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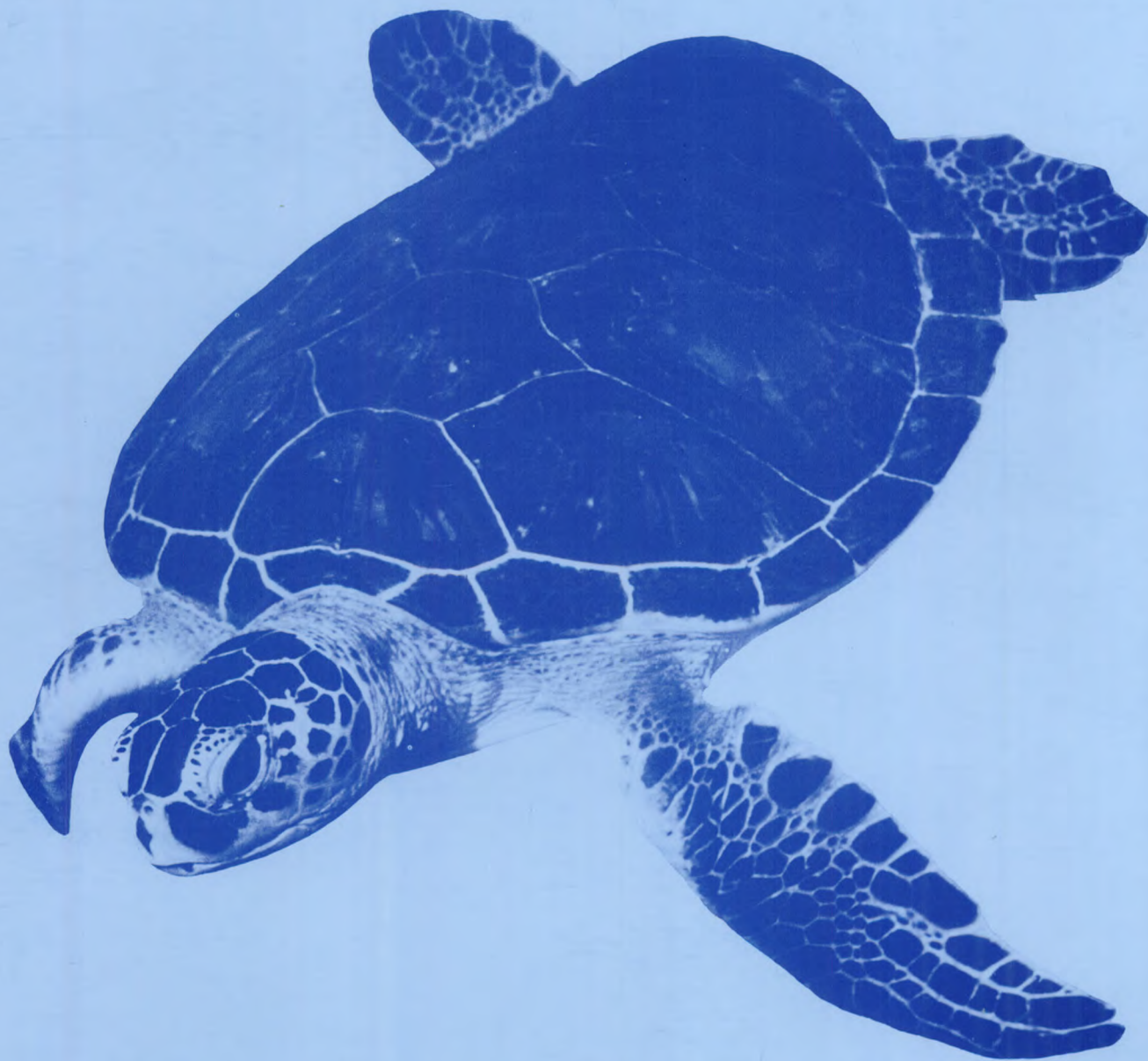
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# **Marine Turtles in the Republic of the Seychelles**

## **Status and Management**



Report on Project 1809 (1981-1984)  
Jeanne A. Mortimer Ph. D.

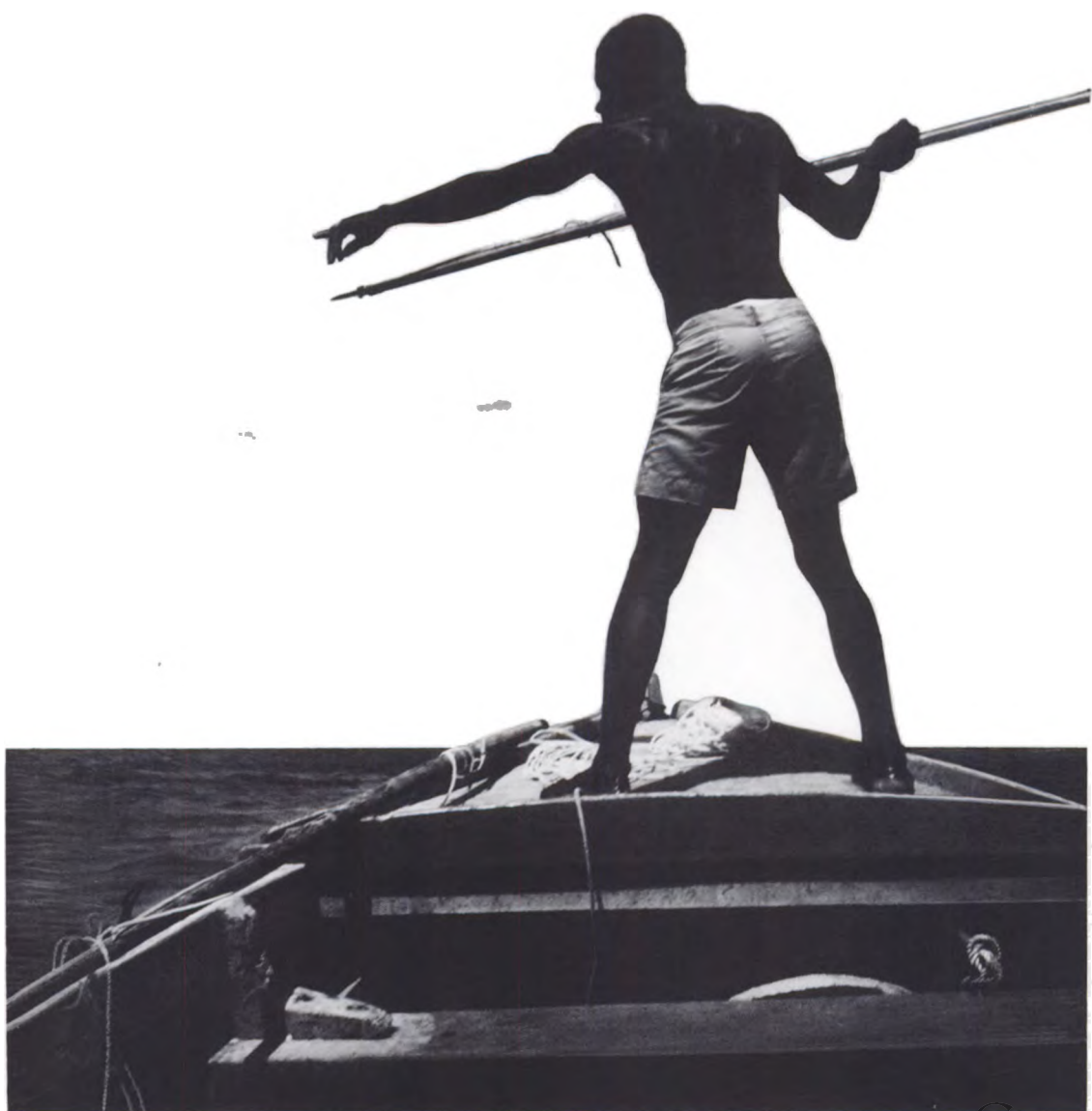
**International Union for Conservation of Nature  
and Natural Resources**

**World Wildlife Fund**

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**Report on Project 1809 (1981-1984)  
Jeanne A. Mortimer Ph. D.**

**International Union for Conservation of Nature  
and Natural Resources**

**World Wildlife Fund**

This project has been funded by IUCN, WWF and the Government of the Republic of the Seychelles. The views of the author expressed in this report do not necessarily reflect those of the participating organizations.



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**Frontispiece:** Turtle hunter, Cosmoledo Atoll (Jeanne Mortimer)  
All photographs in this report are by the author except  
the cover and Photograph E.

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**THE SEYCHELLES MARINE TURTLE PROJECT:**

**WWF/IUCN PROJECT NO. 1809**

**ABSTRACT:** Results of a three-year-long study of the marine turtles of Seychelles are presented. Present and past stocks of both the green turtle (Chelonia mydas) and the hawksbill turtle (Eretmochelys imbricata) in the Seychelles are assessed. Aspects of the biology of the animals relevant to conservation and management of these stocks are discussed. Present and past methods and levels of exploitation are evaluated, and options for the management of the two species are presented.

**FINANCIAL SUPPORT:** February 1981 - January 1984

**World Wildlife Fund:**

- a) Salary for the project leader;
- b) International and local travel;
- c) Purchase of Zodiac GR Mark II and two Evinrude outboard engines;
- d) Purchase of all other equipment;
- e) Miscellaneous expenses.

**Seychelles Government:**

- a) Housing on Mahe;
- b) Inter-island transportation;
- c) Accommodations in the outer islands, including Aldabra;
- d) Work-related local transportation on Mahe and Praslin;
- e) Labor (Park Rangers);
- f) Miscellaneous support.

## OBJECTIVES OF THE PROJECT

The aim of this project was to devise a practicable system of resource management that could be implemented by the Government of Seychelles in order to maintain a substantial marine turtle stock, both as part of the natural heritage of the Seychelles people and as a continuing source of food, materials, and revenue.

The project was designed to gather accurate information on:

- a) sizes of the turtle populations in Seychelles waters;
- b) critical habitats, specific localities of importance, and aspects of turtle biology of direct relevance to the formulation of conservation measures;
- c) past and present methods and levels of turtle exploitation, the trade these animals support, destination of the products derived from them, and the contribution turtles make to the economy of the country.

These data were to be used as the basis for a scientific management scheme for the marine turtle resource. As far as possible, local personnel would be involved in the data gathering, and it was hoped that those most closely involved with the project would be able to administer the management scheme devised.

## SCIENTIFIC AND HISTORIC BACKGROUND

Sea turtles have been an important resource to the inhabitants of Seychelles ever since the archipelago was first discovered in 1609 and permanently settled in 1770. Despite warnings about the dangers of over-exploitation, made by far-sighted individuals as early as the 18th century, exploitation and exportation continued virtually unchecked.

### Hawksbill Turtle (*Eretmochelys imbricata*)

A dramatic decline in populations of the hawksbill ("caret" in Creole) of Seychelles, similar to that described below for green turtles, has not been reported; but, in fact, the status of the hawksbill turtles on a national scale has, until now, been little studied. With the exception of Hornell's report (1927), and brief reports made by Frazier (1974b; 1975), most scientific attention to hawksbills in the Seychelles has focused on the population nesting at Cousin Island, a Nature Reserve administered by the I.C.B.P. (Frazier, 1974a; Diamond, 1976; Garnett, 1979; and de L. Brooke and Garnett, 1983).

It has been observed that because the annual harvest of hawksbills has remained high, hunting pressure may thus far have had little impact on population levels (Wilson, 1979). A closer look at the statistics documenting the annual export of raw hawksbill shell (see page 12) suggests that this is not the case.

### Green Turtle (*Chelonia mydas*)

Populations of the green turtle (called "torti" in Creole) in the Granitic Seychelles and the Amirantes Group suffered a steady decline in numbers that probably began in the late 1700's when the Granitic Islands were settled. It was, however, the organized exploitation of the species for calipee production beginning at the turn of this century that caused the most drastic decline in their populations (Frazier, 1974a; Stoddart, 1976, 1984). This exploitation occurred despite the fact that in 1926 James Hornell (1927) produced a superb report on turtle exploitation in Seychelles and a comprehensive management proposal.

During the 1960's and early 1970's several reports were written on the green turtles in the Southern Islands, most with an emphasis on Aldabra (Honegger, 1967; Hirth and Carr, 1970; Frazier, 1971, 1975, 1976, 1984; and Gibson, 1979). In each of these papers the need for enforceable conservation measures was stressed.

## LEGISLATIVE BACKGROUND FOR THE STUDY

The Turtle Act of 1925 remains the basis for management of the harvesting of turtles in Seychelles. It sets minimum size limits, lays down ownership rights to turtles coming in to land, provides for compilation of statistics on the number of animals taken, stipulates the manner in which they may be treated, and bans certain capture techniques. It also outlaws all capture of turtles within 1,000 meters of the shore without special permission. Although there have been various changes in the law (in 1929, 1948, 1957, 1962, 1963, 1964, 1968, 1970, 1976, 1977, 1978, and 1979) it is generally inadequate for present conditions.

### Laws Protecting Hawksbill Turtles

In May 1977 the Seychelles Government acceded to the Convention on International Trade in Endangered Species (CITES), which forbids the export of any parts or products of species listed in Appendix I of CITES (which includes both the hawksbill and the green turtles). Up until that time, the capture, sale, and export of hawksbill turtle products in Seychelles was conducted with little restriction. In an attempt to fulfill her obligations to CITES, Seychelles passed a law in October 1977 which made it illegal for any person to buy, sell, or preserve hawksbill turtles or parts thereof without a permit from the Ministry of Agriculture. Existing stocks of stuffed turtles were recorded, and no further permits were to be issued upon exhaustion of the stocks. These measures were met with opposition by the curio dealers, and in 1978 the Government amended the regulation.

As a compromise, the new regulation made it legal to take and stuff male hawksbills, but not females. At the same time it set aside protected areas for female hawksbills at Aride, Cousin, Cousine, Curieuse, and South East Islands. A total ban on the slaughter of female hawksbills was not imposed because the shell of females tends to be thicker than that of the males and thus more appropriate for the manufacture of worked tortoiseshell articles. It is noteworthy that in 1962 a law was passed protecting female hawksbills--S.I. No. 29 of 1962. It was repealed exactly two months later--S.I. No. 42 of 1962.

More effective legislation was passed in 1979; and it became illegal to kill any turtles, male or female, within the protected areas. The protected areas were themselves extended to include what is now the St. Anne National Park and Aldabra Atoll. (The map in Figure 2 shows where turtles are legally protected in the Granitic Seychelles.) In addition, the 1979 regulations prohibit the sale, purchase, or export of all stuffed hawksbill turtles regardless of sex.

In the same year, 1979, an effort was made to gather data on the capture rates of hawksbill turtles. The provision in the Turtle Act requiring declaration of all hawksbills captured in Seychelles, which had been ignored for many years, was again enforced.

In 1981, in a further attempt to discourage exploitation of hawksbills, it was declared that only the parastatal company, Seycom, could export raw hawksbill shell. The raw shell it purchased from the turtle hunters at a very low price.

Despite the progress made, problems remain. Seychelles does not yet fully honor her obligations to CITES, for raw shell is still exported. Much poaching occurs in all but the Cousin Island and the Aldabra reserves. The only restriction on the capture of hawksbills outside the reserves is that they must have a carapace length greater than 24 inches. There are no seasonal restrictions. Both males and females can be captured, and females may even be captured while up on the nesting beach.

### Laws Protecting Green Turtles

In 1968, the same year that Aldabra was set aside as a Nature Reserve by the Royal Society, a total ban on the capture of green turtles was imposed. The ban was both unenforcable and unpopular. Hence, in 1976 it was replaced by a measure that allows the taking of male turtles during the months from March through October. No green turtle products may be exported or sold in restaurants, and butchers may not sell more than 2 kg of meat to any customer.

### METHODS AND ACTIVITIES

The data-gathering consisted of four lines of enquiry carried out concurrently. These were the monitoring of breeding activities on selected nesting beaches, stock assessment, identification of critical habitats, and evaluation of the impact of human exploitation.

#### Monitoring of Breeding Activities on Selected Beaches

Turtle tagging programs were conducted at selected nesting beaches in order to gather the following information:

- a) how many times the average turtle emerges from the sea to dig nest holes before it successfully lays a clutch of eggs;
- b) how many egg clutches the average turtle lays during one nesting season;
- c) nest site selection, breeding beach selection, site tenacity;
- d) clutch size, hatching success, hatchling loss;
- e) biometric data on nesting females.

Monel metal ear tags (National Band and Tag Company #49 and #681) were applied to the trailing edges of one or both front flippers, at a point about 10 cm from the body. Some tags were placed through a scale and some through the webbing. Each tag bears a different number, to make possible individual identification of turtles, along with the following message: Reward, Return Dept. Agriculture, Box 54, Victoria, Mahe, Seychelles. For each turtle tagged, the following information was recorded whenever possible: location on the nesting beach, number of nest holes dug, number of eggs laid (if any), and length and width of the carapace.

At Cousin Island, the hawksbill monitoring program continues as it has since 1971. To date, more than 250 hawksbills have been tagged. The long term study of hawksbills nesting at Cousin Island is the most comprehensive ever made of that species anywhere in the world. Information obtained at Cousin was useful for interpreting some of the more fragmentary data gathered during the present study.

Hawksbill tagging programs were also conducted by the Seychellois Park Rangers at Curieuse Island, in the St. Anne National Park, and intermittently at Frigate Island. In the Amirantes Group, Mortimer tagged hawksbills at Poivre Island, D'Arros Island, and the St. Joseph Atoll. Since the inception of the present study, 95 hawksbills have been tagged at Curieuse Island, 58 in the St. Anne National Park, 3 at Frigate Island, 11 at Aride, and 19 in the Amirantes.

Green turtles were tagged by Mortimer during extended visits to the Southern Islands. During a total of four months at Aldabra, distributed over three years, 292 turtles were tagged. An additional 149 recaptures of previously tagged turtles were made on the nesting beaches. During periods when Mortimer was absent from Aldabra, J. Stevenson and some of the visiting scientists occasionally tagged turtles. During five months on Cosmoledo Atoll, Mortimer tagged 91 turtles and made 67 additional recaptures of tagged nesting animals. Assumption Island was visited for two weeks during which 2 turtles were tagged.

### Stock Assessment

It is impossible to make effective counts of turtles that are swimming at large in the sea, but good counts and estimates can be made of the numbers of females nesting in a given area. Such estimates are obtained by a combination of tagging turtles and counting tracks on the nesting beaches. The total number of nesting emergences made by turtles during the season is extrapolated from data gathered during regular counts of turtle tracks on the nesting beach. The figure for total number of emergences is then divided by the estimated average number of times each female emerges onto the nesting beach during the season, a figure derived from tagging data.

On beaches where turtles were being tagged regularly, daily track counts were usually made concurrently. In this way turtle emergences not intercepted by the tagging personnel would be accounted for.

At Aldabra, beginning in December 1980, regular track counts (two to four times per month) were made during every month of the year on beaches along a 6 km stretch of shoreline between Passe Grabeau and Anse Tamarind. J. Collie, R. Pimm, and J. Stevenson were particularly cooperative in making these counts. The Island Managers at Cosmoledo (A. Constance "Mazarin"), at Astove Island (T. Hoareau), and at Assumption Island (Felix Payet) kept records of turtle emergences, as did the Park Rangers on Praslin and D. Todd and P. Meador on Aride Island.

By taking advantage of inter-island cargo ships, yachts, schooners, other small boats, and aircraft, Mortimer was able to visit most of the islands in the Republic of Seychelles (see map in Figure 1), many of them repeatedly. Table 1 gives a summary of visits made to the islands. At each island visited, she counted turtle tracks on the beaches and interviewed the Island Manager and as many laborers and other inhabitants as possible to obtain information about nesting activity in the area. Sometimes the visits were necessarily brief, but in most cases the entire shoreline of the island was examined.

Data on the seasonal patterns of nesting emergences, which were gathered at Cousin Island during the previous 12 nesting seasons, show

a fairly consistent pattern from year to year (see Figure 3). It is reasonable to assume that this pattern is more or less typical of that for hawksbills nesting on other islands in the Granitic Seychelles and the Amirantes Group. Accordingly, the seasonal pattern shown in Figure 3 was used as a basis for the extrapolation of the total number of seasonal nesting emergences that occurred on those islands visited only briefly during the hawksbill season and for which it was possible to make only small numbers of track counts. In addition, population estimates derived in this way were corroborated by data obtained during interviews with island residents.

### Identification of Critical Habitats

An assessment was made of the waters surrounding each island, and of many offshore areas, to determine the presence of juvenile and/or adult feeding grounds for any of the species of sea turtles occurring in Seychelles. This assessment was achieved through combined interviews with local residents and personal observation from boats or while snorkelling. In addition, Mortimer conducted a great many interviews with crew members of ships, fishermen, turtle hunters, and other well-travelled individuals to gain information about areas in Seychelles that she had been unable to visit personally. Information on feeding habits and on the reproductive condition of turtles residing in particular areas was obtained from slaughtered animals.

### Evaluation of the Impact of Human Exploitation

Human exploitation, both past and present, of the sea turtle resource was evaluated using the following combination of methods:

a) For the outer islands most of the information on rates of capture of both green turtles and hawksbills was obtained through personal observation and by interviewing island managers, turtle hunters, laborers, or individuals engaged in shipping live turtles or turtle products to Mahe.

b) On most of the Granitic Islands, including Mahe, Praslin, and La Digue, extensive interviews with local residents were conducted to determine how many hawksbills were taken each year in the vicinity of the nesting beaches. Track counts also yielded valuable information about numbers of animals slaughtered on the beach after they emerged from the sea to lay eggs, as well as numbers that safely returned to the sea.

c) The records on file in the police stations of all hawksbills captured and declared to the police (i.e., "Declaration of Caret") were carefully examined.

## ASPECTS OF THE LIFE CYCLE OF SEA TURTLES PERTINANT TO THEIR MANAGEMENT

### Feeding and Nesting Habitats

The typical life cycle of a sea turtle is diagrammed in Figure 4. The feeding grounds of the juveniles and of the adults in a population are often spacially segregated from each other, even when both occur within a small area. The nesting beaches may be located a long way from the feeding grounds.

The benthic feeding grounds for both green turtles and hawksbills are restricted to areas shallower than 15 fathoms. Beyond that depth, not enough light penetrates to allow the growth of either sea grasses, upon which green turtles feed, or the symbiotic algae necessary for coral reef formation. Hawksbills feed primarily on invertebrate animals and plants associated with coral reefs.

Much of the Seychelles Bank and of the Amirantes Bank is less than 15 fathoms deep (Fig. 5a). In the Southern Group of islands, however, apart from Wizard Reef, the only shallow areas are found immediately adjacent to the islands (Fig. 5b).

### Hawksbill Turtles

Adult hawksbills breeding in the Granitic Seychelles and in the Amirantes may make seasonal migrations between feeding grounds on the distant banks and their shallower breeding grounds in the vicinity of the islands' beaches. Between March and August (i.e., the non-breeding season), adult hawksbills are seldom seen near the islands, and records show that few hawksbills with a carapace longer than 24 inches are captured near the Granitic Islands during those months (Fig. 6). Juvenile hawksbills, on the other hand, are found all year round in the nearshore waters, but are reportedly seldom encountered on the distant banks.

In contrast, both adult and juvenile hawksbills are captured all year round in the shallow waters near the islands of the Southern Group. Possibly these hawksbills are non-migratory. The scarcity of feeding habitat for hawksbills near the Southern Islands may account for the small numbers of hawksbills nesting on these islands compared with the large numbers nesting in the Granitic Islands and in the Amirantes.

### Green Turtles

Green turtles are highly migratory, for their feeding and nesting grounds are often separated by great distances. Limited feeding grounds for both juvenile and adult green turtles occur at each island in the Southern Group, but the exact location of their major feeding grounds remains a mystery. Good foraging pastures are known to occur in the Mozambique Channel, along most of the East African coast, and even on the Seychelles and Amirantes Banks. Turtles nesting in Seychelles may use any or all of these areas. Several other nesting populations of green turtles occur in the Indian Ocean (Fig. 7), and their feeding grounds may overlap with those of the Seychelles nesting

populations. Such sharing of feeding grounds has been documented for green turtles in the Caribbean, Atlantic and Indo-Pacific regions.

