The Ascension Island Green Turtle Colony

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Reprinted from COPEIA, 1975, No. 3, August 5
pp. 547–555
Made in United States of America

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Recoveries of Atlantic green turtles tagged at the Ascension Island nesting ground confirm an exclusively Brazilian origin for the island colony and show its renesting and remigration periodicity and its site tenacity to be similar to those of the more extensively sampled Tortuguero (Costa Rica) colony. Implications of the dual origin of the Brazilian resident colony, where Ascension Island turtles mix with turtles from a Surinam breeding ground, are discussed; and the probable composite nature of *Chelonia mydas*, for which Ascension Island is the type locality is pointed out.

SINCE Carr and Hirth (1962) reported results of the first year's tagging at the Ascension Island breeding ground of the Atlantic green turtle, *Chelonia mydas mydas*, work at the island has been resumed during ten successive seasons. Many of the tags have been put on during short visits to the island or by local collaborators who are unable to give equal attention to the several nesting beaches and who often work through only a part of the night. In spite of this uneven sampling, however, useful information on the reproductive ecology of the colony has accumulated. The present paper summarizes results to date.

RESULTS AND DISCUSSION

Remigration.—Fig. 1 shows remigratory intervals (periods between successive migrations) for the Ascension Island colony. Although data on remigration are not available for most populations of *Chelonia*, different breeding colonies clearly diverge in this regard. The prevalent intermigratory period is evidently three years. Some populations breed mainly or perhaps exclusively on a three-year schedule (Harrisson, 1956; Hendrickson, 1958). Others nest on a dual two-year or three-year cycle (Carr and Ogren, 1960; Carr and Carr, 1970; Hirth, 1971). In some colonies there is evidently a regular four-year period, occurring either as the characteristic regimen (Bustard and Tognetti, 1969; Bustard, 1972) or as a variant period (Carr and Carr, 1970). According to J. P. Shulz (personal communication cited by Pritchard, 1973) Surinam green turtles occasionally nest in successive years.

At Ascension the three-year period clearly emerges as predominant, as Fig. 1 shows; and there is strong evidence that the ratio of two-year to three-year remigrations is the same as that in the Tortuguero colony. The complete lack of one-year returns is also in accord with the larger Costa Rican sample. This correspondence would appear to reinforce the reality of two-year and three-year periods for the island colony. The data also suggest that the single observed five-year interval was produced by the missing of an intervening return after two or three years—that is, that it could not have represented any combination involving a single year. The possibility that a five-year intermigratory period exists cannot, however, be discounted. The four-year returns recorded could obviously be either true periodicity or a product of faulty monitoring. In the more extensive Tortuguero sample, the four-year interval seems to be emerging as a reality; although here, too, there remains the possibility that any unmonitored two-year return may become a four-year return two years later.

Carr and Carr (1970) suggested that regional differences in migratory periodicity might reflect different environmental conditions on the feeding ground, and that the modulated reproductive cycles—changes from a two-year to a three-year period and vice versa—observed in the Tortuguero colony might be produced by ecologic changes from one year to another. That the midocean Ascension colony should show essentially the same migratory periodicity does little to clarify this problem.

Although the Ascension remigration data are not extensive, the significance of the trends observed is supported by their similarity to those in the Tortuguero colony. Their significance is further strengthened by the fact that of the thousands of mature green turtles that have been tagged by various investigators in the Atlantic system—Ascension, Surinam, Tortuguero, Aves Island, Florida—there has been no case of

