

THE ECOLOGY AND CONSERVATION OF THE CARIBBEAN HAWKSBILL
(Eretmochelys imbricata)

FINAL REPORT
WWF PROJECT #1499
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Anne Meylan
Department of Zoology
University of Florida
Gainesville, FL USA

32611

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The Ecology and Conservation of the Caribbean Hawksbill

(Eretmochelys imbricata)

WWF Project #1499

Project Personnel: Anne Meylan, Department of Zoology, University of Florida,
Gainesville, FL 32611

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Panama

SCOPE AND OBJECTIVES

The hawksbill turtle (Eretmochelys imbricata) is threatened with extinction throughout its circumtropical range (Honneger, 1970; Groombridge, 1982). Factors contributing to its decline are many, although trade in tortoiseshell, a natural product derived from its shell, is undoubtedly the foremost. Since ancient times, tortoiseshell has been prized for use in jewelry and artifacts, and today it commands a price exceeding that of ivory on the international market. Secondary factors contributing to the decline of the species are the harvest for meat and eggs, the use of juveniles in the curio trade, and the loss or degradation of nesting and foraging habitats.

As is often the case with endangered species, populations have declined before adequate investigation of the life cycle has been made. As a result, biological information necessary for planning effective protection for remaining populations is virtually nonexistent. Project #1499 was initiated with two related goals. The first is to extend knowledge of the ecology of the hawksbill in its foraging habitat on coral reefs. To achieve this aim, a study of the feeding biology of the species in the Caribbean Sea has been carried out in Bocas del Toro Province, Panama, and at several localities in the Leeward and Windward islands. The second objective is to promote the conservation of the hawksbill in the Caribbean by: 1) providing fisheries offices and relevant organizations in the Eastern Caribbean with data on the location of critical nesting and foraging habitats of the hawksbill and other marine turtle species; 2) identifying factors responsible for the decline of the hawksbill in the Eastern Caribbean and in Bocas del Toro Province, Panama; 3) providing assistance to fisheries offices in the Eastern Caribbean for the evaluation and revision of existing turtle legislation; and 4) stimulating public awareness of the survival plight of the endangered hawksbill in the Eastern Caribbean region and in Bocas del Toro Province, Panama.

PART I. FEEDING ECOLOGY OF THE HAWKSBILL TURTLE IN THE CARIBBEAN SEA

Introduction

Remarkably little is known of the ecology and life history of the hawksbill. Its tendency to nest diffusely, rather than in large aggregations, has made it difficult to carry out the tagging programs that have been so instrumental in the study of other marine turtle species. With few exceptions (Diamond, 1976; de L. Brooke and Garnett, 1983; Limpus, 1980, 1983), most of the data on its nesting biology has been collected incidental to investigations of other species (Carr, Hirth and Ogren, 1966; Carr and Stancyk, 1975; Pritchard, 1969; Hirth and Carr, 1970; Frazier, 1971; Bustard, 1974; Hughes, 1974).

Knowledge of the ecology and behavior of the hawksbill in its resident foraging habitat--coral reefs--is even more fragmentary. Studies on the feeding grounds are hindered by the species' depleted status in most parts of its range, and by its great mobility in its aquatic environment. Although long recognized as an inhabitant of coral reefs, the hawksbill's ecological position in this community has never been determined. ||

Study of the feeding biology of the species can provide insight into several aspects of its life history that would otherwise be difficult to gain. From the diet, for example, one can make inferences about habitat preferences of various size classes, competitive interactions with other species, foraging behavior, etc. An understanding of the nature of the food resource on which it depends--its ecological and geographic distribution, abundance, and dependability--can be gained. Such an indirect approach has its limitations, but the potential for revealing valuable information about this poorly studied marine turtle is considerable.

Background

There have been very few studies focusing on the diet of the hawksbill. The literature has recently been reviewed by Witzell (1983). It consists primarily of anecdotal accounts that list the various food items discovered in the digestive tracts of one or two individuals. The reports suggest wide variety in the diet--crabs, mollusks, gorgonians, sponges, coral, algae, tunicates, seagrass, sea urchins, etc. Most of the accounts are qualitative, and give little or no information on the relative importance of the various items.

More extensive studies of the hawksbill's diet are those of Carr and Stancyk (1975) and den Hartog (1980). Carr and Stancyk (1975) examined the stomach contents of 29 turtles that had been caught off the nesting beach at Tortuguero, on the Caribbean coast of Costa Rica. On the basis of frequency of occurrence of the various food items in the stomachs, sponges and tunicates predominated. Small quantities of seagrass, algae, mollusks and bottom material were also found. The authors concluded that the hawksbill was a relatively indiscriminate feeder whose food consisted mainly of benthic invertebrates. ||

den Hartog (1980) made a detailed examination of the contents of the entire digestive tract of a small hawksbill (36.2 cm carapace length) caught in the Salvage Islands, eastern Atlantic. He identified two species of sponges, the actinian Anemonia sulcata, at least two species of pelagic coelenterates, fragments of marine algae, a spider crab, and some gastropod mollusks. No attempt was made to quantify the components. den Hartog (1980) noted that although some plant material had been eaten, it was poorly digested. He concluded that the hawksbill was essentially carnivorous in its diet.

The aim of the present study was to extend knowledge of the diet and feeding ecology of the hawksbill. The study was carried out in the Caribbean, where existing subsistence fisheries directed at this species provided an opportunity to examine many specimens. Analysis of the contents of digestive tracts proved to be the most feasible approach to studying the diet, because direct observations of feeding hawksbills are rare, and even when possible, it is difficult to discern what is being eaten and in what quantities. These analyses were supplemented by observations of a small number of free-ranging, live turtles, by reconnaissance of foraging habitats in Panama and in the Leeward and Windward islands, and by extensive interviews with subsistence turtle fishermen.

Methods

Partial or entire contents of the digestive tracts of 68 turtles captured at various localities around the Caribbean were examined (Fig. 1). Nearly all of the samples were obtained from turtles killed by subsistence fishermen. Samples from Panama and the Leeward Islands were collected in conjunction with surveys of turtle populations being carried out under a separate grant from the U.S. National Marine Fisheries Service (see Part II). Those from the Dominican Republic and Carriacou, Grenada were obtained from subsistence fishermen through the cooperation of José Ottenwalder, Parque Zoológico Nacional, and Dr. Mel Goodwin, Environmental Research Projects, respectively. Specimens from the Caribbean were brought into the United States under U.S. Fish and Wildlife Service Endangered Species Permit PRT2-4481. Four small hawksbills that washed ashore on beaches in eastern Florida were obtained through the Florida Department of Natural Resources.

