 29 May, and 6 June). Three beach sections were patrolled with varying frequency: Tortuguero river mouth-CCC station, CCC station-mile 5 and Jalova lagoon (mile 18)-mile 14.

Turtles were tagged after finishing oviposition or when returning to the sea. Leatherbacks were tagged in the rear flippers. Green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) turtles were tagged axillary, close to the first scale on the front flippers. Tag numbers, evidence of old tag holes or notches, species, date, time and activity when encountered were noted for each encounter. The location of the nest was defined as open (= open beach without any vegetation), border (= vines or other sparse vegetation partly shading the nest) or vegetation (= continuous vegetation behind the beach with complete shading of the nest).

Tags used during the 2004 Leatherback Program were National Band & Tag Company (NBTC) Monel #49 tags no. VA2901-18, VA2926-46 and VA2951-64, and Inconel #681 tags no.98001-12, 98024-49, 98051-61, and 98075-86.

2.4 Biometric Data Collection

If the turtle was encountered before oviposition, the eggs were counted as they were laid into the egg chamber. The eggs were counted by a person wearing a plastic glove to avoid contamination of the nest. Normal sized and yolless eggs were counted separately.

CCLmin (= from the nuchal notch to the end of the caudal projection NEXT TO the central ridge) was recorded for leatherbacks. For leatherbacks, the caudal projection was classified as complete if no irregularities occurred and incomplete if the caudal projection was irregular or parts of it were missing. CCLmin (= from where the skin meets the carapace by the nuchal notch to the posterior notch between the supracaudals, along the midline) was recorded for green and hawksbill turtles. Measurements were recorded to the closest millimeter. All measurements were repeated three times in order to determine precision. Precision for one encounter is defined as the difference between the shortest and the longest of the three measurements. Precision for turtles encountered more than once is defined as the difference between the shortest and the longest of all measurements collected from the same individual.

2.5 Determination of Nest Survivorship and Hatching Success

For leatherback turtles encountered while the egg chamber was still open (prior to covering) the nest was marked for inclusion in the study of nest survivorship and hatching success.

Three pieces of flagging tape were attached to vegetation behind the nest, and the distance from the centre of the egg chamber to each tape was measured so that the location of the nest could be determined at a later date using triangulation. The third piece of flagging tape ensured that nests could be located even if one piece of flagging tape went missing. Each morning the marked nests were inspected so that the fate of the nest could be determined. Depredation, poaching or beach erosion were noted and resulted in termination of monitoring the nest. Nests were only marked along the beach section between the Tortuguero river mouth and the mile 5 marker.

Marked nests were excavated two days after hatching or 75 days after oviposition (if no evidence of hatching was observed), to determine hatching and emerging success. The number of empty eggshells, pipped eggs, live and dead hatchlings, unhatched eggs without embryo, unhatched eggs with embryo, unhatched eggs with fully developed embryo, depredated eggs, yolkless eggs, twins, deformed and albino embryos were determined for each excavated nest. Only egg shells amounting to more than 50% of an egg were recorded as an egg. The distances from the sand surface to the top egg as well as to the bottom of the egg chamber were recorded for each excavated nest.

2.6 Physical Data Collection

Rainfall (to the closest 0.1 mm) was recorded daily at 9:00 am. Sand temperature was measured using data loggers located at 30, 50 and 70 cm depth in the open, border and vegetation zones of the beach in front of the CCC station. An unknown person located and stole all of the data loggers on 5 August 2004 after a turtle had dug up the loggers located in the border zone.

2.7 Collection of Human Impact Data

The National Park Administrator Eduardo Chamorro provided data on the number of visitors to Tortuguero National Park 2001-2003. Alexander Castillo, Sergio Campos, Teresa Alfaro and Edgar Salas recorded the number of visitors at the CCC Natural History and Visitors Center. Light surveys were conducted on 22 March, 19 April, 20 May, 23 June and 19 July 2004; dates as close as possible to the new moon when natural light levels on the beach are lowest. The beach was surveyed from the Tortuguero river mouth to the mile 5 marker. Each artificial light visible from the beach was noted and the light source was identified. The location of the light source, i.e. Tortuguero (= beach) side or mainland (= river) side was also noted for each light.

2.8 Dead Turtles

Dead turtles encountered during track surveys or other monitoring activities were recorded and an attempt was made to determine the cause of death.

2.9 Environmental Education Activities

Talks and slide shows about sea turtle biology, conservation and environmental economics were given opportunistically to groups staying at or passing by the John H. Phipps Biological Station. In addition, researchers implemented a series of environmental education activities at the Tortuguero village school and high school, involving students from 4th – 9th grade. Students were also invited to accompany RA's on night-time beach patrols to learn more about leatherbacks and the research methods of the CCC.

2.10 Satellite Telemetry

To better understand the migration routes of leatherback turtles, satellite telemetry was used to follow individuals once they left the nesting beach. Two transmitters were attached to leatherback turtles on Tortuguero beach and one on Gandoca beach. Another conservation project operates on the second beach, under the direction of Asociación ANAI. Three CCC personnel traveled to Gandoca to train the ANAI researchers in the transmitter attachment methods.

Following the protocol of Eckert and Eckert (1986), a specially designed harness was used to attach the transmitters, which were mounted on platforms, to the turtles while they laid eggs. On her return to the sea the turtles' movements were followed and subsequent location data used to produce a map of the migrations.

3. RESULTS

3.1 Preparations

Several of the mile markers were washed away during the 2004 Leatherback Program due to an extended period of extremely high tides towards the end of the season, making several sections of the beach almost impassable. It was necessary to replace many of the mile markers south of the CCC station to mile 5 at the start of the 2004 Green Turtle Program.

3.2 Track Surveys

Leatherback nesting was recorded during track surveys conducted from mid-February to mid-June (Figure 1). However, observations of nesting females during 2004 Green Turtle Program night patrols showed that leatherback nesting continued into July. Peak nesting with 11 leatherback nests in one night was recorded during the 4 and 22 April track surveys (Figure 1).

The poaching of leatherback and green turtle nests decreased in 2004 and represented at least 13.1% for leatherback nests and 15.5% for green turtle nests (Table 1). Poaching of leatherback nests was higher outside of Tortuguero National Park (minimum 18 %) than within the National Park (minimum 11%).

Based on the weekly track surveys it is estimated that 503 leatherback nests were deposited between the Tortuguero river mouth and Jalova lagoon during the 2004 leatherback nesting season. For the period 15 March-7 June, extrapolations from the weekly surveys suggest that 419 leatherback nests were laid between Tortuguero river mouth and Jalova lagoon. The RC and RA track surveys, conducted every three days, recorded 388 leatherback nests along the same beach section during the same time period.