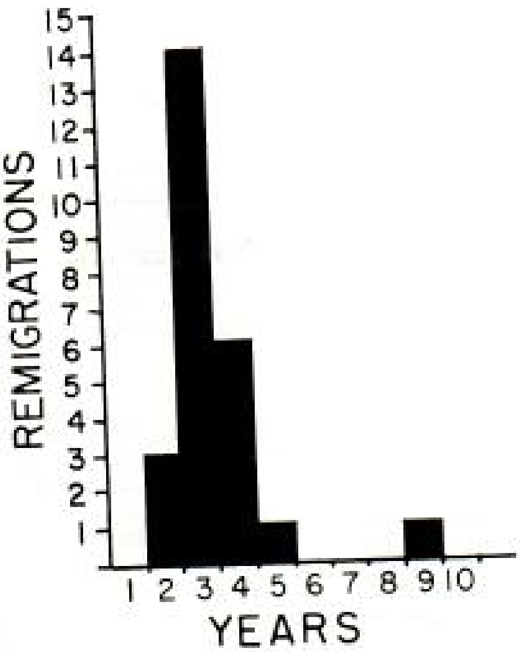

Fig. 1. Intervals, in years, between seasons in which Ascension green turtles were tagged and their subsequent returns to the island.

violated philopatry—that is, none has ever been found nesting on a distant shore. There is, thus, little or no possibility that the intervals recorded at Ascension might have been prolonged because unobserved nestings had occurred somewhere far away.

The relatively small proportion of remigrant recoveries in the Ascension program can be attributed partly to irregular and incomplete patrolling of the nesting beaches. Also, however, attrition on the Brazilian feeding grounds has been increasing for several years, and this obviously would lower remigration figures. Another factor has no doubt been loss of tags, which has apparently fluctuated from season to season, as the quality of the alloy (monel) used in the tags has varied.

Whatever the factors limiting remigratory recoveries may be, our recovery sample seems too small to justify calculations of population size. However, the comparability of the numbers of remigrations, and of captures on the Brazilian feeding range is noteworthy. Thirty-nine Ascension turtles have been recovered in Brazil since the beginning of the program. During the same period, 24 turtles tagged on the island have been retaken there two or more years later, presumably after having made round trips to Brazil in the interim. The difference in the number of the Brazilian captures and remigration returns seems suggestively similar to the difference in the periods of time involved in the one-way trip from Ascension to Brazil, and the round trip, Ascension-Brazil-Ascension.

Recoveries on the resident ground.—When tagging began at Ascension Island in 1960, data from the older tagging program at Tortuguero, Costa Rica had shown the nesting colony there to be an assemblage of periodic, long-range migrants, and had roughed out the non-breeding distribution and reproductive periodicities of the population. One aim of the Ascension program was to determine whether the nesting colony on that small midocean island, like the Tortuguero turtles, made long, scheduled migrations across open sea—in this case from either Africa or Brazil. Such a life cycle would clearly require an advanced guidance system, while the Costa Rican migration might possibly be accomplished by some sort of groping, longshore landmark piloting. Although little progress has been made in the experimental identification of cues used in the island-finding migration (Carr, 1972), the understanding of the ecologic geography and periodicity of the colony that the tag-recovery data has brought has strengthened the circumstantial basis for theorizing about navigation mechanisms.

The Ascension turtles have been shown to come from the coast of Brazil, where thirty-nine Ascension tags have been recovered (Figs. 2 and 3; Table 1). The Brazilian resident range extends both north and south of the latitude of the island. No turtle tagged while nesting on Ascension has ever been taken nesting anywhere else; none has been recovered at the island except during the breeding season; and none has ever nested in consecutive seasons.

From the beginning of the Ascension program it has been hoped that travel-speed data from tag recoveries might provide indirect evidence of migratory routes, and thus of the character of the navigation system used by the migrants. To date, however, the lag that attends most of the long-range recoveries has hindered such calculations. The nearest approach to actual speeds of travel are derived from the periods between the last observation of a turtle at Ascension and its recapture in Brazil (Tables 1 and 2). These intervals obviously bear only on the westward downstream trip in the Equatorial Current, in which the turtles might conceivably

