

# **Sea Turtle Study -** **Cocos Keeling Islands**

**Year 2 of Study - November 2000**

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## **This Report**

This document is the second report of sea turtle research at Cocos (Keeling) Islands (CK). The first report described the initial survey of sea turtles in February/March 1999 and has references to other historical records (Whiting 1999).

## **Acknowledgments**

This research was funded by entirely by Parks Australia North, Cocos (Keeling) Islands. I would like to thanks Wendy Murray for finding the funds to continue this research and to Ismail Macrae and Robert Thorn for their help in conducting the research. This research was conducted under a scientific permit from Parks Australia North. Sea turtle skin and blood samples were brought into Australia with a permit application to Australian Quarantine Inspection Service.

**Cover Photo:** *Large hawksbill turtle captured in Sector 6 on the southern atoll of Cocos (Keeling) Islands.*

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## **INTRODUCTION**

Sea turtle research at Cocos (Keeling Islands) will provide a better understanding of sea turtles locally around the atoll and regionally in SE Asia and the Indian Ocean.

Australia has initially agreed to the Indian Ocean-SE Asia Marine Turtle MoU in July 2000. This agreement will be signed early in 2001 and will promote protection, conservation, replenishment and recovery of marine turtles and their habitats based on the best scientific evidence (Hykle 2000). Cocos (Keeling) Islands is a remote Australian Territory located in the Indian Ocean 2000 km from the Australian mainland. This remote location in a relatively pristine marine environment means that the Cocos Islands are in a unique and strategic location to assess and monitor sea turtles in the Indian Ocean.

## **METHODS**

### **Foraging Turtles**

Research methods were similar to those used in 1999 and are summarised below. Most of the research activities in 2000 involved obtaining a large sample of turtles for a mark-recapture study. This involved capturing and marking turtles for future investigation into size and species structure, population size, growth rates and movements.

### **Capture**

All turtles were captured using turtle rodeo (Limpus, 1978). The same capture locations as last year were used, although this year the inner lagoon of the Southern Atoll was divided into Sectors and thus all turtles were allocated a Sector in which they were captured (see Figure 1). The turtles from the 1999 survey were also placed into Sectors based on their capture locations. Area A from 1999 becomes Sector 6 and Area B becomes Sector 11,

### **Tagging**

Titanium tags weighing 4.1 g each, were applied to the axial scale of each front flipper (Limpus, 1992). This is the same method that was used last year.

### **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  $\pm 0.5$  cm. Turtles were weighed using a 100 kg ( $\pm 0.5$ kg)

hanging clock-face scale. Small turtles were supported using a rope around each front flipper while large turtles were supported using a rope around each flipper.

### **Recruitment**

New recruits into the foraging population have distinct external characters which indicate a long period in the open ocean. These include lack of fouling from invertebrate organisms and marine algae, white plastron with little yellow colour pigment 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.

### **Diet Samples**

Gastric lavage was performed using the method described by (Forbes & Limpus, 1993; Forbes, 1999). This technique involved two plastic tubes of unequal diameter inserted through the mouth and into oesophagus to the anterior part of the stomach. Water was pumped gently through the smaller tube by a hand pump that was submerged in water. Any food items were returned with the waste water through the larger tube and caught into a mesh net attached to its exterior end.

Samples were preserved in 3-5% formalin in seawater and stored in the dark.

### **Blood Plasma**

Blood was drawn from the cervical sinus (Owens & Ruiz, 1980) using a 10 ml syringe and 21 gauge needle. Blood was stored in 5 ml lithium heparin (Bolten *et al.*, 1992) evacuated tubes. Plasma was separated and stored in plastic vials and frozen at -4°C until analysis. Plasma was used in preference to serum because of variable clot formation in serum (Bolten *et al.* 1992). The plasma will be analysed at Berrimah Veterinary Laboratories, Department of Primary Industries and Fisheries, Darwin using a Cobas Mira analyser with ISE module for electrolytes (Millan *et al.*, 1997).

### **Relative Abundance**

Counts of turtles along transects were performed at CK in 1999. Sea surface condition in November 2000 meant that these transects could not be performed during this survey.

## **Nesting Turtles**

### **Density and species of nesting turtles**

Both Horsburgh and North Keeling Islands (Figure 2) were circumnavigated to assess the density of sea turtle nesting. Tracks were identified to species and aged.

## **RESULTS**

A summary of daily activities are listed in Appendix 1.

### **Foraging Turtles**

All data collected has been entered onto a copy of the QDEH database and is tabulated in Appendix 2.

### **Species Composition**

A total of 100 turtles were captured during the 2000 survey; 47 (47%) were green and 53 (53%) were hawksbill turtles.

Combining the two years of data this gives a catch composition of 83 green (56.5%) and 64 (43.5%) hawksbill turtles.

Both species of sea turtles were sighted in most locations around the southern atoll. However, habitat preferences of each species, meant that the proportion of each species differed between locations (shown in Figure 3 & Figure 4). The abundance of hawksbill turtles was similar in both Sectors 6 and 11, but there appeared to be more green turtles in Sector 6. The true structure will become apparent with more catch data. The total species composition using data from both years is shown in Figure 5.

