Patrick H. Berry.

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SURVEYS OF SEA TURTLE POPULATIONS AND HABITATS IN THE WESTERN ATLANTIC

Archie Carr, Anne Meylan, Jeanne Mortimer,
Karen Bjorndal, and Thomas Carr

March 1982

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southeast Fisheries Center
Panama City Laboratory
3500 Delwood Beach Road
Panama City, Florida 32407-7499

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Malcolm Baldrige, Secretary
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John V. Byrne, Administrator
National Marine Fisheries Service
William G. Gordon, Assistant Administrator for Fisheries

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PREFACE

This is a preliminary report of a survey to assess population levels and identify critical habitats of the five genera and six species of sea turtles (Chelonia mydas, green turtle; Eretmochelys imbricata, hawksbill; Caretta caretta, loggerhead; Lepidochelys kempi, Kemp's ridley; L. olivacea, olive ridley; Dermochelys coriacea, leatherback) that occur in the American Atlantic. Results of this investigation will provide grounds for subsequent efforts to determine recent population changes and their causes and for plans by which the species can be graduated from their present endangered and threatened status.

This report presents results of field research conducted by the Caribbean Conservation Corporation under two consecutive contracts with the National Marine Fisheries Service. The periods of the work extended from May, 1978 through April, 1980, and from May, 1980 through August, 1981. The data obtained came from aerial and ground surveys and from an exhaustive series of standardized interviews with all persons who seemed likely to contribute useful information on occurrence, ecology, density, and density trends in the local sea turtle populations. In some cases the same geographic area was surveyed more than once. Because these are interim reports, complete coverage of the literature on marine turtles of the Caribbean area was not attempted.

Field personnel for the project consisted of: Karen Bjorndal, David Carr, Peggy Carr, Thomas Carr (field manager during the first quarter), Anne Meylan, Peter Meylan, Jeanne Mortimer (managing editor and cartographer, 1980 interim report), and Archie Carr (Principal Investigator). Special contributions to the survey were made by Larry Ogren, Guillermo Cuellar, and Argelis Ruiz. Lynda Whitaker served as recording secretary for the project.

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Surveys of Sea Turtle Populations and Habitats in the West Atlantic

Interim Report to
National Marine Fisheries Service

April 1980

Introduction

Although none of the species of sea turtles in the Caribbean has become extinct, all are represented by remnants of once extremely abundant populations. The major decline in their numbers took place long before the current concern over endangered and threatened species. The changes that have occurred during the last few decades are relatively minor, compared with those of previous centuries. Destruction of green turtle and hawksbill colonies, especially, began with the very earliest explorations and has continued for 300 years. The abrupt decline of Kemp's ridley came much later, but has been cataclysmic. Destruction of loggerheads and leatherbacks has been less drastic, but even they have been reduced or depleted over wide areas. This historical background of drastic reduction must be understood if existing populations are to be given the appropriate attention that will avert continued losses. Efforts to assess west Atlantic sea turtle populations and the factors involved in their survival and rehabilitation are essential.

An important extension of our original work plan, one that ought to be part of any new phase of the West Atlantic Survey, is to recognize the vital importance of longshore current systems and weed-line shears as habitats to be surveyed - wherever this can be done without unreasonable outlay for ship time. An understanding of shear-line geography is critical to the search for the "lost" post-hatchling stage of sea turtle ecology, as are also the places and times at which the juveniles leave that stage and invade the benthic littoral habitats in which they mature. Until this information is available our knowledge of the life cycle is seriously incomplete, and effective conservation is handicapped. To achieve better knowledge of shear-line distribution and seasonality seems essential to an understanding of sea turtle ecology.

Another important aspect of the biology and ecology of these turtles that should be investigated is their reaction to winter temperatures in the temperate zone extensions of their ranges. These areas should be searched for hibernation sites and other evidence of overwintering. As more is learned of the seasonal distribution of size groups, overwintering may prove to be increasingly likely in some populations.

The most important remaining geographic gaps in coverage of the region we set out to investigate are the island of Cuba, parts of the Bahamas, the Honduranian Miskitia, the Nicaraguan mainland shore, the Guajira Peninsula of Colombia and Venezuela, and the smaller islands and banks of the western Caribbean. That Cuba and the Guajira will be adequately surveyed at any early date seems unlikely. Most of the other areas will be visited in new phases of the survey, however, and additional field work will be done at some of the nesting grounds to determine seasonal changes in density. Work in Brazil projected in our original contract proposal was deferred because of word that Surinam and Brazil were undertaking a joint program of surveys and tagging along the entire Brazilian coast and on the offshore islands. We have been invited to join that group, to collaborate in both the habitat assessment and the planned tagging projects.

Procedure

Although the work under the present contract has made a useful contribution to knowledge of American sea turtles, we did not reach the firm ground hoped for in quantifying habitat occupancy by the different species and stages of the life cycles of the turtles. Our previous interim report included a matrix in which a prevalence grade for every locality was assigned to each ecologic or developmental stage of every marine turtle species that occurred there. The aim was to extend this system of grading to the whole territory. The more we learned about the fauna, however, the more difficult it became to make relative assessments of the kind the matrix required, simply because actual head counts were impossible in almost every stage of the life cycles of sea turtles. When more of the geographic and seasonal gaps have been filled by later phases of the work, another tabulation of gradings will be attempted. Meanwhile, in the present report, a simpler graphic grading scale was used in the accompanying distribution maps.

Nesting Ground Surveys

Virtually the only means of making valid numerical assessments of marine turtle populations is to count female turtles or their nests on the breeding beaches, and even this procedure is beset with difficulties. As interest in marine turtles spreads, however, increasing numbers of people aspire to make nesting censuses. To learn simply where nesting occurs, flying low along the coast in an airplane during the nesting season suffices. To translate aerial track counts into estimates of population size is a more complicated procedure.

As a purely exploratory procedure, aerial surveys demand no special knowledge, beyond an elementary understanding of sea turtle biology. The first requirement is to be sure of the identity of the species that has made the tracks. If the proper signs are kept in mind, this is usually possible, and often it is no trouble at all. The tracks of big turtles, *Chelonia* and *Dermochelys* for example, are naturally wider and more deeply cut than those of small species, and are more likely than the other three genera to lead to conspicuous body pits. A second requirement is to distinguish tracks leading to actual nest sites from trial crawls. Still another is to judge the time-span over which the tracks have accumulated. Were they all made last night, or since last Thursday, or when? Useful judgments depend on a number of factors.

The time of the last obliterating rain must be known. The state of the tidal cycle on the surveyed shore can be important, and so may the time of the last strong winds. Aerial track counts are more successful if flights are made before 0800 or 0900. Even then, however, it is not always easy to distinguish crawls leading to nests with eggs from those marking sites that have been prospected and abandoned. This is an important source of error, and the count must be refined by factoring in a trial-crawl ratio, even if this is an estimate.

In surveying or censusing nesting grounds, one should be aware that sea turtles, with the possible exception of Kemp's ridley, nest in two patterns: aggregated and dispersed. The pattern of Kemp's ridley is - in the present depleted state of the population - totally concentrated, and though there is evidence that some dispersed nesting may formerly have occurred, this is hard to corroborate. In the hawksbill, the dispersed pattern is most prevalent in the west Atlantic system. All the other sea turtles nest singly over wide areas, and gather in aggregations at a few places. An important function of aerial surveying is to search out nesting aggregations that may have been overlooked. Lacking any better source of quantitative data, however, it is possible to use results of overflights as a basis for calculating the numbers of turtles that use a beach. Obviously, to do this even approximately, something must be known of the nesting season. If the limits and peak density of the season are known, conversion of counted tracks to total tracks per season may be attempted, even when only a single flight was possible.

To convert nest counts to numbers of nesting females, the renesting frequency must be known. No known sea turtle population is composed entirely of females that nest only once in their season at the beach. If the average renesting number for the population is not known, published results from nearby regions may provide grounds for a reasonable guess. If the number should turn out to be, say, 3 nestings per season, then 600 nestings counted during a season, or extrapolated from flight-counts, means that 200 female turtles were there during the season. That figure is not a population estimate, but it provides a basis for comparing a nesting ground with others of the species; and it indicates the season's reproductive potential for that segment of the breeding group. For example, if the average egg complement of the species is 120, then 72,000 eggs were deposited in the section of shore on which counts were made during the season of the survey.

The next step is to convert the number of nesting females per season to the total number of sexually mature female turtles. If the nesting population is strongly site-fixed--that is, if it tends to return to the same place to breed in successive seasons--and if it can be assumed that each female in the population nests every year, then the total number of females for the season obviously represents the total number of sexually mature females in the population. However, with the possible exception of Kemp's ridley, no sea turtle population that has been adequately monitored anywhere has proved to be composed of females a majority of which nest every year. Instead, when a turtle finishes a season's nesting it takes her two, three, or four years--and possibly even longer--to make another migration to the breeding ground. Carr, Carr and Meylan (1978) proposed a formula for calculating total sexually mature populations from yearly arrivals at the Tortuguero nesting ground, where individual female turtles never breed annually but return on 2, 3 and 4-year cycles. On the average, most remigrants that appear at Tortuguero during a season will

have been away for three years. A smaller number reappear after two years, and still fewer after four years. A female may shift from one interval to another, and she may also shift back again. An admitted defect of the Carr, Carr and Meylan equation is that it assumes that all females will be seen in later seasons, whereas fewer than half of a season's nesters are ever seen again. At Tortuguero, for example, this "lost majority" is around 70 percent.

There has been much recent discussion of possible causes of the failure of these turtles to be observed on the nesting beach in subsequent seasons. Some possibilities are as follows:

1. Loss by sampling error--tags are lost without leaving discernible scars.
2. Loss to predation.
3. Loss to old age or disease.
4. Loss to exploitation.
5. Loss to incidental catch.
6. Loss because of a genetic tendency to breed only one time.

There is a difference of opinion among turtle students regarding the relative importance of these and other possible causes of the loss of breeding females. The greatest uncertainty is that surrounding the actual numbers, or even the existence, of the one-season nesters. Until these uncertainties are resolved, the best approach in calculating the number of mature females in a population seems to us to be to: 1) apply the remigration formula suggested by Carr, Carr and Meylan (1978) to only the remigrant fraction of the yearly nesting total (this yields an estimate of the number of mature females in the remigrant pool); and 2) add to this figure the number of turtles that are nesting for the first time that season. The resulting number is an instantaneous estimate of the number of reproductive females in the population, based on that one season's number of arrivals. In itself, it is not a very useful estimate, because there are drastic year-to-year fluctuations in the numbers of turtles nesting at most breeding grounds. Yearly changes in size in the nesting population of *Chelonia mydas* at Tortuguero, Costa Rica are indicated as follows:

1971	7,440
1972	10,727
1973	11,829
1974	7,897
1975	10,171
1976	22,727
1977	5,464
1978	31,211
1979	5,178

Such fluctuations appear to be widespread, and to occur in all sea turtle genera. The variation does not reflect actual changes in the numbers of breeding females in the population involved, nor does it reflect breakdown of nesting site fidelity. Possible causes are discussed by Carr *et al.* (1978). Whatever the explanation may be, it seems clear that a valid calculation of total breeding populations cannot be based on the numbers of females nesting in one season, but must involve averages from several seasons.

Interviews and Other Sources of Data

The field procedure in the survey has been a combination of direct observation and interviewing. The relative emphasis given the two depended on the special circumstances at each locality. Direct observation and reconnaissance were undertaken wherever they seemed feasible and promising. The techniques varied according to local conditions. Evidence bearing on the composition and ecology of the turtle fauna was sought in aquariums, fish houses, local shops and museums. Because the period of the survey was limited, repeated visits to a locality were usually impossible, and information obtained by conversations with qualified local residents was therefore of great importance. In some cases verbal interviews were supplemented by mailed questionnaires, but these reached only a small percentage of the people capable of contributing useful information. In a few instances a locality had been recently visited by other invesitgators, seeking some of the same data, and they were able to provide us with answers to some of the questions we were asking. In a few places within the survey area, research or management programs were in effect, and any published material on the objectives or results of these were studied before the locality was visited.

Because this investigation depended heavily on interviews, an effort was made to standardize the process of questioning. For that purpose, the following procedural outline and sample questionnaire were organized, and more or less consistently used as a guide.

Suggestions for Conducting Interviews

In interviewing fishermen, fisheries officers or anybody else, the objectives are much the same, but the technique will have to vary markedly. Some informants may be willing and able to fill out a written questionnaire, but some will not. And if there is anything more likely to alienate a humbly educated informant than to be asked to fill out a questionnaire, it is for the questioner to take down his answers *verbatim* on a clip board. Taped interviews are useful, but here again, some informants get nervous if you ask their permission to tape the talk, and even more so if you try to do it surreptitiously. Thus, if you can possibly do so, memorize your checklist, do as little writing as possible during the interview, and when you finish, go away to a quiet place, write down what you learned, and fill out your own questionnaire. If there are gaps, and if the informant was good, go back, apologetically. Topics of inquiry can be organized according to the following categories:

1. Data on the informant. Get the name, address, sex, approximate age, and occupation of the informant. Make a special effort to judge his reliability--what his experience and his opportunities to accumulate first-hand information have been; and for how long a time, and in what localities, his familiarity with turtles was acquired. This assessment can be used as part of the basis for a grade that you will give each interview when completed.

2. Species of sea turtles that occur in the area. Find out what kinds of turtles the informant believes occur in the area. Get at this by easy cross-questioning; avoid prompting or leading him into more elaborate answers than his knowledge justifies. Once the occurrence of a species is confirmed, get all local names used for it, be they English, Spanish, Miskito,

Papiamento, Carib, or any other Indian or European language or dialect in local use. Only when you are confident that the informant knows one kind of sea turtle from another, record the names used, and proceed with your interview.

3. Seasonality and ecology of foraging adults. For each species, determine whether mature turtles occur in the region and how the informant knows they are mature. Ask whether they are present as year-around residents, or only during part of the year. The idea of a seasonal resident may get mixed up with that of a seasonal migrant (see below); but the two are different. Get information on both if possible. Try to learn what habitats mature, resident turtles occur in, and how numerous they are in those habitats. Obviously, you can only expect a relative assessment, because there is no known way to count turtles in most foraging habitats; but try to get the best idea possible. Try harder to get a valid impression as to how extensive, and how well occupied, any local foraging habitat for resident adults of each species is.

4. Seasonality and ecology of developmental stages. Once the above information on resident adult turtles of each species is obtained, solicit the same information on the developmental stages--dinner-plate to submature sizes. Closely question anybody who seems to have reliable understanding of and information on the habitat distribution and seasonality of the various size-classes of sea turtles.

5. Nesting. The nearest approach to reliable quantitative information on population levels that can be expected from this survey will come from nesting censuses. In the few places in which tagging programs have been in progress, these will be by far the best sources of data. Most tagging is done where nesting turtles come together in seasonal aggregations the members of which are, to some extent at least, site-fixed; and for some species, *Chelonia*, for example, these gatherings may constitute a big part of the population. In other species--the hawksbill for instance--separate individual nesting appears to be far more prevalent. In spite of these differences, an obligation of the survey is to assess any nesting that may occur in each area. In asking questions about nesting, use charts and maps to identify sites where concentrated emergences may occur. Try also to get per-mile estimates for separate nestings by each species that is represented. Wherever it seems warranted and feasible, interviews should be supplemented by inspection, and in special cases, by aerial counts.

6. Changes in population levels. Another aim of the interviews is to see whether populations are, in local opinion, stable or changing; and if the latter, how and to what degree. This will be hard or impossible to determine reliably in most cases. Estimates of effort expended per turtle caught is an approach, but not a very good one. Fisheries archives and landing records, if there are any, may yield helpful data. For instance, one of several trading stations that existed along the Miskito Coast of Nicaragua two hundred years ago exported four tons of tortoiseshell in 1778. To compare this figure with 1978 exports is useless; the trade is now illegal, and records are defective. Nevertheless, four tons of shell two hundred years ago does suggest that there has been a spectacular decline of hawksbills in the region. In questioning people about population decline, seek out old, sensible individuals who seem interested in the subject and are not scared by the questions. When you

finish an interview, go away quickly, record facts and impressions, and then grade your informant on the information he or she provided and your confidence in it.

7. Migratory routes. Migration is an important feature of sea turtle ecology, with strong bearing on management problems. As was suggested earlier, in talking with an informant you may have trouble distinguishing between the ideas of itinerant migratory passage, and the periodic occupation of developmental or foraging stations. Try to learn what may be known locally about regular routes of migration, such as those of loggerheads in the Florida Straits, and leatherbacks off Texas or the Florida Panhandle or the coast of New England. On the Miskito Coast of Nicaragua the Indians are very familiar with the paths of green turtles going to and from the Tortuguero nesting ground in Costa Rica. Ask every seaman you talk with whether he ever saw a lot of turtles together at sea; and if so, where, when, and how many; and what he figured they were doing. Try to keep this idea of *in transit* migratory movement separate from seasonal occurrence in an area or habitat.

8. Exploitation. Besides information concerning the kinds, abundance, seasonality, and habitat distribution of sea turtles in the places visited, data on exploitation should be collected. Are turtles and turtle eggs taken for local use, for export, for both? Learn what techniques turtlers use, and at what times of the year they operate. Find out whether hawksbills are legally taken, and whether there is a local shell industry. How about turtle skins? Try to get a clear idea of any export trade in turtle products that now goes on, and of its survival outlook in the light of recent regulations of international commerce. Be careful also to learn all you can about local markets for turtle meat and shell. Try to decide whether, if all exports were stopped, subsistence hunting would still be an important drain. Also, make a special effort to determine whether local demand for turtle meat and eggs is mostly restricted to the coast, or extends into the interior.

9. Turtle laws and regulations. If published material on regulations in a place to be visited is available, read it carefully before your departure, as background for interviews. On reaching your destination inquire at local government fisheries offices about the current status of turtle legislation. In order to judge public awareness of restrictions and regulations, when you carry out your interviews ask each individual questioned if he can tell you anything about local turtle laws. See if he knows whether it is legal to catch turtles; whether there are closed seasons, quotas, or size limits; whether taking eggs is illegal. Asking about this will be helpful in grading public awareness of, and attitudes toward, sea turtle regulation.

10. Incidental catch. Our tag returns from Tortuguero very clearly show that, as the shrimping fleets of the Latin American countries have grown, there has been a strong rise in the frequency of turtles caught accidentally in trawls. Get estimates (or records if they exist) of numbers of turtles taken this way. Try to determine what species and size groups are taken, whether they are sold or eaten by the boat crews and their families, and whether there are regulations designed to control incidental catch.

11. Management. The aim of another series of questions is to record and evaluate any government management programs that may be in effect--predator control, nest protection, hatchery projects, colony transplantation, or head

starting. Visit the sites of these if you can; inquire about aims and techniques, and try to form an opinion of the quality and effectiveness of each. Learn what results the operators believe they have seen, or are forecasting. If they tell you they take eggs from the oviducts of slaughtered turtles, incubate them, and release hatchlings or pen-reared young, ask if this seems to be doing any good. If the reply is, "sure--the population is increasing now that we do this," ask how that is known; and so on. A valuable part of this survey will be an accurate inventory and appraisal of management and conservation procedures in the west Atlantic, and of the gaps in that field that will surely be revealed.

12. Research. Make a careful assessment of research projects in progress in the localities visited. Many people confuse management and research; so in your questioning try to keep the two apart. Killing coatis or dogs on a nesting beach is management; its aim is to increase hatchling production. Tagging turtles is research, because its basic aim is to increase knowledge. Those two are easy to separate. Head starting is more troublesome. In one form or another it is being done widely, and in nearly every case the justification claimed is that it circumvents predation and thus increases the population. This could be true; but there is not any proof that head starting has ever increased a population anywhere. On the other hand, as an experimental effort to learn something of the developmental ecology of sea turtles, head starting has promise. Don't preach to anybody about this, but sort out the differences in your own mind, and do everything you can to bring back an assessment of local efforts to generate original data on sea turtle biology.

Provisional Questionnaire

To help systematize the interviews, and insure coverage of pertinent topics, the following set of questions was provided for field personnel. Obviously, the questioner did not stick slavishly to this protocol, but instead gave special emphasis to whatever lines of inquiry each informant seemed best qualified to discuss.

1. Data on the informant.

   a. Name
   b. Address
   c. Sex
   d. Age
   e. Occupation

2. Species of sea turtles that occur in the area.

   a. How many kinds of turtles are known here? Describe them.
   b. What local name is used for each of them?
   c. How do the various kinds rank in abundance? (Ex.: green>hawksbills>...)

3. Seasonality and ecology of foraging adults.

   a. Do fully grown turtles occur here? Which kinds?
   b. Which kinds live in local waters all year around?
   c. What are the seasons when the others are here?
   d. If turtles are seasonal here, do you have any idea where they come from?

e. How do you know this?
f. Are their times of arrival and departure on a predictable schedule, or do the turtles just trickle in and away?
g. What kinds of habitats does each occur in - channels, reefs, turtle grass beds, gorgonia beds, mangrove creeks, other?
h. How many of each kind do you catch in a year? Are these all adults, or are some smaller turtles?
i. How many turtles do you catch in your nets (or by diving) on a good day?
j. How many days (months) do you fish for turtles in a year?
k. Are there any grass beds around here? Do you see adult turtles feeding in these grass beds?
l. Are there any reefs around here? Are turtles common around the reefs?
m. Are there any places where turtles are especially numerous?
n. Do you ever see turtles offshore? How far out? What kinds? What size? Are they in groups when you see them offshore? What do they seem to be doing out there? Are they associated with driftwood, seaweed, or just in the open sea?

4. Seasonality and ecology of developmental stages.

a. What kinds of small turtles do you see?
b. What sizes of each kind do you find (i.e. dinner-plate, wash-tub, nearly grown)? Which live here year around?
c. Do you find the different kinds of small turtles in the same kinds of places? If not, what is the best type of place for each kind?
d. Do the different size classes of a kind show up at different times of year?
e. Do the different size classes of a species live in different places?
f. Do young sea turtles go into mangrove creeks? If so, what do you think they find to eat there?

5. Nesting.

a. Do sea turtles nest locally? If so, which kinds? At what seasons? On what beaches?
b. Are there any places where many turtles gather to nest together? If so, where, and what species is involved?
c. About how many turtles of each species nest per mile of good nesting shore in your area in an average night? In an average year?

6. Changes in population levels.

a. Are sea turtles generally fewer nowadays than they used to be?
b. How would you rate their abundance today as compared with 10 years ago, 25 years ago?
c. On what do you base your belief that changes in numbers have occurred? On annual catch? On changes in the effort that has to be spent catching a turtle? On changes in nesting density on local beaches? On figures you have seen in print? If so, where?
d. If you have seen changes, what do you attribute these to?

7. Migratory routes.

a. At certain times of the year do you see turtles pass by that seem to be *in transit* - heading for somewhere else?
b. If so, what kinds? What sizes? In groups? If so, in groups of what size?
c. Describe the location and schedule of such sightings.
d. Which way does the main current flow in this area? Does it seem to affect the movements of the turtles?

8. Exploitation

a. Is turtle meat sold locally? Does the demand extend throughout the country or is it restricted to coastal people?
b. What is the price per pound?
c. Is meat exported?
d. How important is turtle meat in the diet of local people?
e. Are turtles other than green turtles eaten, or sold for food? Which kinds?
f. Are turtle eggs sent to market? If so, what is the order of preference for eggs of the different species? Does the market extend throughout the country or just along the coast?
g. Is there a market for turtle skins? What kinds of turtles are used? Who buys them, what prices are paid?
h. Is there a local market for tortoise shell? How much does the shell sell for (per pound, per turtle)?
i. Are small turtles preserved or stuffed for sale to tourists? Which kinds? How much do they sell for?

j. Are turtles caught with spear guns? By local people or by tourists?
k. How many people here hunt turtles as their main source of income? Are turtles taken by other fishermen as well?
l. How much subsistence turtling is done by people who use their catch themselves?

9. Turtle laws and regulations.

a. Are there laws and regulations controlling the exploitation of turtles here? (Obtain an official copy of these.)
b. Is the local sale of turtles or turtle products restricted? (If so, list the restrictions, by species, on a separate sheet.)
c. Is it legal to export turtle products?
d. Is it legal to take female turtles off the nesting beach?
e. Is it legal to take turtle eggs? If so, are there quotas, seasonal restrictions or other controls?
f. Have regulations changed recently, now that international trade in sea turtle products is being restricted?
g. Do you think these laws are necessary? What changes would you recommend?

10. Incidental catch.

a. Do trawlers work in local waters? Are they around all year or just in certain seasons?
b. Are sea turtles caught by the trawlers? How do you know this?

c. Has this accidental capture of turtles increased lately?
d. Which kinds of turtles are taken incidentally, what sizes, and with what relative frequency?
e. Are the turtles usually drowned in the net or do they survive?
f. Are turtles that are taken by trawlers eaten by the fishermen, sold, or released?
g. What is the deepest water you ever knew of a turtle being taken in?

11. Management.

a. Are there any landing records on file?
b. Are there any government or private programs directed toward management for protection of sea turtles?
c. Are nest predators destroyed?
d. Are eggs moved to new sites, or incubated in artificial containers?
e. Are the young turtles released immediately after hatching? Where are they released?
f. Are young turtles kept in tanks or crawls for later release? If so, at what ages and sizes are they released?
g. Do the above practices seem to be doing any good? If so, what is the evidence of this?

12. Research.

a. Have you ever seen or heard of a turtle bearing a tag? When, where?
b. Are any tagging projects in operation locally? If so, what species are tagged?
c. If head started turtles are released, are they tagged?
d. Are hatchlings tagged when they are released from hatcheries?
e. Have there been any tag returns in local tagging projects?

Regional Summaries

The following summary accounts of the regions surveyed to date are based partly on field work carried out during the contract period and partly on the literature. Assessments of the relative density of the five genera in their breeding, feeding and developmental habitats are made in Figures 1-13. It is important to note that the density gradients are based on absolute numbers that differ widely from species to species. For example, maximal nesting density for loggerheads is in no way comparable to that for hawksbills. The accounts and maps show only a part of the information gathered during the survey. The data will be treated more fully in other phases of the work.

Florida

Sources of Information. Although a number of projects are producing new data, many important questions of ecologic geography and demography of turtles that occur in Florida waters remain unanswered. Although all five genera occur in the state, the loggerhead is by far the most prevalent species, and

has been for several decades, at least. Formerly large populations of *Chelonia* and *Lepidochelys* have been drastically depleted. Which, and in what numbers, genera other than *Caretta* nested on Florida beaches are not clear in the older reports.

Nesting Habitat. The Florida nesting population of *Caretta*, apparently second in size only to that of Masira Island in Oman, is being extensively studied in tagging programs. Although some of these are accumulating important information, much of it remains unpublished. Extensive aerial nesting censuses were recently made, as a preliminary exercise of the present NMFS West Atlantic Survey, by Peggy and David Carr; and even more recently, techniques of aerial counting were carefully reassessed by Larry Ogren and Tom Carr. Enough data now probably exist to provide a reasonably accurate quantitative estimate of the breeding population; but this depends on establishing a numerical relation between numbers of counted tracks and numbers of nesting females, and on relating the number of females that nest during a season to the total number of sexually mature turtles in the population. In order to determine this, reproductive periodicities will have to be better known, and degrees of philopatry and site-fixity more clearly determined.

Besides the huge breeding colony of *Caretta*, the east coast of Florida is visited by a small number of nesting green turtles, perhaps averaging about 40 females per season, and an even smaller number of leatherbacks. Frank Lund has recorded the nesting of one hawksbill in three different seasons at Jupiter Island.

Adult and Developmental Foraging Habitat. Mature and juvenile loggerheads forage offshore along the entire coastline of Florida. Loggerheads and ridleys apparently hibernate during winter in the artificial ship channel off Port Canaveral (Carr *et al.*, in press). Ridleys and green turtles probably used to overwinter buried in mud along the west coast of the peninsula. Occasionally, adult green turtles are encountered in foraging habitats on the east coast south of Cape Canaveral. In the Dry Tortugas, three female green turtles have been recovered with tags put on at Tortuguero, Costa Rica. Large numbers of immature green turtles (12-115 lbs.) and immature ridleys (7-59 lbs.) used to be caught regularly in the Cedar Key - Crystal River area of Florida. Today immature and subadult green turtles and loggerheads occur in Mosquito Lagoon. Norine Rouse occasionally sees hawksbill turtles while diving off the Palm Beaches, and they occur sparingly on reefs in the Florida Keys.

Exploitation and Protection. Green turtles suffered heavy exploitation in Florida during the 19th century. Landing records indicate that populations had already dropped dramatically by the turn of the century. At present only the loggerhead can be considered at all abundant. Today, it is illegal to take or harass any sea turtle in Florida waters, and nests are protected by law. Some poaching occurs, but on most sections of the coast its effects appear now to be minimal. More deleterious to the turtle populations are alteration of nesting habitat by human development of coastal areas, and depredation on turtle nests by raccoons. The incidental take of sea turtles in shrimp trawls is also a serious problem in Florida.

Research. Turtle tagging programs are being carried out in Florida by Lew Ehrhart, John Fletemeyer, Charles LeBuff, Frank Lund, Ross Witham and

several others. Lew Ehrhart and his students are studying growth rates and local movements of loggerheads and green turtles in their foraging habitat in Mosquito Lagoon, Florida. Seasonal changes in the structure and abundance of loggerhead aggregations in the Port Canaveral Ship Channel are being monitored by the National Marine Fisheries Service.

Alabama, Mississippi, Louisiana and Texas

Sources of Information. The sparse published information on the sea turtles of this region has recently been augmented by data on tagged turtles retaken in shrimp trawls, and from surveys of the area made by Larry Ogren for NMFS in 1977 and 1978. Henry Hildebrand (in press) has written an exhaustive summary of the status of sea turtle populations in the Gulf of Mexico.