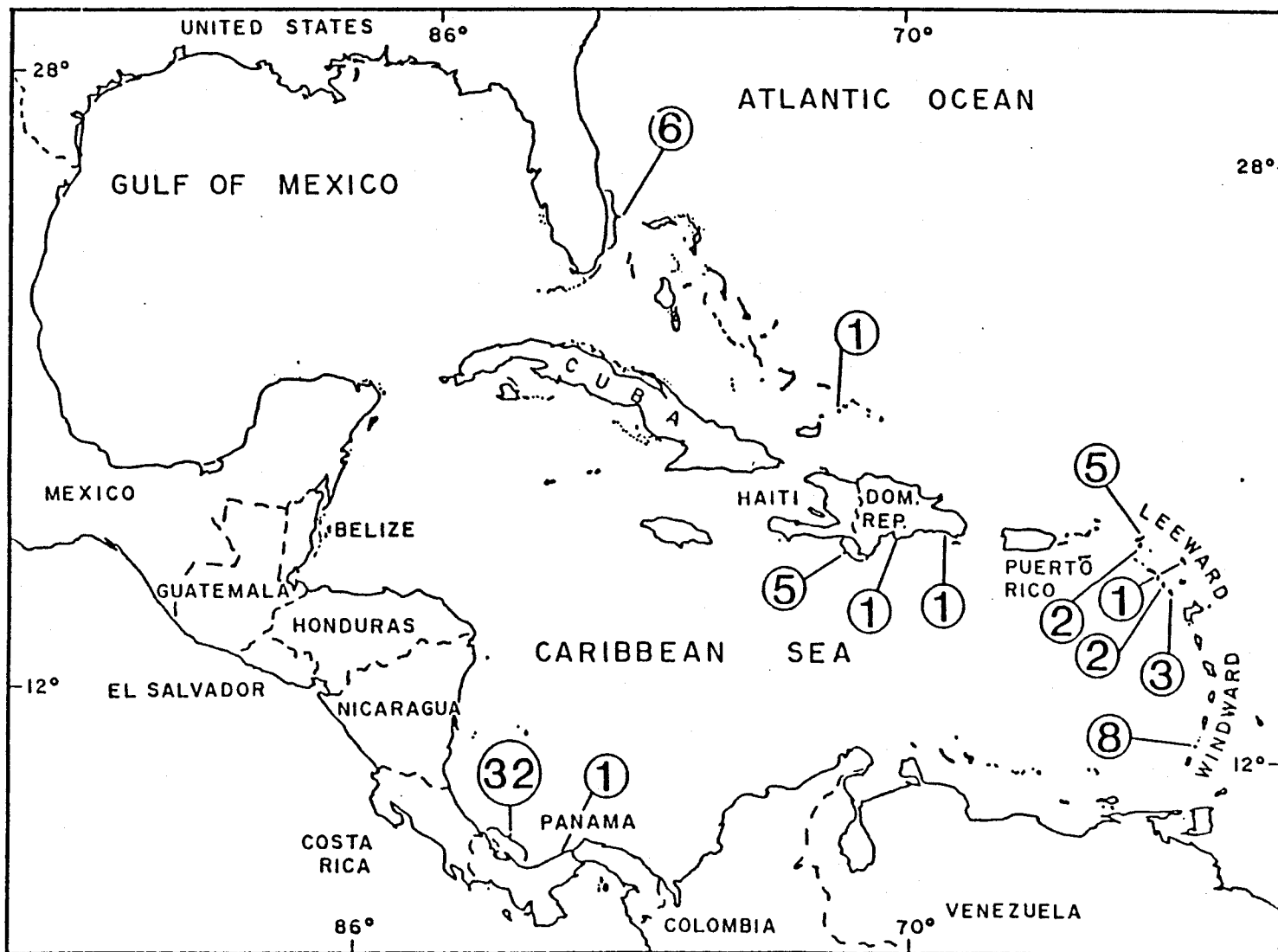


Figure 1. Map of Caribbean. Circled numbers indicate sites of origin of digestive tract samples of *Eretmochelys* used in the study of feeding ecology.

Origins of the samples are as follows:

Bocas del Toro Province, Panama	32
Colon Province, Panama	1
East coast of Florida	6
Pine Cay, Caicos Islands	1
Dominican Republic	7
Anguilla	5
St. Martin	2
Barbuda	1
Redonda	2
Montserrat	3
Carriacou, Grenada	8

The samples were obtained from hawksbills ranging in size from 14-90 cm straight carapace length. Size, sex, and capture information (date, locality, habitat), were collected whenever possible. Small individuals were sexed by gross and histological examination of the gonads when these were available.

Food items in the digestive tracts were identified with the assistance of Dr. Klaus Ruetzler, National Museum of Natural History (sponges); Dr. Nat Eiseman, Steve Blair and Penny Hall, Harbour Branch Foundation (algae); Kurt Auffenberg and David Robinson, Florida State Museum (mollusks); George Burgess, Florida State Museum (fish eggs); and Dr. Frank Maturo, Department of Zoology, University of Florida (bryozoans, miscellaneous invertebrates). Parasites of the digestive tract were identified by Dr. David Blair, University of Canterbury, New Zealand.

Individual food items for each turtle were dried to a constant weight at 105°C and then weighed. This allowed for comparison of percentage composition of the gut contents on a dry weight basis for all turtles.

Results and Discussions

Sponges

Results of the gut analyses were unexpected. Rather than a diverse array of animal prey, the diet of turtles over 23 cm carapace length was made up almost exclusively of sponges. All but one of the 64 turtles in this size range had sponge in the digestive tract. Many samples consisted of little other than sponge. Of the ten orders of Demospongia, only two, the Choristida and the Hadromerida, were well represented in the diet. This is, in itself, remarkable because some of the other orders are extremely abundant on coral reefs. The major genera of sponges found in the digestive tracts of these 64 turtles were Ancorina, Ecionemia, Placospongia, Myriastr, Geodia, Suberites, Chondrilla, Chondrosia, and Tethya. All of these belong to the subclass Tetractinomorpha and are either hadromerids or choristids.

Data from the digestive tract contents suggest that Eretmochelys is a sponge specialist, at least in these areas of the Caribbean. This is a highly unusual feeding niche. Few other marine animals, particularly vertebrates, feed on sponges to any significant extent. Randall and Hartman (1968) investigated the feeding habits of 212 species of West Indian reef and inshore fishes and found only 11 whose diet consisted of 6% or more sponge. The diet of only five of these (four species of angelfish and one false filefish) consisted of more than 33% sponge. The sponge-feeding fish identified in the study are all highly evolved teleosts. Other sponge specialists include some dorid nudibranch mollusks, some amphipods, and several species of starfish.

Explanations in the literature as to why so few animals feed on sponges are essentially two: 1) that the siliceous spicules and/or tough spongin fibers that form the skeletons of most sponges act as mechanical deterrents; and 2) that compounds found in the sponges are chemical deterrents to

potential predators. Sponges contain an unusually diverse array of secondary compounds, or metabolites, that are known to have toxic properties.

A study of the structural, chemical and nutritional characteristics of the species of sponges important in the hawksbill's diet is being carried out as part of my doctoral dissertation project. Parameters being investigated include percentage organic matter, protein content, caloric value, silica content, and collagen content. The purpose of these investigations is to explore various hypotheses as to why the hawksbill focuses on these particular species of sponges. The ultimate biological question to be answered is how hawksbills have been able to invade this nearly empty feeding niche.

Preliminary results indicate that spicules do not serve as an effective deterrent to hawksbills. Choristid sponges are probably the most heavily spiculated group of sponges. Geodia, for example, consists of over 50% silica. The presence or absence of spongin fibers appears to be a more important factor in diet choice. Choristid and hadromerid sponges, which constitute the bulk of the diet, are the only two orders of Demospongia that do not contain tough, proteinaceous spongin fibers. Investigation of the chemical attributes of the prey sponges is still being carried out.

Through correspondence I have learned of incidences of sponge-feeding by hawksbills at other localities in the Caribbean--in Puerto Rico and in the U.S. Virgin Islands. This is in addition to that reported by Carr and Stancyk (1975) for Tortuguero, Costa Rica. There is some evidence from the literature that the sponge-feeding habit of Eretmochelys is more widespread than the Caribbean and Florida. den Hartog (1980) reported sponges from the hawksbill he examined from the Salvage Islands, eastern Atlantic. Sponges are also mentioned as hawksbill food in accounts from Hawaii, Oman, Ascension, the Philippines, and the Seychelles (Witzell, 1983). Systematic sampling would be

necessary to determine their importance at each locality. It seems unlikely that such a highly evolved feeding strategy would be geographically limited.

Habitat

Although the ecological distribution and abundance of sponges in the Caribbean is poorly known, some inferences about habitat occupation of hawksbills can be made from their diet. As a group, sponges are particularly abundant on coral reefs, in some cases rivalling corals in their contribution to reef biomass. Coral reefs are, as previously mentioned, the habitat with which hawksbills are most frequently associated. Sponges are not restricted to coral reefs in their distribution, however. Many species grow on any hard substrates where appropriate light and current regimes prevail. Sponges such as Geodia, Chondrilla nucula and Spheciospongia vesparium grow in a variety of habitats. Spheciospongia, for example, is often found in channels and bays.

Limited evidence of occupation of non-reef habitats by hawksbills was gathered during the surveys. At some localities in Bocas del Toro, Panama, hawksbills are caught around old limestone banks that long ago were living reefs, but today have little or no living coral. In the Leeward Islands, too, hawksbills are caught with some regularity in non-reef habitats. Juveniles, in particular, frequent sandy coastal areas with scattered outcrops of coral rubble, sedimentary rock, or even volcanic boulders. Carr (1952) commented on the presence of hawksbills in mangrove-bordered bays and estuaries along the Pacific coast of Central America. Although hawksbills were not observed in this type of habitat in the present study, it should be noted that some species of sponges that hawksbills feed on are available there, as well.

