

James H. Carr
1978

Survey and Census of Sea Turtles
in the
Western Atlantic

Interim Report to

National Marine Fisheries Service

Archie Carr and Associates

The field work to date has been done in two phases: expeditions made specifically for, and supported mainly by, the WAS program; and in collaboration with related exercises that received other support. Because of the late start of the survey, the proportion of collaborative input was higher than it will be in the next period. Nevertheless, when the final report is in it seems certain that some of the most important, solidly quantitative, data will have come from other projects in which WAS personnel are involved, or from which relevant data can for other reasons be expected.

The following persons made up the regular panel of field investigators for the survey period: Karen Bjorndal, Anne Meylan, Peter Meylan, Thomas Carr (Field Manager), David Carr, William Rainey, Jeanne Mortimer, Peggy Carr, Archie Carr (Principal Investigator).

The expeditions carried out during the period took project personnel to the Dominican Republic, Puerto Rico and its islands, the Virgin Islands, Colombia, Mexico and all Central American countries.

Information on stock levels at the 23 localities visited is summarized in the attached chart. It is expected that when a new report goes in, the chart will have been extended to include some indication of population changes that can be recognized in each area during historical times, and also some quantitative expressions of the amount of unoccupied, though suitable, habitat that exists.

The work of the period has shown that in some types of habitat, diving and surface observation from boats are unreliable techniques for use in a quick census of resident and developmental turtle stocks. Where field time in an area is limited, interviews combined with aerial survey are more productive. As an index of total mature turtles in populations of species that aggregate to breed, by far the most trustworthy source of information are nesting surveys.

In our next report, green turtle population figures based on nesting arrivals will be given for Brazil and the eastern Caribbean. In the final report the same kind of assessment will be made for populations of the leatherback, loggerhead and Pacific ridley. As forecast in our original project proposal, the most intractable census problem is that presented by the hawksbill, for which censuses must be based on data from several different sources.

The attached chart indicates no absolute numbers of sea turtles in the places surveyed, but rather a relative assessment for each locality. Inasmuch as every area included has experienced greater or lesser overexploitation, the grade of A is not much used in the chart. An E in the chart indicates virtually complete absence of the species or stage, but does not take into account the possible existence of single waif-and-stray records based on one or two old specimens in museum collections or included in old faunal lists.

Preliminary Comparative Assessment of Marine Turtle Stocks in
Seven West Atlantic Survey Blocks

Block	Country or Territory	Locality	Sampling Procedure	Overall Sample Grade	<i>Chelonia</i>			<i>Caretta</i>			<i>Eretmochelys</i>			<i>Dermocheilus</i>			<i>Lepidochelys</i>						
					N	F	D	M	N	F	D	M	N	F	D	M	N	F	D	M	N	F	D
13	Mexico	Quintana Roo	Interviews, some air, diving & surface	C	D	C	C	?	B	C	D	?	D	C	C	X	D	D	E	✓			
12	Belize	Key Corker Belize City	Interviews, diving air	C+	E+	C	C+	✓	C-	C	D	?	D	C	C	X	D-	D	E	✓			
12	Belize	Sartaneja to San Pedro	Interviews, diving	B	C	C	C	✓	C+	C	D	?	C	C	C	X	D	D	E	?			
12	Belize	Placencia area	Interviews surface	B	D	C	C		D	C	D	?	C-	C	C+	X	D	D	E	?			
12	Guatemala	Tres Puntas to Rio Motaqua	Interview surface	C	D	C	C	✓	D+	D	D	?	C	D	D	X	C		E	✓			
12	Guatemala	Livingston & vicinity	Interview beach walks	C	E	C	C	?	D	D	E	?	D	D	D	X	E	D	E	✓			
12	Honduras	Western coast & Bay Islands	Interviews	C	D	D	C	?	D	D	D	?	D	D	D	?	E	D	E	?			
12	Honduras	La Ceiba to Puerto Cabezas, Nic.	Interviews	C	D	C	C	?	D	D	D	?	D+	C	C	X	E	D	E	?			
10	Panama	Colon to Isla Grande	Interview, surface	C-	D	D	D	?	D-	D	E	?	C-	D	D	?	E	E	E	✓			
10	Panama	San Bias Islands	Interview, surface diving	C	D	D	C	?	D-	D	E	?	C	C	C	?	E	E	E	✓			
9	Colombia	Cartagena; Baru, Isla del Rosario	Interviews, diving surface	C+	C	C	C	?	C-	C	C	?	C+	C	C	?	E	E	E	✓			
9	Colombia	Barranquilla to Santa Marta	Interviews surface	C-	D-	D	C	?	C	C	C	?	C-	C	C	?	D	E	E	✓			

