Journal of the
Marine Biological Association of India

ABBREVIATION : *J. mar. biol. Ass. India*

Vol. 18 **August, 1976** **No. 2**

REPORT ON SEA TURTLES IN THE SEYCHELLES AREA*

J. FRAZIER

Animal Ecology Research Group, Department of Zoology, Oxford

ABSTRACT

Nearly two years of field work have been conducted in the Seychelles area, twenty months of this at Aldabra Atoll. All major groups of islands in the Seychelles area have been examined (although some very briefly and superficially). Granitic Seychelles, Amirantes, Providence/Farquhar, Aldabras, and Chagos. Throughout this area, the green turtle is the most celebrated species because it is an important food source, while the hawksbill is the most ubiquitous species. Two other species also occur. The loggerhead is known from several localities, and some turtlemen even say it is not uncommon in some places. One person even claims that the loggerhead breeds on Cerf Island in the Providence group. The leathery turtle occurs at least in the Granitic Islands but is rare. There is as yet no indication that the Riddley turtle occurs in this area. Consequently two species—the green turtle and the hawksbill—are of major importance to the Seychelles area.

In all of Seychelles, which includes thousands of square km of ocean and hundreds of islands, there are at present only two localities where the green turtle breeds in any numbers—at Aldabra and Astove Atolls. Even though the numbers of turtles breeding at these localities are far in excess of any other localities in Seychelles, the overall number of green turtles in the Seychelles is dramatically reduced from what it was in previous years.

Nearly every island surveyed had large scale—often catastrophic—erosion occurring on the beaches. This results, in one way or another, in the deterioration of large areas of nesting habitat. Underlying rock, either pavement of beach rock or large cobbles, is exposed ; steep cliffs at the beach crest are produced. Beaches are built during one prevailing wind, but then suddenly washed out during the next.

This large scale destruction of nesting habitat can have nothing but a very deleterious effect on the turtle populations. Nevertheless, the immense decline of the green turtle throughout this area, which has unquestionably occurred, has probably been caused most by man. Unbelievably large scale destruction has been documented for hundreds of years. Because of the methods used in turtling, the result of this is not only to reduce the adult populations but also to diminish reproduction and recruitment to a dangerously low level.

* Presented at the ' Symposium on Indian Ocean and Adjacent Seas—Their Origin, Science and Resources ' held by the Marine Biological Association of India, at Cochin from January 12 to 18, 1971.

For many years the urgency of the situation has been pointed out; however, very little action was taken until recently. At present, all that remains of a population that must have numbered hundreds of thousands is probably just a few thousand. The outlook for the green turtle in Seychelles is not very hopeful; the population is now small enough that it could be easily exterminated.

It is not known to what extent the Seychelles population of green turtles moves or migrates. Tagging programmes have produced no returns to date; but, in light of findings from other areas, it is expected that a certain amount of large scale movement may occur in this population.

If the Seychelles green turtle is to be given a reprieve, it is imperative that the turtles be protected over their entire range—on both breeding and feeding grounds. This necessitates the co-operation of all nations included in the range of the turtles. Obviously, however, the most important country involved in the protection of the Seychelles green turtle is Seychelles itself.

Protection must occur at several different levels.

(1) Government Officials and politicians must be made to realize the urgency of the situation.

(2) Protective legislation must be passed and maintained until such time as it is deemed by specialists that the population can again stand cropping.

(3) This legislation must be enforced. Local illicit trade and killing of the species (which continues to occur despite a recent law totally protecting the green turtle) must be terminated. Although this will be difficult over an area the size of Seychelles and its outlying islands, something positive must be done to enforce the laws or there is little value in passing them.

(4) It may be necessary to enforce the legislation over a wider basis in an attempt to end predation by foreign parties inside territorial waters.

(5) Special attention and protection must be given to the important breeding areas that are left.

(6) Certainly one of the most important aspects for intelligent maintenance and utilisation of this resource in the future is the education of the people—not only the turtlemen and labours, but also the island managers and owners.

The situation with the hawksbill is somewhat different because this species is taken for its epidermal shields ['tortoiseshell'] and not for food. Data available do *not* indicate a decrease in the populations of this species at Seychelles. However, in the same way, there is no good evidence to prove that there has not been a decline. The largest threat to this species seems to be the destruction of large amounts of nesting habitat by the process euphemistically called 'development'.

It is important that a close watch be kept on the hawksbill fishery so that overexploitation is avoided. It is no less important to set aside sufficient area for the species to breed in and to maintain its numbers; without this, the hawksbill will simply cease to exist as its nesting areas are absorbed into roads, housing areas, boating and recreational areas. In conjunction with this it is also imperative to fully protect breeding animals and areas.

The six points listed above also apply to this species.

INTRODUCTION

IN the Seychelles area, which includes the two Crown Colonies of Seychelles and British Indian Ocean Territory (B.I.O.T.), there are well over 100 islands (120 are mentioned here); dozens of off lying rocks, cays and reefs; and nearly 2 dozen areas of large shoal scattered about thousands of square km of the Western Indian Ocean.

During the past century it has become blatantly obvious that the sea turtles in Seychelles (not to speak of the rest of the tropical world) are decreasing at a catastrophic rate; in areas where countless thousands of turtles were taken in a few months, it is now a major effort to capture a few hundred in a year. It is clear, even to the most naive and unsympathetic layman, that if this resource is to be utilised in the future, strong positive measures must be taken immediately to ensure the continued existence of these animals before they vanish altogether. The decisions that will decide the fate of this resource lie with the government, and politicians of the areas involved. With oceanic species like sea turtles, the decisions and actions of one government will have direct bearing not only on its own territory but upon many neighbouring nations. International co-operation is at a premium here.

In order for intelligent action to be taken on problems of conservation of natural resources, specialists must make relevant information available to various governments, but ultimately the resource is the responsibility of the governments and peoples of the nations involved.

Unfortunately, as in the present case, the information available is oft times sketchy. Although several sea turtle surveys, beginning in the early part of this century, have been undertaken in Seychelles, there is still no complete guide to important points such as feeding areas, breeding areas, and population sizes. There are many good, extensive, general reports on the islands (Piggott, 1968, 1969; Stoddart, 1967, 1970), but these are oriented toward agricultural and agronomical interests on the one hand, and general observations on the other; the problem of sea turtles is dealt with only very superficially.

A specific report on the status of sea turtles in Seychelles is needed, but the present report will not be the last word. Far from it, it will become very clear how little is known of this important resource in the Seychelles area. With an area the size of Seychelles, it would take much time and money (neither of which was available) to conduct a thorough survey. Nevertheless, I have had the good luck, thanks to numerous individuals, to be able to visit some of the Seychelles islands, and results of findings relevant to sea turtles are given. With those islands which I have not been able to visit, and they are many, I have had to do the best I can with available published information. An attempt is made to assess one of the most important requisites of sea turtles—the nesting habitat. Estimates on amount of habitat are made by calculating the length of coast available, and the width of the beach above high water mark. The quality of nesting habitat was also taken into consideration. The beach profile (presence of cliffs or rocks), type and density of vegetation on the beach, and many other factors, are involved here. Estimates of density of nesting, an index to population size, were made where possible. A listing of shoal areas which may be important for feeding is also included.

This report is extensive rather than intensive; and due to the need to make it available in a very short time, I have not been able to consult more than a few of the more available references, and consequently have not integrated in certain published information. I feel, however, that the majority of these omissions will not lead to major weaknesses in the report.

The work on Aldabra was carried out on a grant from the Natural Environment Research Council under the auspices of the Royal Society; I am very grateful to these organisations and the many people involved for their support. The trip to Chagos was made possible through the very kind assistance of Mr. D. Gendron of

P. Moulinie & Co., Seychelles ; Mr. J. Todd, Administrator for B.I.O.T., and Captain G. Savy and the crew of the M/V NORDVAER ; I am deeply indebted for their hospitality. The stay on Cousin and the trip to Cousine were possible by the hospitality of Mr. M. Penny and his family, Resident Scientist for the I.C.B.P. Cousin Island Preserve. I am grateful to Mrs. D. Savy for the opportunity to visit Île Thérèse and the agent of Cousine for the chance to visit this island. Mr. J. Lablache, Government Representative, and Mr. W. André, Senior Forester, helped in my work on Praslin, La Digue, and Curieuse. While on Mahé numerous people were very helpful—Messrs. P. Loustau-Lalanne, T. Underwood and René Michel and family. Mr. Guy Lionnet, Director of the Department of Agriculture, helped in many ways, and Mr. K. Jivan Shah was also a great boon to my work. The trip from Mahé, round the Granitic Islands to the Amirantes, Farquhar, Aldabra, and Mombassa was made while aboard the M/V LINBLAD EXPLORER ; I am most grateful to this company, especially Dr. L. Watson, and the staff and crew of the ship. Miss Susan Lee has spent much time in typing the manuscript, often from bad copy.

SCHEDULE

GRANITE SEYCHELLES	
Mahé	27 June to 1 July, 16 July, 1 to 8 August 1970
Thérèse	7 August 1970
Praslin	1, 13 to 15 July, 9, 10 August 1970
Cousine	7 July 1970
Cousin	1 to 13 July, 9 August 1970
Curieuse	14 July, 9 August 1970
La Digue	15 July, 10 August 1970
AMIRANTES	
Desroche	11 August 1970
PROVIDENCE/FARQUHAR	
(Providence)	12 August 1970
(Cerf)	,,
Farquhar	,,
ALDABRAS	
Astove	5 March 1968, 19 to 21 June 1969
Cosmoledo	6 March 1968
Assumption	1 August 1968
Aldabra	8 January to 31 July 1968, 3 June 1969 to 24 June 1970, 16 August 1970.
CHAGOS	
Peros Banchos	22 and 23 July 1970
Salomon	24 July 1970
Nelson	25 July 1970
Diego Garcia	26, 27 July 1970

EXPLANATION OF TERMS

Beach—an area of coast extending from the intertidal inland to the beach platform ; composed mainly of sand but also pebbles and gravel.

Beach Slope—the face of the beach ; that part which is successively covered and uncovered by the tides ; the slope can be steep or gentle.

Beach Flat—a relatively level area, but still rising inland ; usually not vegetated, but can have pioneer species.

Beach Crest—the highest point in a beach ; often in the form of a ridge parallel to the water's edge ; waves rarely go over the beach crest.

Beach Platform—immediately inland of the beach crest ; relatively level, but descends gradually inland ; vegetation is fairly stable ; the platform may be continuous with inland habitats.

Perched Beach—a beach which is positioned on top of something (rock or cliff), and may not have an intertidal area of beach. 'Storm Beach'.

Cliff—a vertical, or near vertical, drop ; need not be of great height.

Account of the Islands

GRANITIC SEYCHELLES

When first discovered by Europeans about two centuries ago, these islands were famous, among other things, for their land tortoises and sea turtles which occurred in large sizes and large numbers (Sauer, 1967). The tortoises are now represented merely by a few handful of introduced herds from Aldabra, and the turtles are far from a conspicuous feature in the fauna.

Mahé

This is the largest and most populated of the Seychelles islands. It is found from 4°33′23″ to 4°47′54″S and 55°22′ to 55°32′19″E. Mahé is shaped rather like a 'Y' leaning to the left, 24.8 km long by about 5.5 km wide. It rises to 905 m, and lies 1,900 km west of the African Continent and 1,100 km NW of Madagascar. Mahé, Praslin, La Digue, and many other smaller islands of the 'Granite group' are found on a large marine plateau, the 'Seychelles Bank', which is 324 by 352 km.

Although there are 80 beaches on Mahé, most of them are small (only 11 are longer than a km) ; and beach only accounts for about 33 km of the total 106 km of coast. Furthermore, many of the beaches have roads, houses, and other things likely to cause disturbance to nesting turtles. Working round the island clockwise, and beginning in the north, the beaches are :—

Name	Length in m	Road (R) House (H) present	Fringing reef
Machabée River	100	R, H	—
no name	230	R	—
Anse Nord DEst	1640	R, H	—
North East Point	200	,,	—
Le Rocher	120	,,	+
Brilliant Point	110	,,	+
Brilliant River	280	,,	+
Providence River	210	,,	+
,, ...	140	,,	+
Anse Talbot, Anse Déjeuner and Anse Francois ..	1280	,,	+
Anse La Rue	1330	,,	+
Anse Cimetière	110	,,	+
Anse Fause	130	,,	+
Anse Aux Pins	60	,,	+

Name	Length in m	Road (R) House (H) present	Fringing reef
Anse Aux Courbes (north)	2250	R, H	+
„ (south)	430	„	+
Fairyland	170	„	+
„	50	—	+
„	50	—	+
„	50	R	+
„	50	R	+
Anse Royale	2580	R, H	+
Anse Baleine	80	„	+
Anse Bouganville	410	„	+
Anse Parnel	270	„	+
Anse Forbans	480	„	+
Anse Marie-Louise	900	„	+
Petite Marie-Louise	100	H	+
Anse Capucins	200	H	
Petit Boileau	220	H	—
Police Bay	620	—	—
Anse Bazarca	330	R	—
Anse Corail	200	R, H	—
Anse Cachée	150	—	+
Anse Intendance	900	—	—
Anse Takamaka	500	R, H	—
no name	90	H	—
Anse Gaulettes (Baie Lazare, or Val Mer) ..	2030	R, H	—
Anse du Gouvernement	350	„	—
Anse La Liberté, Petite Anse	380	„	—
no name	80	H	—
Anse Aux Poules Bleus	150	R, H	—
Anse La Mouche	250	„	—
Anse Louis	480	„	+
Anse Boileau	1710	„	+
„	150	„	+
„	90	„	+
„	90	„	+
no name	90	—	—
Anse Polite	760	—	—
Dans Galets	410	R, H	—
Barbarons	950	„	+
Grand Anse	1390	„	—
Port Glaud (Anse L'Islette)	800	„	+
„	110	—	+
„	1210	—	+
no name	100	—	—
Port Launay	110	—	+
„	80	—	+
„	420	R, H	+
„	100	R	+
„	60	R	
Ternay	350	R, H	+
Anse du Riz	130	—	+
no name	60	—	—
no name	150	—	—

Name	Length in m	Road (R) House (H) present	Fringing reef
Anse Major (Anse Jasmin)	200	H	—
(La Tour River)	230	R, H	+
Bel Ombre	1140	„	+
Beau Vallon (Petit Port, Mare Anglaise)	2770	„	+
Northolm Hotel (S)	80	„	—
„ (S)	50	„	—
„ (N)	100	„	—
La Blache Hotel (S)	110	„	—
„ (N)	110	„	—
(Tirant River)	50	„	—
no name	70	„	—
(Glacis River)	230	„	—
no name	100	„	—

Four beaches from the north and north-east are listed. Although roads and houses are present, the amount of disturbance, relative to the rest of Mahé, may be small. However, further south the situation changes drastically.

Victoria, the capital of Seychelles, is located on the east coast ; as a consequence much of the east coast of Mahé is ' developed '. Houses, roads, boats, breakwaters, and any number of other things are along the beaches ; it would be a rare event indeed if a turtle nested on any beach from Le Rocher south to Anse Royale. There are fewer people and developments in the south and these beaches may be important to turtles.

Police Bay, in the South-west, was examined. It is on the edge of a coconut plantation. The beach crest is densely vegetated with lush *Scaevola*. In front, the beach flat extends for 1 to 3 m ; it is vegetated with *Ipomea* and tall beach grasses. There is a vertical drop of 30 to 50 cm at the edge of the beach flat, and then the beach slopes down to the sea. At the NW end, beach rock is exposed in the slope of the beach. There was no evidence of turtles nesting ; the vegetation on the beach flat looked as if it had not been disturbed for some time. Mr. R. Deltell, the land-owner, told me that about 10 hawksbills per year came up on this beach (mainly from June to February).

The west coast of Mahé is populated in some areas, but it seems likely that some of the beaches are utilised by breeding turtles, most probably hawksbills. For instance, I am told by authorities in the Department of Agriculture that Anse Louis is known to have hawksbills breeding on it. The beaches around Port Glaud and Port Launay, although not examined in detail, appeared to be decent nesting habitat and are relatively free of human disturbance. The locals say that some of these beaches are good for hawksbills.

Farther north, at Bel Ombre and Beau Vallon, are very long and good looking turtle beaches. However, these are important recreational places and it is highly unlikely that turtles would nest here with the amount of disturbance present.

Even farther north, are some smaller beaches, and although disturbance here may not be an important factor, the beaches are littered with huge boulders. It seems unlikely that many turtles would use these beaches.

On the whole, there are few good turtle beaches on Mahé ; those that look potentially very good have been taken over for human uses—incompatible with turtle breeding.

Sauer (1967) is well worth consulting, for he goes into much detail on the coasts of Mahé. Maps consulted :

Direct of Overseas Surveys (D.O.S.) 204 (Sr. Y851)

Mahé, sheets 1 to 11 ; Admiralty charts 1072 and 2899.

There are a large number of small islands off Mahé, which, because they are less inhabited than the main island, may be important turtle breeding areas.

Ste. Anne

This is the largest of the small islands off Mahé ; wedge-shaped, it is 2.3 by 1.5 km. It lies 4.3 km NE of Le Rocher, in the entrance to Port Victoria and is 250 m high. There is a military area with fuel tanks on the western side of the island. Reef almost completely rings the island. Nearly a dozen beaches are indicated ; they constitute 2.8 km of the total coast of 6.5 km.

Name	Length in m	House (H)
Grand Anse	460	H
no name	80	
Anse Manon	270	H
Petit Manon	150	H
Anse Cimetière	160	
no name	230	H
Anse Mare Jupe	640	H
no name	500	H
no name	50	
no name	30	
Anse Cabot	240	H

Île Aux Cerfs

The second largest of the islands off Mahé, it is 2.3 km NE of Pt. Brilliant. It is roughly a figure of '8', 1.75 km by 0.6 to 0.1 km wide. It rises to 108 m. Seven beaches are indicated, 1 on the south, 2 on the north, and 4 on the west ; 4 have houses nearby. The beaches contribute 2.2 km to the total 4.8 km of circumference. Île Aux Cerfs, together with next 4 named islands, is entirely encircled inside a fringing reef.

ÎLE MOYENNE

870 m SE of Ste. Anne and 1.12 km NE of Cerfs, this is an irregular, oval-shaped island. The dimensions are 500 by 270 m and 60 m high. There are two beaches, (one 50 and the other 100 m long in the east and SE respectively), which are 12% of the total circumference of 1.25 km.

ÎLE ROUNDE

This island is an irregular square 180 by 130 m and 30 m high. It is 770 m N of Île Aux Cerfs. The circumference is about 500 m, and no beaches are indicated.

ÎLE LONGUE (Long Island)

560 m NE of Île Aux Cerfs, the island is 1 by 0.3 km, an oval with a protruding sand spit. It rises to 70 m. There are two beaches ; in the SW 120 m long, and 160 m long in the N ; the circumference of the sand spit is 400 km. Thus, there are 680 m of beach. The total circumference of the island is 2.33 km.

ÎLE CACHÉE

Also oval shaped, this island lies 100 m SE of Île Aux Cerfs. Its dimensions are 220 × 120 m. There is one beach in the south (30 m long) in the total circumference of 550 m.

ÎLE ANONYME

This island is farther down the coast, 800 m NE of Anse Francois. It is irregular in shape, 450 by 250 m and 30 m high. Reef is all round it. Five beaches, 2 in the east and 3 in the west make up 360 m of the 1.22 km of coast.

ÎLE DE SUD-EST

This was once an irregular shaped island 200 m NE of Point La Rue, 760 by 310 m and 63 m high. All of it was enclosed within a reef. On the 2.14 km of coast were 3 beaches ; two in the east 130 and 70 m long, and one 360 m long in the west. This island has now been joined to Mahé in the construction of an airport.

ÎLE AUX VACHES

740 m SW of Mahé, this island is nearly round—280 by 250 m. It rises to 49 m. No beaches are indicated.

ÎLOT DE L'ISLETTE

A small, 320 by 100 m irregular shaped island, this lies 100 m SW of Mahé between Thérèse and Port Glaud. There is some beach on it.

THÉRÈSE

This irregularly shaped island rests 700 m SW of Port Glaud. It rises to about 160 m and is about 1.55 km long by 0.75 km wide ; the circumference is 4.21 km. There is little coastal plateau, for the granite rises quite sharply. However, coconuts are cultivated and about half a dozen people work the plantation.