Observations and anecdotal information regarding illegal take are summarized in Appendix 2.

Table 1. Number of nests and poached nests as determined from total counts by RAs and RC.

Date	Leatherback Nests	Minimum Poached Leatherback Nests	Min. % Poached	Green Turtle Nests	Minimum Poached Green Turtle Nests	Min. % Poached
15 March*	10	0	0.0	18	0	0.0
18 March*	13	0	0.0	8	0	0.0
21 March	9	0	0.0	15	0	0.0
24 March	15	3	20.0	22	2	9.1
27 March	22	0	0.0	10	1	10.0
30 March	12	1	8.3	17	3	17.6
2 April	21	6	28.6	16	4	25.0
5 April	34	2	5.9	22	2	9.1
8 April	19	0	0.0	34	0	0.0
11 April	28	1	3.6	19	0	0.0
14 April	19	2	10.5	17	9	52.9
17 April	11	1	9.1	18	6	33.3
20 April	19	4	21.1	34	6	17.6
23 April	22	6	27.3	27	11	40.7
26 April	20	2	10.0	19	4	21.1
29 April	35	6	17.1	23	1	4.3
2 May*	16	0	0.0	13	0	0.0
5 May*	18	3	16.7	11	3	27.3
8 May*	11	0	0.0	13	0	0.0
11 May	18	7	38.9	10	0	0.0
14 May	16	4	25.0	9	1	11.1
17 May	11	0	0.0	4	0	0.0
20 May	17	5	29.4	5	1	20.0
23 May	16	3	18.8	5	5	100
26 May	16	1	6.3	9	0	0.0
29 May	21	3	14.3	5	0	0.0
1 June	6	2	33.3	7	3	42.9
4 June	2	1	50.0	2	2	100
7 June	4	0	0.0	0	0	N/A
Total	481	63	13.1	412	64	15.5

All nests laid and poached since previous track surveys were recorded.

* Heavy rain and high tides may have affected track count.

3.3 Tagging of Nesting Sea Turtles

In total, 795 team hours of night patrols were conducted between 8 March and 7 June 2004.

During these patrols a total of 69 leatherback, 32 green, two hawksbill and one loggerhead turtle encounters were recorded (Appendix 1). This is equal to a mean of 0.087 leatherback, 0.040 green, 0.003 hawksbill and 0.001 loggerhead turtles encountered per patrol hour. In addition, one leatherback was observed still on the beach during a track survey, local police reported tag numbers for a leatherback turtle they saw nesting and two green turtles killed by jaguars were recorded.

The turtles encountered correspond to 54 individual female leatherback turtles, 24 female green turtles, two female hawksbill turtles and one female loggerhead turtle. A total of 67 % of female leatherback turtles were tagged previous to the first encounter in Tortuguero during the 2004 nesting season (Appendix 1).

Previously tagged leatherback turtles (n = 36) were originally tagged on the beaches of Pacuare/Mondonguillo (n = 15), Tortuguero (n = 14), Lagunas de Urpiano/Matina (n = 3), Parismina (n = 1) and in Panama (n = 3).

Evidence of holes or notches were found on 28 % (n = 5) of newly tagged leatherback turtles (n = 18) when they were encountered for the first time during the 2004 Leatherback Program.

A total of 85.9% of the encountered leatherback turtles nested in the open beach zone (n = 61), 14.1 % did not lay eggs (n = 10).

3.4 Biometric Data Collection

CCLmin for leatherback turtles with complete and incomplete caudal projections were compared and found to be significantly different (Mann-Whitney test $p < 0.05$, n = 52). Hence, data for the two categories were not pooled but instead kept as two separate samples of 46 female leatherback turtles with complete caudal projection (CCLmin = 152.5 cm) and six female leatherback turtles with incomplete caudal projection (CCLmin = 144.6 cm) (Table 2).

Table 2. Mean carapace length and clutch size of leatherbacks.

Caudal projection	Carapace length		Clutch size		
	n	× CCLmin (cm) ± S.D.	n	× eggs ± S.D.	× yolkless eggs ± S.D.
Complete	46	152.5 ± 6.1	28	78 ± 19	25 ± 12
Incomplete	6	144.6 ± 8.5	5	84 ± 19	27 ± 8

Leatherback turtles sighted more than once (n = 12) had their caudal projection consistently identified as complete (n = 8) in 66.7% of cases, 16.7% was consistently identified as incomplete (n = 2) and 16.7% of cases were varyingly identified as complete and incomplete (n = 2).

Mean carapace length (CCLmin) for green turtles encountered during the 2004 Leatherback Program (n = 22) was 105.9 cm and the 14 clutches for which eggs were counts contained a mean of 105 eggs (Table 3). The two hawksbill turtles that were measured had a mean carapace length (CCLmin) of 84.7 cm and the loggerhead measured CCLmin 101.4 cm and laid only six eggs (Table 3).

Table 3. Mean carapace length and clutch size of green, hawksbill and loggerhead turtles.

Species	Carapace length		Clutch size	
	n	× CCLmin (cm) ± S.D.	n	× eggs ± S.D.
Green	22	105.9 ± 6.0	14	105 ± 33
Hawksbills	2	84.7 ± 2.1	-	-
Loggerhead	1	101.4	1	6

The precision of the CCLmin measurement during the same encounter was similar for leatherback, green and hawksbill turtles (mean = 0.3 cm) (Table 4a).

The precision of the CCLmin carapace measurements for leatherback turtles measured during more than one encounter was 0.9 cm for two encounters, 1.3 cm for three encounters and 1.0 cm for four encounters (Table 4b).

Table 4a. Precision of carapace measurements.

Species	n	\bar{x} precision for CCLmin (cm) \pm S.D.
Leatherback	67	0.3 \pm 0.2
Green	19	0.3 \pm 0.2
Hawksbills	2	0.3 \pm 0.1
Loggerhead	1	0.5

Table 4b. Precision of carapace measurements for leatherbacks encountered more than once.

Encounters	n	\bar{x} precision for CCLmin (cm) \pm S.D.	Range (cm)
2	8	0.9 \pm 0.4	0.2-1.5
3	2	1.3 \pm 0.8	0.7-1.8
4	1	1.0 \pm N/A	N/A

3.5 Determination of Nest Survivorship and Hatching Success

Leatherback nests for females with complete caudal projection had a mean clutch size of 78 normal eggs and 25 yolkless eggs (Table 2). Nests laid by female leatherback turtles with incomplete caudal projection contained a mean of 84 normal eggs and 27 yolkless eggs (Table 2). A total of 18 leatherback nests were marked between 22 March and 24 May 2004. All three flagging tapes were lost for one of the nests and hence that nest was excluded from further analysis.