### **Size Composition**

Green turtles ranged in size between 42.5 and 114.8 cm ccl (Mean 60.83, sd=1.43, n=47). The size frequency histogram (Figure 6) shows that most turtles captured were in the 55-60 and the 60-65 cm ccl size classes.

Hawksbill turtles ranged in size between 34.6 and 80.5 cm ccl (Mean 58.72, sd=1.862, n=53). The size frequency histogram (Figure 7) shows that the size distribution is bi-modal with peaks occurring in the 45-50 and the 65-70 cm ccl size classes. Size structure using data for both years is shown in Figure 8 - greens and Figure 9 - hawksbills. Length- width and length-weight relationships are shown in Figure 10, Figure 11, Figure 12 and Figure 13.

### **Habitat**

A brief habitat description of each of the catch Sectors is given below.

Sector 6 is located at the entrance to the internal lagoon of West Island. The inshore area supports an abundant seagrass and algal community dominated by the seagrass *Thalassia hemprichii*.

Sector 10 is a very shallow embayment on the protected side of South island and is only accessible at high tide. This Sector has less seagrass and algal when compared to the other two catch Sectors. This area was dominated by small hawksbills that were stationary on shallow silty areas near the shore. They sought refuge in the branches of the bush *Suriana maritima* (Figure 18).

Sector 11 is a shallow embayment to the west of sector 10 with better accessibility than Sector 10. This Sector has abundant seagrass and algae in the shallow water. It has a mixture of green and hawksbill turtles, but appears dominated by hawksbills. Again small hawksbills sought refuge in the branches of the bush *Suriana maritima* at high tide.

### **Growth Rates**

One green turtle was recaptured from 1999. In 21 months this turtle had grown 10.7 cm ccl and increased in weight by 14 kg. This is a rate of 6.2 cm ccl/yr and 8.1 kg/yr. This turtle moved three size classes since last capture using the standard histogram size classes of 5 cm.

### **New Recruits**

No new recruits were identified from their external appearance.

### **Movement**

Only limited information is available on the movement of turtles at CK. The green turtle (CA 4273) was captured in 1999 and was recaptured in 2000 only a few hundred metres from its previous capture location, indicating little movement.

In contrast to this record, one unidentified green turtle tagged in 2000 was observed swimming offshore from Trannies Beach on the north-west corner of West. No turtles have been tagged in this location and the nearest Sector that turtles were captured in 2000 was Sector 6. This indicates that short term movements of several kilometres do occur.

### **Diet Samples**

Diet samples were taken from 10 green turtles and 5 hawksbill turtles. Samples were preserved in 4% formalin and therefore had to be transported to Darwin by ship and will arrive in Darwin in January 2001, where they will be sorted.

## **Blood Samples**

Blood was drawn from 16 turtles; 10 green and 6 hawksbill turtles. The blood plasma analysis should be completed by January 2001.

## **Skin Samples - DNA**

Skin samples were taken from 15 green and 15 hawksbill turtles. These samples will be sent to the sea turtle genetics laboratory at the Department of Zoology, University of Queensland. These samples will be analysed under existing research programs partly funded by Environment Australia.

## **Nesting**

### **Distribution, density and species composition**

#### **North Keeling Island**

North Keeling appears to support low density nesting by green turtles. Green turtle tracks were found on both the north-western and southern beaches (Table 1). The north-west beach has better access but still has quite a large shore break. The high tide line meets the terrestrial vegetation and therefore all successful nests have to be laid in shaded sand underneath the vegetation. The vegetation consists of Coconut palm (*Cocos nucifera*), *Pisonia* (*Pisonia grandis*), Octopus Bush (*Argusia argentea*) and Cabbage Bush (*Scaevola taccada*).

The southern beach is composed of zones of coarse sand and large sized coral rubble. This may lead to a lower percentage of successful nesting attempts.

The large amounts of natural and human debris on the shoreline of North Keeling Island hinder nesting attempts.

Table 1 Track counts for green turtles on beaches on North Keeling Island in November 2000

Date - November 2000	North-west Beach	South Beach
Tuesday 21 <sup>st</sup>	2 turtle tracks	Not Surveyed
Wednesday 22 <sup>nd</sup>	3 tracks (1 laid)	3 tracks (1 laid)
Thursday 23 <sup>rd</sup>	2 tracks (1 laid)	Not Surveyed

#### **Southern Island (Horsburgh, Home, West and South Islands)**

Horsburgh Island - There was no sign of turtle nesting, including tracks or old body pits on Horsburgh Island on 16 November 2000.



Home and West Islands - There were no reports of sightings of turtle tracks on either of these two populated islands during the survey.

South Island - Six turtle tracks were observed on the eastern exposed beaches of south Island on 27 November 2000 (Pers. Comm. Conservation and Land Management (CALM) staff, Perth). The species of turtle or the age of the tracks was unknown.