Nesting Habitat. Today, virtually no nesting by any kind of sea turtle occurs on U.S. shores of the Gulf of Mexico west of Florida. Sparse nesting by loggerheads has been reported on the Chandeleur Islands of Louisiana, and even more rarely on the adjacent islands of Ship, Horn and Petit Bois in Mississippi and Alabama. Since early times loggerhead eggs have been gathered by local people on these and other nearby islands, but very little nesting occur there today. Larry Ogren has suggested that loss or degradation of suitable nesting habitat, caused by storms, may have been the most important factor in depleting Louisiana's nesting populations. The same cause may account for the almost total lack of nesting on the Florida Gulf Coast from Tampa to Panama City. Although much of the Texas coast appears to offer beaches suitable for turtles, there is also a surprising dearth of nesting there. Occasionally, a Kemp's ridley or loggerhead comes up to nest on South Padre Island, but the historical record indicates that nesting on Texas beaches has always been sparse. Larry Ogren has suggested the possibility that in Texas waters, onshore currents driven by predominantly southeasterly winds during the hatching season would impede successful dispersal of the hatchlings, and might be responsible for the lack of nesting colonies there.

Adult and Developmental Foraging Habitat. The most abundant species of sea turtle in the Gulf of Mexico used to be Kemp's ridley. Henry Hildebrand has suggested that the species might logically be called the "Louisiana turtle," because it congregates in the crab-rich shallow waters between March Island and the Mississippi Delta. Of 39 tags recovered from adult female ridleys that had nested at Rancho Nuevo, eighteen came from Louisiana's western parishes, 4 from the eastern parishes, 6 from the Mississippi River Delta, 6 from Texas, 3 from Mississippi, 1 from Alabama and 1 from Florida. Captures in shrimp trawls off Terrebonne Parish, Louisiana, are frequent. Louisiana and the Tabasco-Campeche area of Mexico appear to be the major feeding grounds for adult Kemp's ridleys. Juvenile ridleys 6 to 8 inches in shell length have been captured by trawlers in an area near Mobile Point Peninsula, Alabama, locally referred to as the "Big Gulley," and off nearby Dauphin Island. This area is possibly a regular developmental station for *L. kempi* of ages somewhat younger than those once seasonally abundant on the gulf coast of Florida.

Loggerheads frequent the entire continental shelf, including the outer shelf banks, and are fairly common around oil platforms, rock reefs and shipwrecks off both the Texas and Louisiana coasts. An active green turtle

fishery once existed in Texas, chiefly in Aransas Bay, Matagorda Bay and Laguna Madre, where good feeding grounds occur. This industry had disappeared by 1900, and today green turtles are found in greatly reduced numbers, and mostly small sizes, in the lower Laguna Madre near Port Isabel. Mature and juvenile leatherbacks have been found feeding on jellyfish along a 30 mile line northeast from Port Aransas.

The hawksbill is, and perhaps always has been, clearly the rarest turtle in the Gulf of Mexico. No records of mature hawksbills exist from the coasts of Alabama, Louisiana or Texas, but a few small individuals have been reported from Port Mansfield and from offshore oil rigs.

Exploitation and Protection. As was suggested above, exploitation, both private and commercial, has been considerable in the past. Today all sea turtles and their nests are protected by law in U.S. waters, and poaching is probably rare. However, all sea turtle species in the Gulf are under intense pressure from incidental catch in shrimp trawls.

Research. Much of the experimental work by NMFS on the excluder panel for shrimp trawls has been carried on in the northern Gulf. A headstarting project is in progress at Galveston, Texas as part of the rescue program for Kemp's ridley.

Tamaulipas, Mexico

Sources of Information. For some 15 years the *Instituto Nacional de Pesca* has conducted tagging and management projects in the Gulf of Mexico and several reports on their results have appeared. Since 1976, *Pesca*, in collaboration with the U.S. Department of the Interior and NMFS, has developed an intensive program to rescue the declining colony of *L. kempi*, the only nesting ground of which is located in Tamaulipas.

Nesting Habitat. The sole breeding ground of Kemp's ridley is a 12-mile stretch of the Tamaulipas coast at Rancho Nuevo, about 90 miles north of Tampico. Nesting occurs there from April to July. As recently as 1963, the nesting population was estimated at 42,000 females; by 1975 it had declined to perhaps five hundred. A few green turtles also nest each year at Rancho Nuevo. Much heavier nesting by *Chelonia* may once have occurred on the beaches from Boca Jesus Maria to Tuxpan. This area was likely the source of the turtles that supplied a Texas turtle cannery in the nineteenth century. Before World War II, green turtles nested regularly at Playa Washington, about 12 miles south of the mouth of the Rio Grande. Isolated loggerhead nests have been reported at Rancho Nuevo. Scattered reports of nesting by turtles north of La Pesca (Hildebrand, in press) probably refer to *Caretta*. A few leatherbacks nest each year at Rancho Nuevo. No hawksbill nesting has been reported on any Tamaulipas beach.

Adult and Developmental Foraging Habitat. Apparently the offshore regions of Tamaulipas do not serve as regular feeding habitat for any species of sea turtles.

Exploitation and Protection. Heavy exploitation of nesting sea turtles and their eggs has occurred in Tamaulipas in the past. Except on the Rancho Nuevo beach, which is now well protected, this continues to the present.

Research. Management-oriented research now in progress at the Rancho Nuevo nesting ground of *L. kempi* includes tagging and monitoring the nesting population, hatchery practice, head starting, colony transplantation, and a tracking study to reveal the internesting behavior of female turtles off the breeding shore. Tagging and incubation of oviducal eggs of *Chelonia* are carried out at Isla de Mujeres.

Veracruz, Mexico

Sources of Information. Henry Hildebrand (in press) has reviewed the history of, and literature on, sea turtle populations in this area. In December 1978, Jeanne Mortimer surveyed the coastline of Veracruz south and east of Boca del Rio, visiting coastal towns and interviewing local people. Later she also conferred with scientists at the *Instituto Nacional de Pesca* in Mexico City concerning sea turtle activity in Veracruz.

Nesting Habitat. Green turtles and loggerheads formerly nested in numbers in the northern part of the state, near Cabo Rojo. Green turtles, loggerheads and hawksbills once emerged abundantly on the coast between Montepio and Cerro San Martin, but today this occurs only rarely. Sparse loggerhead nesting was also reported at Punta Gorda, east of Coatzalcoalcos. Near the city of Veracruz there are several offshore islands between Isla Lobos and Anton Lizardo where hawksbills nest sparingly. Because of the close proximity of these colonies to an urban area, they have been heavily exploited. The ridley may have nested in great numbers in Veracruz in early days, and there have been half a dozen varyingly definite and trustworthy reports of such events in recent years. At Boca del Río, Mortimer was told that a ridley (*lora*) nested in broad daylight in the spring of 1978. Long ago Carr found ridleys nesting singly at Anton Lizado and gathered reports of *en masse* nesting near Montepio. When Mortimer visited the latter locality she was told that, although ridleys used to nest there in numbers, there has been virtually no nesting during the past ten years. Twenty years earlier Leonard Giovannoli heard almost identical reports. Nesting by leatherbacks on an island near Anton Lizardo is occasional.

Adult and Developmental Foraging Habitat. Green turtles are reportedly very rare in coastal waters in Veracruz. Loggerheads are reported to be fairly common on rocky bottoms near Cerro San Martin. Good foraging grounds for hawksbills occur among the islands between Isla Lobo and Anton Lizardo. Mature turtles of all the genera are reported to feed occasionally near Montepio. In Alvarado, *Pesca* employees told Mortimer that ridleys are nowadays very scarce off the coast of Veracruz, although between June and August, they are taken in some numbers in shrimp nets, in a rock-bottom area near Punta de Zempoala called Chachalacas. A few mature female ridleys that had been tagged while nesting at Rancho Nuevo, Tamaulipas, have been recovered in this area: at least two near Alvarado, and one at Chachalaca. Leatherbacks are only rarely encountered in Veracruz waters.

Exploitation and Protection. All along the coast of Veracruz turtles are taken whenever they are found, whether nesting, or in the sea. Many people set nets for them, especially near Veracruz and Montepio, and they are often caught incidentally in shrimp trawls. Large quantities of tortoiseshell curios, and whole stuffed turtles are sold in Veracruz, in shops along the

malecón and elsewhere in the city. Mortimer visited one of the workshops in which tortoiseshell products are manufactured. She was told that raw *carey* shell is becoming difficult to obtain, both because it is illegal and because the turtles are becoming scarce. The shops were therefore reducing production of tortoiseshell jewelry, and were instead turning to plastics. *Aceite de tortuga* (sea turtle oil) is readily available in all the coastal towns.

Research. None.

Tabasco, Mexico

Sources of Information. Henry Hildebrand's recent review of sea turtle history and distribution in the Gulf of Mexico includes some information on Tabasco. Jeanne Mortimer visited the area in December 1978 and interviewed people at Sanchez Magallanes, Frontera, and San Pedro. Although fisheries officials in Mexico City and an informant in Ciudad del Carmen both suggested that Sanchez Magallanes would yield information about sea turtles, the people there seemed little interested in the subject, and most were unable to identify the pictures of sea turtles shown them.

Nesting Habitat. No major nesting beaches are known in Tabasco, although there is scattered nesting by green turtles, hawksbills and loggerheads.

Adult and Developmental Foraging Habitat. Both juvenile and mature stages of loggerheads, green turtles, hawksbills and ridleys are captured offshore, but only in very small numbers. The ridley was said to be the most frequently taken, and at least one female that had been tagged on the nesting beach at Rancho Nuevo was recovered at Dos Bocas, Tabasco. Small concentrations of leatherbacks have been seen in Tabasco, especially off Barra San Pedro, during the months from August to November.

Exploitation and Protection. Sea turtles are taken whenever they are encountered in Tabasco, but turtling is not extensive there and apparently never has been.

Research. None.

Campeche, Mexico

Sources of Information. The published information on Campeche sea turtles is well summarized in Henry Hildebrand's recent review. In December 1978, Jeanne Mortimer visited coastal towns in Campeche and interviewed local people in San Pedro, Zacatal, Ciudad del Carmen, Isla de Carmen, Isla de Aguada, Champatón and the City of Campeche. She obtained additional information on the area from *Pesca* officials in Mexico City, Alvarado and the city of Campeche.

Nesting Habitat. Unbroken stretches of white nesting beach extend eastward all the way from the Tabasco-Campeche border to within a few miles beyond Laguna de Término. In this area, the hawksbill was reported to be the most abundant nester, followed by the loggerhead. Green turtles come ashore only occasionally. Northeast of Sabancuy, and all the way to the city of

Campeche, the beach becomes darker and is frequently broken by rocky shoreline. Little nesting occurs, but occasional loggerheads and hawksbills emerge. Green turtle nesting is extremely rare; no ridleys or leatherbacks have been reported on shore. The western shoreline of the Yucatan Peninsula northward from the city of Campeche is mostly mangrove bordered, with little suitable nesting beach.

Adult and Developmental Foraging Habitat. The waters off the west coast of the Yucatan Peninsula, north of Laguna de Término, provide excellent foraging for young and mature loggerheads, hawksbills and green turtles. The loggerhead is the most prevalent species there, with green turtles and hawksbills in lesser, and approximately equal, numbers. Six tags from green turtles that had been tagged while nesting at Tortuguero have been recovered from the vicinity of the city of Campeche, and one has come from the area just east of Laguna de Término. In the region around Isla de Aguada there have been numerous recaptures of ridleys that were tagged while nesting at Rancho Nuevo, Tamaulipas. Although fishermen reported that ridleys are now very scarce, the Tabasco-Campeche region is probably equal in relative importance to the Louisiana region as a foraging habitat for adult Kemp's ridleys. Several fishermen reported another type of turtle, known as *tortuga caballo,* which they said was bigger than a loggerhead. This was no doubt the leatherback. Local people reported that both loggerheads and hawksbills can readily be netted near shore over rocks in about 30-40 feet of water. Near Isla de Aguada, Mortimer found seagrass *(Thalassia testudinum)* washing ashore, so there is clearly some feeding habitat in the area. Leatherbacks are occasionally seen migrating along the Campeche coast.

Exploitation and Protection. For many decades Campeche has harvested more turtles than any other state on the Gulf Coast of Mexico. The catch has declined dramatically during the past ten years. The loggerhead is most heavily exploited by the fishing cooperatives. Although it is illegal to take hawksbills, Mortimer was told in the city of Campeche that shrimpers are permitted to sell shell from turtles that are incidentally drowned in trawls. Hawksbill jewelry is sold in the town of Campeche, and *aceite de tortuga* is for sale in all the coastal towns. During the summers of 1977 and 1978 there was a head starting program in operation at Isla de la Aguada, under the directorship of Roberto de la Torre, of Ciudad de Carmen.

Research. None.

Yucatan, Mexico

Sources of Information. Henry Hildebrand's paper is the only summary of the limited information available on Yucatan sea turtles. During January 1979, Jeanne Mortimer obtained additional data there, mostly through interviews. Yucatan is badly in need of more thorough surveys.

Nesting Habitat. On beaches along the northern coastline there is limited nesting by green turtles, loggerheads, and very occasionally, hawksbills. Reports indicate that these three species nest more frequently on the offshore cays--Arrecife Alacrán, Cayo Arenas, Los Triángulos and Cayos Arcas. Leatherbacks occasionally nest at Arrecife Alacrán, and fishermen use them for shark bait there and elsewhere in Yucatan.

Adult and Developmental Foraging Habitat. Although direct observations were not made, there is evidently extensive foraging habitat on Campeche Bank for juvenile and mature green turtles, hawksbills and loggerheads, especially near the offshore cays and reefs.

Exploitation and Protection. Shrimp trawling is intensive along the coast of Yucatan, and turtles are taken incidentally, although the extent of the catch is not clear. Much tortoiseshell jewelry is retailed in Merida.

Research. None.

Quintana Roo, Mexico

Sources of Information. David and Peggy Carr surveyed the region during late July 1978, visiting Felipe Carillo, Puerto Morelos, Playa Carmen, Tulum, La Colonia, Chetumal and other coastal localities, and interviewing local people there. In early January 1979 Jeanne Mortimer visited and carried out interviews in northern Quintana Roo: at Isla Mujeres, Isla de Cozumel, Playa Carmen and Puerto Juarez.

Nesting Habitat. All along the coast of Quintana Roo and on offshore islands, from Isla Holbox south to the Belize frontier, there are patches of sandy beach on which turtles nest. The section of the mainland shore that is most regularly used is near Boca Paila, where the most frequent nesting is by loggerheads, and some green turtles. Hawksbills nest there only rarely. On the leeward beaches of Isla Contoy nesting by hawksbills is frequent; green turtles and loggerheads nest in moderate numbers on the windward side.

Adult and Developmental Foraging Habitat. Fringe reef and seagrass beds are abundant off the coast of Quintana Roo. These provide foraging habitat for both juvenile and mature loggerheads and hawksbills. Twenty-four tags put on turtles nesting at Tortuguero, Costa Rica, and one tagged at Aves Island have been recovered from the northeast coast of Quintana Roo.

Exploitation and Protection. Turtles are taken in nets set in about 45 feet of water, in areas where turtles are known to have regular sleeping refuges. The law prohibits taking hawksbills at all times, and all other species and their eggs are legally protected during the nesting season (April to July). However, enforcement of the laws is difficult. Shrimp trawling is heavy along the northeastern coast of Quintana Roo, and this may kill some turtles. On Isla Mujeres there is a turtle crawl so constructed as to give the turtles access to a nesting beach. When adult females are captured in nets during the nesting season, they are put in the pens and allowed to lay their eggs before being slaughtered. During the 1978 season, about 5,000 eggs obtained in this manner were hatched. Isla Contoy is protected as a natural reserve for both parrots and sea turtles. During the summer of 1978, between 15 and 20 turtles were tagged there. Employees of *Pesca* were unable to estimate what percentage of the total nesting population that number represented.

Research. None.

Belize

Sources of Information. Published information on the ecology and status of sea turtles in Belize is practically non-existant. During late July 1978 David and Peggy Carr made a reconnaissance there and gathered data, mostly through interviews. Much useful information was obtained from personnel at five fishing cooperatives that are distributed along the Belize coast.

Nesting Habitat. Suitable nesting beaches occur along much of the Belize coast, and on offshore cays. Because of the longtime presence of man, however, little if any nesting now occurs on Ambergris Cay in northern Belize and along several of the smaller islands such as Cay Chapel and St. Georges Cay in Central Belize. In the past, green turtles nested there, but whether any large rookeries ever existed cannot be definitely established. Nesting by loggerheads has been recorded at Half Moon Cay on Lighthouse Reef, and in the past, green turtles and hawksbills also nested there. In southern Belize, loggerheads and hawksbills still nest in moderate numbers, especially on Nicolas and Ranguano Cays and other smaller cays of the area.

Adult and Developmental Foraging Habitat. The great extent of the Belize Barrier Reef affords almost unlimited developmental habitat. In the northern part of the country the reef wanes and there is more grass-flat habitat. Accordingly, juvenile loggerheads and green turtles, and hawksbills of all ages are more numerous in the south than along the northern coast. The most abundant mature turtles in residence are loggerheads. Green turtles and hawksbills occur in approximate equal numbers, with relatively more green turtles in the north, and more hawksbills in the south. Two recoveries of adult female green turtles that had been tagged while nesting at Tortuguero were made in Belize. Adult leatherbacks are occasionally sighted, usually 20-25 miles off the mainland, where they appear to be migrating.

Exploitation and Protection. Although turtles weighing less than fifty pounds are protected by law, and turtling is prohibited during the nesting season, the laws go almost unheeded. Turtles and their eggs are taken whenever found. In July 1978, shrimp trawling was just beginning in Belize, and reports of turtle deaths in trawls were already coming in.

Research. The government was an active participant in Operation Green Turtle of the Caribbean Conservation Corporation during the 1960s, and Belize was one of only two or three localities in which developmental colonies appeared to have been established. The introduced Belize turtles were totally eradicated by two severe hurricanes. No research on the sea turtles of Belize is at present being carried out.

Guatemala

Sources of Information. Little published information is available on the sea turtles of Guatemala. A. Carr surveyed the beaches at Cabo de Tres Puntas; and David and Peggy Carr reconnoitered and carried out interviews along the whole coast of Guatemala during August 1978.

Nesting Habitat. From Cabo de Tres Puntas southeast to Río Montagua there is good nesting habitat. Hawksbills, loggerheads, leatherbacks and

green turtles have all been reported nesting there, although in what number is not known. The hawksbill is the most frequent nester, and the green turtle the least frequent. Crocodiles occasionally nest along the same stretches of beach used by sea turtles at Cabo de Tres Puntas.

Adult and Developmental Foraging Habitat. Apparently, reefs and live bottom are almost non-existent along this coast and immature sea turtles are rarely seen anywhere. Some mature green turtles forage in Guatemalan waters, on a seasonal basis, from December through May. Three tag recoveries from green turtles tagged while nesting at Tortuguero, Costa Rica, have been made in Guatemala.

Exploitation and Protection. A subsistence sea turtle fishery is active on the Guatemalan coast. Eggs are taken from the nesting beach and sold in Puerto Barrios and Guatemala City. Shrimping is heavy in Guatemala, and turtles are regularly drowned in trawls. Loggerheads appear to suffer from this most extensively. Taking eggs and turtles during July, August and September is banned, but this seems to be universally ignored.

Research. No sea turtle research is in progress on the Caribbean Coast of Guatemala.

Honduras

Sources of Information. The very limited amount of published information on the sea turtles of Honduras provides no adequate indication of the status of populations there. David and Peggy Carr visited the Bay Islands in August 1978, and also gathered information along the western half of the mainland. The eastern section of Honduras, especially the Honduranian Miskitia, is unsurveyed, and badly needs attention.

Nesting Habitat. Green turtles, hawksbills and loggerheads all nest on the extensive beaches between Puerto Cortés and La Ceiba but their numbers are greatly diminished. The green turtle nests regularly, though not abundantly, on Vivario, Becerro and Caratasca Cays. Rebel (1974) alluded to group nesting by the leatherback, but gave no locality. Nesting has not been surveyed in the Miskitia.

Adult and Developmental Foraging Habitat. Good developmental habitats for green turtles, loggerheads and hawksbills occur around all the Bay Islands, but the whole area is badly depleted. Along the remainder of the Honduranian coast, little reef development is found. From the Bay Islands to Cabo Gracias a Dios extensive grass flats exist. Green turtles, hawksbills and loggerheads frequent that region, and leatherback sightings are fairly common there. Twenty-seven returns of tags from females tagged while nesting at Tortuguero, Costa Rica have come from Honduras, mostly from the eastern sections of the coast.

Exploitation and Protection. Some hawksbills are killed for their shell, but by far the heaviest pressure on turtles in Honduras comes from incidental catch in shrimp trawls. All shrimpers interviewed admitted to catching green turtles, loggerheads and hawksbills with some regularity. No actual figures were available. Turtles appear to be taken wherever they are found.

Research. At present no research on the sea turtles of Honduras is being carried out.

Nicaragua

Sources of Information. Background information on sea turtle populations in Nicaragua comes from several sources. Most of the tag returns from the Tortuguero green turtle tagging program have been from the Miskito Cays region of Nicaragua. In 1972, Bernard Nietschmann tagged hawksbills on the east coast of Nicaragua. Over a two-month period in 1975-76 Jeanne Mortimer lived in each of the coastal Miskito Indian villages between Bluefields and Little Sandy Bay while gathering data on the feeding habits of green turtles. In August 1977 Karen Bjorndal, and in September 1978 Archie Carr, Anne Meylan and Karen Bjorndal, visited the Miskito Cays on the Research Vessel *Alpha Helix* and had good opportunities to interview Miskito Indian turtle fishermen and others at Bluefields, Corn Island, Miskito Cay, and the region around Morrison Dennis Cays. Nevertheless, important gaps remain in what is known of the status of the sea turtles of the region. No recent information exists on the region from Bluefields south to San Juan del Sur, or about the mainland coast north of Cape Gracias a Dios and the islands and cays far off the coast of Nicaragua (*e.g.* Albuquerque Cays, San Andrés, Old Providence Island, Roncador Cay, *etc.*). These regions will be included in future survey work.

Nesting Habitat. Nesting by hawksbills is sparse and by loggerheads infrequent, along most of the eastern Nicaraguan mainland, and on many of the offshore cays. Bernard Nietschmann found fairly important hawksbill beaches at Kings Cay, Asking Cay and Set Net Cays, and at Cocal in southern Nicaragua. No nesting by green turtles was reported in any of these areas. Future survey work to determine the extent of leatherback nesting, which occurs sparingly along the open shore of the mainland, will be undertaken in 1980.

Adult and Developmental Foraging Habitat. Excellent green turtle foraging habitat occurs along most of the coast and offshore cays. This may be the most extensive pasture ground for *Chelonia* anywhere in the world. This is illustrated by tag returns from female green turtles that had been tagged while nesting at Tortuguero, Costa Rica. From the Miskito Cays area of Miskito Bank, 725 tags have been recovered. An additional 142 tags have come from the Sandy Bay Cays, and 263 have been returned from localities along the mainland Nicaraguan coast. Recovery of two tags that had been put on turtles at Aves Island is the first evidence that Miskito Bank may be a feeding habitat for two different major breeding populations. Very good habitat for mature and juvenile hawksbills also occurs in these same regions, and probably also on Greytown Bank off southern Nicaragua. The possible occurrence of loggerhead turtles in this area needs further investigation. Most loggerheads that are seen are immature, but their habitat distribution is not known.

Exploitation and Protection. At one time three slaughterhouses operated on the eastern coast of Nicaragua; and among them, they were responsible for killing an estimated 5,000 to 10,000 green turtles each year from 1969 to 1975. These enterprises were closed in 1976, and only the hunting of turtles for local use and sale has continued. Hawksbills are hunted constantly for their shells, and their eggs are taken whenever they are found.

The revolutionary government of Nicaragua has expressed interest in establishing a Miskito Cays National Park that would enhance the protection afforded by the Tortuguero National Park to the turtles while they are nesting in Costa Rica. Subsistence turtle fishing by the Miskito Indian population would be permitted, but commercial hunting would be excluded. The new Nicaraguan government lacks funding for the project, and is seeking financial assistance from foreign agencies.

Research. At the present time, no research on the sea turtles of Nicaragua is in progress.

Costa Rica

Sources of Information. Most of the available information on Costa Rican sea turtles was gathered during the course of the 25 years that we have been tagging turtles at Tortuguero. In March 1980 Larry Ogren and A. Carr made a low level aerial survey of the entire coast from Greytown, Nicaragua to the Panama frontier. Yearly surveys of the shore between Puerto Limon and the Nicaraguan frontier have been made. The area south of Cahuita to Sixaola, needs to be more thoroughly surveyed.

Nesting Habitat. The largest breeding colony of *Chelonia* in the Caribbean, and the most thoroughly studied in the world, nests along a twenty-two mile stretch of beach between the mouths of Rio Tortuguero and Rio Parismina. Nesting is most concentrated about midway between these two points. Each season for the past 25 years, from 4,128 to 27,041 females have nested there, between July and September. A leatherback rookery of moderate size is also found on this coast. Leatherback nesting is most concentrated at Matina, about 35 miles south of Tortuguero, but it occurs all along the coastline from the Nicaraguan border to Moin, mainly between March and June. Some nesting by hawksbills occurs along the entire Costa Rican coast, especially between Tortuguero and Parismina, and on the coral beaches from Cahuita to the Panama frontier. Loggerheads and ridleys have not been reported nesting on the Caribbean coast of Costa Rica.

Adult and Developmental Foraging Habitat. Immature green turtles and hawksbills of all post "lost year" sizes are found off southern Costa Rica, between Moin and the Panamanian border. A good hawksbill habitat is in northern Costa Rica near the Nicaraguan border. Concentrations of mature hawksbills are found the year around foraging on Tortuguero Bank, especially in late spring. Half-grown loggerheads turn up occasionally around patch reefs from Moin southward, but little foraging habitat for loggerheads and even less for leatherbacks is in Costa Rica.

Exploitation and Protection. For the past 16 years there has been a law prohibiting the taking of sea turtle eggs from any of the beaches of Costa Rica. Gradually the laws have been augmented and tightened but abuse still occurs. Since 1977 when Costa Rica became a signatory to the CITES convention, it has been illegal to take sea turtles, with the exception of those allowed under subsistence quotas. Turtling to supply the local market in Limon is allowed, but nowhere within 6 kilometers of shore. The northern three-quarters of Tortuguero Beach is under the jurisdiction of the Tortuguero National park, which was established in 1976.

Research. A program of tagging and related ecologic and physiologic research has gone on at Tortuguero under the auspices of the University of Florida since 1955. This has been supported by the Caribbean Conservation Corporation, and formerly had additional support from the National Science Foundation. During the period that the Tortuguero tagging program has been in operation, the West Caribbean population of *Chelonia* has become the best known sea turtle population in the world. Groundwork has been laid for accurate demographic assessments, including calculation of the total mature population from numbers of nesting females per season. Some difficulties involved in these calculations are discussed separately herein.

Panama

Sources of Information. Although Bocas del Toro was an early center of exploitation of sea turtles, both *Chelonia* and *Eretmochelys*, published information on the turtles of the Caribbean coast of Panama is limited. Within the past ten years a report by Dario Tovar (1971), and another by Rigoberto Paredes and Jose B. Sokol (1971) have provided some data, particularly on the exploitation of the green turtle and hawksbill by the local people. During September 1978, Tom Carr visited the segment of coast just west of Colon and gathered information through interviews. During July 1979, Anne Meylan conducted interviews, reconnoitered nesting and foraging habitat in Bocas del Toro Province (at Bocas, Bastimentos, and Zapatilla Cays) and made an aerial survey of the coast from the northern frontier with Costa Rica to Calovebora. Argelis Ruiz surveyed the coast between Calovebora and Punta Toro from the air on August 26, 1979. A. Carr has carried out many interviews with the Indians in the San Blas Islands, and on June 6, 1979 was presented with a short report, by Rafael Araujo, on the arrival and egglaying activity of leatherbacks at Aglatome Bay (Acla), San Blas Islands, by the members of the Biological Investigation Society of the University of Panama. In January and February 1980, Tom Carr visited the Bocas del Toro area to investigate the longshore sargassum-drift habitat and to conduct additional interviews with the local turtlers. The regions east from Bocas del Toro to Colon, and east of the San Blas Islands to the Colombian border remain only sketchily surveyed. The latter, especially, deserves careful attention.

Nesting Habitat. In Bocas del Toro Province, there is fairly good nesting beach all along the mainland coast from the Costa Rican border to Changuinola. Good beaches exist on Isla de Colon, Bastimentos, Zapatilla Cays, and the Valiente Peninsula. Numerous extensive stretches of what appear to be excellent nesting shore run eastward from Río Cañaveral to Calovébora. Although the aerial surveys were not conducted during the peak nesting time of any of the species, there was a pronounced concentration of tracks, presumably those of hawksbills, on Chiriquí Beach, which extends for about 18 miles between Río Cañaveral and Río Chiriquí. Besides Chiriquí Beach, hawksbills are known to nest on the three Bastimentos beaches, on several small beaches on Isla de Colon, on both of the Zapatilla Cays, and at Changuinola. The hawksbill season in Panama is April through August, with the peak occurring in May and June.

Dermochelys nests primarily on Bastimentos and Changuinola; and occasionally on the two Zapatilla Cays. Single reports of nesting emergences on Isla de Caña Blanca (Waikin Cay) and on the coast just west of Santa Catalina were

heard. The nesting season is February through June. Green turtles occasionally nest on Changuinola, Bastimentos and Chiriquí Beach, the best of the three being Changuinola. The nesting season of *Chelonia* is during the summer months. Loggerheads nest only rarely; nesting in July on Bastimentos was reported to T. Carr.

In the San Blas Islands there are many isolated nesting beaches. In general, the hawksbill is the species that emerges most often to nest. Nesting also occurs on the adjacent mainland, where leatherbacks and green turtles come up fairly regularly. Loggerheads are only rarely seen on shore.