Exploitation and Management Problems

Throughout the territory so far surveyed the most important depleting factors are at present the lack of enforcement of regulations, and incidental catch. All the countries reconnoitered to date have turtle laws; but except perhaps for St. Croix, there is adequate enforcement of regulations in none of them. In much of Central America and Colombia the taking of turtles and their eggs goes on almost unhindered. There is also little control of incidental catch of turtles by growing numbers of shrimp trawlers, especially those of Honduras and Nicaragua; and the turtles they take are usually butchered or sold. Even in Belice, where fisheries are relatively well organized and good laws exist, there is little effective protection of turtles of any kind or stage.

Even at this early point of our survey it is clear that no management program for the Caribbean will succeed until revolutionary improvement of enforcement procedures occurs. This will not be easily accomplished. Recent events in Costa Rica demonstrate the need for census and demographic data in coping with irrational proposals for commercialization of turtle stocks.

Costa Rica

Data from, and procedures developed by, the long-term tagging program at Tortuguero, Costa Rica will be an important resource of the present survey in various ways. A striking event of the 1978 season there was a record nesting peak, and its political aftermath. There were more nesting arrivals than in any year since monitoring began, 23 years ago. Seen without reference to past fluctuations this peak could be taken as an abrupt increase in total population, and that was the interpretation given it by coastal people who were disgruntled over recent restrictions of exploitation. The flood of turtles, not just at Tortuguero, but along the inshore approaches to the nesting shore stimulated strong efforts to get a relaxation of prohibitions against harpooning at the nesting ground, and extensions of quotas and the open season. A vociferous delegation from Puerto Limón went to San José to protest the restrictions. At a time of change in the government, this representation from the politically strong Atlantic coast province had considerable impact; and but for vigorous intervention by biologists and other enlightened citizens, great damage could have been done to the unique Tortuguero green turtle population.

The *coup de grace* to the campaign for reduced restrictions came from the prestigious CONICIT, the Costa Rican equivalent of our National Academy of Sciences. At a reception held aboard R/V *Alpha Helix* during its Costa Rican Green Turtle Expedition, Dr. Carlos Villalobos, CONICIT member and Director of the College of Biology, read a resolution by CONICIT urging the ministries concerned to take all Costa Rican sea turtles off the resource list and give them permanent protection.

Size of the green turtle nesting colony at Tortuguero, Costa Rica, and calculated numbers of mature male and female turtles in the West Caribbean population in eight successive seasons.

Year	Size of Nesting Colony	Calculated Size of West Caribbean Population: Mature Males and Females
1971	8,446	46,284
1972	15,426	84,534
1973	9,351	51,243
1974	5,723	31,362
1975	6,378	34,951
1976	23,142	126,818
1977	5,105	27,953
1978	27,041	148,185
		$\bar{x} =$ 68,916