The extent to which hawksbills use non-reef habitats demands further investigation because of the obvious conservation implications involved.

Identification of these habitats is particularly important in areas where reefs are lacking and most, if not all, of the population is restricted to these alternate habitats, e.g. areas along the Pacific coast of Central America. As far as reefs are concerned, the importance of their protection for the survival of the hawksbill is clear. Hawksbills not only feed there, but also find shelter, spending much of their time sleeping in caves and under ledges. To survive, they depend on filter-feeding sponges which, in turn, require clean water and freedom from water-borne sediments. Thus, the dependence of the endangered hawksbill on a habitat that is itself threatened adds to its precarious survival outlook. ||

Role in reef community

Because the hawksbill is the largest vertebrate predator of a major faunal component of the reef, its role in the reef community deserves careful study. Complex interactions with the community's members are to be expected. On an ecosystem level, sponge-feeding by hawksbills has the potential to affect reef succession. By removing large quantities of sponge from the reef, hawksbills are undoubtedly opening up substrate for settlement of new organisms—particularly the larvae of other benthic organisms. Competition for space is one of the dominant forces shaping community structure of the reef. By promoting turnover of the reef's components, hawksbills are surely, to some extent, promoting its diversity.

Other food items

In addition to sponges, over 50 taxa of marine algae were found in the digestive tract contents. With the exception of a few samples from Bocas del Toro, Panama, algae were present in very small quantities. In many cases, it

was obvious that the algae had been growing on sponges, and had been consumed accidentally. Codium isthmocladum, Lobophora variegata and Dictyopteris delicatula were among the most common species represented.

Over 30 species of gastropod mollusks were found in the samples. They accounted for only a minor fraction of the total dry weight of any sample. Many of the shells were empty or compacted with sediment, suggesting that they had been accidentally consumed with other bottom debris.

A wide variety of other benthic invertebrates was identified from the samples, but even considered together, they formed a very insignificant part of the diet. Most were obviously symbionts of the sponges--ophiuroids, hydroids, snapping shrimp, tiny crabs, etc. Tunicates were found in a few of the samples from Carriacou. Carr and Stancyk (1975) found tunicates to be common in the samples examined from hawksbills at Tortuguero, Costa Rica. Several of the turtles from the Dominican Republic had fed on appreciable quantities of an anthozoan coelenterate tentatively identified as a false coral.

Only very small amounts of seagrass were found in the samples, suggesting that there is little overlap in food resources between hawksbills and green turtles. Adult and subadult green turtles in the Caribbean are known to feed primarily on sea grasses, especially Thalassia (Mortimer, 1981). There is probably little overlap in food resources for small size classes of these two species, as well, although the diet of immature green turtles in the Caribbean has been insufficiently studied. Several green turtles from the Leeward Islands that were examined during the present study showed a preference for seagrasses and algae, and thus were not competing with sponge-feeding hawksbills of the same size.

Patterns in the diet

Although quantitative analysis of the diet samples has not yet been completed, some general statements about patterns in the data can be made. With the exception of four small hawksbills that were found stranded on beaches in Florida, the turtles had remarkably similar diets at all sampling localities. The same genera of sponges predominated throughout; at the species level, there were only minor differences. Panama, the Dominican Republic and the Leeward Islands localities showed greater faunistic affinities with each other, than with Carriacou. Most turtles had eaten a very heterogeneous mixture of sponges.

From the samples, it appears that male and female hawksbills have similar diets except during the nesting season, when females practically cease feeding altogether. The digestive tracts of female hawksbills in reproductive condition were typically very contracted, and contained little but bile-stained fluid. Those that contained food had small quantities of sponge, algae and calcareous material—including several species of calcareous algae, coral and limestone rocks. These materials may serve as a source of calcium, an important constituent of egg shells. Female desert tortoises (Gopherus agassizii) are known to consume calcium-rich sediments during the nesting season (Marlow and Tollestrup, 1982).

Lost-year hawksbills

There is some evidence from the literature and from the surveys conducted in Caribbean Panama and the Eastern Caribbean (see Part II) that hawksbills do not enter coastal feeding habitats until they reach approximately 20-23 cm carapace length. Turtles smaller than that are simply not caught or even sighted by divers, turtle fishermen or coastal residents. As for post-

hatchlings of other species of sea turtles, their whereabouts during this period are uncertain. For this reason, this stage in the life cycle has been called the "lost year". It has been hypothesized that small turtles spend the lost year in the open sea, associated with drifting rafts formed by the alga Sargassum (Carr, 1967a, b). Evidence that this is the habitat of very small green turtles and loggerheads has accumulated in recent years, but there has been little evidence linking post-hatchling hawksbills to this habitat. The contents of the digestive tracts of four small hawksbills (< 23 cm straight carapace length) that washed ashore on beaches in Florida provide some corroboration of this theory. Because the turtles were found stranded on the beach, and had therefore experienced some trauma, caution should be taken in interpreting data from these specimens. However, it is notable, that all four contained fragments of one of the two pelagic forms of Sargassum that form the rafts. In addition to Sargassum, one of the hawksbills (20.2 cm carapace length) contained egg masses of pelagic fish of the suborder Exocoetoidei (flying fish, halfbeaks, needlefish). This is further evidence of a pelagic existence for post-hatchling hawksbills.

Carr (1983) called attention to the vulnerability of young turtles in Sargassum rafts to oceanic pollution. Petroleum products and a wide variety of refuse (styrofoam, plastic beads, plastic sheets, etc.) accumulate in these rafts. The present study provides evidence that young hawksbills not only become fouled externally with petroleum products, but will also ingest these materials. Three of the four stranded hawksbills that were examined had tar in their digestive tracts. Two had tar on their shells; one of these was thoroughly coated, with its mouth and nostrils occluded. All four had plastic refuse of some kind in the digestive tract.

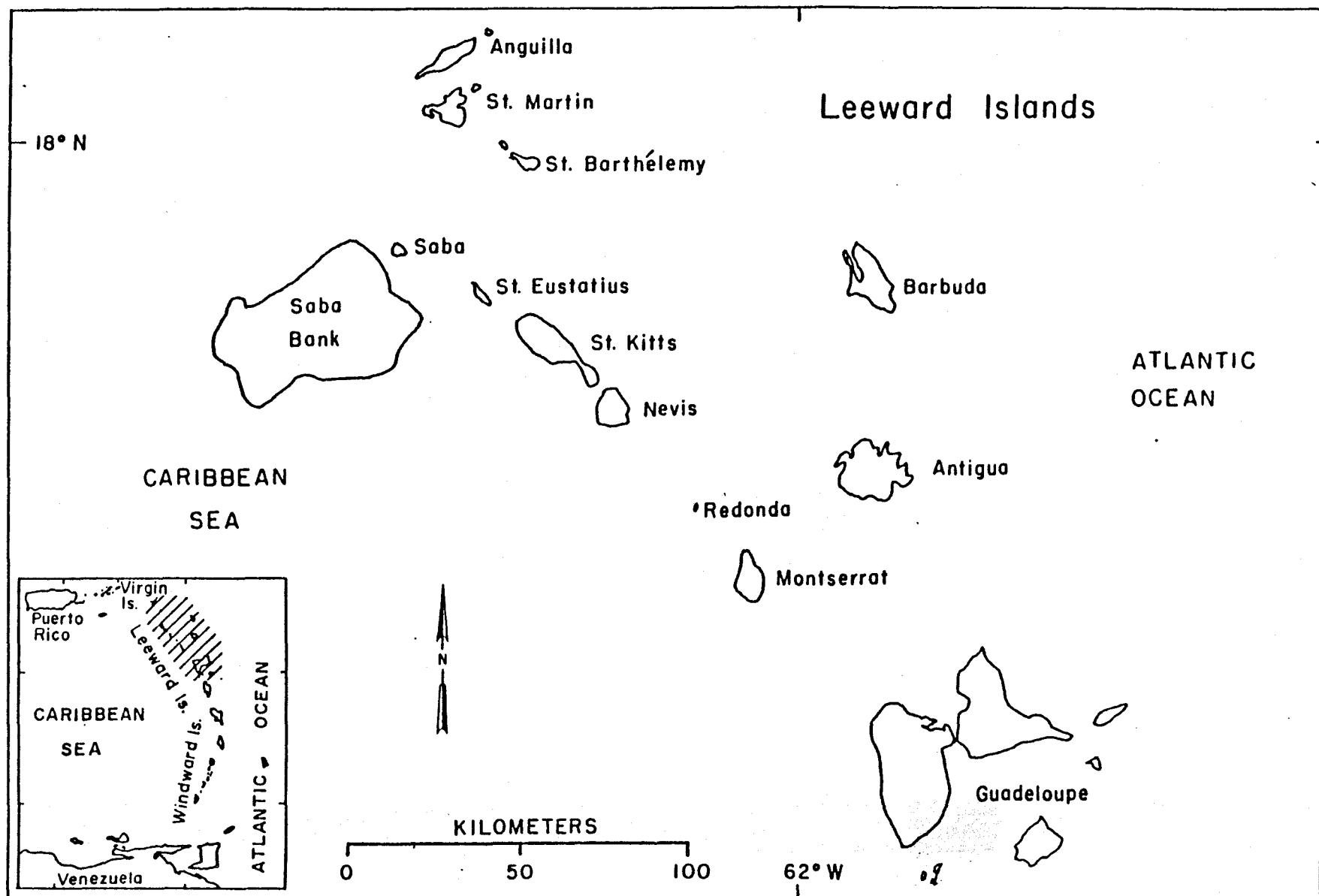
Turtles larger than 23 cm carapace length that were examined during the present study had fed primarily on sponges, suggesting that a major change in the feeding regime may occur at this size. No evidence was seen of any further ontogenetic change once coastal feeding habitats had been entered.