Adult and Developmental Foraging Habitat. Extensive lagoon and offshore habitats are found around Bocas that appear to be highly favorable feeding grounds for both juvenile and adult turtles. These remain largely unsurveyed. Reefs and grass beds exist around Bastimentos, Isla de Colon, and the Zapatilla Cays. Hawksbills reside on banks off Isla de Colon and Bastimentos. Other banks farther offshore are also known to be occupied or visited by turtles, presumably *Eretmochelys* and *Chelonia*. Although much less numerous than in the past, a considerable number of hawksbills of all sizes occurs in the region. Mature hawksbills reportedly migrate to Chiriqui Beach from other areas to nest. Bocas is an important temporary feeding station for migrating green turtles. Thirty-two tags put on at Tortuguero have been recovered there. The turtles are usually caught in nets as they come in to feed on seagrass on the leeward side of the outer cays of the lagoon. A small number of adult green turtles are resident; these are reported to feed on mangroves in the lagoons. Immature green turtles also occur, but in smaller numbers. Adult loggerheads are rare, but subadults are reported to be common in both Chiriquí and Almirante lagoons. Leatherbacks are present only during the nesting season. Ridleys have not been positively identified in the region.

In the San Blas Islands there is an abundance of reef habitats, tracts of seagrass and beds of algae. Hawksbills of all sizes are found with relative frequency. Green turtles also occur in all sizes, but most of them are juveniles. An occasional young leatherback is observed; the adults are present only during the nesting season. Loggerheads of all age groups are present, with adults being the most frequently encountered. Hatchling green turtles, presumably from Tortuguero, have been found off the coast of Panama in offshore sargassum drift-lines.

Exploitation and Protection. Human exploitation of sea turtles is heavy in Panama. The eggs are taken regularly, and nesting females are often killed. Nets are set offshore, and turtles are speared with harpoons, especially in the San Blas Islands. The meat of both green turtles and hawksbills is eaten by coastal residents, although that of the former is much preferred. *Decreto Ejecutivo No. 104, Setiembre 1974,* prohibits the capture of green turtles, loggerheads and olive ridleys in territorial waters from 1 May to 30 September. It is also illegal to collect or sell the eggs or hatchlings of any species of sea turtle.

Research. Anne Meylan is conducting a study of the feeding ecology of the hawksbill in Bocas del Toro Province. No other research on marine turtles in Caribbean Panama is underway.

Colombia

Sources of Information. A. Carr and John H. Phipps visited Islas del Rosario during the 1960s. The status of the Colombian sea turtles is discussed briefly by Rebel (1974) and Bacon (1975). Kaufmann (1975) published results of tagging studies of Colombian loggerheads. In a recent unpublished report, Tufts discussed results of the tagging project being conducted under the auspices of the Instituto del Desarrollo de Recursos Naturales Renovables (INDERENA). A proposal from INDERENA to IUCN entitled, *Programa para la proteccion y conservación de la tortuga, Dermochelys coriacea, en las costas del noroeste de Colombia,* gives some information about the turtles in that region. Tom Carr surveyed the Colombian coast between Punta Baru and Santa Marta during October 4-12, 1978, obtaining information from interviews, and by diving on the coral reefs at Islas del Rosario. The Guajira Peninsula is probably the most important turtle habitat in Colombia, and this remains unsurveyed.

Nesting Habitat. Good nesting beaches, especially for the hawksbill, occur among the Islas del Rosario. Tom Carr found that hawksbills still emerge there regularly, though in small numbers, and that some green turtles and loggerheads nest there as well. Good beaches occur on the mainland between Cartagena and Santa Marta, and loggerheads, hawksbills and green turtles occasionally nest there. Reinhard Kaufmann suggested that the beaches of the Guajira Peninsula are generally unsuitable for nesting, but Tom Carr heard reports that leatherbacks nest there. Some leatherback nesting occurs from March through June on 10 miles of beach in the Choco, on the coast of the Gulf of Uraba.

Adult and Developmental Foraging Habitat. Extensive reefs exist in the Islas del Rosario, and local people consider the region to be excellent hawksbill habitat. Also, moderately extensive grass flats occur there, but green turtles are infrequently seen. In most of Caribbean Colombia, mature green turtles are less commonly encountered than adult loggerheads and hawksbills. Extensive turtle grass habitat exists off the Guajira Peninsula, however, and many of the 58 tags put on turtles while they nested at Tortuguero, Costa Rica, and recovered in Colombia, came from Guajira.

Exploitation and Protection. Exploitation has been heavy, especially on the mainland, and Colombian sea turtles are generally depleted. Along the poverty-ridden northern coast, virtually every nesting turtle is turned when found, and her eggs taken. Turtles are also netted offshore, but too few are left to support a commercial fishery. A. Carr has received word that two factories, operating semi-clandestinely in Bogota, fashion furniture from tortoiseshell. Although laws to protect sea turtles exist, there is general lawlessness in the places in which turtles remain, and enforcement of the regulations is difficult. INDERENA is making an effort to protect a 37-mile stretch of loggerhead nesting beach east of Santa Marta.

Research. During the late 1960s Dr. Reinhard Kaufmann initiated a turtle tagging program on Buritaca Beach, 31 miles east of Santa Marta. Since 1970, INDERENA has taken over that program. INDERENA has recently submitted a proposal to IUCN for a study of the leatherback nesting colony in the Gulf of Urabá, in the Choco of Colombia.

Venezuela

Sources of Information. The second most important nesting ground for *Chelonia* in the Caribbean is Aves Island, a Venezuelan possession where about 600 green turtles nest annually. The colony there has been monitored by William Rainey, and more recently by personnel of FUDENA *(Fundación para la Defensa de la Naturaleza)*, with whom we are collaborating. Assessment of the seemingly meager sea turtle populations and nestings along the mainland coast of Venezuela is incomplete. During the past few years *Fundación Científica Los Roques* has monitored turtle activities at Los Roques Atoll, and A. Carr visited those islands in June 1978. Karen Bjorndal obtained some information on turtle activity in the Gulf of Paria, and at the mouth of the Orinoco River. Recoveries of tags from green turtles tagged on the nesting beach at Tortuguero, Costa Rica, outline the distribution of adult foraging habitat off Venezuela.

Nesting Habitat. In 1979, 76 nests were counted at Los Roques, of which 63 were hawksbills, 7 were green turtles and 6 were loggerheads. Only one leatherback nest was ever reported there, in 1974. The major nesting colony at Aves Island received a serious setback in 1979 from Hurricane David, which almost completely removed the sand from the island. Subsequently, waves and winds have mostly restored original sand levels, and results of the 1980 season are being awaited with great interest. Karen Bjorndal brought back reports of nesting by hawksbills at the mouth of the Orinoco River. Additional nesting surveys on the remainder of the coastline are warranted, although all indications to date are that no significant nesting occurs.

Adult and Developmental Foraging Habitat. There have been 26 Venezuelan tag returns from turtles tagged at Tortuguero. Seventeen of these came from the Guajira Peninsula, three from the Paraguana Peninsula, three from Los Roques, two from Isla Tortuga and one from the Gulf of Paria. Nineteen of the turtles tagged while nesting at Aves Island have been retaken at sea, but none in Venezuelan waters. Most of the recaptures were made in the Dominican Republic and the Windward and Leeward Islands. Two Aves turtles were retaken at Miskito Cays, Nicaragua, and one at Isla Mujeres, Mexico.

Exploitation and Protection. After long neglect, Aves Island is now well protected by personnel of the *Estación Científica Militar*. At Isla Los Roques the *Fundación Científica Los Roques* has launched a hatchery program and a campaign to protect nests from poachers. Mainland beaches receive little protection.

Research. FUDENA and the *Fundación Científica Los Roques* are conducting tagging projects at Aves Island and Los Roques.

Trinidad and Tobago

Sources of Information. A. Carr surveyed the northern and eastern coast of Trinidad in the 1950s *(The Windward Road*, pp. 30-38, 114-117, 121-122, 1958). In a series of papers Peter Bacon has summarized information on sea turtles in Trinidad and Tobago.

Nesting Habitat. Small numbers of turtles - leatherbacks, green turtles and hawksbills - nest on the northern and eastern coast of Trinidad. A. Carr recorded two green turtles nesting at Mayaro and a hawksbill near Brigand Hill, both on the eastern coast. The most prevalent nester is the leatherback, the total nesting population of which was estimated by Bacon in 1972 to number 400-500 mature females. On Tobago, leatherbacks, green turtles and hawksbills all nest, though nowhere in aggregations. No olive ridley has been recorded nesting in Trinidad.

Adult and Developmental Foraging Habitat. A. Carr found the olive ridley to be well known to fishermen along the northern coast of Trinidad. His informants there also knew the other four genera well, and spoke of leatherbacks migrating into and through Trinidad waters at the time of flooding of the Orinoco. No assessment of the frequence and abundance of turtles in the longshore or offshore waters of Trinidad and Tobago has been made but there clearly is an important migratory route along the northern coast. Green turtle foraging grounds occur in the Gulf of Paria, and a turtle that had been tagged on the Tortuguero nesting beach was captured there. Many of the green turtles taken off the northern coast of Trinidad are immature.

Exploitation and Protection. Since early times the sea turtles of this region have been heavily exploited and they obviously are seriously depleted. Laws in Trinidad protect sea turtles and their eggs only during the nesting season, from 1 June to 30 September. Bacon describes the laws as inadequate and poorly enforced, and estimates that during the period 1969-1972, about 30% of nesting turtles were killed on the beach. In 1977 Peter Feinsinger of the University of Florida saw several freshly killed leatherback turtles on the beaches of Tobago.

Research. No sea turtle research is at present being carried out in Trinidad and Tobago.

Bahamas

Sources of Information. Except for the early general accounts, little information on sea turtles in the Bahamas has been published. Karen Bjorndal surveyed Great and Little Inagua islands, during an 18-month sojourn studying green turtles in Union Creek. Later, Bjorndal distributed a sea turtle questionnaire to all commissioners and to other individuals recommended by the Ministry of Agriculture and Fisheries. Replies were received from 15 people. In November 1979 Tom Carr carried out surveys and interviews on Abaco Island and the southeastern coast of North Andros Island. Colin Higgs of the Bahamas Ministry of Agriculture, Fisheries & Local Government provided data on turtle landings in Nassau. Most of the 700-mile-long Bahama archipelago remains unsurveyed. This remains the biggest gap in our work under the NMFS contracts.

Nesting Habitat. At Great Inagua, the best nesting beaches are located on the southeast side of the island. Small numbers of loggerheads, hawksbills and green turtles nest there each year. The green turtle season is from June to September; loggerheads nest from April to July, and hawksbills the year around. The same species nest on Little Inagua in somewhat greater numbers. At Andros and Abaco there are suitable nesting beaches only on the east sides

of the islands. Sparse to moderate loggerhead and hawksbill nesting occurs on both islands. A few green turtles nest on Abaco each season. No leatherback nesting was reported for any of the four islands surveyed.

Adult and Developmental Foraging Habitat. At Great Inagua, the green turtle is the species most commonly seen and caught, and hawksbills are second in abundance. Loggerheads are now only rarely seen. Green turtles and hawksbills of all sizes occur, but most of the loggerheads are mature. Adult leatherbacks are occasionally sighted in deeper offshore waters. Green turtles congregate in protected, shallow water bays, or "creeks," often mangrove-bordered, all around the island. Hawksbills and green turtles are both seen over coral heads and reefs; loggerheads occur in a wide variety of habitats. All species are present the year around.

At both Andros and Abaco the turtles most often seen are juvenile green turtles and hawksbills, both of which are usually found over seagrasses and algae-covered bottoms. At Abaco they occasionally move into salt water mangrove creeks. Juvenile loggerheads are less common; they inhabit coral reef and rock-shoals, and occasionally enter salt water creeks. The most commonly encountered adult turtles are loggerheads and hawksbills, which appear to be resident at all seasons. Adult green turtles were not reported at Andros. One informant emphatically insisted that, years ago, he saw a huge flotilla of ridleys in deep water off the northwest side of Andros.

Information from 15 questionnaires asking which species are present, and which nest in the area involved is tabulated below. Symbols used are as follows: G = green turtle, H = hawksbill, L = loggerhead, Le = leatherback and R = ridley. Leatherbacks were always reported as rare; at Abaco ridleys were reported as very rare, and were said to be "half hawksbill and half loggerhead."

Locality	No. of Responses	Species Present	Nesting
Walkers Cay	1	G, H, L, Le	G, H, L
Grand Bahama	1	G, H, L, Le	G, H, L
Abaco	4	G, H, L, Le, R	G, H, L
Bimini, Cat Cay & Gun Cay	2	G, H, L, Le	G, H, L
Eleuthera	2	G, H, L	L
Long Island	2	G, H, L, Le	G
Conception	1	G, H, L	G, H
San Salvador	1	G, H, L	no data
Great Inagua	1	G, H, L	G, H, L

Exploitation and Protection. On Andros and Abaco, turtles are hunted for local subsistence and for export to Nassau. Both eggs and turtles are taken whenever possible. The most popular turtling technique is "jumping" and spear-gunning. Hawksbill is the preferred meat, and tortoiseshell is shipped to Nassau to be prepared for sale to tourists or for export as unworked

shell. From 1966 to 1969 (the last years for which figures are available) $65,000 worth of tortoiseshell was landed in Nassau from throughout the Bahamas. In the northern islands nesting by loggerheads is said to have diminished more drastically than that by either green turtles or hawksbills. At Inagua, turtles are taken mostly in nets; about 30 were caught annually from 1970 and 1976. Most turtles taken range in weight from 30-80 pounds. It is illegal to take female turtles on the beach. The eggs of all the species are protected, and no turtle smaller than ten inches in carapace length can be taken. Numbers of nesting turtles have greatly decreased during the past 50 years.

Turtle landings in Nassau by month, in pounds of marketable weight, were as follows:

		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1974	G	817	124	702	85	240	60	2,000	932	742	497	112	20
	H	1,450	2,661	4,610	0	741	60	120	3,752	5,961	880	830	935
	L	9,400	13,710	14,695	0	0	0	4,500	3,930	860	150	2,250	5,800
1975	G	675	479	881	80	2,725	1,842	350	728	209	649	645	0
	H	1,856	1,364	4,744	36	1,705	2,690	220	4,940	1,139	3,647	1,333	4,520
	L	5,300	0	3,535	0	0	0	2,550	5,805	880	2,050	5,235	0
1976	G	110	156	3,834	1,017	2,374	60	0	332	700	136	875	547
	H	1,051	2,755	5,513	680	1,450	550	0	4,738	5,419	4,882	3,152	1,310
	L	1,045	280	12,760	0	0	87	2,450	582	1,850	125	2,507	1,310
1977	G	600	342	889	0	350	3,426	305	328	628	2,236	390	110
	H	2,830	4,050	8,805	734	1,434	170	50	4,732	8,236	0	2,463	2,458
	L	1,248	2,500	3,130	200	0	0	2,200	5,621	2,670	1,434	3,138	4,700

In the list below, turtle landings in Nassau in 1976 and 1977, from the islands indicated, are tabulated. Figures are in pounds of gutted weight.

	Green Turtle	Hawksbill	Loggerhead
Abaco			
1976	253	1,458	none
1977	80	670	200
Acklins			
1976	416	100	none
1977	402	none	634
Andros			
1976	2,479	5,667	8,755
1977	2,584	8,537	15,579
Berry Islands			
1976	834	1,495	2,637
1977	310	400	410

Bimini, Gun Cay and Riding Rocks			
1976	none	1,051	900
1977	1,020	6,970	3,866
Cat Island			
1976	30	70	none
1977	none	389	none
Eleuthera			
1976	2,038	3,611	1,197
1977	508	4,882	1,264
Exuma Cays			
1976	145	425	550
1977	none	645	550
Long Island			
1976	none	133	147
1977	none	none	423
Mayaguana			
1976	none	none	none
1977	none	none	200
New Providence			
1976	91	231	none
1977	1,796	2,263	none
Ragged Islands and Western Bank			
1976	4,350	21,404	3,100
1977	805	13,412	3,360

Research. For twenty years the Caribbean Conservation Corporation has had a small colony of green turtles in a seven-square-mile impoundment at Union Creek, Great Inagua. The original aim of this was to test rearing techniques. Today the colony is being maintained as a valuable source of data on the growth rate of young and subadult green turtles under quasi-natural conditions. The Creek was the site of feeding ecology research by Karen Bjorndal, who is continuing to collect data on the growth of green turtles and loggerheads there.

Caicos Islands

Sources of Information. Very little has been published about the sea turtles of the Caicos Islands. Anne Meylan spent a week, beginning August 3, 1979, in the islands and gathered information from interviews with fishermen, fisheries personnel, and local residents on the following islands: South Caicos, Middle Caicos, North Caicos, and Pine Cay.

Nesting Habitat. The Caicos Islands group consists of six major islands (West Caicos, Providenciales, North Caicos, Middle Caicos, East Caicos, and South Caicos) and a number of smaller cays. The Caicos Bank, a shallow sandy

shelf, extends 20-40 miles south of the island chain. There appears to be no concentrated nesting by any species in the islands. What appear to be suitable nesting beaches are mostly distributed along the windward (northern) side of the islands, and on the offshore cays to the south, especially Seal Cays and Ambergris Cays. Hawksbills are the most abundant nesters, loggerheads nest in smaller numbers, and green turtles emerge only rarely. Leatherbacks have not been found nesting in the islands.

Adult and Developmental Foraging Habitat. The entire northern perimeter of the island chain is fringed by reef. Hawksbills of all sizes inhabit the fringing coral reefs and the outer southern cays (Seal Cays and Ambergris Cays). Tidal swamps along the southern shores are extensive, and juvenile green turtles are abundant there in the mangrove creeks. Meylan's observations in the Caicos corroborate evidence from other localities that young green turtles sometimes occur in mangrove creek habitat. Little green turtles are also found in the cuts between the major islands, and in the Bottle Creek area. Adult green turtles are uncommon, but occasionally are seen on the Caicos Bank at the Ocean Hole, a natural depression off the south coast of Middle Caicos. Green turtles of unspecified size feed on grass beds off the northeastern coast of Middle Caicos. Small numbers of loggerheads of all size groups are encountered; there are juvenile loggerheads in shoal areas along the fringing reef. Leatherbacks are almost unknown to the local people, but a former fisheries officer reported that they seasonally pass by Drum Point, on the northeastern corner of East Caicos. Several informants spoke of *mulatto* turtles, which could possible be ridleys, but are more likely young loggerheads. Descriptions of the *mulatto* were conflicting.

Exploitation and Protection. Because of the present lucrative trade in lobster and conch, exploitation of marine turtles is minimal in the Caicos Islands today. Apparently no commercial turtling is now practiced, although turtles are taken incidental to lobster and conch fishing. Juvenile and subadult green turtles are chased down in boats and captured by hand--partly for sport and partly for consumption. Some tortoiseshell is traded to Haitian buyers, but the amounts involved are insignificant. No tourist trade in tortoiseshell jewelry and curios was noted, although this may occur at Providenciales, which is the major tourist center.

The Fisheries Protection Ordinance, effective 12 July 1976, prohibits taking hawksbills of carapace lengths less than 17 inches, and green turtles with carapace lengths less than 15 inches. Taking turtles above the low water mark is illegal. No one may take, buy or sell turtle eggs. Although the fisheries officers generally seemed conscientious about enforcing such restrictions, because of limited manpower, the level of enforcement is probably inadequate.

Research. No sea turtle research is in progress.

Jamaica

Sources of Information. An extensive early literature indicates that Jamaica was an important center of sea turtle exploitation during the early days of exploration and colonization of the Caribbean. The status of the sea turtle populations of the island are briefly discussed by Rebel (1974) and

Bacon (1975). The only recent survey in Jamaica was made by Tom Carr during early May (3-13), 1979. He obtained data from more than 100 interviews. The people interviewed were fishermen, scientists at the University of the West Indies and the U.W.I. Marine Lab, and government fisheries officers.

Nesting Habitat. Beaches suitable for nesting occur all around the island. Hawksbills are the most frequent nesters, but only a few emerge each year. The season lasts from April to August. Loggerheads nest even more sparsely. During the past 45 years, only two leatherback nestings have been reported and no green turtles have been seen on shore in recent decades.

Adult and Developmental Foraging Habitat. Coral reefs and seagrass pastures are abundant in the coastal waters of the island. Hawksbills and green turtles ranging from dinner-plate to mature sizes are found in moderate numbers in these. Hawksbills forage primarily on the outer reef ledges, but they also sometimes appear along weedlines. Both subadult and mature green turtles occur on the grass beds. A tag recovered at Morant Cay came from a green turtle that had been tagged while nesting at Tortuguero, Costa Rica. Before construction in Montego Bay destroyed the mangrove creek habitats, small green turtles reportedly occurred regularly in the creeks. Young green turtles also frequent the offshore drift lines. Adult loggerheads are occasionally caught in drift lines, in deeper water. Leatherbacks are rarely seen in Jamaican waters. Fishermen believe that only a few mature sea turtles of any kind stay near the island the year around. Reports of loggerheads seen far offshore were received, and the observers believed that the turtles were travelling.

Exploitation and Protection. There is a local market for turtle eggs, meat and shell. Because turtles are scarce, no one hunts them full time, but turtles and their nests are generally taken whenever encountered. Hawksbills are captured with spearguns. Loggerheads are gaffed in the offshore weedline. On the main island, Jamaican law protects only the eggs. On Morant and Pedro Cays both turtles and eggs are totally protected by law, but enforcement is inadequate. Recently, the Natural Resources Conservation Department has instigated a conservation campaign to change both laws and attitudes. As a feature of this, an informative pamphlet entitled *Save Our Turtles* is being circulated.

Research. During Tom Carr's visit, scientists at the University of the West Indies expressed an interest in initiating a sea turtle research program in the future.

Dominican Republic

Sources of Information. Sea turtles, probably chiefly hawksbills and green turtles, were extremely abundant in Hispaniola during the early years of the Spanish occupation. The Italian, Cuneo wrote of "an infinity of giant turtles...optimal for eating" in 1495, and references are frequent to turtles in Hispaniola by Columbus, Oviedo, and Peter Martyr. The last, who was the first chronicler of Spain in the Caribbean, described reports of the mass nesting of sea turtles on the island of Alta Vela off the southwest coast of Hispaniola near Cabo Beata. Hispaniola, like Jamaica and the Cayman Islands, seems a clear case of a region in which once abundant green turtle and hawksbill populations were exploited to near extinction at a very early date.

No recent published information on the current status of sea turtle populations in the Dominican Republic is available. In early 1978 Dr. Robert E. Woodruff informed us of the existence of a nesting colony of *Dermochelys* on the northeastern coast of the island. The following August, Tom Carr visited the island, surveyed that and other coasts, and interviewed promising informants along the coasts and in the capital.

Nesting Habitat. Beaches suitable for nesting occur along most of the eastern portion of the island, with the exception of the eastern tip of Punta Engaño. Hawksbills nest, sparsely, on virtually all available beaches along this shore. The only approach to group nesting is apparently made by *Dermochelys*. Two informants gave the size of the East Coast nesting colony of the leatherback as about 100 a year. Loggerheads nest occasionally on both the northeast and southeast coasts, and green turtles, on the southern shore.

Adult and Developmental Foraging Habitat. Coral reefs occur along the entire northeast, and most of the southeast, shorelines. Seagrass beds occur inside the reefs off most of the coast, and in the shallow areas of Punta Engaño. Green turtles and hawksbills of all sizes occur on feeding grounds around the island, and a number of tags placed on turtles while nesting at Tortuguero, Costa Rica or Aves Island, have been sent in from the Dominican Republic. Mature loggerheads, possibly *in transit*, are occasionally encountered in all the areas surveyed. Leatherbacks appear during the nesting season only. Migrating ridleys were reported by a reliable informant to occur with some regularity in the channel between Isla Saona off the southeastern tip of the Dominican Republic, and the mainland. These are doubtless current-borne examples of *L. olivacea*.

Exploitation and Protection. When nesting turtles are encountered, they are regularly killed and their eggs are taken. Hawksbills are actively hunted for their shells, and are frequently taken by divers with spearguns. Tortoiseshell products were for sale in the Dominican Republic. Stuffed green turtles and loggerheads, ranging from dinner-plate-size to adult sizes, were also available in the shops. The overall consensus of knowledgeable people interviewed was that there are far fewer turtles now than in the past.

Research. During his visit to the Dominican Republic in August 1978, Tom Carr learned that scientists at the museum in Santo Domingo were interested in initiating a research program to study the island's sea turtles. We have received word that this program is now being developed, and we will be collaborating in the tagging project there.

Haiti

Sources of Information. Except for Cuba, and most of the Bahamas, Haiti represents the biggest gap in our survey to date. Marine turtles once abounded in Haitian waters, but this is no longer the case, and no recent literature exists on turtles in Haiti. The only information available was gathered by Anne and Peter Meylan when *in transit* to the Windward Islands; and by Diderot Gicca, incidentally to other work.

Nesting Habitat. No information.

Adult and Developmental Foraging Habitat. Dideroy Gicca saw small hawksbills near Gonave Island, off the western end of Haiti. Local people living in the area also had small hawksbill shells hanging as ornaments.

No information was gathered about other sea turtle species.

Exploitation and Protection. Anne and Peter Meylan observed large amounts of tortoiseshell products for sale in the Port-au-Prince airport. The origin of the items was not definitely determined, but the shopkeepers claimed that the shell came from local sources. The extremely poor economic status of Haiti makes it seem unlikely that more than the most vestigial stocks of turtles of any age group remain anywhere about the island.

Research. None is in progress. Surveys are badly needed but will be somewhat difficult to make.

Puerto Rico, Mona, Culebra Island Group, and Vieques

Sources of Information. Rebel (1974) and Bacon (1975) briefly reviewed the status of turtles in the Puerto Rico region. Aerial surveys of Puerto Rico and satellite islands were conducted by David and Peggy Carr (1977). Tom Carr (1974, 1977, 1978) made extensive surveys of the nesting beaches and littoral habitats of Culebra and Vieques islands. Surveys of Mona Island were conducted by Jean Thurston and Tom Wiewandt (1976), and more recently and briefly by A. and T. Carr and Anne Meylan.

Nesting Habitat. Extensive beaches, by all signs appropriate for turtle nesting, are distributed along the northern and western coasts of Puerto Rico, but very little nesting occurs there. Mona Island has approximately 5 miles of nesting shore, comprising numerous small beaches scattered along the north, west and south coasts of the island. Numerous hawksbills and some green turtles and leatherbacks nest on Mona. Both Culebra Island and Vieques have small nesting beaches scattered around their periphery. A sizeable leatherback rookery is on Vieques. These and occasional hawksbills are the main nesting visitants. On Culebra also, leatherbacks and hawksbills are the dominant nesters. On both Culebra and Vieques green turtles and loggerheads nest infrequently, both in smaller numbers than in former years.

Adult and Developmental Foraging Habitat. All four of the islands have extensive coral reef systems and seagrass pastures. The diverse reef areas of Puerto Rico and adjacent islands are inhabited by hawksbills of all ages and sizes except for the "lost year" group. Immature green turtles are also abundant, expecially at Culebra, where they were the prevalent sea turtle. At Vieques, two distinct size classes of immature green turtles were noted by Tom Carr. At Culebra and at Mona young green turtles were found in shallow-water *Thalassia* beds, around sargassum, and in soft-coral beds where algal growth was abundant. Mature green turtles were less numerous than juveniles. David and Peggy Carr recorded both loggerheads and leatherbacks during their aerial surveys, although nowhere in concentrated numbers. Leatherbacks are evidently only present during the nesting season. Olive ridleys apparently stray into

Puerto Rican waters, as they do along much of the borders of the Equatorial Current.

Exploitation and Protection. All species of sea turtles have been heavily exploited throughout the region. This is plainly reflected in the very low density of turtles in excellent habitat near the Puerto Rican mainland. Although all species of sea turtles and their nests are protected by law in Puerto Rican waters, the laws are not adequately enforced, and nesting females and their eggs are taken whenever they are encountered. Spearing hawksbills to obtain their shells for wall hangings is a popular sport among divers in the region. Surreptitious netting of turtles is also common.

Research. No scientific research on Puerto Rican turtles is at present being conducted. Small-scale tagging has been done on Mona Island in past years.

The U.S. and British Virgin Islands

Sources of Information. Rebel (1974) and Bacon (1975) briefly reviewed the status of turtles in both the U.S. and British Virgin Islands. Recently, surveys of varying extent were made in the U.S. Virgin Islands by David and Peggy Carr, William Rainey, Ed Towle, and Tom Carr. No recent information is available on sea turtles in the British Virgin Islands; they ought to be investigated at an early date.

Nesting Habitat. The beaches of the northern U.S. Virgin Islands (St. John and St. Thomas) are generally shorter than those on St. Croix. Concentrated leatherback nesting, involving perhaps 40 females a year, occurs at Sandy Point on St. Croix. According to some reports there is a small rookery on Tortola also, and the leatherback nests scatteringly on the other islands. There is occasional nesting by hawksbills throughout the U.S. Virgin Islands, and more rarely, green turtles come ashore.

Adult and Developmental Foraging Habitat. Coral reef and seagrass habitats are widespread in the Virgin Islands. Seagrass is particularly abundant near St. John. Hawksbills and green turtles, ranging from dinner-plate size to adults, are found throughout the area. Hawksbills occur more frequently than green turtles, but both are rare. Leatherbacks appear only during the breeding season. Loggerheads are seen only rarely.

Exploitation and Protection. In the U.S. Virgin Islands, all sea turtles and their nests are protected by law. Because of limited personnel, enforcement is in most places inadequate. As of September 26, 1978, Sandy Point Beach and adjacent offshore waters up to 100 fathoms in depth, were declared critical habitat for the leatherback nesting colony. Plans are at present underway to purchase the beach itself, to avert the threat of sand mining and development.

Research. Aerial surveys to determine the distribution and abundance of sea turtles in the waters of the Virgin Islands are being made by the Department of Conservation and Cultural Affairs.

Guadeloupe

Sources of Information. The only recent literature on the marine turtles of Guadeloupe is a paper titled *Le Statut des Tortue Dans Les Antilles Francaises* (1976) by A. Kermarrec of the Station de Zoologie et Lutte Biologique in Petit Bourg. This discusses the critical need for conservation measures in the French Antilles, to halt the decline of hawksbill and green turtle populations.