The irrationality of taking protection away from the Tortuguero colony because of a nesting peak in 1978 can be seen by looking at the accompanying table. The causes of the 1978 peak are not clear, but it certainly does not ^{merely} reflect a rise in the West Caribbean population from 27,953 in 1977 to 148,185 in 1978. Increasing protection of the rookery beginning 10-12 years (the probable maturation period of green turtles) ago is no doubt raising recruitment; and the recent closure of three packing plants in Nicaragua and two in Costa Rica ended that heavy toll. However, perusal of the eight year record in the table clearly indicates that other hidden factors are involved in the curious fluctuations shown. One of these is probably the fortuitous convergence of modulated remigration cycles--turtles on 2, 3, or 4-year cycles shortening or lengthening their periods in ways that brought them together at the beach in 1978. If this is what happened it will perhaps be reflected in 1979. That ought to be a big nesting year, since the 3-year period predominates, and 1976 was a heavy nesting season. However, if cycle shortening was really a factor in building the 1978 peak, then the 1979 season ought to be proportionally diminished by reduction of 3-year remigrants.

While our method of calculating total population (see Carr, Carr and Meylan, Bul. Amer. Mus. Nat. Hist., 1978; and Carr and Carr, Rept. to NMFS, 1977) certainly involves some error, the arrivals-data on which those totals are calculated are generated by effort that is quite consistent from year to year; so the yearly changes in the size of the colony are accurately represented. It should also be pointed out that these changes do not reflect change of nesting site by the population involved. Of 15 thousand turtles tagged at Tortuguero, none has ever

been found nesting anywhere else. There is, thus, a Caribbean green turtle contingent for which Tortuguero is the only nesting place. That contingent, though represented most heavily on Miskito Bank, also migrates from other widespread localities, and mixes with turtles with other nesting places; but in each remigration it always goes back to Tortuguero.

Thus, the long-term monitoring and tagging in Costa Rica is beginning to contribute general principles of significance not merely to sea turtle biology but to any effort to arrange rational protection and management for the species.

An immediate application of the Tortuguero results to the problem of censusing Atlantic sea turtle populations is in demonstrating the need to refrain from making definitive population estimates based on nesting arrivals over short periods. For example, the Florida nesting colonies of the loggerhead and green turtle both also were unusually large in 1978, and this has been taken by some observers as proof of the success of certain management practices. Such judgements ought to be withheld for many years to come.

Meanwhile, however, the fact that such autogenous fluctuations occur does not wholly impair the value of single-season nest-track counts as indices of population levels. In the case of the recent loggerhead nesting survey sponsored by NMFS, for example, the population estimate provided can be brought up to date by determining the 1978 nesting arrivals on the shore section on which grounds truth for the survey was established, and using a simple proportion to extrapolate for the whole Florida coast.

UNIVERSITY OF FLORIDA
GAINESVILLE, 32611

DEPARTMENT OF ZOOLOGY
223 BARTRAM HALL
904-392-1107

Appendix I

Dear Sir:

In collaboration with the Bahamas National Trust and with the assistance of the Ministry of Agriculture, Fisheries and Local Government of the Bahamas, the Caribbean Conservation Corporation is conducting a survey of the marine turtle populations of the Bahamas. This is a part of a wide ranging sea turtle census and habitat survey being made throughout the Atlantic with the support of the National Marine Fisheries Service. The lack of even approximate census data for most of this region is a serious obstacle to management of the five species of marine turtles there.

As our first step in the Bahamas, we are sending copies of a questionnaire to all of the Commissioners and to other individuals who have been recommended to us by the Ministry of Agriculture and Fisheries. If you would take the time to complete the enclosed questionnaire, it would be a great help to us. When the questionnaires have been returned to us, we will compile the information and present copies to both the Bahamas National Trust and the Ministry of Agriculture and Fisheries. It is our hope that the results of the questionnaires will indicate which areas of the Bahamas should be surveyed in greater detail.

Thank you very much for your cooperation.

Sincerely,



Karen Bjorndal
Participant, West Atlantic Survey

Appendix 1. Letter from Karen Bjorndal to 110 fisheries officers and others in the Bahamas. Karen is in charge of the Bahamas section of the survey.