### Age to Maturity

Sea turtles in general, with the probable exception of the leatherback turtle (*Dermochelys coriacea*) (Pritchard and Trebbau, in press), take a long time to reach maturity. Independent studies of the growth rates in wild juvenile and subadult turtles were made in Hawaii, Florida, the Bahamas, the U.S. Virgin Islands, and Australia. Wild turtles were captured on their natural feeding grounds and weighed, measured, tagged and immediately released. Over a period of several years, many of these animals were recaptured and their growth increments measured. In each of the five studies, the growth rates recorded were disconcertingly low (Table 2). Green turtles appear to take about 10 to 60 years, loggerheads take upwards of 10 to 30 years, and hawksbills probably take at least 10 to 25 years to attain maturity.

For the sake of illustration, let us assume that the animals in a given population of sea turtles take an average of 25 years to mature. Within that population there will be at least 25 different age classes of juvenile and subadult turtles. It is these animals, as they reach maturity, that will make up most of the nesting population during the next 25 years. It follows that if one were to kill every female turtle that came to nest, without giving the animals a chance to lay eggs, a full 25 years could elapse before a significant drop in the nesting population would be noticed (Fig. 8). A population decline would occur after that, however, and it would be both drastic and virtually irreversible.

Seychelles itself affords a classic example documenting just such an occurrence. At the turn of the present century, each year several thousand green turtles nested at Assumption Island. In the peak of the nesting season, 200 to 300 females could be turned on the nesting beach in one night (Hornell, 1927). During a visit to Assumption Island in 1929 (Dupont, 1929), the Director of Agriculture made the following observations:

"Assumption also abounds in other sea resources, but as soon as the island became inhabited in 1909 and the exploitation of guano was started, all the land and sea birds were destroyed by laborers. It is wonderful, however, to think that after 19 years of constant fishing the resources in turtle have not been depleted except to a slight extent; 1,000 turtles are still captured per annum."

Today the nesting population at Assumption is estimated to be only 200 females per year. Even were the turtles to receive complete protection, it would take many generations of turtles to restore the population to its original levels—and even one "turtle generation" is a very long time!

### Predation and Mortality

Although many kinds of animals eat young sea turtles, popular accounts tend to over-exaggerate how much predation is actually suffered by the eggs and hatchlings. At a healthy nesting beach, where no eggs or hatchlings are taken by either humans or predators introduced by man (such as dogs, pigs, cats or raccoons) and barring mortality caused by erosion, usually about 80-90% of the eggs laid will hatch out and the hatchlings will reach the sea. The most serious natural terrestrial predator in Seychelles is the ghost crab. Predation by birds is relatively insignificant as most hatchlings emerge from the nest at night when the birds are asleep.

Pigs and dogs can cause tremendous damage on a nesting beach by digging up the incubating eggs. Hawksbill nests are especially susceptible to this sort of damage for they bury their eggs in very shallow nest holes. During the months when eggs are incubating in the sand, (September through April for hawksbills), pigs should not be allowed to forage on the nesting beaches. A case in point is that of Alphonse Island where many hawksbills nest. During the time it was privately owned, numerous large pigs--at least 15 to 20 of them--roamed freely on the island and were often seen foraging in the beach sand. It is hoped that the Islands Development Company, which now owns the island, will correct this situation.

What percentage of the hatchlings is killed upon entering the sea is unknown, but predation certainly is not restricted to the young hatchlings. Ample opportunities exist for mortality to occur during the many years it takes a turtle to reach maturity.

For the population to remain stable, each female must in her lifetime produce at least enough offspring that two individuals (one male and one female, assuming a one-to-one sex ratio) will survive to maturity and reproduce in a like manner. No one knows how many eggs out of a clutch of 100 will survive to maturity, but the figure may, in fact, be very low, for one female can lay a large number of eggs in her lifetime. The average female may lay three egg-clutches per season, each clutch numbering about 150 eggs. Tagged individual females have returned to lay eggs as often as one season every three years during a period of twenty years.

Sea turtle populations have adapted to high mortality in the juvenile stages and low mortality as adults. Only large sharks and man prey upon adult turtles. When too many adults are killed by man, the balance between mortality and recruitment into the population is upset.

### Sex Ratios Within Sea Turtle Populations

In many species of turtles, the sex of an individual is not determined by chromosomes, as is the case with humans. Rather it is the temperature at which the eggs are incubated that dictates the sex ratio within the clutch (Yntema and Mrosovsky, 1979 and 1980; Miller and Limpus, 1981; Morreale et al., 1982; Spotila et al., 1983).

Limpus and Reed (in press) found the sex ratio of a population of green turtles on the Great Barrier Reef of Australia to approximate one-to-one. They caution, however, that because the sex ratio of

hatchlings can vary with incubation conditions it should not be assumed to be one-to-one in all populations. In nature, females frequently outnumber males in chelonian populations (Tinkle, 1961). Aldabra tortoises, for example, have a sex ratio of 1 male to 2 females (Swingland and Lessells, 1979). In several shipments of adult green turtles captured on their feeding grounds off the east coast of Nicaragua, females consistently outnumbered males by about 3 to 2 (Carr and Giovannoli, 1957; Mortimer, 1976). Until the natural sex ratio of a given population has been ascertained, it is unwise to advocate uncontrolled slaughter of individuals belonging to either one sex or the other.

## RESULTS AND DISCUSSION: HAWKSBILL TURTLES

In Seychelles most hawksbill nesting occurs in the daytime. Seychellois take this for granted, but in fact, such a rigid preference for daytime nesting has been reported only for hawksbills in Seychelles and off the East African coast. The hawksbills of virtually every other population in the world nest either strictly or primarily at night. Daytime nesting unfortunately makes it easier for people to catch the turtles on the nesting beach. Figure 9 shows the distribution of hawksbill nesting populations in the Indian Ocean.

In Seychelles, hawksbills are killed primarily to obtain the scutes covering the carapace, bridge, and plastron of the turtles. The carapace scutes (or "backshell") are crafted by local artisans into curios that are sold to tourists--large ornamental butterflies, picture frames, spoons, combs, bangle bracelets, rings, miscellaneous pendants and beads, key chains, guitar picks, etc. Prior to late 1983, when the law banning their sale was enforced, whole stuffed hawksbills were also commonly sold. All of the plastron and marginal scutes (i.e., the "bellies and hooves"), and the backshell not utilized by the Seychellois curio artisans, has been exported in recent years primarily to Japan.

Many Seychellois refuse to eat the meat of hawksbill turtles, claiming that it is sometimes poisonous. Others discount this belief. In fact, however, in recent history there are many documented cases of poisoning by hawksbill meat (Table 3). In many parts of the tropical regions of the world where hawksbills occur, the meat is commonly shunned by the indigenous peoples. The highest recorded incidence of poisoning seems to be in the Indo-Pacific region (Table 3). Hawksbill turtles whose meat is poisonous are encountered on only the rarest of occasions. Nevertheless, the symptoms that occur when such meat is consumed are virulent, and death has resulted in about 28% of the cases reported (Table 4).

### Hawksbill Population Estimates

The estimated number of female hawksbills that come to nest annually at each of the major island groups of Seychelles is shown in Figure 10. They are as follows: Granitic Seychelles--about 535-810; Amirantes, Desroches, and Alphonse Islands--about 305-510; Platte and Coetivy Islands--about 210-370; the Southern Group of islands--about 85-155. The breakdown of these figures for each island is shown in Tables 5 to 7. Although the hawksbill nesting populations of the

Granitic Islands are presently the largest in Seychelles, they are also the most seriously and immediately threatened by over-exploitation.

### History of the Export Trade in Hawksbill Shell

Statistics documenting the annual export of raw hawksbill shell are shown graphically in Figure 11 and in greater detail in Table 8. Between 1894 and 1959 there was a general decline in the number of hawksbills captured each year. This trend is probably attributable to an over-all drop in the size of the hawksbill population as a result of over-harvesting.

In the 1960's (Fig. 11) the annual harvest of hawksbills increased. Three events occurred that would explain the upturn in capture rates: a) the price per kilo of shell increased (Fig. 11); b) people began to dive for hawksbills using masks and snorkels; c) outboard boat engines came into use. Thus, both the incentives for hunting hawksbills and the efficiency of capture techniques increased dramatically after 1960. It is noteworthy that between 1970 and the present, despite the skyrocketing prices paid for shell, the capture rate has actually declined slightly from what it was in the 1960's (Fig. 11). This decline may reflect a further drop in the size of the hawksbill population.

In 1981, in an attempt to discourage the capture of hawksbill turtles, the Government made it illegal for anyone but the parastatal company, Seycom, to export raw hawksbill shell. The shell was purchased from the turtle hunters at a low price. From January 1981 to November 1982, Seycom paid Rs 200 per kilo of "backshell" (i.e., carapace scutes) and Rs 400 per kilo of "bellies and hooves" (i.e., plastron and marginal scutes). Between November 1982 and January 1983, it paid Rs 100 per kilo of backshell and Rs 200 per kilo of bellies and hooves. In January and February 1983, it paid only Rs 50 per kilo of backshell and Rs 100 per kilo of bellies and hooves. Finally, in February 1983, Seycom stopped buying shell completely (Mayadas, pers. comm.).

Despite the fact that the price offered was lower in 1982-83 than during the previous seasons, the number of hawksbills declared at the police stations was actually higher in 1982-83 (647) than in either 1980-81 (560) or in 1981-82 (537).

Table 9 shows the income yielded by raw tortoiseshell exported during the past 12 years.

### Declaration of Hawksbills

In 1979, in order to gather information with which to evaluate the hawksbill fishery, the Government revived the provision of the 1925 Turtle Act that requires declaration of all hawksbills captured in Seychelles (i.e. "Declaration of Caret"). Table 10 gives the total numbers and the sex of hawksbills declared each season since 1979-80. The numbers of hawksbills declared from each of the islands are shown in Tables 5 to 7.

Based on export records, the total numbers of hawksbills killed in Seychelles since 1979-80 averaged between 1,263 and 1,570 per year

(Table 10). An average of 738 hawksbills was declared during each of the four years. Thus, only about 47-58% of the animals whose shell was exported between 1980 and 1982 were declared at the police stations (Table 10 and Fig. 12). Many, though not all, of the undeclared hawksbills were probably captured in the outer islands (Table 6 and 7).

### Hawksbill Turtles in the Granitic Islands

More hawksbills come to nest in the Granitic Islands than in any other island group in the Seychelles. Because more than 99% of the human population resides in these islands, however, the animals are intensely exploited.

### Hawksbill Capture Techniques and Their Impact

In the Granitic Islands, and especially in the vicinity of Mahe, Praslin and La Digue, hawksbills are hunted intensively during the breeding season. Offshore, many fishermen harpoon and dive for turtles that aggregate near the nesting grounds to mate. On the beaches themselves, turtles that emerge to lay eggs are usually captured before they even begin to dig their nests.

If, because of over-exploitation, successful reproduction is inhibited for a number of years, an accompanying decline in the population of juvenile hawksbills will occur. Evidence of such a decline comes from the marine biologist, Dr. Rod Salm (pers. comm.). He dove regularly in the vicinity of Mahe, Praslin and La Digue in 1976 and recorded seeing a hawksbill every 1.5 dives. In 1983, during similar dives, he saw only two hawksbills in 15 dives. Hawksbills were sighted five times more frequently in 1976 than in 1983.

Virtually every fisherman and turtle hunter interviewed attested that during the past 20 years the numbers of resident hawksbills in the waters of the Granitic Islands and the Amirantes have decreased significantly. Those questioned were almost unanimous, however, in attributing the decline primarily to the large number of turtles killed by divers after the advent of masks and snorkels in the 1960's. Prior to that, capture methods were far less efficient. Turtles swimming near the surface were harpooned in the same way they are today, using a wooden "baton." But if they were deeper in the water or lying on the bottom, they were much less accessible. In order to see them, the hunter often used a glass-bottomed box and the water had to be clear. From the boat, the hunter would try to harpoon them by dropping a lead pipe affixed to a harpoon head ("baton fon") or to snag them using a hook on a long pole. With the aid of a mask and snorkel, the same capture techniques are employed, but the hunter is now under water with the turtle. When such methods are used, turtles are rarely missed even if they are under forty feet of water. In the days when spearguns were used regularly, an especially heavy toll was taken.

### Reproductive Success of Hawksbills in the Granitic Islands

It is disappointing to count turtle tracks on the beaches of Mahe, Praslin and La Digue because few tracks are actually made there.

Many turtles are captured offshore while mating. Others are captured at the edge of the surf as they begin their ascent of the nesting beach and thus leave no track at all. In beach surveys made during the 1982-83 season, 15 turtle tracks were counted on the beaches of Mahe, but only four of these led back to the sea. Thus, in 73% of these emergences, the turtles were killed on the nesting beach.

Tagging studies at Cousin Island have shown that most hawksbills, if unmolested, will lay three to six egg-clutches during one season. In doing so, they may make ten or more emergences onto the nesting beach (Fig. 13). In the Granitic Islands, the chances are slim indeed that a turtle would survive that many nesting emergences.

The graph in Figure 14 shows the seasonal distribution of captures of hawksbills in the Granitic Islands for each of the past three years. The data are taken from the "Declarations of Caret." On the same graph is shown the seasonal distribution of nesting emergences at Cousin Island, where there is a relatively undisturbed nesting population. Although the number of nesting emergences per day at Cousin Island is greatest during the months of November and December, the largest numbers of hawksbills in the Granitic Islands are captured during the period between mid-September and mid-November. It is likely that most of the captured turtles in Figure 14 were taken early in the season before they could lay even one or two of their normal complement of three to six egg clutches.

#### Proportion of the Total Nesting Females Killed

Of the estimated 535-810 female hawksbills that nest in the Granitic Islands each year, about 160-230 nest in the Nature Reserves and about 480 (+ 100) nest in the unprotected areas (Table 5 and Fig. 15). During each of the past three years, an average of 378 female hawksbills from the Granitic Islands were declared at the police stations (Table 5). This represents 47-71% of the total annual estimated nesting population (Fig. 15). Although this figure seems high, in fact it probably under-estimates the numbers actually killed; since, based on export figures, only about 47-58% of all hawksbills killed in Seychelles are declared at the police stations (Table 10 and Fig. 12). Probably the vast majority of female hawksbills that come to nest in the Granitic Seychelles each year are killed.

#### Distribution of Nesting Activity in the Granitic Seychelles

Table 5 shows the estimated numbers of female hawksbills that come to nest annually on each of the Granitic Islands. The numbers nesting in the nature reserves (i.e., St. Anne Park, South East Island, Cousin Island, Cousine Island, Curieuse Nature Reserve, Aride Island, and Baie Ternay National Park) are compared with the numbers nesting on the unprotected beaches (see Figure 2).

Nesting activity at unprotected areas. Approximately 170 (+ 35) female hawksbills come to nest each year on Mahe beaches that are not nature reserves. The map in Figure 16 and Table 5 show the distribution of breeding activity in the vicinity of Mahe. On Mahe itself, most hawksbill nesting occurs at the south end of the island.

An estimated 65 (+ 15) females come to breed at Praslin annually and about 60 (+10) at La Digue. The maps in Figure 17 show the relative amount of hawksbill breeding activity that occurs at the various beaches on these islands. Interviews with some of the older residents of La Digue and Praslin indicate that many more hawksbills nested on both islands as recently as 25 to 35 years ago. In particular, the northern beaches of La Digue and the north coast and the Baie Ste. Anne region of Praslin had much nesting activity, whereas today there is almost none.

Nesting activity in the nature reserves. Surprisingly heavy nesting occurs on the islands in the vicinity of the St. Anne Marine National Park (Fig. 16). St. Anne Island has about 55-70 females nesting annually. This number probably makes it the most important nesting area in all of the Granitic Islands. About 12 females nest on Moyenne Island, about 3 on Cerf, 20 on Ile Anonyme, and 30 on South East Island. Hawksbills in all these areas, with the exception of Ile Anonyme, are by law completely protected. Unfortunately, virtually all the females that come to nest on both South East Island and Ile Anonyme are killed. During the 1982-83 season, track counts revealed that at least a third of the turtles estimated to nest on islands within the St. Anne Park (St. Anne, Moyenne and Cerf) were poached on the nesting beaches. This figure does not include additional unknown numbers of both males and females that were harpooned from boats offshore or taken by divers.

During the 1982-83 season, the turtles at Cousin Island were little disturbed by poachers, but many turtles were taken at Cousine Island and also at Aride. Of the 20 to 30 females estimated to breed at Curieuse Island in 1982-83, at least seven are known to have been poached from the nesting beach.

#### Hawksbill Turtles in the Outer Islands

The estimated numbers of nesting females that come to breed on each of the outer islands is shown in Tables 6 and 7. The number of hawksbills of both sexes declared to the police during each of the past four years are also indicated, along with additional information on exploitation gathered from other sources.

It is difficult to assess the intensity of hunting that may have occurred during the past two centuries in the outer islands. The little information available suggests that during the 19th Century hawksbills may have been heavily hunted. According to Dupont (1929), in about 1850 an unnamed individual acquired Desroches, Poivre, and D'Arros islands principally for the capture of hawksbills. When the supply of hawksbills decreased, he sold all three islands for Rs 99,000. It was said that the hawksbills of Aldabra were rare during the 19th Century (Colonial Secretary in Mauritius, 1842) and at the turn of this century (Dupont, 1907) because they had been over-exploited for their particularly light-colored shell.

Information obtained in interviews with fishermen, turtle hunters, and island residents suggests that most hawksbill populations in the Amirantes Group, and near Alphonse, Desroches and Platte Islands have been declining steadily. Female hawksbills are regularly captured on the nesting beaches although with not quite the same

intensity as in the Granitic Islands. Exceptions to this lower intensity are some of the smaller inhabited islands such as Remire, Marie Louise, Des Noeufs, Alphonse, and Platte where the limited beach area can easily be checked for turtles. Many people interviewed believed that serious damage to the hawksbill populations is caused by the crews on Mahe-based fishing boats, who dive for turtles on the reefs.

The Southern Islands have fewer nesting hawksbills than any of the other island groups (Fig. 10 and Table 7); however, there are some good feeding areas near Providence, on Wizard Reef, and in the immediate vicinities of the other islands. The hawksbill population on Aldabra has been well protected since 1968 and seems to be thriving, at least on its feeding grounds. Hawksbills at Assumption and Astove Islands are neither particularly numerous nor much hunted. Turtle hunters who have worked at Cosmoledo intermittently since the 1960's claim that the numbers of hawksbills have decreased during the past 15 to 20 years. Large numbers of juvenile and subadults, however, can still be captured (see Table 7).

The southern islands are too far away to be regularly visited by Mahe-based fishing boats. There have been a few major turtling expeditions since 1977, especially to the Providence area, and large numbers of hawksbills were taken at those times. Now, however, only the Islands Development Company has the right to hunt turtles in these waters. It can be hoped that because I.D.C. has a long term interest in these islands, it will harvest the resources in a more responsible fashion than would the crews of fishing boats whose interests lie primarily in making quick profits.

In March 1983, because Seycom stopped buying raw tortoiseshell, the Islands Development Company stopped paying its laborers for hawksbills. This action by the I.D.C. should discourage exploitation of females on the nesting beaches in the Amirantes, at Desroches, Alphonse, and Coetivy, and also give the population at Cosmoledo a chance to recover, unless some of the island residents decide to illegally go into business for themselves.

The lessee on D'Arros and St. Joseph has declared these islands a nature reserve and prohibits the laborers on the island from taking turtles. Many hawksbills, however, are taken by fishing boats on the offshore reefs.

## RESULTS AND DISCUSSION: GREEN TURTLES

Nesting green turtles are today still numerous on some of the Southern Islands, fairly rare in the Amirantes, and virtually extinct in the Granitic Islands. Based on track counts, tagging data, and interviews, the estimated numbers of green turtles nesting at each island are shown in Tables 11 and 12.

In the Granitic Islands and Amirantes Group, the turtles probably decreased steadily in numbers beginning in the late 1700's after the Granitic Islands were settled. But the most drastic decline in the populations was caused during the 20th Century by the organized exploitation of the species for calipee production, and this was focused on the breeding populations in the Southern Islands.

### Green Turtles in the Granitic Islands

When the French first settled on Praslin they built enclosures ("park") to hold the green turtles that they captured in the vicinity of Praslin (H. Daubin, pers. comm.). Excellent green turtle feeding grounds occurred all along the north coast of Praslin and in the Baie Ste. Anne area (see Figure 17). As recently as 20 years ago, green turtles were still regularly captured in these areas and along the west coast of Mahe (A. Constance, pers. comm.).

In 1846, Pridham reported that green turtles "are common from November to April and may be purchased for 12 s. or 14 s. each." He goes on to say:

Turtles were formerly more abundant than they are now; indeed the lower classes at La Digue were the object of sarcasm of the other islanders, who, says Lieutenant Boteler "would hold their noses in passing them, and exclaim, 'Quel odeur de tortue de mer.'"

Today, green turtles are rarely encountered in the waters of the Granitic Islands although there are still some on feeding grounds on the Seychelles Bank. When green turtles are encountered, they are usually hunted.

Probably fewer than 10 green turtles nest each year in the Granitic Islands. Figure 18 shows the number of egg-clutches laid by green turtles at Cousin Island during the past 11 years. Even though the numbers involved are small, a distinct downward trend can be seen.

### Green Turtles in the Amirantes Group, Desroches Alphonse, Platte, and Coetivy

Table 11 shows the estimated numbers of green turtles nesting annually on each of the islands in the Amirantes Group, on Desroches, Alphonse, Platte, and Coetivy Islands. At all these islands combined, probably only 120-285 green turtles nest per year.

Historical records suggest that at one time large numbers of green turtles nested in these islands. In 1770 the log of L'Heuve du Berge reported that the men came ashore at night on an island in the Amirantes, probably Poivre, and took 32 turtles (Fauvel, 1980). Nowadays only 5-10 green turtles are estimated to nest each year at Poivre Island; but A. Bonnelame, the long-time manager on Poivre (pers. comm.), says that 16 years ago there were about twice as many.

Similarly, the journal of Coriolis reported that during the night of 15 August 1788, eight heavy turtles weighing an average of 146.85 kg were taken at Coetivy (Fauvel, 1980). Between the 15th and 20th, they collected 51 such turtles. Today only about 30-50 green turtles are estimated to nest on Coetivy per year.

### Green Turtles in the Southern Group

During the first half of this century large numbers of green turtles were slaughtered to produce calipee for export to the U.K.

Most of the turtles were taken from the Southern Islands--esp. from Aldabra, Assumption, Cosmoledo and Astove. There were virtually no restrictions on the capture of turtles, and the resulting over-harvest led to a serious drop in population levels. Figure 19 shows the decline in the harvest of green turtles between 1907 and 1968.

In 1968 a law banning the capture of green turtles was passed. The law was unpopular and unenforcable, and green turtles continued to be captured illegally for local consumption throughout the Seychelles. In 1976 the ban was lifted and replaced by a measure allowing the capture of male turtles during the months of March thorough October.

The numbers of female green turtles estimated to nest annually between 1981 and 1983 on each of the islands in the Southern Group are shown in Figure 20 and in Table 12. They are as follows:

Aldabra -----	1,980 - 2,420
Assumption -----	160 - 240
Cosmoledo -----	560 - 725
Astove -----	300 - 600
Farquhar -----	400 - 450
Providence and Cerf -----	15 - 30

Table 12 also shows how many male and female green turtles were captured at each island during 1981, 1982, and 1983.

In most parts of the world green turtles have a distinct nesting season, with a beginning, a peak, and an end, similar to that of hawksbills nesting in the Seychelles (Fig. 3). Throughout the Southern Island Group, however, green turtles nest during every month of the year. The seasonality of nesting emergences observed at Aldabra and Cosmoledo are shown in Figure 21. In effect, Seychelles is blessed with twice as many turtles as other localities that have a "typical" nesting season.

### Aldabra

Aldabra has a larger nesting population than any other island in Seychelles, due at least in part to its large size, with which it can accommodate many turtles. The hostile terrain and the inaccessibility of many of the beaches have also given its turtles some protection from man. Nevertheless, the present day nesting population is probably only about one-third to one-fifth what it was at the turn of the century.

Ever since 1968, when Aldabra became a Nature Reserve, the turtles have been totally protected. The results of the present study indicate that the protective measures imposed have paid off.