Anne and Peter Meylan were in Guadeloupe from 15-18 December 1978. Interviews were conducted and nesting beaches reconnoitered around the entire perimeter of Basse-Terre, and at Pointe-a-Pitre and St. Francois on Grande-Terre. Information was gathered about Les Saintes, Marie Galante, La Desirade, and Iles de la Petit Terre, although these islands were not visited.

Nesting Habitat. Beaches are irregularly spaced all along the coast of Guadeloupe, except for the rocky windward (N-NE) coast of Grande-Terre and in the mangrove areas along the Grand Cul-de-Sac Marin. Good beaches also exist on the small islands in the Grand Cul-de-Sac Marin, at Ilet à Kahouanne, La Desirade, Les Saintes and Marie Galante.

Hawksbills and green turtles are the principal nesters. Around Basse-Terre, both species are reported to nest on islands in the Grand Cul-de-Sac Marin (Ilet à Fojou, Ilet à Caret), along the north coast (Plage Ramée, Ilet à Kahouanne, Plage de Grande Anse near Deshaie) and on the east coast (Plage de Grande Anse near Trois-Rivieres, St. Clair, and Plage Viard). On Grande-Terre, nesting is reported at Anse Bertrans and Port Louis and on the peninsula east of St. Francois. Nesting may also occur on other beaches in unsurveyed areas of Grande-Terre, although the northeast coast is extremely rocky, and the south coast is developed for tourism. Nesting is reported to occur on Iles de la Petit Terre, Les Saintes, Marie Galante (at Ballet Beach) and La Desirade. According to informants, only a few turtles nest on any given night on any beach in Guadeloupe. The nesting season for both hawksbills and green turtles is April through September. Leatherbacks nest occasionally on beaches in northern Basse-Terre, including Ilet à Kahouanne. The best nesting beach for this species is Plage de Grande Anse near Trois-Rivieres. Loggerheads nest only rarely on Guadeloupe. Localities mentioned were Ilet à Kahouanne and the beaches near Goyave (St. Clair and Plage Viard).

Adult and Developmental Foraging Habitat. Numerous reefs occur in Grande Cul-de-Sac Marin, along the eastern shore of Basse-Terre (off St. Marie, Goyave, and Petit Bourg), along the southern coast of Grande-Terre (off St. Anne and St. Francois) and along the northern shore of the peninsula extending east from St. Francois. Reefs also are found along the southern shore of La Desirade, around the entire perimeter of Iles de la Petite Terre, and along the southeast coast of Marie Galante. The irregular coastline of Guadeloupe has many sheltered coves in which seagrasses grow in beds.

Hawksbills and green turtles of all ages are year around residents in Guadeloupe waters. Two tagged green turtles have been recaptured in Guadeloupe: one was originally tagged while nesting at Tortuguero, Costa Rica, and the other at Aves Island. Grand Cul-de-Sac Marin provides optimum developmental and adult foraging habitats. St. Rose, one of the main centers of turtle fishing in Guadeloupe, is situated in this area. Another important

center of turtling is Vieux Fort, in southern Basse-Terre. The fishermen there frequently travel to Les Saintes and Marie Galante to set their nets, and these islands can be assumed to provide suitable habitat. Correspondence received by A. Carr confirms that small green turtles occur at Les Saintes. Juvenile green turtles and hawksbills are common along the eastern coast of Basse-Terre.

Except during the nesting season, leatherbacks are rarely seen in coastal waters. Fishermen sight them in deeper offshore waters, particularly when searching for dolphin. No small leatherbacks are ever seen. Loggerheads are also occasionally sighted in deeper offshore waters. They are uncommon in northern and western Basse-Terre, but are fairly well known to fishermen on the east coast near Goyave. Several reports were received that loggerheads are more common around the St. Francois-Moule area of Grande-Terre. Thirty-five loggerheads, mostly of sub-adult size, were found for sale on the island, but their origin could not be determined.

Exploitation and Protection. Exploitation of marine turtles is intense in Guadeloupe. The meat and eggs of hawksbills, green turtles and even leatherbacks are relished by coastal people. A tourist market thrives, especially in the larger towns of Point-a-Pitre and Basse-Terre, for shells, stuffed turtles and jewelry. As was mentioned above, even the shells of loggerheads are sold to tourists. The export of turtle products is not prohibited.

Fisheries statistics for Guadeloupe show an estimated annual take of 30 metric tons of sea turtle (whole animal weight, all species combined) for 1959-1976. This includes figures for St. Bartolemy and St. Martin, which are said to be minor components.

Proposed legislation provides protection for eggs of all species. Leatherback turtles are completely protected, as are green turtles and hawksbills less than 60 cm in carapace length. The capture and sale of the latter two are prohibited between 15 May and 15 September. These regulations do not appear to be enforced, and local people were for the most part unaware that any laws existed.

Ilet a Fajou is currently being considered for inclusion in a National Park. On Basse-Terre, there is already a protected marine zone near the Pigeon Islands, but few turtles appear to be there.

Research. None.

Dominica

Sources of Information. No published information on the marine turtles of Dominica has been located. Peter and Anne Meylan were on the island during the period 19-23 December 1978, conducting interviews along the western coast from Scott's Head to Capuchin, on the northern coast at Calibishie, and at La Pleine and Delices on the eastern coast.

Nesting Habitat. Most of the coastline of this volcanic island is a series of rocky cliffs; there are relatively few beaches. On the west coast

are Rockaway Beach at Canefields, Mero, Pointe Ronde, Portsmouth, Douglas Bay Beach, and Toucari. On the northern coast from Anse du Mer to Woodford Hill there are several small covehead beaches. Only a short section of the eastern coast was reconnoitered, but topographic maps show beaches south of Walker's Rest, at Pagua Bay to the south of Castle Bruce, At Rosalie, and north of La Pleine (at Bout Sable). On the south coast, the only beach shown on the topographic map is located at Berekua. However, one informant reported nesting on a beach at Stowe.

Hawksbills and green turtles are the most frequent nesters on Dominica; the best nesting beaches for both are those in the Portsmouth area (Pte. Ronde to Toucari), Hampstead Beach, Castle Bruce, and Bout Sable. The nesting season of the hawksbill is May through October; for the green turtle the season apparently begins a little later. Leatherbacks nest in May and June at Bout Sable, Lambawan, and Stowe. No nesting by loggerheads was reported. Much of the coast of Dominica is inaccessible by land, and other undiscovered nesting beaches may occur around the island.

Adult and Developmental Foraging Habitat. The coastal shelf around most of Dominica is narrow, and sheltered coves are few. In spite of this, a fair number of green turtles and hawksbills of all sizes are year around residents. Turtle fishermen from Scott's Head set their nets along the windward coast, between Delices and Castle Bruce, and nets are also set along the north coast at Calibishie, and on the west coast at Toucari. These areas presumably provide foraging habitat for both adult hawksbills and green turtles. Juveniles of both are common in all areas. They are caught by divers at Portsmouth and Loubiere, and are sold to tourists. The occurrence of numerous young in a region in which the usual developmental habitats of the two species appear to be very limited is a puzzle that invites careful further investigation. Leatherbacks are relatively uncommon, but are occasionally seen in the Martinique and Guadeloupe channels. No small ones are known. Loggerheads occur even more rarely. They, too, are known best by people who fish in the deep channels between the islands. The loggerhead is frequently called "channel turtle." A fisherman at Calibishie reported catching a loggerhead 15 inches in carapace length. Except for this record, juveniles of the species are unknown.

Exploitation and Protection. A regulation passed in June 1976 protects all turtles between 1 June and 30 September. There is a minimum size limit of 20 lbs. All nesting turtles and their eggs are protected. Because of a shortage of enforcement officers, these rules apparently are not enforced; but coastal people are aware that they exist. The meat and eggs of green turtles, hawksbills and leatherbacks are consumed locally. Meat sells for 2$ E.C. per pound. French buyers travel around the countryside, visiting even the most remote areas, to buy hawksbill shell for export to the French Antilles. The price paid is 12-25$ E.C. per pound. A National Park System is developing rapidly in Dominica. Although the principal concern is for forest lands and fauna, Douglas Bay, north of Portsmouth, is being considered as a site of a National Park. No definite plans have been made yet to include the nesting beach there, but this clearly ought to be done.

Research. None.

Martinique

Sources of Information. The only publications on the marine turtles of Martinique are a report that appeared in a French fisheries journal in 1958 and the previously mentioned status paper by A. Kermarrec on the turtles of the French Antilles.

Martinique was surveyed 24-27 December 1978 by Anne and Peter Meylan. Interviews were conducted along the east coast from La Trinite south to St. Anne, and at Ft.-de-France, Case-Pilote, and Le Precheur on the west coast.

Nesting Habitat. Except along the north coast, beaches exist all around the perimeter of the island. Those on the west coast (between Ft.-de-France and Le Precheur) are characteristically short, narrow, and highly developed. The beaches on the south coast are much more extensive. That at Le Diamant, as seen from the air, appeared to be very long. On the eastern coast there are relatively fewer beaches; those at Macabou, Le Vauclin and La Trinite were reconnoitered during the survey. Beaches that appear to be good for nesting exist on some of the offshore islets such as Loup Garou and Ilet a Madame.

The predominant nesting turtles on Martinique are hawksbills and leatherbacks. Both species nest at the following locations: Loup Garou, Macabou, Bay d'Anglais, Pointe des Salines; of these Macabou is the most important. Hawksbills also nest at Ilet a Madame. The nesting season of the leatherback is February-March, although some informants reported nesting into late summer. The hawksbill season is March through late summer. Green turtles apparently do not nest on any of the above-named beaches. Local people are familiar with the green turtle nesting colony at Aves Island, and believe that the local turtles go there to nest. No loggerhead nesting was reported.

On the west coast, nesting occurs at Anse Ceron, north of Le Precheur, but the species involved was not identified. Many sections of the coast of Martinique were not reconnoitered during this survey, and additional nesting areas probably exist, particularly along the southern shore.

Adult and Developmental Foraging Habitat. Extensive reefs and sheltered waters occur along the southern two-thirds of the east coast. This area is important feeding and developmental habitat for green turtles and hawksbills. Although green turtles do not nest here, they are the most common species in the local waters. Several tags have been recovered from green turtles in this area--one from a turtle originally tagged while nesting at Tortuguero, Costa Rica, and three from turtles tagged at Aves Island. Loggerheads ranging in size from subadult to adult are also fairly common. They live farther offshore than the other two species. It is not known whether they are permanent residents of the area or are just passing through at certain times of the year. One informant reported that they were most commonly caught from December through February. No juveniles of this species are known. Leatherbacks are also usually caught far from shore. Fisheries officers in Robert reported that they are taken seasonally near Trinite, possibly when coming in to shore to nest. One juvenile (approximately 16 inches straight carapace length) was caught in the vicinity of Le Francois; it was preserved and taken away by a civil official.

At Case-Pilote on the west coast, a captive juvenile olive ridley was seen and photographed. This had been caught locally. Surprisingly, local residents did not recognize the ridley as distinct from the green turtle.

Exploitation and Protection. The level of exploitation of marine turtles in Martinique is higher than that anywhere else in the Lesser Antilles. The tourist trade in shell, stuffed turtles and jewelry is monumental. In Ft.-de-France boxfuls of stuffed juvenile hawksbills were for sale in souvenir markets. Meat and eggs of hawksbills, green turtles and leatherbacks are consumed locally. Nesting turtles are taken on the beach whenever they are found. According to fisheries personnel at the fisheries institute in Robert, there are at present no laws protecting turtles in Martinique. Fisheries statistics show annual takes of 20-40 metric tons (all species, whole animal weights) for 1959-1976. However, because turtle catches are not officially monitored, these are only gross estimations of the total take. There are no marine reserves offering protection to marine turtles.

Research. None.

St. Lucia

Sources of Information. A summary of information gathered by Peter Pritchard during a visit to St. Lucia is given by Cato, Prochaska and Pritchard (1978) in *An Analysis of the Capture, Marketing, and Utilization of Marine Turtles*. Anne and Peter Meylan surveyed the island during the period 27-31 December 1978. Interviews were conducted at Gros Ilet, Castries, Souffriere, Choiseul, Vieux Fort, Micoud, and Cas-en-bah (Anse Lavoutte).

Nesting Habitat. St. Lucia has numerous beaches that appear to be suitable nesting habitat. Some are small and situated in sheltered coves; others are high energy beaches facing the open sea. The most extensive of these are distributed along the southeastern tip of the island, and at Grande Anse, Fond d'Or, Anse Lavoute, Reduit (Gros Ilet), Vigie and Choc. The predominant nesters on St. Lucia are hawksbills and leatherbacks. Hawksbills nest to some extent on nearly all St. Lucia beaches. The season is April through October. Specific sites on the west coast are Anse Becune, Pt. Saline, Pigeon Island, Anse Cochon, Anse Jambon and Anse Mamin. On the eastern coast, nesting occurs from the southernmost tip of the island to Burgot Point, at Anse Ger, at the mouth of the Troumassee River, and at Praslin, Grande Anse and Cas-en-bah (Anse Lavoutte). Leatherback nesting occurs mostly on the east coast, on beaches from the southern tip of the island to Burgot Point, on the Maria Islands, at the mouth of the Troumassee River, and at Fond Bay, Grande Anse and Cas-en-bah. Heavy nesting at Grande Anse was reported, and the species involved there is most probably the leatherback. Leatherbacks also nest occasionally on the west coast, on Reduit Beach and Pigeon Island. The leatherback season is March and April, although some nesting occurs during the summer months. Loggerheads nest infrequently; localities include Pigeon Island, Cas-en-bah and Pitton Sivons. Green turtles appear to nest very rarely, if at all.

Adult and Developmental Foraging Habitat. The coastal shelf is broad and relatively shallow around the northern and southern ends of the island. On both coasts are numerous sheltered coves with seagrass beds. Both juvenile

and mature green turtles and hawksbills are year-around residents. Turtle nets are set in feeding areas along the northern coast from Gros Ilet to Anse Lavoutte, on the west coast at Souffriere and Choiseul, and on the east coast at Anse Sable and near Micoud (Fond Bay to Pt. Canelles). One tag has been recovered on St. Lucia: a green turtle originally tagged while nesting at Aves Island was captured near Vieux Fort. Two washtub-sized green turtles that had been caught at Gros Ilet were butchered and sold in the public market at Catries during the survey period. Loggerheads and leatherbacks are less common in coastal waters. Fishermen see them when they look for schools of flying-fish, or for floating plywood associated with the weedline. Small loggerheads are occasionally found in the area around Gros Ilet. Small leatherbacks are unknown, except for one specimen weighing about 20 lbs., reported by a fisherman from Souffriere.

Exploitation and Protection. Green turtles and hawksbills are protected by a fisheries ordinance passed in 1971. The season is closed from 1 May through 31 August. Nesting turtles and eggs are protected at all times. The minimum size limit is 15 lbs. Nets cannot be set nearer than 100 yards to shore. A license is required for the export of turtles. Some public awareness of these regulations exists, but enforcement officers are too few to insure that the fishermen take the rules seriously. No protected marine areas are found in St. Lucia.

Research. None.

St. Vincent

Sources of Information. A short description of the turtle industry of St. Vincent was published by Rebel (1974). Anne and Peter Meylan visited the island from 31 December 1978 through 5 January 1979. They interviewed people on the west coast from Kingston to Richmond Beach, and in the St. Vincent Grenadines at Union Island. Aerial reconnaissance of the Grenadines was carried out in a small two-engine plane.

Nesting Habitat. All along the leeward coast of St. Vincent there are beaches that appear suitable as nesting habitat. The windward shore was not surveyed, and the maps available do not show the distribution of beaches along that coast. In the St. Vincent Grenadines, which include all of the islands south to, but not including, Carriacou, numerous beaches appear to be likely nesting habitat. On the mainland of St. Vincent, hawksbills are the predominant nesters. They emerge on nearly every stretch of beach, but everywhere in reduced numbers. Nesting localities on the western coast include Richmond Beach, Rose Bank, Troumaka Bay, Cumberland Bay, Wallilabou Bay, and Barrouallie. On the east coast, some nesting occurs at Orange Hill, Colonarie Bay, and Stubbs. The nesting season for the hawksbill is March through September. Leatherbacks nest occasionally on the leeward coast, especially on Richmond Beach, Dark View, Barrouallie, and Clare Valley. On the east coast, nesting is reported at Mt. Pleasant. Additional localities on this coast almost surely exist, but these were not located. Loggerheads and green turtles may nest, very rarely, on the west coast, although no positive records were obtained. The extent of nesting by any species on the east coast was not determined.

In the Grenadines also, hawksbills are the predominant nesters, using beaches on nearly all of the islands. In some areas, human exploitation has measurably reduced their numbers, but the inaccessibility of some beaches offers the possibility that concentrated nesting by this species still occurs in the area. The nesting season is April through September. As on the mainland, green turtles nest only rarely; a few reports of nesting at Palm Island (also called Prune Island) seem credible. Loggerheads nest occasionally. Eggs from two nests were collected on Palm Island by the island's owners, and the hatchlings were raised in captivity. Nesting by the leatherback is very rare; one definite record exists for Richmond Beach on Union Island.

Adult and Developmental Foraging Habitat. Except off the southeast coast, the shelf around St. Vincent is narrow and offers relatively little foraging habitat for sea turtles. Hawksbills and green turtles of all sizes are present the year around along the west coast, but not in substantial numbers. Hawksbills are more numerous than green turtles. A few fishermen in Chateaubelair, Rose Bank, Clare Valley and Questelles set turtle nets along the coast. Loggerheads and leatherbacks are taken in deep waters. The latter are harpooned by pilot whale fishermen from Barrouallie. February and March are the months in which they most commonly appear. Small leatherbacks and loggerheads are not known in the area.

In the St. Vincent Grenadines, green turtles are far more common than on the mainland, equalling or exceeding hawksbills in numbers. Their prevalence can be attributed to the presence of extensive tracts of shallow water with good forage. Both species are more abundant around the islands than on the mainland. Subadult loggerheads, seldom less than 70-80 pounds in weight, are also very common. Juveniles of this species are not known in the Grenadines. Leatherbacks are uncommon, although most fishermen say they have seen them at sea at one time or another. The shallow, reef-studded waters undoubtedly pose problems for this species. One is known to have stranded on a reef near Mustique. Union Islanders strongly associate the presence of this species with periods of heavy flow of the Orinoco River. Small leatherbacks are never seen.

Exploitation and Protection. At the time of the survey in 1978, regulations called for a closed season from 1 May through 31 August. Nests were protected, and an export permit was required to take turtles out of the country. A new law, to become effective January 1980, would prohibit the capture of all species of marine turtles by all methods the year around. The sale of turtles locally or abroad would be prohibited. Presumably, this law is now in effect; its prospects for enforcement are unpredictable.

Annual exports of up to 1,500 pounds of hawksbill shell from St. Vincent to St. Lucia have been reported. A large proportion of that catch was said to have originated from Becquia, where the species is now said to be badly depleted. Prior to 1970, shell was also sold to Barbados and Japan. Exploitation in 1978 appears quite heavy, especially in the islands. The large number of tourists traveling through in sailing yachts provides a ready market for meat and shell. The use of spear guns to capture small turtles for sale as souvenirs is becoming increasingly popular. A French "yachtel" owner on Union buys all the turtles local fishermen care to sell, and then sells them in his establishment or exports them to Martinique and France. In Kingston, few turtle products were seen for sale.

Tobago Cays is a National Park, under the authority of the National Trust. Birds are protected there and fishing is restricted, but marine turtles are apparently not specifically protected.

Research. None.

Grenada

Sources of Information. Rebel (1974) and Bacon (1975) briefly discussed the marine turtles of Grenada. Anne and Peter Meylan visited the islands of Carriacou and Grenada during the period January 5-9, 1978. On Carriacou, interviews were conducted at Hillsborough and Windward. Aerial reconnaissance of the Grenadines southward from Carriacou to Grenada was made in a small two-engine airplane. In Grenada, interviews were conducted on the west coast at St. George's Place, on the south coast at Woburn and La Sagesse, and on the east coast at Crouchu, Soubise, Grenville, Conference and La Poterie.

Nesting Habitat. Favorable nesting habitat for marine turtles in the Grenadines is extensive. Hawksbills are the prevalent nesters. From April through October they come out on several beaches on Carriacou (Petit Carenage, north of Tarlton Point, at Grand Bay, Anse La Roche, Bogles and Hillsborough Beach) and on nearby Sandy Island, White Island, Mopion, Punaise, Petit Saint Vincent and Petit Martinique. Nesting also occurs throughout the southern Grenadines. A few leatherbacks nest each year on Carriacou, at Petit Carenage and Anse La Roche. No loggerheads or green turtles nest on these beaches.

On Grenada also, hawksbills and leatherbacks are the predominant nesters. They emerge in small numbers, during the summer months, all along the southern and western coasts (Hog Island, Little Bacolet Bay, La Sagesse Bay, Soubise, Pearls) and on Levera, Sandy Island, Green Island and Caille Island. Nesting by leatherbacks appears to be moderately concentrated on the east coast, on the beach extending from Telescope Point north to La Poterie. Leatherbacks also nest on the southern shore at Hartman's Lagoon (near Woburn), L'Anse Epine, Caliviny, Hog Island, Westerhall and Baccaye. Green turtles nest only rarely; two reports of their emerging on Marquis Island were received. Loggerheads nest rarely on Grenada.

Adult and Developmental Foraging Habitat. The extensive shallow waters and reefs of the Grenadines provide excellent foraging habitat for green turtles and hawksbills, both juveniles and adults. Green turtles are more common there than hawksbills. Fishermen set turtle nets around Carriacou and the surrounding islands. One green turtle that had originally been tagged at Aves Island was caught there, as was a head started green turtle that had been released in Surinam. Loggerheads are third in abundance in the Grenadines. Leatherbacks are occasionally sighted at sea, and an exceptionally small (20-pound) individual was once caught near the southern shore of Carriacou.

Around Grenada also, green turtles are the most numerous turtle. They sometimes reach huge sizes, allegedly up to 700 pounds. Green turtles and hawksbills of all post-lost-year sizes are year-around residents. Most turtle fishing on the island is done along the southern and eastern shores (Woburn, La Sagesse, Crouchu, Soubisse, and La Poterie). A green turtle originally

tagged at Aves Island was captured at Black Bay (St. Marks Parrish). Loggerheads are typically of subadult size in Grenada; few are smaller than 40 pounds. Leatherbacks are seen only during the nesting season. No small individuals are present.

Exploitation and Protection. The season from 1 May through 30 September is closed. Fishermen appear to be well informed about local laws, but they do not necessarily abide by them. Exploitation of marine turtles in Grenada is moderately intense. The trade in stuffed turtles and shells is lively in the Grenadines between local fishermen and tourists passing through in yachts. On Grenada, turtle products sell for high prices in the tourist shops. One adult hawksbill was priced at 750$ E.C. The meat of all species is eaten locally, although that of the leatherback and loggerhead is not relished. Meat sells for 1.75$ E.C. per pound. Turtles are taken on nesting beaches, and in some places are netted as they approach the beach to emerge. No protected areas exist.

Research. Melvin Goodwin is conducting a head-start project for hawksbills in Carriacou.

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Figures 1-13. Distribution of ecologic and developmental stages of five species of west Atlantic sea turtles. Densities are rated on intraspecific scales; cross comparisons are not possible.

Figures 1-3. Green turtle

Figures 4-6. Hawksbill

Figures 7-9. Loggerhead

Figure 10-12. Kemp's ridley

Figure 13. Leatherback

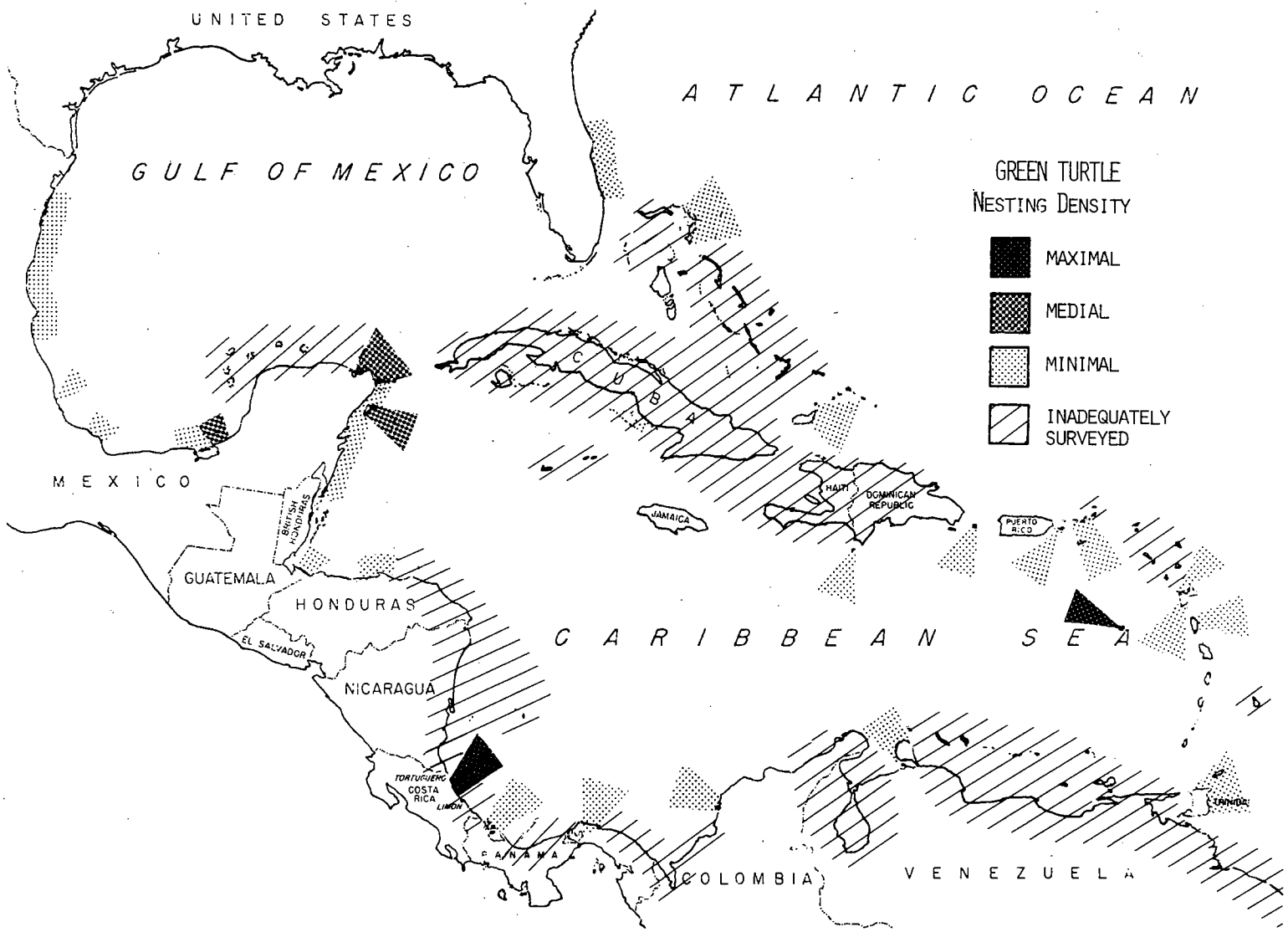
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Figure 1.

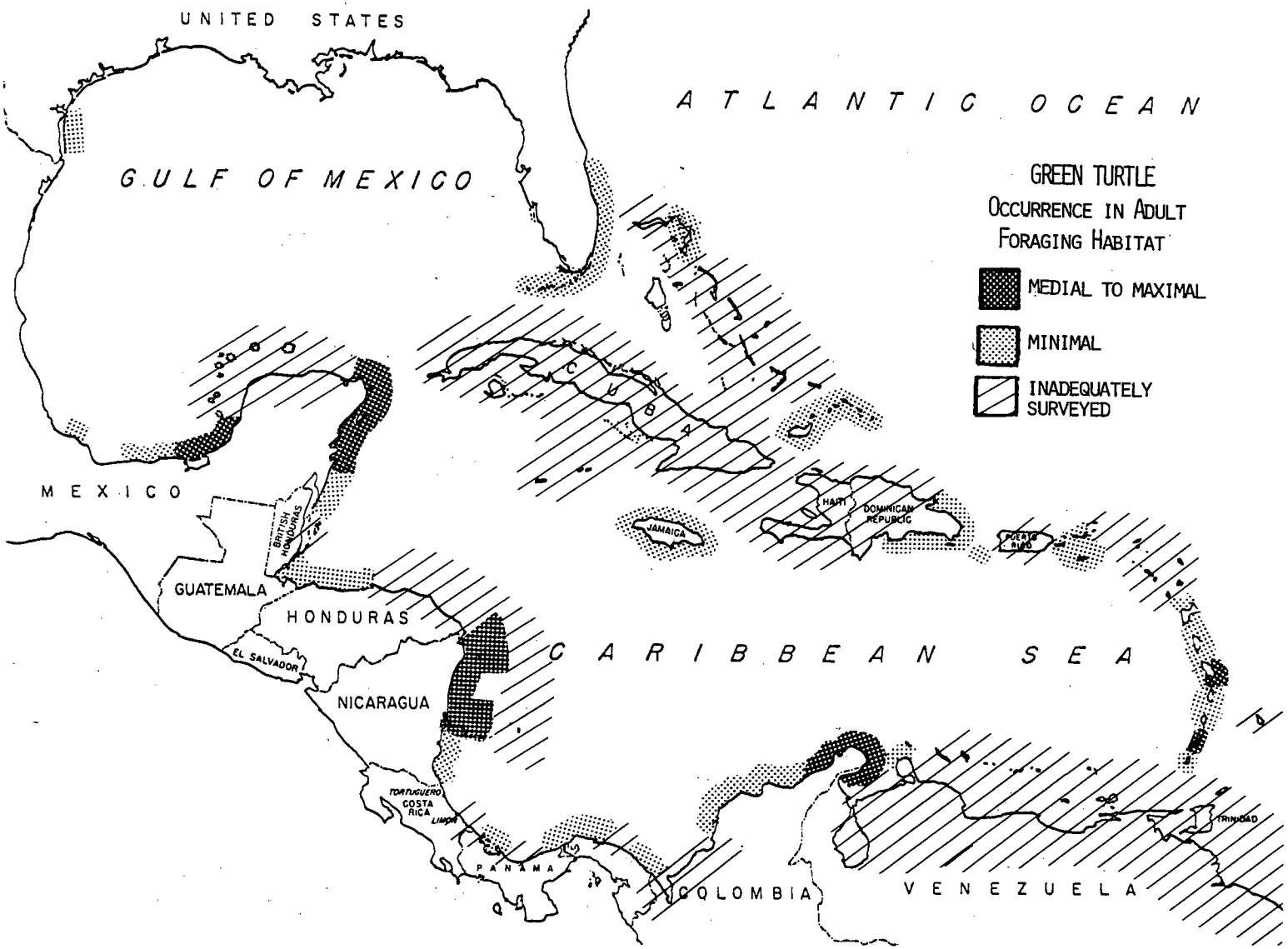
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Figure 2.