PART II. STATUS AND CONSERVATION OF THE HAWKSBILL TURTLE IN THE CARIBBEAN SEA

A. Eastern Caribbean

Introduction

Shortly before Project 1499 was initiated, a survey of marine turtle populations in the Windward Islands (Fig. 1) was carried out by A. Meylan and P. Meylan as part of a project titled "Surveys of sea turtle populations and habitats in the Western Atlantic" (U.S. National Marine Fisheries Service, Contracts 03-78-D08-0025 and NA 80-GA-C-0071, A. Carr, Principal Investigator). The survey was undertaken to gather preliminary data on the occurrence, distribution, seasonality and habitat occupation of all species of sea turtles that occur in the region. Other than a few scattered nesting records, there was practically no information available on the marine turtle fauna of the area. Concurrent with the initiation of Project 1499, a similar survey, again with funding from NMFS, was begun by A. Meylan in the adjacent Leeward Islands (Figs. 1 and 2). The relevance to Project 1499 of the survey data pertaining to the hawksbill was apparent from the outset, and judged to be necessary background for effective regional conservation action on behalf of this species. For this reason, a limited amount of the funds from WWF was used to expand the scope of the survey of the Leewards to give particular attention to the hawksbill, and to emphasize aspects of the survey bearing on its conservation such as population trends and status, exploitation factors, legislation, protected areas, etc. By extending field time at particular localities in the Leewards, data for the study of the unique feeding ecology of the hawksbill were also collected.



Methods

Survey methods are described in detail in Appendix 1. Information was gathered primarily by interviews with fishermen, fisheries officers, coastal residents, and persons involved in turtle commerce; by surveys of nesting beaches and foraging habitats; and by surveys of public markets, landing areas, fish houses, shops, etc. The schedule of field work was as follows:

Anguilla 9-12 April 1980; 29 Jan.-2 Feb. 1981; 14-15 April 1981
 St. Martin 6-9 April 1980
 St. Barthélemy 12-14 April 1980
 Saba 14-16 April 1980
 St. Eustatius 16-17 April 1980
 St. Kitts/Nevis 17-20 April 1980; 18-21 May 1983
 Barbuda 22-24 April 1980; 8-11 Sept. 1980; 26-28 Jan. 1981
 Antigua 20-22 April 1980; 5-8 Sept. 1980; 28 Jan. 1981; 9-10 May 1982
 Montserrat 28 Aug.-5 Sept. 1980; 22-26 Jan. 1981; 21-25 May 1983
 Guadeloupe 15-18 Dec. 1978
 Dominica 19-23 Dec. 1978; 10-13 May 1982
 Martinique 24-27 Dec. 1978
 St. Lucia 27-31 Dec. 1978; 13-15 May 1982
 St. Vincent 31 Dec.-5 Jan. 1978
 Grenada 5-9 Jan. 1978

Results

The survey data are presented in Appendices 1 and 2. Appendix 2 is excerpted from a National Marine Fisheries Service Technical Memorandum published in 1982. This publication was distributed to fisheries offices and private organizations throughout the Eastern Caribbean as a source document

for the Western Atlantic Turtle Symposium, held in Costa Rica July 17-22, 1983. Appendix 1, which presents data for the Leeward Islands, was published in 1982 in the Atoll Research Bulletin, Smithsonian Institution Press. Copies will soon be available for distribution in the Leeward Islands.

Data presented in these reports are by no means complete, the surveys having been limited by both time and funding considerations. In general, coverage of the large and rugged main islands of the Windward group and of the numerous small islands of the Grenadines was less thorough than that of the more accessible Leewards. Barbados was not included in the survey. For both island groups, a considerably greater investment of time and funds would be needed to corroborate data from informants concerning nesting localities, seasons and levels of abundance. It is hoped that these preliminary survey results will provide a working background for further study, and will stimulate badly needed conservation action on behalf of the marine turtle fauna of the area.

Discussion

Status of Hawksbill Populations in the Eastern Caribbean

Quantitative data on the status and trends of hawksbill populations in the Eastern Caribbean are difficult to obtain, partly because of the unique censusing problems presented by all sea turtles (see Meylan, 1982, for discussion), and partly because so few historical records have been kept. The best indicator of population trends is the pattern of change in the annual number of arrivals of reproductive females at nesting beaches. Unfortunately, these data have not been consistently gathered for any of the beaches in the area. Landing records are also unavailable, except for a few selected years for some of the islands, e.g., 1943-1948 for Antigua; 1948 for Plymouth,

Montserrat; 1959-1968 for Dominica (Rebel 1974). In any case, landing records are subject to many biases and are not reliable indicators of population trends.

The best information currently available on population trends of marine turtles in the Eastern Caribbean is the observations of fishermen who catch turtles for a living, of residents who live along nesting beaches, and of persons involved in the turtle trade. During the surveys, the question as to whether sea turtle populations were stable, diminishing or increasing was posed to people of these categories throughout the Windwards and Leewards. The nearly unanimous response was that they were diminishing. Opinions were based on a wide variety of evidence: number of turtles seen on the nesting beach, availability of turtle meat and eggs in the public market, number caught per day or per season by net fishermen or divers, etc. Examples of decline specifically in reference to hawksbill populations were numerous. Many are given in the individual island accounts in the Atoll Research Bulletin (Appendix 1).

Reports of the scarcity of hawksbills in both nesting and foraging habitats were corroborated by evidence gathered during the surveys. Nesting appeared to be extremely diffuse and sporadic. No areas of concentrated nesting were reported by informants or discovered during ground surveys.

Conservation Problems Presented by the Hawksbill in the Eastern Caribbean

During the course of the surveys, numerous factors were identified as having a negative effect on hawksbill populations in the Eastern Caribbean. These are briefly described here. Their relative importance on each of the various islands is discussed in the accounts of the individual islands (Appendices 1 and 2).