## **DISCUSSION**

### **Foraging Turtles**

#### **Species Composition**

There is a high proportion of hawksbill turtles (45%) at CK when compared to other study locations in the region: Ashmore Reef (1.4% hawksbills) and Fog Bay (38% hawksbills). Research needs to continue as Cocos (Keeling) Islands represent an internationally significant foraging population of hawksbills.

#### **Size Composition**

Green Turtles - The modal size of green turtles at CK is larger than those of two other Indian Ocean study sites in northern Australia (50-60 cm ccl). In Fog Bay most green turtles were in the 40-45 cm size class while at Ashmore Reef most turtles were within the 40-50 cm ccl size classes.

Hawksbill Turtles - The hawksbill turtles at Cocos (Keeling) Islands were in a similar size range to those captured at Fog Bay, Indian Ocean. However, at Cocos (Keeling) Islands a higher proportion of turtles occurred in the larger size classes with a modal peak at 65-70 cm ccl. The hawksbill turtles that are greater than 70 cm ccl may be breeding adults.

#### **Growth Rates**

One growth rate was obtained from a green turtle in Sector 6. Comparisons to other populations are difficult because of only one record. However, this single growth rate is faster than other growth rates reported in the region; Fog Bay - 1.45 cm ccl/yr (Range 0.4-3.48, n=20), Ashmore Reef - 3.79 cm ccl/yr (Range 1.4-5.9 cm ccl/yr, n=16) (Whiting 1999).

#### **Movement**

Movement of turtles within the lagoon is difficult to determine without VHF radio or satellite tracking equipment. Understanding the movements of turtles in the lagoon may only be necessary if there was ever increased mortality due to boat strike or there were plans for development within the lagoon. I suspect that the adult sized green turtles are foraging at night and at dusk and dawn and resting during the day. Therefore they may be moving greater distances to foraging grounds than the smaller turtles. Large numbers of adult turtles are

frequently seen offshore in Sector 1 and during the day but large numbers are seen foraging between Sectors 2-6 at dusk.

## **Significance**

### Foraging Turtles

With a higher proportion of hawksbill turtles captured and sighted during the 2000 survey, the Cocos (Keeling) Islands represent a highly significant aggregation of turtles. Hawksbill turtles are critically endangered (International Union for the Conservation of Nature -IUCN) and are currently a priority for the IUCN Sea Turtle Specialist Group.

Little is known about either foraging or nesting turtles in the Indian Ocean and this has been the focus of the of the Indian Ocean and SE MoU organised by the Convention of Migratory Species (Hykle 2000). All species of sea turtles have suffered serious declines in SE Asia. The declines in eastern Indonesia have particular relevance to Cocos because it is within the migratory distances of sea turtles. Therefore the declines in the Java region may affect the abundance of turtles in the waters of the Cocos Islands. Because hawksbill turtles do not nest at Cocos and green turtles only nest in low numbers, it is suspected that the foraging turtles at Cocos migrate to a distant beach to nest. Therefore the recruitment of foraging turtles from the open ocean would have originated from these distant shores. Hence, the abundance of new recruits to the foraging grounds or of turtles in the small size classes will not only provide estimates of turtles at Cocos but help to monitor the health of nesting beaches in the eastern Indian Ocean.

Future studies using satellite telemetry could identify the links between the foraging turtles at Cocos (Keeling) Islands and their distant nesting beach. This would require the use of a laparoscope to determine which turtles are getting ready to breed in the next season.

## **Short-Term Recommendations**

### GIS Database

The development of a GIS database would help with all types of research both in the North Keeling National Park and also on the southern atoll. This could be used for all fauna and flora sightings as well as monitoring human pressures in the waters of the southern atoll.

### Continue Sea Turtle Study

Foraging studies of sea turtles need a minimum of 5 years to obtain good population estimates. The current study is being conducted in accordance with the objectives of the Draft Sea Turtle Recovery Plan and is the only foraging study of sea turtles being conducted by EA. The results will be of benefit at a local, regional and international scale. As the results of this study are far reaching, financial support to continue this project could be gained at a national and international level.



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Figure 1 Map of Cocos (Keeling) Islands showing the sea turtle 9

Figure 2 Map of North Keeling Island (Pulu Keeling National Park).