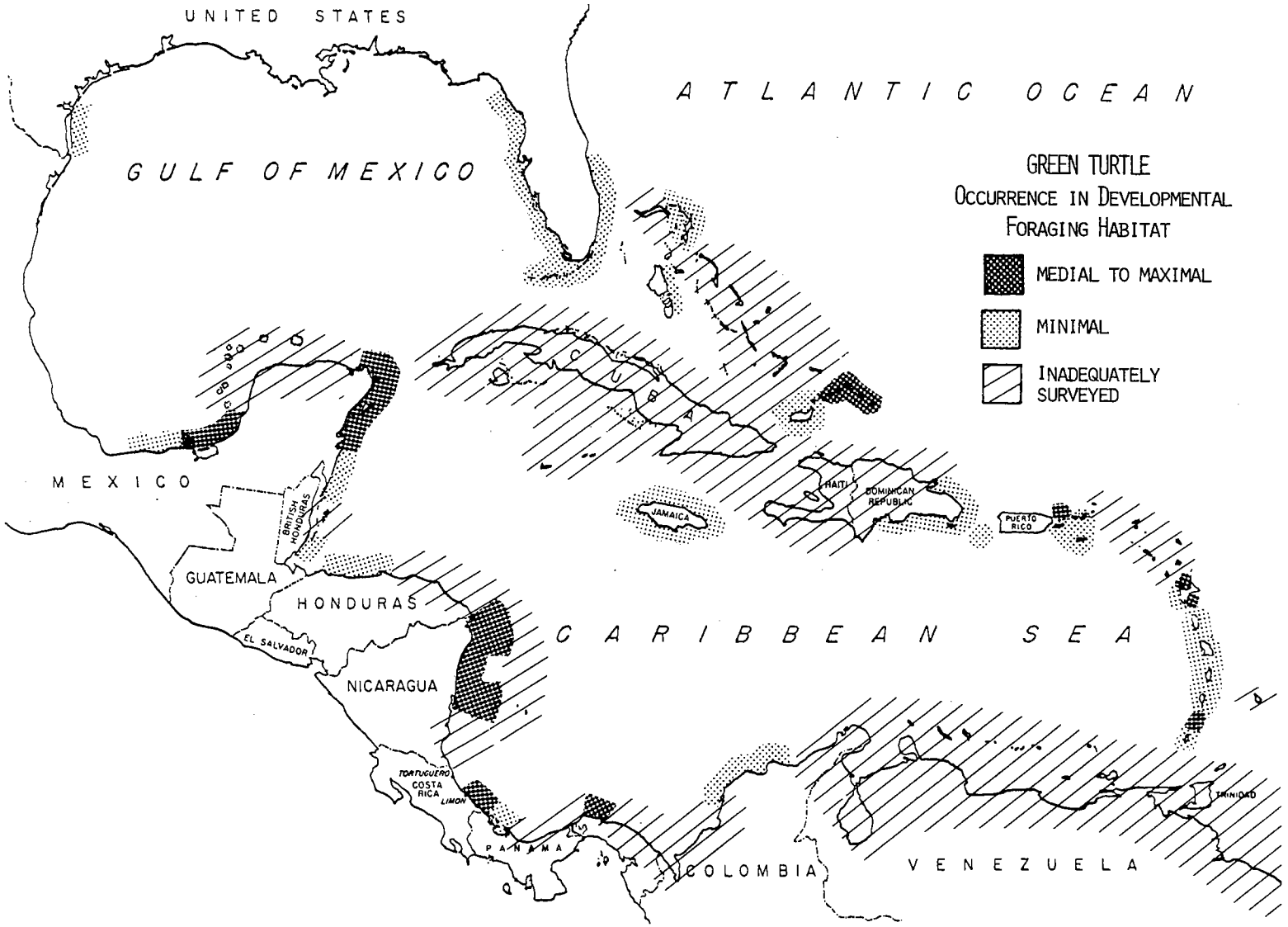
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Figure 3

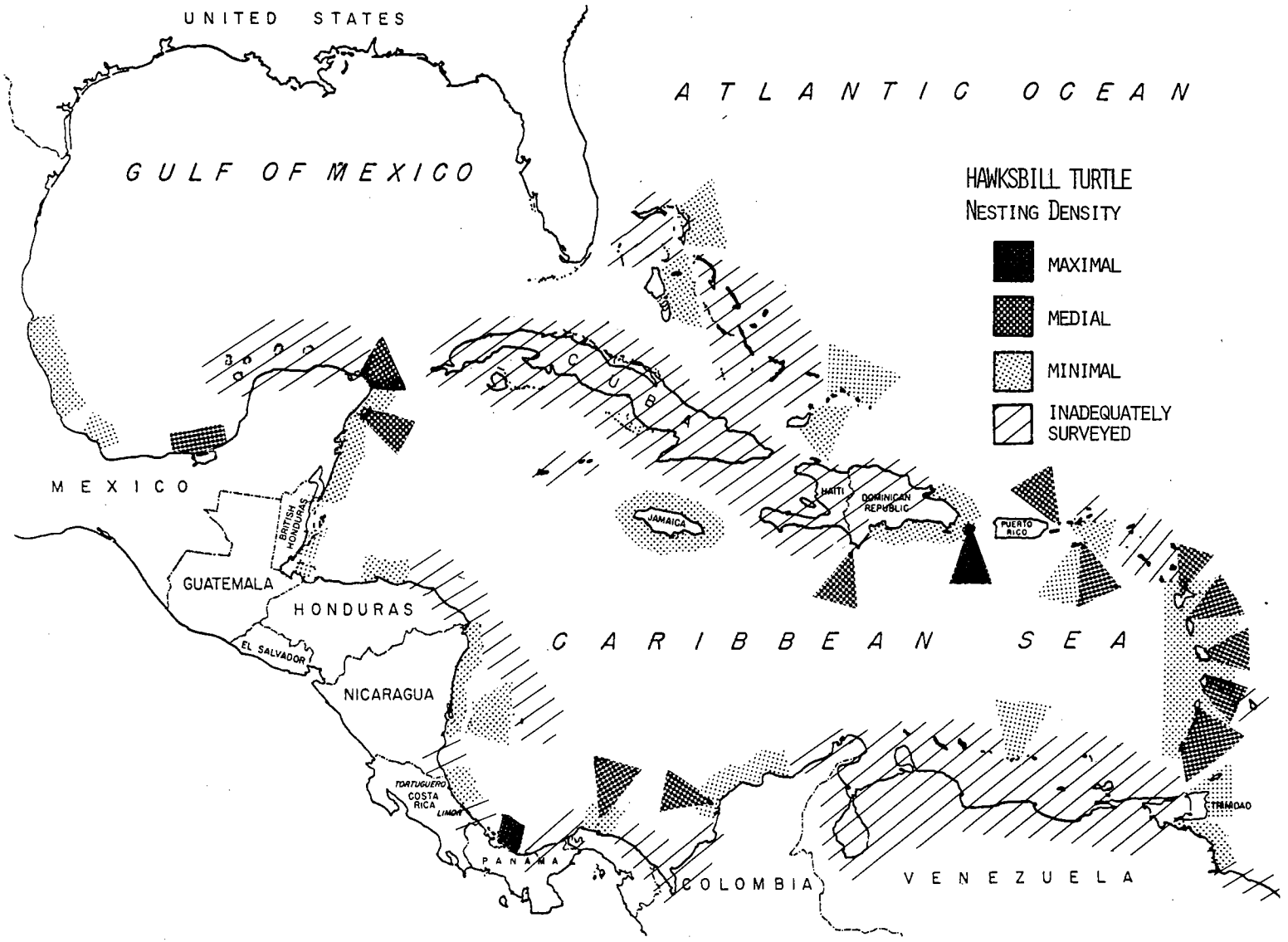
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Figure 4.

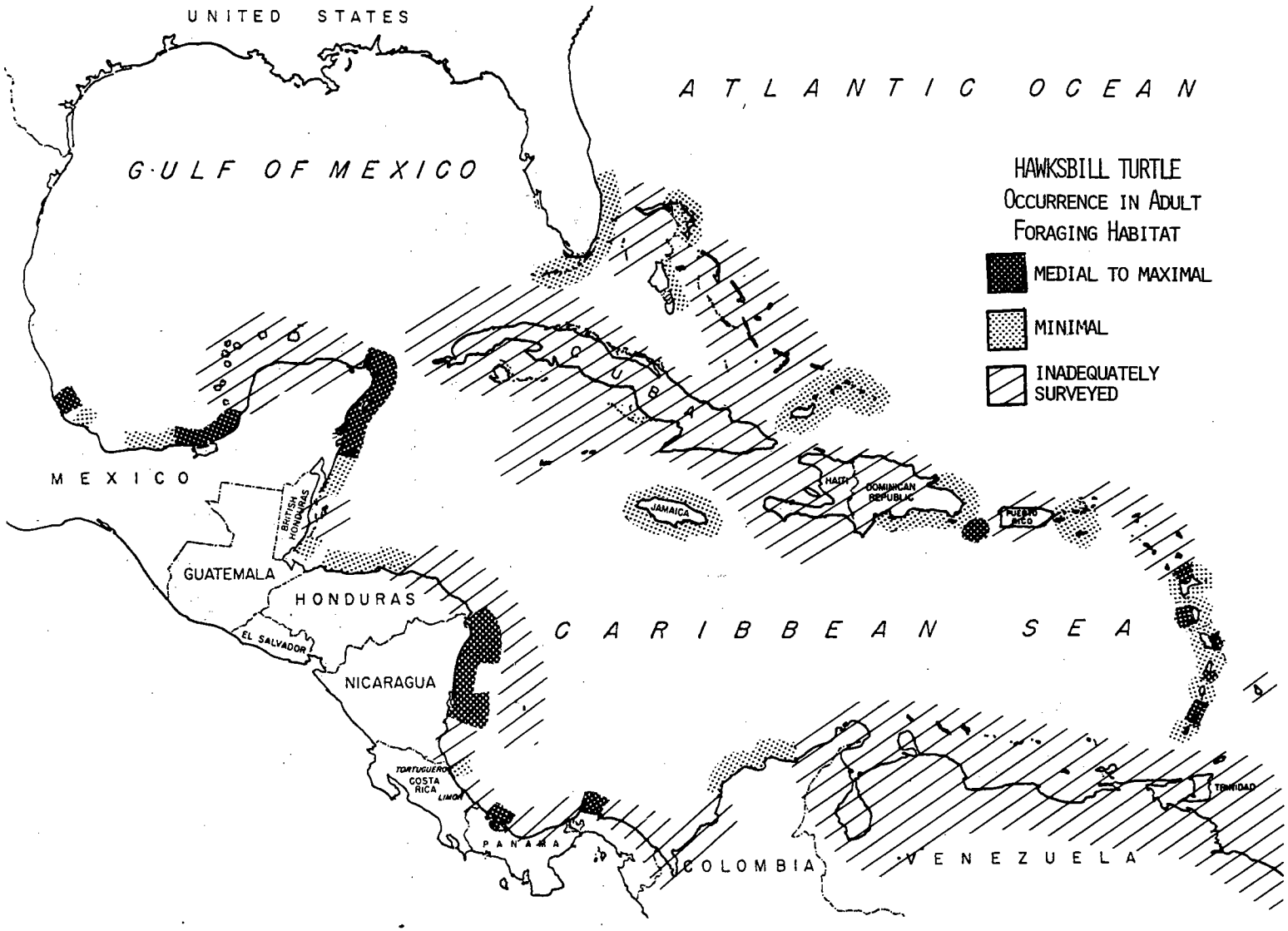
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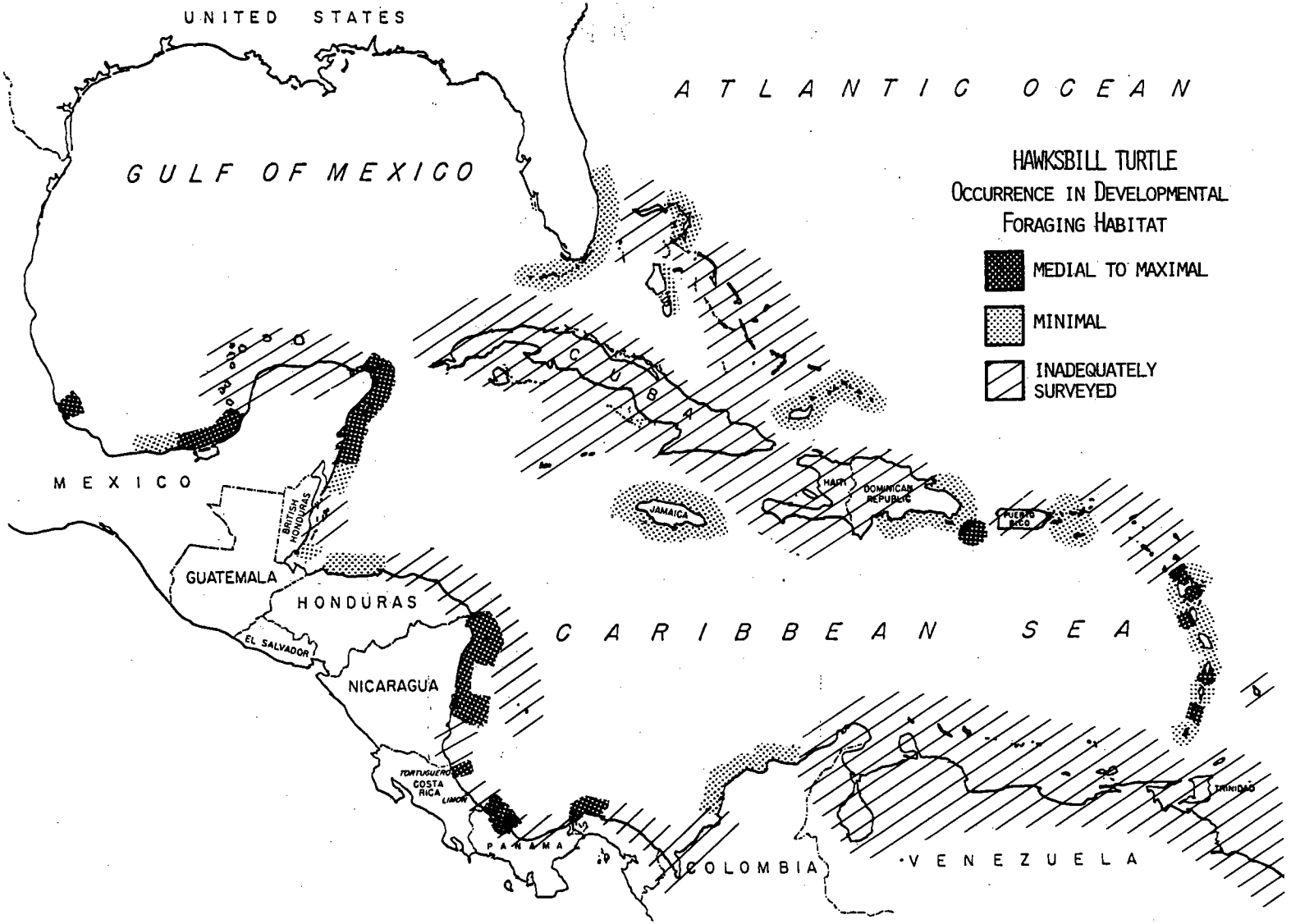
Figure 5.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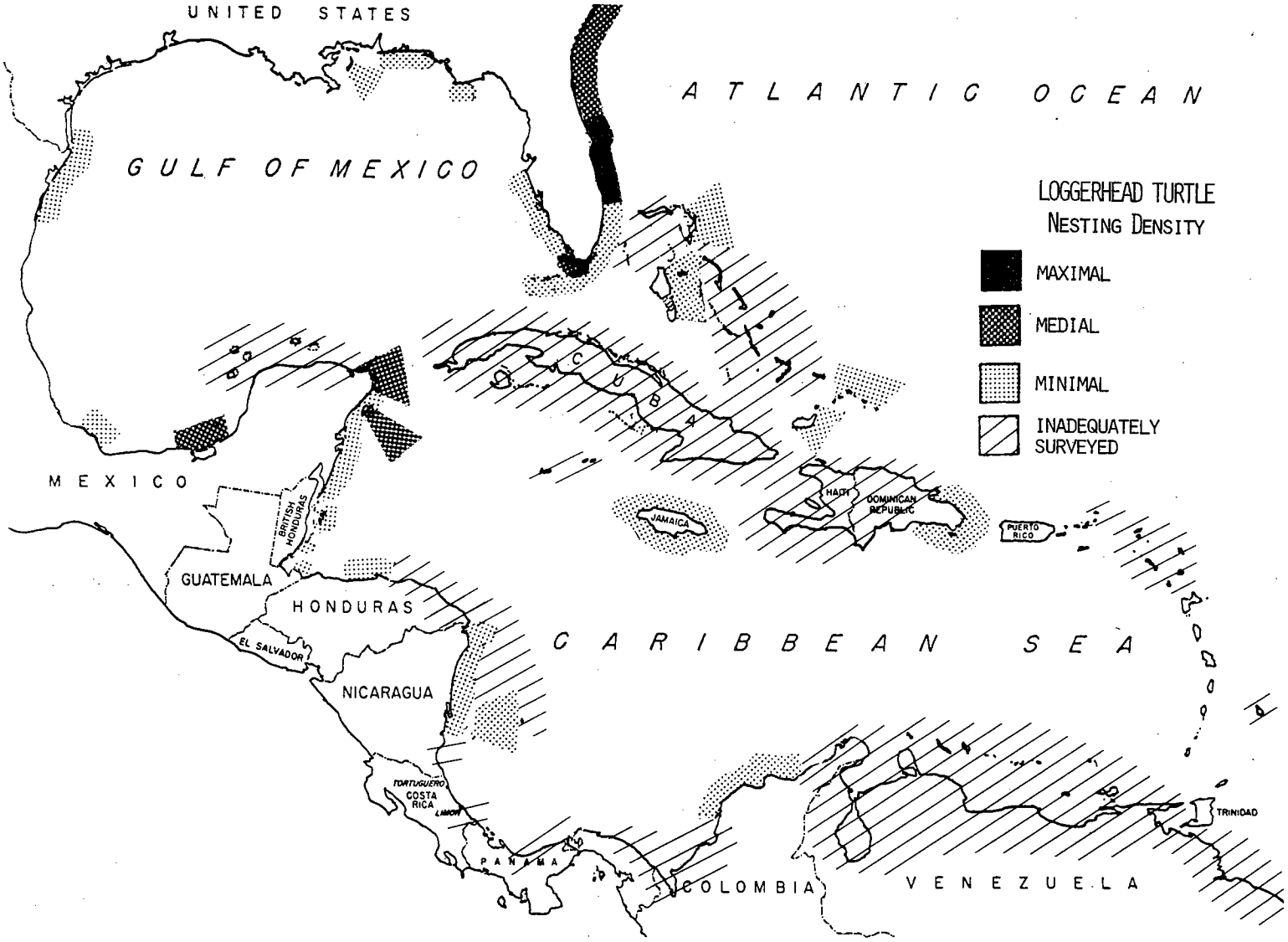
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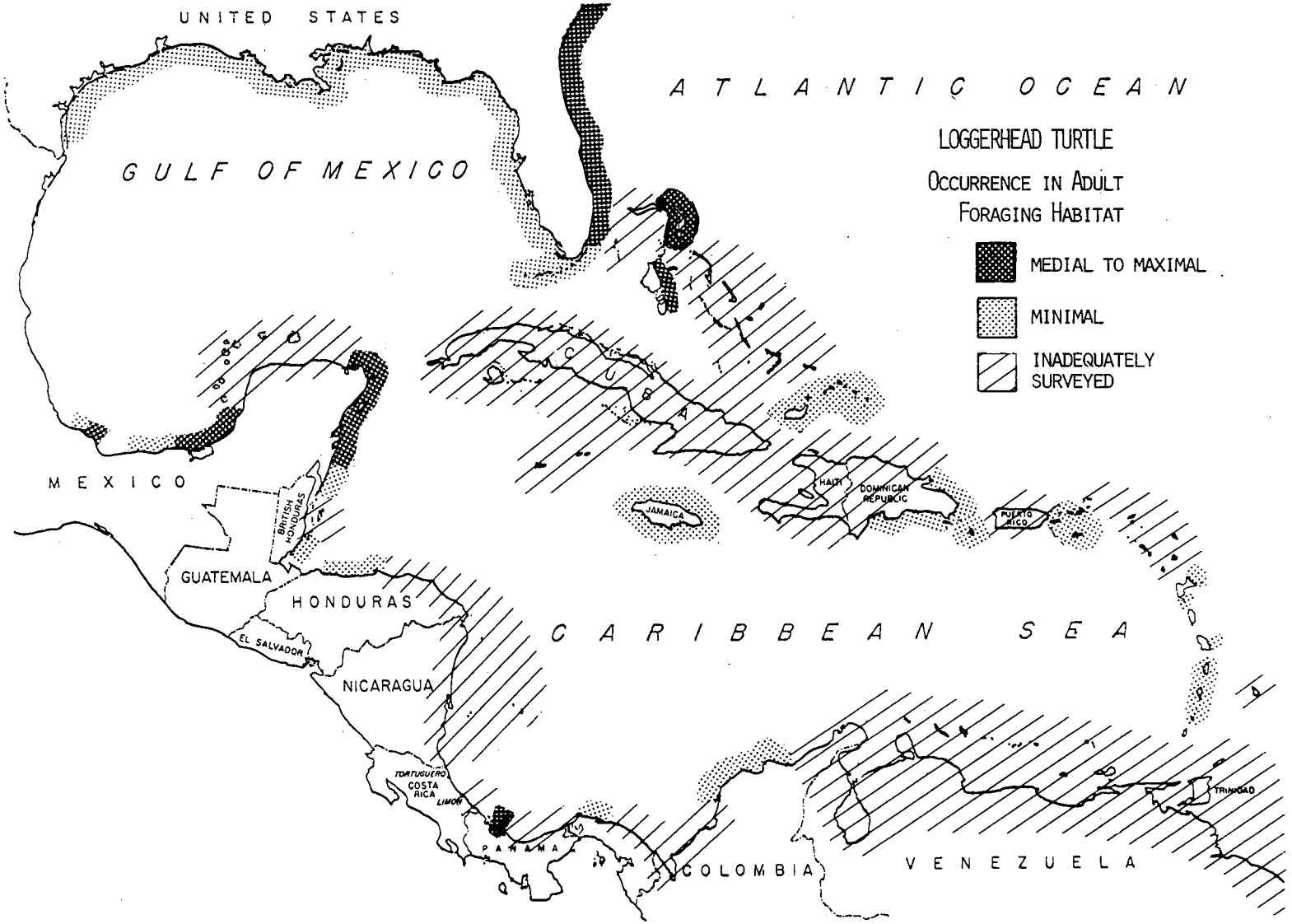
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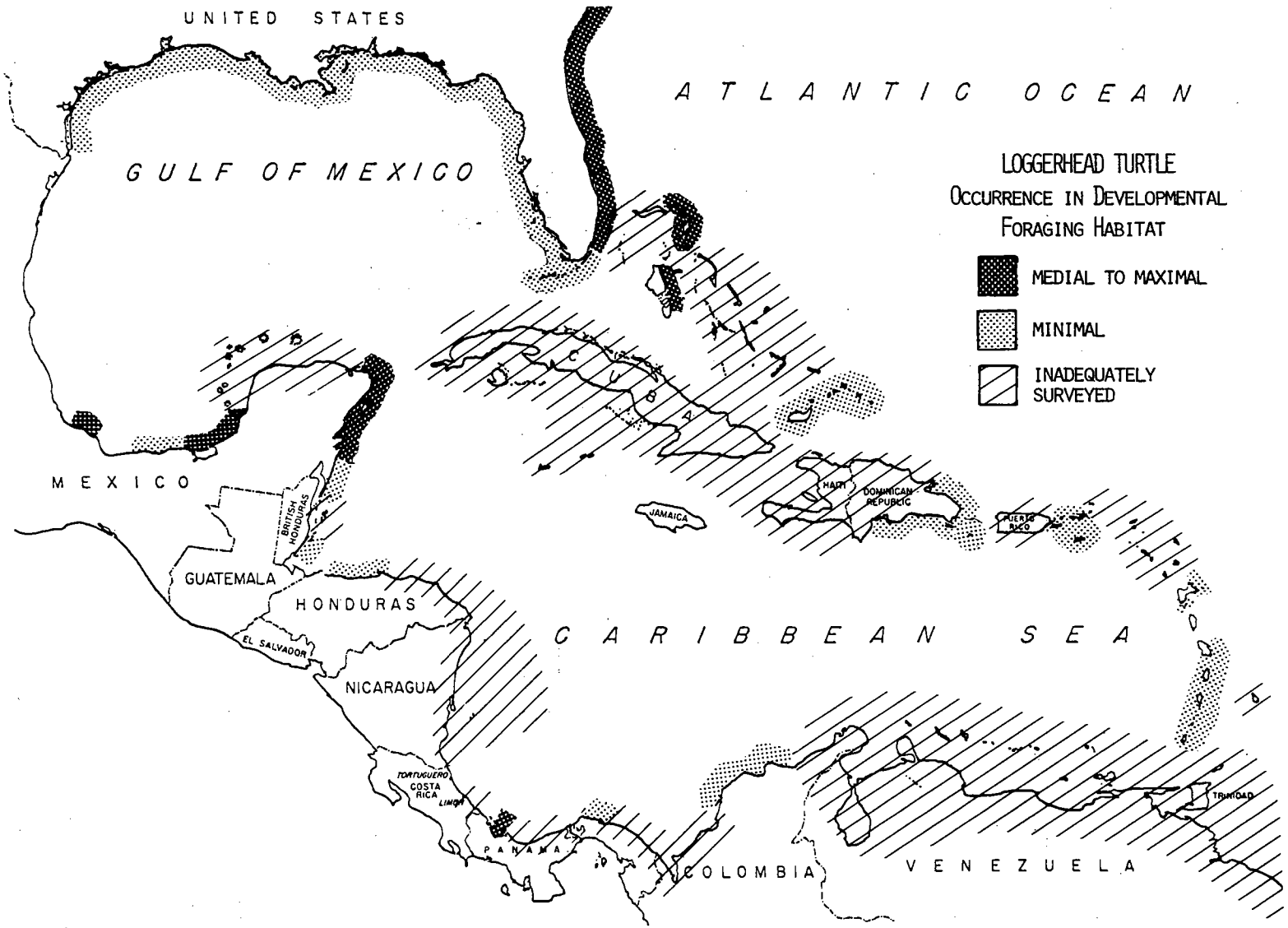
Figure 8.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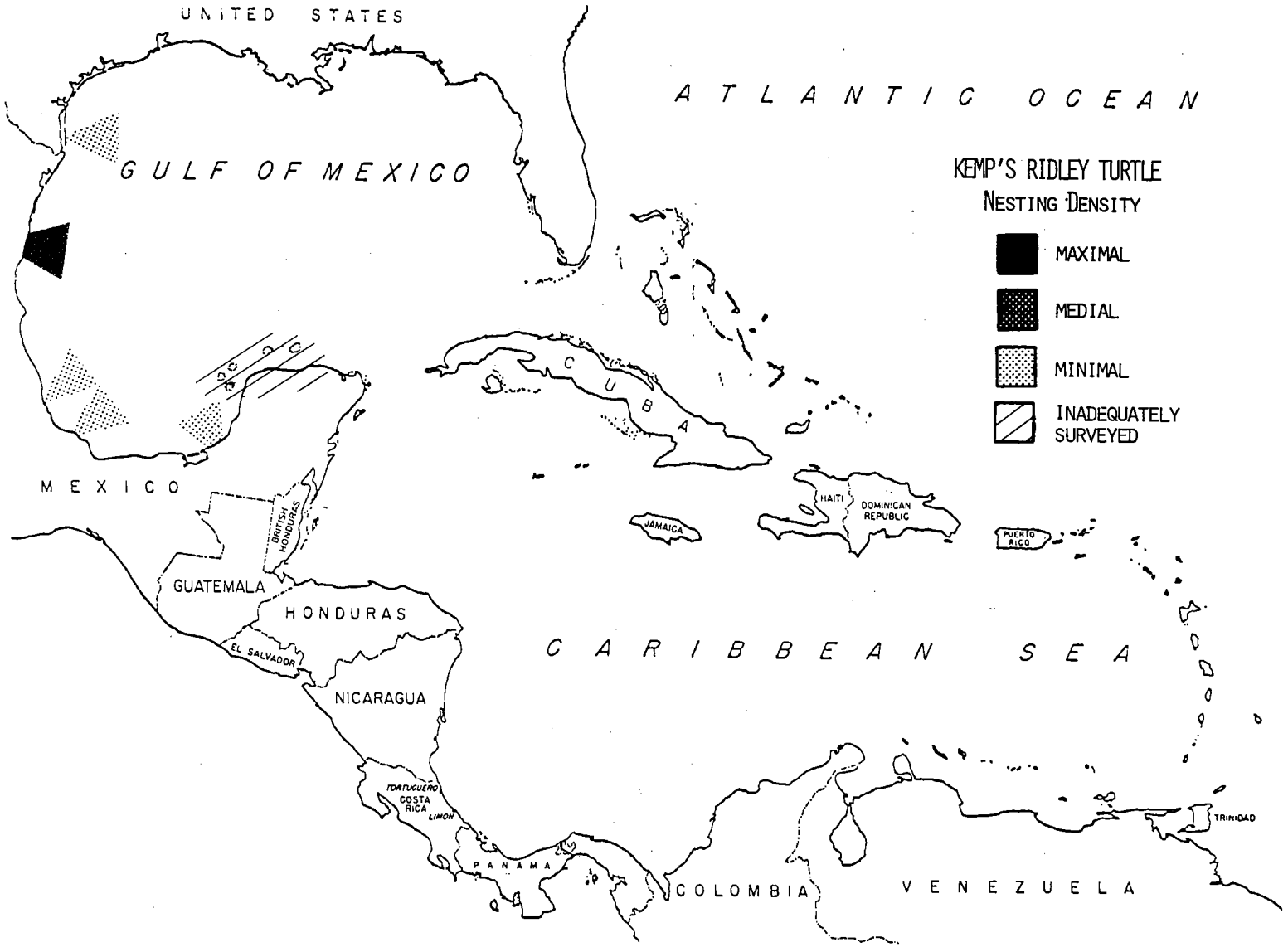
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Figure 10.