The incubation period for monitored leatherback nests for which emerging was observed (n = 2) varied between 66-73 days with a mean of 70 days.

The fate, hatching and emerging successes of 17 marked and monitored leatherback nests are summarized in Table 5.

Table 5. Fate, hatching and emerging success of marked leatherback nests.

Fate	n	% of total	Hatching success (%)	Emerging success (%)
<i>Undisturbed</i>				
1. Undisturbed	3	17.6	63.2	59.9
<i>Disturbed</i>				
2. Washed out	8	47.1	0.0	0.0
3. Poached	2	11.8	0.0	0.0
4. Unhatched	2	11.8	0.0	0.0
5. Two nests together	2	11.8	19.1	19.1
TOTAL	17	100	13.8	13.2
(6. Flagging lost	1)			

The total number of eggs for all marked nests is estimated at 1,165 eggs (70.7 x 15 + 52.5 x 2). Overall hatching success was 13.8 % for monitored leatherback nests (161 empty shells

from 1,165 eggs). Emerging success for monitored leatherback nests is estimated at 13.2 % (154 emerged hatchlings from 1,165 eggs in 17 nests).

Table 6. Results of nest excavations.

Fate	Empty Shells	Pipped eggs	Live hatchlings	Dead hatchlings	Unhatch. No embryo	Unhatch. Embryo	Unhatch. Full embryo	Depredated	Destroyed	Total eggs	\bar{x} eggs/nest
Marked nests											
1	134	6	0	7	20	27	9	16	0	212	70.7
2	0	0	0	0	0	0	0	0	0	0	N/A
3	0	0	0	0	0	0	0	0	0	0	N/A
4	0	4	0	0	65	32	4	0	0	105	52.5
5	27	0	0	0	9	0	35	0	5	76	N/A
ALL	161	10	0	7	94	59	48	16	5	393	N/A

Fate 1=Undisturbed, 2= Washed out, 3=Poached, 4 =Unhatched, 5 = Two nests together

The distance from the sand surface to the top egg at the time of excavation for undisturbed nests (n = 3) varied between 64-71 cm with a mean of 67 cm. The distance from the sand surface to the bottom of the egg chamber for the same nests varied between 84-86 cm with a mean of 85 cm.

Six of the monitored leatherback nests that were washed out (n = 8) were located within 3.31 m of the high tide line at the time of oviposition. The three undisturbed nests were all located at least 4.15 m from the high tide line at the time of oviposition.

There were no deformed, albino or twin embryos encountered during nest excavations.

3.6 Physical Data Collection

Rainfall during months with leatherback nesting (February-July) was heaviest in May (Table 7). July was the month with least rain (Table 7).

Table 7. Rainfall, December 2003-August 2004.

Month	Total rainfall (mm/month)*	\bar{x} rainfall (mm/24hrs)*
December	1,219.2	39.3
January	494.9	16.0
February	326	11.2
March	555.8	17.9
April	611.8	20.4
May	858.6	27.7
June	785.4	26.2
July	324	10.5
August	531.4	17.1

*Data for 48 hours for 21-22 March, 21-22 April, 3-4, 6-7 August

*Data for 96 hours for 15-18 May, 24-27 June

*Data for 120 hours for 24-28 May, 17-21 August

*Data for 144 hours for 17-22 June

*Data for 24-29 April estimated at 150 mm

Mean monthly sand temperatures are shown in Table 8. Sand temperatures were very similar in all three beach zone, ranging between 24.8 – 30.0°C; although temperatures at 70 cm depth

in the open zone were considerably lower than normal (Table 8). It is very likely that due to the high tides experienced during the season the data loggers were submerged by ground water and that the temperatures recorded do not accurately reflect the sand temperatures experienced by undisturbed leatherback nests located in the open zone.

Table 8. Mean monthly sand temperatures.

Zone	_ Open × temp (°C)			_ Border × temp (°C)			_ Vegetation × temp (°C)		
	30	50 ^a	70 ^b	30 ^c	50 ^c	70 ^d	30 ^e	50 ^f	70 ^f
<i>Depth (cm)</i>	30	50 ^a	70 ^b	30 ^c	50 ^c	70 ^d	30 ^e	50 ^f	70 ^f
December	N/A	26.6	26.2	N/A	N/A	26.0	N/A	24.6	25.1
January	N/A	27.5	26.6	N/A	N/A	26.3	N/A	24.8	25.3
February	N/A	29.0	26.5	N/A	N/A	27.2	N/A	25.5	25.8
<i>Retrieval depth (cm) 14 March</i>	40	48	70	N/A	N/A	63	N/A	53	69
<i>Depth (cm) 14 March</i>	30	50	70	N/A	N/A	70	N/A	50	70
March	N/A	29.0	24.8	27.3	27.1	27.0	26.2	25.9	26.1
April	N/A	30.0	24.9	27.7	27.3	27.3	26.4	26.6	26.5
May	N/A	28.5	23.9	27.0	27.0	27.1	26.1	26.5	26.5
June	N/A	28.9	24.0	27.4	27.3	27.4	26.3	26.7	26.7
<i>Retrieval depth (cm) 18 June</i>	N/A	48	65						
<i>Retrieval depth (cm) 21 June</i>				0	0	0			
<i>Retrieval depth (cm) 30 June</i>							28	47	64
July	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
August	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

^a Data until 18 June

^b No data for 8-13 March, data until 17 June, possible that ground water reached data logger

^c Data for 14 March-20 June

^d Data until 20 June

^e Data for 14 March-30 June

^f Data until 30 June

3.7 Collection of Human Impact Data

The number of paying visitors coming to Tortuguero National Park has continuously increased since 2001 and totaled 67,669 paying visitors in 2003 (Table 9).

Table 9. Number of Paying Visitors to Tortuguero National Park, 2001-2003.

Year	CR Visitors	Foreign Visitors	Total
2001	6,175	39,057	45,232
2002	5,745	44,594	50,339
2003	8,643	59,026	67,669

Information from ACTo.

The number of paying visitors registered at the CCC Natural History and Visitors Center increased during the first eight months of 2004 (Table 10). For every month, with the exception of July and August, the 2004 visitation levels have been the highest for that month for any year.

The increase in the capacity of both hotels and cabins in the Tortuguero area in 2004 followed a similar trend to that observed in recent years (Table 11). Many of the larger lodges initiated on-going expansion programs, some of which are projected to continue into 2005. The overall room and bed capacity of the hotels remains more than twice the capacity of the cabins.