Appendix 2. Abstract of Carr-Meylan results for the RV Alpha Helix Green Turtle Expedition.

Appendix 3. Manuscript on an observation bearing on the lost year sea turtle habitat. Submitted to Copeia.

Appendix 4. Cartoon instigated by the green turtle exploitation lobby during the heavy nesting season in Costa Rica.

Marine Turtle Survey Questionnaire

Name:

Position:

Address:

What geographical area will you be covering in answering these questions?

What kinds of sea turtles (green turtle, hawksbill, loggerhead, leatherback or ridley) are in your area?

What size are the turtles that are seen in your area? Please answer separately for each species.

If there are turtles in your area, are they there all year, or only part of the year? If they are only there part of the year, when do they arrive and when do they leave?

What is the average number of turtles of each species seen in your area each month?

Over what kind of ocean bottom are each of the species of turtles normally seen: sand, rock, reef, grass or other (please describe)?

Do any turtles nest in your area? If so, which kinds and at what seasons?

How many nests of each species are laid each year in your area?

Do you know whether there has been an increase or decrease in the number of turtles in your area over the last 50 years? If so, how great has the change been?

Any additional information or observations that you might be inclined to furnish would be greatly appreciated.

Please return to: Karen Bjorndal
Dept. of Zoology
University of Florida
Gainesville, Fla. 32611 U.S.A.

Alpha Helix Expedition to Costa Rica
and Nicaragua - 1978
Participant Report
Archie Carr and Anne Meylan
Abstract

As participants in the cruise we had two main objectives. One was to reconnoiter Miskito Bank off the Nicaraguan coast which is the chief resident territory for the green turtle colony that we have studied on its Costa Rican nesting beach for 22 years. The cruise to Nicaragua was made during the initial ten days of the expedition. Information was obtained by visiting the Miskito Indian turtle fishermen in their camps around Miskito Cay, Morrison Dennis cays and outlying reefs and islets. Having worked with only the mature nesting female contingent of this population for so long, it was enlightening to see the turtles on their feeding ground, where both sexes, and both mature and sub-mature turtles are abundant. Data gathered will be of use in future demographic work with the colony, and of particular value for the management recommendations that we are constantly being asked to make.

During the last 10 days of the expedition we carried out the second phase of our participation, which was to test the orientation behavior of female turtles displaced 25-70 miles into the open sea after being interrupted in their nesting emergence. The aims of the test were (1) to see whether the headings taken were random, or oriented; and (2) if the latter, whether the courses were consonant with the assumed "goal," that is, the course to the nesting beach. Using combined radio and visual tracking techniques, contact with three turtles was maintained for, respectively, 30, 24 and 25 hours. The headings taken by the turtles were clearly oriented; the travel of all was non-random by day as well as by night.

Although the travel paths of all three turtles took them south of the assumed goal, the prevailing southerly current could have accounted for the error-if error it was. Though preliminary in nature, and in part merely a test of equipment, this was by far the most successful open-sea tracking of sea turtles that has ever been done. In addition to the tracking tests, 20 female turtles were taken from Tortuguero nesting beach before they had nested, displaced 67 miles offshore, tagged, and released. Within five days one of these was recorded on the beach only a mile from the site of her interrupted nesting effort. An interesting by-product of the cruise was seeing hatchling green turtles in sargassum rafts when we stopped in the weed-line, 23 miles off the Panama coast, for the express purpose of searching for turtle hatchlings. The three that we found almost certainly had come down from the Tortuguero nesting ground, 100 miles to the northwest. The evidence reinforces the theory that the "lost" first year of the lives of sea turtles is passed in drifting sargassum.

