

Sea Turtle Study - **Cocos Keeling Islands**

Year 4 of Study – January 2003

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Acknowledgments

This research was funded entirely by Parks Australia North, Cocos (Keeling) Islands. I would like to thank the Parks Australia North staff (Wendy Murray, Ismail Macrae, Robert Thorn and Nordianna Hajat) for their support both in the field and in the office. Two images (marked on photos) taken by Robert Thorn were used in this report.

This contract with Parks Australia (RS17) was conducted under a scientific permit from Environment Australia (E2002/0061) and approval from the Animal Ethics Committee at the Northern Territory University (A01024). A report on previous research was submitted to and accepted by the Northern Territory University Animal Ethics Committee in 2002.

Cover: Foraging habitat in outer area of Sector 6, West Island, Cocos (Keeling) Islands.

EXECUTIVE SUMMARY

This document is the fourth report of sea turtle research at Cocos (Keeling) Islands (CK).

Summary of Results and Outcomes in 2003

- 67 new green turtles captured, tagged and measured
- 78 new hawksbill turtles captured, tagged and measured
- 17 growth rates from recaptured of hawksbill turtles
- Overall species composition for 2003 was 41% green 59% hawksbill turtles
- A higher percentage of hawksbill turtles were found in the sectors of South Island when compared to West Island
- Mean growth rate of hawksbill turtles was 3.4cm/yr
- No new growth rates were obtained for green turtles
- Surveys indicated that large green turtles use intertidal flats adjacent to West Island at night
- One mating tagged turtle indicates that that at least some foraging green turtles nest on either the southern or northern atoll
- Observations of a tagged green turtle indicate separate resting and foraging areas
- All data was entered into a copy of the DBXL sea turtle database that is used by sea turtle researchers in Queensland and the Northern Territory.

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INTRODUCTION

This is the fourth year of sea turtle research at Cocos (Keeling) Islands. The previous trips were conducted in February 1999 (Whiting 1999), November 2000 (Whiting 2000) and February 2002 (Whiting 2002). This fourth field trip (January 2003) continued with the mark-recapture program that began in 1999. The results presented for this field trip are put into context with previous results.

The aims of the study this year were to:

- Continue with the mark-recapture study with the long-term goal of estimating population size
- Catch a sample of turtles to continue with the assessment of species composition and size structure
- From the captured sample, obtain growth rates from previously tagged turtles
- Continue with the assessment of the nesting population on the southern and northern Atolls
- Collect genetic material from nesting female turtles

METHODS

Research methods were similar to those used in 1999, 2000 and 2002 but have been summarised below for conciseness.

Foraging Turtles

Capture

All turtles were captured using turtle rodeo (Fig. 8a-8e) (Limpus, 1978) in Sectors 57 and Sectors 12-13 using a 3.4m dinghy (map Figure 1) (Fig. 7a – 7f). Most turtles were brought aboard for measuring and weighing (Fig. 8f). Large turtles (over 60 cm curved carapace length) were too heavy to bring aboard and were tied to the gunwhale of the vessel so they could be tagged and weighed (Fig. 8g). During this trip more time was spent catching turtles on high tides late in the afternoon.

Tagging

Titanium tags weighing 4.1 g each, were applied to the axial scale of each front flipper (Limpus, 1992).

Measurements

Measurements of turtles were conducted using standard procedures (Limpus and Reed, 1985). All curved measurements were conducted using a flexible fibreglass tape. For green turtles, the curved carapace length (ccl) was measured from the anterior of the nuchal scale, along the mid-line of the carapace to the posterior notch between the two post-central scales. For hawksbill turtles, the curved carapace length was measured to the end of the longest post-central scale. Curved carapace width (ccw) was measured at the widest part of the carapace. Both ccl and ccw had an error of less than ± 0.5 cm. The tail

length of large turtles was measured from the carapace to the tip of the tail. Turtles were weighed using a 100 kg (+/-0.5kg) hanging clock-face scale. Small turtles were supported using a rope around each front flipper while large turtles were supported using two ropes around their body. Large green turtles could not be weighed because the boat was too small to handle them safely.

External Examination

Each captured turtle was examined externally for damage, condition and commensals.

Weak turtles were recorded in poor condition if they had low body weight, sunken plastron, sunken eyes and were weak. Turtles were examined for fibropapilloma growths that effect turtles in other study sites around the world.

“New Recruits” into the population were recorded as those with distinct external characters which indicated a long period in the open ocean. These included lack of fouling from invertebrate organisms and marine algae, white plastron and a distinct colour difference between the skin on the ventral and dorsal parts of the shoulder.

Growth rates

The main measurement for growth studies of turtles is either the curved carapace length (ccl) or the straight carapace length (scl), both of which can be derived from the other. At CK, growth rates of sea turtles were measured in cm ccl/ year. Turtles with damage to the carapace that could affect the measurements were not measured.

Night Survey

Sectors 5 and 6 were surveyed at night by using an underwater torch from a dinghy. This survey was to assess the species and size composition of turtles using the intertidal seagrass areas at night. The first transect started at Rumah Baru, went south and ended at the Point at the entrance of the internal lagoon of West Island and the other started at Rumah Baru, went north and ended at Bob’ Folley. The surveys were between 50 and 100 m from shore in water depths between 70 to 100 cm. A large dive torch with a narrow beam was used and allowed turtles to be sighted at distances of approximately 40m either side of the vessel. Data from this night survey are reported under the relevant headings in the Results section (Species Composition, Size Composition and Population Size).

Boat Tows – in-water transects

On two days in-water surveys were used to estimate the size and species structure of turtles in deeper water. This involved one person with snorkel and mask being towed by a rope behind a boat (similar to manta-tows). Turtle counts were recorded and species and size classes were recorded. Short-tailed and long-tailed adult sized turtles could be separated. This was conducted offshore from North Point West Island.

Population Estimates

Population estimates were calculated using the existing data. These results must be considered preliminary because of the limited number of recaptures. Several methods can be used to estimate population sizes with mark-recapture data, however this preliminary analysis was conducted using Jolly-Seber analysis (Caughley 1977) and was calculated using Krebs/Win Software (Krebs & Brzustowski 1998).