In independent studies performed in 1967 by Hirth (Hirth and Carr, 1970) and in 1968, 1969, and 1970 by Frazier (1971; 1975; and 1976), the nesting population was estimated to number less than 1,000 nesting females per year. Similarly, in 1975, Gibson (1979) estimated the nesting population at only 700 individuals. In 1981 and 1982 the population was calculated to be about twice that recorded previously (i.e., 1,980-2,420).

Part of the difference among the various population estimates may be attributable to the different techniques employed in deriving them, but an examination of the raw data presented in the earlier papers indicates that the nesting population has indeed increased during the past 16 years. It is difficult, however, to ascertain the exact magnitude of its growth. Because the most recent population estimate is based on data gathered over a three year period, the observed increase in numbers cannot be attributed to cyclical fluctuations.

Possible explanations for an increase in the Aldabra nesting population. After only 13 years of complete protection, the nesting population of Aldabra appears to have increased significantly. Although more eggs were probably laid since 1968 than in previous years, it is unlikely that those which hatched out are now returning to Aldabra as nesting adults. Studies indicate that green turtles usually take much longer than 13 years to reach maturity. The recovery at Aldabra might be better explained by a combination of the following factors:

a) In 1948, a five month long closed season was established for female green turtles on Aldabra and Cosmoledo (S.I. No 452 of 1948). As a result, fewer females may have been killed, and more egg clutches laid. Today, about 33 to 35 years later, the young that emerged from those egg clutches may have reached adulthood and are returning to the nesting beach to breed.

b) According to Stoddart (1971), in 1945, when the lease to M. D'Emmerez de Charmoy expired, "commercial exploitation [of Aldabra] lapsed temporarily" until 1955 when M. Harry Savy acquired a new lease. Consequently, between 1945 and 1955, nesting turtles suffered less disturbance than in previous years. Thirty-eight years elapsed between 1945 and 1981, probably enough time for the hatchling turtles produced in 1945 to reach maturity.

c) Since 1968, very few female turtles have been killed on the nesting beaches of Aldabra. This has enabled a larger proportion of each year's annual nesters to return in subsequent seasons to breed again. Tagging studies in other parts of the world show that female green turtles return repeatedly to the nesting grounds after intervals of 2, 3, 4 or more years spent at their feeding grounds (Carr et al., 1978; Ehrhart, 1981).

The implications of a population increase at Aldabra. These data indicate that protection on the breeding grounds within the boundaries of Seychelles has been sufficient to bring about an increase in the green turtle population. In 1976 one of the strongest arguments in favor of lifting the ban on killing green turtles was that the turtles that breed in Seychelles are later killed on their feeding grounds in other countries. In other words, "Why should the Seychellois give up turtle meat only to let people in other countries kill the same turtles?"

It is unfortunate that turtles do not recognize international boundaries. Nevertheless, it is the country within whose territory the breeding grounds occur that has the greatest responsibility for the survival of a population. Breeding turtles are more vulnerable than are feeding turtles. Large numbers of breeding turtles will concentrate themselves into a small area of near-shore waters. In

contrast, the same turtles when feeding will disperse over thousands of square miles of foraging pastures, often located many miles from land. For example, green turtles are encountered feeding on remote portions of the Seychelles and Amirantes Banks (see page 8) and far from land on the continental shelf of Nicaragua (Mortimer, 1981). Moreover, the behavior of breeding turtles makes them easy to kill. They often mate very close to shore, at which time the males are so preoccupied with copulation that they are oblivious to danger. Finally, in order to lay their eggs, females must emerge onto the land where they are absolutely vulnerable.

### Assumption Island

The history of Assumption Island is a classic case documenting the over-exploitation of a green turtle colony. (See discussion on page 9.) Around the turn of the century, at least five or six thousand females probably nested at Assumption each year. At the peak of the nesting season in the early 1900's, as many as 300 females could be turned on the beach in a single night. Today, only 160 to 240 females are estimated to nest at Assumption each year.

The main nesting beach at Assumption is probably the most perfect in all of Seychelles insofar as it satisfies the physical requirements of nesting green turtles. It has a broad expanse of beach sand, a deep offshore approach, and lush feeding pastures in the immediate vicinity.

This open expanse of beach is unfortunately located immediately adjacent to the settlement. During most of this century, Assumption was heavily populated by guano workers, who apparently could find no better way to spend their evenings than by turning turtles on the nesting beach. This tradition has survived right to the present. Although only a handful of laborers were present on Assumption during all of 1982, in that time it is estimated that they killed as many as 100 females a figure equal to 42-63% of that year's nesting population (Table 12). Assumption was abandoned by humans, at least temporarily, in December 1982.

Before the calipee trade began, the nesting populations of Aldabra and Assumption were probably more or less equivalent in size. Today, the Aldabra population, with about 2,000 nesting females per year, is but a fraction of what it was, while that of Assumption has been virtually exterminated (Fig. 20). In fact, many of the turtles that nest on Assumption Island may be visitors from Aldabra, which is located only 20 miles away (Fig. 1).

### Cosmoledo, Astove, Farquhar, and Providence

The history of green turtles at these four islands is not as well documented as at Aldabra and Assumption.

Past levels of exploitation. There are few records describing the size of the nesting populations on Cosmoledo, Astove, Farquhar, and Providence prior to large scale human exploitation. At Astove in 1895, Baty was told of 150 turtles being taken in a single 24-hour period (Stoddart, 1971, citing Bergne, 1900). Both Cosmoledo and Astove were heavily mined for guano during the present century, so

large numbers of turtles were probably taken for calipee at the same time. In 1937 the bones of turtles killed on Cosmoledo, Astove and Assumption were shipped to Aldabra to be ground into bone meal for export (Director of Agriculture, 1937).

Turtle hunters, who worked at Cosmoledo intermittently from the 1960's to the present, report that the green turtle populations have declined during the past 20 years. In particular, the numbers of green turtles nesting at Zil Menai, where the settlement is located, are said to have decreased noticeably.

Although an estimated 400-450 females nest at Farquhar each year, the nesting activity is dispersed over 15 km of nesting beach. It is not known how large the nesting population may have been in years past. Providence and Cerf islands have few nesting green turtles, but there are good feeding grounds in their lagoon.

Present levels of exploitation. Two levels of green turtle exploitation occur in the Southern Islands. Some green turtles are killed for local consumption, and others are taken for the Mahe market.

Because female green turtles have more fat, their meat is preferred to that of the males. Thus, the females are usually killed for local consumption in the islands. On most islands, 60 to 75 females are killed each year (an average of about 1 or 2 per week). See Table 12. This slaughter represents a large proportion of the estimated annual nesting population: 8-13% of that on Cosmoledo, 10-25% of that on Astove, and 13-19% of that on Farquhar.

In 1981 only live male green turtles were openly brought into Mahe. They were transported from the Southern Islands aboard the cargo ship Cinq Juin, which can carry 100 turtles on her deck. During the 1981 turtle season, Cinq Juin visited the Southern Islands once every two months: in March, in May, in August and in October. Table 12 shows the numbers of male green turtles imported to Mahe in 1981. The turtles were kept alive on the islands in turtle ponds ("park torti") until the Cinq Juin arrived to carry them to Mahe.

In 1982, four months elapsed between the March voyage of Cinq Juin and her return to the southern islands in July. Turtles that had been kept alive in the turtle ponds for longer than two months were unlikely to survive the journey back to Mahe, so, many turtles were killed on the islands and sent back as salted meat ("kitouz"). The final voyage of the season, in October, was made by Lady Esme, which does not have the capacity to carry more than a very small number of live turtles. Table 12 shows the numbers of males killed at each island during 1982.

In 1983, shipping was even more limited. Not only were the voyages during the turtle season spaced far apart, but most trips were made by Lady Esme. Almost every turtle captured was shipped to Mahe as "kitouz." Estimated numbers of turtles captured at each island in 1983 are shown in Table 12.

## RECOMMENDATIONS FOR THE MANAGEMENT OF THE HAWKSBILL TURTLE POPULATION

The hawksbill population is dwindling as an exploitable resource. In the account below the various options for management of the hawksbill population are discussed and their relative merits assessed.

### Size Limits

Present laws protect hawksbills with the carapace length less than 24 inches, but allow the element most valuable to the population, the breeding adults, to be hunted. Some people would advocate reversing the size limits to protect the sexually mature individuals. When other factors are considered, however, it is apparent that such a change in legislation could be a mistake.

During all months of the year, juvenile hawksbills reside in shallow waters near the islands. Thus, they are more continuously accessible to the turtle hunters than are the adult turtles, which spend most of their time on the deeper banks located some distance offshore. Juveniles are also easier to catch because they are less wary than the adults.

If juveniles were hunted, they would probably have to be sold as stuffed turtles. Their small shell scutes are less suitable for making curios than are those taken from adults.

### Protection of Females

Unlike female green turtles, female hawksbills are not protected by law; they may be legally captured even while laying eggs. Because the shell of female hawksbills is usually thicker and thus superior in quality to that of the males, past attempts to impose legislation protecting female hawksbills have been defeated. Even if a female protection law for hawksbills were passed, enforcement would be difficult. There is no way to prove unequivocally whether a packet of shell has come from a male or a female hawksbill.

It is essential, however, that females receive protection. They are at the same time the most valuable segment of the population, since they lay the eggs, and the most vulnerable. Anyone can turn a turtle on the nesting beach, whereas, to hook one or to harpoon one requires at least some skill.

### Turtle Ranching and Headstarting

Turtle ranching on quite a large scale was attempted at Curieuse Island in 1912, and there have been many other smaller rearing projects in Seychelles. In fact, in virtually every country in the world with a natural stock of sea turtles, there have been attempts to raise them in captivity for commercial exploitation. Often such a venture is combined with a program of "headstarting" turtles, whereby a percentage of the young captive turtles, upon reaching a certain age, is released into the wild population. The larger size of the headstarted turtles enables them to avoid many of the predators that attack hatchlings.

In theory this is a good idea, but in practice there are problems. Raising turtles successfully in captivity demands much hard work and a degree of good luck. The turtles should be fed chopped fish (or an equivalent protein source) at least once a day. Their water must be immaculately clean, for they are subject to a wide variety of diseases, most of which are difficult to control. Either an expensive pumping and filtering system must be installed, or much time will have to be spent carrying water. Unless the turtles are fed in containers apart from their living quarters, the water will be fouled at every feeding. To provide adequate containers for the animals is difficult. Facilities that will comfortably accommodate 100 hatchlings may be too cramped for even a couple of one-year-old turtles. Young turtles kept in groups will nip each other. The resulting cuts almost inevitably get infected by fungus that then spreads over the body. Usually the worst damage is to the flippers and the eyes of the infected turtles. Even if the turtle does not die, its appearance will be marred by the extensive tissue damage, and its value as a stuffed specimen is reduced.

By the time the headstarted turtles are ready to be released they are often so debilitated by disease that their chances of survival are reduced. In fact, there are uncertain benefits to headstarting even the turtles that are healthy. Although in some cases turtles reared in captivity seem able to survive in the open sea, in other release experiments (Carr and Mortimer, unpublished data) a large portion of the animals were found dead or dying within a year of their release. An even more crucial question is whether, upon reaching adulthood, the turtles will return to the nesting beach to breed. The manner in which a turtle is imprinted by cues at its natal nesting beach is not known. Imprinting probably occurs shortly after hatching from the egg and may involve sensory impressions from the sand, the sea, the currents, the sun, or some other source not yet thought of.

Given sufficient capital outlay and expertise, many of the technical problems associated with ranching might be solved, especially for hawksbill turtles. Doing so, however, will not enhance the survival prospects of the wild hawksbill population. Until the wild populations decline to the point that it becomes cheaper to rear turtles in captivity than to capture them in the wild, hunting pressure on wild turtles will continue. In the meantime, the presence of a turtle ranching operation will only impede enforcement of conservation laws now in effect. As of January 1984 there was virtually complete enforcement of two laws protecting hawksbills: a) prohibition of the marketing of stuffed turtles; and b) protection of hawksbills with the carapace measuring less than 24 inches. Establishing a hawksbill ranching project would necessitate exemptions on these two points for ranched turtles, thus undermining the enforcement of the same laws as they pertain to the wild population. Such a move would also be a transgression of commitments that the Government of Seychelles made when it signed the CITES convention in 1977.

#### Closed Season

A law might be passed to protect breeding hawksbills during the first few months of the nesting season. In theory, this would ensure that each turtle laid at least one clutch of eggs. In practice, such a law would be difficult to enforce. Even within the Nature Reserves today, where a limited area is regularly patrolled by Park Rangers, a large percentage of the turtles are taken illegally.

### Temporary Moratorium

A temporary moratorium on the purchase and sale of hawksbill products would probably be ineffective. People knowing that the regulation was temporary would tend to hoard shell, which can be stored for indefinite periods of time without deterioration.

### Limited Utilization of Hawksbill Shell

Many fewer hawksbill would be killed each year if all export of raw hawksbill shell were to stop and if only enough turtles were taken to provide shell for the local curio trade. Unfortunately, such moderation would be difficult to achieve. To restrict the number of hawksbills killed, where they were killed, and by whom, would be virtually impossible.

Since late 1980, the parastatal agency, Seycom, has bought large amounts of the hawksbill shell procured by turtle hunters. It had been suggested that Seycom could discourage people from killing hawksbills by offering them a low price for shell. Capture statistics indicate otherwise. During the 1982-83 season Seycom paid a much lower price for shell than it did during the previous two seasons. Surprisingly, however, more hawksbills from the Granitic Islands were declared to the police stations in 1982-83 (647) than in either 1981-82 (537) or 1980-81 (560).

For many Seychellois, hunting turtle not only satisfies a financial need but also is an enjoyable sport, with roots that go back into the cultural heritage. Moderation, although ideally the best solution, may not solve the problem that in the Granitic Seychelles has reached critical proportions.

### Total Ban

The most complete protection for the hawksbill would be afforded by a total ban on the possession, purchase and sale of all hawksbill products. When Seychelles signed the CITES treaty in 1977 she essentially agreed to impose just such a ban.

Export of raw hawksbill shell is in direct contravention of the CITES agreement. Nor is Seychelles honoring her obligation to CITES when she condones the sale of tortoise shell curios to tourists. It was agreed at the Fourth Meeting of the Conference of the Parties in Botswana in April 1983 that all Parties to the CITES agreement should vigorously control the export of tortoiseshell products leaving the country in the form of tourist souvenir specimens.

## RECOMMENDATIONS FOR THE MANAGEMENT OF THE GREEN TURTLE POPULATION

The green turtle in the Granitic Seychelles and in the Amirantes is essentially finished as an exploitable resource. The few that remain are heavily hunted and their numbers appear to be steadily dwindling. Although the green turtle populations of the Southern Island Group are much reduced from their former numbers, it is not yet too late to initiate responsible management practices.

If present levels of exploitation are maintained, the nesting populations of all the islands except Aldabra will continue to decline. In most cases, however, this will happen gradually. During the remainder of our lifetimes, and possibly even during our children's lifetimes there will be turtles to exploit, although in decreasing numbers. The question is whether we are willing to make sacrifices now for the sake of future generations, because as the populations decrease in size, they become increasingly more difficult, if not impossible, to rebuild.

### Protection of the Nesting Females

It is essential that the females be protected. Because they lay eggs, they are reproductively the most valuable segment of the population and at the same time the most vulnerable. Although female green turtles are completely protected by law, they are still heavily hunted. Largely this is because the meat of the female, which has more fat, is preferred to that of the male, but in some cases they are hunted simply because they are easier to capture than males. Efforts should be made to curtail exploitation of the females.

### The Cropping of Males

The laws of Seychelles state that male turtles with carapace length greater than 30 inches can be captured during the months of March through October. There is at present no effort to limit the numbers of males caught during these months. In fact, there is a push to catch as many as possible during the season.

A better policy of resource management would be to set quotas regulating the numbers of males killed at each island between March and October. Having said this, it must be admitted that to set any quota will by necessity involve several unknowns. No one knows exactly what percentage of the male population can be safely cropped.

Because one male can inseminate several females, males are relatively more expendable than females in the population. Males appear to be far more abundant around the southern islands than are the females. This apparent relative abundance, however, is misleading and should not be used as an argument to advocate the wholesale slaughter of males.

By their behavior at the nesting grounds, males make themselves more conspicuous than females. They move around a great deal looking for females with which to mate, and they also feed regularly. Females, on the other hand, spend most of their time resting on the bottom (Booth and Peters, 1972). Gut analyses done during the present study reveal that females often even abstain from feeding.

Data from other nesting colonies (Ehrhart, 1981) indicate that on the average female green turtles nest about once every three years; whereas, males may come to the breeding grounds every year (Balazs, 1983; Limpus *et al.*, 1984). Thus, during any given nesting season about one third of the adult female population and most of the adult male population may be at the nesting grounds. Because we do not know the sex ratios in sea turtle populations, we do not really know how many males there are. In populations of turtles, females sometimes outnumber males. For this reason caution must be exercised when setting quotas.

If we assume a one-to-one sex ratio, probably a figure equal to 10% of the estimated number of females nesting each year on an island could be cropped from the male population of that island without too much damage occurring. This would result in about 3.5% of the total male population being taken each year. Accordingly, the quotas would be: 16-24 males at Assumption ( $\bar{X}$  = 20); 56-73 at Cosmoledo ( $\bar{X}$  = 65); 30-60 at Astove ( $\bar{X}$  = 45); and 40-45 at Farquhar. The total numbers of turtles killed for both local consumption and shipment to Mahe should be included in the established quota.

During each of the past three years, the number of males captured at most islands in the Southern Group was much higher than 10% of the annual female nesting population (Table 12). A population of 30 people living on an outer island can easily consume 60 to 70 turtles per year. Thus, utilization of turtles by the residents of the outer islands could on its own surpass the quotas set, even before any turtles are sent to Mahe.

The importation of turtle meat from the Southern Islands to Mahe is not motivated by economic considerations, for the trade is not particularly lucrative. It is done more as a public service to the people of Seychelles, to give them access to a traditional food item otherwise unobtainable.

Each person residing in the Southern Islands can consume about two turtles per year. There are more than 64,400 people now living in the Republic of Seychelles. The total estimated population of female green turtles nesting annually on all the islands of Seychelles including Aldabra is between 3,535 and 4,750. Certainly, there is not enough turtle to satisfy the demands of everyone.

One solution would be to try and restrict the amount of turtle consumed by the residents of the outer islands so that turtle meat might be more equitably shared by all Seychellois. Any such restrictions, however, would be virtually impossible to enforce from Mahe, considering the isolation of the Southern Islands and the attitudes of the "Zilwa" towards turtle.

Another option would be to restrict the importation of turtle meat to Mahe. At the very least, the trade in green turtles should be limited to live turtles. As long as salted turtle meat can be freely imported into Mahe, enforcement of restrictions on the sex and the numbers of turtles captured will be very difficult.

### The Problem of Salted Turtle Meat

When shipping limitations make the transportation of live turtles impractical, the current practice is to ship the turtles in salted form. To condone the importation of "kitouz" (dried, salted turtle meat), however, is potentially damaging to the green turtle populations for several reasons.

It is virtually impossible to determine the sex of a turtle after it has been salted and dried. The animal is cut into numerous small pieces, and of these only the front flippers and the tail bear distinguishing sexual characteristics. There is little doubt that during the 1983 season many females were killed and salted in the outer islands for shipment to Mahe. Astove, in particular, with a population of only five men, reportedly captured over 100 turtles. In 1981 and 1982, when live turtles were shipped back aboard the ship Cinq Juin, Astove, under the same management, was able to produce only about 10 to 13 male turtles every two months.

Enforcement of a closed season is impossible if the turtles are shipped to Mahe already salted and dried. Turtles are easiest to catch during the closed season when the weather is calm and large numbers of turtles are mating and laying eggs. During the last five months of the eight-month-long open season, the south east monsoon is blowing and the numbers of breeding turtles have dropped (Fig. 21). Although "kitouz" will get rancid if kept too long, it can be stored for much longer periods of time than can live turtles.

In theory the Islands Development Company (I.D.C.) could place a limit on the number of turtles for which it would pay its laborers. By weighing each shipment of "kitouz" brought into Mahe, counting the number of flippers included, and checking that all fore-flippers have the hooked claws of the male, I.D.C. could control its own imports of turtle meat from the outer islands. (See Appendix A.)

Unfortunately, the independent activities of the laborers in the outer islands are more difficult to control. Let us assume, for example, that the I.D.C. office informs an island manager that once his island's quota of turtles is reached he will not be paid for any additional turtles. Now, suppose that a crew member on one of the inter-island ships were to offer the same island manager a good price in exchange for a quantity of "kitouz."

As long as "kitouz" can be legally imported into Mahe, there will be problems in distinguishing between that which has been brought in legally by I.D.C. and that which has been illegally imported either by the ships' crews, by the island laborers, or by anyone else. A 115 kg live turtle needs to breathe, to be kept cool, and to be sprayed with water occasionally. A live turtle is far more difficult to smuggle into port than are 50 pieces of "kitouz" weighing in the aggregate for each turtle only 15 kg.

Because the preparation of "kitouz" is so labor intensive, I.D.C. reportedly does not make a profit from its sale. More money can be made from the sale of live turtles (G. Savy, pers. comm.). The primary reason for shipping turtle meat as "kitouz" is that it enables more turtles to be imported into Mahe. This is not a desirable objective--rather the reverse.

## EXECUTIVE SUMMARY

### Principal Values of the Resource

1. Products derived from green turtles include: a) Meat; b) Calipee; c) Oil; d) Eggs; e) Blood (drunk as a health tonic); and f) Shell (plastron scales used in the past to manufacture lamp shades).
2. Products derived from hawksbill turtles include: a) Tortoiseshell (the Seychellois export raw shell and also work it to produce curios for tourists); and b) Meat (eaten by some but considered poisonous by others).
3. Sea turtles are a tourist attraction. Tourists enjoy seeing live turtles in their natural habitat.
4. The Seychellois consider sea turtles an important element of their cultural heritage. Turtles are featured on coins and paper currency, on postage stamps, and as the insignia of the Central Bank of Seychelles.
5. Some Seychellois enjoy keeping sea turtles as pets.
6. Sea turtles are of great interest to scientists.

### Principal Threats to the Resource

1. Female turtles are slaughtered on the nesting beach. a) On many islands, most of the female hawksbill turtles that come to nest each year are killed, even before they are allowed to lay their eggs. b) In the Southern Islands, a population of 30 islanders can locally consume about 60 to 70 green turtles annually. It is primarily females that are eaten, for their meat is preferred to that of the males. c) The meat of several hundred green turtles is shipped to Mahe annually from the outer islands. That which is shipped as "kitouz" (i.e., salted and dried turtle meat) often includes a significant number of female turtles.
2. Adult turtles are hunted offshore in the vicinity of the breeding beaches of Seychelles.
3. Adult and juvenile turtles are hunted on their feeding grounds in Seychelles and to some extent (green turtles in particular) may be hunted in the territorial waters of other nations.
4. Nesting habitat is destroyed by construction of buildings, roads, and seawalls too near the beach, and by taking sand from the beaches.
5. Destruction of the feeding grounds and of the offshore breeding habitat is caused by: a) Chemical pollution from oil spills and the dumping of waste products; b) Mechanical pollution from improper garbage disposal. (For example, because of their similarity to jellyfish, plastic bags are consumed by sea turtles, and can cause death.); and c) Too much boating activity which frightens turtles away.

6. Turtle eggs and hatchlings are destroyed by feral animals such as pigs, dogs, cats, and rats.

7. Accidental death of adults and juvenile turtles may occur after entrapment in fishing nets or trawling gear.

#### Principal Recommendations

1. Adult female turtles should be completely protected everywhere in Seychelles, particularly when they are nesting.

2. No raw hawksbill shell should be exported.

3. Steps should be taken to restrict the number of hawksbill turtles killed each year to supply the curio industry. (Moderation will be difficult to achieve. The most complete protection would be afforded by a total ban on the possession, purchase, and sale of all hawksbill products. Seychelles essentially agreed to impose such a ban when she signed the CITES treaty in 1977).

4. A closed season on the capture of green turtles during the months of November through February should be maintained.

5. The number of male green turtles slaughtered annually at each island should not exceed a figure equal to approximately 10% of the estimated number of female turtles nesting each year at that island. At the present time the number of turtles consumed by the outer island residents alone surpasses this recommended quota. For this reason, the importation of green turtle meat from the outer islands to supply the Mahe market should be discouraged.