There is only one beach ; it is on the east side facing Mahé. I estimated its length as less than 300 m, but the D.O.S. map indicates it to be 600 m. There is a small boat shelter at the south end. The beach crest is thickly vegetated with *Scaevola* ; there is also the occasional *Calophyllum inophyllum*, *Cordia subcordata*, *Terminalia catappa*, and *Cocos nucifera*. Although the beach platform is heavily shaded, there are occasional gaps in the beach crest vegetation. Erosion is active and recent, producing sand cliffs of about 30 to 50 cm in some places, but the cliffs are as much as a metre high to the north. In some places shrubs and trees are being undermined.

The beach platform is occasionally littered with leaves and husks from the coconut plantation ; there is also a fairly continuous and dense ground cover vegetation. *Not* more than about 5 m inland from the beach crest could be used for nesting. The approach to the beach involves crossing a small reef, but this does not appear to be much of an obstacle. There were several large granite outcrops in the beach slope in one small area.

The beach is an easy one to approach and ascend ; the final ascent to the beach platform could be difficult due to cliffs and dense vegetation. The substrate is heavily shaded and possibly is difficult to dig in. It does not—in its present state—appear to be usable to green turtles. Hawksbills could probably nest here fairly successfully.

Ocypodes (ghost crabs), which prey on hatching turtles, are probably present but not very numerous. No signs of turtle were seen. The locals claimed that about a dozen hawksbills nested per year ; green turtles are very rare.

Conception

Just north of Thérèse, this island lies 1.65 km SW of Port Launay. It is in the shape of a teardrop, leaning to the west, 1.5 km long by 0.55 km wide and 130 m high. No reef is present. On the 2.56 km of coast, no beaches are indicated.

There is also a large number of rocks off Mahé ; these are small and without beach so are probably of little importance to turtles. They are : Albert Rock, Beacon Island (Ile Seche), Harrison Rock (Grand Rocher), Rat Island (Brulée), Roche Tortue (La Tortue Roche), Ile Souris, Petit Boileau, Mancienne Rock, Roche de. Intendance, Ile Chauve Souris, Les Trois Dames, and Ilot (North Islet). Mamelle is about 14 km to the north-east.

It would seem that neither Mahé, nor the islands immediately off Mahé, has very many nesting turtles at present, for the local feeling is that most turtles to be found in granitic Seychelles are at Praslin and La Digue.

Maps consulted : D.O.S. 204 (Sr. Y851) Mahé, sheets 1 to 11.

Praslin

The home of the ' coco de mer ', this is the second largest island in Seychelles. It is an irregular, elongate shape 12 km NW to SE by 2 to 5 km wide. The island rises to 367 m and is 38 km from Mahé. There are nearly 30 beaches, including the longest continuous stretch of beach in all Seychelles, Anse Kerlan with Grand Anse, which is over 5 km long.

Name	Facing	Length in m	Road (R) House (H) present
Anse Lazio (Chevalier Bay) ..	N	550	R, H
Anse Boudin	N	1180	R, H
Anse Takamaka	„	330	„
Anse Possession (Baie Pasquiere)..	„	1180	„
Anse Petite Cour	„	240	„
Anse Volbert (west)	„	160	„
„ (east)	„	1120	„
Anse Gouvernement	„	230	—
Anse Matelot	„	200	—
Grand Anse	NE	580	H
Petite Anse	„	330	H
Anse La Farine	SE	760	H
Anse Budamier	„	220	—
Anse Bonnett Carré	„	150	—
Anse Takamaka	„	?	R, H
Anse Madge	„	1220	R, H major settlement
Anse L'Amour	„	?	R, H „ „
Petite Anse	„	50	—
Anse Marie Louise	„	340	—
Anse Consolation	„	360	—
(no name)		175	R, H
Anse Cimetière	S	130	„
Anse Bois de Rose	„	180	„
Anse Bateau	„	2440	„
Anse Citron (north)	„	150	„
„ „ (south)	„	80	„
Grand Anse to Bois Verse ..	SW	4880	„ major settlement
Anse Kerlan	W	1360	„
(together)	„	(5240)	„
Anse Kerlan	„	700	„
Petite Anse Kerlan	„	180	„
Anse Georgette	NW	220	—

There is fringing reef at all beaches except Anse Lazio and Anse Georgette. The total length of coast is 44.25 km ; 19.7 km of this is beach.

Grand Anse, the large beach in the west, was examined in detail. A jetty divides the beach into two stretches. That on the SE seems to be of little use to turtles as there are boat houses, shops, breakwalls and roads along it. In many places there is no area on the beach crest free for nesting, or even no beach crest. This stretch of beach is over 1 km long. On the other side of the jetty, the beach runs for about 4 km up to the NW. Here there is also human disturbance, but to a lesser extent. Houses and boat shelters are along the beach but at least the beach crest is free in many places.

The sand is fine grained. The beach has a long gentle slope to the sea, but there is no real beach flat. In July, there was a layer of sea weed (*Sargasso, Cymodocea ciliata*, etc.) 15 cm or more deep along the beach. At the beach crest there is a 30 to 60 cm drop ; some of this looks to be fresh erosion, while some appears to be a year or so old. The beach crest does appear to be eroding, but not terribly fast.

The vegetation along the beach crest is mainly *Scaevola*, which is very lush and dense in places. In fact, in some areas *Scaevola* would be difficult for turtles to penetrate and even if they could, the substrate would be very heavily shaded and ; consequently, cool. The *Scaevola* is not continuous, however, and where it is absent a thick, broad leafed grass grows extremely densely along parts of the beach crest. *Ipomea pes-capre* also occurs, but it is not common. In a few areas the coconut plantation grows almost to the beach crest. There is a reef off Grand Anse which can be treacherous in some conditions, but it is nearly 1 km from the beach.

Anse Kerlan, which is continuous with Grand Anse, was surveyed by boat, along with the rest of the beaches on the north-west coast. It has houses and roads behind it with a certain amount of disturbance on the actual beach. The beach crest vegetation seems to be primarily *Scaevola*. Farther north are 3 distinct beaches : Anse Kerlan, Petite Anse Kerlan, and Anse Georgette. They all have houses, and all but Anse Georgette have roads. These beaches all look similar, with *Scaevola* the dominant beach crest plant. The farther north, the less disturbance is evident, and it seems likely that some of the north-western beaches may be used by nesting turtles. I was informed by Mr. J. Lablache, who has spent much of his life on Praslin, that these north-western beaches were important turtle beaches. No sign of turtles was seen here.

Opposite Curieuse Island, on the north side of Praslin are several long beaches which Mr. Lablache also described as important turtle beaches : Anse Boudin, Anse Takamaka, and Anse Possession. These beaches are nearly continuous. At Anse Possession, the beach slope is long and very gentle. There is either no beach flat or a very small one. The ground cover on the beach crest is dense, mainly grass, and the coconut plantations extend right down to the beach crest. A mere 2 or 3 m from the beach crest is a low wall along the side of a dirt road.

Anse Takamaka and Anse Boudin also have very gentle beaches, although there are frequent extrusions of large granitic boulders. There are a few places where *Scaevola* and *Calophyllum* occur on the beach crest or beach platform. To the west, there is a rather wide beach flat but this is subject to a good amount of disturbance due to houses, boat sheds, schools and so on.

No sign of turtles was seen along these beaches. This was not surprising as there is a good deal of human activity here. The most singularly important disturbance to nesting turtles is probably the coastal road which runs parallel to these beaches 2 to 3 m away. It is sad to note that these were at one time supposed to be important turtle beaches.

Some of the less populated beaches may still have turtles nesting. One of the beaches in the south-west is said to have turtles nesting occasionally. On the whole, there is probably little turtle activity on Praslin.

Maps consulted : D.O.S. 204 (Sr. Y851) Praslin, sheets 1 to 4 ; Piggot, 1963, sheet 2 ; Admiralty chart 1072. See also Sauer (1967).

COUSINE (South Cousin)

This double-hummocked island is 5.1 km south-west of Bois Verse, Praslin and 2 km south-west of Cousin. It is roughly triangular in shape, 1 km north-west to south-east by about 450 m wide. The highest point, in the north, is at 70 m.

Of the 2.6 km of coast, about 40%, or 1 km, is included in a large ' L ' shaped beach along the north and east coasts. The island is completely encircled by reefs.

Less than a dozen people who work the small coconut and banana plantations inhabit the island. In the fledging season, thousands of young wedge-tailed shearwaters are collected for human consumption.

The north beach is the short leg of the ' L '. There is no beach flat. The beach slopes rather steeply, and in some places beach rock is exposed. At the beach crest, there is active and recent erosion producing cliffs of 60 cm to 70 m and exposing many roots of shrubs. There are some *Scaevola* on the beach crest but much of the north coast is under *Casurina*, *Pisonia*, or *Cordia*. The ground cover for this is lush *Borehavia* or various grasses. Inland from the beach crest, the beach platform slopes downward and after 5 to 8 m the substrate is mainly phosphatic rock, or else very densely vegetated. The fringing reef off the north coast is in at least a metre of water.

At the north-east point, the beach changes direction sharply. The beach crest ends abruptly at a line of *Casurina*, under which is heavy ' leaf ' litter from the trees. Inland, the beach platform is about 5 m wide, and much of it is well vegetated. The beach flat here is quite wide, 30 m, but it steadily diminishes until it is 10 to 15 m at the southern end of the beach. At the same time, the slope of the beach increases in steepness to the south.

South of the north-east point, at the boat shelter, the beach crest vegetation changes from a row of *Casurina* to an open area with a ' sort ' of lawn accompanying a guest house. Along the beach crest there is a small hump, but opposite the guest house this develops into a vegetated cliff about 1 m high. It increases both in height and steepness until it is nearly vertical and 3 m high at the southern end, just past the manager's house. It is not known whether or not this steep cliff has been produced naturally, say by the sea eroding a vegetated dune, or artificially. The whole east coast looks to have been very modified by man.

A large area of the beach flat is covered in *Ipomea pes-capre* opposite the manager's house. The beach ends against a steep granite slope in the south.

Ghost crabs were present in small numbers. There were no signs of turtle nesting but the skeleton of a small hawksbill was found discarded on the beach. The manager claimed that the best season for hawksbill was September to December, when 8 to 10 could be caught per month. Green turtles were not known to lay on this island in recent times, but are said to have long ago. The eastern beach is said to undergo seasonal changes, building from December to March (calms & north-west wind) and degrading from April to September (south-east trades) when it becomes very small.

The north coast, in its present condition, is probably of little use to either green turtles or hawksbills because of the lack of beach flat, the cliff at the beach crest, and the poor quality nesting habitat past the beach crest. The east coast, despite certain limitations (primarily the inaccessibility or lack of nesting habitat inland from the beach crest) could be a fairly decent beach—at least when it is not going through seasonal erosion. Turtles can nest at the foot of either the mound or the *Casurina* trees.

Maps consulted : D.O.S. 204 (Sr. Y851) Praslin, sheet 2 ; Piggot, 1963, sheet 2 ; Admiralty chart 1072.

COUSIN (North Cousin)

This island, once a coconut plantation, is now a most impressive nature reserve owned by the I.C.B.P. (International Council for Bird Preservation). Nearly a circle, 810 by 600 m, it lies about 2.35 km WSW of Bois Verse, Paslin, and rises to 58. Beach almost completely rings the island, commencing at Anse Vaqua in the WNW, running the full length of the north and east coasts and nearly all of the south coast, and ending at Anse Fregate in the SW. The total circumference of the island is over 2 km, and the beach accounts for more than three-quarters of it.

The beach at Anse Vaqua begins at the base of a steep granitic cliff and runs north for more than 100 m to the north-west point of the island, opposite Roche Cannon. This stretch of beach is gently sloping and littered with eroded coral rubble ; there is no beach flat. Outcrops and granite boulders are common in the wave wash. The coral reef, about 75 m off the shore, is growing in several places and probably never dries out ; however, the seaward edge may be dangerous to cross in certain conditions owing to heavy surf and shallow water. The beach crest has a few small *Suriana maritima* shrubs, and immediately inland is a thick mat of *Borehavia* sp. ; farther inland are *Achyranthes aspera* and a few stunted *Pisonia grandis*. All this is under the shade of fairly dense *Casurina* and scattered coconut palms. There is a rather thick litter of *Casurina* needles with the *Borehavia*.

It might just be possible for a turtle to nest on this beach crest, but it is unlikely that they would ascend the beach because of the prominence of outcrops and coral litter.

At the north-west corner there are two rather large outcrops, and the beach changes direction sharply. The beach appears to be a dynamic one, for less than a metre out from the beach crest is a growing *Suriana* which has been buried by nearly half a metre of sand. The beach is, however, at the moment actively eroding, with a ' J ' shaped profile (i.e. *J*). On the beach crest, and inland from it, is thick *Borehavia* and lush *Achyranthes*, all under mature *Casurina*.

Moving eastward several metres, the beach flat increases from about 1 m to nearly 3 m wide. Accompanying this is a decrease in the degree of erosion at the beach slope. Shrubs and trees become dominant on the beach crest with scattered *Pisonia* and coconut palms, occasional *Suriana* and *Cordia subcordata*, and frequent *Scaevola* sp. The *Scaevola*, in fact, often hangs over the beach flat nearly reaching the slope of the beach. Although the shrubs and trees are continuous along the beach crest, there is enough room under some for turtles to nest, although the substrate is heavily shaded. About 100 m east of the north-west corner, a row of large *Casurina* takes over at the beach crest. The ' J ' shape is gone from the beach and the slope is more gentle. After the *Casurina* trees is some stunted, discontinuous *Scaevola* and *Pisonia* ; under which is dense *Borehavia* and *Achyranthes*, probably too dense for nesting. Farther east is a large patch of *Sporobolus* (?) 30 by 20 m on the inland edge of the beach flat ; lush *Scaevola* commences again at the beach crest, and the beach is even more gentle. Yet it is opposite the labourers' houses that the beach is the flattest of anywhere on the island, with a very gentle slope from the beach crest right to the sea. The beach begins also to widen quite a bit here. Around the houses the beach crest vegetation is obviously disturbed ; in fact, much of it is lacking. After the houses, lush *Scaevola* returns with *Ipomea pes-capre* in front on the beach flat ; here also is an area of seedling *Casurina*. Although the beach flat is even wider here, about 20 m, the sharp slope at the seaward

edge recurs ; it drops nearly 2 m to the sea. At the boat shelter there is a sudden change in vegetation ; *Scaevola* becomes very rare and, instead, a dense stand of *Casurina* takes over. This evidently was part of an old plantation, for the trees are in rows. Under the *Casurina, Achyranthes* is very dense, growing to 50 cm or more in height. There is also the odd *Geuttarda* and sickly *Scaevola* at the seaward edge of the *Casurina*. At the outhouse the *Casurina* plantation ends, and with it the dense *Achyranthes*. The beach flat here is about 40 m wide, and at the seaward edge there is a sudden drop of 2 m or more. This north beach is nearly 700 m long.

The beach retains much the same profile along the east coast, except that the width of the beach flat diminishes steadily to the south-east corner. The east beach flat is said to change dramatically with the change of seasons (Penny, pers. con.) ; at the time of these observations it was quite wide. At another season, it is said to be almost non-existent, ending nearly at the line of vegetation. This line of vegetation along the east coast is somewhat irregular. In the north-east there is a sort of 'lawn' of *Sporobolus* (?) under a few large *Casurina* by the Resident Scientist's house. Here, there is a drop of about 30 cm from the level of vegetated sand to the beach flat. At the edge of the beach flat is an area of *Scaevola* seedlings, some are nearly 50 cm high. Scattered *Scaevola* bushes occur for about 40 m before the south-east boat shelter. Just north of this shelter is an area of *Ipomea pes-capre* on an expanse of beach flat slightly elevated from the surrounding. There are a few small *Pisonia* and *Scaevola* here as well. South-west of the boat shelter is a very large, lush *Scaevola* with *Ipomea* sprawling on the beach. Farther along the beach crest, the *Scaevola* is quickly replaced by *Casurina* ; under this is extremely dense *Achyranthes* and *Sporobolus*. A few sickly *Pisonia* are present also. The east beach is over 200 m long.

At the south-east corner the beach flat is narrowed to 2 or 3 m ; there is a sharp drop of over a metre to an apron of beach rock. From this corner to the south-western end of the beach, there is active erosion occurring ; also, just round the south-east corner the beach flat entirely disappears. From east to west, the vegetation of the south coast changes from a few *Scaevola* and some *Casurina* to very dense *Pisonia* which grows to the edge of the beach flat. *Scaevola* returns and takes over all the way to Anse Frégate, except for a few openings devoid of shrubs and a stand of *Thespesia* just at the commencement of Anse Frégate. Along the south coast the ground cover is dense *Borehavia/Achyranthes*. The south beach is about 500 m long.

There is also a fringing reef along the south which dries in places and with a heavy surf it is very treacherous. There are growing reefs along the north and east coasts but as these are always in several metres of water they offer no obstacle.

There are very large populations of Ghost crabs on Cousin. At the north-east point there were hundreds of *Ocypode ceratophthalmus* and their burrows. Inland from the beach crest are countless numbers of *Ocypode cordimana*.

Cousin is said, by a number of experienced turtlemen, to be one of the most important breeding areas for the Hawksbill turtle in granitic Seychelles. The peak laying season is said to be June to August by some, and September to December by others. Records of strandings (for nesting) on Cousin were kept by M. and M. Penny.

Although it is said that over 100 turtles, or perhaps one per night, may nest on Cousin during the peak breeding season, there is little evidence of much nesting activity. The west beach, at Anse Vaqua, does not look to be used, nor does it look very usable. At times, the offshore reef could prove dangerous to turtles. The beach crest vegetation along the north coast is often very dense and/or heavily shaded ; nevertheless, much of it could probably be utilised by nesting hawksbills.

There are sections of the north coast beach flat that could accommodate a substantial number of turtle nests, but the presence of *Sporobolus* and seedling *Casurina* indicates that at least some areas of beach flat have not been disturbed for some time.

The ground cover on the east coast seems rather dense, but hawksbills could probably dig in it. Whether or not there is sufficient depth of substrate is debatable. The beach flat on the east seems to be quite suitable for nesting—as long as the beach does not erode after eggs are deposited. However, here again there are indications that the beach has been free from disturbance for some time since there are seedling *Scaevola* and areas of *Ipomea.*

The south coast, because of its beach structure (little or no beach flat and sharply eroding face) and dense vegetation appears to be pretty useless to the turtles. Also the reef flat, when dry, would prove an important obstacle to them.

Maps consulted : D.O.S. 204 (Sr. Y851) Praslin, sheet 2 ; Piggott, 1963, sheet 2 ; and Admiralty chart 1072. See also Fosberg in press : Atoll Research Bulletin.

CURIEUSE

This has been aptly called ' The red island ' (Sauer, 1967) ; it is covered with decomposed, red, granite soil which is heavily eroded. The island is shaped like a ' V ' on its right side, 3.64 km east-west by 1.6 km north-south. It rises to 172 m. The distance from Anse Boudin, Praslin is a mere 1.1 km. Much of the south and east coasts of Curieuse is beach, but neither the north nor the west coast has any. Of the 8.8 km of coast, 6.55 is unusable to turtles, 1.15 of this is enclosed in a large turtle pen.

The beaches and their lengths from east clockwise to south are : Pt. Rouge (Grand Anse), 350 m ; Anse Papaie, 250 m ; ' A ' (no name), 200 m ; ' B ' no name, 200 m ; Mandarin (on the south-east point), 150 m ; Anse Caimen (Anse St. José) east, 350 m ; and Anse Caimen west, 750 m. Fringing reef and houses are present at all beaches except Mandarin.

The most easterly beach, Point Rouge or Grand Anse, is the farthest from human habitation ; there is an old house inland from the beach but it has not been used for some time. In the north, the beach flat is nearly 8 m wide with no recent erosion, but as the beach progresses to the south the beach flat diminishes to almost nothing and a very dramatic cliff of 1 to 1.5 m comes very near to the beach crest. At the north end large trees of *Thespesia, Scaevola,* ' Par chance ', and *Geuttarda* occur at the beach crest ; there is also *Tournfourtia, Suriana,* and *Dactyloctimum.*

In about the middle of the beach a large *Casurina* is being badly eroded ; it sits, with roots exposed, 2 m from the beach crest in a position which looks most in-

congruous with the rest of the beach crest vegetation. At this point there is a vertical drop of about 50 cm in the beach. Farther south is more dramatic erosion, a washed out *Geuttarda* and another large *Casurina*. The beach here is a complex of 4 terraces separated by vertical drops; the total drop from beach crest to sea level is about 2 metres. On the beach crest a broad leafed grass forms a thick mat; there is also *Borehavia*. Finally, at the south end where the beach drops nearly 1.5 m, there is a multitude of exposed roots of *Cocos* and *Scaevola* and also fallen coconut trees, which have been eroded out. The beach ends much as it begins—against steep granite.