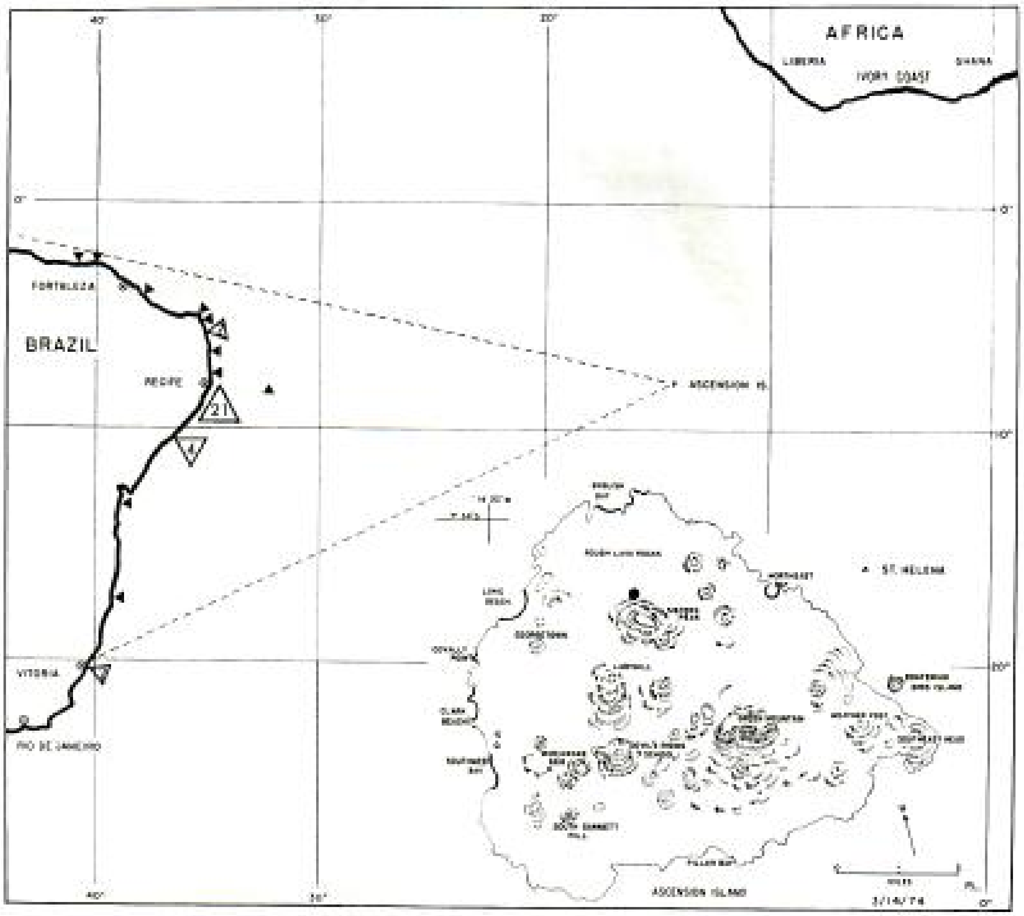

Fig. 2. Total Brazilian recoveries of turtles tagged at Ascension Island.

be washed passively toward the mainland shores. As a source of evidence of travel paths—and thus, of possible guidance cues—the up-current, island-finding phase of the migration is critical. For this journey no speeds or routes can be calculated, even approximately, because the minimum (two-year) remigratory cycle is too long to reveal actual time at sea.

The most rapid travel so far recorded in the Ascension project was that of turtle P484, which was tagged at Ascension 25 March 1973 and recovered 1 June 1973 at Gravata, Pernambuco. The previous record was that of No. A12, tagged at Ascension on 24 February 1960, last seen at Ascension 15 March 1960, and on 6 June 1960, recovered at sea off Recife, Brazil, which lies due west of Ascension. It was evidently about to make its homing landfall when intercepted. Of five other Brazilian recoveries of turtles tagged at the island during the same two-month period as A12, only one appears likely to have been intercepted while still in migration. This was A198, caught in June, 1960 (exact date not given), at the mouth of the Parnaiba River in Ceará. The tagging-to-recovery periods for the other four—A144, A155, A199 and A204—ranged from 336 days to 1324 days. The sites of recapture extended for a distance of 2700 km northward and southward of Recife along the coast of the Brazilian Bulge. Of this set of seven recoveries from the 1960 tagging season, four were made north of the Recife-Ascension latitude, and three to the south of it. The Vitoria return (A144) represents the southernmost recovery for the Ascension project.