6. Salted and dried turtle meat (i.e. "kitouz") should not be imported into Mahe.

7. The dredging of sand from turtle nesting beaches and construction near such beaches should be stopped.

8. Pigs should not be allowed to forage on hawksbill nesting beaches between the months of September and April.

9. Steps should be taken to insure that no oil spills or chemical dumping takes place in waters where turtles are known to occur.

10. Protection of sea turtles in the nature reserves should continue, and in some cases (especially in the St. Anne Marine Park and at South East Island) the level of protection should be increased.

11. In the nature reserves, monitoring of sea turtle populations by the Park Rangers and the Wardens should continue as it has during the past three years.

12. Records should be kept of the numbers of hawksbill turtles killed in the Granitic Islands as well as in the outer islands. The numbers of green turtles imported into Mahe from the outer islands should also be recorded.

13. A program of conservation education should be incorporated into the curriculum at the National Youth Service (N.Y.S.) villages on St. Anne Island, and special emphasis should be placed on the problems of sea turtle conservation. The hawksbill population nesting at St. Anne Island is possibly the most important in all of the Granitic Seychelles.

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Table 1. Schedule of visits by J. A. Mortimer to the islands.

<u>ISLAND</u>	<u>DATES VISITED</u>
<u>Southern Island Group:</u>	
Aldabra	30 May 81; 23 June-2 Aug 81; 1-2 Jan 82; 27 May-12 July 82; 30 March-19 Apr 83.
Assumption	30 May 81; 27-28 June 81; 3 Aug 81; 1-2 Jan 82; 10-21 March 82; 26 May 82; 12 July 82.
Cosmoledo	29,31 May 81; 3-4 Aug 81; 31 Dec 81 - 25 May 82; 13-14 July 82.
Astove	29 May 81; 1 June 81; 5 Aug 81; 30 Dec 81 13-14 Feb 82; 15 July 82.
Farquhar	27 May 81; 2 June 81; 6 Aug 81; 27-28 Dec 81; 17-18 July 82; 3 May-13 July 83; 28 Sept-24 Oct 83.
Providence	26 May 81; 3 June 81; 7 Aug 81; 24-26 Dec 81; 19 July 82.
<u>Amirantes and Other Coralline Islands:</u>	
Bird	10-11 Dec 83.
Remire	4-5 Dec 82.
D'Arros	25,29 Aug 81; 19,24 Nov 82; 5-6,9,16,19,23 Dec 82.
St. Joseph Atoll	16-23 Dec 82.
Poivre	19 June 81; 24,30 Aug 81; 19-24 Nov 82; 7-16 Dec 82.
Marie Louise	26-27 Aug 81; 22 Dec 81; 8 Dec 82.
Desroches	8-10 May 81; 19 June 81; 21-23 Aug 81; 22 July 82; 31 Aug-1 Sept 82; 6-7 Dec 82.
Alphonse	28 Aug 81; 23 Dec 81; 21 July 82.
Platte	1,3 May 81.
Coetivy	2-3 May 81; 25-27 Aug 81; 17-28 Jan 82.

Table 1 (cont'd).

<u>ISLAND</u>	<u>DATES VISITED</u>
<u>Granitic Islands:</u>	
Aride	21-24 Feb 81; 2 Apr 81; 17-18 Jan 84.
Praslin	18,20,25 Feb 81; 26-28,30 March 81; 4 Apr 81; 18 Sept 81; 23 Oct 81; 23,25-30 Nov 81; 12 Aug 82; 1-2 Sept 82; 6,8,10 Nov 82; 7-10 Jan 83; 15,18-19,21 Feb 83; 17,21,22 Jan 84.
La Digue	3 Apr 81; 24-25 Nov 81; 5-11 Aug 82; 6-8 Nov 82; 7-9 Jan 83; 19-20 Feb 83; 20-21 Jan 84.
Felicite	20 Feb 83.
Gran Soeur	20 Feb 83.
Cousin	18-20 Feb 81; 19-24 Sept 81; 23-25 Oct 81; 9 Nov 82; 16-18 Feb 83; 19-20 Jan 84.
Curieuse	25 Feb 81; 1-2 Apr 81; 26 Oct 81; 23-24 Nov 81; 30 Nov-2 Dec 81; 9-10 Nov 82; 21 Jan 84.
Marianne	31 March 81.
Frigate	22 Nov 81; 8 Jan 83.
Silhouette	9-15 April 81.

Table 2. Growth rates of wild immature turtles. Data are taken from studies in Australia (Limpus, 1979; Limpus and Walter, 1980), in Hawaii (Balazs, 1979; 1981), in Florida (Mendonca, 1981), and in the U.S. Virgin Islands (Boulon, 1983).

SPECIES	OBSERVED RATE OF GROWTH	NUMBERS OF ANIMALS	STUDY LOCATION	FOOD	ESTIMATED AGE TO MATURITY
GREEN TURTLES	5.3 cm/year	n = 4	S.E. end Hawaiian Archipelago	Algae	11 + years
	1.0 cm/year	n = 17	French Frigate Shoals, Hawaii	Algae	58 + years
	1.2 cm/year	n = 9	N.W. end Hawaiian Archipelago	Algae	46 + years
	1.3 cm/year	n = 45	Great Barrier Reef, Australia	Algae, Jellyfish	30 + years
	3.5 cm/year	n = 12	Mosquito Lagoon, Florida	Seagrass	25-30 years
LOGGERHEADS	5.0 cm/year	n = 35	U.S. Virgin Islands	Seagrass	15 + years*
	1.1 cm/year	n = 4	Great Barrier Reef, Australia	Molluscs, Crabs, Jellyfish	30 + years
	5.9 cm/year	n = 13	Mosquito Lagoon, Florida	Horseshoe Crabs	10-15 years
HAWKSBILLS	2.1 cm/year	n = 2	Great Barrier Reef, Australia	Encrusting Animals	25 + years
	3.4 cm/year	n = 15	U.S. Virgin Islands	Sponges	10-15 + years*

\*derived from Boulon's data

Table 3. Reported cases of poisonous turtle meat.

Date	Location	No. of Cases	Deaths	Species of Turtle	Reference
1697	Windward Is., Caribbean	2	0	Hawksbill	Chevallier and Duchesne (1851) 1
1840	Colombo, Sri Lanka	28	18	Spp?	Tennent (1861) 1
1888	Sri Lanka	12	12	Hawksbill	Deraniyagala (1939) 1
1912	Queensland, Australia	1	0	Hawksbill	Banfield (1913) 1
1917	Philippines	33	14	Spp?	Taylor (1921) 1
1921	Sri Lanka	24	7	Hawksbill	Loveridge (1945) 1
1933	Netherland Indies	2	1	Spp?	Kariadi (1933) 1
1935	New Guinea	100	9	Hawksbill	Bierdrager (1936) 1
1935	West Java	4	1	Spp?	Siegenbeck van Heukelom (1936) 1
1939	Taiwan	57	7	Spp?	Kinugasa and Suzuki (1940) 1
1949	Gilbert Islands	"a group"	5	Hawksbill	Cooper (1964) 1
1954	Philippines	14	14	Hawksbill	Ronquillo and Caces-Borja (1968)
1954	New Guinea	6	2	Hawksbill	Romeyn and Haneveld (1956) 1
1956	Solomon Islands	2 +	2 +	Hawksbill	Vaughan (1981)
1961	Kerala, India	130	18	Hawksbill	Pillai et. al. (1962) 1
1965	Papua New Guinea	5	5	Spp?	Likeman (1975)
1966-68	Japan	4	0	Hawksbill	Hashimoto et al. (1969)
1974	Papua New Guinea	21	3	Hawksbill	Likeman (1975)
		450 +	118 +		

<sup>1</sup> cited in Halstead (1978)

**Table 4. The symptoms of turtle meat poisoning.**

Severe vomiting and diarrhea  
Hot sensations in abdomen; Cold sensations in extremities  
Mucous membrane of mouth and throat is red, swollen and sore  
Tongue coated in white membrane  
Heavy salivation and difficulty in swallowing  
Foul breath  
Boils  
High fever; Chills  
Loss of hair  
Peeling of skin over most of body  
Affects liver and kidneys  
Frequent urination of highly colored urine  
Dizziness  
Blurred vision  
Headache  
Sleepiness followed by coma

**Death in 28% of cases**

**Note:** Those who do survive often take many months to fully recover.

Table 5. For each of the Granitic Islands, and for Bird and Denis Islands, estimates of the numbers of female hawksbills nesting annually are compared with the numbers of females that were captured and declared at the Police Stations. Areas within the Nature Reserves are listed separately (on the following page) from those areas where hawksbills can be hunted legally.

Locality	Estimated No. <sup>1</sup> Females Nesting per Year	Females <sup>2</sup> Declared to Police	Notes <sup>3</sup>
<u>Areas Not Protected</u>			
Mahe shoreline (clockwise, see map Fig. 16):			
From Belombre to Airport	6	1	
From A. aux Pins to A. Marie Louise	33	39	
From A. Capucin to A. du Government	79	41	
From Petite Anse to A. Major	53	24	
Ile Anonyme	20	0	Most are killed
Praslin	65	70	
La Digue	60	65	
Felicite	20	3	
Gran Soeur	20	16	
Petite Soeur	20		
Marianne	10	7	
Frigate	20	5	
Silhouette	25	14	
North Island	25	21	
Bird and Denis	22	14	
Miscellaneous offshore localities	--	57	
Subtotal	478 (+100)	377	

Table 5 (cont'd).

Locality	Estimated No. <sup>1</sup> Females Nesting per Year	Females <sup>2</sup> Declared to Police	Notes <sup>3</sup>
<u>Nature Reserves</u>			
St. Anne Island	55-70	0	At least 20 poached
Moyenne	12	0	At least 5 poached from beach
Cerf	2	0	
South East Island	20-40	0	Most are poached
Baie Ternay area	15 ?	0	?
Cousin	20-30	0	At least 1 poached, but generally well protected
Cousine	10-20	0	Many poached
Curieuse	20-30	0	At least 7 poached from beach
Aride	5-10	2	Many poached
Subtotal	159-229	2	
Total	537-807	379	(i.e. equivalent to 47-71% of total estimated nesting population—including that of protected areas.)

<sup>1</sup> Based on track counts, interviews and tagging data.

<sup>2</sup> Average of 1980-81, 1981-82, and 1982-83 nesting seasons.

<sup>3</sup> From 1982-83 nesting season.

Table 6. Estimated numbers of female hawksbills nesting annually in the Amirantes, and on Desroches, Alphonse, Platte, and Coetivy Islands. Data on the exploitation of hawksbills, derived from "Declarations of Carat" and other miscellaneous sources, are also presented.

Island	Estimated No. Females Nesting per Year	Hawksbills of Both Sexes Declared to Police			Information Taken from Interviews with Island Managers and Laborers		
		79-80	80-81	81-82	79-80	80-81	81-82 82-83
African Banks	20-30 ?	0	0	0	2	--	--
Remire	10-15	0	9	5	2	--	--
D'Arros	25-40	0	0	0	0	Some poaching occurs <sup>1</sup>	
St. Joseph Atoll	80-100	0	0	0	0	Many turtles poached by fishing boats <sup>1</sup>	
Sand Cay and Bertaut Reef	5-15 ?	0	10	4	55	--	--
Poivre	35-70	0	92	38	0	--	24 females killed 36+ females killed
Etoile	15-30 ?	0	4	5	0	--	31+ (sex?) captured --
Boudeuse	10-25 ?	0	0	0	0	--	--
Marie Louise	10-20	0	0	0	0	--	-- 9+ females killed

Table 6 (cont'd).

Island	Estimated No. Females Nesting per Year	Hawksbills of Both** Sexes Declared to Police				Information Taken from Interviews with Island Managers and Laborers			
		79-80	80-81	81-82	82-83	79-80	80-81	81-82	82-83
Des Noeufs	15-35	0	0	0	0	--	--	--	8-13+ females killed
"Amirantes"	---	0	0	3	0	--	--	--	--
Desroches	30-50	0	0	0	13	--	--	36 females killed	--
Alphonse	20-40	0	2	0	0	--	--	15+ (sex?) killed	--
St. François and Bijoutier	30-50	0	0	0	0	--	--	--	--
Platte <sup>2</sup>	60-70 ?	37 females	0	2	0	--	--	--	army (?)
Coetivy	150-300	0	0	0	0	--	--	"army took lots"	60-80 killed
<hr/>									
515-890									

\* Based on track counts and tagging during 1982-83 season, and on interviews.

\*\* Months of July through June.

1 Turtles protected by island lessee.

2 As recently as the 1970's 75-100 females reportedly came ashore per season; All were killed.

Table 7. Estimated numbers of female hawksbills nesting each year in the Southern Islands, and data on the exploitation of hawksbills, taken from "Declarations of Caret" and other miscellaneous sources.

Island	Estimated No. Females Nesting per Year	Hawksbills of Both Sexes Declared to Police 79-80 80-81 81-82 82-83				Information Taken from Interviews on Islands 1981	1982
Aldabra	30-40	0	0	0	0	--	--
Assumption	0-5	0	0	0	0	--	--
Cosmoledo	15-25	76	0	32	13	69-134 killed	105 killed
Astove	0-5	0	0	3	0	--	--
Farquhar	20-35	0	0	22	0	40-60 killed?	40-60 killed?
Providence	0-5	0	1	5	0	fishing boats come to dive for and to harpoon turtles	
Cerf	20-40	0	0	0	0		
<hr/>							
85-155							

Table 8. Annual exports of raw tortoiseshell during the past century. Shown for each year are the numbers of kilos of shell exported, the average price earned per kilo of shell, and an estimate of the number of animals that would have been necessary to produce the amount of shell exported.

Year	Raw Hawksbill Shell Exported (Kg.)	Price/Kilo (Rs)	Equivalent Number of Animals <sup>1</sup>		
			Mixed Shell	Back Shell Only	Plastron and Marginals Only
1883	?	17.21	?	?	--
1894	1,736	28.85	1,240	1,929	--
1895	1,802	41.45	1,288	2,003	--
1896	1,701	38.66	1,215	1,890	--
1897	1,522	38.99	1,087	1,691	--
1898	1,281	32.00	915	1,423	--
1906	2,754	21.32	1,967	3,060	--
1907	734	42.20	524	816	--
1910	1,053	35.63	752	1,170	--
1914	614	37.58	439	682	--
1915	475	29.11	317	528	--
1916	875	18.54	625	972	--
1917	515	24.11	368	572	--
1918	215	29.14	154	239	--
1919	4,034	17.10	2,881	4,482	--
1920	1,280	43.66	914	1,422	--
1921	?	?	?	?	--
1922	1,242	41.01	887	1,380	--
1923	1,047	38.25	748	1,163	--
1924	1,505	50.66	1,075	1,673	--
1925	1,179	50.58	842	1,310	--
1926	984	48.54	703	1,094	--
1927	1,171	46.79	681	1,060	--
1928	1,067	30.81	762	1,186	--
1929	995	26.20	711	1,106	--
1930	1,335	25.53	954	1,471	--
1931	1,008	19.62	720	1,120	--
1932	1,434	17.53	1,024	1,593	--
1933	1,191	21.33	851	1,323	--
1934	1,104	16.51	789	1,227	--
1935	742	12.71	530	824	--
1936	1,095	12.83	782	1,217	--
1937	896	11.80	640	996	--
1938	932	11.85	666	1,036	--
1939	765	11.29	546	850	--
1940	10	10.00	7	11	--
1941	0	--	0	0	--
1942	148	38.62	106	164	--
1943	475	19.26	339	528	--
1944	1,440	18.05	1,029	1,601	--
1945	314	30.57	224	349	--
1946	1,224	22.35	874	1,360	--
1947	587	24.18	419	652	--

Table 8 (cont'd).

Year	Raw Hawksbill Shell Exported (Kg.)	Price/Kilo (Rs)	Equivalent Number of Animals <sup>1</sup>		
			Mixed Shell	Back Shell Only	Plastron and Marginals Only
1948	1,767	22.16	1,262	1,963	--
1949	270	11.93	193	300	--
1950	879	9.32	628	977	--
1951	1,629	12.31	1,164	1,810	--
1952	25	5.84	18	28	--
1953	1,431	7.27	1,022	1,590	--
1954	455	9.43	325	506	--
1955	334	8.21	239	371	--
1956	364	2.01	260	404	--
1957	825	5.56	589	917	--
1958	1,621	7.42	1,158	1,801	--
1959	307	5.99	219	341	--
1960	905	10.48	646	1,006	--
1961	1,243	10.58	888	1,381	--
1962	1,700	15.59	1,214	1,889	--
1963	2,323	11.50	1,659	2,580	--
1964	1,457	22.61	1,041	1,619	--
1965	2,407	22.61	1,461	2,273	--
1966	1,150	27.36	821	1,278	--
1967	605	25.35	431	671	--
1968	1,898	27.64	1,356	2,109	--
1969	1,665	31.77	1,189	1,850	--
1970	2,010	40.57	1,436	--	--
1971	1,108	69.63	791	--	--
1972	375	138.54	--	--	750
1973	633	350.67	--	--	1,266
1974	1,108	258.73	--	--	2,216
1975	600	186.69	--	--	1,096
1976	459	166.93	--	--	918
1977	759	493.77	--	--	1,518
1978	1,480	494.98	--	--	2,470
1979	968	529.67	--	--	1,324
1980	862	?	--	--	1,724
1981	2,527	205.74	--	--	883-1,805
1982	591	817.82	--	--	1,182

<sup>1</sup> It is not certain if prior to 1969 all the scutes were exported, or just the backshell. After 1969 the export records distinguish between backshell and plastron and marginal scutes. Between 1969 and 1970 the Japanese began to monopolize the market.

The average hawksbill yields 0.9 kg of backshell, and 0.5 kg. of plastron and marginal scutes (i.e. bellies and hooves.)

Sources: Trade Statistics; Annual Reports of the Department of Agriculture; and records of export permits granted.

**Table 9.** Annual income earned from the export of raw tortoiseshell between 1971 and 1982. These figures are compared with the total annual domestic exports of Seychelles for the same years.

Year	Total Domestic Exports of Seychelles (Rs million)	<u>EXPORT OF UNWORKED TORTOISESHELL</u>	
		Rs	% of Total Domestic Exports
1971	7.92	77,153	0.97
1972	9.53	51,951	0.55
1973	12.97	221,973	1.71
1974	18.72	286,678	1.53
1975	12.90	102,307	0.79
1976	17.94	76,621	0.43
1977	24.38	374,770	1.54
1978	24.70	611,297	2.47
1979	30.95	350,641	1.13
1980	32.93	698,468	2.12
1981	27.47	519,899	1.89
1982	20.33	483,330	2.38

**Source:** Trade Statistics

Table 10. Relationship between the quantity of hawksbill shell exported and the number of hawksbills declared to the police stations.

"DECLARATION OF CARET"				EXPORTATION OF HAWKSBILL SHELL <sup>1</sup>				
Sex		Males	Females	Unknown	Total	Mixed Shell (Kg)	Plastron and Marginals (Kg)	Equivalent <sup>2</sup> Number of Animals
1979-80	124	115	414	653	1980	--	862.2	1,724
1980-81	233	267	407	907	1981	2,527* ?	(or) 441.5**	883-1,805
1981-82	192	312	117	621	1982	--	591.0	1,182
1982-83	293	363	116	772				
Average for four nesting seasons				=	738	Average for three years = 1,263-1,570		

Therefore, only 47-58% of the animals used for export between 1980 and 1982 had been declared.

<sup>1</sup> Taken from Trade Statistics and records of export permits granted.

<sup>2</sup> On the average there are 0.5 kg plastron and marginal scales, and 0.9 kg backshell per animal.

\* Trade Statistics

\*\* Export Permits

**Table 11. Estimated numbers of female green turtles nesting annually outside the Southern Group of islands.**

<b>Island</b>	<b>Estimated No. Females Nesting per Year</b>
African Banks	1-10
Remire	1-10
D'Arros	5-20
St. Joseph Atoll	5-10
Sand Cay and Bertaut Reef	0 ?
Poivre	5-10
Etoile	15-30 ?
Boudeuse	15-30 ?
Marie Louise	1-10
Des Noeufs	1-10
Desroches	10-30
Alphonse	5-10
Bijoutier	10-20 ?
St. Francois	5-10 ?
Platte	0
Coetivy	30-50
Bird	5-10
Denis	5-10
The Granitic Islands	1-10
	<hr/>
	120-290

Table 12. Estimated numbers of green turtle females nesting annually at islands in the Southern Group, and the rates at which males and females are being captured at each island.

<u>GREEN TURTLES IN THE SOUTHERN GROUP</u>						
Island	Estimated No. Females Nesting per Year	1981		1982		1983 (Jan-Sept)
		Males	Females	Males	Females	Males Females
Aldabra	1,980-2,420	--	--	--	--	--
Assumption	160-240	?	?	?	<u>100?</u>	50+ ?
Cosmoledo	560-725	<u>124-146</u>	<u>60-75?</u>	<u>172-183</u>	<u>60-75</u>	130? <u>45-55</u>
Astove	300-600	<u>40+</u>	<u>50-75?</u>	40?	<u>50-75?</u>	40? 100?
Farquhar	400-450	<u>30</u>	<u>60-75?</u>	30?	<u>60-75?</u>	<u>75</u> <u>45-65</u>
Providence	0-5	?	?	?	?	20+ ?
Cerf	15-25	?	?	?	?	? ?

<sup>1</sup> Underlined numbers are those for which I have very reliable information, either because I was residing on the island for long periods, made repeated visits, or had access to reliable informants.