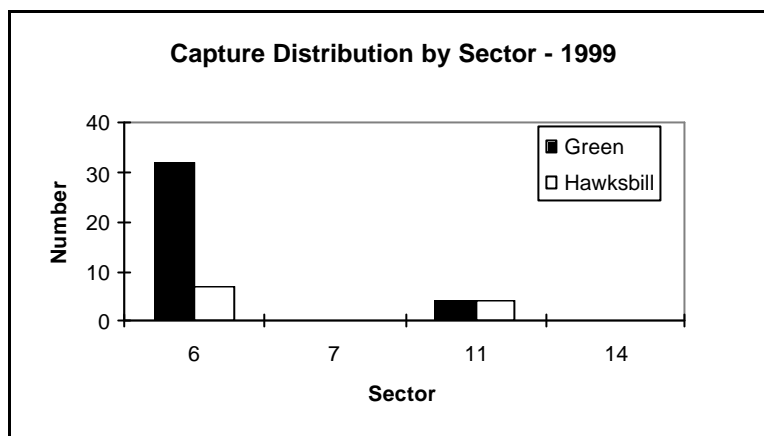


Figure 3 Capture distribution of species by Sector - 1999

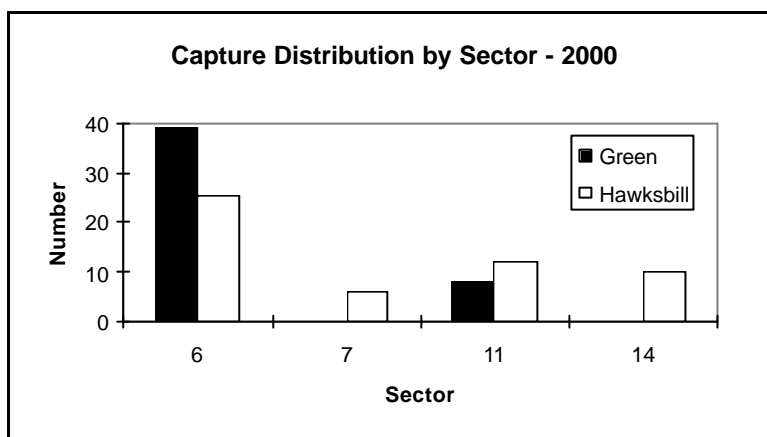


Figure 4 Capture Distribution of Species by Sector - 2000

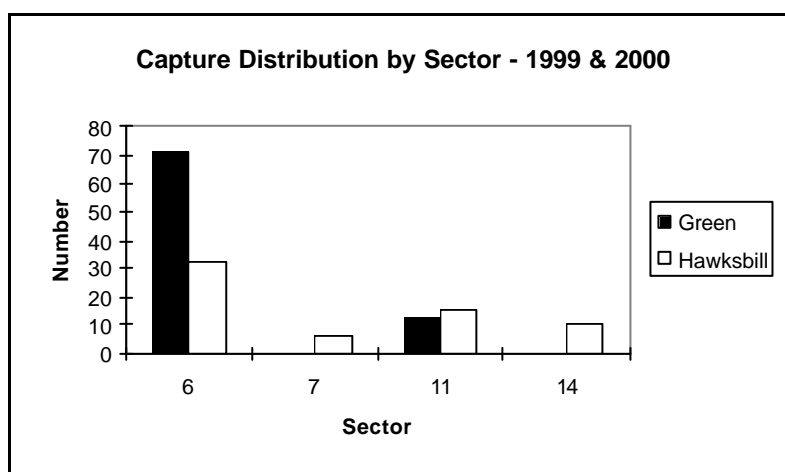


Figure 5 Capture Distribution of Species by Sector - Both Years

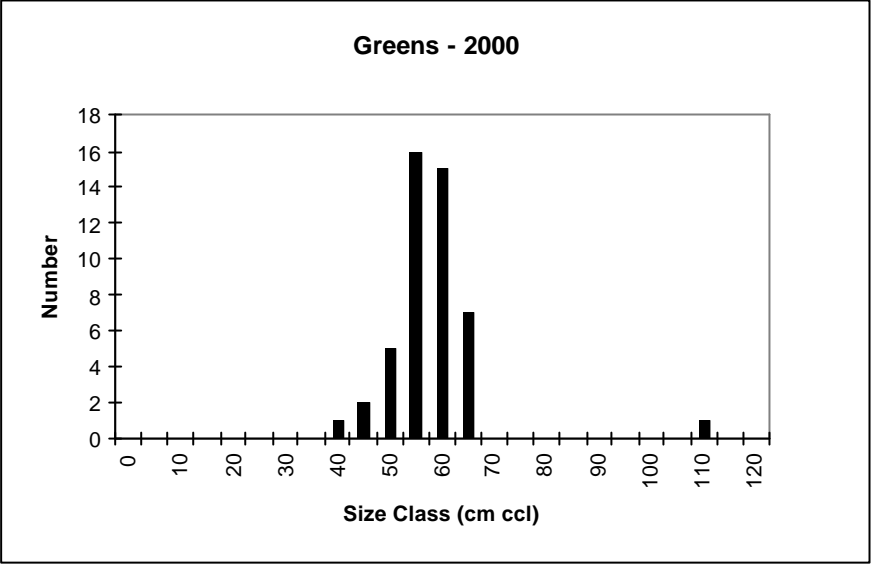


Figure 6 Size Class Capture Distribution of Green Turtles at Cocos Islands for 2000