Tortoiseshell trade

Trade in tortoiseshell is responsible for much of the exploitation of the hawksbill in the Eastern Caribbean. Tortoiseshell is crafted locally to produce jewelry and curios for the tourist market, and the raw scutes are exported to Europe and Japan. In recent years, the islands of the Caribbean have begun to supply an increasing percentage of the imports of raw tortoiseshell to Japan, the world's largest consumer. In the 1970's the islands of the Caribbean supplied approximately 25% of this total; in 1980 and 1981, the figure was nearly 40% (Meylan and Mack, 1983, Appendix 3). Several of the Eastern Caribbean islands appear in Japan's import statistics (Table 1), but all appear to engage in the tortoiseshell trade, either directly or indirectly. The volume of trade reported is not large, relative to that reported by countries such as Panama and Cuba, but neither are the hawksbill populations from which the turtles are taken. During the period 1965-1982, the Leeward and Windward islands supplied 1.53% of Japan's worldwide imports of raw shell (calculated from Roet, 1984). Roet (1984) notes that significantly greater imports from Dominica, St. Lucia and the French West Indies were reported by Japan during the period 1977-1982 than in the two preceeding 6-year periods.

The import statistics represent only a portion of total trade in tortoiseshell. Although Japan is the major importer, other countries are involved, and not all provide import statistics. Also, local use of tortoiseshell for the souvenir trade is not recorded.

Because of complex trade routes, the statistics indicating the country of origin of the turtles are often misleading. Tortoiseshell buyers based primarily in Guadeloupe, St. Martin and St. Lucia, regularly make a circuit through the islands, visiting fishermen along even the most remote shores to

Table 1. Recorded Japanese imports of raw hawksbill shell from countries of the Leeward Islands and Windward Islands (1965-1982) (Adapted from Roet, 1984).

Country	Quantity (kg)			Total
	1965-1970	1971-1976	1977-1982	
Barbados	690	1,373	43	2,106
Dominica	0	132	303	435
French West Indies	427	274	1,239	1,940
Grenada	0	631	75	706
Leeward/Windward Is.*	1,583	0	0	1,583
St. Lucia	0	965	1,670	2,635
St. Vincent	0	814	410	1,224
Total	2,700	4,189	3,740	10,629
Total worldwide imports to Japan	206,308	262,196	225,124	693,628

* A previous reporting category that included several Eastern Caribbean islands.

buy raw tortoiseshell. The sale is usually a private transaction, and the tortoiseshell is transported from the country of origin without the knowledge of government officials. In fact, the tortoiseshell may cross many international boundaries before reaching its final destination. One particular case noted during the surveys illustrates this point well. A tortoiseshell buyer in Philippsburg, St. Martin (Dutch), reported buying shell from Anguilla (independent), from both parts of St. Martin (French and Dutch), and from St. Barthélemy (French), for export to a company in Holland. He reported that the tortoiseshell from St. Barthélemy was actually derived from turtles caught in the waters of St. Eustatius (Dutch). The effect of complex trade routes such as these is to obscure the facts as to which hawksbill populations are being exploited. Interviews with tortoiseshell dealers and suppliers during the surveys indicated that no populations in the Eastern Caribbean were immune to this pressure.

Prices paid to the fishermen for tortoiseshell vary markedly from island to island (see Appendices 1 and 2). In 1980, prices in the Leewards ranged from US\$12-100/kg. Approximately 1.5-2.5 kg of shell can be obtained from an adult hawksbill (Roet, 1984).

Much of the hunting pressure on hawksbill populations is stimulated by this strong cash incentive. Hawksbill meat does not contribute significantly to the diet of local people, partly because captures are nowadays so few and unpredictable, and partly because most people prefer the meat of green turtles, which is generally more available.

The principal legislation bearing on trade in tortoiseshell in the Eastern Caribbean is CITES, and this has come into effect in the region only recently. Members of the European Economic Community (EEC) have recently implemented CITES, and one consequence has been that France (and its overseas

departments Guadeloupe and Martinique) has withdrawn its reservation on sea turtles. Thus, neither France nor its departments can import, export or reexport turtle products. This regulation should have an impact on the activities of French tortoiseshell dealers who buy shell throughout the region, and on the large souvenir trade on the French islands. Under the treaty, tourists cannot carry turtle products out of the islands to any country other than France. Whether this new legislation will improve the survival status of the hawksbill in the Eastern Caribbean will obviously depend upon how actively it is enforced.

Another development that should have positive repercussions on the tortoiseshell trade is the signing of CITES by the Netherlands in the spring of 1984. Japan reported imports of 20,563 kg of raw tortoiseshell from the Netherlands during the period 1965-1982 (Roet, 1984). The origin of this tortoiseshell is not stated, although Roet speculates that it may have come from the Netherlands Antilles. There is no question that at least some of it has come from these islands. A tortoiseshell dealer interviewed on St. Martin did not hesitate to say that he exported to a company in Holland. It is not clear how the joining of CITES by the Netherlands will affect the tortoiseshell trade within the Netherland Antilles, inasmuch as the island group is semi-autonomous, but the closing of the market provided by the Netherlands can only have a beneficial effect. ||

Exploitation for the souvenir trade

Another major pressure on hawksbill populations in the area is harvest for the souvenir trade. Polished carapaces of hawksbills, particularly juveniles, are sold widely, both in shops and directly by fishermen to tourists. The major souvenir markets are on the islands most developed for tourism (e.g., Antigua, Guadeloupe and Martinique), but turtle souvenirs are

Souvenirs
#

available on every island in the region. Tortoiseshell jewelry and artifacts are manufactured by local artisans, and on Guadeloupe and Montserrat, by prison inmates. Stuffed and polished hawksbills are sold on Guadeloupe and Martinique for very high prices. A stuffed hawksbill 43 cm in carapace length that was seen at the airport in Fort de France was priced at \$US 200.

Turtles for the souvenir trade are often harvested from the waters of islands that do not have such a market, and in some cases, from outside the Caribbean. In 1979, a ship seized by U.S. custom agents in Puerto Rico, was carrying hawksbill curios from the Philippines to Guadeloupe. The fact that turtles were being brought into the area from outside suggests the magnitude of the souvenir trade, and is possibly an indication of local depletion.

There are encouraging signs that the ban by the United States on importation of turtle products by returning U.S. residents has helped reduce the volume of the souvenir trade on some islands. In May, 1983, shopkeepers on Nevis and Montserrat attributed a drop in sales of turtle souvenirs to this legislation. They had reduced their stocks, and divers reported a consequent decline in their hunting efforts. Unfortunately, many of the area's tourists are from other countries (including some CITES signatories) which do not actively discourage this trade.

Within the islands, there are no national laws regulating the use of turtles in the tourist trade, nor is the trade monitored in any way. The closed season restriction for capture of turtles or sale of meat does not apply to sales of turtle souvenirs.

Killing of hawksbills on the nesting beach

Nesting habitat for hawksbills is limited on many of the islands of the Eastern Caribbean, particularly those of volcanic origin. The beaches that do exist are often near villages, and human traffic is consequently heavy. An

alarming realization during the surveys was the nearly complete surveillance of beaches, and the widespread poaching of nesting turtles of all species. Hawksbills rarely nest unobserved, except during very bad weather or on inaccessible beaches (which are few). Moreover, even when turtles do nest undisturbed, the track left in the sand from the emergence cues egg poachers to the nest.

Most islands in the region, with the exception of Dutch St. Martin, St. Eustatius and Saba, have legislation protecting female turtles on the beach (Table 2). Unfortunately, even where this legislation exists, it is rarely enforced. The explanation most frequently given by fisheries personnel is lack of manpower and funds. Most of the islands have a single fisheries officer who is in charge of supervising all fisheries. Even where there are sufficient manpower and funds, the task of protecting nesting hawksbills is a difficult one, because of their diffuse nesting distribution and protracted season. To a certain degree, however, lack of enforcement can more accurately be traced to the failure of government officials to recognize the need to protect the resource. Sea turtles are often regarded as an unimportant resource.

Spearfishing

The traditional method of catching turtles in the Eastern Caribbean is with large-mesh tangle nets. In the past, a relatively small number of fishermen on each island specialized in their use, and invested considerable time and effort in learning how and where to set them. Only large subadult and adult turtles were usually captured, because smaller turtles could pass through the net. Today, the turtle net fishery is dying out. It has been largely replaced by fishing with spearguns, which are widely available. Spearguns are not only more effective in capturing turtles, but they also

allow a wider range of size classes to be captured. Turtles are usually taken incidental to fishing for reef fish and lobster, and consequently, more fishermen are involved in their capture. The older generation of net fishermen attribute the decline in turtle populations to the advent of spearfishing.]