# THE REPUBLIC OF SEYCHELLES

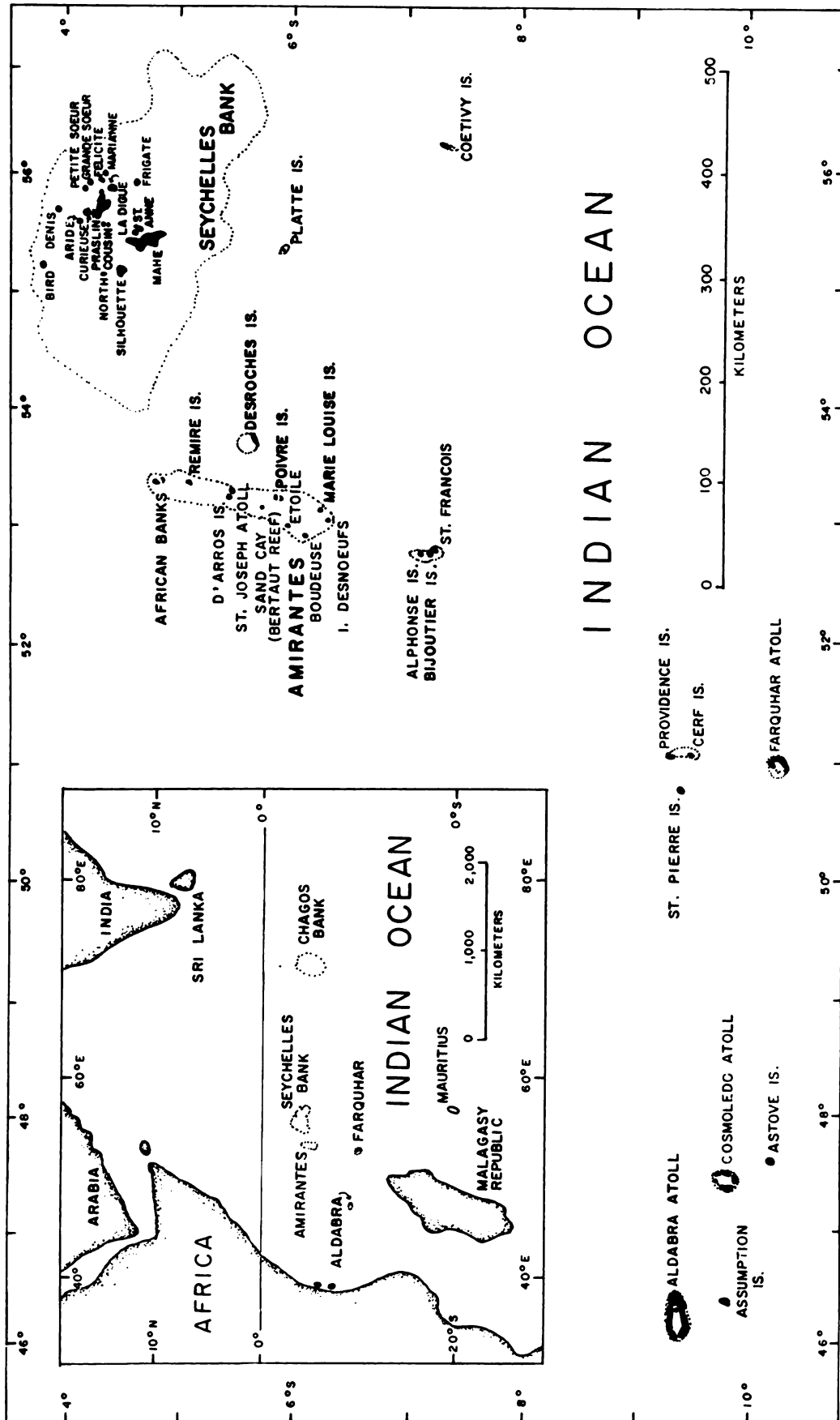
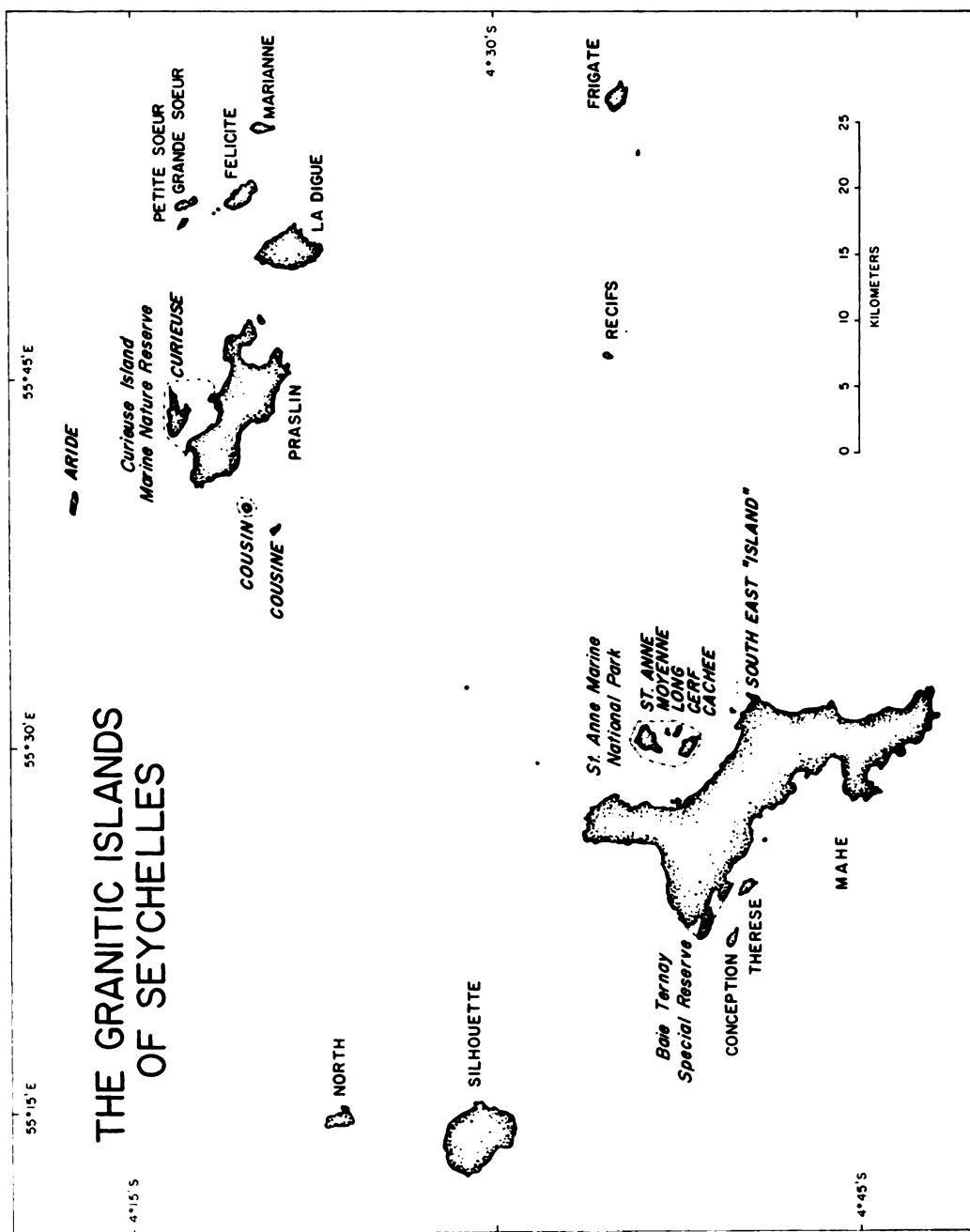
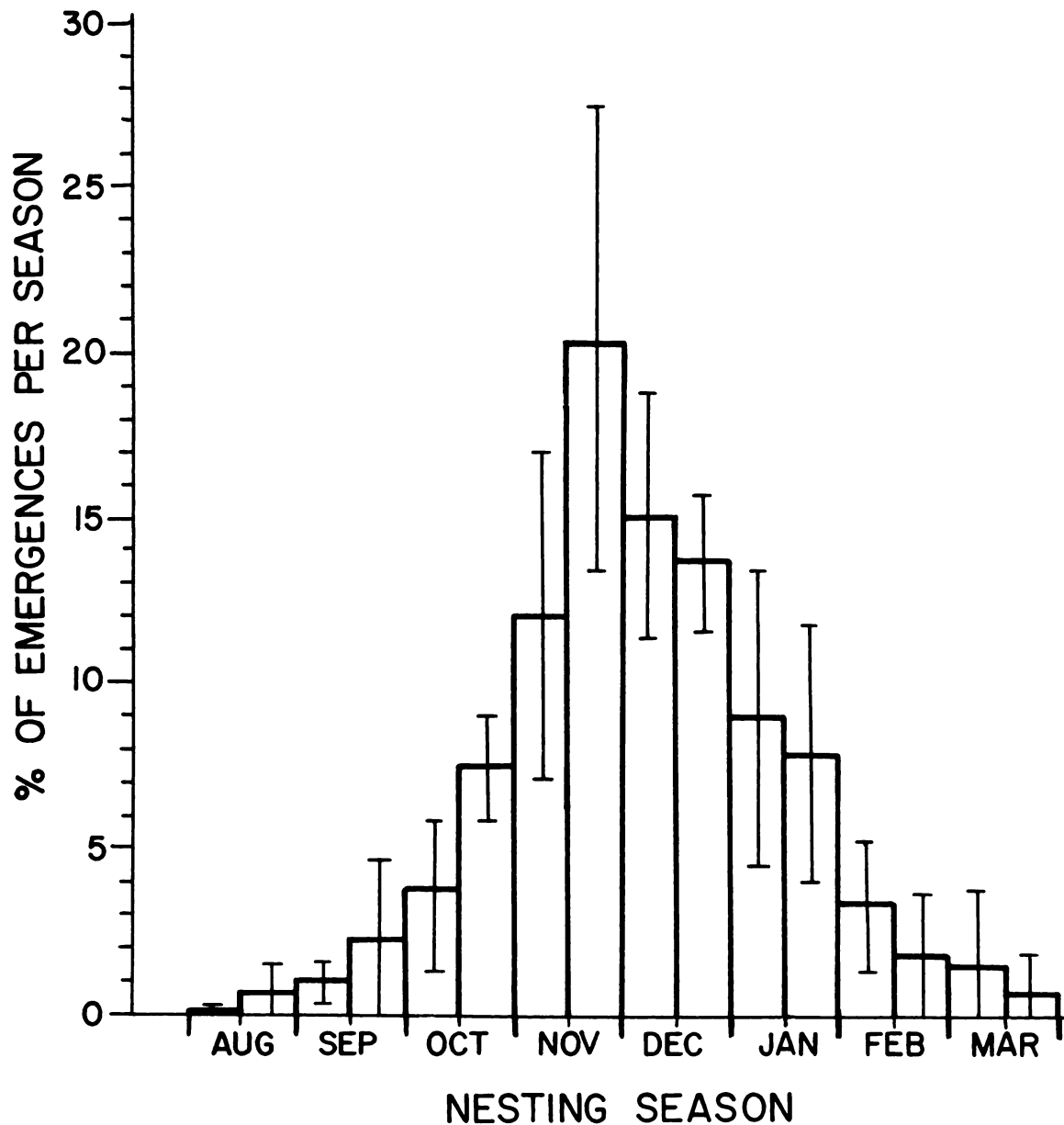


Figure 1. Map of the Republic of Seychelles.

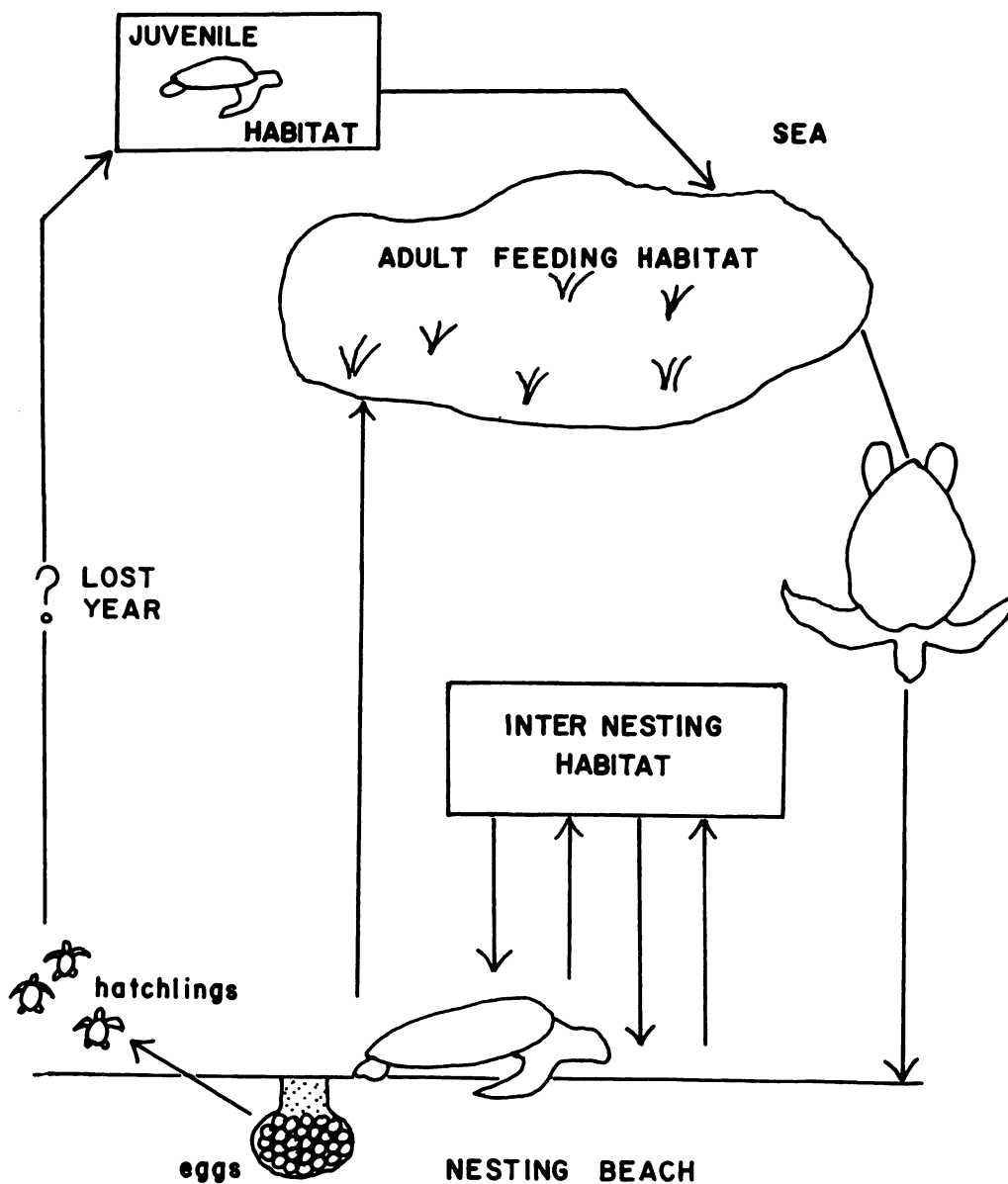


**Figure 2.** Map of the Granitic Islands of Seychelles. *Italics indicate where turtles are protected by law.*

## COUSIN ISLAND -- 1972-1983



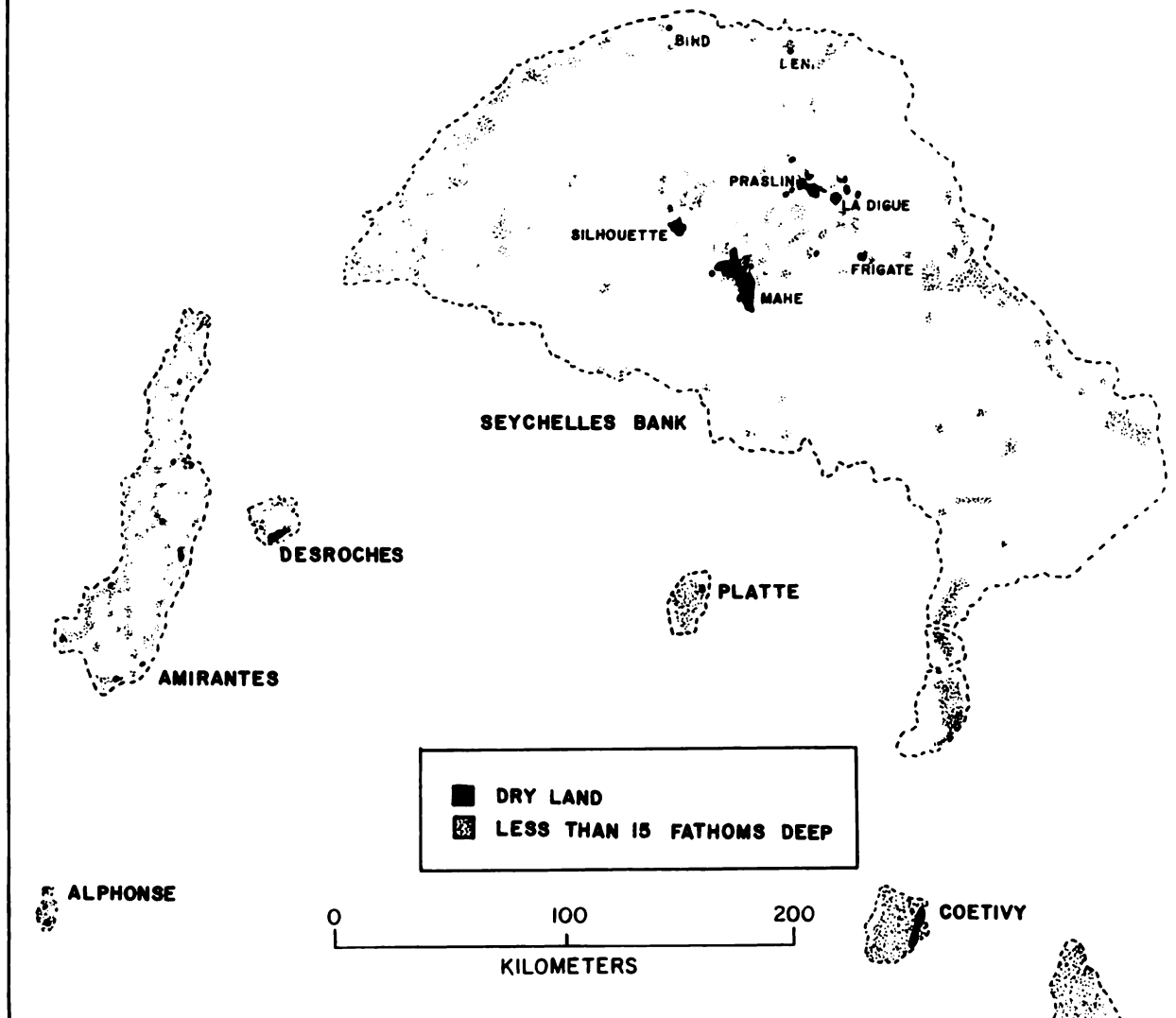
**Figure 3.** Temporal distribution of nesting emergences by hawksbill turtles at Cousin Island between 1972 and 1983. For each nesting season, the percentage of total emergences occurring during each semi-monthly interval was calculated. The averages for all eleven seasons are indicated by the bars. The standard deviation is shown by brackets.



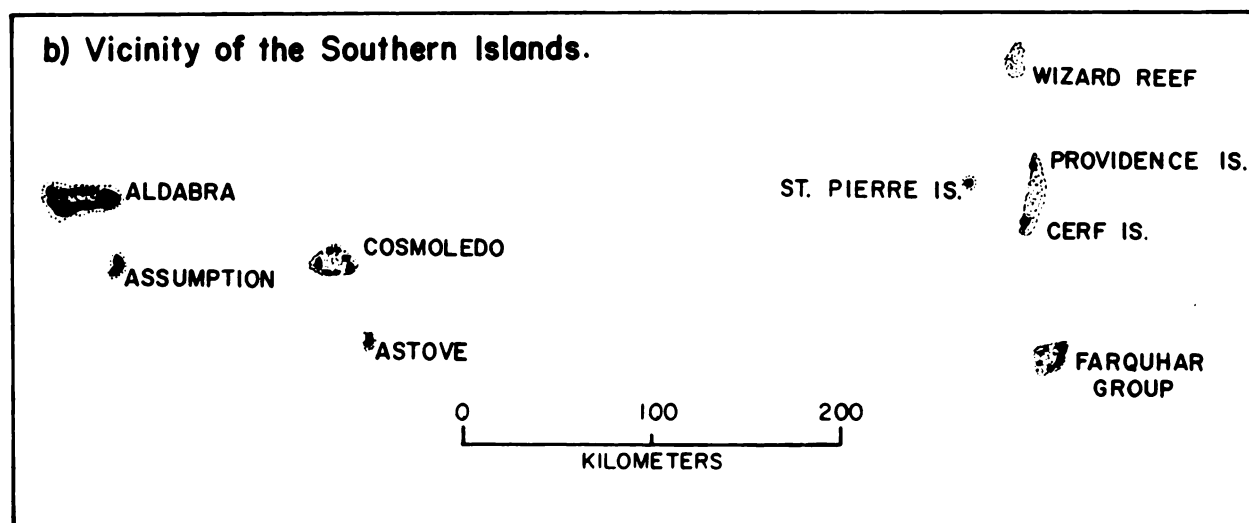
**Figure 4.** The life cycle of sea turtles, a generalized diagram based on the life cycle of the green turtle (following Carr et al., 1978; and Ross, 1979).

The female turtle lays eggs in a hole she digs on a particular nesting beach, fills the hole and then returns to the sea. After two months, the baby turtles, each weighing some 40 grams, emerge from the eggs, dig out of the sand, and go to the sea. Approximately one year later the juvenile turtles, now weighing about 1 kilo, appear on the juvenile feeding grounds. Where they go in between leaving the nesting beach and reaching the feeding grounds is unknown, but presumably they drift with ocean currents and feed on floating seaweed and other sea life. The nesting beaches may be located a long way from the adult feeding grounds. Minor feeding grounds sometimes occur in the inter-nesting and copulatory habitat offshore from the breeding beaches.

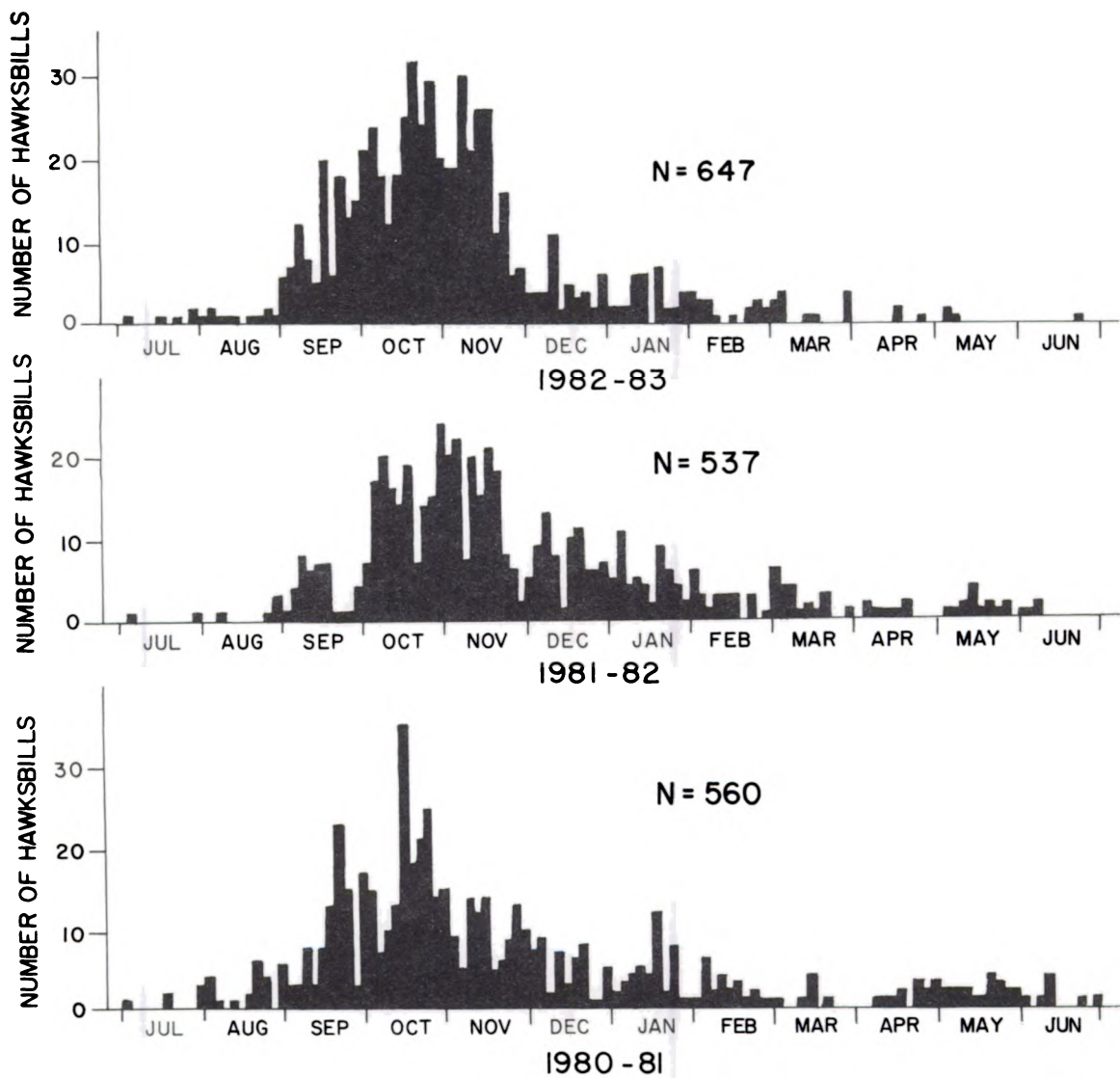
a) Vicinity of the Seychelles Bank and the Amirantes Bank.