Nesting Turtles

North Keeling Island

A short visit was made to North Keeling Island to record turtle nesting activity. Because of uncertain weather and sea conditions an overnight stay was not possible. The initial aim was to stay over night and collect genetic samples from nesting turtles.

Southern Atoll - South Island

A patrol of the southern beach of South Island was made to record to turtle nesting activity.

Figure 1 SPOT Image of the southern Atoll of the Cocos (Keeling) Islands. The catch Sectors are marked in yellow. This image is used with permission from Department of Transport and Regional Services (DoTRS).

RESULTS

Foraging Turtles

Most turtles were captured in Sectors 5, 6, 12 & 13.

Species Composition

A total of 162 turtles were captured during the 21 day research period in January 2003. This comprised, 67 (41.4%) green and 95 (58.6%) hawksbill turtles. Using data from all years, a total of 460 turtles have been caught to date. This includes 202 green (43.9%) and 258 (56.1%) hawksbill turtles. Table 1 shows the variation in species composition between years which varied from 23% hawksbills in 1999 to 70% hawksbills in 2002.

Table 1 Number of each species captured in each year

	Greens	Hawksbills	Total
1999 (Mar)	36 (76.6%)	11 (23.4)	47
2000 (Nov)	47 (47.5%)	54 (53.5%)	101
2002 (Feb)	45 (29.0%)	105 (70.0%)	150
2003 (Jan)	67 (41.4%)	95 (58.6%)	162
Total	195 (42.4%)	265 (57.6)	460

Species composition varied between sectors. Sectors 12 and 13 had a higher percentage of hawksbill turtles than sector 6 at West Island. In 2003, sector 6 had 63% green turtles and 37% hawksbill turtles, while sector 12 had 27% green turtles and 73% hawksbill turtles. Using data for all years sector 6 had 61% green and 39% hawksbill turtles, while sector 12 had 27% green and 73% hawksbill turtles. See a breakdown of species composition by Year in Table 1.

Table 2 Number of Each Species Captured by Year and Sector

Sect.	Year								Subtotal Greens	Subtotal Hawksbill	Total
	1999 G	H	2000 G	H	2002 G	H	2003 G	H			
2	1								1		1
5	100%				1	5	1		2	5	7
6	31	7	39	26	16.7%	83.3%	100%		29%	71%	
7	81.6%	18.4%	60%	40%	46.3%	53.7%	63%	30%	153	99	252
				6					61%	39%	
				100%						6	6
12	4	4	8	12	13	51	10	27	35	94	129
	50%	50%	40%	60%	20.3%	79.7%	27%	73%	27%	73%	
13				10		13	4	38	4	61	65
				100%		100%			7%	93%	
Total	36	11	47	54	45	105	67	95	195	265	460

Night Survey - The night boat-survey provided a different method to obtained species composition and size structure in Sector 4 and 5. Only green turtles were sighted during the night survey in Sectors 4 & 5 (Table 3).

Table 3 Boat surveys conducted at night from Rumah Baru

Trans.	Direction	From	To	Green	Hawksbill
1	South	Rumah Baru	Point of Internal Lagoon	7 adult (T?) 1 adult (M) 1 juvenile	0
2	North	Rumah Baru	Bob's Folley	16 adult (T?) 1 adult (M) 2 juvenile	0

T? = Tail length unknown

M = Mature male

Size Composition

Year 2003

Green turtles ranged in size between 37.9 and 113.2 cm ccl (mean 73.3, sd=24.3, median=73.4, n=66). The size frequency histogram (Figure 2) shows that most captured turtles were in the 55-60 and the 60-65 cm ccl size classes.

Hawksbill turtles ranged in size between 31.5 and 86.2 cm ccl (mean 56.9, sd=12.25, median, 55.0, n=95). The size frequency histogram (Figure 3) shows that the size distribution is bi-modal with peaks occurring in the 45-50 and the 65-70 cm ccl size classes.

The size range of green turtles was extended this year with two small turtles captured (37.9 cm ccl & 39.3 cm ccl). The size range of hawksbill turtles was also extended with a small turtle (31.5 cm ccl) and a large adult sized turtle (86.2 cm ccl).

The night survey (Sector 4 & %) produced 25 (89%) adult-sized green turtles (including 2 adult males) and 3 juveniles (Table 3).

Size Structure between Locations

Sectors 5, 6 and 7 are located adjacent to West Island and were pooled to form the group West Island, while sectors 12 and 13 are located adjacent to South Island and were pooled to form the group South Island. Figure 4 & Figure 5 compares size structure between these localities. These histograms show that a higher proportion of large green and hawksbill turtles are found near West Island than at South Island.

Growth Rates

In 2003, growth rates were obtained for 17 hawksbill turtles and no green turtles. The results presented below include the 2003 results plus the eight growth rates obtained in 2002. As no growth rates were obtained in 2003 for green turtles, the 2002 results are presented for comparative purposes. More growth rates are needed for each size class before a more detailed analysis can be conducted (Table 6 & Table 7). For green turtles,

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more growth rates are needed in all size classes and for hawksbill turtles more growth rates are needed in the smaller size classes.

Figure 6 show that hawksbill turtles have very high growth rates (between 5 and 7 cm/yr ccl) in early years (40-50 cm ccl) and this slows down as that reach sizes over 70 cm ccl (0 –3 cm/yr ccl). More growth rates are needed for green turtles before any more analysis can be conducted.

Table 4 Growth Rates of Individual Green Turtles (sorted by size)

Tag Number	First Capture			Second Capture			Mean Size	Days at Large	Growth per year	
	Date of Capture	CCL (cm)	Weight (kg)	Date of Recapture	CCL (cm)	Weight (kg)			CCI (cm)	Wt (kg)
CA4487	30/11/00	42.5	9.0	13/02/02	48.5	13.5	45.5	440	5.0	3.7
CA4273*	02/03/99	49.5	16.0	21/11/00	60.2	30.0	54.85	630	6.2	8.1
CA4376	21/11/00	57.7	25.0	15/02/02	64.9	44.0#	61.3	451	5.8	15.4
CA4440	26/11/00	59.0	26.5	11/02/02	68.5	36.5	63.8	447	7.8	8.3
Mean									6.2	8.9

This weight should be used with caution as it is heavier than other individuals of this size.