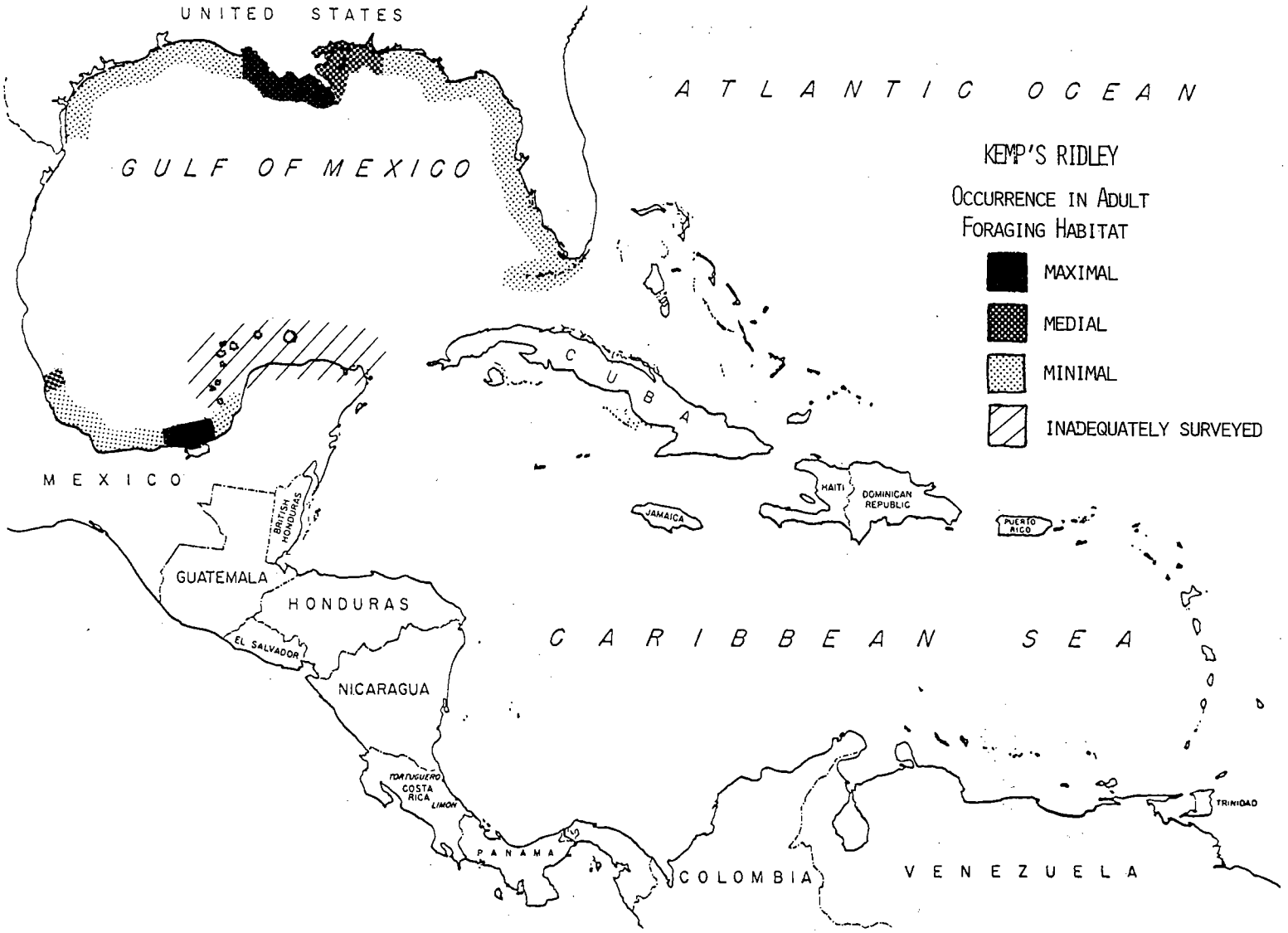
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Figure 11.

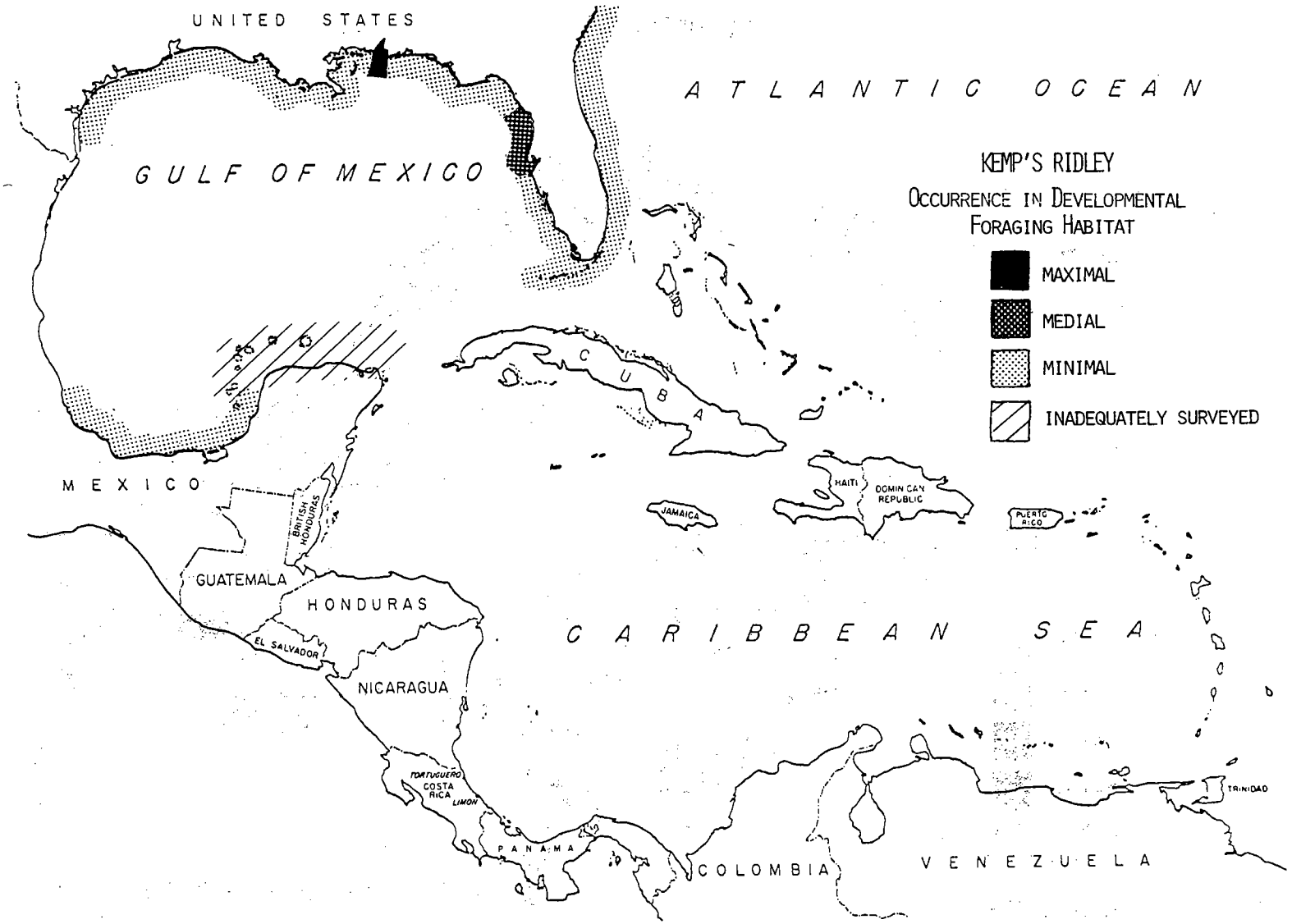
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Figure 12.

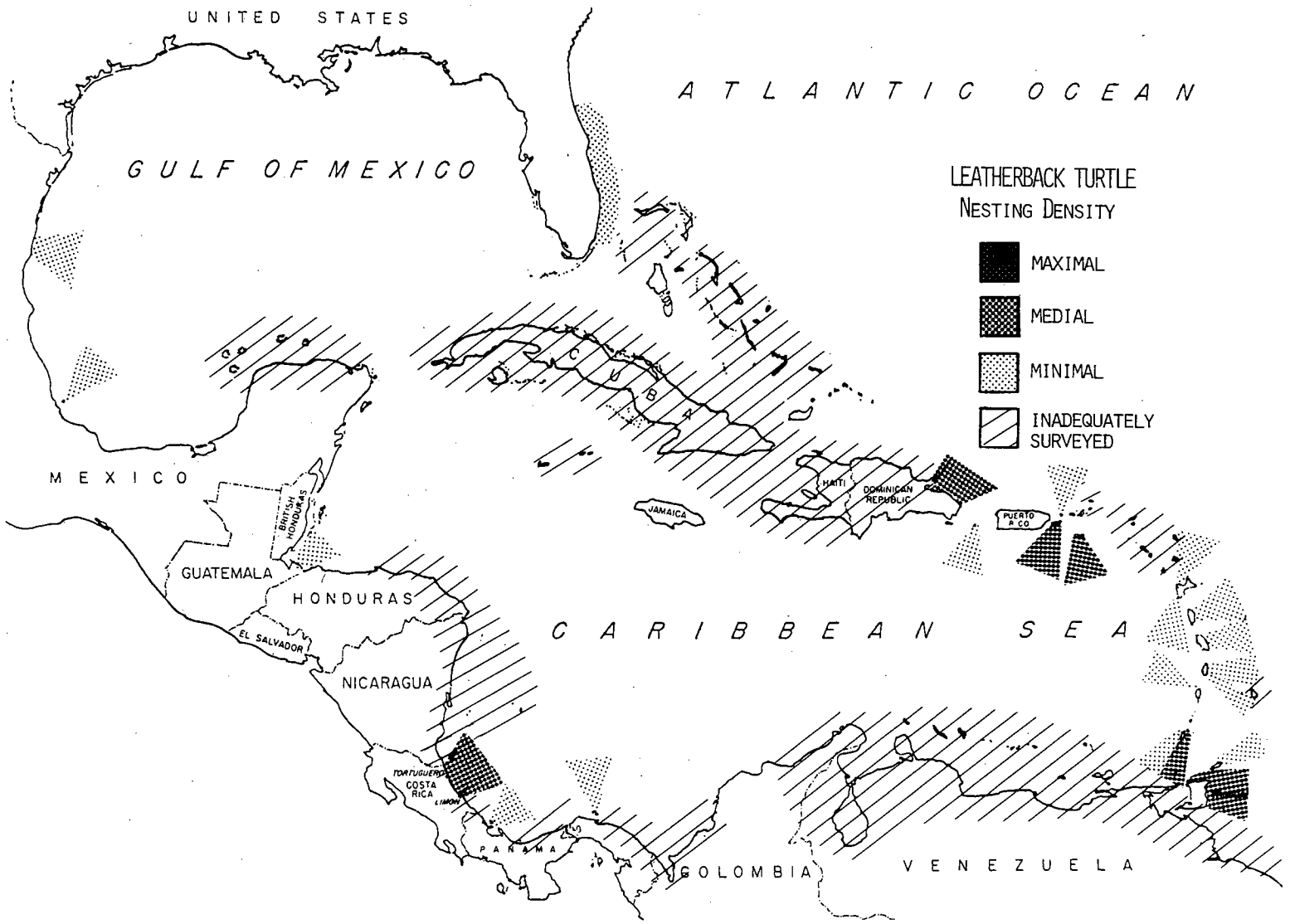
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Figure 13.

Interim Report to
National Marine Fisheries Service

August 1981

Introduction

This is an account of work done since our last report was submitted in April, 1980. The aim of both investigations has been to accumulate data from interviews and from aerial, shore, and shore-water surveys, that could provide, for the first time, some understanding of population levels throughout the geographic ranges of the sea turtle species that occur in the West Atlantic system. Nowhere in the world has such wide coverage been attempted.

To determine actual numbers of sea turtles in non-nesting habitats is almost impossible. Occurrence and relative abundance of the various developmental and reproductive stages in their separate habitats can be anecdotally recorded, but to translate the observations into population estimates now appears to be an intractable exercise. Nevertheless, the surveys of the non-breeding stages and their habitats should be, and are being, continued, and if nothing more, the results will provide better understanding of the ecology of the species. Meylan's work in Panama has greatly extended our knowledge of developmental habitats in that region; and surveys there, and in Nicaragua and the San Andrés Archipelago, have advanced knowledge of the complex migratory routes of mature green turtles. Work on the sargassum weed habitat of post-hatchling-to-yearling turtles has confirmed the fundamental bearing of drift-lines and shears on the suitability of a given shore as nesting habitat.

The most useful sources of data for quantitative assessment are nesting ground surveys. Track counts made on the ground or from the air can, if the renesting and trial-crawl rates are known, be converted to numbers of nesting turtles, and if the population is site-fixed and the remigration schedule is known, to the number of sexually mature females in the population for the season.

During the period covered by this report, aerial surveys were made wherever appropriate and feasible. Throughout the territory covered, habitat types were identified and inspected, and occupancy or the lack of it was noted. A great deal of time was spent carrying out the standardized, exhaustive interviews described in our last report; and our faith in that procedure is strong. If carried out with fishermen - and not just fisheries officers - by interviewers versed in sea turtle problems, interviews are a valuable and indispensable tool. From the beginning, however, we have also consistently solicited, and occasionally received, the cooperation of officials of local fisheries agencies. In some cases the officials legally responsible for marine resource management were found to be not much concerned with turtles, and our overtures for official collaboration were necessarily directed elsewhere. Details of contacts with local agencies and agents are given in the reports for separate localities.

Because of the differing character and complexity of the sea turtle habitats of the surveyed regions, and the different logistic problems, the present report is necessarily inconsistent in its treatment of the various regions. The material on the Leeward Islands and Panama is only partially presented. Surveys in Panama have confirmed that it is an extremely important area in the distribution and ecology of some or all stages of the life cycles of Caribbean sea turtles. The last work there was completed only recently, and time has not permitted a thorough analysis of the data. Accordingly, the present report presents only highlights in a body of information that will, in a later report, show Panama to be, along with the feeding ground of *Chelonia* in Nicaragua and its nesting ground at Tortuguero, one of the three most important sea turtle regions in the Caribbean.

A schedule of the field work that was carried out between April 1980 and July 1981 is presented in Table 1. As this report was being assembled, Chuck Carr completed a survey of the Honduranean Miskitia. Results of that first inspection of the beaches of easternmost Honduras will be reported later.

Regional Summaries

Nicaragua

Much has been written about the green turtle colony of the Miskito Cays area of Nicaragua and the turtle industry there. Dr. Bernard Nietschmann of the University of California at Berkeley has published extensively on his long-term studies of the people of the Miskitia, and their intimate relationship with *Chelonia*. Despite the attention the region has received, however, little is known about the status of turtles along the extensive shore of the mainland.

The original inhabitants of eastern coastal Nicaragua, the Miskito Indians, were ecologically closely adjusted to the large populations of *Chelonia mydas* that inhabit the banks and reef-system habitats of the area. For more than 100 years the region has been subjected to steady international exploitation. The most active exploiters were schooners from the Cayman Islands, the crews of which were well aware that the Nicaraguan feeding ground was the most populous in American waters, and that the green turtles there made regular migrations to Tortuguero, Costa Rica, to nest.

At the World Conference on Sea Turtle Conservation held in Washington, D.C. in 1979, Reynaldo Arostegui, Chief, Department of Wildlife, Nicaraguan Institute of Natural Resources and Environment, suggested that his government might look with favor on a project to create a sea turtle reserve in the Miskito Cays, and asked for support for such a move. In October, 1980, A. Carr visited Nicaragua in company with Dr. Bernard Nietschmann, University of California, Berkeley; Dr. Nancy Foster, Office of Coastal Zone Management, NOAA; Dr. A. F. Carr III, New York Zoological Society; and Nicaraguan officials, to make preliminary plans for such a reserve. One reason the Nicaraguans are interested in special protection for the Miskito Cays area is the growing numbers of illegal foreign boats there, and the increasing use of dynamite in poaching lobsters and fish from the reefs. The occasion presented an opportunity to make aerial surveys along the coast from Punta Perlas,

abreast of the Pearl Cays, to Little Sandy Bay above Dakura, and thence out over Miskito Bank in a route shown in the appended figure (Fig. 1).

The aim of the coastal survey was to inspect the beach for evidence bearing on the apparent lack of concentrated turtle nesting anywhere along the entire 400 miles of the shore. In the 120 miles of flight from Pearl Point to Dakura, we recorded only eight nesting tracks, all old and partly obliterated by rain. The involved species was in no case determinable.

The dearth of nesting by loggerheads, green turtles and leatherbacks is probably attributable to low-energy wave action along this entire section of shore. The weak wave action, in turn, is obviously a result of the broad array of offshore banks and cays. Why there is not more hawksbill nesting on the mainland beaches is not clear, however, because elsewhere that species comes in to small patches of sand. With few interruptions, the entire surveyed shore was found to be a continuous narrow platform of gray, mostly volcanic sand, appearing from the air to be little different from the volcanic beaches of Costa Rica, including Tortuguero. The disadvantages as nesting beach thus must be the shallowness of the sand and the resulting tendency for embryos to drown in the salt water that washes over the beach in high winds, or rises from sea water level below. This possibility should be investigated by sampling water levels in the beach-sand profile. Whatever the defects of the beach, no concentration of nesting was seen anywhere on the section of the surveyed shore; and interviews along the coast supported the belief that it is very sparse everywhere.

It should be emphasized that from the air this whole coast gave little visible sign of being unacceptable as a nesting beach. It is an even, homogenous strand, without rocky approaches, mangroves, or sections cut out by storms. Two visible clues to its unsuitability were the diffuseness and low power of the breakers, which even with an easterly wind blowing were not concentrated along a surfline near shore, but spread in a broad offshore band; and the presence of banana patches and gardens immediately behind the strand. The latter indicated a lack of salt spray in the air, confirming that heavy surf needed to build a nesting beach does not occur.

The aim of the flight and boat cruise through the keys was to observe the distribution of the various reef-system habitats that make this section of Miskito Bank one of the world's most important feeding grounds for *Chelonia*. The ecological advantages of the area are the enormous expanses of sea grass patches interspersed with the coral structures required as "sleeping rocks." The cruise also afforded the opportunity for careful interviews with the Creole and Miskito people on board.

Although the eastern Nicaraguan coast is extensive, there seems little likelihood that major rookeries will turn up between Bluefields and Cabo Gracias a Dios. However, flights should be made along the whole coast during August, when green turtles would be most likely to go ashore. Two sections of the coast now remain unsurveyed--the piece from Bluefields south to Greytown; and that from Dakura up to the Honduranian frontier. The flight south from Bluefields is especially needed, because word-of-mouth information locates a good hawksbill nesting shore at Cocal, north of Greytown; and the bank offshore there is a well-known feeding ground for hawksbills. At present the only unspoiled Nicaraguan nesting localities for hawksbills are in the Pearl

Cays, where according to Dr. Barney Nietschmann, the best is Maroon Cay. When the flight northward from Dakura to Honduras is made, the entire coast of mainland Central America will have been surveyed at least once.

Costa Rica

Work in Costa Rica was done in collaboration with personnel of the Caribbean Conservation Corporation turtle camp at Tortuguero. The most important contribution from the Tortuguero project is the unique record of long-term demographic trends in the site-fixed nesting population based on the Tortuguero breeding shore.

As the work under this contract has proceeded, it has grown increasingly clear that quantitatively reliable sampling of sea turtles in the sea is extremely difficult to achieve. The habitats can be visited and mapped, and valuable information on occupancy and trends can be obtained from multiple standardized interviews with fishermen and turtlers. But hard data of a kind that can be used in any worthwhile calculations of population levels are available only on a nesting beach. The most useful information comes from a beach that is the sole nesting ground of the population, and on which tagging and monitoring have been conducted through long periods of time.

On those scores the nesting ground at Tortuguero is better qualified to yield useful population data than any sea turtle rookery in the Caribbean; and it is the most thoroughly studied population in the world. The data generated there should greatly increase the significance of results from fragmentary aerial sampling done under the contract elsewhere.

The table below shows results of the last ten of the 26 seasons of the Tortuguero program.

Year	No. Turtles Recorded 5-Mile Study Beach			Est. Turtles Nesting on 22-Mi. Beach	Est. Females in Nesting Population
	Remigrants	Recruits	Total		
1971	150	725	875	7,440	12,347
1972	183	1,416	1,599	10,727	16,998
1973	133	836	969	11,829	19,095
1974	103	489	592	7,897	13,119
1975	147	514	661	10,171	17,550
1976	352	2,046	2,398	22,727	30,359
1977	101	328	429	5,464	9,029
1978	529	2,268	2,797	31,211	44,028
1979	104	324	428	5,178	8,079
1980	691	2,479	3,170	52,046	76,316
1981*	212	378	590	8,430	13,695
				X =	23,692

A striking feature of this record, and a cautionary lesson to over-anxious demographers, is the drastic fluctuation in the size of the nesting colony. These data should be pondered by anybody setting out to use data from nest-track surveys as indices to population levels. The seasonal differences at Tortuguero obviously do not reflect actual changes in the sexually mature

*Added in press.

female population. Causes of the fluctuation are not understood. It is not a result of straying from the home nesting ground. The Tortuguero population is better than 99% site-fixed on the 22 miles of the nesting shore. A part of the fluctuation is produced by cycle modulation--by females on one nesting schedule shifting to another. That such shifting occurs is amply proved by the Tortuguero data. Concurrent shifts by females on different regimens possibly could bring disproportionate numbers of turtles to the nesting beach at the same time. This does occur, but its possible role in causing the fluctuations has not been determined.

Thus an important feature of this body of data to the West Atlantic survey is the clear indication that aerial and other nest-track surveys, to have value in population level calculations, must continue through several seasons. This does not mean, of course, that single-flight surveys are not useful in locating heavy concentrations of nesting, or in identifying shores where none at all occurs, in a given season.

Besides providing this data base, ancillary projects at Tortuguero during the past year have advanced understanding of the effects of incubation temperatures on sex in sea turtle eggs and on the ecology of post-hatchling sea turtles in the "lost-year" habitat.

Another function of the Tortuguero program that is directly applicable to the aims of the contract is that of receiving observers and trainees from agencies of other west Atlantic countries. At the present time a group of five Nicaraguans from the Institute of Natural Resources and the Environment has just finished a two-week stay at the camp, and visitors from other countries are expected as the season progresses. This new emphasis in the Tortuguero program should be helpful in the aim of the West Atlantic Turtle Symposium committee to assist prospective participants in generating creditable reports for their respective countries. A special advantage to these visitors is the chance to make practice aerial survey flights under supervision, along a heavily tracked turtle beach for which optimal ground truth is available.

Results of a low-level aerial survey of the whole Costa Rican shore from Nicaragua to Panama, in which A. Carr participated will be reported separately by Larry Ogren.

Panama

In 1979, preliminary reconnaissance of nesting and foraging habitats in Bocas del Toro Province, Panama, revealed that the region is an extremely important area for sea turtles. Four species nest on the beaches there, and three of these occupy the diverse foraging habitats that the area provides. Because of its rich fauna, this province has since the early 19th century been one of the main centers of commerce in turtles in Central America.

The initial aim of the field work was to locate important nesting sites. In 1979, an aerial survey was made of all beaches in the province, with the exception of those within Chiriquí Lagoon. Results were presented in an earlier report to National Marine Fisheries Service.

In May and June, 1980, A. Meylan flew selected beaches in the province and carried out ground surveys at Floris Beach on Isla de Colon, at three beaches on Bastimentos, at Zapatilla Cays, and at Playa Chiriquí (see Fig. 2

and Table 2). All beaches in the province were flown again in April, 1981, as part of a complete fly-over of the Caribbean coast of Panama (Fig. 3 and Table 3); Meylan repeated ground surveys at important beaches during May and June, 1981 (Table 4).

These surveys, in conjunction with interviews with local turtle fishermen, have provided much new information on the distribution of sea turtle nesting in the province. Two new nesting localities for the leatherback have been discovered--Playa Chiriquí, on the mainland coast between Río Cañaveral and Río Chiriquí, and Playa Changuinola. The only other nesting site previously known for this species on the Caribbean coast of Panama is at Bahía Aglatomate, in the San Blas Islands. As is shown in Table 4, 834 tracks of leatherbacks were observed at Playa Chiriquí in mid-June, in spite of the fact that the count was made near the end of the season. The tracks and nests were of varying ages, and they may have represented several weeks nesting. Approximately 15-20 leatherbacks were still nesting nightly. Tracks on all but the uppermost part of the beach had been scoured away by high tides, and thus any estimate of the number of turtles nesting there would be conservative.

Nesting at Playa Changuinola extends from Bocas del Drago northward at least as far as the Río San San. Several other minor nesting sites for the leatherback have been located in the province, and will be reported later.

Leatherbacks are rarely seen in the waters around Bocas except during the nesting season. Several are caught incidentally in nets set for other sea turtles, but they are usually released unharmed. No evidence that their nests were poached was found on any of the surveyed beaches.

Another aim of field work in this province has been to determine the importance of Playa Chiriquí as a hawksbill nesting shore. For many decades, this beach has been reputed to be the site of aggregated nesting by the hawksbill. This is particularly interesting, in view of the fact that hawksbills are characteristically dispersed nesters. Although only sparse nesting by this species was observed during the two visits to the beach (see Tables 2 and 4), interviews with turtle fishermen and former *veladores* have convinced us that hawksbills nested here in considerably greater numbers in the past. Since the 1930s, each mile of the beach has been leased out to *veladores* for the specific purpose of catching nesting hawksbills as they emerge to nest.

The low track counts observed can be attributed to several factors. Most important is the severe depletion of the hawksbill nesting population there. Prices for tortoiseshell have reached as high as $50 per pound in recent years, thus creating extraordinary pressure on the population. Other minor factors are the protracted nesting season, which lasts for at least six months, and the short lifetime of tracks on this storm-swept beach. Enough hawksbills still nest there to support a *velador* system, but it is the high cost of shell, rather than the abundance of hawksbills, that keeps the system profitable.

Data on the distribution of hawksbill nesting in the remainder of the province, as well as its occurrences in foraging, developmental and migratory habitats, will be discussed in the final report.

Green turtles nest in small numbers at several localities in the province, but it is primarily in foraging habitats that they are abundant. There are extensive seagrass beds in the lagoon that provide forage for both resident and migratory green turtles. Approximately 20 tags that were originally put on turtles nesting at Tortuguero have been recovered during field work in Bocas since 1979. This brings the total number of tags recovered in the province to 43. Figure 4 and Table 5 show the distribution of recoveries from Río San San to Colon. Only two other tags have been recovered in Panama: one at Porto Bello, and the other at Sordo Cay, near Isla Grande.

Green turtles *in transit* between Tortuguero and feeding grounds in Panama, Colombia and Venezuela are the target of a net fishery in Bocas del Toro. In good years, sufficient numbers of turtles are caught to warrant building crawls to keep them in, until they can be butchered at the public market. They are no longer shipped to Colon from Bocas on a commercial scale, but they are an important part of the diet of coastal people throughout the province. This fishery has provided us with the opportunity to obtain morphometric data on male green turtles that are presumably members of the Tortuguero population. Such data are unavailable at Tortuguero, as there is no legal fishery there.

An unexpected finding of the survey is the occurrence of loggerheads in Chiriqui Lagoon. Loggerheads, in general, are scarce along the Central American mainland, and practically the only nesting sites are in Colombia and in the Nicaraguan Miskitia. The mollusk-rich waters of Chiriqui Lagoon provide good forage for this species, and there is one beach in the lagoon where they are reported to nest. This is Daira Beach, west of Río Guariviari (Fig. 2). The beach was surveyed on foot in June, 1981, but no tracks were seen. Additional surveillance of this beach is warranted, in order to determine whether it is in fact used by loggerheads today, and if so, to what extent.

In April of 1981, Meylan made an aerial survey along the Panamanian coast from Colon east to Puerto Obaldia, near the Colombian border (Fig. 5 and Table 6). The offshore islands were not surveyed. Much of the coast consists of rocky shores and mangrove-fringed bays, and is unsuitable for nesting. An important discovery of the survey was another sizable new leatherback nesting locality at Playa Pito (Fig. 6). More than 126 tracks were counted on the 6-mile beach, between the mouths of Río Pito and Río Armila. This beach, also, deserves further attention.

Field work in Panama is still in progress; this report constitutes a preliminary summary of results there.