Table 10. Visitors to the CCC Natural History and Visitors Center, January 2002-August 2004.

Month	2002		2003		2004	
	Total	× Per Day	Total	× Per Day	Total	× Per Day
January	1756	57	2230	72	2814	91
February	2108	75	2855	102	3648	126
March	2581	83	2921	94	3924	127
April	1738	58	2591	86	2940	98
May	1239	40	1410	45	1497	48
June	1463	49	1575	53	2089	70
July	2673	86	3272	106	3260	105
August	3419	110	3864	125	3415	110
September	2043	68	1706	57		
October	2104	68	1791	58		
November	2276	76	2453	82		
December	2124	69	2372	77		
TOTAL	25524	70	29103	80	23587	97

Table 11. Room and bed capacity of the hotels and cabinas in the Tortuguero area.

Hotels/Lodges	Rooms	Beds	Cabinas	Rooms	Beds
Caribe*	-	-	All Rankin Lodge	7	32
Evergreen	30	60	Aracari	13	25
Hotel Vista del Mar	35	85	Casa Marbella	5	10
Ilan-Ilan	24	57	La Casona	6	19
Jungle	44	88	Jumanji***	12	40
Laguna	71	142	Ella y Yo	3	6
El Manati	10	20	La Espiga de Oro	3	12
Mawamba	54	130	Hostel el Icao	5	10
Pachira	80	142	Joruki	9	17
Samoa Lodge**	20	40	Lapa Verde****	5	10
Tortuga	24	49	Meryscar	20	50
Turtle Beach Lodge	30	90	Miss Miriam	14	28
<i>Total – Hotels</i>	<i>422</i>	<i>903</i>	Miss Miriam #2	12	24
			Miss Junnie Hotel	12	24
			Sabina	24	72
			Tortuguero	8	27
			Pisulin/Tropical Lodge	12	24
			(CCC	7	32)
			<i>Total – Cabinas</i>	<i>177</i>	<i>462</i>
			TOTAL	599	1365

*Caribe Lodge was not open in 2004, **Samoa Lodge previously known as Caribbean Magic

Jumanji previously known as Chanu, *Lapa Verde previously known as Pancana

Results of the monthly light surveys are shown in Table 12. It can be seen that the majority of the lights that are visible on the beach are coming from either lodges or village cabinas. The beach sections with artificial lights remain the same but the number of lights in front of the village (mile 2 6/8-3 3/8) has increased from previous years. In July, the Costa Rican Electricity Institute (ICE) shaded several of the village streetlights located close to the beach, and painted the bulbs of others to compare different methods of minimizing the light's impact on the beach. Although the lights are still visible their intensity is reduced, now they can not be seen from a long distance.

Table 12. Artificial lights visible from the beach, Tortuguero river mouth to Mile 5.

Mile	Light source	Beach side	River side	April	May	June
5/8	Tortuga Lodge					X
6/8	Tortuga Lodge		X	X	X	X
1 1/8	Ilan-Ilan Lodge		X		X	
1 1/8	House	X		X		X
1 2/8	All Rankin Lodge	X		X	X	X
1 3/8	Manati Lodge		X			X
1 3/8	Laguna Lodge	X		X	X	
1 4/8	Laguna Lodge	X			X	X
2 2/8	Mawamba Lodge					X
2 3/8	Mawamba Lodge	X		X	X	X
2 4/8	CCC	X				X
2 5/8	CCC	X		X		X
2 6/8	Houses + Street Lights	X		X	X	X
2 7/8	Houses + Street Lights	X		X	X	X
3	Houses + Street Lights	X		X	X	X
3 1/8	Houses + Street Lights	X		X	X	X
3 2/8	Houses + Street Lights	X		X	X	X
1/8-6/8, 1 1/8-5	Red light from mast (m2 6/8)	X			X	X

3.8 Dead Turtles

Table 13. Dead turtles.

Date	Species	Sex	Mile	Comments
21 March	Cm	F	9 4/8	Killed by jaguar.
27 March	Cm	F	10 4/8	Killed by jaguar. Tags 98026 and 98027 recorded.
30 March	Dc	?	13 4/8	Turtle reported by track surveyor 28/3/04. Washed ashore, no obvious signs of injuries. Too decomposed to perform necropsy.
2 April	Cm	F	9 4/8	Killed by jaguar.
2 April	Cm	F	12	Killed by jaguar.
8 April	Cm	F	10	Killed by jaguar. Tags 98051 and 98052 recorded.
14 April	Cm	F	8	Killed by jaguar.
17 April	Cm	F	8	Killed by jaguar.
20 April	Cm	F	10	Killed by jaguar.
23 April	Cm	F	8	Killed by jaguar.
23 April	Cm	F	9	Killed by jaguar.
23 April	Cm	F	10	Killed by jaguar.
27 April	Cm	F	9	Killed by jaguar.
29 April	Cm	F	8 4/8	Killed by jaguar.
2 May	Cm	F	10 4/8	Killed by jaguar.
5 May	Cm	F	12	Killed by jaguar.
5 May	Cm	F	12 4/8	Killed by jaguar.
8 May	Cm	F	9 4/8	Killed by jaguar.
11 May	Cm	F	10	Killed by jaguar. Tag 98044 recorded.
11 May	Cm	F	10	Killed by jaguar.
11 May	Cm	F	10	Killed by jaguar.
11 May	Cm	F	10 4/8	Killed by jaguar.
14 May	Cm	F	10	Killed by jaguar.
20 May	Cm	F	11 4/8	Killed by jaguar.
29 May	Cm	F	14	Killed by jaguar.
1 June	Cm	F	15	Killed by jaguar.

Cm=green turtle, Dc = leatherback turtles

One leatherback and 25 green turtles were found dead during the 2004 Leatherback Program (Table 13). The leatherback was washed up dead and was too decomposed to determine the cause of death. All dead green turtles were killed by jaguars.

3.9 Environmental Education Activities

The RC and RA's worked with students from the Tortuguero school and high school on seven occasions during the 2004 Leatherback Program (Table 14).

Table 14. Activities conducted at the Tortuguero schools from March – June 2004.

Date	Number of Students	Activities
31 March	30+ high school students	Beach clean-up and litter awareness talk
1 April	40+ 4 th , 5 th and 6 th grade students	Village clean-up and litter awareness talk
14 April	30+ high school students	Slide show presentation on Tortuguero's turtles
2 May	20+ high school students	Slide show presentation about the bird monitoring project being conducted in Tortuguero
25 May	20+ high school students	Combined activity with Polaris K-12 School students visiting the CCC station from Alaska
27 May	20+ high school students	Recycling talk and activity making paper from used paper
3 June	15+ students from school and high school	A writing competition was organized whereby the students wrote about the myths and histories of the relation between the village and the animals found in Tortuguero National Park.