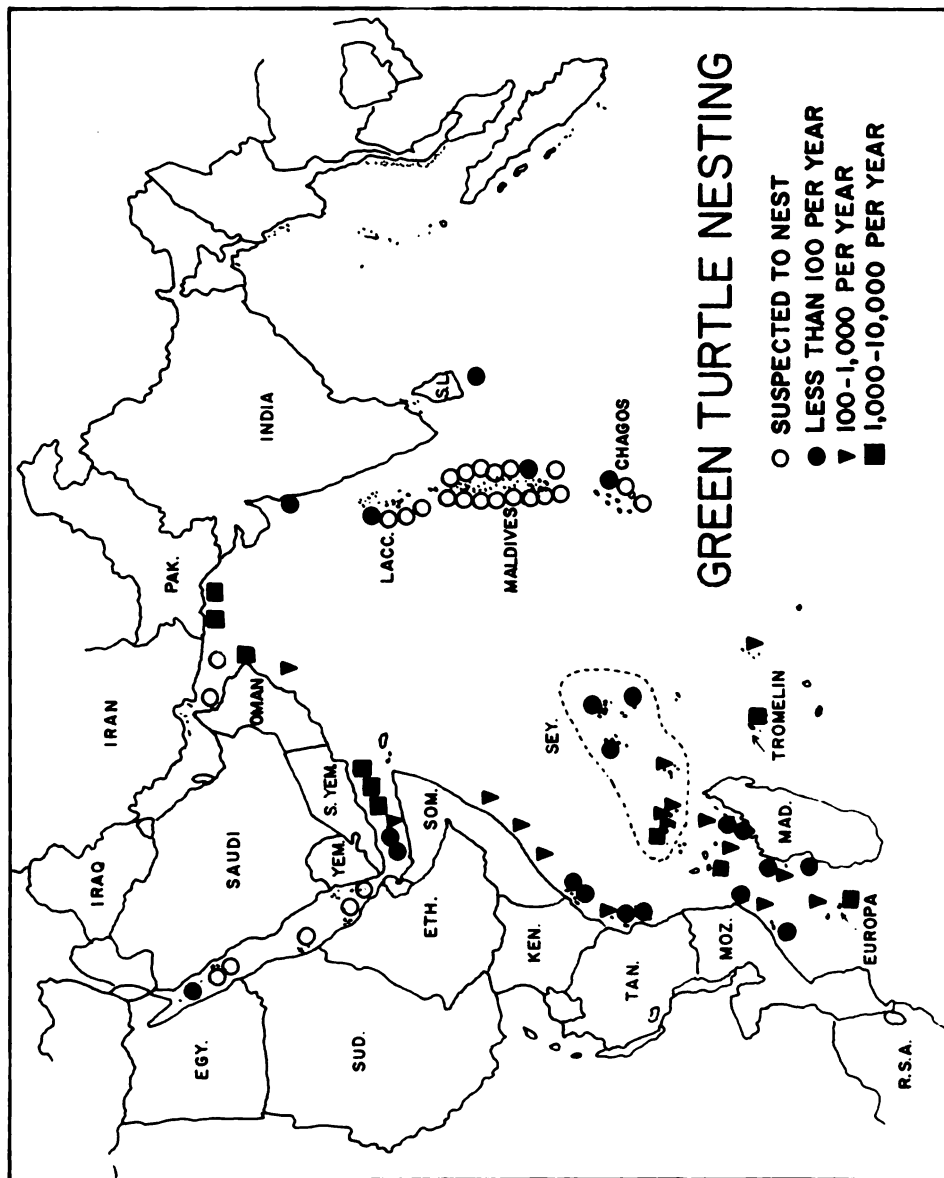
b) Vicinity of the Southern Islands.



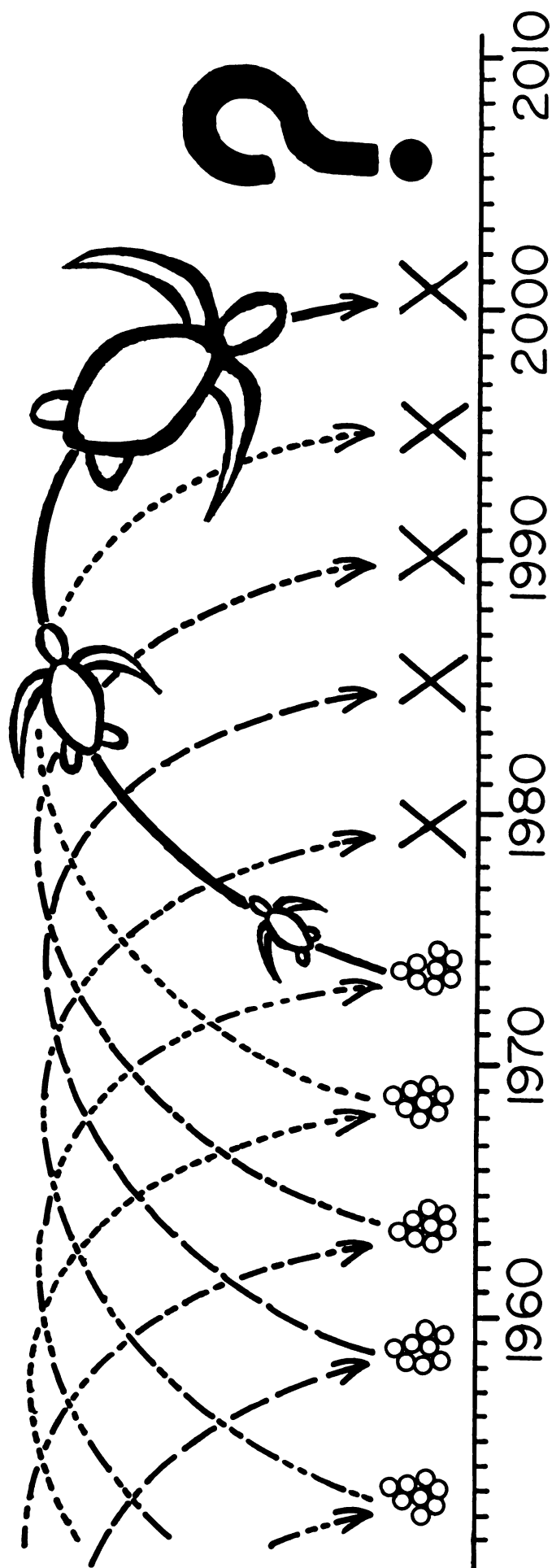
**Figure 5.** Potential feeding habitat for green turtles and hawksbills in the waters of the Republic of Seychelles. Speckled patches indicate areas shallower than 15 fathoms. Black areas indicate dry land.



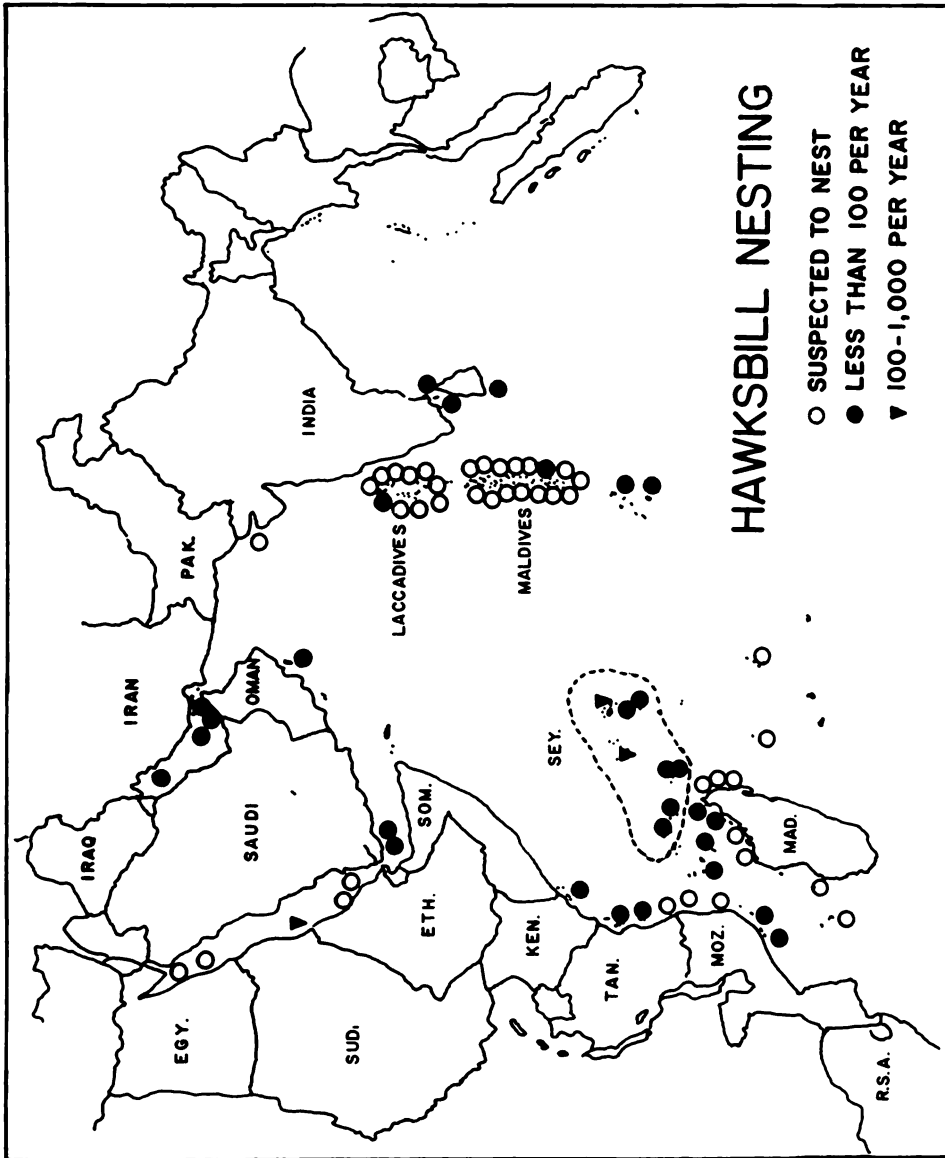
**Figure 6.** Temporal distribution of recorded captures of hawksbill turtles in the vicinity of the Granitic Islands during the 1980-81, 1981-82, and 1982-83 seasons. Data are taken from the "Declarations of Caret."



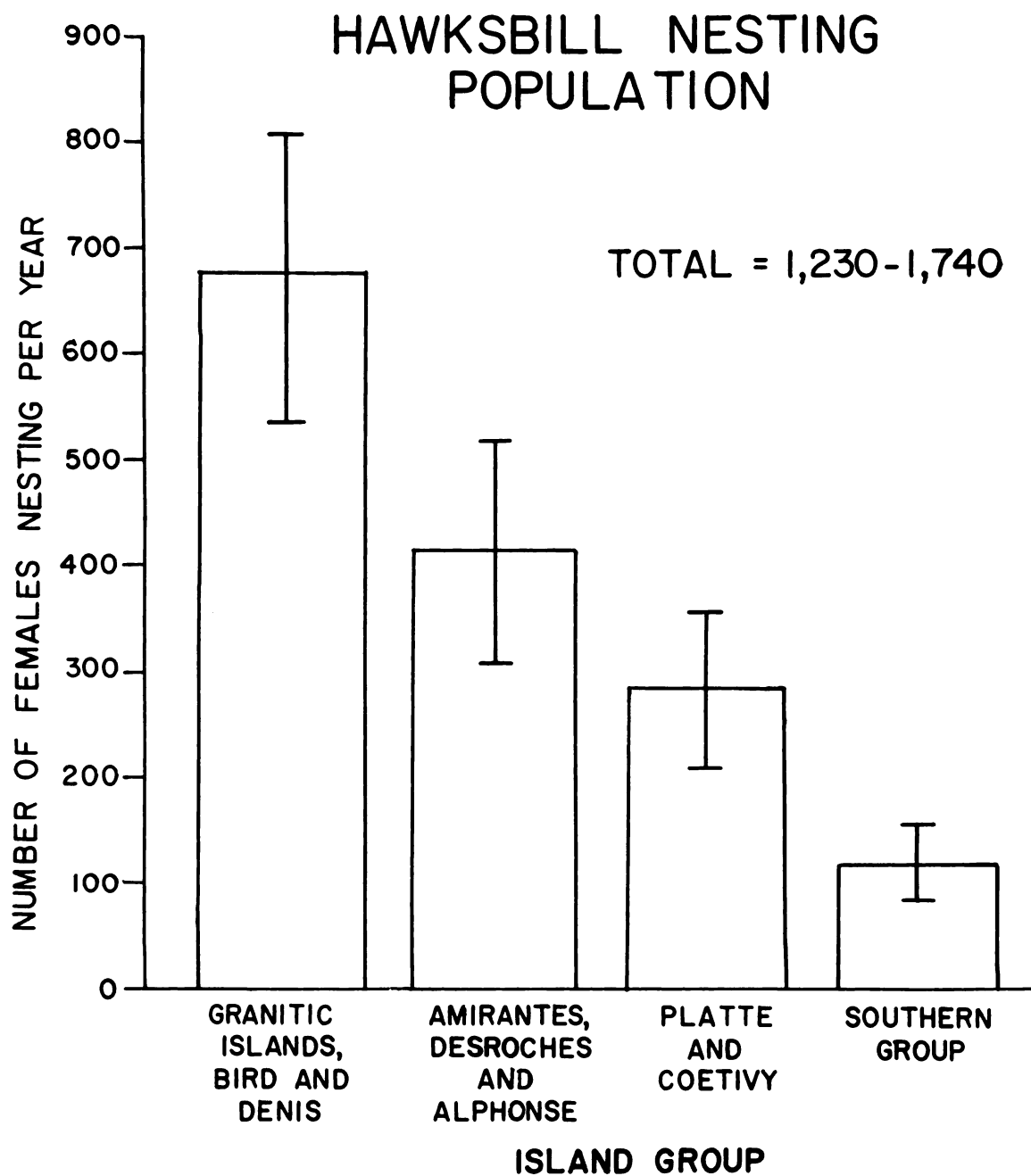
**Figure 7.** Distribution of major nesting populations of green turtles in the western Indian Ocean (modified from Frazier, 1984).



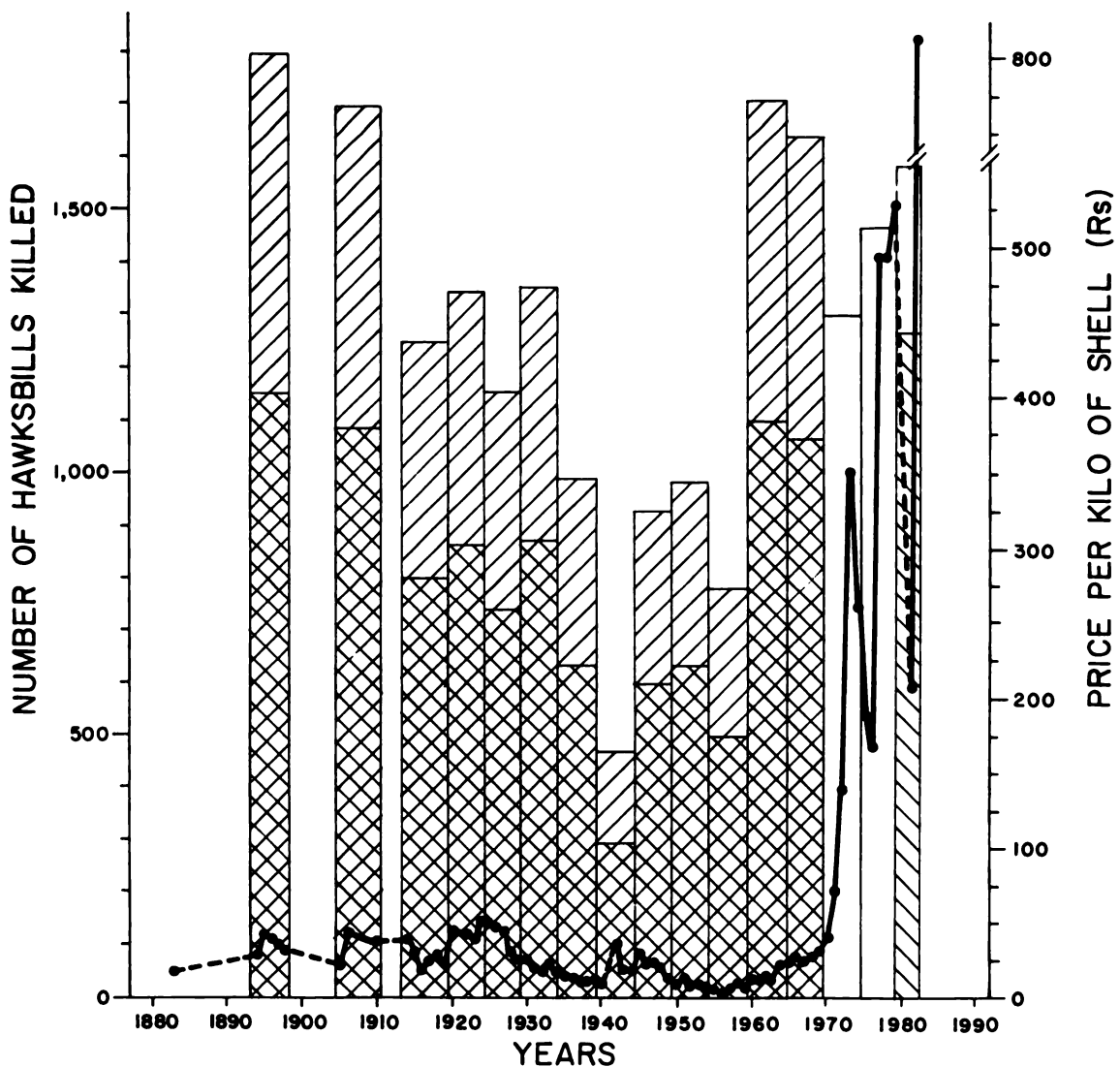
**Figure 8.** Schematic diagram showing the response of a nesting population to over-exploitation of the nesting females. Because sea turtles take such a long time to reach maturity, the effects of over-exploitation of nesting females may not become apparent until it is too late to save the population. For the purpose of illustration it is here assumed that the females take 25 years to reach maturity. If, beginning in 1975 every nesting female is killed before she can lay her eggs, no serious decline in the number of females that come to nest will occur until the year 2000. By that time, however, the population will have already reached the brink of extinction.






**Figure 9.** Distribution of major nesting populations of hawksbill turtles in the western Indian Ocean (modified from Frazier, 1984).



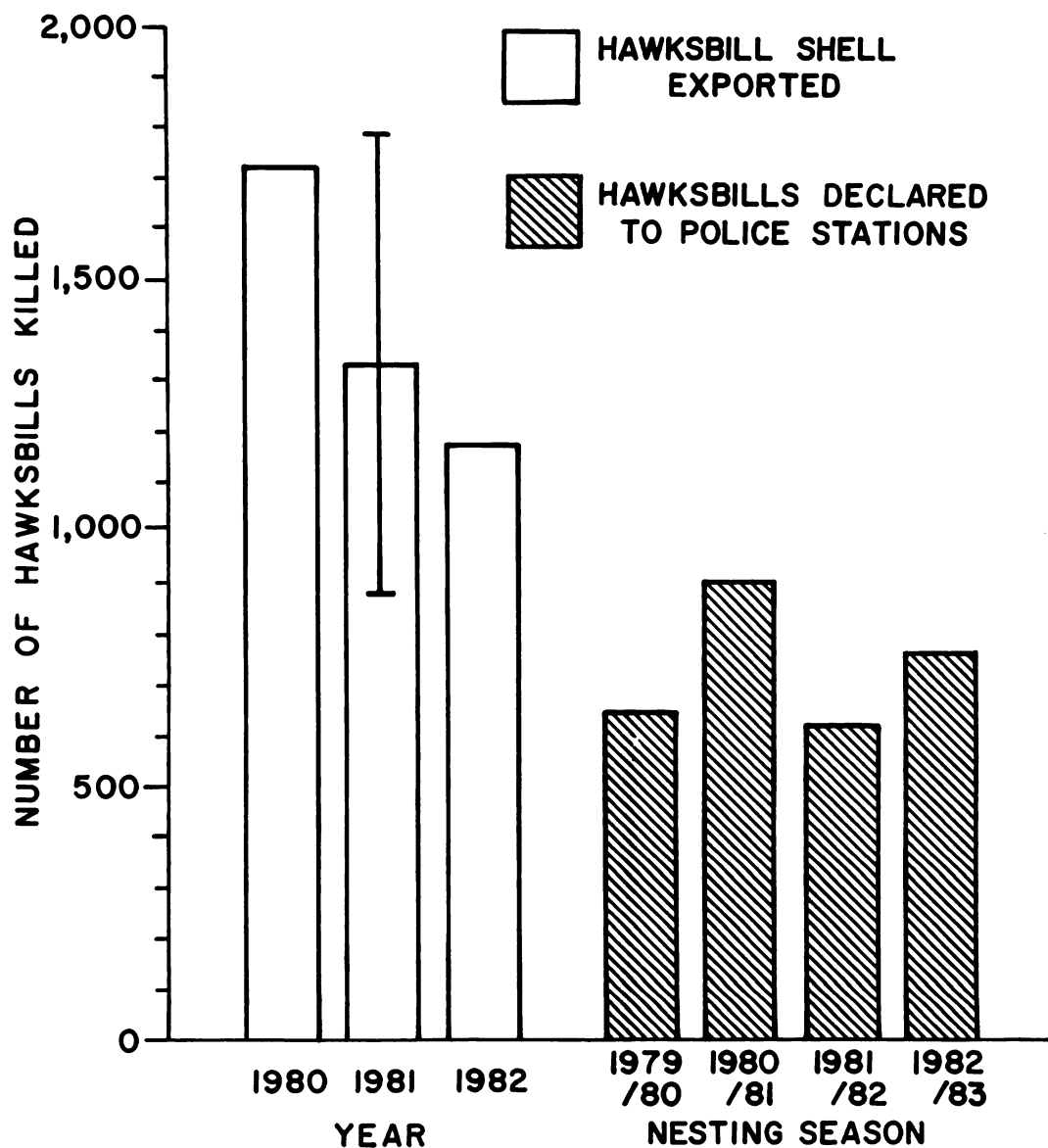
**Figure 10.** The estimated numbers of female hawksbills nesting annually at each of the major island groups of Seychelles. Brackets indicate the range of the estimate.



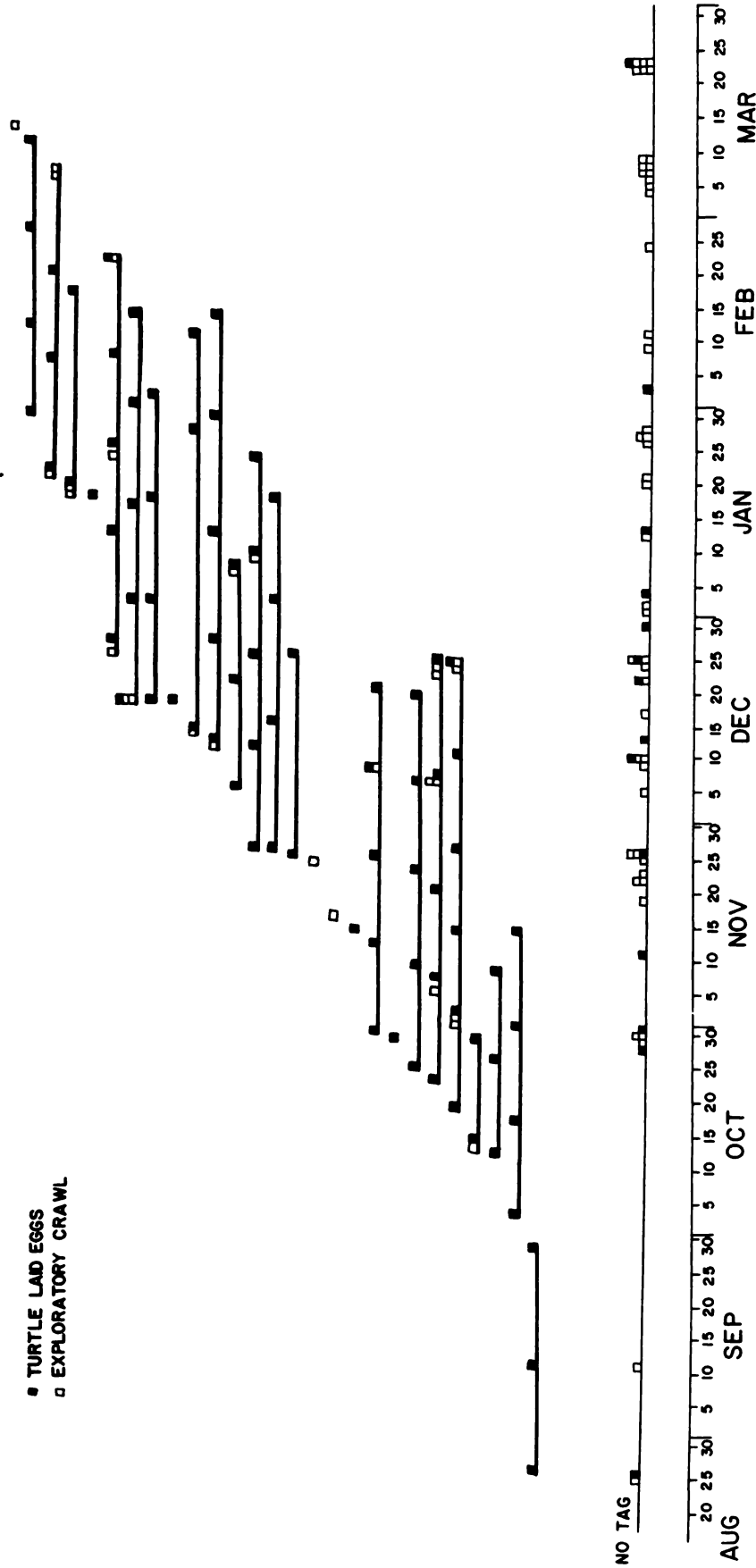
**Figure 11.** Relationship between the number of hawksbills killed to produce raw shell for export, and the price earned per kilo of shell exported, during the past 100 years. Each bar represents a five-year period and shows the average number of hawksbills whose shell was exported annually during that period. The shading on the bars indicates how many hawksbills would have been captured if:

-  only the backshell (i.e. the carapace scutes) was exported;
-  only the bellies and hooves (i.e. the plastron and marginal scutes) were exported;
-  both the backshell and the bellies and hooves were exported.