The San Andrés Archipelago

This is a preliminary report on the status of sea turtle populations and exploitation in the islands of the San Andrés Archipelago, off the eastern coast of Nicaragua. Since early times the people of the main islands, San

Andrés and Providencia, have been widely known as hawksbill hunters, not taking the species just for its shell but also preferring the meat above that of the green turtle. Background on the history of turtling in the islands is given by John Parsons, and the four atolls of the group are described by Milliman (Atoll Research Bull., 129, 1969). We have long been familiar with San Andrés turtling and turtlers because of 26 years' association with expatriate San Andreans at the turtle station at Tortuguero, Costa Rica, and in Nicaragua, and Panama. More recently, firsthand information was obtained on the present status of turtle populations in the islands when Carr spent a week in the archipelago in mid-June, 1980. Movements among the islands were seriously hampered by travel restrictions and lack of transportation during a time of unrest over international traffic in contraband. The localities covered herein are the major islands, San Andrés and Providencia; and the four atolls, East Southeast Cays, Albuquerque Cays, Roncador Bank and Serrana Bank. The region is a critical one, and if prospects for access to the more remote parts of the archipelago improve before this contract terminates, further surveys should be given high priority. The islands are shown in Fig. 7.

San Andrés and General. On San Andrés, Carr hired cars and traveled along the coasts of the island, walking beaches and interviewing every fisherman who was familiar with the outlying banks and atolls. Almost everybody had opinions about turtles. Two exceptionally invaluable sources of information were Hershel Mosquito, a fisherman at St. Louis, and Richard Bart, owner of three boats at the fisherman's cooperative by the airport. The latter was particularly helpful. He is a Colombian with a college degree, and is very intelligent. The information from him and from 18 other informants hangs together pretty well.

As nesting territory, San Andrés is finished. Long ago, hawksbills and loggerheads nested regularly on the island, in approximate proportions of 3 to 1. Now the town has spread along the whole extent of the best beach, at the northeast end of the island, and all the smaller beaches are settled up. Most of the shore of San Andrés is ironshore, as the Caymanians call it--low bluff of old ragged coral. There is a reef along the whole northeast extent of the coast, and good foraging habitats occupy the lagoon between. Today nesting is desultory and sporadic on all the San Andrés beaches. There are good beaches on nearby Johnny Cay and Haines Cay and these, likewise, are only very rarely visited by either hawksbills or loggerheads, which are the only nesting turtles in the region. Carr found general agreement that the proportions of these two are about three hawksbills to one loggerhead, and that this ratio prevails all about the archipelago from Serrana Bank to Albuquerque Cay. It is also said to be the same for foraging colonies of the two species. A turtle found nesting on shore is always killed, and the eggs are always taken. Everybody admits that, throughout the archipelago, nesting has declined markedly. Apparently, mature green turtles rarely came to San Andrés, even in early days, except as strays, and the leatherback turtle is almost totally unknown. Hershel Mosquito said, "When I see a leatherback over toward San Blas, 15 years ago it frighten me badly." This complete gap in the range of *Dermochelys* is noteworthy. No ridley is known in the region, either, but that is expected.

All informants agreed that turtles, mainly green turtles, but also some adult loggerheads and hawksbills, show up periodically as itinerants in the

area. From May to August they move past the San Andrés reef, appearing to come from the north, and to be heading south when they leave. It is a general belief that these green turtles are migrating to Turtle Bogue (Tortuguero) to nest. Where they come from is not known--only "up Quitasueño way," they say.

Despite the enormous amount of tourist shopping on San Andrés, which is a free port with more than 400 shops visited by great numbers of Colombians, there is very little open trade in tortoiseshell jewelry. The floods of Bogotanos who come to the island do not come for trinkets; they come for Sony tape decks, TV's, electric fans and every conceivable kind of electric and electronic appliance. On the day Carr left, there was a block-long line of cartons lined up in front of the ticket counter for the SAM flight to Cartagena and Bogota. I saw no tortoiseshell trinkets at all. This is not primarily because Colombian law forbids it, but because of the high prices paid for raw shell by people from outside. Carapace plates alone bring $30-40 a pound. If the plastral scales are included, prices go up to $50-60 a pound, depending on the thickness of the scutes. The main buyer is said to be a Caymanian, who comes by when he gets a cable saying that 50 pounds of shell is available. It is said that this same man buys shell in Nicaragua, Costa Rica and Panama.

Nobody interviewed, except Hershel Mosquito, claimed to have seen post-hatchling sea turtles anywhere in the archipelago. Mr. Mosquito said he once found two hand-size hawksbills "in the water, near rock patches."

Before diving became the chief--and almost only--method of turtling in the islands, they were taken by netting--over in the Miskito Cays--and more usually by handline fishing, using Portuguese man-o-war (or sea bladders, as they are called locally) as bait. This method was familiar to everybody interviewed. It is said to be most effective when green turtles feed in open water on flats set with turtle grass or gorgonians. Only the green turtle will take this bait, and those caught are always juveniles or subadults. Mature green turtles are virtually unknown as feeding residents in San Andres waters--only as migrants. The time to fish with sea bladders is early morning or late afternoon, and only when several turtles can be seen blowing on a flat. After picking up half a dozen bladders on the beach, the fisherman baits a hook with one of them, inserting the hook through the thick tissue beneath the float, due care being taken to avoid puncturing the bladder, or touching the viciously painful tentacles. Then he paddles quietly out to a place upwind, or up-current, from the flat, anchors his boat, and pays out the line baited with the man-o-war. The bait is carried by the wind or current down to where the turtles are feeding. Everybody who described this technique assured Carr that sea bladders are irresistable bait for young green turtles, and that hawksbills pay them no attention at all.

Neither the San Andrés nor the Providencia people have ever heard of hawksbill meat poisoning anybody who ate it. Fish, yes, but turtles, no. As it has been for 100 years or more, hawksbill is still the favorite meat of the native San Andreans. The preference for hawksbill over green turtle is not sour grapes--they simply like it better. "It's my delight," one man said. However, he and most other people interviewed considered hawksbill meat to be a vanishing blessing, and absolutely sure to disappear.

The most striking result of the observations and interviews in the islands was the belated realization that, because of a special set of factors involved in the exploitation of the marine resources of the archipelago, the hawksbill is certain to be wiped out there. The reason for this is that, even though hawksbill fishing has, in itself, become an unreliable way of making a living, spear-fishing for snapper, grouper and lobsters has not. This spear-fishing brings the fishermen directly into hawksbill habitat. Any turtle speared simply adds $100-250 to the profit from the rest of the catch. Thus, the depletion that the hawksbill has undergone does not relieve the pressure on it, because the profit from the combined catch of turtles, lobsters and snappers will keep the divers working and traveling out to the most distant reefs, right up to and beyond the time that the last turtle has been taken. With that system in operation, and with practically every nest in the archipelago being meanwhile raided by the eggers, the survival of the hawksbill in the archipelago seems impossible. The same set of interrelated factors is operating throughout the Caribbean.

The decline cannot be precisely documented quantitatively by landing records, because there are none. Richard Bart, however, who is an exceptionally objective and outspoken individual, said, after some pondering, that during the past ten-year period the take of combined loggerheads and hawksbills has declined from 100 turtles per boat per season to about 25 per boat per season. This occurred at a time when diving techniques and equipment were improving.

Providencia. This is a volcanic island, much higher and more heavily wooded than San Andrés and with freshwater springs and streams. Excellent turtle beaches occur around the shore of the island. None is quite as extensive as that now incorporated into San Andres city, but most of the Providencia coast is set with small, cove-head beaches that seem (and certainly once were) good hawksbill nesting ground. The people there share the traditional preference of the San Andreans for hawksbills for eating. The resulting steady pressure, combined with the recent fantastic rise in the prices paid for tortoiseshell, has almost wiped out the once sizeable nesting population on Providencia. Both hawksbills and loggerheads still nest there, but they come ashore only seldom, and even then almost no nest escapes the egg hunters. In the waters around the island there is good developmental and foraging habitat, occupied or periodically visited by young careyes and loggerheads, and occasionally by small green turtles. Santa Catalina Island, narrowly separated from Providencia on the north side of the bigger island, is physiographically similar, although with an even more precipitous shoreline, and with almost no sandy shore. It is said to be hardly ever visited by nesting turtles. Hawksbills feed around the fringe and patch reefs, and these are also visited occasionally by adult and immature loggerheads.

East Southeast Cays (Courtown Cays). This is the southernmost atoll in the archipelago ($12^{\circ}24'$ N, $81^{\circ}25'$ W) and it lies only about 17 miles to the south of San Andrés. Good nesting beaches and developmental habitats for both hawksbills and loggerheads occur here, but the populations of both have declined very badly during the past ten years. The islands of this atoll are the ones most frequently visited by commercial fishermen and turtlers. Besides being close to San Andrés, ESE has the only fresh water on any of the

outlying islands, and has in the past offered excellent reef fishing. When Henry Fowler visited these keys in 1944 he was impressed by the diversity of fishes there, and also by the numbers of lobsters. When John Milliman surveyed the atoll in 1969 he noted the poor representation of both, and suggested that over-fishing had caused the change. There can be no doubt at all that he was right. As everywhere else in the archipelago, the fishermen who go to ESE take away everything that can be speared. They mostly are accomplished free divers, who regularly search the reef-fronts and the coral patches down to 6-7 fathoms, usually in the early morning, for snapper, grouper, lobsters and turtle. At night, in the hawksbill nesting season--June through August--they go ashore and take nesting turtles and their eggs. Many of the fishermen understand that this is self-destructive harvesting, but say, "If we don't spear the turtles somebody else will." In any case, turtles are being obliterated at ESE Cays, and as long as combined catches of snapper, lobsters and turtles can be taken away, trips to the atoll will be profitable, and the process is bound to continue.

Albuquerque Cays (Southwest Cays). This is a circular atoll about three miles across, with two well-wooded cays, North Cay and South Cay. Seabirds nest there; numerous migrant birds stop over in the woods, and there is a resident species of hummingbird on the island. The beaches here are the best hawksbill nesting ground remaining in the archipelago south of South Cay on Serrana Bank--which is the northernmost of the atolls. The atoll at Albuquerque provides excellent feeding habitat for hawksbills; and also for developmental stages of the loggerhead, though not for adults. Young green turtles (10-30 pounds) also occur, but much more rarely. The numerous people who go to Albuquerque go mainly after fish, lobsters, immature turtles, and bird eggs; but they also closely watch the short extent of nesting beach on North Cay, and take both the nesting female turtles and their eggs. Both hawksbills and loggerheads nest on Albuquerque, in proportions about the same as their occurrence in the foraging and developmental habitats. The older fishermen say that green turtles once nested occasionally on these cays, but for 10-15 years have not been seen on shore. However, both the nesting and foraging populations at Albuquerque appear to be less depleted than those of ESE Cays. This must be because Albuquerque is farther away from San Andrés (70 miles, vs. around 17 miles). Nevertheless, all informants agree that turtles are much fewer there than they were, even as recently as ten years ago.

Serrana Bank. This extensive bank is the largest of the atolls, being about 16 miles in greatest diameter; and it also is the northernmost (14° 16′ N, 80° 20′ W). Every fisherman interviewed considered this the best turtle ground, with the best representation of both nesting and forage habitats, remaining in the region. There are six cays in the group: East Cay, South Cay, Little Cay, Narrow Cay, Southwest Cay, and North Cay. The most heavily used nesting shore today--mainly because it is least accessible from San Andrés--is on North Cay, a low, scantily vegetated patch of rubble and sand. Besides the relatively well-used nesting beach there, there is extensive favorable feeding ground on the bank. Hawksbills and loggerheads, both mature and immature, are fairly abundant, and occasional young green turtles occur. There is a military garrison on South Cay.

Quitasueño Bank. No beaches exist anywhere in this extensive area of shallow water--only reefs and rock patches. There is good feeding habitat for hawksbills and loggerheads, however, and also a few patches of turtle grass. No trustworthy reports of resident green turtles could be obtained, but the half-dozen people who knew of the southward migration of green turtles past the San Andrés reef believed that some of the itinerant turtles may come from Quitasueño. The waters of the bank are very difficult to navigate, and accordingly the developmental hawksbill population there is less heavily exploited than in most localities in the archipelago.

Roncador Cay. Roncador is a small cay located on Roncador Bank, due south of Serrana and east of Providencia. It is only about 400 yards long and has low, sparse vegetation. There are two short but formerly very good hawksbill beaches, and on these loggerheads also occasionally nest. There is also excellent reef-system habitat, inhabited by foraging adult and juvenile hawksbills, with loggerheads in about the same proportion as elsewhere in the region. Roncador is too far away to be regularly visited by fishermen from San Andrés, but they go there occasionally, especially during the nesting season of the numerous seabirds that nest on the cay. Boats from Cartagena frequently fish there, and everybody interviewed agreed that turtles of this classic and formerly populous hawksbill habitat have declined sharply.

Leeward Islands

All of the Leeward Islands (Fig. 8) were surveyed by Meylan during 1980 and 1981. Return visits were made to selected islands that seemed to warrant additional attention. Antigua, Anguilla and Montserrat were visited a second time, to meet with national delegates of the West Atlantic Turtle Symposium.

A substantial percentage of the nesting habitat in these islands has now been reconnoitered, mostly on foot. Interviews were conducted with turtle fishermen, divers, shopkeepers, and residents living along beaches, to obtain information on species occurrence, abundance and seasonality. Reconnaissance of developmental and adult foraging habitats was made by boat surveys and by diving. A survey of marine habitat types recently completed by the East Caribbean Natural Areas Management Program provided valuable information on the distribution of beaches, sea grass beds, and living reefs, and facilitated the present survey of marine turtles. The Caribbean Conservation Corporation provided ECNAMP with detailed data on turtle nesting and foraging habitats for inclusion in resource maps that are to be distributed to each East Caribbean country.

The two principal marine turtle species in the Leeward Islands are green turtles and hawksbills. Both appear to be year-round residents. Hawksbills nest to a greater extent than do green turtles, but nesting by both species is sparse to moderate. Specific nesting and foraging localities for both species will be described in the final report.

Leatherbacks are far less common in the Leewards than green turtles and hawksbills, but small concentrations nest at several localities. St. Kitts has what further observations may reveal to be the best nesting aggregation in the island group, although it is difficult at this point to estimate the size of the population.

Loggerheads are caught infrequently at sea; most are subadults. No definite nesting sites for this species were found during the survey.

Turtle resources in the Leeward Islands have been badly depleted in recent years, and only the islands which are less developed for tourism, such as Anguilla, Barbuda and Montserrat, still have reasonably healthy turtle colonies. Even these, however, are currently being exploited to meet the demands for meat and shell in the tourist centers such as St. Maarten and Antigua.

One of the major threats to sea turtles in these islands is loss of nesting habitat. Hotels and high-rise condominiums are rapidly going up on some of the best remaining nesting shores in the region.

With the exception of the Dutch Antilles (St. Maarten, Saba and St. Eustasius), there are laws on each island protecting turtles. Enforcement throughout the region suffers badly, though, from lack of funds and personnel. The Dutch Antilles have no laws whatsoever protecting turtles or their eggs.

Los Roques, Venezuela

In 1978, A. Carr briefly visited the Los Roques Atoll (Fig. 9) to consult with biologists of Fundacion Cientifica Los Roques. Information on sea turtle distribution was obtained from personnel of the station who were operating a headstarting program for hawksbills. In November of 1980, Meylan visited Los Roques for six days, to obtain additional information, particularly about the distribution of sea turtles elsewhere around the atoll. An aerial fly-over of the entire atoll was made, to assess the extent and quality of nesting and foraging habitats. The islands of Gran Roque, Cayo Pirata, Isla Agustin, Carankey, and Isla Fernando were visited by boat in order to conduct interviews with fishermen knowledgeable about sea turtles.

The extensive reefs and grassbeds of the atoll provide excellent foraging habitat for green turtles and hawksbills, and these are the two most common species in the area. A number of green turtles that had been tagged while nesting at Tortuguero, Costa Rica, have been caught at Los Roques, providing further evidence of its suitability as a foraging ground. The atoll is largely uninhabited, except for the northeastern corner, around the town of Gran Roque. Fishermen recognize the best turtle foraging areas as those most remote from this settlement, in the southwestern corner of the atoll (Fig. 9).

Hawksbills, locally called parapi, are the principal nesters. Green turtles are thought to be more common than hawksbills, but they nest much less often. Loggerheads also nest in small numbers. Specific nesting and foraging areas of all species will be described in the final report.

Leatherbacks, locally called cardon, apparently do not nest in the islands, although they have been captured at sea with eggs. There is no evidence of nesting by olive ridleys, although they are said to occur as occasional waifs in the area.

Exploitation pressure seems to have slackened considerably over the last 15 years. In former times, green turtles were an important export item. They were sent live by boat to La Guaira, on the Venezuelan mainland. A law now prohibits catching turtles or taking eggs. There seems to be a general awarenes of the law, although the only enforcement is in the area of Gran Roque, where the national park guards are stationed. Low-level subsistence use of turtle meat and eggs undoubtedly continues, and there is evidence of some trade in tortoiseshell with the mainland and with Isla Margarita. Yachts visiting the atoll are reported to take turtles and eggs.

The main objective of the Fundación's Dos Mosquises field station is restoration of the hawksbill, although green turtles and loggerheads are also reared at the laboratory. When turtles attain one kilogram in weight, they are tagged and released, and their dispersal, survival, and growth in the wild are monitored.

Table 1. Schedule of field work, April 1980 through July 1981

Date	Locality	Purpose
3 March 1980	Costa Rica	aerial survey of entire Costa Rican coast
6-9 April 1980	St. Maarten, Leeward Is.	beach surveys; boat survey; interviews
9-12 April 1980	Anguilla, Leeward Is.	beach surveys; interviews
12-14 April 1980	St. Barthelemy, Leeward Is.	beach surveys; interviews
14-16 April 1980	Saba, Leeward Is.	beach surveys; interviews
16-17 April 1980	St. Eustatius, Leeward Is.	beach surveys; interviews
17-20 April 1980	St. Kitts, Nevis, Leeward Is.	beach surveys; boat survey; interviews
20-22 April 1980	Antigua, Leeward Is.	beach surveys; interviews
22-24 April 1980	Barbuda, Leeward Is.	beach surveys; interviews
15 May - 11 June 1980	Panama, Bocas del Toro	aerial surveys; beach surveys; boat surveys; interviews
4-12 June 1980	Colombia (San Andrés, Providencia)	aerial flyover; beach surveys; boat survey; interviews
24 August 1980	Panama, Bocas del Toro	aerial survey
28 Aug. - 5 Sept. 1980	Montserrat, Leeward Is.	beach surveys; diving; attend CCA*Meeting
5-8 Sept. 1980	Antigua, Leeward Is.	beach surveys; interviews
8-11 Sept. 1980	Barbuda, Leeward Is.	beach surveys; diving; interviews
17-19 Sept. 1980	Nicaragua (Miskito Cays and mainland coast)	aerial flyovers; boat surveys; interviews
21-30 Nov. 1980	Venezuela (Los Roques)	aerial flyover; beach surveys; boat surveys; diving; interviews
22-26 Jan. 1981	Montserrat, Leeward Is.	mtg. with WATS*delegate; beach surveys; boat survey; diving; interviews
26-28 Jan. 1981	Barbuda, Leeward Is.	beach surveys; boat survey; interviews

Table 1 (continued)

Date	Locality	Purpose
28 Jan. 1981	Antigua, Leeward Is.	mtg. with WATS delegate
29 Jan. - 2 Feb. 1981	Anguilla, Leeward Is.	mtg. with WATS delegate; beach surveys; boat surveys; diving; interviews
22-30 April 1981	Panama	aerial survey entire Caribbean coast; weedline search; mtg. with WATS delegate; beach surveys; boat surveys; interviews
25 May - 19 June 1981	Panama (Bocas del Toro)	beach surveys; diving; boat surveys; interviews
31 July - 1 Aug. 1981	Honduras (Miskitia)	aerial survey; interviews

* CCA = Caribbean Conservation Association
WATS = Western Atlantic Turtle Symposium

Table 2. Ground survey of tracks or nests of *Dermochelys coriacea* and *Eretmochelys imbricata* on Playa Chiriquí, Panama (8°56'N, 81°39'W), 21-23 May, 1980. Tracks and nests of varying ages are represented.

Dermochelys coriacea

Section of beach	No. of Tracks or Nests	No. of Halfmoons
Miles 0-7*	139	3
Miles 7-12	101	2
Miles 12-18	106	1
Totals	346	6

Eretmochelys imbricata

Section of beach	No. of Tracks	No. of Halfmoons
Miles 0-7	4	1
Miles 7-12	0	0
Miles 12-18	13	0
Totals	17	1

* Distance estimated from Río Cañaveral

Table 3. Results of an aerial survey of turtle tracks on the Caribbean coast of Panama, from Colon to Río San San, 29 April 1981, 0615 to 1140. Tracks of varying ages are included; not all were associated with nests. Most can be attributed to *Dermochelys coriacea*. Only localities within each zone where tracks were observed are noted. Abbreviations for map sources are given below. Observers: Anne Meylan, Argelis Ruiz; pilot: Jose Hall.

LOCALITY		TRACKS
Zone 2	Colon to Calovébora (D.M.A. 26069):	
	Chagres village	4
	Mid-way between Palmas Bellas and Salud	1
	Gobea	2
	West of Icacal	1
	Mid-way between Punta Platanal and Coclé del Norte	2
	East of Belén	2
	Río Concepción to Río Guasaro	3
Zone 1	Río Calovébora to Río Sixaola (D.M.A. 26069; Isla Popa, E762X37431, A.M.S.; Bocas del Toro, E762X37442, A.M.S.; Isla Colon, E762X37443, A.M.S.):	
	Río Calovébora to Santa Catalina	2
	East of Rio Pasaula	3
	Peñasco de Guapan (Buppan) to Río Chiriquí	4
	Río Chiriquí to Río Cañaveral	198
	(two indep. counts)	190
	Long Beach (Bastimentos)	6
	Dreffe Beach (Bastimentos)	1
	Wizards Beach (Bastimentos)	3
	Flat Rock Beach, locally called Floris Beach (Isla de Colon)	6
	North of Lime Point (Isla de Colon)	2

Table 3 (Cont.)

Zone 1 (continued)		
	Boca del Drago to Río Changuinola	111
	Río Changuinola to Río San San	32
	Río San San to Río Sixaola (to Costa Rican border)	not surveyed

D.M.A. - Defense Mapping Agency, U.S.A., nautical chart.

A.M.S. - U.S. Army Map Service; prepared with Dirección de Cartografía de Panama, available through Instituto Geográfica Nacional, Panama.

Table 4. Ground survey of tracks or nests of *Dermochelys coriacea* and *Eretmochelys imbricata* on Playa Chiriquí, Panama (8°56'N, 81°39'W), 13-14 June 1981. Tracks and nests of varying ages are represented. On the night of 13 June, 16 leatherbacks and 3 hawksbills emerged to nest.

Dermochelys coriacea

Section of beach	No. of Tracks or Nests	No. of Halfmoons
Miles 0-9*	445	not counted
Miles 9-18	389	not counted
Totals	834	

Eretmochelys imbricata

Section of beach	No. of Tracks	No. of Halfmoons
Miles 0-9	6	0
Miles 9-18	7	1
Totals	13	1

*Distance estimated from Río Cañaveral

Table 5. Localities in Panama where green turtles *(Chelonia mydas)* tagged at Tortuguero, Costa Rica, have been recaptured. Three turtles were captured on nesting beaches; the remainder were taken at sea.

Provincia de Bocas del Toro	Number of recaptures
Río Sixaola	1
Between Río Sixaola and Río San San	1
Río Changuinola	1
Isla de Colon	6
Carinero	2
Bastimentos	8
Zapatilla Cays	3
Almirante Lagoon	2
Chiriquí Grande (Laguna Chiriqui)	2
Cusapín (Valiente Peninsula)	4
Cayo Paloma (Valiente Peninsula)	1
Old Bess Point (Valiente Peninsula)	6
Río Caña	5
No specific locality data	1
Provincia de Veraguas	
Belén	1
Río Palmilla	4
Salud	2
Chagres River	1
Canal Zone	
Colon	1
Provincia de Colon	
Sordo Cay (N.E. of Portobello)	1
Isla Grande	1

Table 6. Results of an aerial survey of turtle tracks on the Caribbean coast of Panama, from Colon to Puerto Obaldia, 28 April 1981, 0624-1200. Tracks of varying ages are included; not all were associated with nests. Most can be attributed to *Dermochelys coriacea*. The entire mainland coast was flown, but only localities within each zone where tracks were observed are noted. Abbreviations for map sources are given below. Observers: Anne Meylan, Argelis Ruiz; pilot: Jose Hall.

LOCALITY		TRACKS
Zone 3	Colon to Nombre de Dios (D.M.A. 26066):	0
Zone 4	Nombre de Dios to Punta San Blas (D.M.A. 26065):	
	Cuango	1
	Playa Chiquita (east of Cuango River)	2
	Beach at 79°05'W	2
Zone 5	Punta San Blas to Punta Brava (D.M.A. 26064, 26061, 26042)	0
Zone 6	Punta Brava to Isla de Pinos (Ustupu, Sheet 10, 1:25,000 Especial I.G.N.; Ustupu, E762X1389 III, A.M.S.):	
	Mansukum (Portogandi) - northwest of Río Navagandi	3
	Napakanti (Navagandi)	1
Zone 7	Isla de Pinos to Kwipkan sukun Murru (Caretto E762X1388 II and E762X1388 IV):	
	Beach east of Napakanti Tiwar River	5
	Bahía Aglatomate	10
Zone 8	Kwipkan sukun Murru to Puerto Obaldia (La Palma, Sheet 11, 1:25,000 Especial, I.G.N.; Anachukuna E762X1388 II, A.M.S.; D.M.A. 5693):	
	Río Pito to Río Armila	109
	(two indep. counts)	126, est. 1

D.M.A. - Defense Mapping Agency, U.S.A., nautical chart.

I.G.N. - Instituto Geográfica Nacional, "Tommy Guardia", Ministerio de Obras Públicas, Panama.

A.M.S. - U.S. Army Map Service; prepared with Dirección de Cartografía de Panama, available through Instituto Geografica Nacional, Panama.

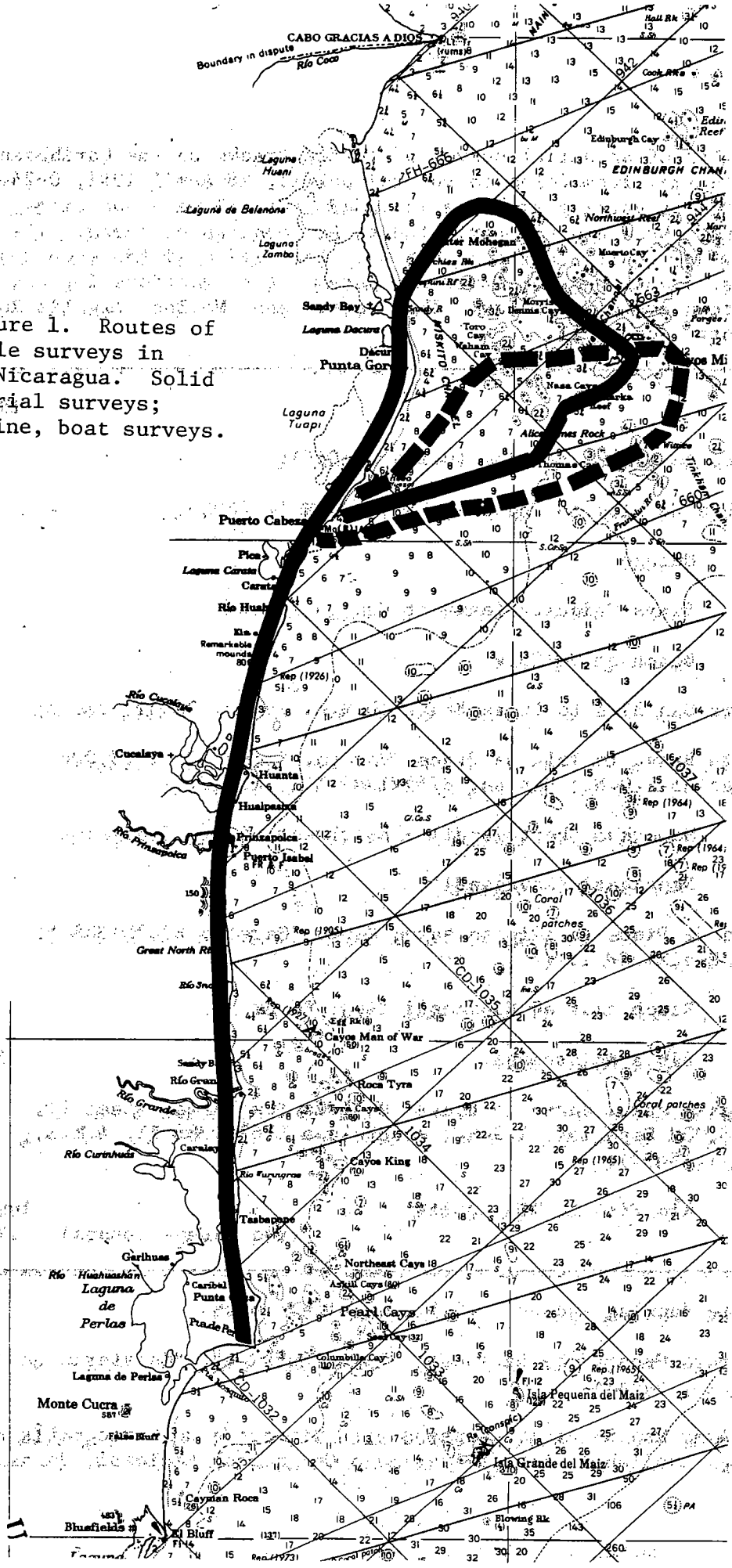

Figure 1. Routes of sea turtle surveys in eastern Nicaragua. Solid line, aerial surveys; broken line, boat surveys.