All of the activities were conducted in either the school or the high school facilities in the village. The activity on the 25 May was arranged especially to allow the students visiting from Alaska the chance to interact with local students from Tortuguero village.

In addition, during the course of the 2004 Leatherback Program a core group of 4-5 students from the school and high school accompanied RA's on night-time beach patrols on an almost weekly basis.

3.10 Satellite Telemetry

Two leatherback turtles were attached with satellite transmitters on the Tortuguero beach on the 26 and 27 May, 2004. Both turtles were encountered between mile 16 and 16 4/8 prior to the start of oviposition. During the attachment of the second transmitter we were accompanied by a ranger from Tortuguero National Park, the UK Ambassador to Costa Rica, Mrs. Georgina Butler, and by renowned underwater photographer Jeff Rotman.

Both turtles had tags when encountered; the first, who was named "Marina" (Transmitter Number 47764), had been tagged in Tortuguero in 1996. The second, named "Britannia" (Transmitter Number 47765), had originally been tagged in Mondonguillo in 2000.

Maps of their migration routes can be seen in Appendix 3. Unfortunately as of 7 July, 2004, we have not received further signals from Britannia. It headed in a northerly direction and the last location was close to the southern coast of Cuba, where Britannia remained for several days prior to the loss of signal. Marina traveled a distance of 3,352 miles. Marina's last location was off the US east coast. On leaving the beach Marina's movements indicated that the turtle may have returned to nest on the 6 June, though this cannot be confirmed.

On 29 May, 2004 Emma Harrison, Sebastian Troëng and Dan Evans of the CCC, assisted by Cristina Ordoñez, the CCC's RC in Panama, and ANAI researchers attached a satellite transmitter (Transmitter Number 47766) to a leatherback turtle in Gandoca. Having successfully completed the attachment whilst the turtle was laying, final checks of the harness showed that one of the shoulder straps had come undone, and so the turtle had to be restrained while it was returning to the sea so that the strap could be secured and tightened. The turtle, named "Purruja", was seen nesting on Soropta beach, Bocas del Toro province, Panama, 10 days later (8 June, 2004). She was encountered by monitors from EWT's Soropta project during a night-time beach patrol. The harness and transmitter were still attached, however they reported that the harness had slipped to the right and appeared to be rubbing a little on the carapace and shoulder area. It is possible that this observed movement of the harness, resulting from the complications encountered during the attachment procedure, caused stresses on other straps which may have come undone, causing the harness to fall off, for we received no further locations after the 21 June, 2004. Having nested in Panama, Purruja was also heading north when the signal was lost.

4. DISCUSSION

4.1 Preparations

The mile markers put up in March 2004 were indispensable for night-time patrols and track surveys, however the loss of several of the markers due to beach erosion was a little problematic towards the end of the program. In addition to the patrols of CCC personnel, the markers are often utilized by park rangers to locate themselves on the beach.

4.2 Track Surveys

Leatherback nesting was observed from February through July with peak nesting during the March-May period (Figure 1). Track surveys conducted by the RC and RAs coincide with the period of heaviest leatherback nesting (Figure 1, Table 1).

Estimated leatherback nesting was lower in 2004 than in previous years, a situation that was also reported from several other nesting beaches along the Caribbean coast. This is a trend that has been seen here over the last five years, and hopefully it is a result of leatherbacks utilizing nesting beaches other than Tortuguero and not an indication of a declining population.

The two methods used for estimating the number of leatherback nests show differences for individual beach sections as well as for the total estimates of 419 leatherback nests and 388 leatherback nests. It may be that high tides erased some of the tracks before the RC and the RAs could count them (Table 1). This could explain why the RC and RAs nest counts were lower than the nest estimate derived from the results of the track surveyor who only recorded fresh nests.

Poaching of leatherback nests during the 2004 Leatherback Program was comparable to levels of poaching seen in previous leatherback nesting seasons. It was encouraging to see that poaching levels within Tortuguero National Park were lower than those outside the park

limits, suggesting that protection initiatives implemented by park rangers are having a positive effect. The area south of Jalova lagoon still shows the highest levels of poaching (minimum of 18%), and it might be beneficial for the park to commence a minimum patrol effort along that section of beach in future seasons, when personnel and funds permit.

4.3 Tagging of Nesting Sea Turtles

The period of tagging patrols from mid-March to mid-June coincides with the period of heaviest leatherback nesting (Figure 1) and it is suggested that night patrols be conducted during the same period in future years.

The number of leatherback turtles encountered during nightly patrols (n = 69) was the lowest number of encounters recorded for the past 4 years. It is hoped that this is a consequence of the low site fidelity shown by leatherback turtles along the Caribbean coast of Costa Rica and Panama, with turtles using different nesting beaches within and between nesting seasons, and not that the low numbers of females observed indicates a declining population. Continued monitoring of the Tortuguero beach in the future is obviously needed to confirm either of these possibilities.

The degree to which leatherback turtles move between different nesting beaches is clearly evident by the number of individuals bearing tags from other projects. Of 36 females encountered with tags just 14 (38.9%) had been tagged in Tortuguero. With respect to this, improved communication between turtle conservation projects along the coast, aided by the implementation of the regional database, will greatly facilitate the transfer of information that is vital to determine if the observed declines in leatherback nesting numbers are widespread or localized phenomena.

The patrolling effort on the beach during the 2004 Leatherback Program was between 21 – 33% less than in the previous two years, which may help explain why the number of encounters was lower than for previous years. This may in part be due to a combination of less volunteer participants during this season and one of the research assistants having to leave early, which necessitated at times a reduced number of patrols. Furthermore, far fewer leatherbacks were encountered during patrols in the last four miles of beach close to Jalova, an area where previously nesting density has been higher. Comparing encounter rates between recent years, those calculated for leatherbacks during the 2004 Program were almost half what was recorded in either 2002 or 2003. Whilst green turtles showed great variability in their encounter rate from 2002 – 2004, hawksbills were encountered at a similar rate in all three years.

4.4 Biometric Data Collection

The mean carapace length (CCLmin) of female leatherback turtles with complete caudal projection was significantly larger than the mean carapace length (CCLmin) of females with incomplete caudal projections. It is therefore suggested that the classification of the leatherback turtles' caudal projection be continued in future years. Consequently, it is important to ensure that the RAs receive adequate training to be able to accurately distinguish between a complete and incomplete caudal projection.