There is a reef, of rather inactive appearance, some 50 m wide off Pt. Rouge beach. At low tides waves break over this, but it may not be a major obstacle to turtles as the reef platform does not seem to dry out.

There was a good deal of nesting activity on this beach. A total of 16 relatively fresh pits were seen, about half a dozen of which appeared to have eggs. All of these pits were rather large, and in digging them the turtles had disturbed a very large area—even digging up or breaking off vegetation. It would appear that this beach is used by green turtles and not hawksbills; if this is so, then it must be one of the last, if not *the* last, places in Granitic Seychelles where green turtles nest.

The amount of area available to the turtles is very small. About 3 m inland and parallel to the beach crest is a large drainage ditch which runs most of the length of Pt. Rouge beach. It would be very difficult, if not impossible, for turtles to cross this. The ground cover is rather thick in some areas, and much of the beach crest is barricaded with trees and shrubs; furthermore, there is little available beach flat on the north half and almost none on the south.

Separated from Pt. Rouge beach by granitic cliffs is Anse Papaie, a beach smaller than Point Rouge but otherwise not unlike it. In the north it has *Scaevola*, *Thespesia*, *Ipomea pes-capre*, a tall grass, and *Geuttarda*; there is about 1 metre of beach flat here and no present erosion. Like Pt. Rouge, the beach flat diminishes until at the south end there is none; to the south, the beach cliff appears and by the south end it is about 0.5 m high. At the south end there is dramatic evidence of active erosion where coconut and *Scaevola* are both badly undermined.

There is not much area available for nesting on this beach, and there was little evidence of turtle activity here. One very recent turtle pit, probably of a green turtle, was on the beach crest.

Toward the eastern settlement is a series of very flat, heavily vegetated, fine-sand beaches. The most eastern end of these has a small erosional drop of 30 to 50 cm at the beach crest. There is dense *Ipomea pes-capre* and *Scaevola* on the beach crest, but there are openings in the shrubs in a few places. An old *Calophyllum inophyllum* is being eroded out, and a few coconut and *Thespesia* trees are soon to follow. The odd *Colubrina* and intermittent *Scaevola* shrubs take over again at the western and where there is a small rock outcrop some 20 m from the end of the beach, which has a large granitic outcrop.

There was no evidence of turtle activity on this beach; any nesting that did occur would have to be done in the vegetation of the beach platform. That there were 5 old houses close to the beach along here, would indicate that human disturbance may once have been a deterrent to the turtles.

Adjacent to the above beach is a small 30 m beach with very dense shrubs. The eastern half is continuous lush *Scaevola*. The western end of the beach ends in a dense stand of *Thespesia* sp. ; there is long grass inland from the beach crest.

There was no evidence of turtle activity here either ; in fact, very little of this beach could have been used by turtles owing to the dense beach crest shrubs. The presence of old houses, again, would be a deterrent.

Farther west, separated by a small outcrop, is a gently sloping beach in front of present-day human habitation ; there are boats, drying tables, and houses. Like the preceding beach, there is no beach flats ; inland of the beach crest is lush *Ipomea pes-capre* and a grass. As expected from the amount of human disturbance here, there was no sign of turtle activity. These last 3 beaches overlook Bai la Rai.

A beach 150 m long on the south-east point was not examined.

Opposite Praslin is Anse Caiman, a very long beach ; only the eastern end was examined in detail. It begins at the foot of a steep outcrop, and runs west to another outcrop. The beach flat is some 20 to 30 m wide. At its eastern end there is a secondary beach flat, which forms a terrace slightly above the first. This raised beach flat is semi-circular in shape, with a diameter of about 40 m, so that this entire beach is club-like in shape. There is a drop of about 50 cm at the beach crest.

Vegetation along the beach crest is : *Thespesia, Calophyllum, Casurina, Scaevola* and *Cyperus*, all of which are scattered. Much of the beach flat and the area inland from the beach crest could be used for nesting, but there was no sign of turtle activity here. It may well be that the two inhabited houses, one at each end of the beach, were responsible for this.

The most western half of Anse Caimen is a long crescent-shaped beach with picturesque qualities ; it is gently sloping and overhung with large *Calophyllum, Casurina*, and other trees. Although I was not able to examine it in detail, it appeared not to have any turtle activity. This, by the way, is the site of an old leper colony abandoned some years ago, so there are many houses and buildings behind the beach.

The discovery of the (apparent) green turtle nests was pleasant surprise, even though the population is very tiny. It is sad to note, however, that even though this is crown property and turtling is not allowed, there was evidence, in the form of recent carapace and plastron bones, that turtles are still being taken here. With proper protection measures the population nesting on this island might grow substantially as there is a good amount of unused beach.

Maps consulted : D.O.S. 204 (Sr. Y851) Praslin, sheet 1 ; Piggott, 1963, sheet 2 ; Admiralty chart 1072 and also Sauer (1967).

ARIDE

At 4°12'36"S ; 55°40'E, this island is 8.9 km north of Chevalier Point, Praslin. It is rectangular 1.7 km east-west by 0.55 km north-south. Aride rises to 135 m. Fringing reef is present on the south side. The circumference is 4.5 km ; about 800 m is contributed by Glacis Désirée, a beach on the south coast.

An experienced turtleman, Mr. James Brioche, relates that waters around the island are often treacherous, but that it is often a very good place to find hawksbill and they nest on its beaches in good numbers during the nesting season.

FOU (Booby Island)

Nearly in a straight line betwen Praslin and Aride, Fou is located at 4°15′23″S ; 55°40′22″E, 4.3 km north of Praslin and 4.8 km south of Aride. A tiny island, about 200 by 200 m, it rises to 28 m. Little else seems to be recorded.

CHAUVE SOURIS

This small, 140 m × 60 m, figure of 8 shaped island lies 350 m north-east of Anse Volbert, Praslin. Its elevation is 20 m and it is inside the fringing reef of Praslin. A 50 m beach is present in the south-west. Owing to its size, the island can be of little importance to nesting turtles.

ST. PIERRE

This island is probably of even less importance as it is even smaller and seems to be just a rock outcrop with no beaches. It is 900 m north-east of Chauve Souris and 1.35 km north-east of Anse Volbert, Praslin. It is 100 by 60 m, and lies inside the general fringing reef for Praslin.

ILE ROUNDE (Round Island)

Appearing more rectangular than round, this island is 400 m south-east of Anse la Farine, Praslin. It rises to 75 m and is 600 m north-east to south-west by 360 m wide. With a circumference of 1.74 km, it has a beach more than 100 m long in the north-west. Houses are present here and fringing reef encloses the island except in the south-east.

Maps consulted : D.O.S. 204 (Sr. Y851) Praslin, sheets 1 and 4; Piggott, 1963, sheet 2 ; Admiralty chart 1072 ; Baker, 1960 (C).

LA DIGUE

The smallest of the 3 main islands of Seychelles, it lies 4.6 km west of Praslin and 46 km north-east of Mahé, rising to 333 m. It is nearly triangular in shape 5.2 km north-south by 3.5 km east-west. There are 17 beaches :

Name	Facing	Length in m	Road, (R) House (H)	Fringing reef
Anse Patates	NE	120	R, H	—
Anse Gaulettes..	,,	860	R, H	+
Anse Grosse Roche	,,	430	R, H	+
Anse Banane	,,	200	H	+
,, ...	,,	100	H	+
Anse Fourmis	,,	350	—	+
Anse Caiman	,,	250	H	—
Anse Cocos	SE	250	H	—
Petite Anse	,,	360	H	—
Grand Anse	,,	440	H	—
Anse Songe	,,	50	H	—
Grand L'Anse	,,	230	H	—
Anse Marron	S	50	—	—
Anse Bonnet Carré	SW	350	—	+
Anse Pierrot	,,	100	—	+
Anse la Source A'Jean	,,	150	—	+
Anse La Réunion with Anse Union ..	W	2900	R, H	+ main settlement here
Anse Sévère	NW	475	R, H	+

This gives some 7.7 km of beach, or more than 50% of the total circumference of 13 km.

The locals claim that green turtles are very rare, but hawksbills occasionally nest on the eastern side. It is clear that there is far too much human disturbance along the biggest beach (Anse La Réunion/Anse Union) for nesting turtles to tolerate; roads, houses, boats, piers, breakwaters, etc. are all along the beach. Time was not available to see more than the main beach. It seems possible that there is some reasonable nesting habitat in the less populated areas of La Digue.

Maps consulted: D.O.S. 204 (Sr. Y851) La Digue; Admiralty chart 1072. See also Sauer (1967).

There are 4 islands to the north of La Digue, which, although they were not visited, are said to be important breeding areas for hawksbills.

FÉLICITÉ

An elongate, almost rectangular-shaped island, 2.7 km north-south by 1.2 km east-west, it rises to 228 m and lies 3 km north-east of La Digue. The circumference is about 8 km, and there does not appear to be a fringing reef present. There are probably at least six beaches:

Name	Facing	Length in m
Anse Péniche	N	?
Anse Songe	E	150
Anse Takamaka	SW	200
Petite Anse	W	?
Grand Anse	W	200
Anse Parc	NW	150

MARIANNE (Mary Anne Island)

Lying 7.1 km east-north-east of La Digue, this island is about 2 km by 0.75 km, in the shape of an inverted tear-drop. The elevation is 130 m.

One beach, Anse La Daube, about 300 m long, is present in the west; fringing reef does not appear to be present.

GRANDE SOEUR (East Sister)

6 km north-north-east of La Digue and 9.5 km north-east of Praslin, this island is elongate, 1.75 km north-south by 0.6 km east-west. It rises to 113 m and the circumference is about 4.3 km. Grand Anse on the east is about 200 m long, and Point Cèdre in the west is also about 200 m long. An experienced turtleman has told me that this is an important breeding area for hawksbills.

PETITE SOEUR (West Sister)

The little sister lies about 600 m west of the big sister. Elongate in a north-west by south-east direction, it is less than 1.3 km long, about 300 m wide, and 106 m high. The circumference is about 2 km, and there is a small beach on the

west about 300 m long. I have been told that this is also an important breeding area for the hawksbill.

In the south-east of the Seychelles group are the 3 islands of Frégate, L'Ilot and Récif.

FRÉGATE

4°35′S ; 55°56′12″E puts this island 31.1 km south-east of Praslin and 45.6 km east-north-east of Mahé. It is rather oval in shape, 2.1 km by 1.25 km, and rises to 122 m. Fringing reefs are present. A beach of 500 m length is indicated in the south-west, but more beach may be present in its 5.7 km of circumference. It is reported to be an important breeding area for hawksbills.

L'ÎLOT

This tiny island lies about 3.2 km west-south-west of Frégate ; it is elongate east to west, about 460 m by 150 m, and rises to 24 m. Little else seems to be recorded about it.

RÉCIF

A small island, irregular in shape, 280 m by 760 m, it lies 24 km south of Praslin and 27.8 km east-north-east of Mahé (4°34′36″S ; 55°45′52″E). Some fringing reef is present ; beach is not indicated.

Maps consulted : Piggott, 1963, sheet 2 ; Admiralty chart 1072 ; Baker, 1960 (C). See also Sauer (1967).

In the north-west of the Seychelles are 2 rather large islands, Silhouette and Île du Nord.

SILHOUETTE

This is the fourth largest island in the granitic group. Nineteen kilometers north-west of Mahé, it is from 4°27′40″ to 4°30′40″S and 55°12′30″ to 55°15′30″E. It is roughly oval shaped with dimensions of 5·5 by 3·8 km and 752 m high.

Seven beaches are indicated :

Beach	Facing	Length in m
Anse Mondean (Mondon)	N	200
La Passe	ENE	1600
Anse Lascars ..	,,	250
,, ,, ..	,,	200
Anse Patates ..	SE	900
Grande Barbe ..	SW	1000
Point Étienne ..	W	300

All of these beaches, except Anse Mondean, have fringing reefs. Large settlements are at Grande Barbe and La Passe. The circumference is 17 km, 4·45 km of which is beach.

ÎLE DU NORD

From 4°22′56″ to 4°24′3″S and 55°14′15″ to 55°15′26″E, this island lies 27 km north-west from Mahé and 7 km north of Silhouette. It is an oval-shaped island, 2·5 by 1 km, rising to 215 m. There are three major beaches :

Name	Facing	Length in m
Anse Cimetière ..	E	1000
Anse Bonnet Carré ..	SW	800
Grand Anse ..	NW	200

Fringing reef is present at Anse Cimetière. The total circumference is 6.3 km.

Maps consulted: Piggott, 1963, sheet 2; Admiralty chart 1072; Baker, 1960 (B).

Two islands are often included with the granitic Seychelles, although they are in fact low lying sand cays. They lie on the northern edge of the Seychelles Bank. Locals claim that they are good areas for turtles.

ÎLE AUX VACHES (Bird Island)

At 3°43′S ; 55°12′18″E puts this island 96 km north-east of Mahé. It is nearly triangular in shape, about 1·7 km by 0·72 km. Its circumference, of about 4 km, is all sand beach. There is a fringing reef on the east.

ÎLE DENIS (Denis Island)

Found at 3°48′S ; 55°40′E, this is about 87 km north of Mahé. It approaches a triangle or semicircle in shape ; 1.7 km by 0.83 km. The total circumference is about 4.5 km ; at least 3 km of this is continuous sand beach, and the remainder may well be also. A fringing reef is present except in the north-west.

Fryer (1910) visited these islands in the early part of this century and was impressed by the amount of erosion that had occurred. He also makes the ironic comment : ' The fauna calls for little remark : it is recorded that dugongs, giant tortoises and green turtles abounded : the dugongs are extinct, the tortoises are represented by a few introduced specimens, and the green turtle (*Chelonia mydas*) is very scarce '. It will be seen that this pattern of disappearance of formerly abundant species will be repeated throughout the Seychelles area.

Maps consulted : Piggott, 1963, sheet 3 ; Admiralty charts 721 and 724.

Two islands which do not seem to apply to any grouping of islands in the Seychelles, and are rarely visited other than by locals, are Coetivy and Île Platte.

ÎLE PLATTE (Flat Island)

At 5°50′12″S ; 55°20′21″E, about 120 km south of Mahé, it is elongate with the long axis pointing north-west/south-east. Dimensions are 3·7 by 1·9 km ; it appears to be ringed by sandy beach. The circumference must be about 10 km.

COETIVY

Found at 7°9′S ; 56°15′E, about 256 km south-south-east of Mahé, Coetivy is also an elongate island, but the long axis runs north-east/south-west. It is about 6 km by 1 km, having a circumference of nearly 15 km, most of which is said to be good island beaches. A fringing reef runs all round it except in the south-west.

Many locals claim that hawksbills are extremely numerous here, and it is said that many females are turned as they come up the beaches to lay. Green turtles are not uncommon on the marine plateau which extends to the west of Coetivy. This island has a coconut plantation.

Dupont (1929) claimed that sand was accumulating on the reefs and that Coetivy had grown, and was still growing. He also states that few turtles, either green or hawksbill are captured at Coetivy, ' while so many of these reptiles are captured at Plate ' (Île Platte).

Maps consulted : Admiralty charts 721 and 724. See also Sauer (1967).

Although the islands of the Seychelles Bank long ago were known for the multitudes of sea turtles which were found there, only hawksbills are thought to be representative of this area nowadays.

AMIRANTES

209 km east of Mahé is the Amirante Bank ; this runs from 4°50′ to 6°20′S and 52°50′ to 53°25′E. Strictly speaking, there are 6 island groups and 17 islands, with 4 reefs or cays. However, it is usual to include 2 other island groups, Desroche and Alphonse, within the Amirantes, although they do not lie on the Amirante Bank.

AFRICAN BANKS

At 4°53′S ; 53°23′E, these are the most northerly islands in the Amirantes ; two islands, North and South, are present. They are 2·78 km apart. North is 560 by 170 m with a circumference of 1,730 m, which is possibly all sandy beach.

South Island is smaller, 280 by 110 m with a circumference of 1,220 m, all of which is sand. In addition, there are about half a dozen sand banks.

Stoddart (pers. comm.) saw no sign of turtle here in September 1968.

REMIERE

24·1 km south of African Banks, Remiere lies at 5°6′S ; 53°19′E. The island is 750 by 600 m, and the circumference is 2·25 km. The beach is 1·75 km of the coast. Stoddart (pers. comm.) saw no sign of turtles here in September 1968.

DAROS AND ST. JOSEPH

This group lies 33·4 km south of Remiere ; there are 10 islands in the group.

Daros rests at 5°25′S ; 53°18′E ; it is an oval 2.3 by 1·25 km. The total circumference is 5·75 km, all of which is sand.

2·3 km to the east is the island of Ressource. It is roughly hook-shaped, 800 m long by 200 m wide. The circumference of 2·5 km is all sand.

A further 2 km east is Fouquet. This is trapezoidal in shape, 900 by 250 m. Again, the entire circumference, 2·2 km, is all sand.

St. Joseph is the largest island in the group ; it is about 500 m south-east of Fouquet. Shaped like a 'V' on its side, it is 2·8 by 2 km. The total coast-line is 8·6 km, of which 6.3 is beach.

West of St. Joseph are an additional 6 islands. Unfortunately, the names of these appear to be somewhat in question.

Name Piggott (Admiralty)	Distance from St. Joseph (km)		Dimensions		Circumference (km)
			length (m)	width (m)	
Benjamin (Pelican) ..	0.6	W	600	200	1.4
Pelican (Chein) ..	1.4	W	300	150	0.9
Paul ..	1.75	W	250	100	0.7
Chein (Benjamin) ..	0.9	SW	400	200	1.4
Bōno Sable ..	3.35	W	200	50	0.5
Bōno Coco (Ile Poule) ..	3.25	W	200	200	0.7

These small islands are all sand cays so they represent 5·6 km of beach. Gaymer (1966) indicates that very small numbers of green turtles lay here, and that hawksbills used to occur here in fair numbers.

Poivre

37 km south of Daros is this group of 2 islands.

Poivre itself is at 5°46'S ; 53°19'E. It is oval shaped, 2·5 by 4·3 km with a circumference of 13 km. At least 3 km of its coast, and possibly all of it, is sand.

Ile due Sud lies 1.6 km south of Poivre ; irregular in shape, with many indentations, it is 6·3 by 4 km with a circumference of 34 km, 1·5 km of which is unusable to the turtles.

Marie Louise

At 6°10'S ; 53°9'E, this island lies 46·3 km south-south-west of Poivre. It is wedge-shaped, 1·34 by 0·55 km, and has a circumference of 3·24 km ; 300 m of this may be unusable to nesting turtles.

Des Noeufs

At 6°14'S ; 53°3'E, it lies 13 km south-west of Marie Louise. It is almost round, 800 × 700 m, and the circumference is 2.54 km. At least 300 m of the coast is beach.

Des Noeufs is uninhabited but is worked from Marie Louise when sea bird eggs are collected (this is one of the world's largest breeding grounds of Sooty tern). Green turtles are said to occur (and to be taken, albeit illegally) ; I also understand that green turtles hatchlings are raised on Marie Louise.

In addition, there are 4 reefs or cays charted in the Amirantes ; Eagle Reef 3·7 km north-east of Remiere, Bertaunt Reef 11.1 km north-west of Poivre, Etyile Cay 35.2 km north-north-west of Marie Louise, and Boudeuse Cay 27·8 km north-west of Des Noeufs. Veevers-Carter (pers. comm.) reports dense nesting on Boudeuse Cay, and points out that there are no beaches.

DESROCHE

At 5°41'S ; 53°41'E this island is not truly on the Amirante Bank but 37 km east of Poivre. Desroche is actually on the south-east corner of a large submerged atoll 185 km in diameter. The island is 5·25 km long and 300 to 100 m wide. The circumference is 12 km, all of which is sand.

The western end of the lagoonward beach is gently sloping and overhung with large lush *Scaevola.* In places there are signs of some erosion with drops of about 30 to 50 cm at the beach crest.

The west side is indented with several little bays and coves ; it appears to have beach rock in places.

In the short time that was spent here, no signs of turtle activity were seen ; Stoddart (pers. comm.) also saw no signs in September 1968. An experienced islander related that hawksbills were not uncommon, but green turtles were very rare. The reason for this is not known, for the lagoonward beaches, at least, looked quite acceptable as turtle nesting habitat. The amount of erosion present on the lagoonward beach did not appear to be a deterrent either to ascent or to nests. What the heavily battered south coast is like is difficult to say.