Habitat destruction or degradation

Construction and other human activities. The development of tourism on islands such as St. Martin, Antigua, Montserrat, Guadeloupe, Martinique and St. Lucia, has spurred rapid construction of hotels and condominiums on beaches. On St. Martin nearly every beach has been developed. Associated with this development are sea walls, artificial lights, and human traffic--activities that deter turtles from nesting. Artificial lights are also known to disorient hatchlings emerging from their nests. Throughout the surveys, people who were interviewed reported declines in nesting levels associated with beach development.

A relatively easy measure that can be taken to mitigate the effects of artificial lights is to shield or eliminate those that face the sea. A voluntary program to do this along Florida's east coast nesting beaches has recently been initiated.

↙ Sandmining. It is common practice in the eastern Caribbean to use beach sand for building construction purposes. Usually, the beach nearest the construction site serves as the source. Effects on turtles can be direct, by disturbing incubating eggs; or indirect, by promoting erosion or other physical damage to the beach. ECNAMP (1980) provided a partial list of sandmining sites for each of the Lesser Antilles. During the surveys, sandmining was evident on beaches known to be used for nesting by turtles

at: Anse Lavoutte and Grande Anse on St. Lucia; Hurricane Hill Beach and Indian Castle on Nevis; Sandy Point on St. Kitts; and Fox Bay and Farm Bay on Montserrat. This is undoubtedly only a partial list of nesting beaches affected by this practice.

There are relatively easy solutions to this problem. Sandmining can be restricted to beaches not used for nesting by turtles, or to times outside the nesting and hatching season.

Dynamiting and bleaching of reefs. Fishermen on some of the Eastern Caribbean islands use dynamite or bleach to drive fish out of the reef. ← Although these are highly illegal practices, understaffed fisheries departments are unable to completely curtail them. For the reef-dwelling hawksbill, destruction of the reef habitat has obvious consequences.

Oil pollution. Because of their proximity to oil shipping routes, many of the windward (eastern) beaches of the Eastern Caribbean islands are periodically fouled with various forms of seaborne petroleum products. During the surveys, weathered oil was observed on turtle nesting beaches on Nevis, Dominica and St. Lucia. Although a preliminary study on the effects of petroleum on marine turtles concluded that weathered oil had no detectable effects on developing turtle embryos, the same study found that fresh crude oil added on top of sand that covered incubating eggs caused significant embryonic mortality (Fritts and McGehee, 1982). The potential for a spill that would deposit fresh oil on Eastern Caribbean beaches is very real.

Oil can also severely damage feeding areas for turtles such as reefs, seagrass beds, and floating rafts of the pelagic alga Sargassum. There is limited evidence that these rafts are the habitat occupied by hawksbills of post-hatchling size. Three of four small (less than 23 cm carapace length)

hawksbills that stranded along Florida's east coast and were examined during the present study had both Sargassum fragments and oil droplets in their digestive tracts. Two had oil externally; and the mouth of one was tarred shut.

Inadequate legislation and enforcement

Laws pertaining to sea turtles in the Leeward and Windward islands are given in Tables 2 and 3. Most of these regulations were written decades ago, and were based on extremely limited knowledge of the marine turtle fauna. Population levels of some species have changed markedly, and pressures on existing populations have multiplied since these regulations were formulated. A fundamental defect of the legislation is the failure to take into account biological differences among the various species. For example, the 3 to 4-month closed season fails to protect hawksbills adequately, because the protracted nesting season lasts for six months or more. Differences in growth rates and size at sexual maturity make a single minimum capture size for all species of questionable value. In any case, many turtle biologists would question the rationale of emphasizing the protection of small turtles, and would instead argue for increased protection of females of reproductive size. This follows from the recent discovery that marine turtles grow very slowly, and reach sexual maturity only after a very long period. This makes reproductive females extremely important members of the population.

Although knowledge of marine turtle biology has advanced considerably in recent years, there has been only limited effort to incorporate this knowledge into the body of protective legislation. An opportunity to do this may exist in the Eastern Caribbean. In the fall of 1983, the regional office of FAO in Barbados was engaged in preparing guidelines for fisheries legislation for several countries in the Eastern Caribbean. The draft section for marine

Table 2. Legislation pertaining to marine turtles in the Leeward Islands, Lesser Antilles.

	<u>Date of Legislation</u>	<u>Species Protected</u>	<u>Closed Season</u>	<u>Minimum Capture Size</u>	<u>Penalty for Violation</u>
Anguilla	1948 (revised 1977)	all species	1 June-30 Sept (turtles, eggs)	>9 kg	Fine <US\$37 Forfeiture of goods, equipment
St. Martin	Neth.-none Fr. see Guadeloupe				
St. Barthélemy	see Guadeloupe				
Saba	none				
St. Eustatius	none				
St. Kitts	1948	all species	1 June-30 Sept. (turtles, eggs)	>9 kg	Fine <\$US9 Forfeiture of goods, equipment
Nevis	"	"	"	"	"
Barbuda	1927 (revised 1962)	all but <u>Caretta</u>	1 June-30 Sept. (turtles, eggs)	>9 kg	Forfeiture of goods, equipment
Antigua	"	"	"	"	"
Montserrat	1951	all species	1 June-30 Sept. (turtles, eggs)	>9 kg	Fine <\$US18 Forfeiture of goods, equipment
Guadeloupe	1979	<u>Chelonia</u> <u>Eretmochelys</u> <u>Dermochelys</u>	15 May-15 Sept. (<u>Chelonia</u> , <u>Eretmochelys</u>) year-round (<u>Dermochelys</u>) year-round (eggs, all spp.)	>60 cm carapace length (<u>Chelonia</u> & <u>Eretmochelys</u>)	

Table 3. Legislation pertaining to marine turtles in the Windward Islands, Lesser Antilles.

	<u>Date of Legislation</u>	<u>Species Protected</u>	<u>Closed Season</u>	<u>Minimum Capture Size</u>	<u>Penalty for Violation</u>
Dominica	1976	all species	1 June-30 Sept (turtles) year-round (eggs)	>9 kg	
Martinique	1927		year-round (eggs)		
St. Lucia	1971	<u>Chelonia</u> <u>Eretmochelys</u>	1 May-31 August (turtles, eggs)	≥6.8 kg	Fine ≤ \$US 93 Forfeiture of goods, equipment
St. Vincent	(information incomplete)		1 May-31 August (turtles, eggs)		
Grenada	(information incomplete)		(turtles, eggs)		

turtles was circulated to members of the steering committee and technical team of the Western Atlantic Turtle Symposium for comment. The proposed regulations were, unfortunately, far from satisfactory. They were virtually identical to those formulated 50 years ago. A number of sea turtle biologists sent comments to FAO urging a comprehensive overhaul of the legislation. As yet, however, no further action has been taken. This would appear to be an ideal opportunity to promote unilateral conservation action on behalf of marine turtles in the Eastern Caribbean. The IUCN Marine Turtle Specialist Group could be enlisted to advise FAO in the revision of this legislation. The new guidelines could then be sent to interested countries through existing FAO channels.

Lack of sanctuaries

As shown in Tables 4 and 5, there are very few protected marine areas in the Eastern Caribbean. Moreover, only a portion of them are of relevance to hawksbills. Palaster Reef Marine Park of Barbuda and Diamond Reef Marine Park of Antigua include potential foraging habitat for hawksbills although occupancy was not investigated during the surveys. Several of the proposed marine parks such as the southern peninsula of St. Kitts, Tobago Cays of St. Vincent, and Douglas Bay/Toucari Bay of Dominica, could benefit hawksbills if specific regulations for their protection were included.

Table 4. Locations of marine parks and protected areas in the Leeward Islands, Lesser Antilles.