The scale for the bars is on the left-hand axis of the graph. The line graph shows the price per kilo of raw shell, and its scale is on the right-hand axis. Details are in Table 8. Figures for "kilos of shell exported" were taken from Trade Statistics, Department of Agriculture Reports, and the records of export permits granted. These figures were converted into turtle equivalents—one hawksbill yields an average of 0.9 kg of backshell and 0.5 kg of bellies and hooves.

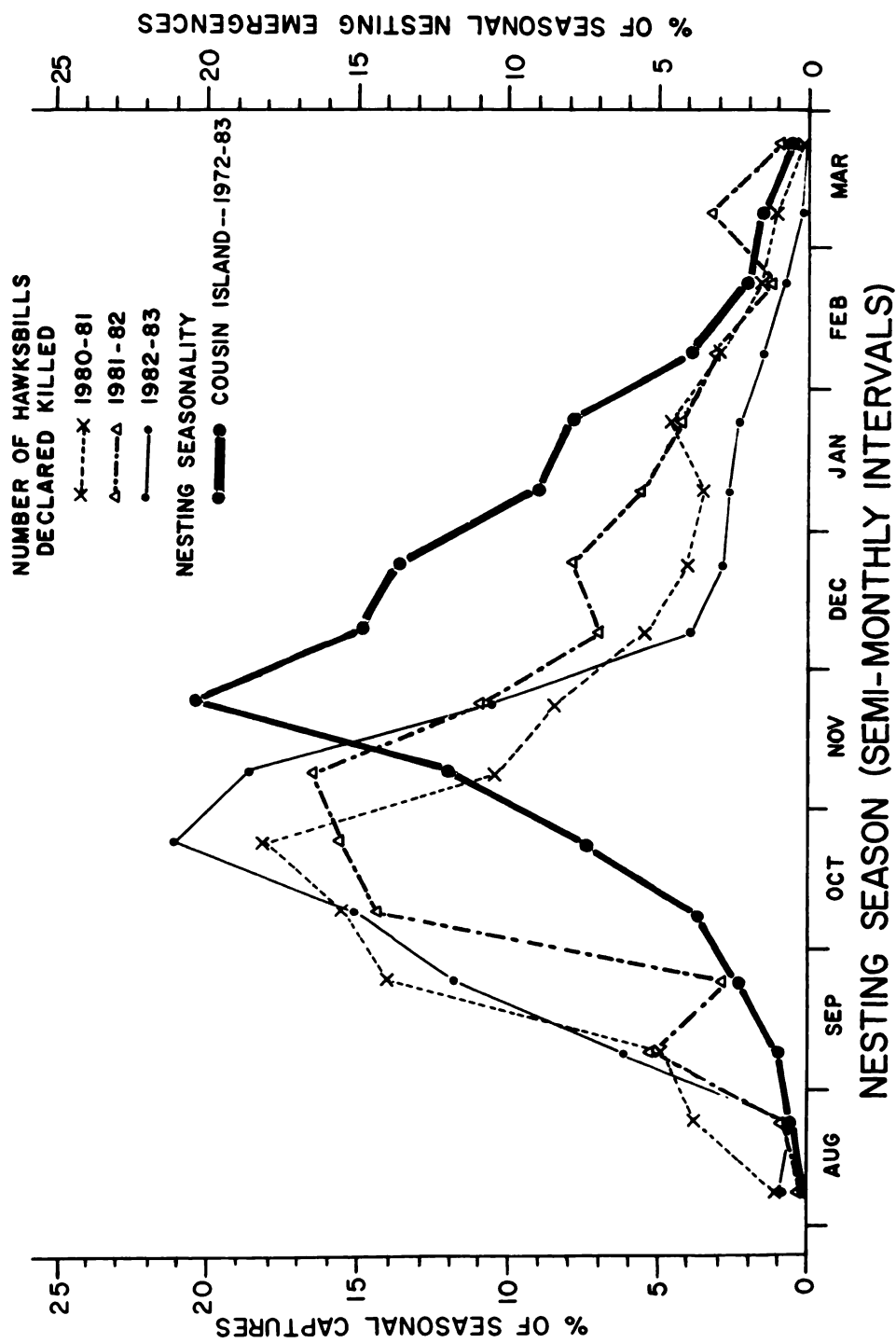


**Figure 12.** Comparison between the number of hawksbills declared to the police stations as having been killed during each of the past four seasons, and the number of hawksbills known to have been killed to produce raw shell for export during each of the past three years. Details are in Table 10. Brackets indicate the range of the estimate.

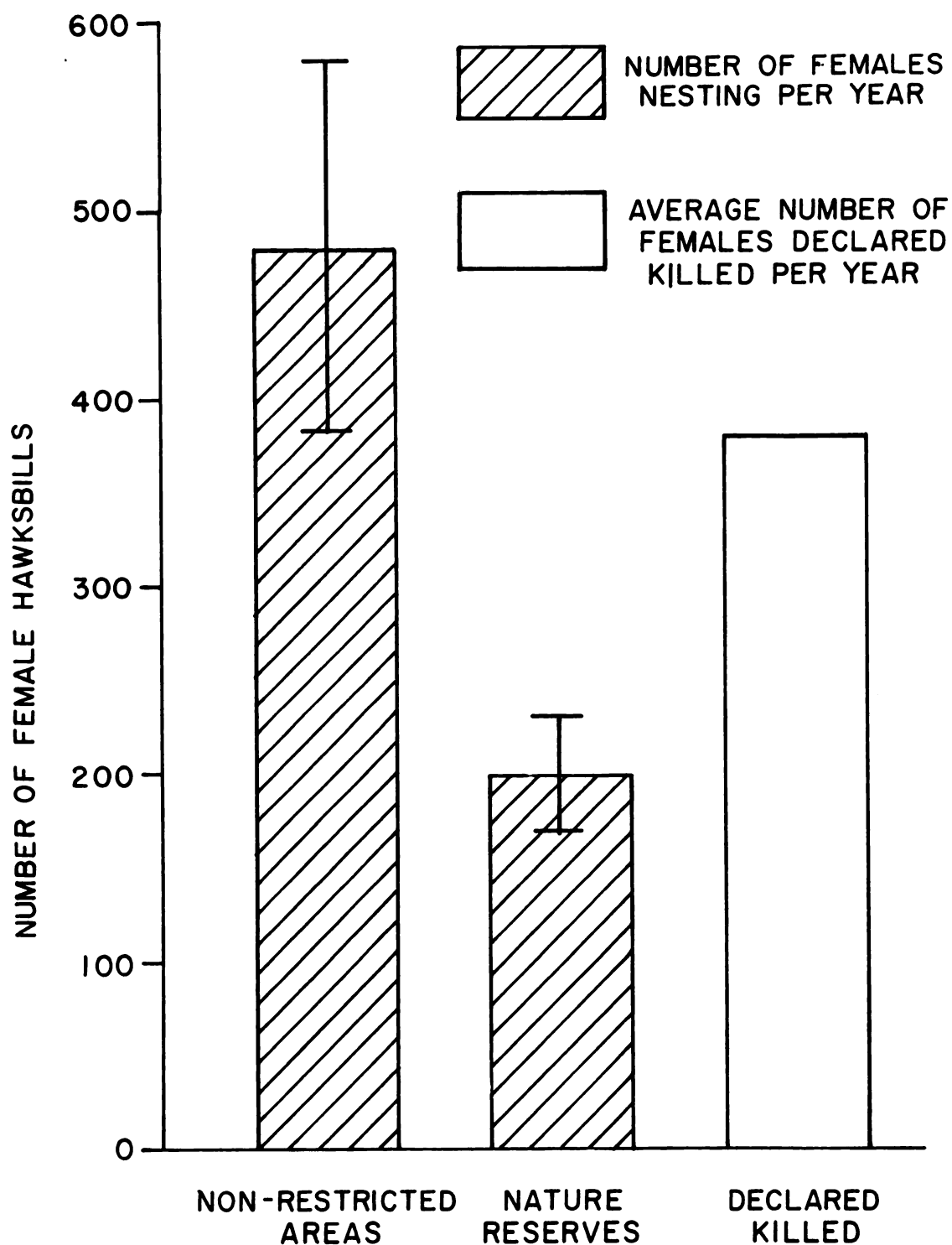


### COUSIN ISLAND -- 1982-83

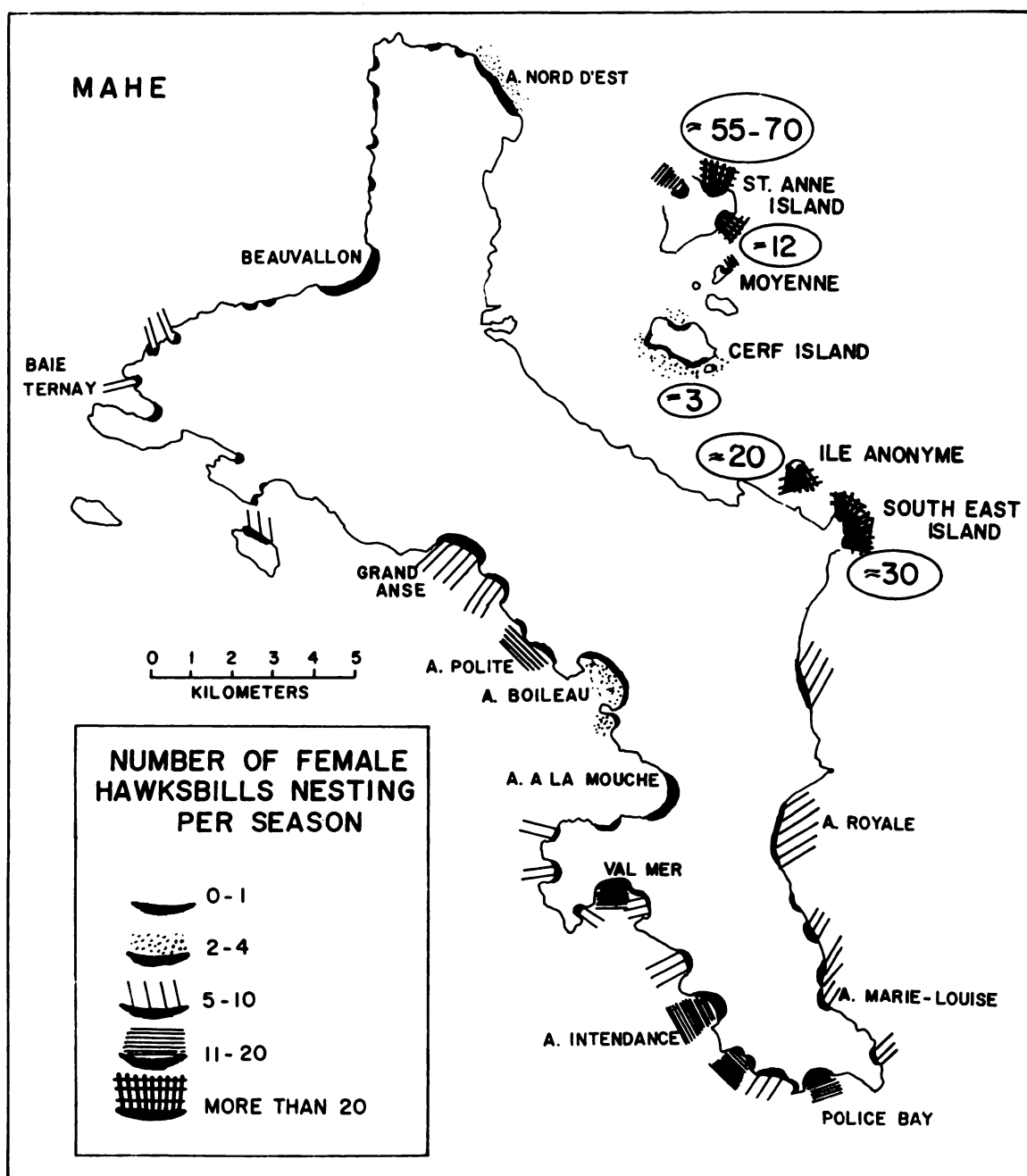
**Figure 13.** Multiple emergences made by individual hawksbills at Cousin Island during the 1982-83 nesting season. Each horizontal line represents a different tagged turtle. The lower line indicates nesting emergences that were not detected until after the turtle returned to the sea. Most hawksbills will lay three to six egg clutches if not molested.



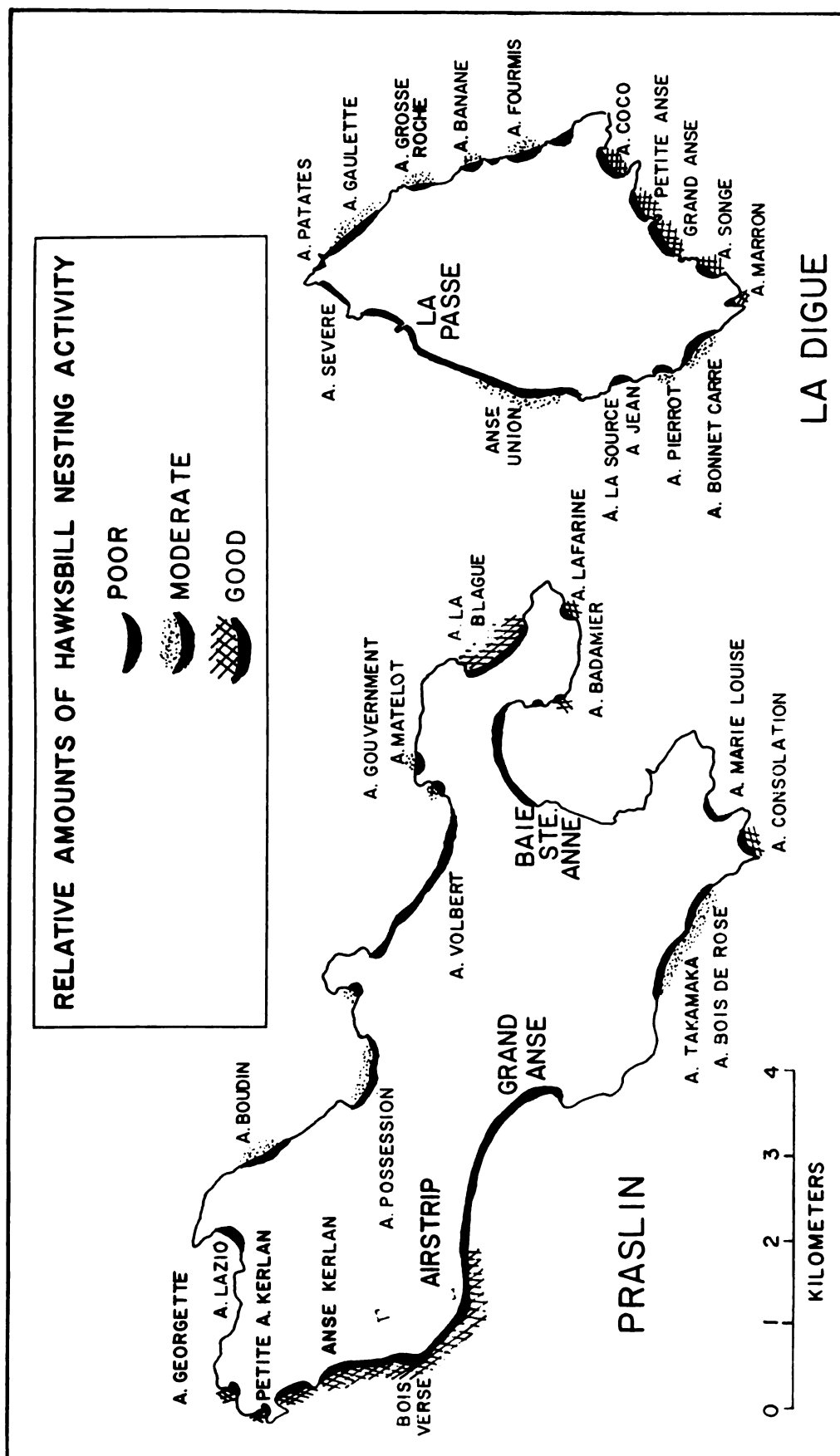
**Figure 14.** Relationship between the temporal distribution of nesting emergences by hawksbill turtles in a relatively unexploited nesting population (i.e. at Cousin Island) and the temporal distribution of captures of hawksbill turtles recorded in the Granitic Islands.



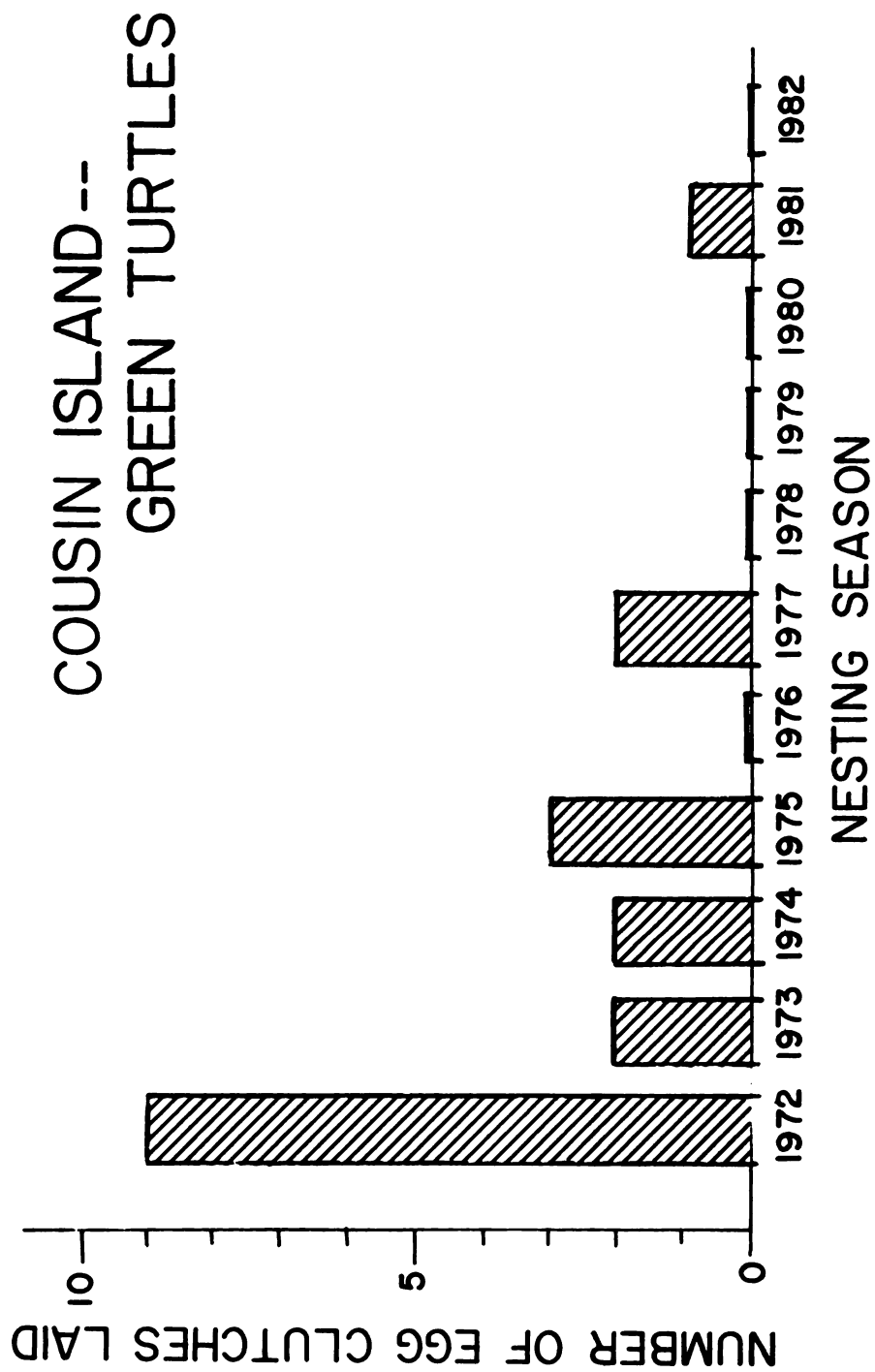
**Figure 15.** For the Granitic Islands of Seychelles, a comparison between the estimated numbers of female hawksbills nesting annually, and the average number of female hawksbills captured and subsequently declared at the police stations. The amount of nesting activity in the nature reserves is compared with that occurring in areas where turtles are not legally protected.



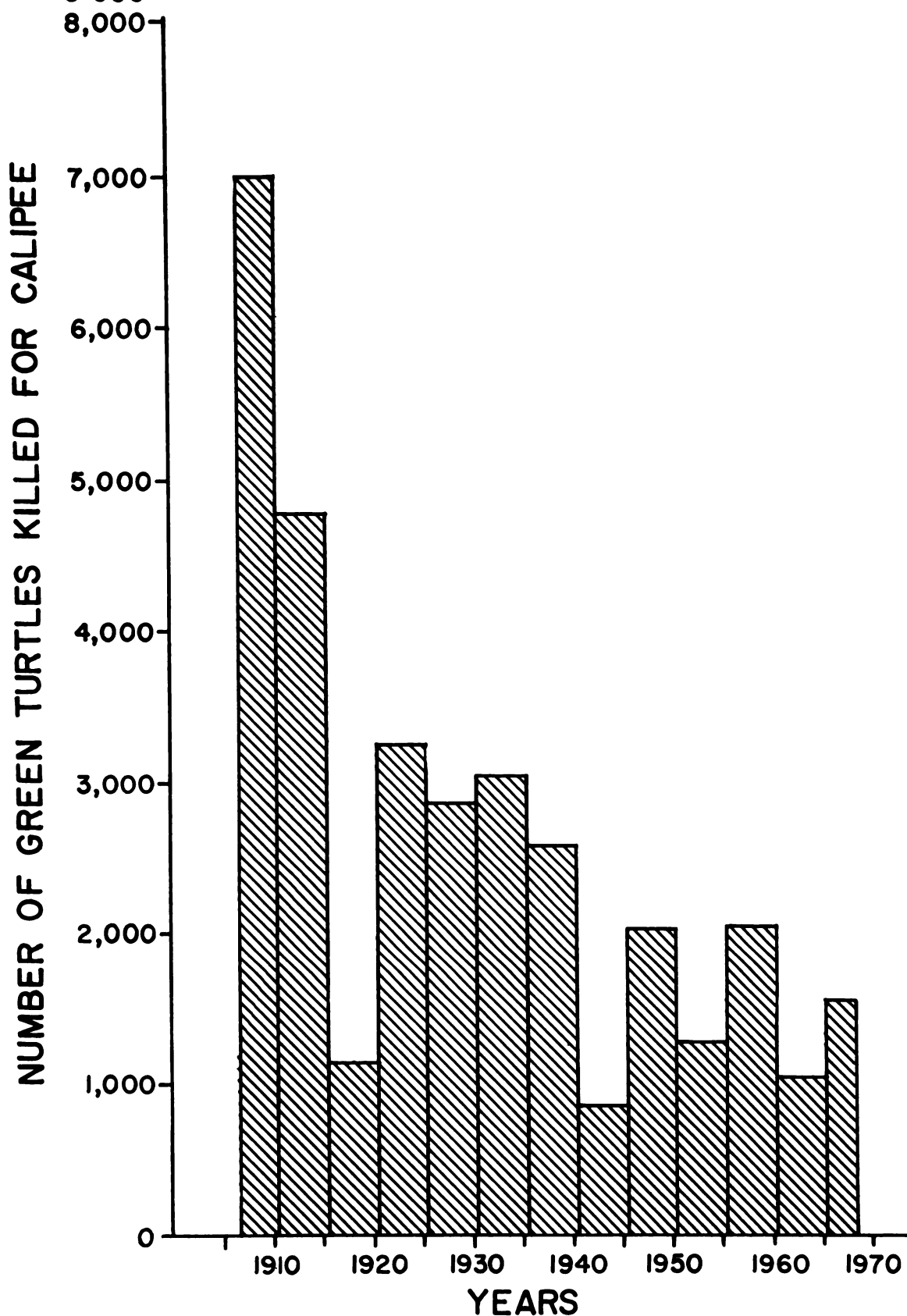
**Figure 16.** The distribution of hawksbill nesting activity on Mahe.