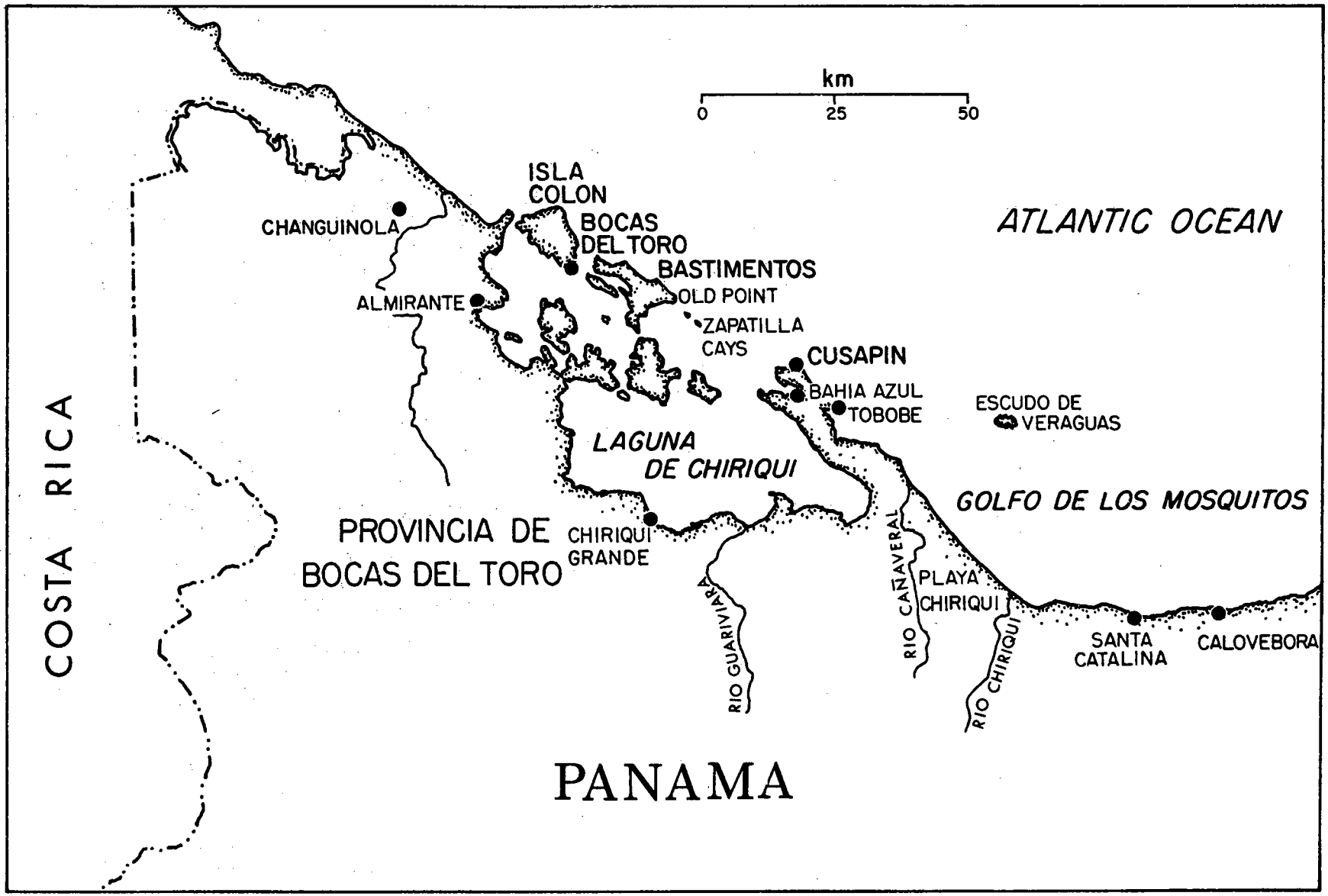

Figure 2. Bocas del Toro Province, Panama.

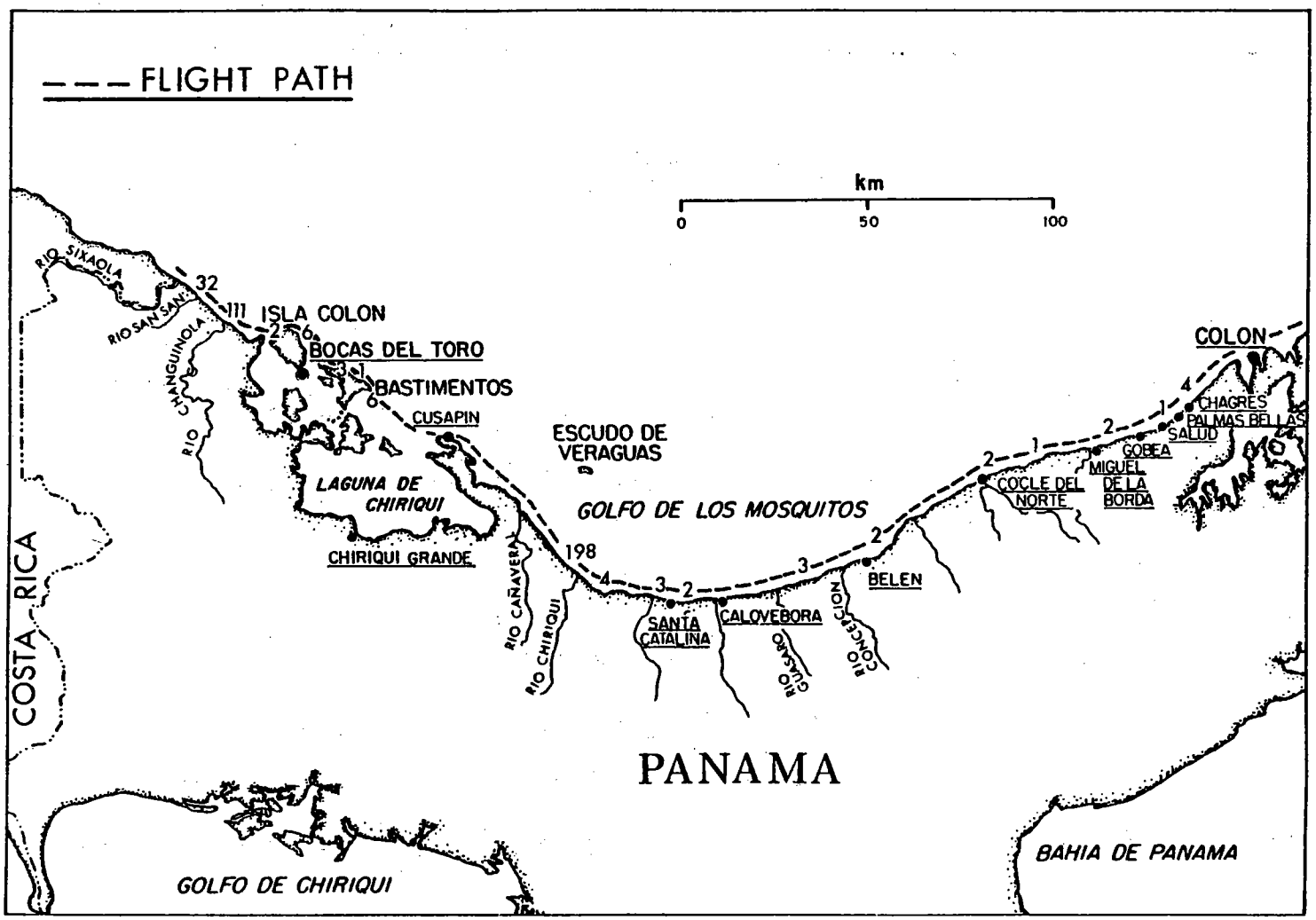

Figure 3. Results of an aerial survey of turtle tracks on the Caribbean coast of Panama, from Colon to Río San San, 29 April 1981, 0615 to 1140. Details of the survey are given in Table 3.

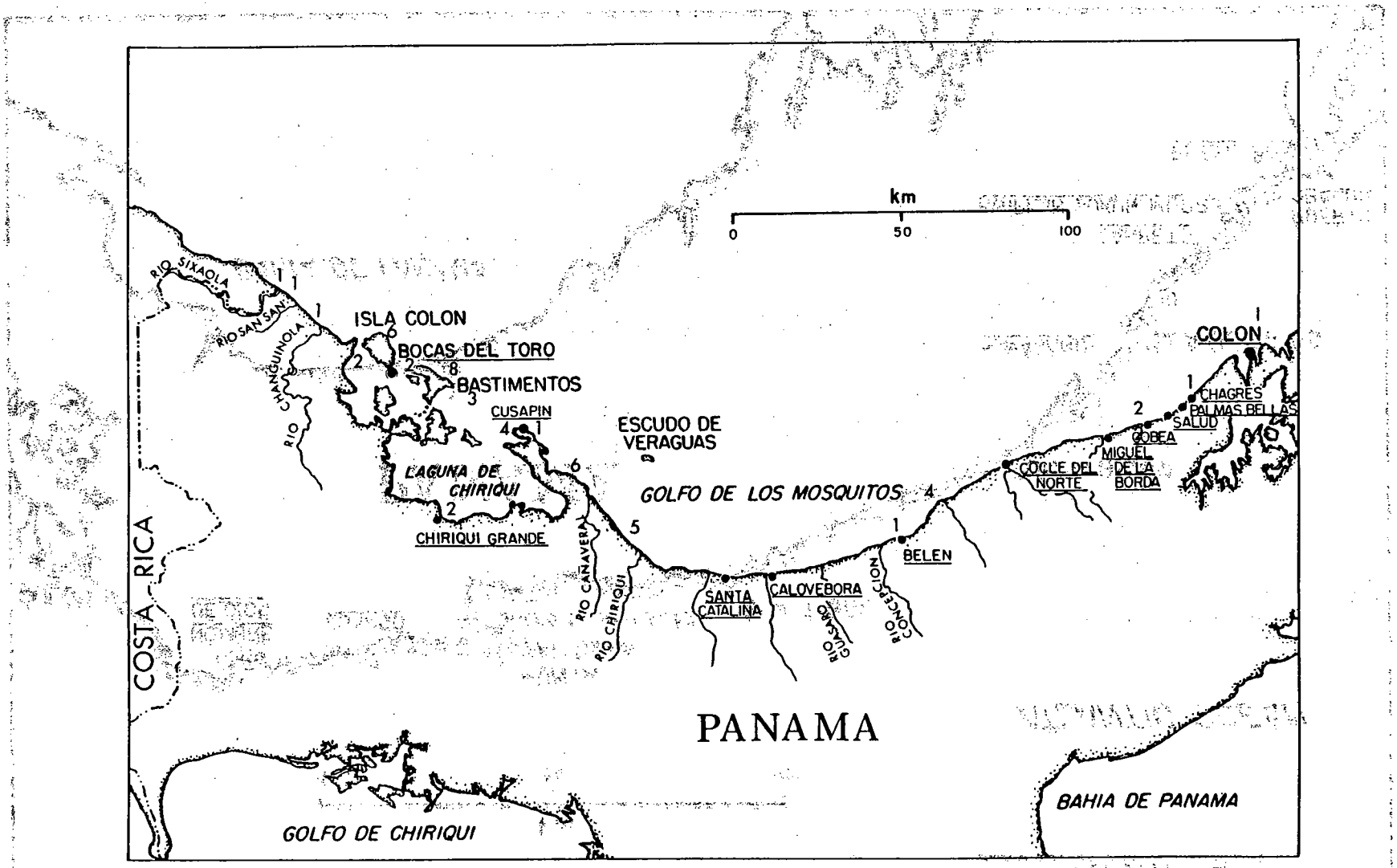

Figure 4. Localities in Panama where green turtles (*Chelonia mydas*) tagged at Tortuguero Costa Rica have been recaptured.

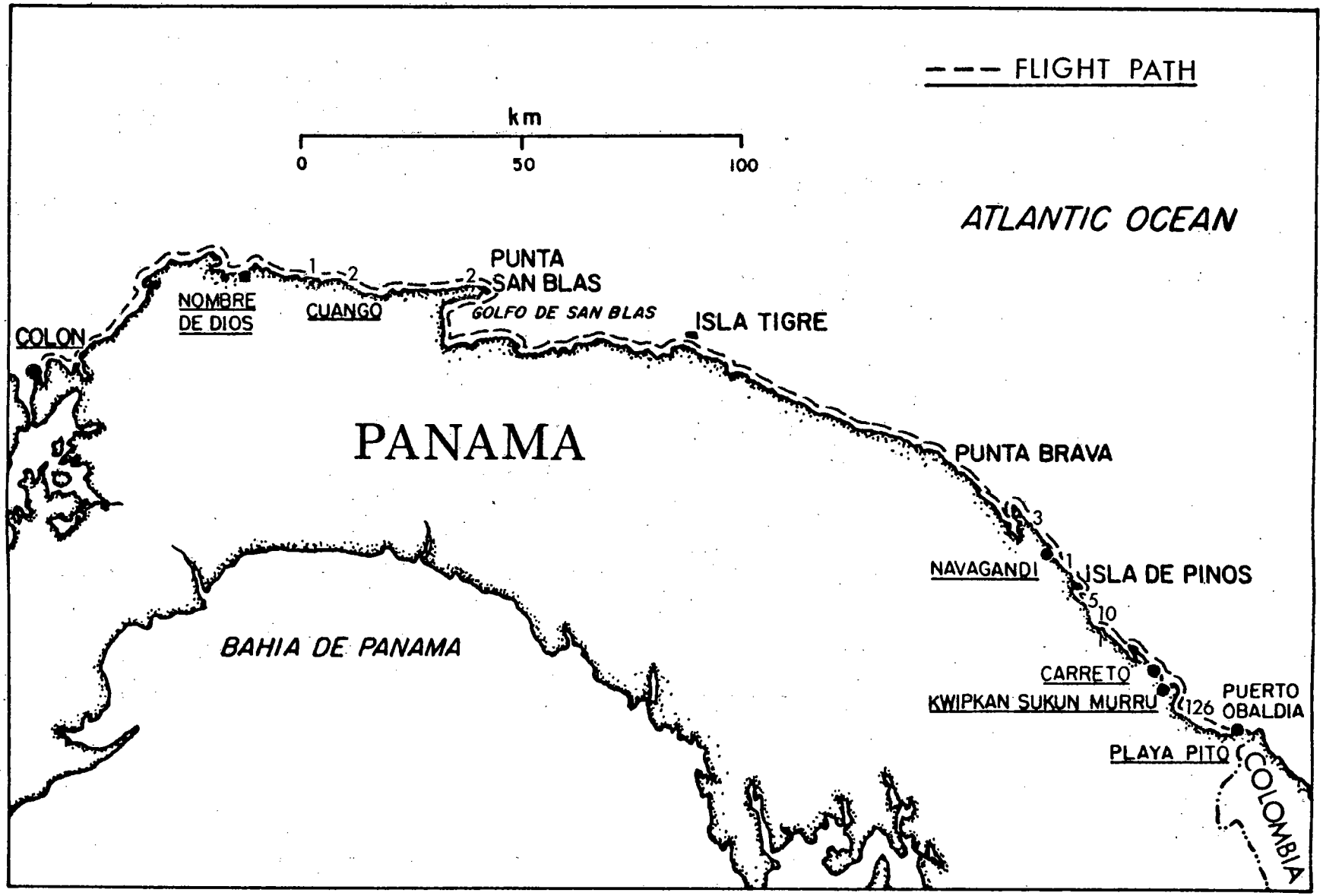

Figure 5. Results of an aerial survey of turtle tracks on the Caribbean coast of Panama, from Colon to Puerto Obaldia, 28 April 1981, 0624-1200. Details of the survey are given in Table 6.

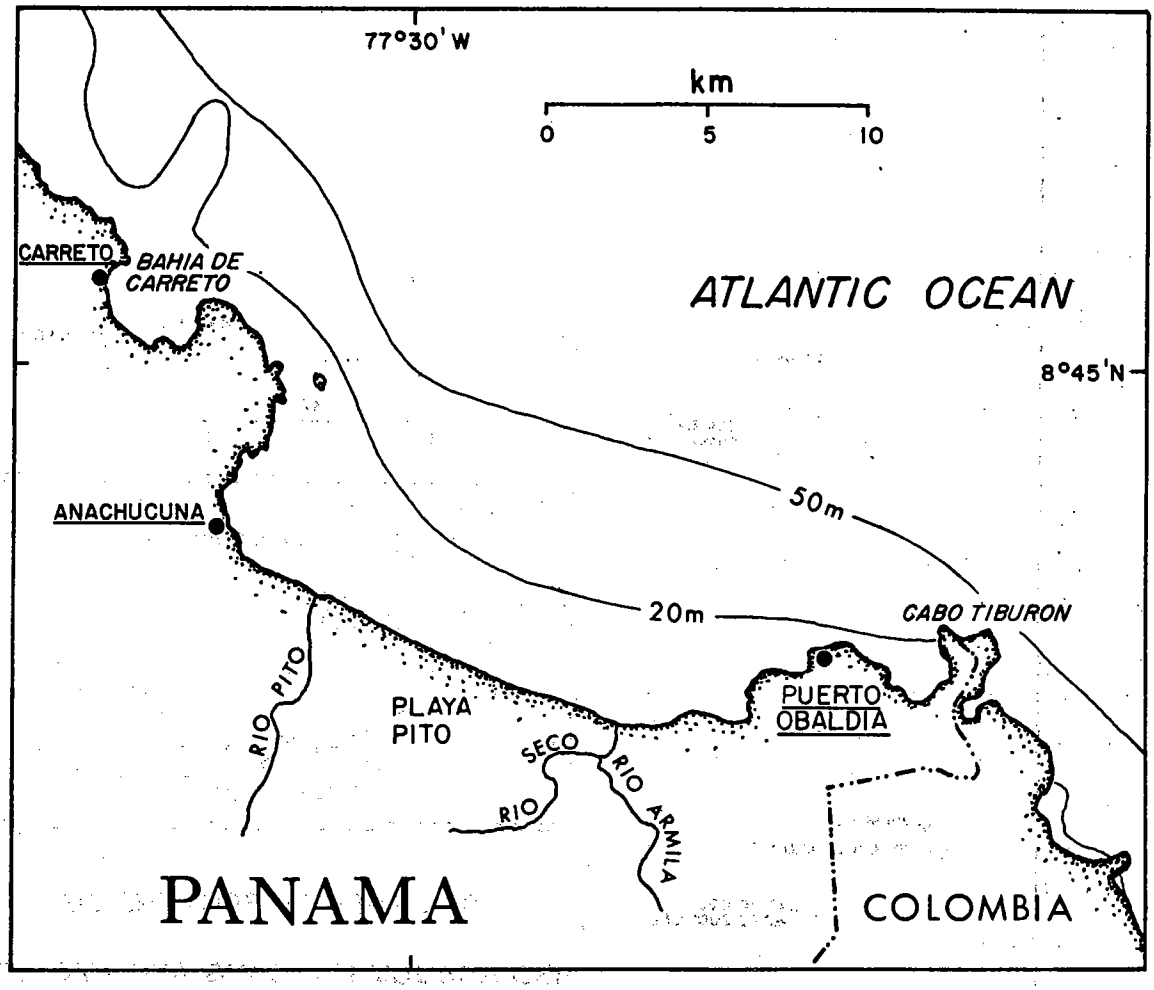

Figure 6. Playa Pito, where a new leatherback colony was discovered in April, 1981.

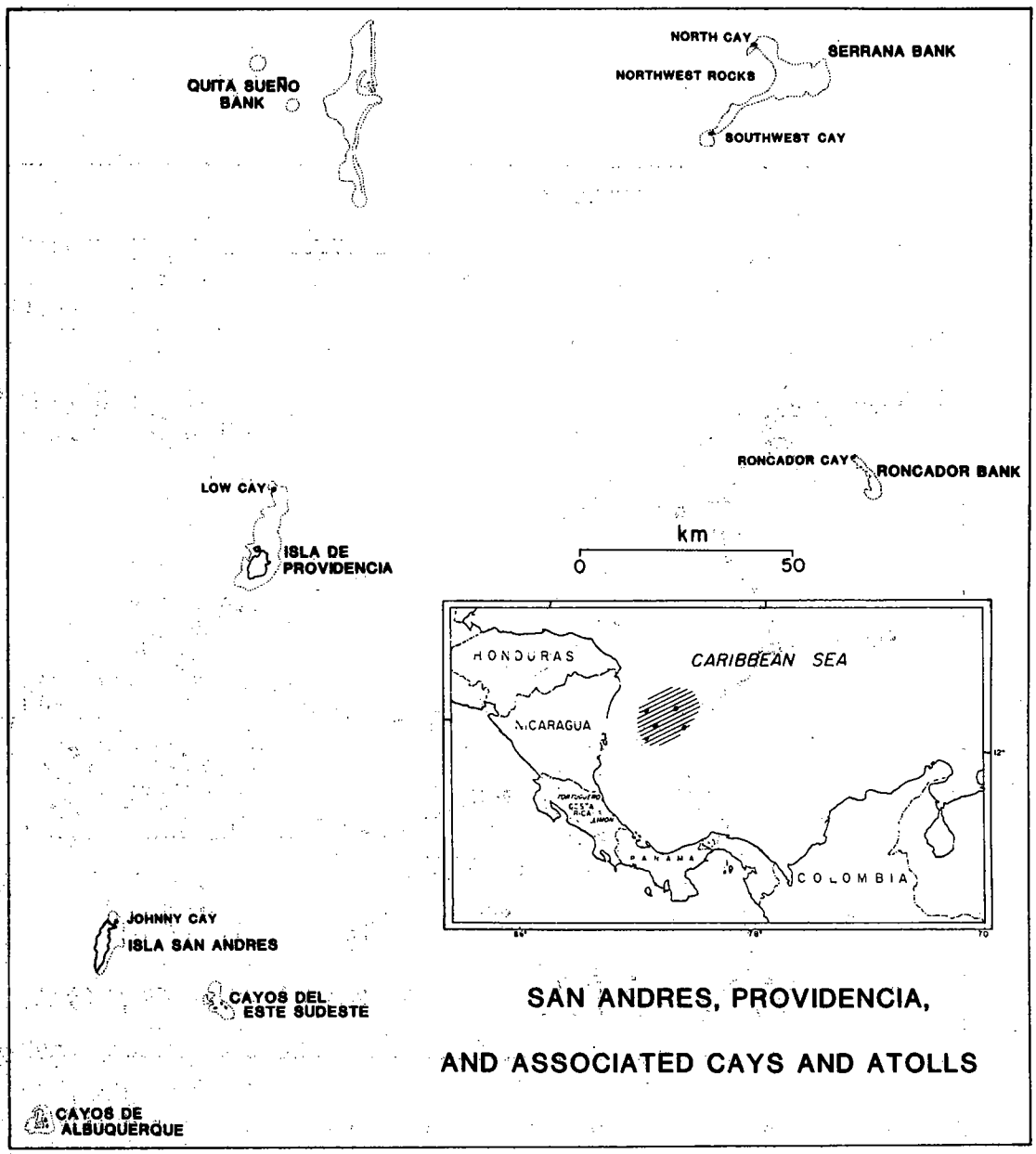

Figure 7. Islands and atolls of the San Andrés Archipelago, in the western Caribbean off Nicaragua.

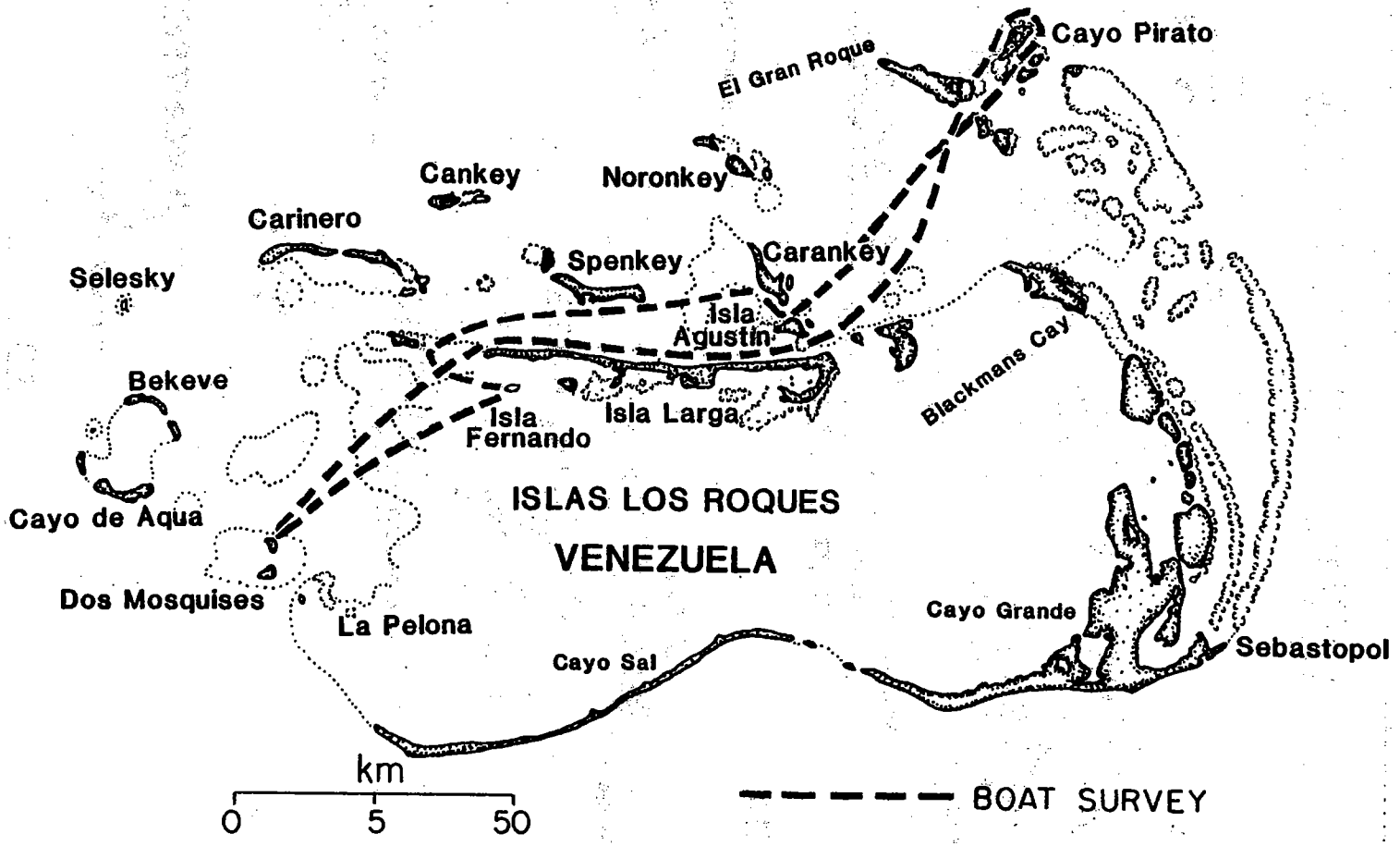

Figure 8. Los Roques Atoll, Venezuela. Dotted line indicates route of boat survey.

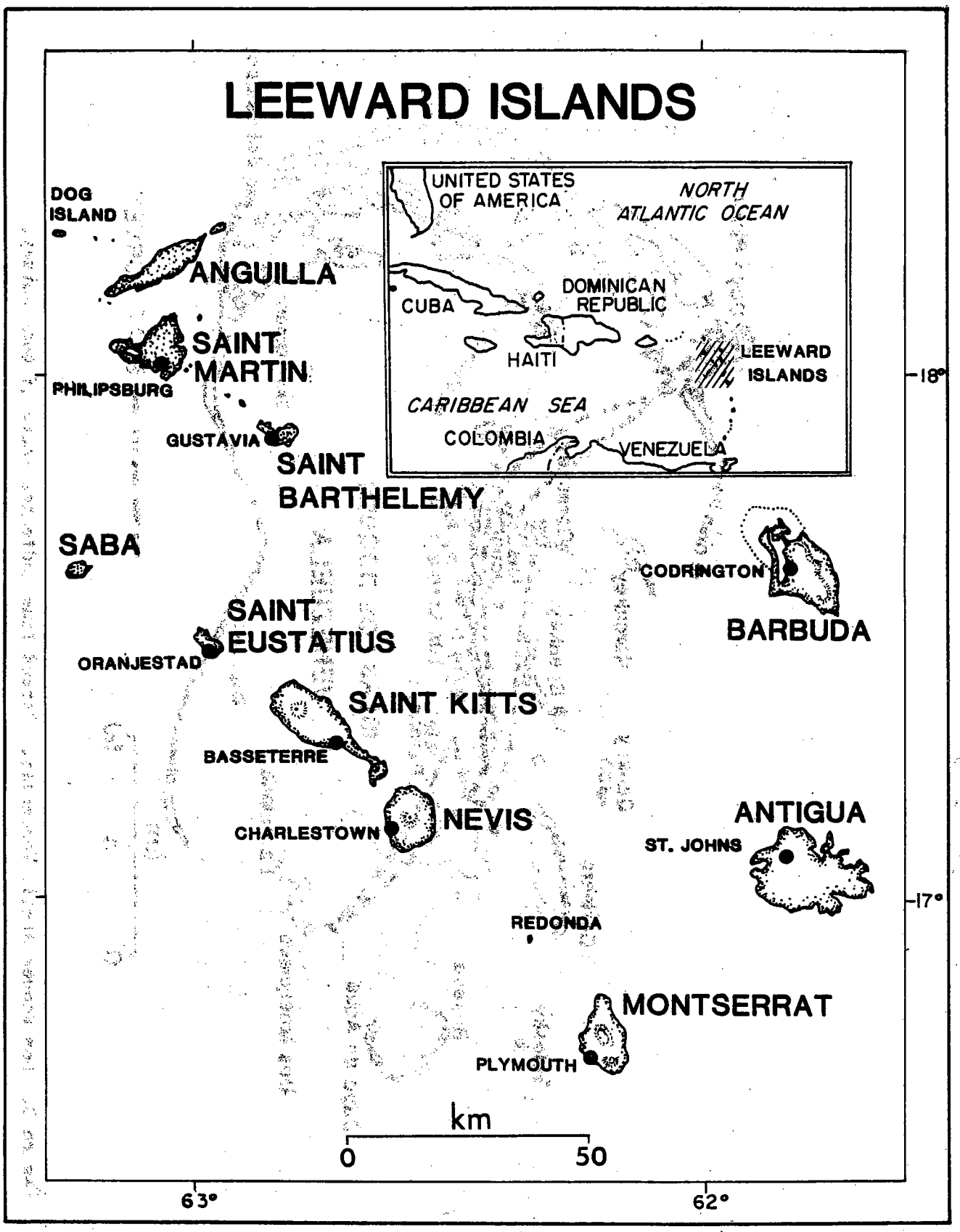

Figure 9.

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