Table 5 Growth Rates of Individual Hawksbill Turtles (sorted by size)

Tag Number	First Capture			Second Capture			Mean Size	Days at Large	Growth per year	
	Date of Capture	CCL (cm)	Weight (kg)	Date of Recapture	CCL (cm)	Weight (kg)			CCI (cm)	Wt (kg)
CA4580	05/02/02	33.9	5.0	13/01/03	39.6	7.0	36.8	342	6.1	2.1
CA4627	07/02/02	44.9	9.0	11/01/03	49.7	12.0	47.3	338	5.2	3.2
CA4319	16/11/00	43.2	8.5	08/02/02	51.9	13.5	47.6	449	7.1	4.1
CA4682	10/02/02	45.3	10.0	07/01/03	50.4	13.0	47.9	331	5.6	3.3
CA4384	21/11/00	47.1	10.5	03/02/02	54.5	15.5	50.8	439	6.2	3.7
CA4534	04/02/02	52.0	11.0	10/01/03	54.9	15.0	53.5	340	3.1	4.3
CA4384	03/02/02	54.5	15.5	04/01/03	59.1	21.0	56.8	335	5.0	6.0
CA4540	04/02/02	55.0	16.5	10/01/03	58.7	18.5	56.9	340	4.0	2.1
CA4655	10/02/02	55.0	19.5	08/01/03	58.9	21.5	57.0	332	4.3	2.2
CA4247	01/03/99	48.6	13.0	09/01/03	66.2	30.0	57.4	1410	4.6	4.4
CA4635	08/02/02	56.9	17.0	07/01/03	61.1	23.0	59.0	333	4.6	6.6
CA4560	05/02/02	59.0	19.5	12/01/03	63.7	24.5	61.4	341	5.0	5.4
CA4680	10/02/02	61.0	23.0	04/01/03	66.2	29.0	63.6	328	5.8	6.7
CA4647	08/02/02	65.5	24.0	07/01/03	67.2	28.0	66.4	333	1.9	4.1
CA4342	19/11/00	66.2	28.0	15/02/02	70.7	30.5	68.5	452	3.6	2.0
CA4502	02/02/02	69.0	32.0	06/01/03	71.0	35.0	70.0	338	2.2	3.2
CA4414	25/11/00	66.7	27.0	09/01/03	73.4	35.0	70.1	775	3.2	3.8
CA4342	14/02/02	70.7	30.5	08/01/03	70.8	32.5	70.8	328	0.1	2.2
CA4420	16/11/00	73.4	39	03/02/02	74.3	42.5	73.9	434	0.8	2.9
CA4420	03/02/02	74.3	42.5	09/01/03	74.3	42.5	73.9	340	0	0
CA4263	01/03/02	72.1	36.5	12/02/02	78.5	45.5	75.3	1079	2.2	3.0
CA4330	16/11/00	74.4	-	03/02/02	76.7	40.5	75.6	444	1.9	-
CA4390	21/11/00	75.0	26.5	11/02/02	77.8	36.5	76.4	442	2.3	4.1
CA4240	23/02/99	77.4	39.0	9/02/02	79.6	46.0	78.5	1082	0.7	2.4
CA4240	09/02/02	79.6	46.0	10/01/03	80.5	48.0	79.0	335	0.8	2.3
Mean									3.4	3.5

Table 6 Mean Growth Rates of Green Turtles by Mean Size Class (10cm increments)

Size Class	Growth Rate cm ccl/yr				Growth Rate kg/yr			
	Mean	sd	Range	n	Mean	sd	Range	n
40-50	5.0	-	-	1	5.0	-	-	1
50-60	6.2	-	-	1	6.2	-	-	1
60-70	6.8	1.4	5.8-7.8	2	11.9	5.0	8.3-15.0	2
70-80								

Table 7 Mean Growth Rates of Hawksbill Turtles by Mean Size Class (10cm increments) – all years

Size Class	Growth Rate cm ccl/yr				Growth Rate kg/yr			
	Mean	sd	Range	n	Mean	sd	Range	n
30-40	6.1			1	2.1			1
40-50	5.9	0.99	5.2-7.1	3	3.5	0.46	3.2-4.1	3
50-60	4.5	0.94	3.1-6.2	7	4.2	1.7	2.1-6.6	7
60-70	4.1	1.72	1.9-5.8	4	4.6	2.0	2.0-6.7	4
70-80	1.4	1.0	0-3.2	10	2.6	1.2	0-4.1	9

Fidelity and Inter-season Movements

One hawksbill turtle showed inter-season movement between catch sectors on the southern atoll of Cocos (Keeling) Islands. This turtle (CA4240) was first captured in Sector 12 near South Island on 23rd February 1999, was recaptured on 9th February 2002 in Sector 6 and recaptured again on 10th January 2003 in Sector 6. This initial movement between sectors was a minimum distance of 8.5 km.

New Recruits

Several green turtles were classified as new recruits. They were CA7492 (37.9 cm ccl) (9a and 9b), CA7507 (46.2 cm ccl) and CA4788 (46.8 cm ccl).

Health and Condition of Turtles

Dead

Two dead turtles were reported to the Parks Australia office during the length of the field work. On 7th January 2003 a resident reported a green turtle floating dead in the middle of the lagoon of the Southern Atoll (E of West Island jetty). It was reported to have had no visible external damage but was covered in algae. As most of the green turtles at Cocos are not covered with algae it is likely that this turtle may have been sick for several months prior to its death. On 22nd of January a beach-washed turtle was reported on the southern shores of the internal lagoon of West Island. This turtle could not be found, so no external examination could be conducted.