A significant development in the Ascension research is evidence of shared occupancy of the Brazilian feeding ground by Ascension and Surinam green turtles (Figs. 2, 3, 4; Table 2). This use of the same nonbreeding range by

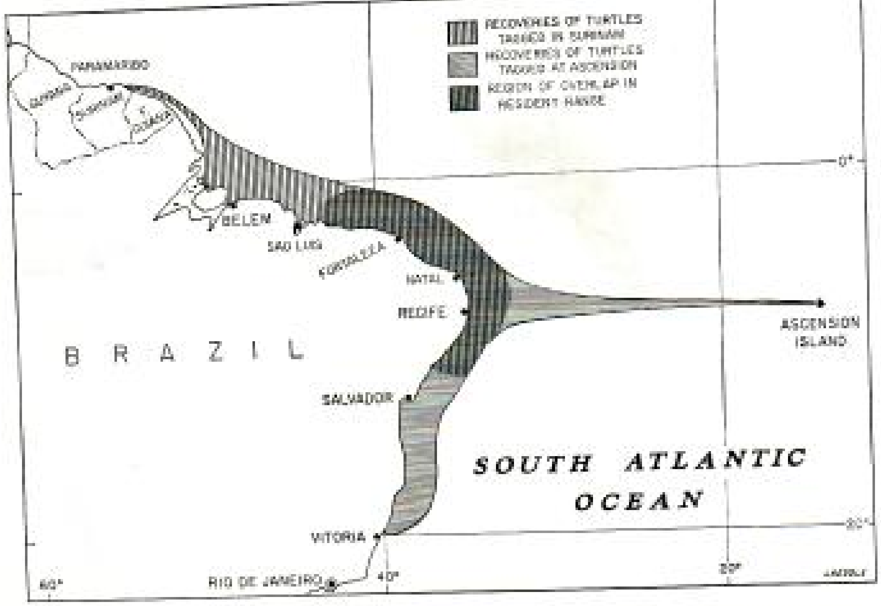

Fig. 3. Overlap of tag-recoveries from the Ascension and Surinam tagging programs (Surinam data from Pritchard, 1973, and unpublished).

green turtles from widely separated nesting localities is the only such case that has been made known. It constitutes an interesting reversal of the situation at Tortuguero, where turtles from different resident areas assemble at the same season on the same nesting shore. Fig. 4 shows seasonal distribution of the catches of Ascension and Surinam turtles and total monthly takes for the state of Ceará for the period 1972–1974 (Paiva and Nomura, 1965).

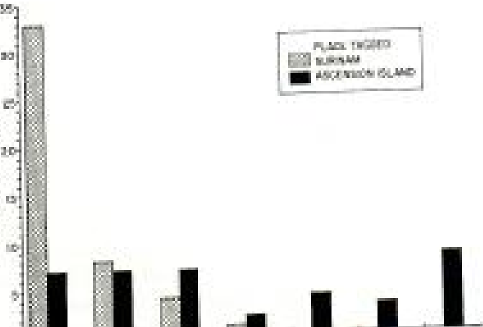

Fig. 4. Days elapsed between the time turtles were tagged at Ascension Island and in Surinam and the time of their recovery in Brazil (Surinam data from Pritchard, 1973, and unpublished).