The precision of carapace measurements was consistent with previous years (0.3 cm), although this decreased considerably for turtles encountered on more than one occasion. This

highlights the need to ensure that all RAs receive adequate instruction in the correct location in which to take the CCLmin measurements. Volunteer participants must also be closely supervised when taking measurements to avoid decreased accuracy impacting the data.

4.5 Determination of Nest Survivorship and Hatching Success

The overall hatching success of the monitored leatherback nests was low at 13.8 % (Table 5). The primary reason for this was that almost 50% of the marked nests were lost due to beach erosion resulting from the high tides. Only three of the 17 nests (17.6%) were undisturbed; the others were either poached or unhatched. The reason for the low hatching success in those nests that were not washed out may have been the low sand temperatures recorded, or inundation from ground water as a consequence of the high tides. Both of these factors could have negatively impacted egg survivorship during the incubation period.

It was interesting to note that no incidence of deformed embryos, or twins, was recorded during nest excavations. Obviously the sample size was relatively small, but it is worthwhile continuing to monitor the occurrence of such deformities within the population, especially as they may be useful indicators of levels of chemical contaminants in the sand or ground water.

4.6 Physical Data Collection

As in 2003, heavy rainfall was recorded for May (Table 7), which may have caused the low sand temperatures that were experienced in all zones in the latter part of the 2004 Leatherback Program (Table 8). The combination of heavy rainfall and low temperatures may well have resulted in the very low success rate of the marked nests. Furthermore, for those nests which were undisturbed and hatched successfully it is likely that a high percentage of male hatchlings were produced.

Following the theft of all of the data loggers in August, it was decided to move their location to ensure that a similar situation did not occur again. It is impossible to ensure that they will not be disturbed by nesting turtles, as was observed prior to the theft, but when they were moved they were buried in a manner that should minimize their discovery by people.

4.7 Collection of Human Impact Data

The trend of increasing visitation to Tortuguero National Park, which has been recorded over the last two years, continued through the 2004 Leatherback Program (Table 9). This is also reflected in the on-going expansion of the majority of the lodges and the building of new cabins in the village (Table 11). At the CCC visitor center, a similar increase in tourist numbers was observed from previous years. Whilst this signifies increased economic benefits for the local community, with regard to turtle-based ecotourism, it should also be viewed with a degree of caution as to the potential negative impacts that such expansion may present for the area in the future.

One potential negative effect of any development close to the beach is the increase in the number of artificial lights that are visible. Many of the new lights that were recorded in the light surveys each month were from recently constructed cabins in the village. It was encouraging however, to have the support of ICE in trying to minimize the impact of the street lighting, and on-going communications between ICE and the CCC suggest that in the

near future further measures may be taken to alleviate the lighting issues in front of the village.

4.8 Dead Turtles

The number of dead turtles encountered during the 2004 Leatherback Program was high, at 25 green turtles and one leatherback (Table 14). All of the green turtles had been killed by jaguars, but it was impossible to determine the cause of death of the leatherback due to its advanced decomposition. On several occasions jaguars killed more than one turtle per night, suggesting that turtles are not being predated primarily for food, as very little of the meat was subsequently eaten.

Jaguars were found to return to the kills, however, and this provided the opportunity for a BBC Natural History film crew to set a camera trap on a dead turtle and obtain video footage of a jaguar eating a recently predated green turtle.

No leatherbacks or hawksbill turtles were predated, presumably due to the large size of the former and the scarcity of the latter this season, although both species have been taken in previous years (Troëng 2000).

4.9 Environmental Education Activities

The implementation of the environmental activities in the local school and high school was improved this year, due to better communications with the high school director and direct coordination of events with the school teachers. Some small difficulties remained with regard to cancellation of classes without informing the RC or RAs, although this resulted in minimal disruption.

To eliminate any repercussions regarding the safety of students interested in joining RAs on night-time beach patrols, a signed parental permission form was requested from every student who wished to participate; in addition, all students were escorted home at the end of the shift. A small group of students regularly worked with RAs throughout the course of the program, and gained hands-on experience of the work performed by the CCC. It is hoped to continue this initiative, and develop this interest in the students who may be potential RAs in the future.

In subsequent years it may be beneficial to liaise with the directors of the school and high school to establish a curriculum of events that would compliment the teaching schedules of the different grades. Furthermore, if logistical constraints permit, it would be good to expand the education program to include the children in grades 1 – 3, thus ensuring that the maximum numbers of students are involved in environmental activities.

4.10 Satellite Telemetry

The information gained from the satellite transmitters attached to the three leatherback turtles in 2004 will augment data collected from two transmitters attached during the 2003 Leatherback Program, furthering the knowledge of migration routes of leatherbacks nesting along the Caribbean coast of Costa Rica and Panama.

In both years, females were observed to cross the Caribbean, heading close to Cuba and other islands in the eastern Caribbean, before passing into the Atlantic and heading north, either following the coast of the United States, or into more open waters.

Valuable experience in the attachment procedure was gained by CCC personnel, and it was an extremely beneficial exercise to help strengthen links between the regional turtle conservation projects for the CCC to be able to share their expertise with the Gandoca researchers. Hopefully, these types of cooperative activities can be continued, and expanded upon, in future programs.