	<u>Existing</u>	<u>Proposed</u>
Anguilla	None	Seal Island Reserve, Sandy Island, Shoal Bay
St. Martin	None	Guana Cay, Molly Beday, Hen and Chicken, Cay Bay, Man O'War Shoal
St. Barthélemy	None	None
Saba	None	None
St. Eustatius	Jenkins Bay	None
St. Kitts	None	Southeastern peninsula
Nevis	None	None
Barbuda	Palaster Reef Marine Park	Codrington Lagoon
Antigua	Diamond Reef Marine Park	Guiana Island to Great Bird Island; Fisher's Hill to Proctor's Point
Montserrat	None	None
Guadeloupe	Ilets à Goyaves	Grand Cul-de-Sac Marin

Source: ECNAMP 1980, 1982; A. Putney, in litt.

Table 5. Locations of marine parks and protected areas in the Windward Islands, Lesser Antilles.
Source: ECNAMP (1980)

	Existing	Proposed
Dominica	none	Douglas Bay/Toucari Bay
Martinique	none	vicinity of Les Anses d'Arlet
Saint Lucia	none	Pigeon Island north of Fond d'Or Bay Savannes Bay to Maria Islands southern tip of Vieux Fort peninsula Anse des Pitons Anse Mamin
St. Vincent	Milligan Cay Buccament Bay	Young Island Tobago Cays
Grenada	Sandy Island (Carriacou)	vicinity of Levera, Green and Sandy islands

Recommendations for the Conservation of the Hawksbill in the Eastern Caribbean

1. Prohibit the export of tortoiseshell.
2. Discourage or prohibit the use of hawksbills and other sea turtles in the souvenir trade.
3. Prohibit the use of spearguns and SCUBA for capturing hawksbills and other sea turtles.
4. Revise legislation protecting turtles (possibly through the IUCN Marine Turtle Specialist Group and the regional FAO office in Barbados).
5. Enforce turtle regulations, particularly those protecting reproductive females.
6. Establish protected areas for hawksbills that include nesting and/or foraging habitats.
7. Prevent degradation of nesting beaches and foraging habitats.
8. Encourage the Netherlands Antilles to establish protective legislation for turtles at St. Martin, Saba and St. Eustatius.
9. Encourage airlines and cruise ship lines operating in the Eastern Caribbean to advise tourists of laws pertaining to the purchase of endangered species products.

B. Bocas del Toro Province, Panama

Surveys

One of the principal sites for the study of the feeding ecology of the hawksbill was Bocas del Toro Province, Panama. Samples were collected from subsistence fishermen at a number of localities around the province. Concurrently, surveys of the distribution, status and habitat occupation of the four species of marine turtles that occur there were conducted for the U. S. National Marine Fisheries Service. This province is of particular importance as hawksbill territory, providing nesting, foraging, migratory and developmental habitats. The survey work included multiple aerial surveys of the coastline of the province, a single survey of the entire Caribbean coastline of Panama, and repeated ground surveys of selected beaches on Isla de Colón, Isla Bastimentos, Cayos de Zapatillas and on the mainland between Playa Chiriquí and Old Bess Point. Results of these surveys were published in a NMFS Technical Memorandum (Carr et al., 1982). A final report on the survey data collected in the province has not yet been prepared.

Status of Hawksbill Populations

Bocas del Toro Province has historically been a center of exploitation of marine turtles, particularly the hawksbill and green turtle. Early explorers of the Caribbean coast of Central America bartered for tortoiseshell here as early as 1817 (Roberts, 1827). In more recent years, these two species have, in addition, been the targets of a moderately intensive subsistence fishery. No catch statistics are available for this fishery. There are records of international trade in tortoiseshell, dating back to 1965 (Table 6). These document heavy, sustained exploitation. A significant portion of the tortoiseshell is believed to originate in the Province of Bocas del Toro.

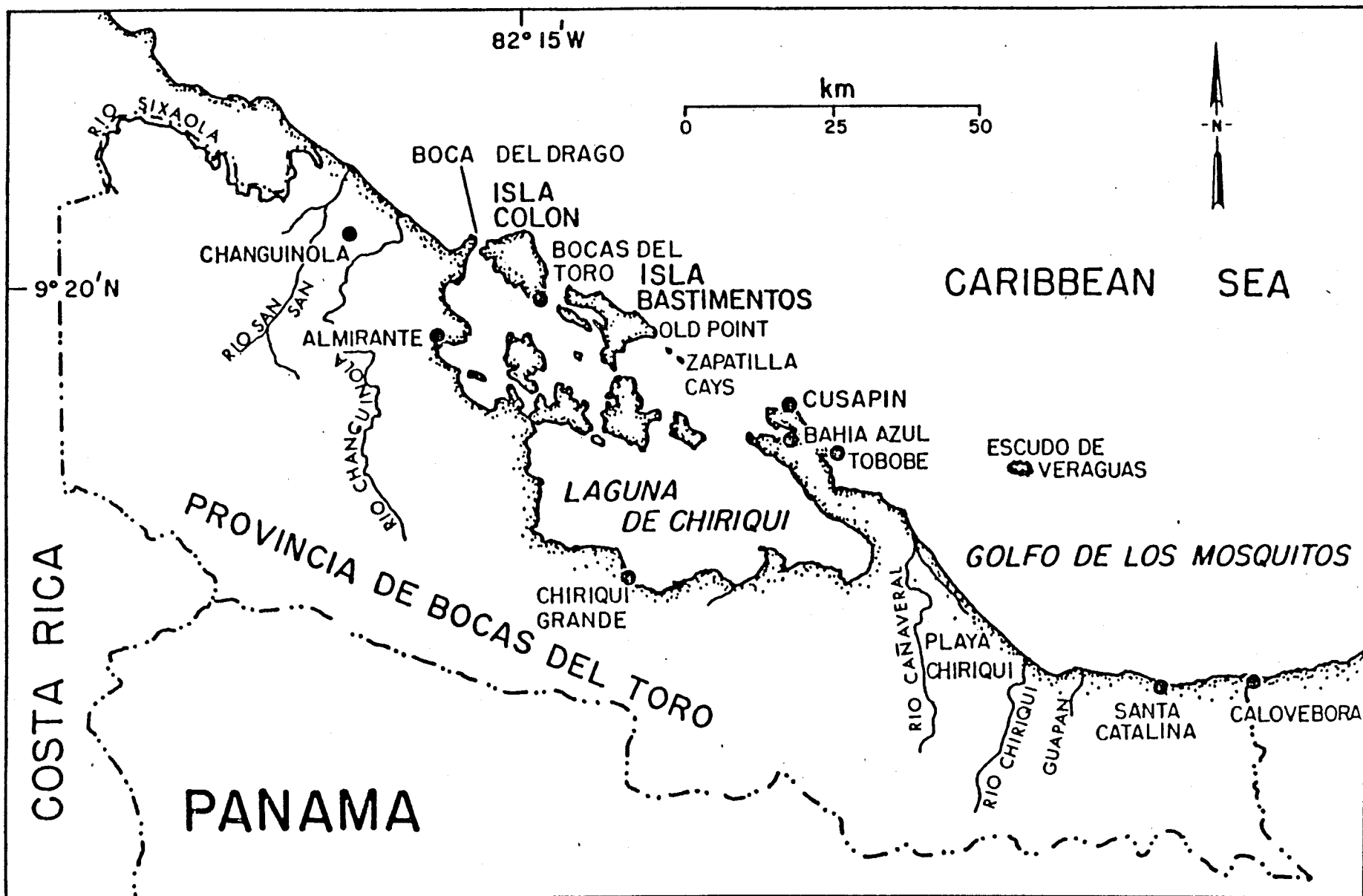


Figure 3. Map of Bocas del Toro Province, Panama.