**Figure 17.** The distribution of hawksbill nesting activity on Praslin and La Digue Islands.

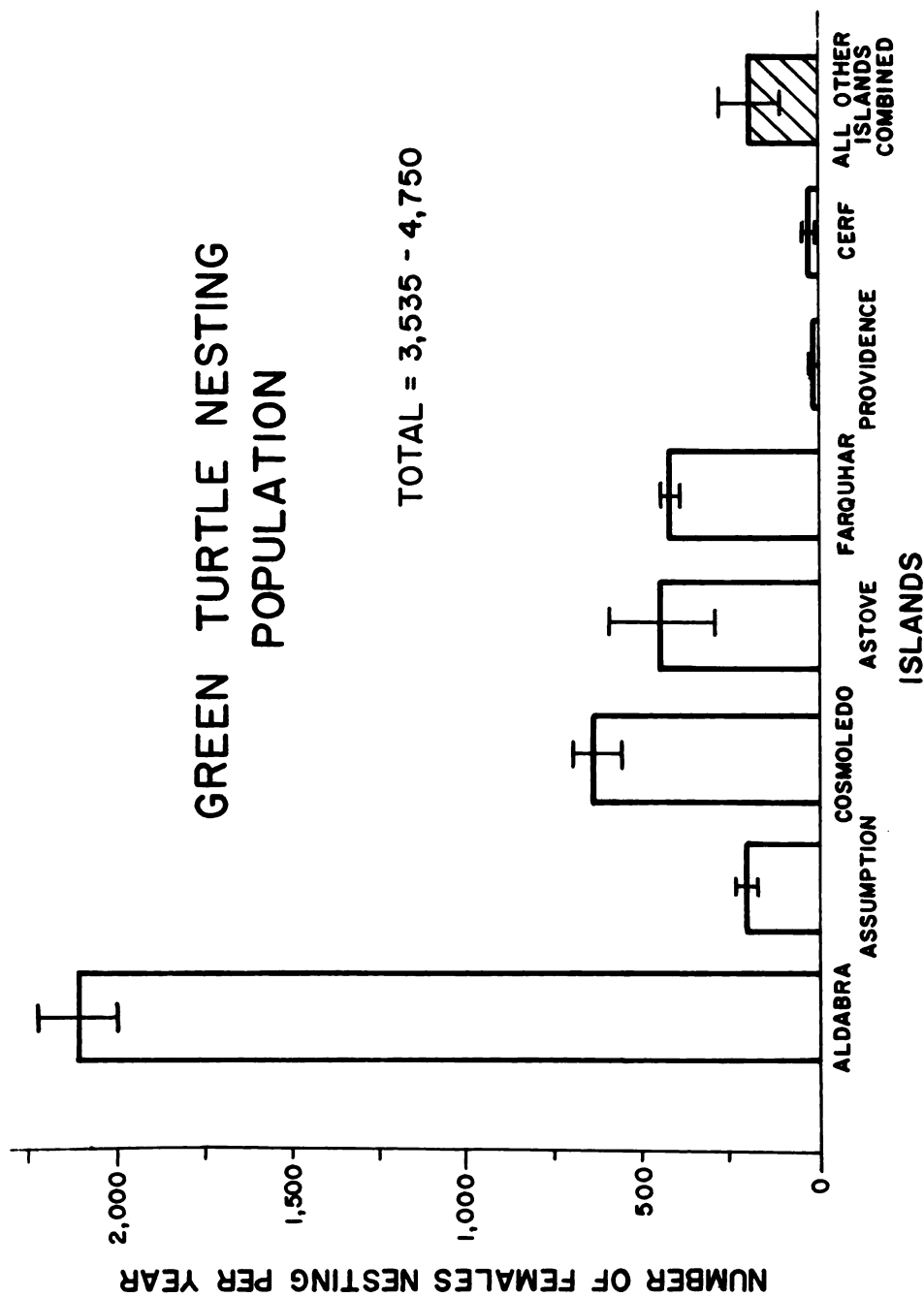


**Figure 18.** Numbers of egg clutches laid annually by green turtles on Cousin Island since 1972.

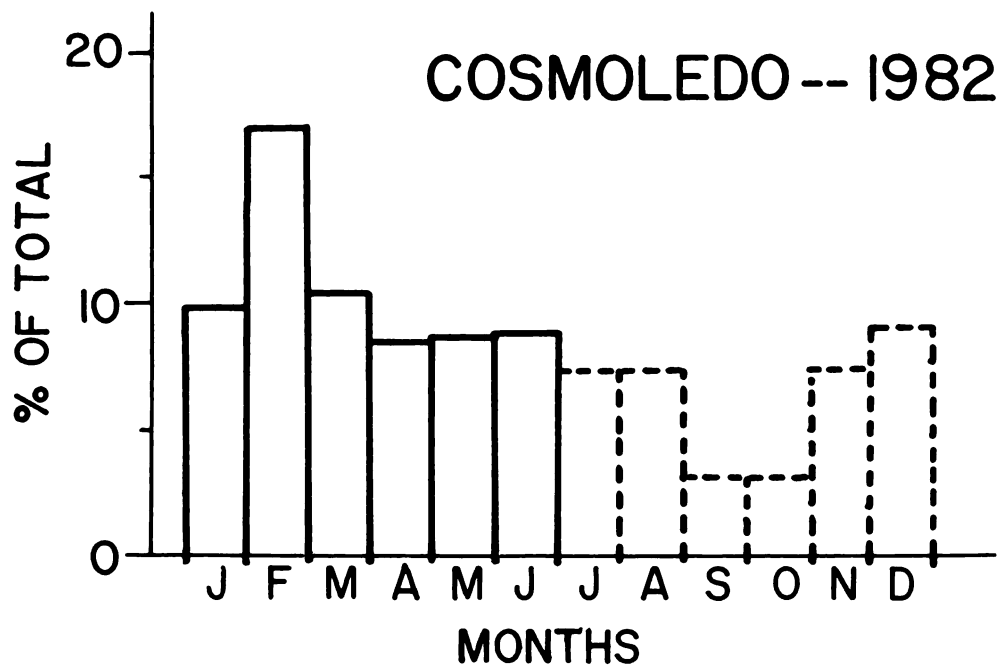
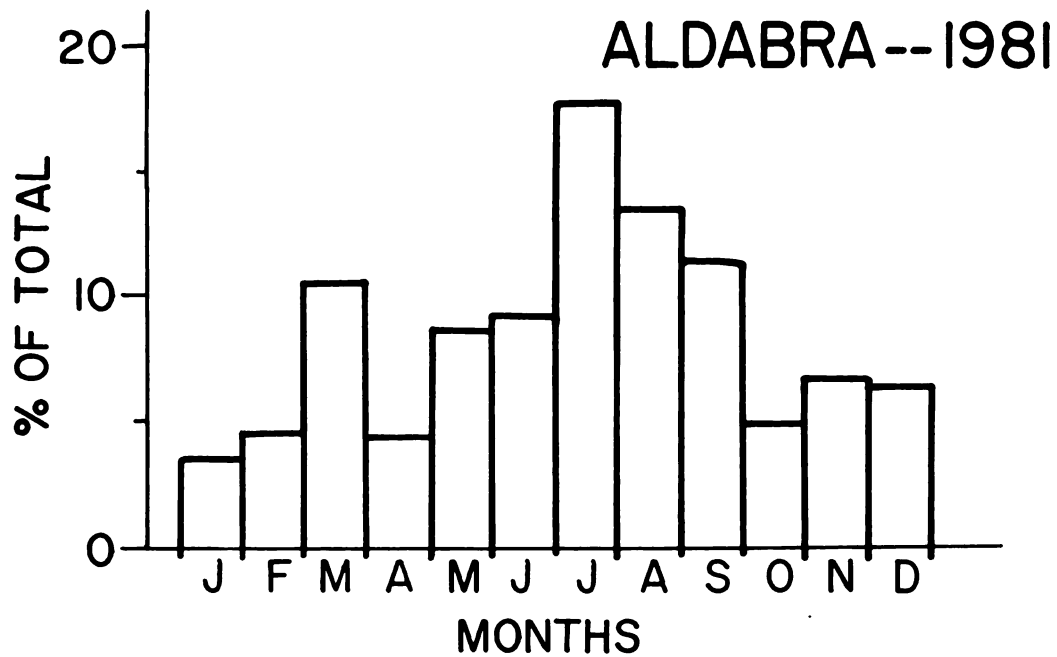


**Figure 19.** Numbers of green turtles killed for calipee between 1907 and 1968. Each bar indicates the average number killed during a five year period, except the first and last bars which respectively depict four and three year periods. Numbers were derived by converting the amount of calipee exported each year into turtle equivalents--i.e. one turtle yields about 1.5 kg of calipee.

Sources: Trade Reports, Colony of Seychelles; and Stoddart (1976; and 1984).



**Figure 20.** Estimated numbers of female green turtles nesting annually at each island in Seychelles. Brackets indicate the range of the estimates.



**Figure 21.** Temporal distribution of green turtle nesting activity on Aldabra Atoll in 1981, and on Cosmoledo Atoll in 1982.



## APPENDIX A

### A METHOD FOR DETERMINING HOW MANY ANIMALS ARE INCLUDED IN A SHIPMENT OF "KITOUZ" AND CHECKING FOR THE PRESENCE OF FEMALES

#### Background Data

Comparisons were made between the weights of edible meat obtained from freshly slaughtered turtles and the live weights of the same animals. In all cases the total combined weight of the four flippers, tail, neck and all the red meat ranged from 33.0 to 39.6% of the live weight (Table A.1). After they were salted and dried, the weights of these portions were about 13.4% of the live weights. The small amount of information available suggests that the wet salted weight of the same parts (i.e. after the meat has been salted, pressed, and is ready to be put onto the drying rack ("farfar")) is about 25.0% of the live weight.

Live weights of 17 male turtles were taken. These ranged from 91 to 142 kg; the average was 113.3 kg and standard deviation of these weights was 14.2. Thus, the weights of most of the turtles ranged from 99.2 to 127.5 kg.

Based on the above data, dry salted meat from a 113.3 kg turtle would weigh about 15.2 kg, and its wet salted weight would be about 28.3 kg.

#### Procedure

These figures could be used to estimate the number of animals in a shipment of "kitouz," using the following procedure:

All the various parts--front flippers, rear flippers, necks, tails and red meat--should be packed separately before leaving the islands, if possible. Intestines and heads (when these are salted) should be set aside from the rest of the turtle parts since they are not needed for the calculations. (Of course, it would be wise to check the contents of the sacks to be sure that only heads and intestines are included.)

The total weight of all the flippers, necks, tails, and red meat should be taken. If the "kitouz" is dry, that weight should be divided by 15.2 kg; if it is wet the weight should be divided by 28.3 kg. This calculation will give you an estimate of the minimum number of turtles that are included in that shipment.

All the front flippers should be counted to be sure that there are two front flippers from at least the calculated minimum number of turtles. (If possible, all the necks, tails and rear flippers should also be counted to insure that the shipment does not include red meat from a larger number of turtles, the more bony parts of which were left in the islands.)

Finally, each of the front flippers should be checked to be sure that they all have the hooked claws characteristic of the males, instead of the short straight claws characteristic of the females.

The claws should then be cut off the front flippers to prevent recycling of male flippers. Turtles possessing "intermediate" claws (very rare) should be left in the islands for local consumption.

The chief weakness of this method is that "kitouz" is likely to be filched off the "farfar," so the parts of some of the turtles may be missing.

Table A.1. Relationship between the weights of live green turtles and that of the fresh and salted turtle meat obtained from them.

		WET WEIGHT				WEIGHT OF DRY, SALTED MEAT							
SEX	LIVE WEIGHT	Red meat, Flippers, Tail and Neck		Intestines		Total		Red meat Flippers, Tail and Neck		Intestines		Total	
		Kg.	% of Live	Kg.	% of Live	Kg.	% of Live	Kg.	% of Live	Kg.	% of Live	Kg.	% of Live
F	162.0	57.0	35.2	8.5	5.2	65.5	40.4	19.0	13.6	1.8	1.3	20.8	14.8
F	140.0	55.5	39.6	7.0	5.0	62.5	44.6						
M	111.5	36.8	33.0	7.0	6.3	43.8	39.3						
M	125.8	44.5	35.4	7.0	5.6	52.0	41.4	18.5	14.7	1.5	1.2	20.0	15.9
M	130.0	48.3	37.1	9.5	7.3	57.8	44.4						
M	114.5	42.8	37.3	7.3	6.3	50.0	43.6						
* M	100.0	33.5	33.5	7.0	7.0	40.5	40.5						
M	110.0	41.0	37.3	11.0	10.0	52.0	47.3	13.0	11.8	1.5	1.4	14.5	13.2

WEIGHT OF WET, SALTED MEAT					
Red meat, Flippers, Tail and Neck		Intestines		Total	
Kg.	% of Live	Kg.	% of Live	Kg.	% of Live
* 25.0	25.0	6.0	6.0	31.0	31.0

## APPENDIX B

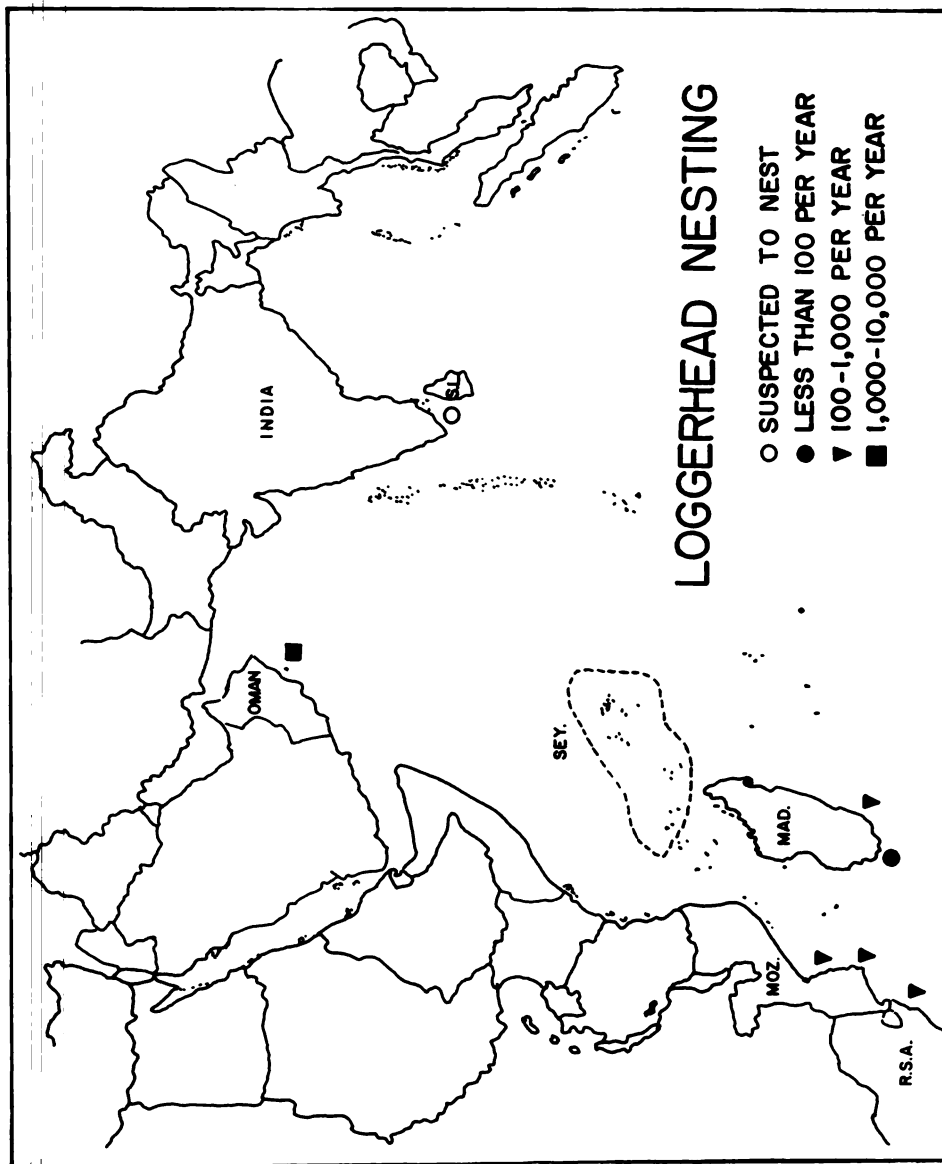
### LOGGERHEAD AND LEATHERBACK TURTLES IN THE SEYCHELLES

The loggerhead turtle (Caretta caretta) is sighted regularly, though infrequently, in the waters of Seychelles. No nesting records for loggerheads occur in Seychelles, but immature and subadult individuals have been recorded in the lagoons at Aldabra, Cosmoledo, and Farquhar atolls, and near Praslin.

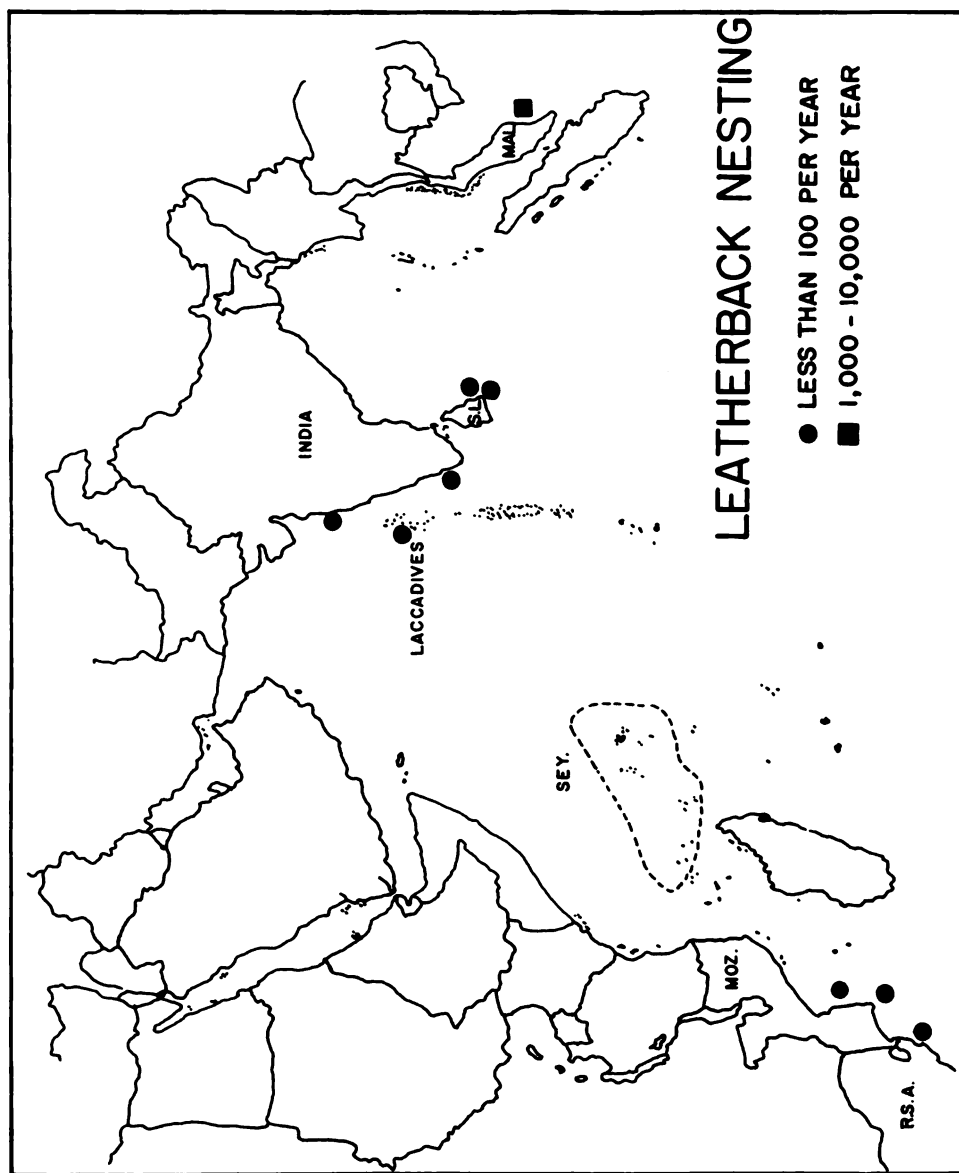
The Seychellois call this turtle "nam koyo." Because neither nesting loggerheads nor females bearing mature eggs are ever seen in Seychelles, many Seychellois believe the "nam koyo" is not a true species, but rather a cross between the green turtle and the hawksbill turtle. For this reason it is sometimes called "torti batar," the bastard turtle.

The loggerheads that occur in Seychelles, in fact, are probably derived either from the population that nests at Masirah in Oman, from the smaller nesting populations of southern Africa and Madagascar, or from both (Figure B.1). They apparently come to Seychelles to feed, but breed elsewhere.

The leatherback turtle (Dermochelys coriacea) or "torti karambol" is seen with some regularity in the deeper waters of the Granitic Islands. This spectacular turtle, which often weighs upwards of 500 kg and feeds almost exclusively on jellyfish, also nests on very rare occasions in the Granitic Islands. Figure B.2 shows the nesting range for this species in the Indian Ocean.



**Figure B.1.** Distribution of major nesting populations of loggerhead turtles in the western Indian Ocean (modified from Frazier, 1984).



**Figure B.2.** Distribution of major nesting populations of leatherback turtles in the western Indian Ocean (modified from Frazier, 1984).

# **Photographs**



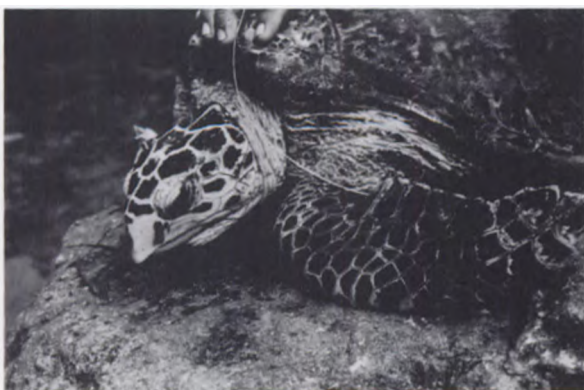


**A** *Track of green turtle moving towards the viewer*



**B** *Track of hawksbill turtle moving away from the viewer*

**C** *Green turtle*



**D** *Hawksbill turtle*



E Author measuring green turtle (Bruce Foster)



F Numbered tag on front flipper of female green turtle

G Sexual dimorphism in tail length of the green turtles: male (right); female (left)



H Sexual dimorphism in claws of front flippers of green turtles: male (right, long and curved); female (left, shorter and straighter)



**K Turtle hunter hauling in  
harpooned hawksbill,  
Cosmoledo Atoll**



**I Aerial view of Cousin  
Island, a nature reserve in  
the Granitic Islands  
administered by the ICBP**



**J Hawksbill nesting beach, La Digue  
Island in the Granitic Islands**





**L** Hoisting live male green turtles aboard the Cinq Juan for shipment to Mahe



**M** Green turtles being butchered at Farquhar Atoll for production of "kitouz" and for local consumption



**N** Salted green turtle meat ("kitouz") drying in the sun







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