ALPHONSE

Like Desroche, this group lies just off the Amirante Bank ; Alphonse itself is 90·8 km south-south-west of Des Noeufs at 7°S ; 52°45'E. It is triangular in shape, 2·2 km north-south by 1·95 km east-west. The circumference, which is all sand, is 6·39 km.

Bijoutier is a tiny island 6·1 km south of Alphonse.

11·1 km farther south lies St. Francois. It is in the shape of a broken 'u', 1·2 km north-south by 1·2 km east-west. The total circumference, which is all sand, is 11.12 km.

Gaymer (1966) indicates that both green and hawksbill turtles have been taken at Alphonse, and that fair numbers of hawksbills may lay here.

Maps consulted : Piggott, 1963, sheets 3 and 4 ; Admiralty charts 721 and 724.

Local feeling is that there are fair numbers of both green and hawksbill turtles in the Amirantes, and there are many stories about illegal exploitation of these animals by Seychellors as well as foreign fishermen.

The Amirantes are *not* known for large aggregations of breeding turtles at present, so if there are fair numbers of turtles in this area they are present for some reason other than breeding—possibly feeding.

PROVIDENCE GROUP

Of the three major islands in this group, one is almost certainly of no value to sea turtles. This is the raised limestone island of St. Pierre. The other two islands, Providence and Cerf, are low lying sand cays which appear to have plenty of good nesting habitat.

St. Pierre

St. Pierre lies at 9°19′S ; 50°43′E, some 335 km north-east of Madagascar and 728 km south-west of Mahé. It is 35 km west of the line running north-south which joins Providence and Cerf. The island forms a raised limestone table about 1·9 km in diameter. In its circumference of about 5.5 km, there is but one very small beach in the north-east, and even it is renowned for being a treacherous place to land. Clearly, this island could be of very little importance to sea turtles. (It is a major source of guano in Seychelles).

Providence

This cay lies at 9°14′S ; 51°2′E, 358 km north-east of Madagascar and 700 km south-west of Mahé. It is elongate, running 3·7 km north-south and is 0·75 km wide. The circumference is about 7·5 km, most of which appears to be sandy beach. The island has a coconut plantation.

Coppinger (1883) claimed that green turtles nest here in April ; and earlier, in 1769, a shipwrecked, French crew is reported to have lived on turtles and coconuts for two months (Grant, 1801).

Cerf (Banc du Sud)

At 9°32′S ; 50°59′E, Cerf is about 30 km south of Providence. It is long and narrow, 3·5 km by 0·1 km, with several offlying bars and islets. The total circumference, which is all sand, is 7 km.

There is evidence (Stoddart, 1967) to indicate that Cerf has accumulated large amounts of sand and, in this century, has grown from half a dozen or so small sand banks to the form described above. It has also a coconut plantation but is not often inhabited.

I am told by Mr. F. Payett, who has considerable experience at these islands, that ' Name Coyio ', the loggerhead, has nested on small sand bars at Cerf. There is also a type of seaweed which this species relishes at Cerf.

A large reef encircles both Providence and Cerf together. As it appeared from the ship, this reef may be hazardous to turtles under some circumstances, but there appeared to be a considerable amount of good nesting habitat at these two islands.

Maps consulted : Piggott, 1963, sheet 4 ; Admiralty charts 724 and 2899.

FARQUHAR GROUP

This atoll lies between 10°6′ and 10°16′S by 51°2′ and 51°12′E, about 96 km south of Providence, 230 km north-east of Madagascar, and 770 km south-west of Mahé. It is a large triangular-shaped atoll with a width of 19 km. Much of it is submerged, but its main land mass is in the east, consisting of North and South islands, both of which have coconut plantations. There are also several small islands : Goelette, Île Lapin, Île du Milieu, Île des Déposés, and the 3 Manahas in the pass between North and South islands. None of these small islands has permanent inhabitants; and probably as a consequence, many of these small islands are important sea bird islands. By the same token, some of them, Goelette especially, are claimed to be important green turtle breeding areas.

North Island

North Island is in the shape of a backwards ' C '. If straightened out the ' C ' would be about 10·5 km long ; the width is a fairly constant 0·5 km. The circumference of the island is about 21 km, much of which is usable beach.

South Island

South Island is elongate with the long axis running north-east/south-west. It is about 6·9 km long by 0.9 km wide. The circumference is about 15·5 km, much of which, except for occasional salt marshes, should be suitable for nesting. North and South Islands are separated by a channel about 700 m wide, and there is a fringing reef on their seaward sides.

I was only able to visit North Island, where the Settlement is. A survey of the lagoonward side at ' Race Point ' indicated that the southern half of the beach was very heavily eroded and much beach rock and coral rubble was exposed. The cliffs at the beach crest drop a metre or more. The southern side is vegetated mainly with coconut and *Casurina* and a ground cover of *Fimbristylis* (?).

The coast opposite the main channel in the north is very different ; here the major plants are *Scaevola* and *Suriana*. The *Suriana* forms a zone about 10 m wide, seaward of the *Scaevola*. Both bushes are low, usually less than 2 m high, and scattered enough to allow turtles to move through them, but with some difficulty in places. The beach slopes at nearly 45° along this strip, but instead of eroding, it appears to be stable or even building. Thus, at the top of the rather long beach slope is a permanent beach flat vegetated with shrubs.

There was a certain amount of nesting activity in evidence, much of it recent. About a dozen turtle pits (most probably green turtle) were seen over a distance of several hundred metres. Many were with eggs ; and other than the fact that some were shaded and some were against the stout trunks of a *Suriana*, the nesting habitat looked very good. It is somewhat puzzling why more green turtles do not nest at Farquhar.

Maps consulted : Piggott 1963, sheet 4 ; Admiralty charts 718 and 2899.

ALDABRA GROUP

West of Farquhar by 367 km is a group of 4 remote islands in the outline of a trapezoid. These islands are singularly the most famous turtle islands in all of

Seychelles, and Parsons (1962) lists many references, and devotes considerable time to turtles in this group. All of the 4 islands are uplifted coral limestone, and have large areas of beach.

ASTOVE

This small atoll, with nearly a complete land rim, is at 10°4'S × 47°44'E. The atoll is 5.25 by 3·75 km and rises to all of 14 m. The total seaward circumference of the atoll is nearly 14 km ; at least 3 km, and probably more, of this is unusable to the turtles.

Most of the north coast is unusable ; there are 1 to 2 m undercut cliffs much of the way. *Thespesia*, *Suriana*, *Scaevola*, *Ipomea*, *Plumbago* and *Achyranthes* are found on the beach crest.

At the north-east point is a small 15 to 20 m indentation with an apron of smoothed beach rock and a perched beach. Here, and farther east, were 14 turtle pits, 3 of which were recent. Opposite the most northern dune the shore is smoothed beach rock and boulders and later large pebbles and rounded coral debris. South of the next large dune, there is suddenly a 40 m beach. Behind this is a series of sprawling dunes, oriented in a south-east/north-west direction. There was turtle nesting at this beach, as well as some distance south in an area of boulders and beach rock with a small perched beach. 33 pits, 23 recent, were present.

Farther south, on an expanse of smooth beach rock, were the remains of a slaughtered turtle. There was also quite a bit of turtle nesting here—71 pits, 36 of which were recent. This point is about one-third of the way from the north to the south point.

Scaevola and *Tournfourtia* are common on the beach crest while *Pemphis* is rare. The ground cover consists of *Fimbristylis* and *Dactyloctimum* in the lee of the south-east trades, and *Sporobolus* in the exposed areas. A small beach here had 54 pits with 33 of them recent. Farther on, in an area of cobbles, were 55 more pits, 20 of them recent.

A small beach, bordered on both north and south sides by beach rock, had no evidence of nesting, but farther south was the third major beach on which there was a large amount of nesting activity. 90 pits were counted, 62 of them recent. Sadly enough, there were also the remains of 2 more slaughtered turtles, like the one before, with most of the flesh just left to rot.

At the east point is a large zone of cobbles on the beach. The reef platform is 200-300 m wide and very shallow. Along farther south is a large dune and on the beach 60 turtle pits, 29 recent. On farther is a gravelly beach and 17 more pits, 6 of which are recent. Off the shore several metres is a series of highly dissected rocks, many of them like mushrooms or tables. Farther on, is a small dune and at the beach are 12 pits, only 2 of them recent.

The south-east point is extremely dramatic. All along the south coast is the indication that the beach sands are being washed from the underlying beach rock and that large areas of nesting habitat are being degraded.

At the south-east point, however, there is no question that large scale erosion is occurring. There are vertical cliffs 2 and 3 m high, cut into the dunes by the sea.

A pile of bleached turtle bones stands out as a reminder of the hordes of turtles that used to be slaughtered here. Amid cliffs and cobble are 23 more pits, 10 recent. At a small sandy beach and on the south shore are 28 pits, only 4 are recent.

Beaches on the south coast, west of the channel and at the south-west of the island, were not examined.

On the west coast is a long continuous beach about 2.3 km long. In the south there is a vertical drop of nearly 2 m to the sea ; the beach crest is 3 or 4 m wide. Behind it is a dense line of beach crest vegetation. The height of the drop decreases to the north and the beach crest vegetation spreads out, so that at the old, ruined pier there is an extensive area of *Ipomea pes-capre* sprawling on the beach. In this first sector of the western beach were 18 pits, only one of which was *old*.

Farther north, the beach slope is more gentle and there is no vertical drop. The beach crest vegetation becomes dense again as *Suriana, Scaevola, Geuttarda* and the occasional *Tournfourtia* appear, but there are cleared areas around buildings. The next land mark is the large cross in front of the manager's/lessee's house. This second sector of beach had 51 pits, 23 were recent.

The final, or northern, sector of the west beach runs from the cross north for about 900 m to the beginning of undercut cliffs at the northern point. Along this stretch *Scaevola* is dominant on the beach crest ; it is low but quite dense and most of the 94 pits in this sector were well under the shrubs—some, well shaded. 60 of the pits were recent. The beach is gently sloping except in the north where 1 m cliffs begin to appear in the beach.

The most stable, and best-looking, beach is that in the west. However, there are far more pits on the east coast, 425 as against 203. The north and south coasts contribute very little, 14 and 28 respectively. The reason why more turtles nest on the east coast, with its eroding beaches, battered shores and exposed reef platform, is probably due to human disturbance. It is obvious that, despite the lessee's wishes, illegal slaughter was going on—and probably to some extent. The western beach, although it appears to be much better habitat, is closer to the settlement and consequently to human disturbance.

With a total of 670 turtle pits, 330 of which were recent, that is, within the last 2 months or so, it would seem that the number of females nesting at Astove in 1968-69 was less than 1,000 (taking into mind (*a*) pits may remain easily visible for a year or more, (*b*) females lay more than once in a season, and (*c*) females often dig several holes before laying).

Dupont (1929) estimated 400 green turtles per year were captured and dried calipee and quitouze made from them. In 1964 Honegger (pers. comm.) saw no signs of nesting at Astove. Hirth and Carr (1970) observed 18 recent nests on the western beach and then concluded that Astove was the best nesting area in Seychelles.

As far as green turtles in Seychelles are concerned, Astove certainly has some of the most intense nesting. However, to make population estimates from 18 nests is optimistic, at least. There are beaches on Aldabra with nesting far denser than any beach on Astove, and I would be surprised if there are more nests on Astove than Aldabra. One must also consider that the turtles which breed on Astove may well breed on Aldabra (or other nearby islands) or *vice versa*.

Of the Hawksbills, Dupont (1929) says they: ' ... are said to be extinct on this island where they never occurred in great numbers'. I was told that both hawksbills and small green turtles were common in the vicinity of the southern channel.

COSMOLEDO

This is a large atoll with nearly 20 islands ; it is from 9°38'38" to 9°45'30"S by 47°30'4" to 47°39'12"E ; this is 40·8 km north-north-west of Astove.

The islands are as follows :

Name		Dimensions in m		Shape
East North	..	400	250	triangular
no name	..	tiny		—
Île du Trou	..	tiny		—
Goëlette	..	250	100	inverted ' V '
Grand Polyte	..	1000	100	elongate NW/SE
Petite Polyte	..	tiny		—
Grand Isle (Wizard)	..	2600	250	crescent
Fagot (Pagota)	..	500	150	tear-drop
South Island	..	2000	250	elongate NE/SW
Moustique	..	250	100	—
Isle Macaque	..	tiny		—
Observation	..	tiny		—
no name	..	tiny		—
Middle ..	..	tiny		—
no name	..	tiny		—
no name	..	tiny		—
West North	..	800	300	elongate
no name	..	tiny		—

It is difficult to estimate what total length of beach is available for turtles at Cosmoledo. If each island were a rectangle with the above dimensions, the total circumference would be 18.6 km. Of this, the lagoonward coasts are probably not used by green turtles although they may be used by hawksbills, which are said to be numerous at Cosmoledo. Thus, there may be something *less* than 9 km of lagoon coast available for hawksbills ; and again, something *less* than 9 km of seaward coast available for nesting green turtles.

I was only able to check Wizard and Menai Islands. Wizard, or ' Grand Isle ', as it is called locally, has a small beach on the seaward side about 100 m long. This was riddled with turtle pits, ' nearly 50 ' were estimated. The remainder of the seaward beach, however, is rocky and unusable to the turtles. A fringing reef is present along this shore, and it dries at low water. The lagoonward beach of Wizard is over 1 km long ; it is gently sloping and vegetation comes close to the water's edge. There was no indication of turtle activity here.

The seaward beach at Menai looks quite decent as nesting habitat ; there are scattered shrubs, *Scaevola* and *Suriana*, along the beach crest, but there is adequate

room above high water mark for many nests. As Hirth and Carr (1970) say, it is probably the disturbance caused by the settlement which is responsible for the lack of turtles on this island.

In 1929, Dupont (1929) estimated that 600 green turtles could be captured and turned into calipee and quitouze at Cosmoledo in 1 year. Travis (1959), however, claimed that 7,000 turtles were captured per annum at this atoll ; Parsons (1962) feels that this is in error. Certainly there is not a shred of evidence for Gaymer's (1966) guess of 12,000 turtles at Cosmoledo, and Hirth's claim (Hirth and Carr, 1970) that Cosmoledo has the second best nesting area in Seychelles for green turtle, is based on very slender evidence. Honegger (1967) saw 23 carapaces of slaughtered turtles on Grand Polyte in 1964. With the available information, it is difficult to make meaningful estimates of the number of nesting turtles at Cosmoledo. Owing to its close proximity to Aldabra and Astove, it is likely that it shares some of the populations which nest on these islands. Certainly, when compared with other islands in Seychelles, it has very intense nesting and *relative* to other Seychelles islands it is of high importance to nesting green turtles.

Cosmoledo is said by the turtlemen to have many hawksbills. Hirth and Carr (1970) without presenting any information, assert the same. Hawksbills are taken for their 'tortoise-shell' at Cosmoledo. [Hirth's and Carr's (1970) comment that hawksbill flesh is eaten by Seychellois must have arisen from a misunderstanding ; it is very rare for these people to eat this species].

I am told by experienced Seychellois that there is a sand bar in the south of the lagoon where 'Name Coyio', the loggerhead, is often taken, and Fryer (1911) states that this species is at least more common at Cosmoledo than at Aldabra, although he was not able to examine one.

Assumption (Assomption)

This crescent-shaped island is at 9°44′S × 46°30′E, 111 km west of Cosmoledo. It is 6·9 km long by 2 km wide. The dunes in the south-east rise to about 30 m. Five major beaches are indicated : in the north and east is one 4·25 km long ; in the east is one 800 m and another 400 m long ; in the west is one 2·9 km to the south, and one 2·25 km long to the north. This gives a total of 10.6 km of available beach. A further 6 km of coast is unusable for nesting.

The southern-most beach on the west coast was the only one I examined. To the south, there are *Suriana* and *Scaevola* shrubs on the beach crest. The nesting habitat looks good but there was no sign of activity—probably due to the settlement close by. To the north the beach still looks good but there is a large boat shed used for guano and there must be a tremendous amount of disturbance here.

Assumption has clearly had very large populations of green turtles nesting on it ; Hornell (1927) relates how 200 to 300 nesting females could be turned in *one* night, and Parsons (1962) even tells how 400 were turned in one night on her shoes.

Observations from recent visits by Gaymer (1966), Hirth (F.A.O., 1967), Hirth and Carr (1970), Honegger (1967) and myself all illustrate that the present populations of green turtles on Assumption are very very small. Nevertheless, there are numerous rumours, some from reputable people, about illegal turtling here. If these are true, then there is little chance of the turtle population recovering.

ALDABRA

This large, raised reef atoll is famous for its green turtles and its hawksbills. It has nearly a complete land rim, broken into four major islands and lies from 9°19′ to 9°26′S by 46°12′ to 46°31′E which is 37 km north-west of Assumption. It is 35 km east-west by 14 km north-south. The highest point (a dune in the south) is at about 20 m. The atoll is oval shaped but bulges somewhat in the south-west. The outer circumference is about 83 km, but very little of this is usable beach for the turtles. The majority of the seaward beaches are pocket beaches ; that it, they are recessed from the perimeter of the limestone cliffs on the coast and form an indentation in the coast line. The lagoonward beaches are gently sloping and not usually indented.

Picard (West) Island is in the north-west corner of the atoll, 5 km by 2 to 3 km. This island is the site of the human settlement. The longest continuous beach on the atoll runs along its west shore for about 1.5 km. It is gently sloping and has no beach flat. Only about one third of the beach, at the southern end, is free from beach rock ; the rest of the beach has a border of beach rock in the wave wash which becomes more and more of a barrier the farther north. With waves breaking on the beach, landing can be very treacherous. There appears to be a trend for erosion of the sand and exposure of the beach rock, for there was far more beach rock exposed in 1970 than in 1968. Erosion is probably worst from October to March when there are north-westerly winds.

The beach crest is vegetated much of the way, but it is entirely affected by man. There are boats, boat shelters, houses, lights, drying tables, building materials, and even a cemetry along it. The vegetation, what there is, is mainly coconut or *Casurina*, with scattered *Scaevola*, and a patch of sisal. The ground cover is *Sporobolus* or other grasses, occasionally *Ipomea*, and at one place a pumpkin patch. In places the beach platform is littered with refuse from the fishermen's houses. At the northern end there is large scale erosion most ; dramatic are several old *Casurina* 2 or 3 m from the present beach crust with roots exposed and eroding free. Very large numbers of *Ocypode ceratophthalmus* inhabit this beach, scavaging on the fish offal.

With this amount of disturbance, it is surprising to note that green turtles do nest on this beach ; although the number involved cannot be more than a half dozen in a year.

The only other beach on the seaward coast of Picard Island is Anse Var. This is a tiny pocket beach with an apron of beach rock. A dense, impenetrable stand of *Pandanus* covers 3/4 of the beach crest, and *Hibiscus* (locally called ' Var ') is east of it. The available area for nesting is about 5 by 5 m in the south-west corner of the beach. Two old pits were seen there in 1968 and none subsequently. Thirty or so years ago a man and his family were stationed at Anse Var specifically for turning turtles as they came up the beach to lay. Nowadays, he would be out of work.

On the Picard side of Grande Passe (Main Channel) is a series of beaches. Most of these are ' false l'anses ' because they are completely flooded at high tide. There are, however, two major beaches which can accommodate nesting turtles. They are referred to as ' Grande Posh '. The northern one is about 50 m long. The sand is very fine, and there is a long gentle slope. The beach flat is small or absent but there is a beach platform quite suitable for nesting. *Casurina* and shrubs are present

but they are not too dense. There is a ground cover of grass. In June 1970, there were signs of recent nesting by both green and hawksbill turtles. Not more than two or three individuals of each species could nest here annually.

The southern portion of Grande Posh is separated from the northern by a point of land. The beach is 20 m long. There is no beach flat and the beach slope is quite steep (about 45°) and eroding somewhat. The beach platform is shaded by large *Casurina* and there is a ground cover of low grass. Ghost crabs were present on the beach slope.

Although the beach platform looked quite decent, nesting habitat, there were no signs whatever of turtle nesting here.

Across Grande Passe is the uninhabited island of Polymine, 3·5 km long by 1 to 2 km wide. On the west side of this island, bordering Grande Passe, are a series of steeply sloping beaches composed of eroded coral rubble ; they are of no use to nesting turtles.