To account for the peaking of the Surinam component in the period from April to September, when 81% of the Surinam recoveries were made, Pritchard (1973) noted that this is the time when the tagged females are returning from their reproductive migration. He reasoned that, traveling along shore and in a vitiated condition, they would be more likely to be caught in nets placed across their return routes. As a possible explanation why some of the turtles were caught during the year following that in which they had been tagged, he cited a personal communication of J. P. Shulz indicating that Surinam turtles sometimes nest in consecutive years, and so would make annual migrations. When the Ascension recovery data are grouped with the foregoing, as in Fig. 5 the concurrence of tracking is interesting, because no Ascension turtle has ever been known to migrate in consecutive years. Moreover, most of the Brazilian recoveries of Ascension turtles occurred long after the return to the resident ground must have been made. Nothing is known of any local seasonal movements of green turtles along the Brazilian coast that might account for seasonality in the catch. The main food of the Ceará colony is benthic algae (Ferreira, 1968), and it is at least possible that seasonal changes in the productivity of algal beds could stimulate local migrations, and so

TABLE 1. LONG DISTANCE RECOVERIES OF TURTLES TAGGED AT ASCENSION ISLAND, 1969–1973. All recovery localities were close inshore on the Brazilian coast except that for No. A12, which was taken in the open sea off Recife.

Latitude	Tag no.	Days to recovery	(km) Traveled	Speed of travel for the six shortest intervals (km/day)
0°–5°	A198	73 ± 15	3085	53–35
	A199	336	2972	
	A2	1068	2661	
	B542	81 ± 22	2661	33–26
5°–10°	A204	847	2370	
	A241	303	2302	
	A1416	271	2415	
	A2224	261 ± 20	2342	
	B64	113 ± 15	2370	
	B421	307 ± 15	2370	
	B555	562 ± 15	2297	
	A12	83	2201	27
	B129	181	2342	13
	B253	582	2376	
	B315	1010 ± 45	2376	
	B871	545	2336	
	B375	346	2376	
	B427	909	2376	
	B649	1582 ± 15	2370	
	B800	221	2376	
	B881	465 ± 15	2376	
	B868	433	2376	
	B607	1348	2376	
	B851	910	2376	
	B878	1024 ± 6	2376	
	B717	452	2376	
	B901	848	2376	
	A155	1324	2415	
	B578	1200 ± 15	2415	
	B541	1500 ± 60	2376	
	P484	68	2302	34
10°–15°	C570	466 ± 15	2665	
	B598	708	2665	
	B589	1535	2443	
	B663	1564 ± 6	2443	
	B846	179	2703	15
15°–20°	C532	1438	2826	
20°–21°	(tag no. illegible)		2977	
	A144	656 ± 15	3047	

make the turtles more susceptible to interception by nets at some seasons than at others.

Thus, green turtles occupying a common feeding range along the Brazilian coast, both north and south of the easternmost extension of the Bulge, leave simultaneously to travel to two widely separated places to nest. One of these breeding grounds is a mid-Atlantic island; the other is located in Surinam, far to the north beyond the mouth of the Amazon. The nesting seasons at the two correspond closely. The Ascension turtles living below Recife have to travel northward and eastward in their migration; those north of Recife move southward and eastward. At the same time, members of the Surinam colony are traveling comparable distances northwestward from their range in Ceará, and northeastward, then northwestward, from localities south of Recife.

CARR (1967) pointed out the difficulty of accounting for the evolutionary origin of the Brazil-Ascension migratory pattern without assuming major geographic changes in the area, and suggested that the changes were somehow related to continental drift. The necessary conditions now appear to be provided by sea-bottom spreading theory (Carr and Coleman, 1974); and this must likewise have been involved in the peculiar tendency of two turtle populations to leave a shared feeding range and in concert depart for two different nesting grounds several thousand km apart. Once such ecologic divergence arose, it obviously would be genetically maintained by the separation of the two populations at breeding time, because mating occurs at nesting time, and thus at widely separated places. However, to explain the differential behavior of the Ascension turtles residing on the Brazilian coast to the north and to the south of the island latitude is more difficult. These two segments of the linearly distributed feeding colony must leave on markedly different initial travel paths. The problem is to account for the adaptive origin of such a divergent pattern of orientation behavior in animals of the same breeding population—which these are, since they presumably mix during mating time at the island. The case has its analog in the simultaneous departure of the Tortuguero turtles for Colombian (southern) and Nicaraguan (northern) feeding ranges when they have finished nesting in Costa Rica.