Table 6. Japanese imports of unworked hawksbill shell from Panama (1965-1983)

Year	Quantity (kg)	Declared import value (1000 yen)	Exchange Rate*	Value \$U.S. (per kg.)	Declared import value (1000 \$U.S.)
1965	9,357	44,599	360.00	13.24	123.887
1966	11,998	60,102	360.00	13.91	166.892
1967	9,866	52,282	360.00	14.72	145.228
1968	8,259	46,206	360.00	15.54	128.345
1969	12,189	73,100	360.00	16.64	202.825
1970	10,744	78,882	360.00	20.39	219.070
1971	11,981	102,202	349.33	24.42	292.576
1972	8,389	92,553	303.17	36.39	305.276
1973	8,990	261,024	271.70	106.86	960.671
1974	9,350	187,915	292.08	68.81	643.374
1975	9,313	145,194	296.79	52.53	489.211
1976	5,885	125,713	296.55	72.03	423.897
1977	4,450	108,746	268.51	91.11	405.440
1978	6,505	111,174	210.44	81.21	528.271
1979	4,810	237,014	219.14	224.86	1,081.577
1980	3,360	152,318	226.75	199.92	671.731
1981	3,011	84,808	224.68	125.36	377.459
1982	2,243	64,268	259.68	110.34	247.493
1983	3,889	130,891	234.25	143.68	558.772
144,589				55.14	7,971.995

* Exchange rate: Based on 1984 International Financial Statistics (IFS). For 1965-1980 the exchange rate is based on the average exchange rate for that year. For 1981-1983 the exchange rate is based on the average exchange rate for the last quarter of that year.

Source: E. Roet, Center for Environmental Education, unpublished compilation of statistics reported by Ministry of Finance, Japan.

This exploitation has had severe consequences. Hawksbill populations are now badly depleted. This is indicated by the small numbers of hawksbills that fishermen now catch with nets and harpoons, and by the scarcity of hawksbills nesting on beaches in the province. Chiriquí Beach, once a site of aggregated nesting, now supports only a remnant population. On other beaches in the province, hawksbills nest in very low density, and are, in most instances, captured before laying their eggs.

Conservation problems

In the course of carrying out Project 1499 and the above-mentioned surveys, a number of factors were identified as having an adverse effect on hawksbill populations there. These are described here briefly.

Tortoiseshell trade

The greatest threat to hawksbill populations in Bocas del Toro Province, and in all of Panama, is international trade in tortoiseshell. Panama is one of the largest exporters of tortoiseshell in the Caribbean. Table 6 presents data on the importation of tortoiseshell to Japan from Panama during the period 1965-1983. During these years, a total of 144,589 kg of tortoiseshell was declared. Based on the estimate that a single hawksbill yields on average 1.5-2.5 kg of shell (Roet, 1984), this represents between 57,836-96,393 turtles.

Prices paid directly to fishermen for raw tortoiseshell are as high as U.S. \$110/kg. This cash incentive places extraordinary pressure on the hawksbill population and encourages coastal inhabitants to ransack even the most remote nesting beaches. As a consequence, few hawksbills return to the water after nesting.

The system of transporting raw tortoiseshell from places of capture to markets in Colón, for eventual export to Japan, is well organized. Fishermen sell the raw scutes directly to dealers in the town of Bocas del Toro, or to middlemen who operate cargo boats that travel along the coast between Bocas and Colón. Colón appears to be the main destination of the goods, although some travels by plane via Bocas del Toro to Panama City.

CITES
violations

Panama is a signatory of CITES and as such is prohibited from engaging in international commerce in products of endangered species. In spite of this, exports of tortoiseshell from Panama to Japan have continued at least through 1983, when 3,889 kg of tortoiseshell was declared (Table 6).

In the spring of 1984, a film team for the BBC series Nature filmed a short documentary about the tortoiseshell trade in Caribbean Panama. Background information for the film was provided by the author, and a brief interview discussing the survival situation of the hawksbill in Panama was filmed in Gainesville. Other interviews were then filmed with a tortoiseshell dealer in Bocas del Toro, and with officials of the wildlife agency Recursos Naturales Renovables, in Panama City. The latter is charged with protecting Panama's sea turtles. An official of the agency expressed the hope that Japan would cease importing tortoiseshell from Panama, and explained the difficulty that the trade imposes on his agency in its obligation to protect the hawksbill. The film was televised in Britain in May, and will eventually be made available for distribution.

Subsistence use

Although the primary motive for capturing hawksbills in Panama is to obtain tortoiseshell, meat and eggs are also widely used. During certain times of the year, both are sold in the public market in Bocas del Toro. Turtle meat is particularly important as a source of protein along the Costa

In the summer of 1982, an ad hoc advisory committee consisting of experts from a variety of scientific and technical fields was established to focus attention on the environmental problems posed by the pipeline, and to serve on a volunteer basis as scientific advisors to the oil companies and the pipeline builder, Petroterminal. In September 1982, a presentation was made to representatives of these companies in Panama City, to alert them to the threats that the pipeline poses to the marine turtle fauna. In April 1983, data on the nesting and foraging distributions of marine turtles in the vicinity of the terminal was provided, on request, for incorporation in environmental sensitivity index maps.

Beyond this, the success of the ad hoc committee in improving the environmental prospects of the project was limited. The oil companies expressed concern for the protection of the environment, but their actions belied a weak commitment. Neither they nor Petroterminal were willing to take the measures necessary to guarantee its protection. In May 1984, a BBC film team fortuitously obtained footage of a several week-old spill in the lagoon, and included it in a feature in their documentary series Nature. Because of the remoteness of the terminal and Chiriqui Lagoon, spills such as this ordinarily would go unnoticed by the outside world. This lack of surveillance is one of the most serious problems concerning the pipeline. What is urgently needed is an independent, long-term monitoring program to study the effects of the pipeline and its associated activities. Such a program is essential to preserve the environmental integrity of the habitats on which coastal peoples and turtles, alike, depend.

Inadequate legislation

The hawksbill is not included in Panama's national turtle legislation. The reason for this is not clear, because it is considered an endangered

species, by a government resolution dated 24 January 1980 (N° DIR-002-80). Plans to implement protection by adding the hawksbill to the legislation that currently protects the green turtle have been under consideration for several years, but have failed to materialize.

As mentioned previously, the hawksbill has not been afforded much protection by Panama's membership in CITES. The volume of trade in tortoiseshell continues to be extraordinarily large.

Lack of sanctuaries

Long Beach, on Isla Bastimentos, is a sanctuary for marine turtles. This 10 km beach is an important nesting area for hawksbills, as well as for leatherbacks. Because of its remoteness, however, protection of turtles is difficult to enforce, and poaching of nesting hawksbills is consequently very heavy.

This is the only sanctuary in the province. Several additional sites, including marine areas, deserve consideration. A sanctuary that would include Long Beach and additional nesting beaches on Isla Bastimentos and the adjacent Zapatilla Cays, as well as the surrounding reefs and seagrass beds, would tremendously benefit several species of marine turtles (Fig. 3).

Chiriquí Beach, which extends between Río Cana and Río Chiriquí, also deserves consideration for protected status. This area was once a site of aggregated nesting by hawksbills. Although reduced to very low levels today, the population could possibly recover, if given rigorous immediate protection. Chiriquí Beach is also an important nesting site for leatherbacks. Survey data collected in 1980-1983 indicate that the colony that nests there may be one of the largest in the Caribbean (Meylan et al., in press).

Recommendations

1. End the export of tortoiseshell from Panama through vigorous enforcement of CITES.
2. Reduce subsistence take of hawksbills by adopting and enforcing protective national legislation. Nesting turtles, in particular, need total protection from capture.
3. Establish a long-term, independent monitoring program near the Caribbean terminal of the trans-isthmus pipeline to study its environmental effects.
4. Establish additional sanctuaries in Bocas del Toro Province that include nesting beaches and foraging areas for hawksbills.

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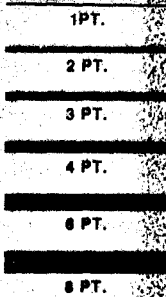
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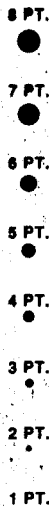
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RULES



BULLETS



LEADING GAUGE



ASHTON-TATE
BYLINE

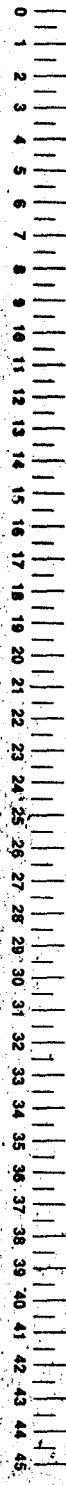
METRIC



INCHES



PICAS



POINTS



POINT GAUGE

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