About midway along the north coast is Anse Cedres Polymine a pocket beach in the extreme some 100 m inland from the north coast. The beach is about 50 m long but a small portion in the west is inaccessible. It slopes rather steeply and there is no beach flat. The beach platform extends inland for 10 or more metres in some places, but it is interrupted by dense shrubs *Ipomea pes-capre* sprawls over the platform, and to the east a short grass takes over. There has been large scale erosion in the past on this beach ; a *Casurina* stands on the beach slope 3 m from the beach crest with roots exposed. However, there does not appear to be much erosion at present. Nesting here is desultory, the beach platform is deeply pitted but the number of nesting individuals cannot be more than a dozen a year.

Near the eastern end of Polymine Island, close to Johnny Channel, is a false, l'anse called ' Ti (Petite) Anse Cedres Polymine '. It is also a pocket beach and is about 20 or 30 m wide ; the approach is littered with large champignon boulders, and the beach slope is gravelly in places ; but, most important, the beach is walled in by raised reef cliffs— not only along its sides but also at the high water mark. Consequently, the entire beach is flooded at high water.

On the western side of Johnny Channel, the east end of Polymine Island, are several small beaches. They are steep sloping and composed of weathered coral rubble, and it is unlikely that turtles ascend them. There is only one good beach on the lagoon side of Polymine. Just before the Polymine side of Grande Passe, in the south-west of the island is a long beach reported (R. Hughes, Pers. Com.) to have turtle pits. ' Anse Polymine ', as it is called, has not been inspected by me.

West of Polymine Island, across Johnny Channel is Middle Island. It is 16.5 km long and 2 km wide. On the east side of Johnny Channel is a very steep beach entirely of coral rubble ; it is of no use to turtles. Beginning in the north-west of the coast is a small beach—Anse Coco. Like all the beaches on the north coast it is distinctly a pocket beach ; it is inset 15 to 20 m from the coast, and is a mere 15 m long with a rock cliff 0·5 to 1 m high at the high water mark. In the centre of the beach is a small pass which a turtle can ascend. The platform above the rock wall varies from 3 or 4 m to 6 or 8 m wide. There is a dense stand of *Pandanus*, a coconut tree, and a dense stand of *Cordia subcordata* ; *Ipomea pes-capre* sprawls on the sand. There is a certain amount of eroded coral rubble with the sand, and close to the rock cliff the substrate is not deep enough for laying.

Not more than half a dozen turtles could nest here annually. The beach is an inhospitable one for turtles with the rock cliff at the high water line. The decayed remains of a turtle at the base of this cliff were gruesome evidence for this.

Some 500 m east of Anse Coco is another pocket beach of better quality for nesting turtles. This is Anse Porceau ; it lies 30 to 40 m in from the coast and is about 35 m wide. It slopes at about 30° up to a beach platform heavily pitted by turtles. The platform is from 5 to 10 m wide. At the inland edge of the beach platform is a dense, impenetrable stand of *Cordia subcordata* (' Porceau ' in Creole). At the east and west edges of the beach are areas of sparce, low grass cover. Although the density of turtle pits on this beach is high, the number of actual nests (i.e. with eggs) seems quite low. Probably not more than 2 dozen turtles nest successfully on this beach in a year. There are several cases of eggs being dug up by turtles on this beach and I consider it to be overpopulated (see discussion later).

Toward the other end of Middle Island, some km from Anse Porceau, are three pocket beaches close together. The most easterly is Ti (Petite) Anse Malabar. It is recessed some 15 m from the coast and is about 10 m long. The approach to the beach involves crossing beach rock and broken cobble. The beach platform, which is less than 5 m wide, is contained on all sides by a rock rim (Actually part of the pocket that the beach sits in) which is 0.5 to 1 m high and insurmountable to turtles. There are a few *Tournfourtia* and *Suriana* trees on the platform and *Ipomea* sprawls over the western half. Not more than half a dozen turtles could nest on this beach in a year.

Twenty metres to the east is the large Anse Malabar beach. It is also a pocket beach contained in a rim of rock. On the east side is a low area where turtles can climb off of the beach but there is not adequate substrate for nesting here. The beach is less than 15 m long but the beach platform extends back for 15 m or so. The approach to the beach is clear, except that in some seasons there is a large concentration of *Cymodocea* leaves in the wave wash. Several *Tournfourtia* trees are in the centre of the platform, and a small coconut-leaf hut is at the back.

There is very dense nesting on this beach, and because it was not possible to check more than about once a month, it is difficult to estimate the number of turtles that use this beach; it is unlikely to be more than fifty per year. This beach is over populated.

400 m farther east is Anse Badamier. It is also a pocket beach, but has a very small beach platform which is contained in the rock pocket. The beach is at maximum 25 m long and the platform about 5 m wide. Much of the beach is in the shade of a large Badamier (*Terminalia catappa*) three. There is a low area in the rock wall, at the very back, where turtles can ascend farther, however, the substrate here is too compacted for them to be able to dig in, as it is no longer beach sand. On this beach most turtles nest up against the rock wall ; there cannot be more than a dozen here in a year.

At the east end of Middle Island, bordering Passe Horeau, are two beaches—one of sand and one of eroded coral. The latter is of no use to turtles. The sand beach is about 20 m long and there is a small beach flat 2 or 3 m wide. The sand is large grained and gravelly in appearance. Shrubs form a dense barrier to the beach. I have seen no evidence of turtles on this beach, but the locals inform me that occasionally a turtle will nest here. It cannot be more than one or two a year.

There are no lagoonward beaches on Middle Island. The last major island at Aldabra is by far the largest ; this is South Island. It is in the form of a hook, beginning west of the north-east corner and ending south of the north-west corner. It accounts for about the two thirds of the land rim.

In the north-east is a large pocket beach—Anse Cedres. The western third of it is composed of 2 m cliffs and is unusable except for a small 3 or 4 m beach which allows access to the upper perched beach. The main beach is on the eastern side, about 25 m long and 20 m wide. It is shaded by one *Pisonia*, and many *Casurina*, and *Sordia* trees. To the back of the beach there is a retaining rock cliff. At the sides there is *Casurina* litter and the substrate is not sufficient for nesting but turtles can, and do, wander out onto this terrace. Because of the nature of the terrace, with many pot holes and crevices, this can be dangerous. In fact, two turtles died, and I saved a third, that had strayed too far from the beach and became trapped in the rocks.

This beach is very disturbed ; there is hardly a square metre without a turtle pit. Nevertheless, few of the pits seem to be successful ; one turtle may spend the whole night digging four or more pits and still not lay. This beach is highly over-populated. The number of females per year on this beach cannot be much more than fifty.

For some 5 km there are no beaches along the north-east coast. At Point Hodoul, in the east, is a small beach but it is insurmountable to turtles. The first beach is not until 3 km further south. Here, on the east coast the beach rock and dissected limestone is battered away by the south-east trade winds and the shore has a very different shape to the north coast. There is no pocket but the beach is merely an area of smoothed rock, which runs down to the sea. Although it is covered with sand, pinnacles of rock jut up in many places on the slope and the ascent of this beach cannot be easy for a turtle. The length of the beach along the beach crest is about 50 m. The beach platform runs back for nearly 100 m through an area of eroded dunes. This is in the middle of a large *Sporobolus* grassland. Despite the large amount of good nesting habitat available, this beach is little used ; fewer than a dozen females might nest here per annum.

About 500 m south is the Cinq Cases beach. The beach slope is much the same as the previous beach except that there is at the same time an area almost solely of sand 3 to 4 m wide. The beach crest is over 200 m long and the platform extends back for 100 m or more to a series of large wind bent *Geuttarda* trees. As before, this beach is in the middle of a large *Sporobolus* plain. This is the largest single area of good nesting beach on all of Aldabra today, and in times gone by must have been a very active turtle beach. Something evidently has kept the *Sporobolus* from invading the beach platform and the most likely explanation is that the nesting activities of the turtles are responsible. Nevertheless, fewer than a dozen turtles a year could use this beach nowadays.

400 m farther south is a small beach about 10 m long and with a platform not more than 2 or 3 m wide. This beach usually has a sandy slope. Few turtles nest here, fewer than a half dozen a year.

The reef platform is a mere 30 or 40 m off the coast but it does not dry out. During the south-east trades these three east coast beaches are very exposed, and this can be a very treacherous bit of coast.

There are no more true beaches until the south coast, some 15 km distant. There are however, numerous small pocket beaches which flood at high water. Still it is not uncommon for turtles to nest on these false l'anses. The nests, of course, are completely destroyed by the rising tides.

Anse du Bois is the first true beach in the south coast. It is a pocket beach in which the beach slope is very narrow, about 5 m, but the beach crest is about 40 m long. The beach platform is a *Sporobolus* plain with a few bare patches. There is a concentration of nesting at the beach crest, but turtles have nested some 50 m inland.

In 1968 the beach was little used, but in 1969-70 there were more turtles here. Yet, the number of nesting females per year on Anse du Bois is less than forty.

500 m to the west is the small beach Anse Bigo. Again, it is formed by a cut in the coastal limestone, this time about 25 m wide ; the beach crest is about 30 m long. This beach is also on a *Sporobolus* plain where most of the nesting occurs at the beach crest. Nests can occur some 10 m inland, but 3 m is as far as they have gone. Twenty females would be an annual maximum for this beach.

Because the entrance to the beach crest is narrow, turtles are in danger if they do not re-orientate to the beach correctly when returning. On two occasions females got trapped in the coastal rock ; one was helped to the sea but the other died before being discovered.

About 100 m farther west is Deuxieme L'Anse, a rather complex beach which sits behind a series of residuals (remnants of the former coast). There are three cuts in the coastal rock which lead to the beach crest, one 30 m, one 20 m and one 4 m wide. The beach crest is about 130 m long. Nesting is concentrated at the beach crest but can occur up the face of the dunes some 50 m inland—or even on rare occasions on the inland side of the dunes 100 m or more from the beach crest.

As with the previous beach, Deuxieme L'Anse had very little nesting in 1968 but quite an increase in 1969-70. The annual number of females nesting on this beach is probably less than one hundred and fifty. Even though this beach has a relatively wide entrance to the beach crest, it is still dangerous for turtles to stray when returning to the sea. Two females were helped back into the sea after they became helplessly wedged in the rocks.

About 100 m west, set also behind residuals, is Premier L'Anse. Two alleys lead through the coastal limestone to the beach crest, one 17 m and the other 7 m wide. The beach crest is 40 m long. Inland for 75 or 80 m is a section of very heavily eroded dunes ; and although turtles nest mainly at the beach crest, they have, on occasion wandered to the edge of the dunes to nest. In fact, one animal was found dead in a large sink-hole 100 m from the beach crest. The terrain at Aldabra is not at all easy for turtles to move on another case of turtle death at this same beach was when a female missed the alley to the sea and, fatigued, became jammed in the coastal ' champignon ' (highly dissected limestone).

This beach also showed a marked upswing in nesting activity during 1969-70, when I estimate at most, one hundred females could have nested in the year.

Dune Jean Louis is the next beach west. It also sits behind coastal residuals. The beach crest is nearly 200 m long, and, like the previous south coast beaches, it is

in the middle of a *Sporobolus* plain. Most nesting occurs at the beach crest, but some turtles climb the dune and go as much as 100 m inland. Although the approach to the beach is wide, more than 50 m, turtles occasionally get caught in the rocks at the coast. The 1969-70 seasons were more active than the 1968 season up to one hundred females may nest here in a year.

On the Dune Jean Louis beach, as well as on Premier L'Anse, are large numbers of ghost crabs(*Ocypode ceratophthalmus*), and on numerous occasions these have been seen preying on hatchling turtles.

About 300 m further west is Dune Patates, and although there is no beach proper, a turtle did come up the cobble and dig into the *Sporobolus* to lay.

Dune Opik is the next beach, 1 km west. It is nearly 100 m long. This beach is unique to other south coast beaches in several respect. It is not a pocket beach, but opens directly to the sea. It is not situated in the middle of a *Sporobolus* plain but is on the windward side of a large, stable dune. In the wave wash is an apron of beach rock from which the sand covering has been eroded. Also, this beach has undergone a marked decrease in nesting activity in 1968 there were many recent pits ; but in 1969-70 a mere half a dozen turtles could have nested here. Mr. Harry Charles, who has spent many years on Aldabra, recalls when this used to be a very active beach (one of the best on Aldabra), and at that time there was a complete sand covering to the beach slope.

Anse La Croix is 1 km to the west. It is a false beach which is beginning to develop an approach through the rock up to the perched beach above the high water mark. Turtles could, with no danger, ascent to the perched beach, but there is no indication that they do. Nesting occasionally occurs on the false beach, below the high water mark.

Entreboy is the next beach, some 1·5 km west. This is a pocket beach ; it opens to about 15 m at the sea, but the rock rim closes slighly just below the beach crest. The length of usable beach crest, however, runs for approximately 30 m, and the beach platform extends from 15 to 20 or 25 m inland. The beach platform is in the middle of an area of poor quality *Sporobolus* plain with *Sclerodactylon*.

To the north-west are small eroded dunes which the turtles occasionally nest among.

Recently, the locals claim that Entreboy is one of the most important beaches on Aldabra. This certainly seemed to be the case in 1968 and 1969, but in 1970 nesting activity dropped off on this beach. The maximum number of nesting females in a year would be 100. This beach may be slightly overpopulated at the beach crest.

There is only one other true beach on the south coast ; this is Anse Cuive. However, there are two other places where turtles do nest—at Magination and Dune d'Messe. In order to nest here they must cross an apron of beach rock which is somewhat pinnacled, but there is a large area of beach crest which is available for nesting. Not more than one or two turtles nest at either of these sites in a year.

Anse Cuive, 3 km west of Dune d' Messe and 6 km west of Entreboy, is a rarely visited beach. It opens to about 30 m wide with a small beach rock apron

exposed in some seasons. The slope up the beach, like the other south coast beaches, is gentle, 30° or less. There are some 40 m of beach crest available for nesting, and the beach platform runs 10 to 20 m inland. The beach is in an area of patchy *Sporobolus* plain with much *Sclerodactylon*. *Tournfourtia* are on the limits of the beach as well. Small eroded dunes are in the north-west. There seems to be about 50 nesting females per year at Anse Cuive.

Tambalico, the next beach, is 10 km distant, on the west coast. It marks the Southern end of a 6 km strip of coast with over 20 beaches. Tambalico is a pocket beach with 3 to 4 m vertical walls. The beach is about 20 m wide, but there is very little beach above the high water mark, and at very high tides the beach is probably flooded entirely. I am told by Mr. Charles that this was once a very active turtle beach but at present there cannot be more than one or two turtles a year nesting on it.

A few hundred yards to the north is a small false beach sitting in a high walled pocket. On several occasions turtles nested here, but there cannot be more than two or three females a year.

Ti Tambalico is the next beach. It is funnel like, with a wide opening to the sea (about 30 m) but a rather narrow upper beach area. (about 10 m). The rock wall at the back of the beach is low enough for turtles to climb up onto the soil. There are about 6 nesting females a year on this beach. Despite the small number, the beach is overpopulated, as the available nesting area is very small and it is common for nests to be dug up.

Anse Tamarind is several hundred metres north. It is much the same in shape as Ti Tambalico except that there is slightly more area above the high water mark. Not more than a dozen turtles could nest here annually.

Anse rebice, the next beach, is clearly a pocket beach, but it is not so much recessed from the coast as simply cut into the steep raised reef rock. The beach crest is about 20 m long and the platform is 10 m or less wide. The platform is studded with *Tournfourtia* and other strand trees ; nesting occurs below and among these trees. Twenty nesting females a year would be a maximum for this beach.

The most active each on the west coast is Anse Badamier, which, true to its name, has a large Badamier tree on its north side. This is also a pocket beach which is recessed vertically rather than horizontally. The beach crest, which is interrupted by *Pemphis* to the south ; is about 50 m long. At most the beach platform is 10 m wide ; it is clear over most of its area but there are *Tournfourtia* trees in the middle of the beach and *Pemphis* in the south. To the north is *Sclerodactylon*, in which the turtles occasionally attempt to nest.

The profile of these southern beaches on the west coast undergoes dramatic changes with the change in prevailing winds and Anse Badamier has the most marked changes. For most of the year it had a fairly moderate slope with a slight drop of 0.3 to 0.5 m at the top of the beach. Suddenly, toward the end of the north-west winds, the beach slope washed almost entirely off the underlying rock and left a vertical cliff of 2 m or more. This, of course, was a complete barrier to the turtles and nesting activity dropped off sharply with this change in the beach. Sometime after the south-east winds began, more sand was deposited in the beach and nesting picked up again. A yearly maximum for Anse Badamier is between fifty and one hundred nesting females.

Anse Bar de Mou is a small beach behind a large sand bar ('Bar de mou'). The beach crest is less than 30 m long and the platform 5 to 10 m wide, is studded with low *Tournfourtia*. Like the previous west coast beaches, inland from the beach platform is a mixed scrub woodland with dense shade and very little soil. Not more than a dozen turtles nest at this beach yearly.

For about a kilometre there are steep champignon cliffs after which is Anse Gale. The beach crest is over 100 m long, but the main approach up the beach is less than 50 m wide because there is an immense accumulation of flat, beach rock blocks on its southern end. The platform is less than 10 m wide and slopes down markedly from the beach crest. *Tournfourtia* and *Suriana* are scattered over it and to the back its a mixed scrub woodland, but there is no longer a retaining rock rim. The only real feature that Anse Gale shares with the stereotyped pocket beaches is the steep raised reef rock on its northern border at the sea. Otherwise, it does not really look like a pocket beach. Twenty turtles a year might nest here.

About 100 m north is the tiny beach La Moulroun ; its beach crest is no more than 20 m long and the approach up the beach, which is cluttered with large flat beach rock blocks, is about 5 m wide. Nesting is restricted to the beach crest or just 1 or 2 m inland of it. There are *Pemphis* and *Tournfourtia* here and inland is a short grass plain. Less than half a dozen turtles nest here per year.

Anse Mais is a characteristic pocket beach, recessed from the coast and with high rock cliffs on either side. The beach crest is about 40 m long and although the approach to the beach is clear (except for masses of *Cymodocea* leaves at some times) the slope is quite steep—about 45°. The beach platform is shaded with *Casurina* while *Geuttarda* and *Scaevola* are also present. The platform slopes down from the beach crest and is sparcely vegetated with grass in some places. This is the site of a fishing camp. About 20 turtles nest here annually.

The beach Trois Cèdres is about 200 m north of Anse Mais. There are in fact, more than three *Casurina* here but from a distance they appear like three. The beach crest is about 20 m long, but the northern third is densely vegetated ; all but the southern third is in heavy shade. The beach platform is about 5 m wide and then grades into a poor quality low grass turf. Most nesting occurs in the southern third of the beach, but in total, not more than six females nest here in a year.

Ti Anse Badamier is separated from Trois Cèdres by a point of rock, and like Trois Cèdres is recessed some 15 m from the coast. It has a steeply sloping beach and a large apron of rock at its base. Nesting occurs at the beach crest which is about 15 m long. *Sideroxylon*, *Maytenus* and other shrubs occur on the beach crest. Less than six females a year lay here.

Yet another Ti Anse Badamier is several hundred yards to the north. There is a small beach flat 5 m or so wide, with a concave beach crest 20 m long. There are scattered sedges (*Cyperus*) and shrubs (*Sideroxylon*, *Pemphis*, etc.) on the beach crest. Not more than a dozen turtles could nest here yearly.

The last beach of much importance on the west coast is Deux Cèdres. Again, contrary to its name, there are more than two *Casurina* here. The beach crest is about 50 m long and the platform less than 5 m wide. The beach crest is vegetated with *Suriana* and *Casurina* and a low quality grass plain runs up to the nesting area. Not more than thirty turtles nest here annually.

Four more beaches are without names. The first and third are very small with beach crests 5 m or less and respectively three and one nesting females per year. The second and fourth each has less than six nesting females per year ; their beach crests are ten to fifteen m long.

The next three beaches, which are quite close together, are collectively called Anse Grande Coco. The total length of beach crest for them is about 60 m, and less than six turtles nest yearly on each of them.

An un-named beach with steep slope and rock apron lies between Anse Grande Coco and the two Anse Anglais beaches. It has a beach crest about 20 m long and less than six females a year nest here.

Anse Anglais beaches are the last coastal beaches to be found on Aldabra. Grande Anse Anglais has a beach crest about 60 m long and no platform to speak of. There is a beach flat about 5 m wide with sparse *Cyperus*. The beach crest has shrubs *Geuttarda*, *scaevola*, and *Tournfourtia*. Despite the size of this beach, its contribution is less than six nesting females per year.