Sick

Several turtles were sick or had serious damage. Two hawksbill turtles were classified as sick. They were weak, thin and covered in algae. The first turtle (CA 4534 - 54.9 cm ccl) was covered in algae and thin. This second turtle (61.3 cm ccl) was seriously ill and may not survive. It didn't move when approached, and once captured and placed in the boat, it was found to be very weak. The scales on the head and flippers were peeling off and the carapace scutes were loose. Once released it had buoyancy problems, it could not reach the bottom in water of 50 cm depth and swam in circles on the surface (Fig. 9d).

One adult male green turtle (ca7401) had infected eyes (Fig 9d).

Damage (including boat strike)

A green turtle (CA 7468) with probable boat strike damage to the carapace was captured in Sector 12. The wound was 10cm by 2cm in area and 1.5 cm in depth and located in the 3rd central scale. It was healed but penetrated through the carapace bone and only the thin peritoneum stopped it from entering the body cavity. One adult sized green turtle (CA 7660) had a severe laceration on the throat (Fig. 9e) of unknown cause. One adult male turtle (CA 7618) had the right rear flipper missing.

Minor natural damage was found on three hawksbill turtles and one green turtle. Damage consisted of notches in the margins of the carapace and small notches from hind flippers.

Deformed

A hawksbill turtle (CA 7439) had an irregular hump in its carapace which was possibly a spinal deformity. Another small hawksbill turtle (CA 7579) had a slightly humped carapace. Another hawksbill turtle (CA 7666) had a deformed narrow carapace on anterior left side.

Foraging and Resting Areas

During the boat-tow surveys offshore from North Point (Sand Shutes towards Horsbough Island), 14 turtles were sighted. One short-tailed adult-size turtle had shiny tags and was found resting on a sandy area with nine other turtles. The shiny tags showed that it had been tagged during the current field trip, which mean that it was one of three turtles tagged on 15 January 2003.

Link Between Foraging and Nesting Turtles

In mid January, Robert Thorn (PAN) observed two mating turtles in the outer end of the Rumah Baru boat channel. One of the turtles was tagged (likely to have been applied during last 4 study years of this project) indicating that at least some foraging turtles in the southern atoll breed at the southern or northern atolls.

Maturity of Adult-Sized Turtles

Three adult sized green turtles with short-tails were considered adult female turtles because of both fresh and healed damage to the shoulders and carapace. Males bite the shoulders, neck, flippers and tail of females and other males and this provides direct evidence of mating. The hooked claws on the front flippers of males are used to attached to the carapace of the female while mating and can sometimes leave the carapace marked. Figure 9f shows these claw marks on the left front of the carapace.

Preliminary Population Estimate

Preliminary population estimates for hawksbill turtles at South Island and West Island capture areas were attempted using the limited recaptures obtained so far (Table 8, Table 9 & Table 10)

Table 8. Total captures and Recaptures for hawksbill turtles in West Island sectors

		Hawksbill – West Island			
Turtles Captured		1999	2000	2002	2003
	Recaptured	7	32	36	30
	1999			14	2
	2000			6	1
	2002				9

Table 9. Total captures and recaptures for hawksbill turtles in South Island sectors

		Hawksbill – South Island			
Turtles Captured		1999	2000	2002	2003
	Recaptured	4	22	54	65
	1999				1
	2000				
	2002				5

Table 10. Population estimates for hawksbill turtles at West and South Island

Population Estimate						
West Island				South Island		
	Min.	Estimate	Max.	Min.	Estimate	Max.
1	0	0	0	0	0	0
2	80.7	408	6011	47.6	529	28536
3	48.5	84	248	82.5	504	13276
Mean		246			516	

Nesting Turtles

North Keeling Island

The north-western beach of North Keeling was surveyed for nesting activity on Saturday 18 January 2003. Five green turtles tracks were judged to be from the previous night, while eight green turtles tracks were still visible from within the last week. The nesting beach and green turtle tracks are shown in Figures 10a to 10d. One dead turtle was found over turned at the base of the dune on the high water mark (Figure 10e). It appeared to have flipped while attempting to crawl up a steep incline covered with natural debris. A skin sample (J6922) was taken for genetic analysis.

Southern Atoll - South Island

The southern beach of South Island was surveyed for nesting activity on Tuesday 14 January 2003. No turtle tracks were present, although seven nesting body pits (Figures 10f and 4g) were visible from previous nesting attempts. The age of these body pits could have ranged from several weeks to several months.

DISCUSSION

Foraging Turtles

Species Composition

The species composition of turtles captured in 2003 reflected the species composition of all years. In 2002, the species composition was biased towards hawksbill turtles. This was most likely caused by limited catching time during late afternoon and early evening, when green turtles, especially the larger size classes, tend to forage. To obtain an unbiased species composition catching must be conducted during most parts of the day (including night) and tide cycles. If catching cannot be conducted at night, then an alternative method such as transect surveys should be conducted to determine species composition and size structure.

Species composition varies between localities. Using those sectors with high catch numbers in Table 2 shows that Sector 6 contains 61% green and 39% hawksbill turtles, Sector 12 contains 27% green and 73% hawksbill turtles and Sector 13 contains almost all hawksbill turtles with 93%.

Size Composition

For green turtles, the 2003 data show a tri-modal distribution. Three groups of turtles can be seen in Figure 2; Group 1 45-60cm, Group 2 65-80cm and Group 3 80-115 cm ccl). This may be caused by irregular recruitment from rookies because of ocean currents or fluctuations in egg production or nest success. This is not shown with hawksbill turtles

which have a normal distribution; they recruit after 30 cm ccl, have an increase in numbers and then decline.

Size structure varies with locality for both species. The Sectors at South Island have small green and hawksbill turtles while Sectors at West Island have a higher proportion of larger turtles. This is definitely related to water depth and access to the seagrass/algal beds.

Size composition is also related to time of day and tide height. Larger green turtles are more common on the intertidal foraging areas of West Island on Spring High tides especially if they occur late in the afternoon or at night.

Night surveys should be continued to increase knowledge regarding foraging behaviour and timing of different size classes.

Growth Rates

Growth rates were obtained for 17 hawksbill turtles making a total of 25 growth rates for hawksbill turtles at Cocos (Keeling) Islands. No inter-season recaptures of green turtles were made, so no additional growth rates were obtained for this species. A full analysis of growth rates will be made next year with a larger sample size.