Evidence of Passive Migration of Green Turtle Hatchlings in Sargassum. A puzzling feature of the natural history of marine turtles is the so-called "lost-year" mystery. After entering the sea, hatchling turtles of all kinds disappear from human sight for about one year. Despite wide interest and diligent searching, nowhere in the world has anyone found a place where post-hatchling sea turtles occur. The prevailing hypothesis is that they swim offshore until they encounter sargassum rafts, take refuge in these, and drift with long-range currents. After about a year, they somehow make their way into coastal and reef-system habitats, in which dinner-plate sized turtles are regularly found. Since this theory was first proposed (Carr, 1967, 1967a), several authors have reported finding hatchling sea turtles associated with sargassum, both in the sea off nesting beaches and in wrack deposited on shore by storms (Carr, 1967; Caldwell, 1968; Smith, 1968). Frick (1976) and Fletemeyer (1978) observed hatchling turtles voluntarily joining sargassum rafts soon after leaving the nesting beach.

During the recent Green Turtle Expedition of the Research Vessel *Alpha Helix* we were able to add corroboration to the sargassum-refuge theory. On 11 September 1978 at 1500 CST, a mature female green turtle that we had been radio-tracking since the evening before crossed a band of sargassum 40.2 km off the Panamanian coast (9°49.4'N 82°17.4'W). The depth at the locality was approximately 1,600 m. Mixed into the well-consolidated line of sargassum mats were coconuts, logs, and other land-derived debris. Fish and feeding birds were numerous. The ship stopped briefly in the weedline for the express purpose of searching for green turtle hatchlings. Within 10 minutes, we sighted three of them. One was

resting in sargassum; another was paddling about in a break in the mat. The third was picked up out of the weeds near the bow of the ship by a frigate-bird which, within view of five observers on the fore-deck, juggled, dropped, and recovered the turtle three times before moving away with it. We were unable to reconnoiter the shear further, because the turtle we had been tracking was continuing on her course. However, our finding three little turtles within less than a hundred meters of the band of flotsam suggests that they were numerous.

A south-trending current of 0.5 m/sec (1 knot) is charted for the region (Anon, 1975; see Figure 1). The nearest green turtle nesting aggregation is at Tortuguero, Costa Rica, 160 km to the northwest, and it seems very probable that the hatchlings observed had come down from there. Frick's observations (1976 and unpubl.) revealed that, after passing through the surf, Tortuguero hatchlings swim directly away from land. The resultant of their seaward heading and displacement by the prevailing current off the shore would very likely bring turtles into the area in which we found them. The alternative conclusion--that the three we saw had corrected for current set and had swum there from some isolated nest on the adjacent Panamanian coast--seems next to impossible.

The above observation suggests that the "infantile frenzy" and the consistently seaward headings taken by Tortuguero hatchlings are an adaptive prelude to their incorporation into drifting sargassum rafts far south of the nesting beach. The consolidated alignment of rafts along inshore shears increases the probability that a hatchling will find refuge in the weed (see Figure 2). The poorly known relation of local currents and shearlines to the Equatorial Current makes it difficult to visualize the subsequent course of their passive migration.

The southerly September gyre off Costa Rica and Panama turns eastward along the Colombian coast and rejoins the Equatorial Current, which generated it in Costa Rican waters to begin with (Figure 1). Whether rafts bearing Tortuguero hatchlings remain in the Southwest Caribbean gyre, or are picked up by the westerly Equatorial Current--or perhaps both--is unknown. The routes of their eventual travel into the inshore developmental habitats of their kind are even more unpredictable.

Acknowledgements. These observations were made while we were participating in the Green Turtle Expedition of the Research Vessel *Alpha Helix* to Costa Rica and Nicaragua. Our work on that cruise had supplementary support from National Science Foundation Grant OCE77-09842, Biological Oceanography Division, and from the Caribbean Conservation Corporation.