Ti Anse Anglais is separated from the last named by a point of raised reef rock. The beach crest is about 25 m long and most nesting occurs along it. The beach platform is less than 5 m wide and well vegetated with *Sideroxylon* and *Tournfourtia*. Less than six turtles nest here annually.

On the northern tip of South Island, bordering Passe Magnan, and less than 50 m from Anse Anglais, is a stretch of low beach. As this floods at high water, it is of no use to turtles. Farther along, on the lagoon side of South Island, opposite Anse Anglais/Anse Mais, are several low lying beaches. I have not examined them, but doubt if they are made by turtles. There are no further sand beaches on South Island until Passe Houreau where there is a small sand beach. This is not used by turtles.

In the lagoon at Aldabra are several islets. Espirit is at the west end, 1.1 by 0.5 km. The north shore is fringed with mangrove and so is much of the south shore, but there are several low beaches, in the shade of *Casurina* trees, on the south shore. The total amount of beach crest is less than 50 m. One small depression in the sand was found just above the beach crest at about the centre of the island ; possibly this was dug by a hawksbill.

Sylvestre is a tiny islet 50 by 100 m just off the east tip of Espirit. There were six small turtle nests under *Sideroxylon* shrubs in the centre of the island in March 1970. It seems unlikely that more than half a dozen female hawksbills nest here in a year.

Ile Michele is in the south-east of the lagoon ; it is about 1·5 by 0·5 km. There are sand beaches interspersed among the mangroves on the east side, but no evidence of turtle activity.

There remains two more large islets in the east of the lagoon which are separated from each other by a narrow pass. Île Aux Cèdres and Île de Egrets. There are four or five small beaches on the south-west of Île Aux Cèdres. One is the site of a fishing camp and is densely shaded by *Casurina* ; the leaf litter is also dense. The other beaches are 5 m or less wide and merely cuts up through the champignon,

enclosed with *Pemphis*. I am told that both green and hawksbill turtles nest on these beaches, but I only found one small depression possibly dug by a hawksbill. Ile de Egrets was not examined, but it does not appear to have beaches.

These data are summarized in the following Table. It must be emphasized that full analysis of the field data is not yet complete, and in order to be conservative I have *over* estimated so that the figures appearing in the totals row are surely maxima. It is clear that the annual number of green turtles nesting at Aldabra is in the order of one thousand ; for hawksbills it is a mere dozen. Furthermore, despite its large size and relatively large turtle population, Aldabra has a mere 3.5 km of beach available.

Beach	Turtles	Beach crest length (m)	Beach platform width (m)
PICARD			
Settlement	6	1,500	
Anse Var	0	5	5
Grande Posh (N)	3+3H	50	5
Grande Posh (S)	0	20	5
POLYMINE			
Anse Cèdres	12	50	10
Anse Polymine			
MIDDLE ISLAND			
Anse Coco	6	15	5
Anse Porceau	24	35	10
Ti Anse Malabar	6	10	5
Anse Malabar	50	15	15
Anse Badamier	12	25	5
Passe Houreau	1	20	3
SOUTH ISLAND			
Anse Cèdres	50	35	20
N of Cinq Cases	12	50	100
Cinq Cases	12	200	100
S of Cinq Cases	6	10	3
Anse de Bois	40	40	50
Anse Bigo	20	30	10
Deuxièm L'Anse	150	130	50
Premier L'Anse	100	40	80
Dune Jean Louis	100	200	100
Dune Patates	1	5	1
Dune Opik	6	100	20
Anse La Croix		10	1
Entreboy	100	30	25
Magination	2	10	1
Dune d'Messe	2	10	1
Anse Cuive	50	40	20
Tambalico..	2	20	1
	2	10	0
Ti Tambalico	6	10	1
Anse Tamarind	12	10	5
Anse Rebice	20	20	10
Anse Badamier	75	50	10
Anse Bar de Mou	12	30	10

Beach	Turtles	Beach crest length (m)	Beach platform width (m)
Anse Gale	20	100	10
La Moulroun	6	20	5
Anse Mais..	20	40	10
Trois Cèdres	6	20	5
Ti Anse Badamier	6	15	1
Ti Anse Badamier	12	20	5
Deux Cèdres	30	50	5
No Name	3	5	1
No Name	6	10	1
No Name	1	5	1
No Name	6	15	1
Anse Grande Coco	6	60	5
Anse Grande Coco	6	60	5
Anse Grande Coco	6	60	5
	6	20	1
Grande Anse Anglais	6	60	5
Ti Anse Anglais	6	25	5
ESPIRIT	1H	50	5
ÎLE SYLVESTRE..	6H	100	20
ÎLE MICHELE	0	50	5
ÎLE AUX CÉDRES	1H	40	1
TOTAL	1052+11H	3,540	770

'H' — Hawksbill

The history of the Aldabran population of green turtles clearly indicates a decline of disastrous magnitude. Parsons (1962) and Hornell (1927) relate many accounts of the staggering numbers of turtles taken from this atoll : in 1847 a hundred men caught 1,200 turtles in a short time ; in 1862 turtles slaughtered were 1,800 (and nearly 500,000 tons of meat left to rot on the beaches) ; 1,500 animals in 1909 reached Mahé and this figure represented no more than one third of the total number originally dispatched ; 1912 statistics indicate that 9,000 turtles were used in the production of that year's calipee ; before World War II 3,000 to 4,000 turtles were captured yearly, by the post-war period only 1,500 were captured.

Perhaps the highest figure attached to Aldabra was by Spurs (1892) who claimed to be able to capture 12,000 animals in a year. By the time Dupont visited Aldabra the annual total was 3,000 (1929). From 1964 to 1967 the yearly import figures into Mahé have been from 295 to 363 turtles per year (Hirth and Carr, 1970).

Numerous other authors have, without giving figures, spoken of the massive decline in the Aldabran population (Voeltzkow, 1897 ; Fryer, 1911 ; Wheeler 1953 ; Veevers-Carter, 1962 ; Honegger, 1967 ; Newman, 1965).

Finally, two estimates for the population size of the green turtle at Aldabra have appeared. Gaymer (1966) guessed that 6,000 females nested annually, but there is no evidence for this figure. Hirth, in three different publications (F.A.O., 1967 ; Hirth, 1969 ; Hirth and Carr, 1970), estimates that fewer than 1,000 females nest at Aldabra in a year. There is no indication of how this figure was reached, but it is consistent with my latest information (discussed above). The figure 1 summarizes the yearly catch of green turtles from Aldabra.

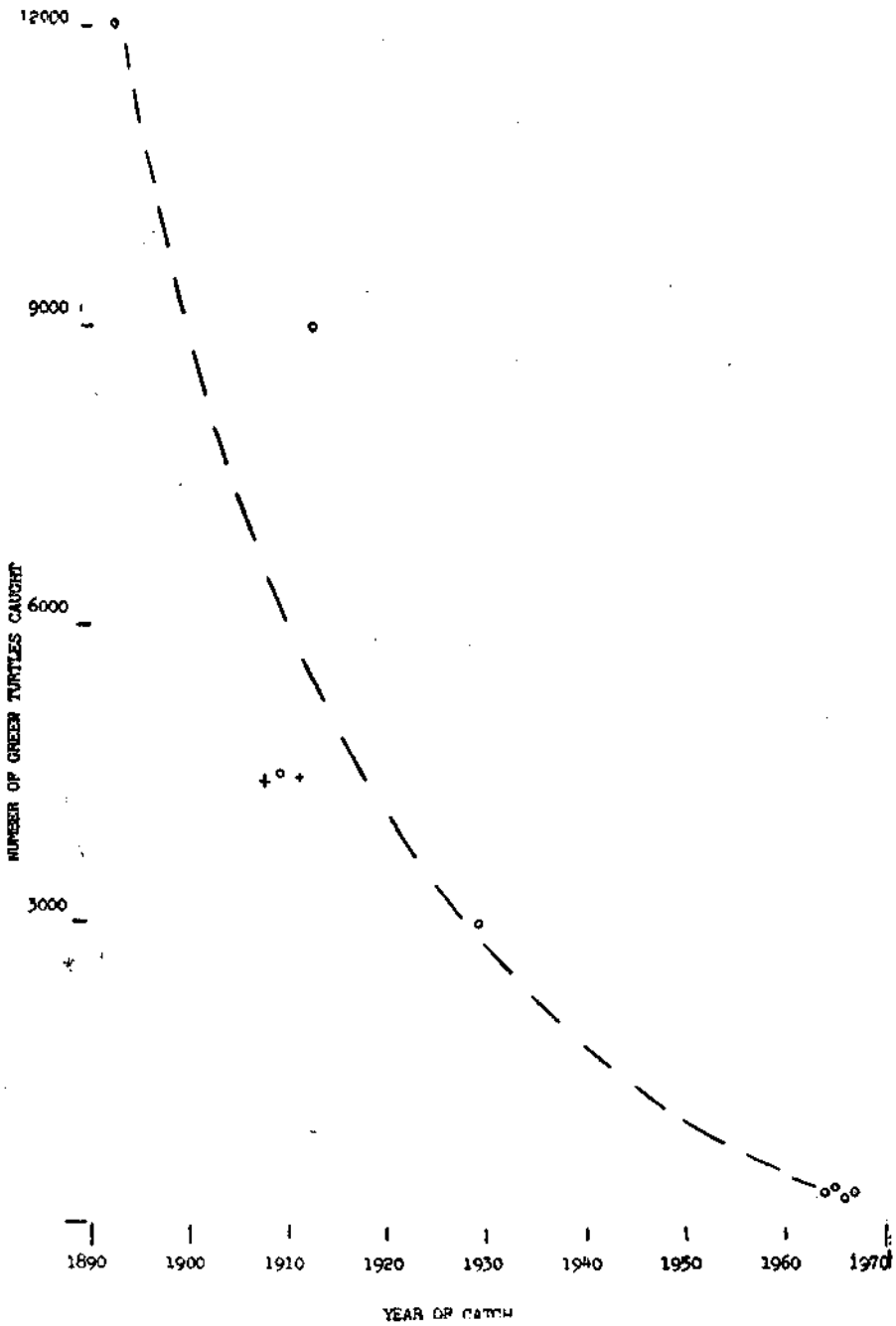
12000
9000
6000
3000
NUMBER OF GREEN TURTLES CAUGHT
1890
1900
1910
1920
1930
1940
1950
1960
1970
YEAR OF CATCH

Fig. 1

Of the hawksbill, Spurs (1892) says it has decreased in numbers, Fryer (1911) says it is scarce at Aldabra. In 1929, Dupont claimed the species was less numerous than formerly and that the blonde variety was nearly extinct. But Hornell (1927) claimed that the blonde race was resident in the lagoon at Aldabra.

Voeltzkow (1897) indicated that the hawksbill is migratory at Aldabra, while Hornell (1927) seems not to favour this idea.

My data are not sufficient for an estimate of the size of the hawksbill population at Aldabra. There are definitely several size classes present, but the absence of substantial breeding sites raises a problem. It may be that, in fact the population is migratory and Aldabra is a non-breeding area for it. Or, it may be that the Aldabran population consists of waifs or the remnants of another population.

Maps consulted : Admiralty charts 718 and 2899 ; D.O.S. Aldabra ; and Piggott 1963, Sheet 3.

It has been said (Hornell, 1927) that the Aldabra group of islands are most important for their green turtle populations, but that the hawksbill is better represented in granitic Seychelles. The present data are in complete agreement with this.

CHAGOS ARCHIPELAGO

2,000 km east of the granitic Seychelles, 1,500 km south of India, and 500 km south of the Maldives, Chagos lies from 5°13′ to 7°27′S by 71°16′ to 72°30′E. It includes 65 islands and thousands of square miles of ocean with a very large shoal—the Great Chagos Bank. These islands are low lying cays or, at most, raised reefs. Their history is somewhat different from the islands previously discussed, for some years ago they were a dependency of Mauritius and have only just become associated, administratively, with the Seychelles by being included in the B.I.O.T. (along with Aldabra, Farquhar, and Desroche). The Chagos islands are also unique in that they are low, out lying islands with permanent inhabitants—the ' Creole des Isles '.

Peros Banhos

This is a large atoll consisting of nearly 3 dozen islands. It is the most north-westerly of the Chagos group at 5°13′ to 5°27′S by 71°44′ to 71°58′E, and is nearly 26 by 26 km. The atoll is, in fact, almost square, except for bulges in the north-west and south-west. Beginning at the northern pass and working clockwise, the islands are indicated in the following Table.

On the whole, the islands are elongate in shape, but are oriented in different directions depending on their positions in the atoll. If, for the sake of a very rough estimate, each island was assumed to be a rectangle with the dimensions indicated in the Table, then there would be about 96 km of coast—nearly as great as the circumference of Mahé. This reflects the large size of Peros Banhos, and the large number of islands. If all the islands are like those in the south-west which I surveyed, then much of the lagoonward coast should be available for nesting ; this would amount to less than 50 km.

Time was available to survey only five islands ; Mapou de L'Île du Coin north to Île du Coin. Île Anglaise, Île Manpatre, and Île Poule. These are all coconut

Island	Length (m)	Width (m)
Petite Île de la Passe	190	190
Île de la Passe	930	370
Moresby Islands	1480	830
Île St. Brandon	370	190
Île Parasol	460	280
Île Longue	1300	280
Grande Île bois mangue	650	280
Petite Île bois mangue	560	190
Île Manöel	1390	370
Île Yéyé	1480	830
dry sand bank	90	90
,,	90	90
,,	190	90
Petite Île Coquillage	650	370
Grande Île Coquillage	1110	190
Coin du Mire	190	90
Île Vache Marine	460	280
Île Fouquet	650	70
Mapou de L'Île du Coin	460	170
Île du Coin	3150	560
Île Anglaise	700	280
Île Manpatre	740	370
Île Gabrielle	280	90
Île Poule (Passe de L'Île Poule)	2130	700
Petite Soeur	2220	740
Grande Soeur	2410	560
Île Finon	190	90
Île Verte	280	190
Île Manon	190	90
Île Pierre	3890	650
Île Diable	1390	1390
Petite Île Mapou	280	190
Grande Île Mapou	740	370
Île Diamant	2590	560
† sand bar	2040	190

plantations, from one shore to the other, but they are not 'cleaned' so there is quite a bit of regeneration and succession going on under the coconut palms.

Mapou de L'Île due Coin is in the south-west of the atoll, nearly 500 by 200 m in size. The north point has a small sandy beach with a beach flat ; it appears to be a building beach. The east coast, however, is eroding, but only slightly, producing vertical drops of about 0.3 m at the beach crest. *Scaevola* grows lush and dense, overhanging the beach ; *Geuttarda* is common—especially inland ; and one *Cordia subcordata* was found on the beach crest. For much of this lagoonward coast, there are two adjacent strata of beach rock at the wave wash, but they do not look an important barrier to nesting turtles.

The south end of this island is hook-shaped with a sand bar. To the west is a layer of beach rock which has been laid down on an east facing coast. The seaward coast of the island looks pretty useless to nesting turtles. There is a wide area of

beach (?) rock on the beach slope which runs down to an extensive pavement area with small surge channels in the wave wash. The beach crest is badly eroded, with a drop of 1 m which exposes a conglomerate substrate ; wind beaten *Scaevola* grows densely on the beach crest. To the north are large blocks and slabs of beach rock and at the north-west corner a conspicuous ridge of dissected beach (?) rock, not quite metre high, runs out 30 m perpendicular to the coast.

Île du Coin is separated from the former by a shallow channel of pavement, with coral rubble and active, but scattered, coral heads. At its seaward and lagoonward edges the channel dried completely. Île du Coin, which is more than 3 by 0.5 km is the site of the main settlement.

On the lagoonward shore the beach crest is vegetated mainly with *Scaevola*, which is dense and lush but not impenetrable, for there are many gaps in it. Vines of several species are common on the *Scaevola*. *Geuttarda* occurs but it is not common, and one *Hibiscus* was seen. Inland from the beach crest the vegetation would afford little problem to a nesting turtle, for it is not dense. At one place the beach is building and has covered shrubs and moved the beach crest about 1 m lagoonward. However, for much of the east coast there is an erosional drop of a half metre at the beach crest and large areas of roots are exposed. Beach rock occurs in several patches but to the south it becomes more and more conspicuous forming a ridge in the wave wash and then finally a large sheet.

There is a large sand bar and a beach flat at the south end of Île du Coin. At the south point is a series of beach rock strata which indicate that previously, the south point was farther north-west and the seaward beach farther west.

The present seaward beach is not a good one for turtle nesting. There is a rock pavement (beach rock ?) at the water's edge and coral rubble on the beach slope, which is quite steep in some places. The beach crest has a storm beach character being elevated above the rest of the island. It has vertical erosional drops of 0.5 to 1 m and is densely vegetated with wind blown *Scaevola*. Coconut palms and a grass are also found on the beach crest. In fact, the roots of the coconuts are so dense that they form a compact mass much like ' chipboard '. There are several small gaps in the rock apron where sandy beaches appear, but they are rare and often littered with coral rubble. Opposite the settlement, to the north-west, is a quiet cove with sand. One small nest (hawksbill) was found just below the beach crest here. A ridge of (beach ?) rock runs 20 m or so perpendicular to the shore—out across the reef flat. On the north side, there is no beach, for the land drops abruptly 1 m or more to the sea. It is actively eroding, cutting into the coconut plantations here. At the north-east point a beach flat, about 15 by 30 m, develops.

Île Anglaise is separated from Île du Coin by a channel which is over 1 m deep. Anglaise is 700 to 280 m. The lagoonward beach is presently building, accumulating sand, but the accumulation is over an old erosional surface, for there is a vertical drop of a metre or more at the beach crest. Dense *Scaevola* overhangs the beach and is quite impenetrable in places ; coconut palms also grow up to the beach crest. The inland vegetation seems dry, but much of the lagoonward beach appears to be quite acceptable for turtle nesting.

A wide, but shallow, pass, with numerous sand bars, separates Île Anglaise from Île Manpatre. Île Manpatre is much the same as Île Anglaise. The lagoonward beach is eroding in some places, building in others. A small bit of beach

rock is exposed at the wave wash. *Tournfortia* is on the beach crest, and the island vegetation appears quite dry.

Between Île Manpatre and Île Poule is a channel cluttered with many sand bars oriented in different ways. A long bar of rock rubble runs out the pass to the sea, and at the seaward edge is an elevated rock platform about 10 m long.

Île Poule is about 2 by 0.7 km, and although it is a coconut plantation there is quite a bit of ' wild ' vegetation, most notable of which are huge 30 metre high *Pisonia* trees. Only the south end of the island was examined. The beach crest of the lagoonward shore is covered with dense, impenetrable *Scaevola*. There is a small beach flat at the south-east point. A great amount of coral rubble with uprooted *Scaevola, Suriana* and *Cocos* on the south side is also there. One tree is 2 m from the beach crest on bare beach rock. The beach rock occurs in several strata and there is also an elevated rock ridge parallel to the shore. The beach slope—what there is—consists of coral rubble. The beach crest is dense with *Scaevola* in front of *Geuttarda*.

The seaward side also looks to be of little use to nesting turtles. The reef platform, which has a boulder zone at the seaward edge, is largely a plain, smooth pavement. The beach slope is steep and mainly coral rubble. There has been very dramatic erosion here, as uprooted coconut palms are quite common along the shore. *Scaevola* and *Cocos* are dense on the beach crest.

Thus, the seaward shores of at least the south-western islands of Peros appear to be of little use to nesting turtles. The lagoonward shores, where the *Scaevola* is not too dense, appear to be reasonable nesting habitat. Beaches are building in some places but the overall picture is one of extensive erosion such that long standing areas (indicated by the sizes of the trees on them) are being cut out. In some cases it seems that islands, off their shores, have moved some distance since certain strata of beach rock were formed, presumably on their shores. The channels that are shallow apparently have only moderate currents as they are cluttered with sand bars. The cause of the erosion is not clear ; but it may have already ruined good seaward nesting beaches.

Little is recorded about the turtles of Peros. Gardiner (1909) states that about 120 green turtles were caught annually at the beginning of this century ; this species was taken mainly during the south-east trades when they were laying. He also states that only about 35 hawksbills were taken annually ; this species laid during the north-west winds. I questioned two island administrators who have spent considerable time in Chagos. One claimed that 40 to 50 green turtles would be taken at Peros in a year and that their season was June to September ; he also claimed that roughly 50 hawksbills could be taken and their season was July to September. The other administrator estimated over 100 green turtles at Peros, mainly in their laying season from June to September ; of hawksbills he said 200 to 300 could be here and they laid from November to February. Mr. M. Molinier, son of the ex-owner of Chagos, claimed that ' Name Coyio ', the loggerhead, breeds on Grand Coquillage in the east of the atoll, but I was unable to find confirmation for this statement.