Fidelity and Interseason Movements

There are distinct differences in the size structure of both species between the catch areas of the South Island (sectors 6 & 7) and catch areas of West Island (Sectors 12 & 13). The mean size and range is much smaller for both species at South Island catch areas. The turtles of the South Island catch area must move away from this feeding area when they reach a certain size and forage elsewhere. The hawksbill turtle (CA 4240) is the first evidence of this movement, and has now been recaptured in consecutive years in its new feeding area in sector 6. This turtle was between 77.4 and 79.6cm ccl when it left the South Island catch area.

New Recruits

New Recruits vary in size depending on the times that the post-hatchling turtles spend in the open ocean. Identifying hawksbill new recruits is more difficult because of their natural yellow colouration.

Health and Condition

There were several health issues that need future monitoring at Cocos (Keeling) Islands. Boat strike will continue to be an issue and is discussed below. In addition, there were two turtle deaths in the southern lagoon during the three week field trip in January, plus a three sick hawksbill turtles. The monitoring of health and condition of turtles should be continued.

Foraging and Resting Areas

The sighting of a tagged turtle during a boat-tow survey off the North Point of West Island, together with a similar sighting of a tagged turtle in 1999 (Whiting 1999) indicates that green turtles that forage in sectors 2-7 probably rest in deeper waters north of West Island during low tides. This is a minimum movement of 6 km which could be made at least once per day. Adult sized turtles rarely foraging on the intertidal areas during the middle of the day and probable spend most daylight hours in these resting areas.

Link Between Foraging and Nesting Turtles

The tagging study on the southern atoll has only tagged foraging green and hawksbill turtles. The sighting of a tagged mating green turtle near Rumah Baru indicates that at least some green turtles that forage on the southern atoll, also breed on the northern or southern atolls of Cocos (Keeling) Islands.

Maturity of Adult Turtles

Fresh and healed mating scars on green turtles captured near West Island indicates that Cocos (Keeling) Islands supports a foraging population of mature green turtles.

Preliminary Population Estimate

The population estimate obtained for hawksbill turtles following the 2003 field trip must be regarded as preliminary only. These calculations show the data that is needed for such calculations but must be used with caution until more recaptures are obtained. For this reason I have not calculated the population per unit area to get the number of turtles per km².

Sea turtle and Seagrass interactions

Green turtles are well known vegetarians (Lanyon et al 1989) with diets consisting of seagrass or algae or a combination of both. The duration and timing of feeding depends on the population and their location. The feeding behaviour of some populations is closely linked to the diurnal cycle (Bjorndal 1989, Mendonca, 1981, Ogden et al 1983) while with other populations, the food source is intertidal and thus feeding is dependant on the tidal cycle (Balazs, 1980 and 1987). Human activity in some areas may deter feeding by turtles at certain times.

It is well known that green turtles, like terrestrial herbivores, are intricately linked to their food supply. Obviously, they require good seagrass beds to maintain normal grazing behaviour, but also seagrass communities would dramatically change with the removal of green turtles. Green turtles establish and maintain grazing plots which allow new growth and they also effect seagrass community structure. Green turtles also have major effects on nutrient cycling in seagrass communities (Bjorndal, 1997) because they reduce the decomposition time of seagrass blades. Under normal conditions, using a similar species to *Thalassia hemprichi* (at CK), it is estimated that the nitrogen deposited from the decomposition (digestion) of seagrass due to turtle feeding is 2.9g/N/day compared to the

release of nitrogen from seagrass under normal conditions of 0.04g/N/day. This nitrogen cycling rate is 70 times faster with sea turtles. Green turtles consume approximately 4g dry wt of seagrass per kg of body mass. For green turtles at CK, the average weight of green turtles is approximately 70kg (accurate mean is difficult to calculate because large turtles cannot be weighed) which gives a mean seagrass consumption of 280g dry wt/day per day. Although population estimates for green turtles are unavailable, current capture rates would put a minimum population of green turtles in Sector 6 in the hundreds. As an example, if the estimate of green turtles feeding in Sector 6 was 300 individuals, that would equate to 84kg dry wt of seagrass removed by turtles per day. This equates to 420 kg wet wt of seagrass per day (using dry wt, wet wt ratio of 1: 5, Fenchel 1979). This calculation is to be used as an example to show the importance of green turtles on the community structure and nutrient cycling of seagrass communities. No comparative data are available for green turtles in algal communities or for hawksbill turtles.

Nesting Turtles

North Keeling Island

North Keeling had five fresh tracks from the previous night. Track counts should be continued by PAN staff on their visits to North Keeling Island. This will provide information on the peak nesting months and allow for an estimate of the size of the nesting population. Only one genetic sample was obtained from the nesting population. This was from an untagged dead turtle on the north-western beach of North Keeling. More samples should be collected from nesting turtles by Pan staff on their normal visits to the island.

Southern Atoll - South Island

Green turtle nesting is considered of low density on South Island. No recent tracks were recorded although, some nesting had occurred in the past two months.

Conservation Issues

There are several conservation issues related to sea turtles at Cocos (Keeling) Islands.

Disturbance

Disturbance is an indirect impact that can cause disruption to normal behaviour and ultimately a loss of foraging area for turtles. Boat activity and noise are common sources of disturbance to turtles. This impact is easy to observe when boating. Turtles will stop their activity and swim away from the disturbance for several hundred metres. Disturbance can disrupt normal activities such as foraging, mating and resting with unknown short- and long-term effects.

Boat Strike

Turtle-boat collisions are an issue that should be monitored at Cocos (Keeling) Islands. All turtles are susceptible to collision when they float on the surface or feed on the

bottom in shallow water. During January 2003, one green was recorded as having healed injuries from boats. A hawksbill turtle may have also had healed injuries from a boat collision. In addition, two turtles were reported dead during this field trip. PAN should endeavour to view all dead turtles reported to their office and record and photograph any external injuries or conditions to help identify cause of death..