LITERATURE CITED

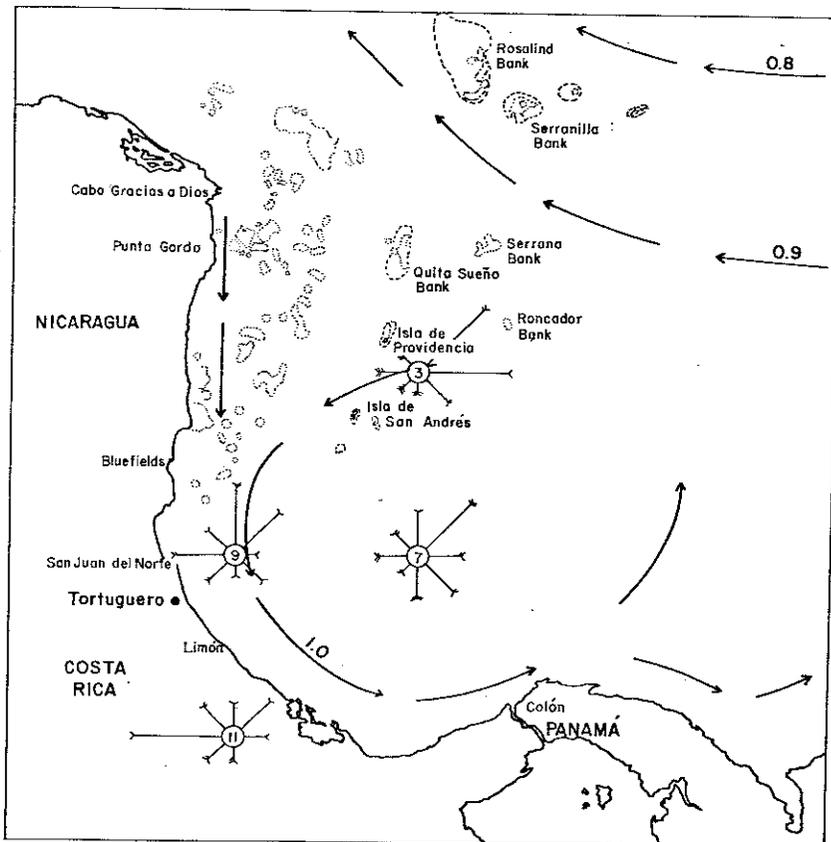
- Anonymous. 1975. Atlas of pilot charts. Central American waters and South Atlantic Ocean. Defense Mapping Agency Hydrographic Center Pub. 106.
- Caldwell, D. K. 1968. Baby loggerhead turtles associated with sargassum weed. *Quart. J. Florida Acad. Sci.* 31(4): 271-272.
- Carr, A. F. 1967. Adaptive aspects of the scheduled travel of *Chelonia*. p. 35-55. In: *Animal Navigation and Orientation*. R. M. Storm (ed.). Oregon State University Press. Corvallis, Oregon.
- Carr, A. F. 1967a. *So excellent a fishe*. Natural History Press. New York, N.Y.
- Fletemeyer, J. R. 1978. Underwater tracking evidence of neonate loggerhead sea turtles seeking shelter in drifting sargassum. *Copeia* 1978(1): 148-149.
- Frick, J. 1976. Orientation and behavior of hatchling green turtles (*Chelonia mydas*) in the sea. *Anim. Behav.* 24: 849-857.

Smith, W. G. 1968. A neonate Atlantic loggerhead turtle, *Caretta caretta caretta*, captured at sea. *Copeia* 1968(4): 880-881.

Archie Carr and Anne Barkau Meylan, Department of Zoology, University of Florida, Gainesville, Florida, 32611.

Legends for Figures

- Figure 1. The southwestern Caribbean, showing prevailing currents in the month of September (From Meylan [unpub. M.S.] after Atlas of Pilot Charts, Central American Waters and South Atlantic Ocean, Anon., 1975).
- Figure 2. Sargassum along a shear approximately 48 km off Tortuguero, Costa Rica. The elevations at right center are mountains far inland.





8—LA REPUBLICA. Martes 29 de agosto de 1978
San José Costa Rica