It is clear that despite the large area of Peros and its many kilometres of suitable nesting beaches, few turtles occur.

SALAMON

25.2 km east of Peros, this atoll lies from 5°18′ to 5°22′S by 82°12′ to 72°17′E. Thus, the atoll measures 7.4 km by 9.3 km. The atoll is rather like a tear-drop ; there are 11 islands :

Island	Length (m)	Width (m)
Île de la Passe	650	560
Île Mapou	280	190
Île Takamaka	740	930
Île Fouquet	1580	370
Île Sépulture	240	90
Île Jacobin	240	150
Île du Sel	240	110
Île Poule	90	90
Île Boddam	2320	560
Île Diable	560	560
Île Anglaise	2340	330

If each island were assumed to be a rectangle, the total circumference would be about 26 km, but probably less than 10 km of this is available for nesting.

Île Boddam was the only island examined in detail ; this is the site of the main settlement. More than 2.3 by 0.5 km, this island is a coconut plantation ; the grounds are cleaner than on Peros, and there is little other than a ground cover of herbs under the palms. The lagoonward shore, at the north-east point, has a small beach flat with many *Scaevola* seedlings. The sand is very fine grained. To the south, there is dense *Scaevola* overhanging the beach. Occasionally *Morinda citrifolia* are behind or with the *Scaevola* on the beach crest. There is some localised erosion ; but on the whole, the beaches appear to be stable, or even building.

At about the centre of the lagoonward shore is the settlement with pier, stores, houses, etc. After this, the *Scaevola* again takes over. Toward the south coast medium-sized *Calophyllum* trees overhang the beach crest together with the *Scaevola*. The beach crest here is badly eroded, exposing many roots and dropping nearly a metre in places. The beach slope is very gentle with variegated sand. The logoonward shore is slightly concave, producing a long gentle curve which is most marked in the south.

At the south-east point is a large area of beach rock with undercutting and much surface dissection. There is a cement bench mark inscribed ' Sealark 1905 ' on this rock and, as it is at least 10 m from dry land, it may indicate that a good amount of erosion has occurred here in the last 60 years.

On the south shore there is an erosional drop of 0.5 to 1 m at the beach crest. The beach crest vegetation is fairly open. The entire south shore is composed of beach rock with coral rubble above it ; the slope is very gentle. The reef platform which may dry in places, extends for about 50 m from the shore.

The south-west still has large amounts of beach rock but it is in three strata. There are several small sandy beaches in the south-west, but the rest of the west coast

is unusable to nesting turtles. Beach rock is present in scattered places ; the beach slope is littered with coral rubble which ranges in size from large blocks to large pebbles. The beach crest, however, is the most unsatisfactory aspect from the turtle point of view, for it is eroded along its entire length with vertical drops of 1 m or more. Also, most of the beach crest is densely rooted so that after erosion the substrate resembles ' chipboard '. The extent of the erosion is indicated by coconut palms which are standing with roots fully exposed as compact balls some 2 to 3 m from the beach crest. There are some places, however, where some deposition appears to have been made over the erosion. *Scaevola* is often dense on the beach crest, but there are also many areas of beach crest with no shrubs.

To the north-west, the reef flat is about 15 m from the shore and has a boulder zone at its seaward edge. The reef beyond this is active coral interspersed with narrow but deep channels.

The north shore has been subjected to considerable erosion. There are many uprooted coconut palms and a vertical drop at the beach crest of 1 m most of its length. *Scaevola* is dense, but not continuous on the beach crest. The beach is covered with large coral rubble.

On the whole, only the lagoonward beach of Île Boddam would be of much use to nesting turtles, and even this is not all good nesting habitat. The island appears to have undergone considerable erosion, and this may have washed away formerly good nesting beaches. The three small islands east of Île Boddam, Île Poule, du Sel, and Jacobin, appear to have decent nesting habitat, but time was not available to examine them more closely.

Little seems to be known of the turtles here. An experienced islander claims that 2 or 3 green turtles a year and perhaps 20 hawksbills a year can be taken at this atoll.

Nelson Island

This island is in the shape of a dog's bone 1.85 by 0.93 km ; it lies at 5°41′30″S by 72°20′E, about 37 km south of Salamon Atoll. It is uninhabited and there is a small stand of coconuts in the north, but otherwise most of the island is densely vegetated with shrubs such as *Scaevola* and *Tournfourtia*.

The east shore is convex forming a long gentle curve. The beach crest is densely vegetated with *Scaevola* and *Tournfourtia*, and a few coconuts, but there are gaps in the vegetation where turtles can, and do, nest. The beach slope is at about 30° and there is no recent erosion, but some of the coconuts are with roots exposed. The reef platform, which is mostly a plain pavement, extends for about 100 m off the shore.

The west shore, in contrast, is concave with *Pemphis* and *Suriana* on the beach crest, which is slightly eroded. Also, the beach slope is steeper, about 45°.

About 2 dozen turtle pits were seen on the east shore, and many had eggs and several were very recent. No pits were seen on the west shore. I was informed that 30 to 40 turtles could be taken on Nelson during their nesting season, which is July to September.

TROIS FRES (THREE BROTHERS)

In fact, four islands are in this group. They lie 77.8 km south-south-west of Peros, from 6°7′ to 6°9′30″S by 71°32′ to 71°35′E in a line north-west by south-east. The three large islands are 900 by 900 m, 900 by 600 m, and 1,100 by 600 m. The distance from first to last is about 6 km.

EAGLE

There are two islands in this group, which is 19.51 km west-south-west of Trois Fres at 6°11′S by 71°21′ E. The larger island is 4.6 by 0.9 km, and the 3.4 km to the south-east is 0.9 km in diameter.

DANGER

In the shape of a tear-drop, this island is 16.7 km south-south-west of Eagle ; it lies at 6°23′S by 71°16′E, and measures 2.4 by 3 km.

Very little is known about the last four island groups : Danger, Eagle, Trois Fres, and Nelson. They all lie on the northern or western edge of the Great Chagos Bank.

EGMONT ATOLL (SIX ISLANDS, SIX ÎLES)

About 28 km south-south-west of Danger Island this atoll is just off the Great Chagos Bank (6°39′S ; 71°22′E). The atoll is elongate 9.6 by 3.7 km. Seven islands are indicated :

Island	Length (m)	Width (m)
Île Sud-est	1670	560
Île Takamaka	560	370
Île Carre pate	460	280
Île Lubine	2870	560
Île Sipaille	1300	560
No name	280	90
Île des Rats	560	370

The total circumference is about 11km. Mr. J. Todd tells me that the atoll has changed somewhat from the indicated positions on the chart ; islands have been added, subtracted, and combined. An experienced islander thought that many green turtles nest here, but a schooner captain claims that, at least during the south-east trades, there are few hawksbills and fewer greens.

DIEGO GARCIA

This atoll lies from 7°13′25″ to 7°26′30″S and 72°21′ to 72°30′E. It is 122.3 km south-east of Egmont and 220 m south of Salamon. Diego Garcia is nearly a complete land rim, broken only in the north where there are three islands across the channel. They are East Island, 800 by 200 m, Middle Island, 300 by 250 m, and West Island, 275 by 75 m. (Local creole names are also applied to these islands). The atoll itself is an odd shape, somewhat boot-like, 24.6 km north-south by 15.8 km east-west, and the land rim varies from 60 to 800 m wide. The outer circumference is about 60 km and the inner about 45 m. The majority of the circumference, both inner and outer, is sand beach, but not all of it is suitable for nesting.

The seaward shore from East Point, opposite the settlement, north to Cust Point, in the north-east, was examined. There is a reef platform, up to 100 m wide; it dries in places and appears to be fairly barren. The beach slope is long and gentle with beach rock very common at the base. Beach flat is absent or very small, 1 m or less wide. The beach is mainly sand, but there is some coral rubble, and at Point Cust it is covered with large blocks of beach rock. *Scaevola*, *Geuttarda*, and *Suriana* are common on the beach crest, but coconut palms and other species also occur. The vegetation was extremely dense and would pose major problems to a nesting turtle. It is even difficult for a man to penetrate this line of vegetation; the locals cut traces through it in order to reach the beach. In places there is erosion at the beach crest which produces drops of 0.3 to 0.5 m; in other places there appears to be none. On the whole, the beach seems to be retreating, as Stoddart (in preparation) has described.

There was no evidence of turtles here, and this is not surprising as it is difficult to see how they could find enough unrestricted area above the highwater mark for nesting.

The seaward shore on the west, south of Point Marianne, was only viewed from a speeding car. It appeared to have decent nesting beaches with long gentle slopes, a wide reef platform, but a considerable amount of erosion at the beach crest; some places there appeared to be drops of 1 m or more. Vegetation appeared to grow right to the beach crest, but was not as dense as on the east coast.

The lagoon shore was examined from Cust Point to East Point, at Point Marianne, and scattered points between. In the south and opposite Horsburgh Point there are marshes, but otherwise the shore appears to be mainly sand. In the east it is very gently sloping, overhung with *Calophyllum*, and eroded to 0.5 m at the beach crest. At Point Marianne the shore was still gently sloping but not so conspicuously overhung with vegetation. *Calophyllum* is common, and *Scaevola* also occurs but is not common on the beach crest. Erosion did not appear to be conspicuous in the east either. Some, but not all, of the lagoon shore appears to have suitable nesting habitat.

No signs of turtles were seen in the lagoon either. The locals claim that most nesting occurs in the north-west at Simpson Point on the seaward side, but time was not available to visit it. I am told that very few green turtles and only a few dozen hawksbills occur yearly. Bourne (1886) claimed that green turtles were most numerous during the south-east trades and hawksbills, during the north-west winds, when 3 or 4 could be captured in a week. Stoddart (in preparation) recorded hawksbills in the lagoon in July 1967. Green turtle poaching evidently occurs as I was offered ' tortue saler '.

Although there is extensive beach area at Diego, it seems that there is much to be desired in the quality of the nesting habitat. On the whole the islands of the Chagos are a bit of a mystery, for they have many kilometres of beach but very few turtles, and there are no indication that huge numbers occurred in times past. It seems that this archipelago is not usable for turtle nesting for some reason. The simplest explanations are that the beach crest vegetation is too dense, or that sand beaches have been washed out and left behind rocky beaches with vertical cliffs—quite unsuitable for turtles.

Maps consulted : Admiralty charts 3, 4, 920 and 2899.

Conclusion

Three major points are revealed in the above account of the islands. First, sea turtles are not an overly conspicuous part of the biota throughout the Seychelles area, but, especially in the case of the green turtles, are common in only a few places. Second, nesting beaches throughout the area are undergoing large-scale degradation ; this is due to both natural and human causes. Third, populations of sea turtles, at least green turtles, are far, far smaller than they were in the last century.

It is clear from the account of the islands that few of the Seychelles islands have large numbers of sea turtles. Two atolls in particular, Aldabra and Astove, stand out as having aggregations of nesting green turtles ; Wizard Island (Cosmoledo Atoll), North Island (Farquhar Atoll), and Curieuse Island also have been turtles nesting but to a lesser extent. However, the great majority of islands in the Seychelles area (Granitic Seychelles, Amirantes, and Chagos Archipelago) lack areas of aggregated nesting. The almost exclusive use of Aldabra and neighbouring islands is puzzleing, for Aldabra is one of the harshest environments. There are no great pastures of lush sea grasses for feeding ; the nesting habitat is pocketed within treacherous, dissected limestone cliffs, and relative to the total length of coast there is very little nesting habitat. Strangely, in the above points the islands not used by the turtles appear to be for more hospitable.

The key to this puzzle may lie in some inconspicuous requisites of the nesting habitat and in these requisites Aldabra presumably offers the best option. The other islands, although appearing more hospitable to men, may be lacking in some important factors, necessary for successful nesting. It is for this reason that I have gone to some length to describe these beaches in detail.

The problem of utilisation and choice of nesting beaches has received some attention in the past. Bustard and Greenham (1968) found that factors such as moisture and concentration of rootlets in the sand are strongly related to hatching success.

Hendrickson and Balisingham (1966) postulated that grain size of the beach sand may be important in selection of nesting beaches, but Hughes (pers. comm.) feels that it is not so much grain size as exposure and profile of the beach which are important. Hirth and Carr (1970) made a preliminary attempt to outline characteristics of the sand of different nesting beaches. While this is a useful start it must be emphasized that there may be large scale variation in beaches with both space and time. On Aldabra, for instance, beaches could go through phenominal changes in a week or so, and there were substantial differences in beaches in different parts of the atoll, as I have already described.

In some ways the Aldabra beaches were unique to the Seychelles area. On the whole they are very open, fully exposed, and with very little vegetation. The beach platforms are large and often contiguous with the inland habitats; beach flats are not common. The 'wide open spaces' of the Aldabran beaches, although a typical of Seychelles, do seem to be very similar to some other green turtle nesting areas—for example Yemen (Hirth and Carr, 1970). This characteristic of 'wide open spaces' may be an important clue to good nesting grounds (although it may not be exclusively true to them).

There is another point that may be relevant to the problem of why the turtles seem to be restricting their nesting activities to just a few of the hundreds of Seychelles Islands. This is the tendency to return to the same beach for nesting—' site attachment '. It has been shown that turtles nest on a beach in one year, migrate to other parts—often quite distant—and return to virtually the same stretch of beach in subsequent years to re-nest (Carr and Hirth, 1962 ; Harrisson, 1956, 1958). If this tendency exists in the Seychelles turtles, and if the Aldabra group of islands have become established as the primeval nesting ground, then nesting will be concentrated here for as long as the tendency for site attachment lasts. At the time of the establishment of this behaviour, the area involved must probably was the best habitats available. However, it is not impossible that as the environment changes the turtle are caught with out-moded habits and persist in breeding on traditional beaches which, although formerly the best available, no longer offer the best nesting habitat.

To what extent long-standing and present-day factors are involved in the distribution of breeding populations of green turtles in Seychelles is not known, but the fact remains : the distribution of breeding areas throughout the Seychelles is very limited.

The hawksbill is even more of an enigma, for the species is widely occurring (although apparently not abundant anywhere) but no substantial nesting areas are known. On Aldabra and Astove very few individuals nest and no large nesting areas were seen at any of the other islands visited.

The second major point revealed by the account of the islands is that degradation of the nesting habitat is very wide spread, infact, nearly every island visited had some retreating beaches. Erosional drops were very drastic in places, for instance the south-east of Astove and the south of Aldabra there are drops of several metres. Exposure of underlying rock also caused dramatic changes in the character of a beach, as witnessed many times on Aldabra. These forms of catastrophic beach erosion have deleterious effects on nesting turtles.

If the beach slope is not relatively smooth but rocky and uneven the chances of a turtle ascending are very small. If there are obstructions such as vertical cliffs on the beach, the turtles will not be able to ascend to a suitable level, and will either have to return to the sea or nest in an unsuitable place where the nest will either be washed out or chances for survival of the hatchlings will be very low. The vast changes in beach which occur seasonally are also capable of causing large-scale destruction to nests. If a nesting area is washed out, or frequently flooded, prior to the eggs hatching, there will be little hope for successful nests.

Man is directly responsible for degradation of large areas of nesting habitat. Constructions on the shore, such as break waters, piers, jettys, boat shelters, roads, and so on, are major obstacles to the turtles. This type of habitat degradation is most pronounced in the Granitic Seychelles where kilometre upon kilometre of beautiful nesting beaches are disturbed.

Man's activities are also indirectly responsible for habitat degradation over large areas, and as this is much less obvious to the untrained observer, it is of great importance. Domesticated animals : dogs, cats, pigs, and commensal species such as rats can cause untold damage to eggs and hatchlings. In Aden, ' Feral dogs are the most serious predators on incubating eggs ' (Hirth and Carr, 1970). Also, men attracts natural predators to the nesting habitat by discarding fish offal and other

materials on the beaches. In the sea many scavengers (which also prey on hatchlings) are attracted to the beach. On land large numbers of ghost crabs that congregate on the offal are important predators of eggs and hatchlings. On Aldabra it was found that ghost crabs could devastate over 60 per cent of a clutch. Numerous other invertebrates, such as burying beetles and maggots, also prey on the eggs; but they may be linked to the crabs in some way. There are indication that invertebrate predation on eggs varies dependent on the distance of the nest from the beach crest; if this phenomenon is generally the case, it points even more strongly to the importance of inconspicuous requisities in the nesting habitat.

One type of human disturbance, comes from artificial lighting. This disturbance affects two different stages of the life history, but hatchlings are most drastically affected. It has been shown by numerous workers (Ehrenfeld and Carr, 1967; Ehrenfeld, 1968; Mrosovsky and Shettleworth, 1968) that hatchlings orient to that part of the horizon with the greatest light intensity. Normally this area is over the ocean, and as a consequence the turtles reach the water. If, however, the brightest part of the horizon is not over the sea but inland, the hatchlings will commit mass suicide moving inland. McFarland (1963) has described just such an occurrence in relation to road lights, and cases of hatchlings coming to open lights on Aldabra have also been reported. In highly 'developed' areas with houses and much lighting, the changes of hatchlings finding the sea must be very small.

In addition to hatchlings, lights also effect females. Carr (1967) has related how merely lighting a cigarette can cause a nesting female to abandon the beach and return to the sea. The Seychellois turtlemen tell similar accounts. Likewise my own observations indicate that lights will cause females to desert the beach, although this does not happen a hundred per cent of the time.

Just why females abandon beaches with lights is not known, but it is clear that such disturbed beaches will have: (*a*) fewer females coming ashore, (*b*) consequently, fewer nests, and (*c*) those nests that occur and hatch will be subject to mass destruction through disorientation of the emerging hatchlings.

The problem of lights may not be so central to nesting female hawksbills as this species nests mainly during the day in Seychelles. This does, however, leave the females open to disturbance by people on beaches during the day. It still remains, nevertheless, that hawksbill hatchlings would suffer the same mass disorientation by inland lights.

The last form of nesting habitat destruction to be discussed here is that done by the turtles themselves. When nesting, a female green turtle digs a 'body' pit about 1 m square and 0.5 m or more deep; at the posterior of this pit she digs a further 0.5 m forming a flask-shaped hole. If she is not able to complete this hole (e.g. sand caves in or obstructions are in the way) she will abandon it and dig another body pit. This may occur several times, and the turtle may even fail to lay after making four or five attempts in a night. When she finally completes a nest, she lays the eggs (about 125 in number) in the flask-shaped hole and then covers it; she then proceeds to 'swim in the sand' with the huge front flippers. This effectively covers the pit behind her but at the same time she is constantly digging in front; this may continue for 10 m or more and well over a ton of sand can be disturbed.

If there is dense nesting in an area then there will be a high probability that a nesting female will disturb one of these nests—the denser the nesting, the higher the

probability that a nesting female will destroy a comrades nest, for if a female digs into a nest there is little hope that any of the clutch will hatch. Moorhouse (1933), Hendrickson (1958), and Bustard and Tognetti (1969) have discussed this phenomenon in other nesting areas.

There is another less direct but equally deleterious affect. On a heavily used beach, there will be much digging. Digging produces disturbed sand which is loose and dry ; but successful nests require moist, compact sand which will not cave in during the final digging of the nest hole. The more digging there is on a beach, the greater are the chances a female will encounter an area of disturbed sand and will have to abandon a nest attempt and dig elsewhere. The more failed nest attempts, the more disturbed sand there will be and the greater the chances subsequent females will fail and have to make several attempts to nest. Thus, the situation becomes a closed, positive feedback loop in which the habitat becomes worse and worse.

Beaches which are characterised by many nesting attempts, close spacing of nest pits and loose, dry sand I have called ' over populated '. Such beaches can be found on the north and west coasts of Aldabra where the nesting area (beach platform) is enclosed by the sides of the rock pocket in which the beach rests. Over populated areas are also found along the beach crest of some of the southern beaches.

Habitat destruction by the turtles themselves is an important problem which cannot be ignored. As I will discuss below, however, in the Seychelles area disturbance by man may be on underlying cause for this self-inflicted problem.