Removal of natural shoreline vegetation

Removal of natural shoreline vegetation is a conservation issue for marine turtles. Small hawksbill turtles regularly found sheltering under the branches of *Pemphis acidula* bushes. This is an issue that should be monitored and brought to the attention of the local council.

Marine Debris

The West Island Rubbish Dump (closest to town) still does not have any barriers to prevent wind from blowing plastic and other debris into the sea. I have raised this issue several times in past reports, but it continues to be a marine conservation issue. There are responsibilities under international law to prevent debris entering the marine system. Plastics in the ocean are a major problem and result in wildlife fatalities and injuries.

Physical barriers such as fencing around the area of the dump could prevent the majority of sheet plastic and plastic bags entering the sea. Figure 2g shows that piles of plastics are left at the West Island Dump and Figure 2h shows that this plastic ends up being blown into the surrounding area.

CONCLUSION

The field trip in 2003 was successful with 162 turtles were captured, the highest number of captures in any year. Seventeen growth rates were recorded from hawksbill turtles making a total of 25 growth rates for this species. New insights into the behaviour of turtles were discovered. Large green turtles actively feed at night close to shore on eastern side of West Island. A tagged turtle found off the North Point of West Island indicates that movement of at least 6 km may occur between feeding and resting areas. This could be confirmed with telemetry equipment. Current data indicates, that following another field season, estimates of population size could be calculated for hawksbill turtles in the capture areas. Unfortunately, low recapture rates of green turtles in 2003, may mean that this will not be possible for green turtles next year.

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Figure 2. Size structure of green turtles in 2003

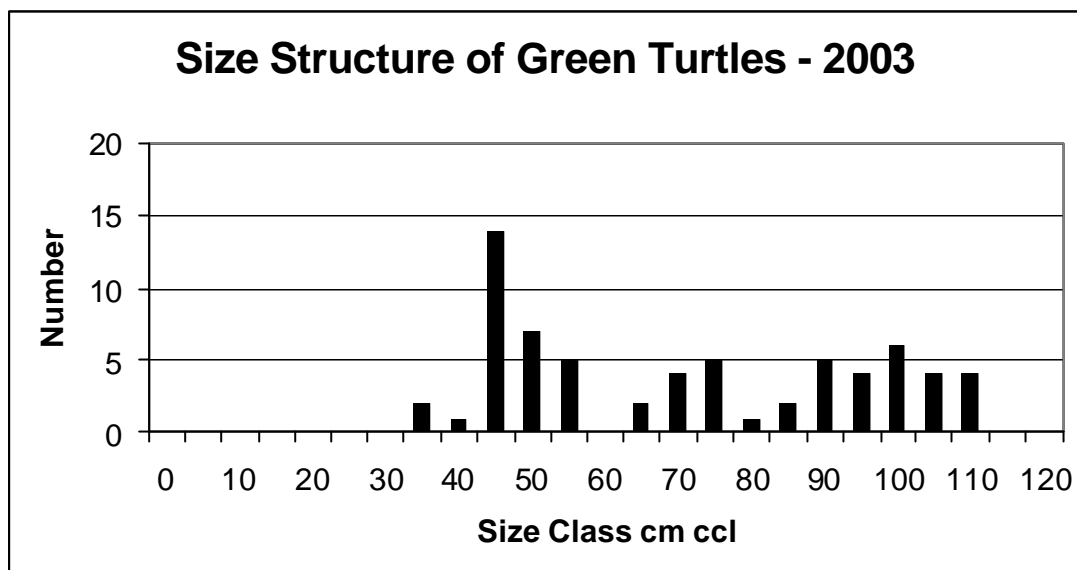
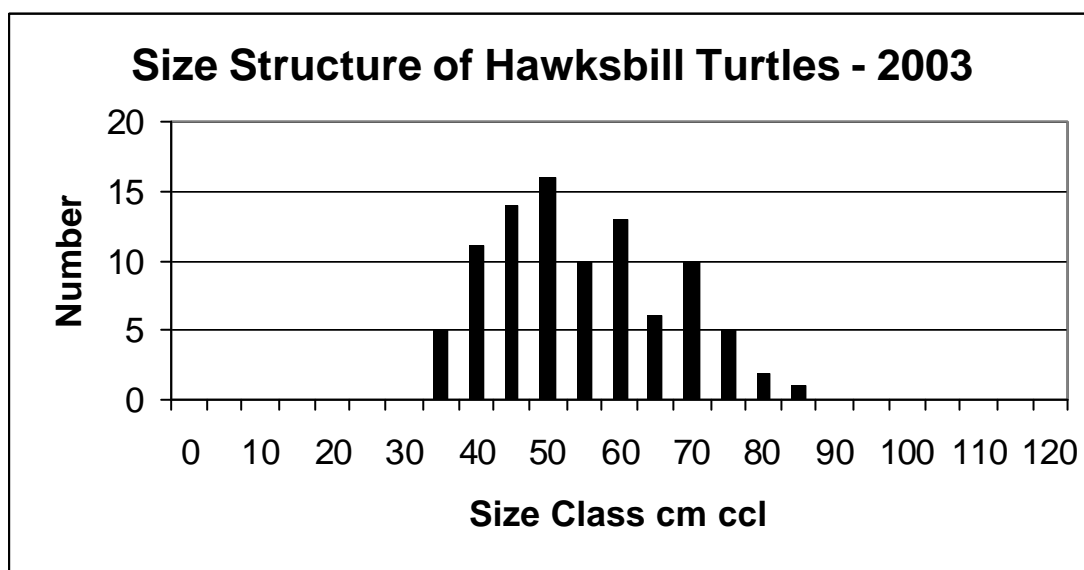