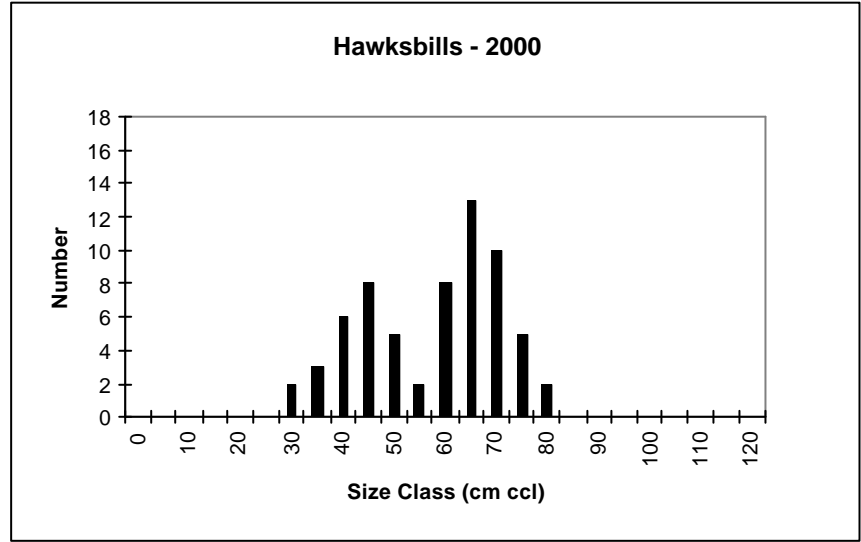


Figure 7 Size Class Capture Distribution of Hawksbill Turtles at Cocos Islands for 2000



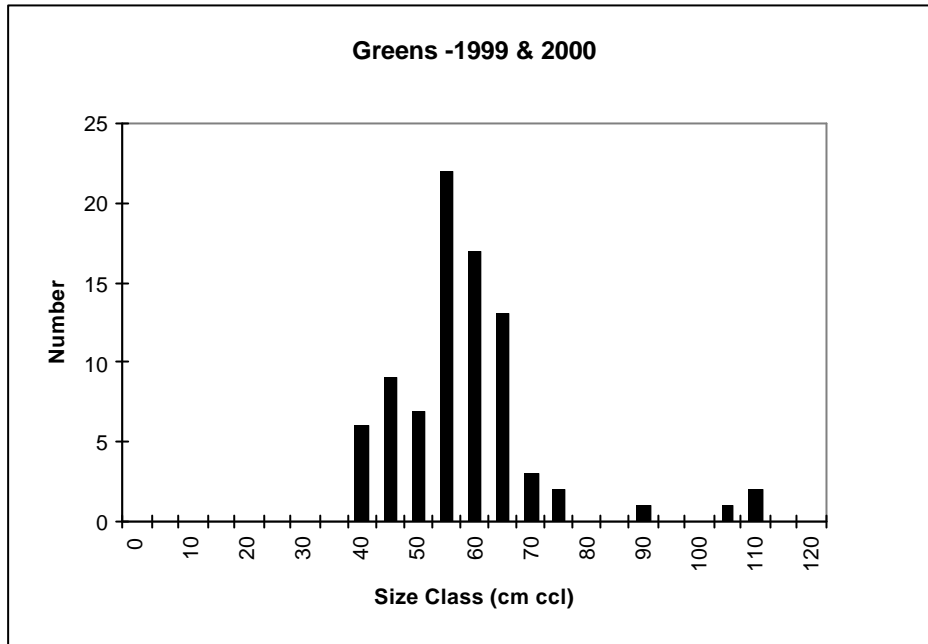


Figure 8 Size Class Capture Distribution of Green Turtles at Cocos Islands for both 1999 & 2000

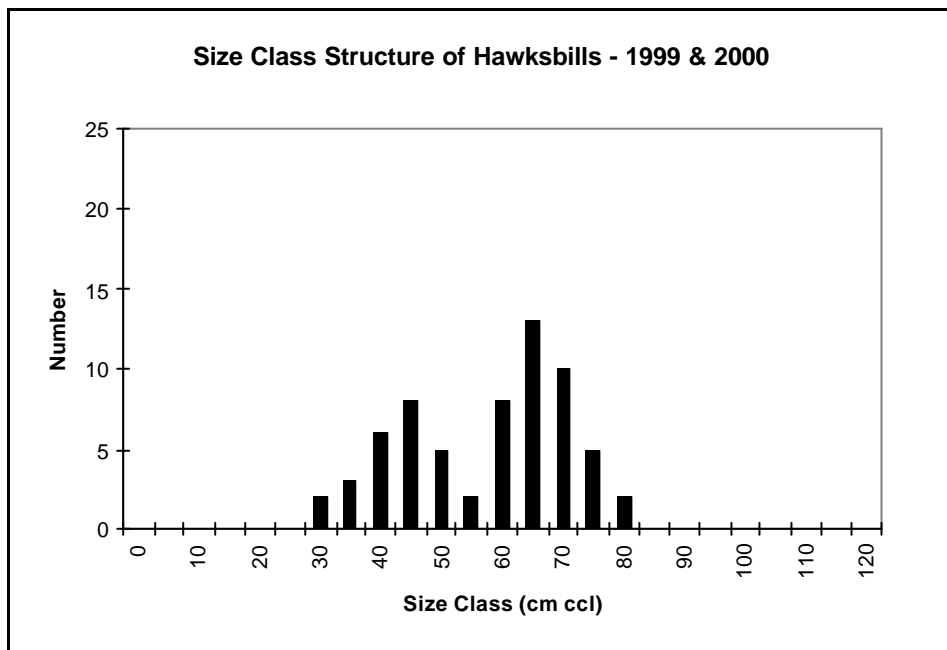


Figure 9 Size Class Capture Distribution of Hawksbill Turtles at Cocos Islands for both 1999 & 2000