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Leatherback Nests

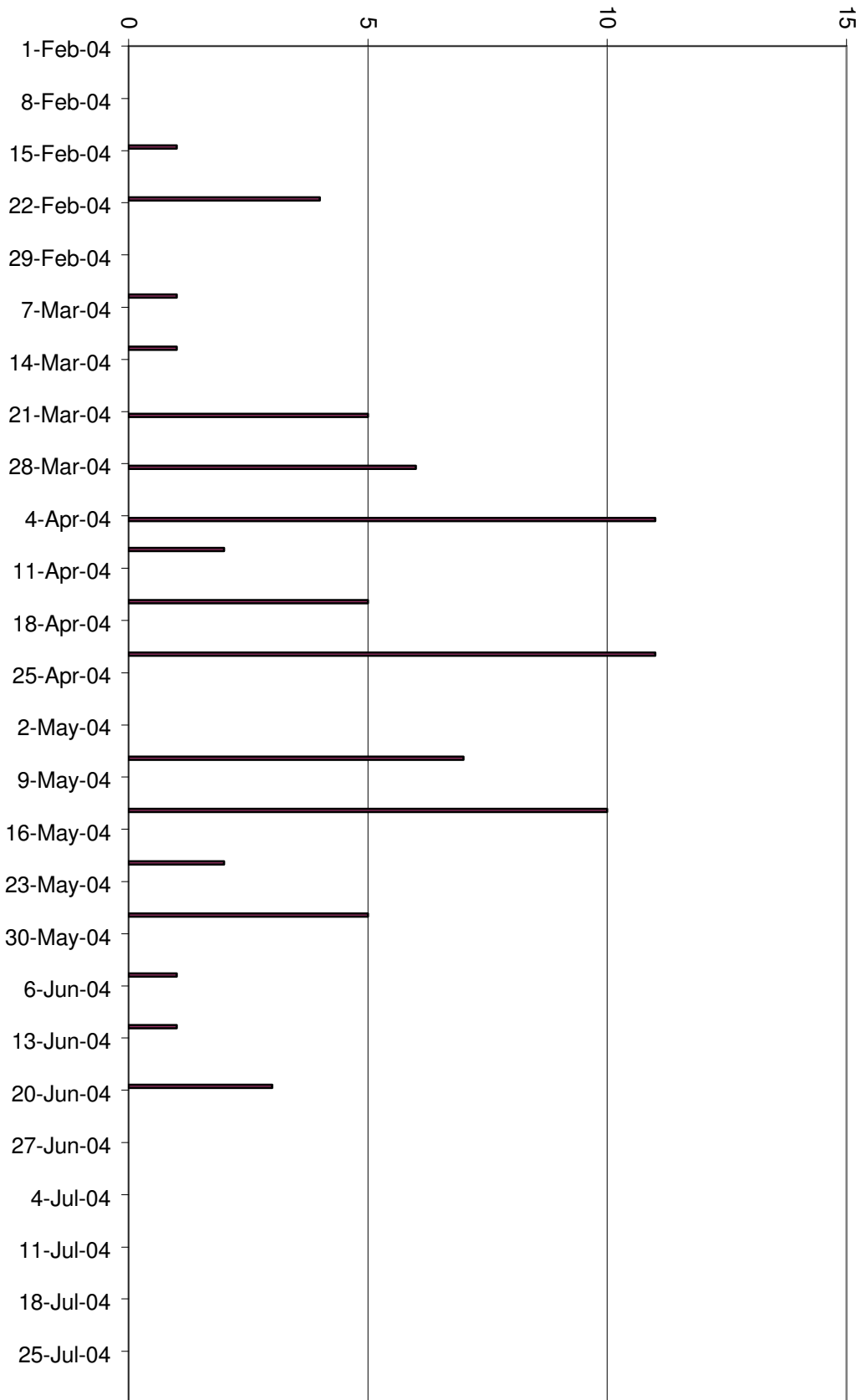


Figure 1. Seasonal distribution of leatherback nesting activity as determined from track surveys, Tortuguero rivermouth (mile -3/8) - Jalova lagoon (mile 18).

1 APPENDIX 1. SEA TURTLE ENCOUNTERS.

Date	Leatherbacks			Greens		Hawksbills		Loggerhead	
	Newly tagged turtles	Previous. tagged turtles	Renest- ers	Total	Newly tagged turtles	Renest- ers	Total	Previous. tagged turtles	Total
08-Mar-04				0			0		0
09-Mar-04				0			0		0
10-Mar-04				0			0		0
11-Mar-04				0			0		0
12-Mar-04				0			0		0
13-Mar-04				0			0		0
14-Mar-04				0			0		0
15-Mar-04	1	1		2	2		0		0
16-Mar-04	2			4			0		0
17-Mar-04				4			0		0
18-Mar-04				4			0		0
19-Mar-04				4			0		0
20-Mar-04				4			0		0
21-Mar-04		1		5	2		0		0
22-Mar-04	1	3		9	1		0		0
23-Mar-04		1		10	2		0		0
24-Mar-04		1		11			0		0
25-Mar-04	1	3		15			0		0
26-Mar-04		1	1	17	1		0		0
27-Mar-04				17			0		0
28-Mar-04				17			0		0
29-Mar-04	1			18			0		0
30-Mar-04		1		19			0		0
31-Mar-04	2	3		24	1		0		0
01-Apr-04	1		1	26	2		0		0
02-Apr-04	1	1		28	1		0		0
03-Apr-04		2		30		1	0		0
04-Apr-04				30	1		0		0
05-Apr-04		1		31			0		0
06-Apr-04				31			0		0
07-Apr-04				31			0		0
08-Apr-04		2		33	1		0		0
09-Apr-04	1		2	36			0		0
10-Apr-04				36			0		0
11-Apr-04				36	1		0		0
12-Apr-04		1		37			0		0
13-Apr-04		2		39	1		0		0
14-Apr-04		1	1	41		1	0		0
15-Apr-04	2	1		44			0		0
16-Apr-04				44	1		0		0
17-Apr-04				44	1		0		0
18-Apr-04		1	1	46			0		0
19-Apr-04	1			47			0		0
20-Apr-04			2	49	1		0		0
21-Apr-04	1	2		52			0		0
22-Apr-04				52	1		0		0

23-Apr-04	1	1		54			22			0		0
24-Apr-04	1	1		56			22			0		0
25-Apr-04				56		1	23			0		0
26-Apr-04				56			23			0		0
27-Apr-04				56	1		24			0		0
28-Apr-04				56		1	25			0		0
29-Apr-04	1			57	2		27	1		1		0
30-Apr-04			1	58	1		28			1		0
01-May-04				58			28			1		0
02-May-04				58			28			1		0
03-May-04				58			28			1		0
04-May-04			1	59			28			1		0
05-May-04				59			28			1		0
06-May-04				59			28			1		0
07-May-04				59			28			1		0
08-May-04				59			28			1		0
09-May-04				59			28			1		0
10-May-04				59			28			1		0
11-May-04		1		60		1	29			1		0
12-May-04			1	61			29			1		0
13-May-04				61			29			1		0
14-May-04				61			29			1		0
15-May-04				61			29			1		0
16-May-04				61			29			1		0
17-May-04				61			29			1		0
18-May-04		1	1	63			29			1		0
19-May-04				63			29			1		0
20-May-04		1		64		1	30			1	1	1
21-May-04				64			30	1		2		1
22-May-04				64			30			2		1
23-May-04			1	65			30			2		1
24-May-04		1		66		1	31			2		1
25-May-04				66			31			2		1
26-May-04			1	67			31			2		1
27-May-04			1	68			31			2		1
28-May-04			1	69			31			2		1
29-May-04				69			31			2		1
30-May-04				69			31			2		1
31-May-04				69			31			2		1
01-Jun-04				69			31			2		1
02-Jun-04				69			31			2		1
03-Jun-04				69			31			2		1
04-Jun-04				69			31			2		1
05-Jun-04				69			31			2		1
06-Jun-04				69			31			2		1
07-Jun-04				69	1		32			2		1
Total	18	35	16	69	24	8	32	1	1	2	1	1

APPENDIX 2: Observations and Anecdotal Information on Poaching

On one occasion during the 2004 Leatherback Program, a live green turtle was encountered on the beach at mile 12 4/8, in the middle of the national park. She had been flipped over during the night close to the high tide line, presumably by poachers, and abandoned. Upon finding her during a morning track survey, the RC and an RA flipped her back over and she returned to the sea.