Figure 3. Size structure of hawksbill turtles in 2003



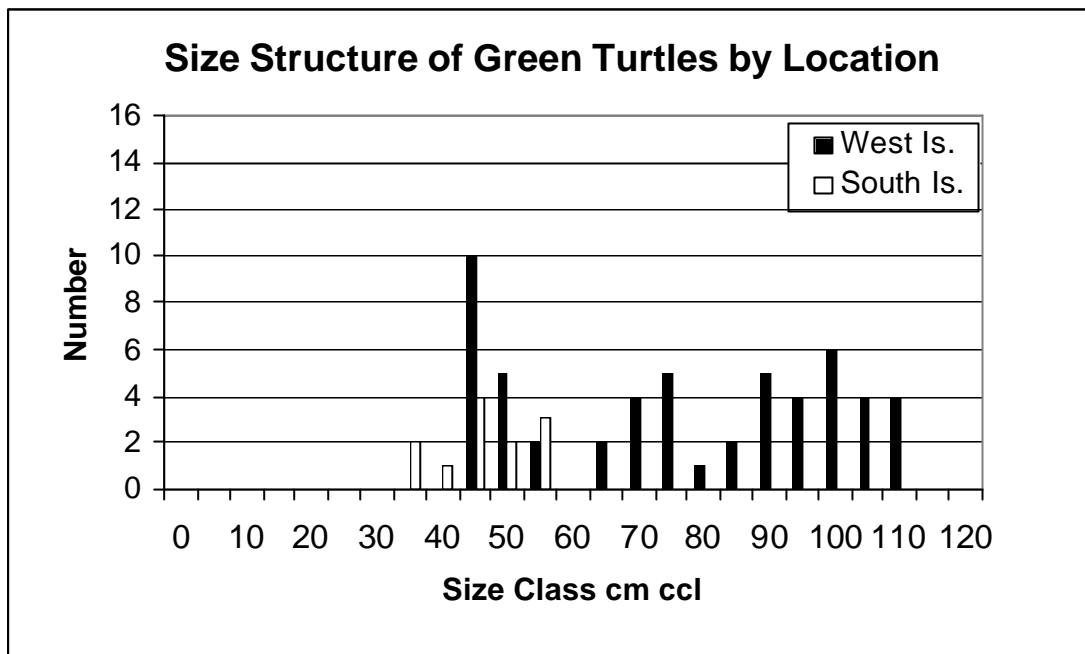


Figure 4. Size structure of Green turtles by locality

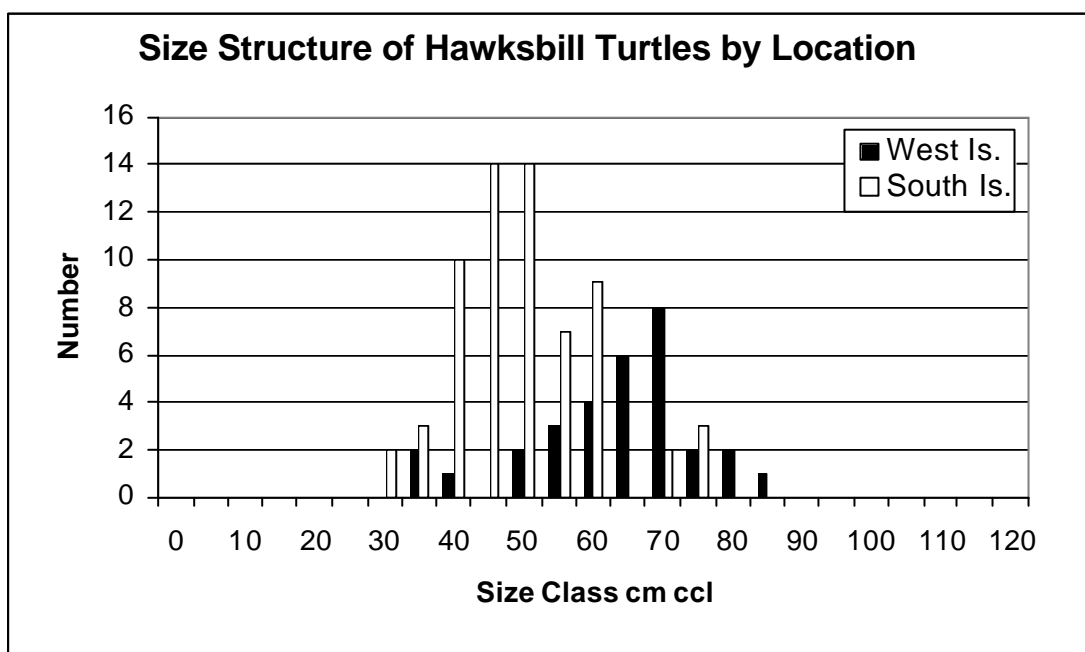
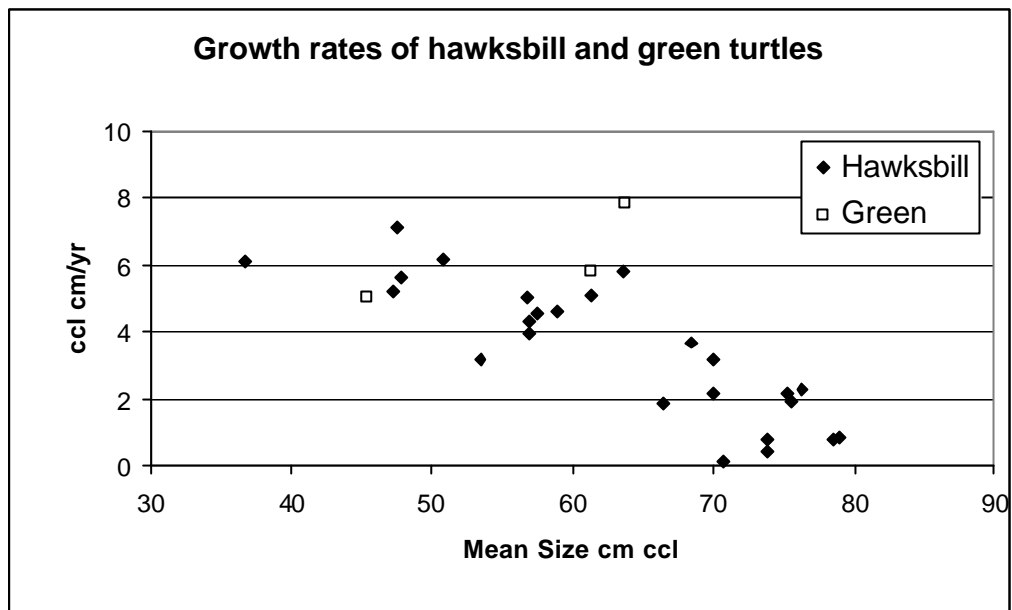


Figure 5. Size Structure of hawksbill turtles by locality

Figure 6 Growth rates for hawksbill and green turtles – all years



APPENDIX 1. DIARY OF ACTIVITIES

The weather and sea conditions were relatively good during the field work and they did not adversely affect the work schedule.