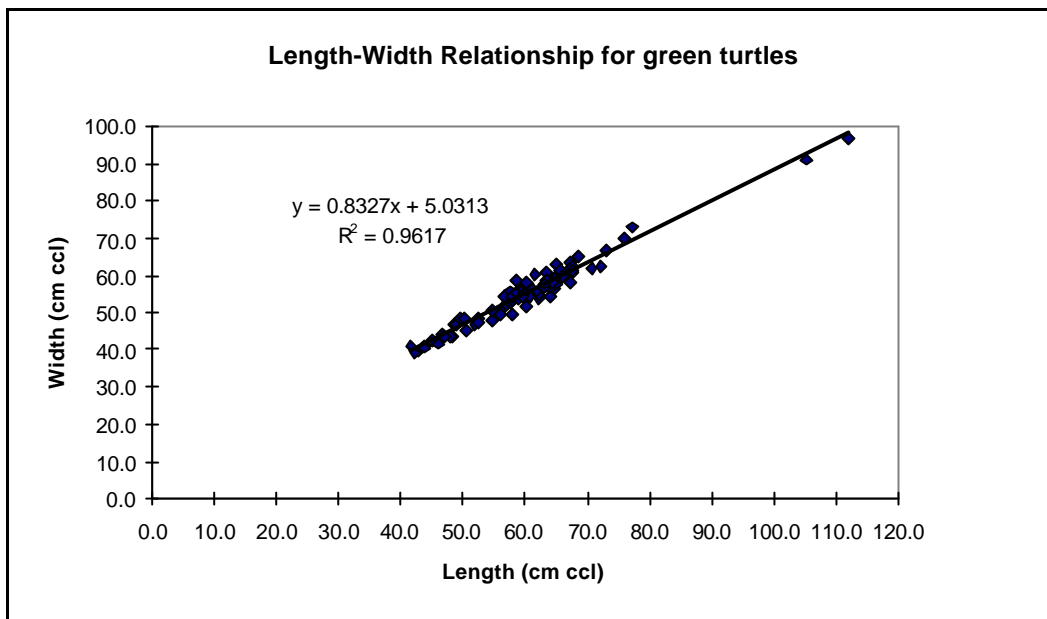


Figure 10 Length-width relationship for green turtles

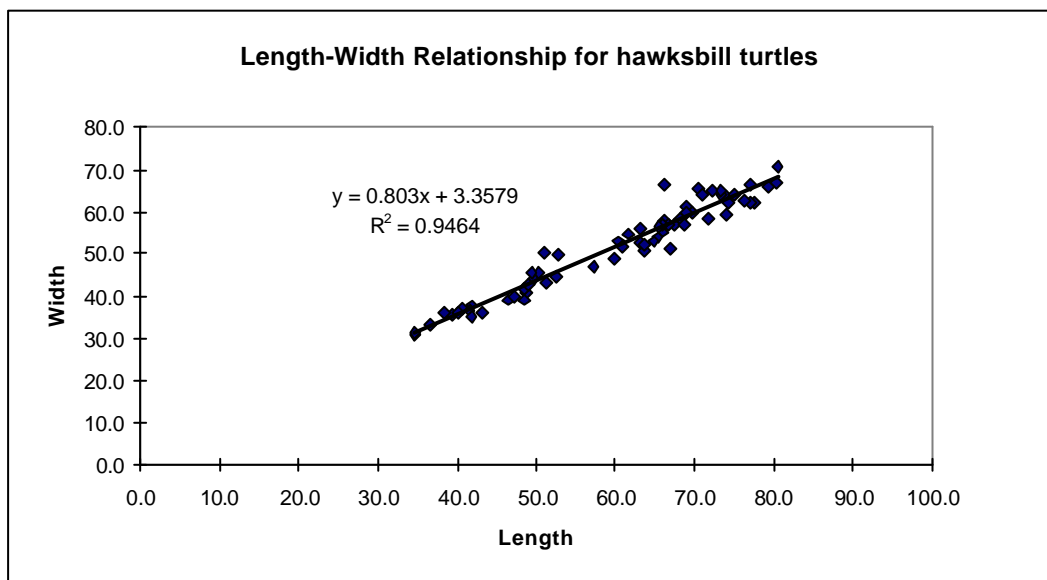


Figure 11 Length-width relationship for hawksbill turtles

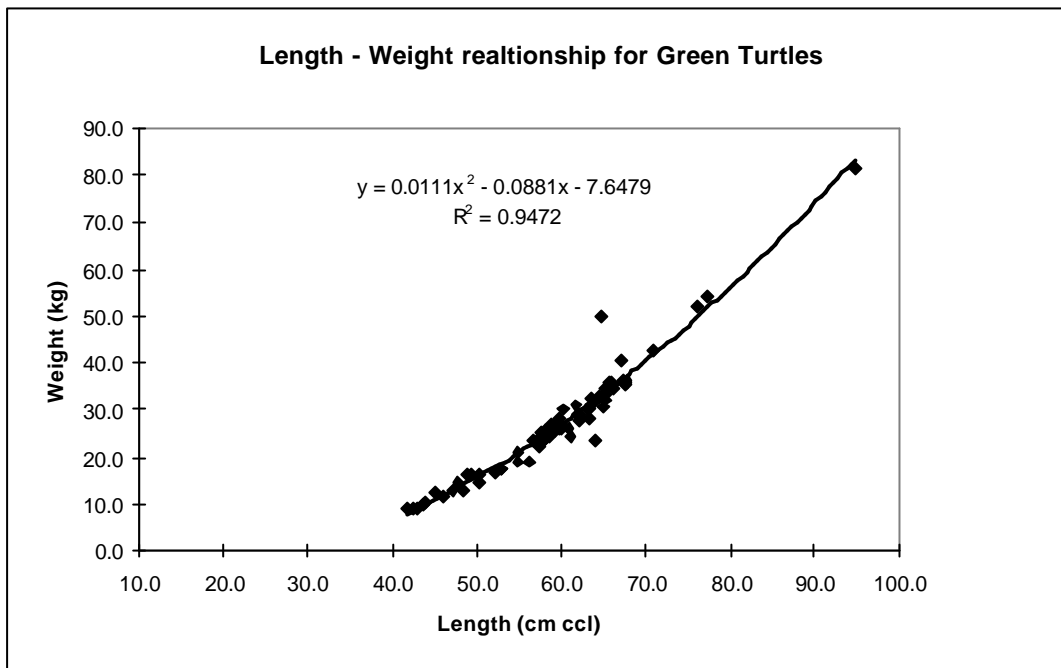


Figure 12 Length-weight relationship for green turtles at Cocos Islands

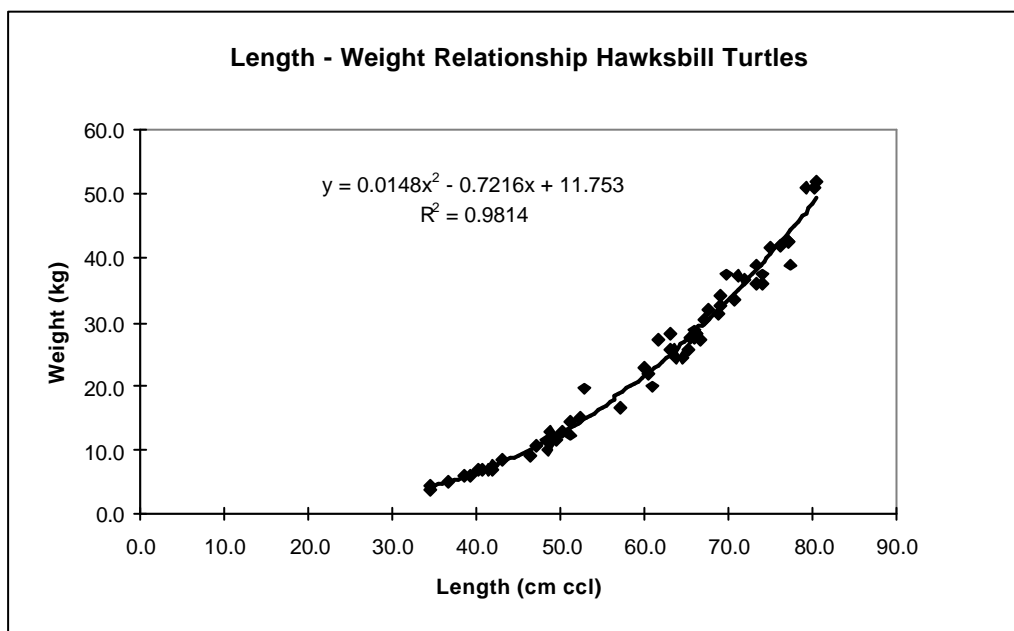


Figure 13 Length-Weight Relationship for hawksbill turtles at Cocos Islands

Figure 14 Ismail Macrae holds a hawksbill turtle

Figure 15 The colourful carapace of a small green turtle

Figure 16 Fouling by algae on the carapace of a hawksbill turtle

Figure 17 *Thalassia hemprichii* and algae from Sector 6, West Island

Figure 18 Refuge habitat for hawksbill turtle on the leeward side of South Island

Figure 19 The seagrass around West Island Jetty provide good foraging habitat for green turtles

Figure 20 The Refuse Tip at West Island is located at the high tide line and creates significant threats to marine wildlife through ingestion and entanglement in debris.

Figure 21 Nesting track of green turtle on NW beach of North Keeling Island

Figure 22 Natural and human debris hinder nesting by turtles on North Keeling Island

Figure 23 Green turtle nests are laid under the shade of Coconut Palms and Pisonia Trees.

Figure 24 The southern nesting beach on North Keeling Island is composed of coarse sediment and large pieces of coral rubble.

## **APPENDIX 1 DIARY OF ACTIVITIES**

### Friday 10 November 2000

Scott Whiting (SW) - Flight Darwin to Perth

### Saturday 11 November 2000

SW - Flight Perth to Cocos (Keeling)

### Sunday 12 November 2000

Prepared turtle catching and processing equipment. Visited the jetty to look for turtles.