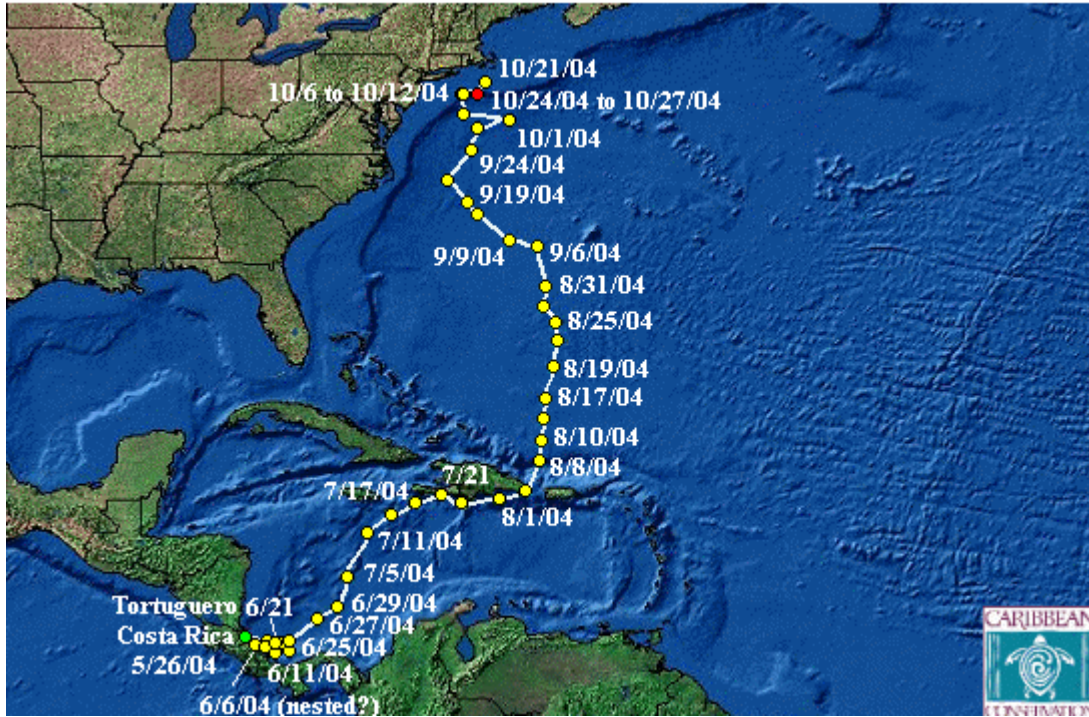
Although poaching levels were relatively low throughout the season, on numerous occasions nests older than three days were found to have been poached. Old leatherback, green and hawksbill nests were observed poached during track surveys.

Most of the poaching activity recorded during the 2004 Leatherback Program occurred between miles 7 – 18, within the limits of Tortuguero National Park. However, nests that were laid between miles 18 – 22 were frequently taken by poachers. This stretch of beach lies beyond the southern limit of the park, and hence receives no regular patrols from the park guards.

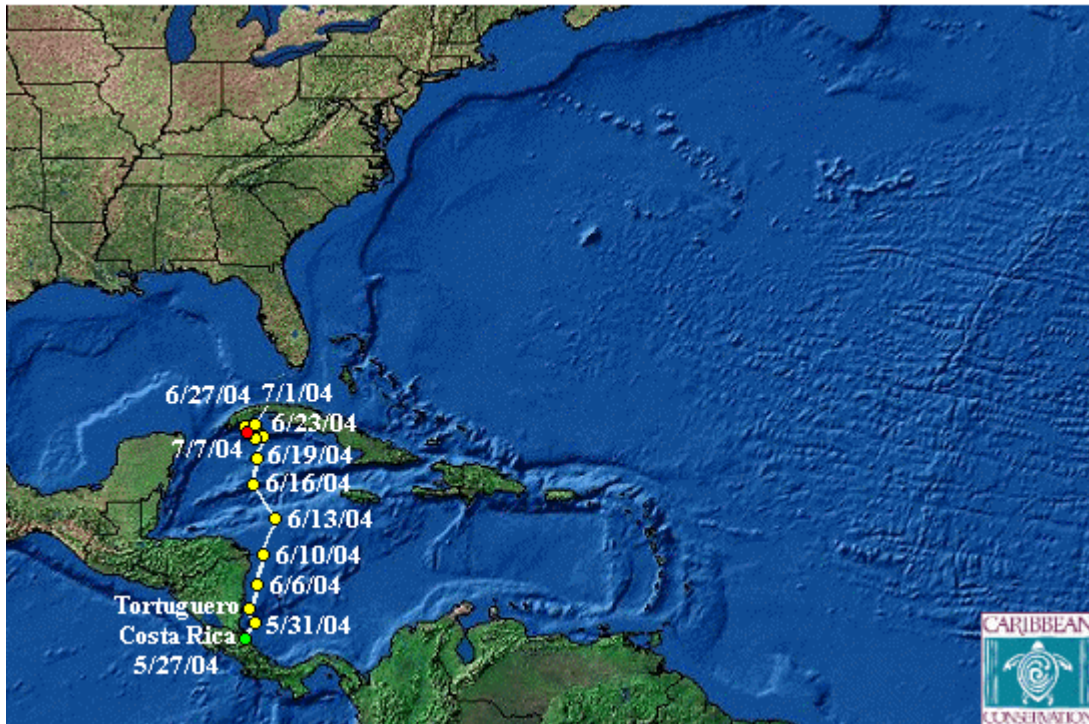
Occasionally, people were observed on the beach during track surveys. During two consecutive censuses a small group of young men was passed close to the mile 15 marker. The RC and an RA spoke to them briefly and then they headed north on the beach. Paint found on a tree at the river side of the mile 15 trail entrance suggested that they had been dropped off by boat and crossed through the trail to reach the beach. Park personnel were informed of their activities. Another morning the RC and an RA saw a group of men being picked up off the beach. A boat made a beach landing close to mile 15 and three young men ran from hiding positions in the vegetation and boarded the boat, which then took off rapidly to the south. Attempts were made to contact park personnel to inform them of this activity.

APPENDIX 3: Leatherback Movements Recorded by Satellite

Marina



Britannia



Purruja