3 January 2003 – Friday – High Tide 0529 0.7m – Low Tide 1037 0.3m

Scott Whiting arrived at Cocos (Keeling) Islands from Perth. Discussions with Parks Australia staff regarding proposed turtle research.

4 January 2003 – Saturday – High Tide 0616 0.8m – Low Tide 1123 0.3m

Wendy Murray (WM) and Scott Whiting (SW) captured five turtles in Sector 6 comprising three hawksbill (two recaptures) and two green turtles.

5 January 2003 – Sunday – High Tide 0700 0.8m – Low Tide 1208 0.3m

Rain and wind all day and could not catch.

6 January 2003 – Monday – High Tide 0743 0.7m – Low Tide 1250 0.3m

Nordianna Hajat (NH) and SW captured three turtles in Sector 6 comprising one hawksbill (recapture) and two green turtles. Very windy, catching was difficult.

7 January 2003 – Tuesday – High Tide 0824 0.8m – Low Tide 1332 0.4m

Robert Thorn (RT) and SW captured 11 turtles in Sector 6 comprising seven hawksbills (3 recaptures) and 4 green turtles. Windy and rainy.

8 January 2003 – Wednesday – High Tide 0906 0.8m – Low Tide 1417 0.5m

Ismail Macrae (IM) and SW captured nine turtles in Sector 6 comprising six hawksbill (3 recaptures) and three green turtles. Raining but calm

9 January 2003 – Thursday – High Tide 0952 0.8m – Low Tide 1510 0.5m

NH and SW captured 10 turtles in Sector 6 between 830 and 1030hrs, comprising 6 green turtles and 4 hawksbill turtles (4recaptures).

SW accompanied IM, RT and NH to the east side of Home Island in the vessel Peronda.

No turtles were seen during the transit to and from this location.

10 January 2003 – Friday – High Tide 1043 0.9m – Low Tide 1617 0.6m

IM and SW captured 22 turtles in Sector 12 between 930 and 1230hrs, comprising 21 hawksbills (1 recapture) and 1 green turtle.

On the return trip to Rumah Baru, one hawksbill (hawksbill) turtle was captured in Sector 6.

11 January 2003 – Saturday – High Tide 1141 0.9m – Low Tide 2235 0.6m

IM and SW captured 16 turtles in Sector 12 between 1030 and 1330 hrs, comprising 8 green turtles and 8 hawksbill turtles (one recapture). A new recruit to the green turtle population was captured in this sector and measured only 37.9 cm ccl. At 2130hrs IM and SW checked for turtles in Sectors 4 and 5.

12 January 2003 – Sunday - High Tide 1241 0.9m – Low Tide 1925 0.6m

IM and SW captured 22 turtles in Sector 13, comprising 19 hawksbill and 3 green turtles. One green turtle was classed as a new recruit and one hawksbill turtle was in poor condition.

13 January 2003 – Monday – High Tide 1336 1.0m – Low Tide 2046 0.4m

NH and SW captured 20 turtles in Sector 13, comprising 1 green turtle and 19 hawksbill turtles. One hawksbill turtle was in poor condition.

14 January 2003 – Tuesday – High Tide 1425 1.0m – Low Tide 2143 0.4m

NH and SW traveled to South Island. SW walked the southern beach of South Island to check for nesting activity. Seven old body its were found but no new tracks.

15 January 2003 – Wednesday – High Tide 1509 1.1m – Low Tide 2225 0.3m

RT and SW captured 10 turtles in Sector 6, comprising 2 hawksbill and 8 green turtles (one adult male, one sub-adult, 3 juveniles and 3 adult females). One adult male turtle was also Captured in Sector 5

16 January 2003 – Thursday – High Tide 1551 1.2m – Low Tide 2301 0.3m

WM and SW captured 7 turtles in Sector 6, comprising two hawksbill and five green turtles (2 juveniles, one sub-adult and two adult males).

17 January 2003 – Friday – High Tide 1631 1.2m – Low Tide 2337 0.2m

WM and SW conducted in-water manta tow transects at North Point. One turtle tagged two days before was sighted.

18 January 2003 – Saturday – Low Tide 1017 0.3m - High Tide 1712 1.3m

Walked the north-western beach of North Keeling Island. One dead nesting turtles was found.

19 January 2003 – Sunday – Low Tide 1101 0.3m - High Tide 1752 1.3m

WM and SW captured nine turtles in Sector 6, comprising all green turtles (4 adult females, 3 adult males and 3 juveniles)

20 January 2003 – Monday - High Tide 0632 0.8 – Low Tide 1146 0.3m

NH and SW captured one green and one hawksbill turtle in Sector 6 in morning. In afternoon, captured one hawksbill turtle and 5 green turtles (1 adult male, 2 adult females, 1 sub-adult and one juvenile).

21 January 2003 – Tuesday - High Tide 0715 0.8m – Low Tide 1233 0.3m

RT and SW captured 6 green turtles in Sector 6 (1 adult male, 3 adult females, one sub-adult and 1 juvenile).

22 January 2003 – Wednesday - High Tide 0759 0.9m – Low Tide 1323 0.3m

All Pan staff and SW captured two green turtles (1 adult male and 1 juvenile) in Sector 6 for purpose of filming methodology.

23 January 2003 – Thursday - High Tide 0846 0.9m – Low Tide 1418 0.4m

WM and SW tried to conduct manta-tows at off North Point but sea conditions were too rough.

24 January 2003 – Friday

SW flight from Cocos Islands to Perth.