### Monday 13 November 2000

Went to Scout Park. Walked around Pulu Maria to look for turtles. In afternoon snorkelled off the yacht club. Collected and photographed algae.

### Tuesday 14 November 2000

900hrs Went to West Island Jetty to look for turtles.

Went of an area of West Island south of Rumah Baru. Snorkelled 200m offshore and collected and photographed algae.

1300hrs sighted a 3.5 m tiger shark along side West Island Jetty.

### Wednesday 15 November 2000

800hrs Robert Thorn and SW to South Island to catch turtles. No turtles were sighted along the way on route to South Island. Ten hawksbill turtles were captured in a small shallow seagrass dominated bay (12° 10.01' S/96° 55.10' E).

Came back via West Island Jetty. Sighted ten adult sized turtles off the end of the jetty, including 1 adult male.

1630 RT and SW patrolled around North Keeling Island in the PAN patrol boat, Peronda.

Thursday 16 November 2000. Turtles were mating offshore on the eastern side of North Keeling. There were tracks from six turtles on the north-western sandy beach on North Keeling.

Three pods of dolphins were sighted around North Keeling: Pod 1 (6-8 individuals) west of North Keeling, Pod 2 (6-8 individuals) North-East of North Keeling and Pod 3 (8-10 Individuals) East of North Keeling).

### Wednesday 16 November 2000

Morning - RT and SW accompanied by cat eradication staff from CALM visited Horsburgh Island. There were no signs of turtle nesting; no fresh tracks or old body pits. One adult sized and 2 juvenile green turtles were observed on the southern entrance to Horsburgh Island on departure.

Afternoon – RT and SW captured five turtles in Sector 6 (West Island); two hawksbills, two juvenile greens and 1 adult female turtle.

### Friday 17 November 2000

Checked with West Island Health Clinic about importation of blood samples to mainland.

Compiled gastric lavage kit.

Afternoon – worked on notes.

Saturday 18 November 2000

Worked on notes.

Sunday 19 November 2000

Ismail Macree and SW captured 14 turtles in Sector 6; 11 hawksbill and 3 green turtles.

Monday 20 November 2000

Observed turtles at West Island Jetty. Walked along the beach to the Northern Point of West Island.

Afternoon – Spent 2.5 hours snorkelling at the entrance to the inner lagoon West Island, offshore from runway. Collected and photographed seagrass and algal community. Didn't see any turtles.

Tuesday 21 November 2000

RT and SW caught 21 turtles in Sector 6; 12 green and 9 hawksbill turtles. Eight gastric lavage samples were taken from 5 green and 3 hawksbill turtles. Seven blood samples were taken from 4 green and 3 hawksbill turtles.

One green turtle, tagged in 1999, was recaptured

Wednesday 22 November 2000

730 hrs Wendy Murray (WM), IM, RT and SW travelled to North Keeling Island (Pulu Keeling National Park) on the RJ Hawk. The PAN staff conducted monthly bird survey while SW surveyed the coastline for sea turtle nesting.

North Beach – nesting for night of 21 Nov. 2 fresh green turtle tracks, 5 tracks approx. 3 days old and 7 tracks approximately 1 week old.

Thursday 23 November 2000

Walked around North Keeling Island.

Nesting for night of 22<sup>nd</sup> North Beach - 3 green turtle tracks (1 laid). One nesting turtle on beach at 0430hrs.  
Southern Beach - 3 nesting tracks (1 laid)

Afternoon – Checked internal lagoon. Sparse seagrass - *Thalassia hemprichii* (Thalassia hemprichii) on a very soft and muddy substrate.

Collected DNA samples from Masked and Redfooted Boobies

Friday 24 November 2000

Turtle Nesting north beach; 4 tracks (1 laid).

Packed up camp and were picked up at 1200hrs.

Saturday 25 November 2000

IM, RT and SW captured 10 turtles in a bay north of South Island: 4 hawksbill and green turtles. Diet and blood samples were taken.

Sunday 26 November 2000

IM and SW captured 20 turtles in Sector 6: 8 hawksbill and 12 green turtles.

Monday 27 November 2000

Filled out AQIS permit application to import skin and blood samples into mainland Australia. This took several phone calls but was not resolved.

Disposed of sharps and biowaste in authorised containers at West Island Health Clinic.



Tuesday 28 November 2000

Continued with trying to get AQIS permits for importation of samples.

Wednesday 29 November 2000

RT and I captured 10 turtles; 8 greens and 2 hawksbills in Sector 11 near South Island.

Thursday 30 November 2000

RT and I Captured 10 green turtles in Sector 6.

Friday 1 December 2000

RT, IM and I went to Home Island to give a talk on sea turtles to the community.

Saturday 2 December 2000

I flew from CK to Perth with National Jet. I had to wait several days in Perth until the sea turtle blood plasma and skin samples could be released from quarantine.

## **APPENDIX 2 PRINT OUT OF SEA TURTLE DATABASE**