The third major factor revealed by the account of the islands is that present-day turtle populations are much below former levels. The most dramatic illustration of this is the graph of yearly catch of green turtles at Aldabra. The numbers of animals caught in the last century are astounding and indicate that the turtle populations in Seychelles easily numbered in the hundreds of thousands. After a detailed, long-term study of the nesting beaches on Aldabra (which most probably has more green turtle nesting than any other island in the Seychelles area) my figures indicate that a *maximum* 1,000 females nest on Aldabra in a year. Thus, nowadays there cannot be more than a few thousand green turtles in the entire Seychelles area.

The situation with hawksbills, as has been alluded to throughout this report, is not at all understood. Export data do not indicate a marked decline in this species although this does not necessarily prove that there has been no decline. The species is wide ranging but not abundant, and does not appear to have aggregated nesting areas. Indeed, it is difficult enough to estimate the size of the present hawksbill population much less those of fifty years ago.

The downward changes that have been shown to occur in turtle populations are usually attributed to the direct effect of predation by man. It is clear that this has been a very severe pressure on the turtles but it must be realised that man has also disturbed the turtle populations by indirect means.

I have discussed how man has caused the degradation of nesting habitat, and also how the turtles themselves are capable of ruining their own habitat, both of these points can be linked. The amount of nesting habitat available, or the amount of nest destruction occurring will be important factors effecting the survival of eggs and hatchlings, the recruitment of the population, and the growth of the population. Quite simply, if the amount of nesting habitat is reduced and/or the amount of nest

destruction increases the population will begin to decrease in size. This is a form of density dependent population regulation, for if the amount of nesting habitat is fixed and the turtles begin nesting more and more densely, nest destruction will increase so that they are literally limiting their own populations. Bustard and Tognetti (1969) have described a mathematical model of this in green turtles.

The relationship between man and this density dependent regulatory mechanism is quite simple. Man has made large areas of nesting habitat unusable to the turtles, either directly by buildings, road, etc. or indirectly by lights and other disturbances. Often these beaches that man uses are the best nesting beaches for the turtles as they are sheltered and have smooth beach slopes and large beach platforms. As a result, the turtles are forced to concentrate their nesting in less area and in less suitable beaches. The upshot is that they destroy their own habitats and effectively curb successful breeding on over populated beaches. This appears to be very close to the present situation on two Aldabran beaches (Anse Cèdres and Anse Malabar) where very few nest attempts seem to be successful and those that are, are often dug up.

There are even further complications in considering the size of turtle populations. With an animal that takes some years to mature and then probably lives for many more years, there will be large time lags in the fluctuations of the population. When a population reaches that stage (either by increase in numbers or by decrease in nesting habitat) when it is over populating its available nesting areas, it will begin destroying its own nests and recruitment into the population will drop. Gradually, the structure of the population will become more and more skewed (or ' unhealthy ') with a disproportionately large number of old animals and a disproportionately small number of young animals. As the old animals finally die off the population left will be very small, but the nesting habitat will now be less populated and breeding will become more successful and the population will begin to grow. Cyclic changes in a population, such as this, are known to occur in many different types of animals in nature but a disastrous effect can be produced by introducing disturbance into such a system—as seems to have happened with man and the turtles of Seychelles.

RECOMMENDATIONS

(1) In the above discussion I have tried to make it clear that conservation of sea turtles involves more than simply the restricting of turtle hunting ; it is imperative that nesting areas be rigidly protected. This protection must be not only from direct disturbance (e.g. poaching) but also the many indirect disturbances that I have discussed above (e.g. lights on beaches). A beach completely clear of poachers but lighted at night is probably of much less value to nesting turtles than a beach whose habitat is undisturbed except by occasional poachers (not that they should be tolerated).

(2) For the green turtle in Seychelles nowadays, there are very few important nesting areas. Aldabra and Astove are most outstanding, while Cosmoledo, Farquhar, Curieuse, and possibly Assumption also have a small amount of nesting. As Aldabra and Astove have the most important beaches, the protection of turtles on them must rank as first priority in any conservation programme. Certain parts of Aldabra are presently nature reserves, and the boundaries of the reserves may be extended. Mr. H. Savy, who leases Aldabra, is well aware of the present problems

of turtle conservation and has effected rearing programmes on his islands in the past. Astove Atoll was leased, until his death, by Mr. M. Veevers-Carter, former Fisheries Development Officer of Seychelles. Mr. Veevers-Carter was also aware of the problems of turtle conservation and fought for the acceptance of the present law completely protecting the green turtle. While on Remire he was active in rearing hawksbills and on Astove he expressed the desire, to numerous of the Royal Society Expedition members, to start turtle tagging programmes and other turtle research on Astove. It would seem particularly appropriate if this atoll were made a turtle reserve.

Cosmoledo, Farquhar, and possibly Assumption have nesting green turtles far in excess of most other places in Seychelles (but this is because most other places in Seychelles have no nesting). Whether or not the nesting on these areas makes an important contribution to the turtles of Seychelles is not known, for they have not been properly examined. One is inclined at this stage, with the turtle populations at such a low ebb, to call any contribution to the population an important one. These three islands are leased privately.

The last green turtle nesting area in Seychelles is Curieuse. It should be relatively simple to protect the turtle beaches on this island for it is Crown property. The areas important to turtles are in the east where it is of little use to people. Should this island be turned into a ' fisherman's club ' there is still no reason why the eastern quarter (east of the turtle pen) cannot be set aside. As Curieuse is apparently the only island in Granitic Seychelles with green turtles nesting it has important potential, for if properly managed it could lead to a regrowth of the populations in the area.

(3) Advising on reserves for hawksbills in Seychelles is not easy. The small Granitic islands in the east of the Granitic Group appear to be most important. Cousin, presently an I.C.B.P. reserve, would be an ideal turtle reserve, for there is a resident warden. Other small islands around La Digue and Praslin, and Coetivy and Fregate, although they have not been properly surveyed, are said to be important hawksbill areas ; this is worth examining in detail, for very few important hawksbill areas are known.

(4) Once established, turtle reserves must be permanent ; as the animals typically return to the same beach to nest, a beach becomes permanently fixed in the breeding habits of the turtles. To change reserves' boundaries after the turtles have begun to use them could be disastrous.

(5) Management of nesting is done in some areas ; this involves protection of eggs and sometimes rearing of young (Bustard, 1969 ; Carr, 1967 ; Hendrickson, 1958). This can involve considerable expense in money as well as personnel, and there is no indication that rearing programmes make significant contributions to wild populations. There also seems to be an element of disagreement between turtle specialists in regard to the assets of artificial incubation ; Pritchard (1969) has suggested that hatching success is higher in natural than in artificial nests. Rearing programmes must be initiated only after due consideration has been given them. As funds and personnel for turtle reserves are likely to be very limited it seems more positive, at this stage at least, to acquire and maintain suitable nesting areas—rather than pour limited resources into programmes that may well not be successful.

(6) Just how much management a nesting area requires is not known ; certainly a warden to guard against disturbance is important ; whether or not habitat main-

tenance should be practised is difficult to say—too little is known about nesting requirements. Removing flotsome (such as large pieces of wood and debris likely to be injurious to the female and hatchlings) from the nesting area would be simple and likely to increase the quality of the area. (Unless really necessary, the sand should not be disturbed by digging).

The problem of overpopulated beaches has been raised. It may be possible to increase the total hatchling output by some sort of manipulation, for example: removal of eggs to artificial nests, or, more effective, shunting females to other beaches. However, careful thought must be given before any programme such as this is started.

Ideally, a smooth running turtle reserve would be left to the turtles themselves.

(7) Direct overall protection must also be provided for turtles. Breeding females must not be taken on any account, for it is around these animals that the fate of the populations lies. Hatchlings and small animals must also be afforded permanent protection, for these animals are too small to be of any value other than as tourist curios or bait, and hatchlings can be collected so easily that any trade in them could easily devastate a population.

(8) Because the green turtle population is badly decimated, it will need total protection until some time as it has built up to a level where controlled croping will not injure it. The evaluation of the population status needs to be done objectively, and hence requires the advice of trained specialists. Large scale actions contradictory to the advice from specialists will lead to problems. Premature cropping, for example, can cause serious damage to the population which may require many years to recover.

(9) Points of legislation and enforcement must be given serious consideration; it is of little value to have laws which are effective only on paper. Nesting areas must receive intensive protection. Protection must also be afforded to those species, sex, and age classes that require it. Elicit trade in protected animals must be curtailed. If it is found that the occurrence of turtling within territorial waters by foreign parties is important, this will also have to be dealt with in a positive way. (Simply lamenting the fact that it occurs will not resolve the situation). Clearly, however, with an area as large and scattered as Seychelles this will not be easy.

(10) One very important aspect that is often ignored is education of the public. The people of Seychelles should be made aware of the problems of conservation of their natural resources. Not only labourers and fishermen but also island managers and owners. The final responsibility for the fate of the turtle populations lies with the people of Seychelles, and the problem of conservation is as much sociological as biological.

References

Bourne 1886. Cited by Stoddart : In preparation.

Bustard, H. R. 1969. Queensland protects Sea Turtles. *Oryx*, **10** (1) : 23-26.

——— and P. M. Greenham 1968. Physical and Chemical Factors affecting hatching in the green sea turtle, *Chelonia mydas* (L.). *Ecology*, **49** : 269-276.

——— and K. P. Tognetti 1969. Green Sea Turtles : A Discrete Simulation of Density-Dependent Population Regulation. *Science*, **163** : 939-941.

Carr, A. 1967. *So excellent a Fishe.* Natural History Press, New York.

——— and H. Hirth 1962. The ecology and migrations of sea turtles : 5. Comparative features of isolated Green Turtle colonies. *Amer. Mus. Novitates*, 2901.

Coppinger, R. W. 1883. *Cruise of the 'Alert'. Four years in Patagonian, Polynesian and Mascarene waters* (1878-82). W. Swan, Sonnenschein & Co., London. Cited by Stoddart 1967, p. 61.

Dupont, P. R. 1929. Visit to the outlying islands by the Governor accompanied by the Director of Agriculture. Government Printing Office, Victoria. 38 pp.

Ehrenfeld, D. 1968. The role of vision in the sea-finding of the green turtle (*Chelonia mydas*) : 2. Orientation mechanisms and range of spectral sensitivity. *Anim. Behav.*, **16** : 281-287.

——— and A. Carr 1967. The role of vision in the sea-finding orientation of the Green Turtle (*Cheloniamydas*). *Ibid.*, **15** : 25-36.

F.A.O. 1967. Reports to the Governments of Southern Yemen and the Seychelles Islands on the green turtle resource of South Arabia, and the status of the green turtle in the Seychelles Islands. Based on the work of Dr. H. F. Hirth, F.A.O./T. A. Marine Turtle Biologist. Rep. F.A.O./U.N.D.P. [TA, (2467)].

Fryer, J. C. F. 1911. The structure and formation of Aldabra and neighbouring islands—with notes on their flora and fauna. *Trans. Linn. Soc. London, ser. 2, Zool.*, **14** (Percy Sladen Expedition Reports, 3) : 397-442.

Gardiner, J. S. 1909. Description of the expedition. *Ibid.*, **12** (Percy Sladen Expedition Reports, 1) : 1-55.

Gaymer, R. 1966. The green turtle *Chelonia mydas japonica* (Thunberg) in the Seychelles, Amirantes and Aldabra group. Mimeographed, 1-7.

Grant, C. V. 1801. *The History of Mauritius.* London : Bulmer. Cited by Sauer, 1967, p. 45.

Harrison, T. 1956. Tagging turtles and why. *Sarawak Museum Journal*, **7** (8) ; 504-515.

———. 1958. Long term tagging returns 1952-8. *Ibid.*, **8** (12) ; 772-774.

Hendrickson, J. R. 1958. The green sea turtle *Chelonia mydas* (Linn.) in Malaya and Sarawak. *Proc. Zool. Soc. London*, **130** : 455-535.

——— and E. Balasingam 1966. Nesting Beach Preferences of Malayan Sea Turtles. *Bull. National Mus. Singapore*, **33** (10) : 69-76.

HIRTH, H. F. 1969. Marine Turtles in the Seychelles and Aldabra. *In :* I.U.C.N. 1969. Marine Turtles. Supplementary paper No. 20. Proceedings of the working meeting of marine turtle specialists, Morges, Switzerland. 10-13 March 1969.

HIRTH, H. AND A. CARR 1970. The green turtle in the Gulf of Aden and the Seychelles Islands. *Verh. K. ned. Akad. Wet.*, **58** : 1-44.

HONEGGER, R. 1967. The Green Turtle (*Chelonia mydas japonica* Thunberg) in the Seychelles Islands. *Br. J. Herpet.*, **4** : 8-11.

HORNELL, J. 1927. *The turtle fisheries of the Seychelles Islands.* London : H.M.S.O.

MOORHOUSE, F. 1933. Notes on the Green Turtle (*Chelonia mydas*). *Reports of the Great Barrier Reef Committee*, 4 : 1-22.

MROSOVSKY, N. AND S. SHETTLEWORTH 1968. Wavelength preferences and brightness cues in the water finding behaviour of sea turtles. *Behaviour*, **32** : 211-257.

NEWMAN, K. 1964. An outline report on the present status of birds and turtles in the Seychelles. Typescript 10 pp.

PIGGOTT, C. J. 1968. A Soil Survey of Seychelles. *Tech. Bull. Land. Resour. Div. Dir. Overseas Surv.*, No. 2.

———. 1969. A Report on a visit to the Outer Islands of Seychelles between October and November 1960. Tolworth : Directorate of Overseas Surveys. 1-121.

PRITCHARD, P. C. H. 1969. Sea Turtles of the Guianas. *Bull. Fla. State Mus.*, 13 (2) : 85-140.

SAUER, J. D. 1967. *Plants and Man on the Seychelles Coast.* University of Wisconsin Press, London.

SPURS, J. 1892. (Report on Aldabra to T. Risely Griffiths, Esq., Administrator of Seychelles Islands. Port Victoria, Seychelles, 19 July 1891). Colonial Reports—Annual No. 40 Mauritius (Seychelles and Rodriguez). Annual Reports for 1889 and 1890, with a report on the island of Aldabra. 46-50. London : H.M.S.O.

STODDART, D. (Ed.). 1967. Ecology of Aldabra Atoll, Indian Ocean. *Atoll Research Bulletin*, 118.

STODDART, D. R. (Ed.). In press. Coral Atolls of the Western Indian Ocean. *Atoll Research Bulletin.*

TRAVIS, W. 1959. *Beyond the reefs.* New York : Dutton.

VEEVERS-CARTER, M. 1962. The development of the Green Turtle (*Chelonia mydas*) Fisheries of the Seychelles. Mahé : Department of Agriculture, Report.

VOELTZKOW, A. 1897. Einleitung : Madagaskar, Juan de Nova, Aldabra. Abhand. Senckenb. naturf. Gesellsch. 21, 1-76. Aldabra, Indischer Ocean 1895, pp. 40-73 (mimeographed translation from D. R. Stoddart).

WHEELER, J. F. G. 1948. Memorandum on the Green Turtle (May 12, 1948). Appendix 5, 143-145. *In* : Wheeler and Ommanney 1953, Report on the Mauritius-Seychelles Fisheries Survey, 1948-1949. Colonial Fisheries Publications, 1 (3), 1-145.

Maps and Charts

Admiralty Chart 3. Chagos Archipelago, 1906. Hydrographer of the Navy, Taunton, England.

Admiralty Chart 4. Principal Groups of the Chagos Archipelago, 1907. *Ibid.*

Admiralty Chart 718. Islands North of Madagascar, 1967. *Ibid.*

Admiralty Chart 721. Seychelles Group : Amirante and other outlying islands, 1966. *Ibid.*

Admiralty Chart 724. Islands between Seychelles and Madagascar, 1968. *Ibid.*

Admiralty Chart 920. Diego Garcia, 1950. 1 : 25,000. *Ibid.*

Admiralty Chart 1072. Mahé Island and Approaches, 1960. 1 : 132,000. *Ibid.*

Admiralty Chart 2899. Chagos Archipelago to Madagascar, 1965. 1 : 3,500,000. *Ibid.*

Baker, B. H. 1960(A). Geological map of Mahé, Seychelles Islands. 1 : 50,000. Ministry of Commerce and Industry ; Mines and Geological Department, Kenya Colony ; Memoir No. 3, 1963.

——— 1960(B). Geological map of Silhouette and Île de Nord (Seychelles Islands). 1 : 50,000. *Ibid.*

——— 1960(C). Geological map of Praslin and Neighbouring Islands. 1 : 50,000. *Ibid.*

——— 1961. Geological Sketch map of Aldabra Atoll (Seychelles Islands). 1 : 50,000. *Ibid.*

D.O.S. 1963. 204 (series Y851). Mahé (sheets 1 to 11). 1 : 10,000. Directorate of Overseas Surveys ; Tolworth.

D.O.S. 1964. 204 (series Y851). La Digue. 1 : 10,000. *Ibid.*

D.O.S. 1964. 304 (series Y852). Aldabra Island (sheets 1 and 2). 1 : 25,000. *Ibid.*

D.O.S. 1967. 204 (series Y851). Praslin (sheets 1 to 4). 1 : 10,000. *Ibid.*

Appendix I : Sea Turtles in Madagascar

Three days, 13, 14 and 15 August 1970, were sepent in Madagascar. Diego-Suarez, Nossi-Be, and Nossy Komba were visited.

Very little regarding the sea turtles of Madagascar is recorded so very little can be stated irrevocably. It is known that there is an immence area of marine pasture, and also a tremendous amount of coast line and what appear to be good

nesting beaches. Thus, in the Madagascar area appear to be all the requisites necessary for every large sea turtle populations.

From examining the curio and souvenir shops, it is clear that predation by man must be very intense. Large numbers of stuffed turtles, both green and hawksbill (to say nothing of countless numbers of terrapins, snakes, lizards, and crocodiles), were for sale in the shops. Clearly, these animals have been taken for the tourist trade—there could have been little benefit made of their food value as most of the specimens were quite small. It would appear then that large numbers of turtles are being slaughtered for no other purpose than the tourist trade, and a vast food resource is being ignored and badly misused.

There does not appear to be any official control in the sea turtle fishery at Madagascar. There are no : limits to sizes or numbers of animals taken ; there are no restrictions or reservations for breeding animals or breeding grounds in many areas ; there are not even records of the most elementary or casual nature on these animals. This state of affairs is in no way good or admirable.

Of all the localities where sea turtles have been studied, nowhere are they being exploited efficiently. Nearly everywhere in the world these animals are being over exploited to the point of extermination. In the great majority of localities the demand for food is the force behind the exploitation. Slaughtering turtles soley for curios and souvenirs seems to be unique to Madagascar.

Sea turtles represent a very large source of protein. Adult green turtles of 300 lbs. (136 kg) are common and there are records of animals up to 800 lbs. (364 kg). The leathery turtle even grows to half a ton (455 kg). The eggs are also a very important food item in some areas. A female lays nearly 200 eggs in each nest and may lay 3, or as many as 8, times in a season. Along with the dugong, and sea cows, the sea turtles are unique in that they make available, in a highly palatable form, products from the sea which are otherwise unusable to mankind. There is no possible doubt that the sea turtles are as extremely important food source.

However, like any resource this must be managed carefully. Unfortunately, some resources, especially those which come from the sea, occur in such abundance that their populations appear to be unlimited. But, plentiful as the sea turtles were in olden days, their numbers are now drastically reduced. The Madagascan populations are not immune to this fate. It is known that the Mascarene and Seychelles populations have been brought near to extermination, and indeed exterminated in some places, during recent times. There is also evidence to show that some of Madagascar's off lying islands have suffered the same fate.

There is yet another complication with sea turtle's populations. Their range of movements can be very large. It has been shown in the Atlantic that green turtles migrate over 1,000 miles (2000 km) between feeding and breeding grounds. Thus, the populations of turtles that occur at Madagascar may well migrate to other waters. These turtles will then be exploited by more than one nation, and their fate will be even that much more tenuous.

On the whole, sea turtles in the Western Indian Ocean are in a desperate state ; if they are to continue to exist and to be utilized as an important resource then immediate action must be taken. The Republic of Malagasy is far behind other

Western Indian Ocean nations in the conservation of sea turtles, and it is imperative that the Malagash realize the urgency of the situation. They must take positive measures to protect sea turtles in Madagascan waters and co-operate with nations already involved in the intelligent exploitation of this resource. If action is not taken very soon, a resource worth (annually to Madagascar alone) thousands of tons of high protein food will cease to exist. It is in the interest of the people of Madagascar and the people of neighbouring nations that effective conservation measures be made for the sea turtles of the Western Indian Ocean.