Renesting.—On the basis of 76 renesting returns of female turtles to Ascension Island beaches, Carr and Hirth (1962) concluded that the Ascension green turtle nested at 12–14 day (av. 12.5 day) intervals during her season at the island. They observed five nestings by one

TABLE 2. TIME (DAYS) AND DISTANCE (KM) OF TRAVEL OF GREEN TURTLES CAUGHT WITHIN THE SECTION OF THE BRAZILIAN COAST SHARED BY ASCENSION AND SURINAM TURTLES (DATA ON SURINAM RECOVERIES FROM PRITCHARD, 1973).

	Surinam	Ascension
No. of tagged turtles recovered	51	39
Approximate maximum distance traveled from rookery	3000	3100 (to point farthest N. of Ascension lat.) 2375 (to point farthest S. of Ascension lat.)
Approximate minimum distance traveled from rookery (to region of overlap)	1750	2290
Time between last observation at rookery and recovery of tag in Brazil	32–593, av. 215	68–1500, av. 618

female, and found circumstantial evidence that more may occur. Since the Ascension work began, 261 turtles have now been observed nesting two or more times in a given season; three of these emerged five times, and six nested four times.

In Fig. 5 the duration of the intervals between all observed renestings is plotted. Although the data no doubt include a certain number of false emergences, wrongly recorded by collaborators as nestings, the main peak of the histogram nevertheless comes at the expected point—12 through 14 days—and two possibly significant lesser peaks can be seen at points corresponding roughly to multiples of that interval. These latter two peaks evidently represent cases in which intervening nestings were missed by the taggers.

A problem that invites study is the physiologic tour de force of the evidently foodless sojourn of green turtles at the Ascension nesting ground. For example, a turtle that nests four times, at intervals that average 12½ days, stays at the island for 50 days. It seems evident that this is a period of almost complete fasting. When to this deprivation is added the presumably equally foodless periods of open-sea travel between the island and the Brazilian Coast the physiologic stress imposed by reproduction seems formidable.

A limited amount of information on the behavior of the Ascension turtles during the internesting interval is presented by Carr, Ross and Carr (1974).

Philopatry and site tenacity.—Of the 1300 mature female turtles that have been tagged at Ascension Island none has been found nesting anywhere else. At Tortuguero, where the tagged sample is more than ten times as large, a similar regional homing tendency is evident—all recorded renesting and remigratory returns have occurred on the 35 km beach between the mouths of the Tortuguero and Parismina rivers. At both study beaches, likewise, a more fine-scale site fixity is to be seen in the tendency of a female turtle to nest near the point on the home shore where she emerged previously. It seems convenient to refer to the broader place-sense as philopatry, and to the more fine-scale discrimination within the nesting ground as site fixity or site tenacity.

At Tortuguero Carr and Carr (1972) found that the average separation of successive emergences (on both the renestings of a given season and remigratory visits after two or more years) was 2 km (mode .2 km). At Ascension, the nesting ground comprises a few short sections of beach arranged around the 40 km circumference of the island, and separated by rocky cliffs and headlands. We now have recorded 24 remigrations at Ascension, and although precise locality records are in some cases precluded by changes that have occurred in the character of the beaches from year to year, a tendency to site fidelity seems clearly evident. When all cases of obliteration or subdivision of original cove beaches were taken into consideration, only two out of the 24 remigrants were found to have strayed from the site at which they were tagged.

When the far more voluminous renesting data (Fig. 6) are examined, a tendency toward site selection can also be seen. Although the tendency might be expected to show up more clearly in these short-term returns, this has not proved to be true. This reversal of expectations may be attributable to greater sampling error in the renesting records. There has no doubt been disparity in the effort expended by collaborators in different seasons and at the various tagging beaches and they may have handled turtles with varying degrees of care. When an

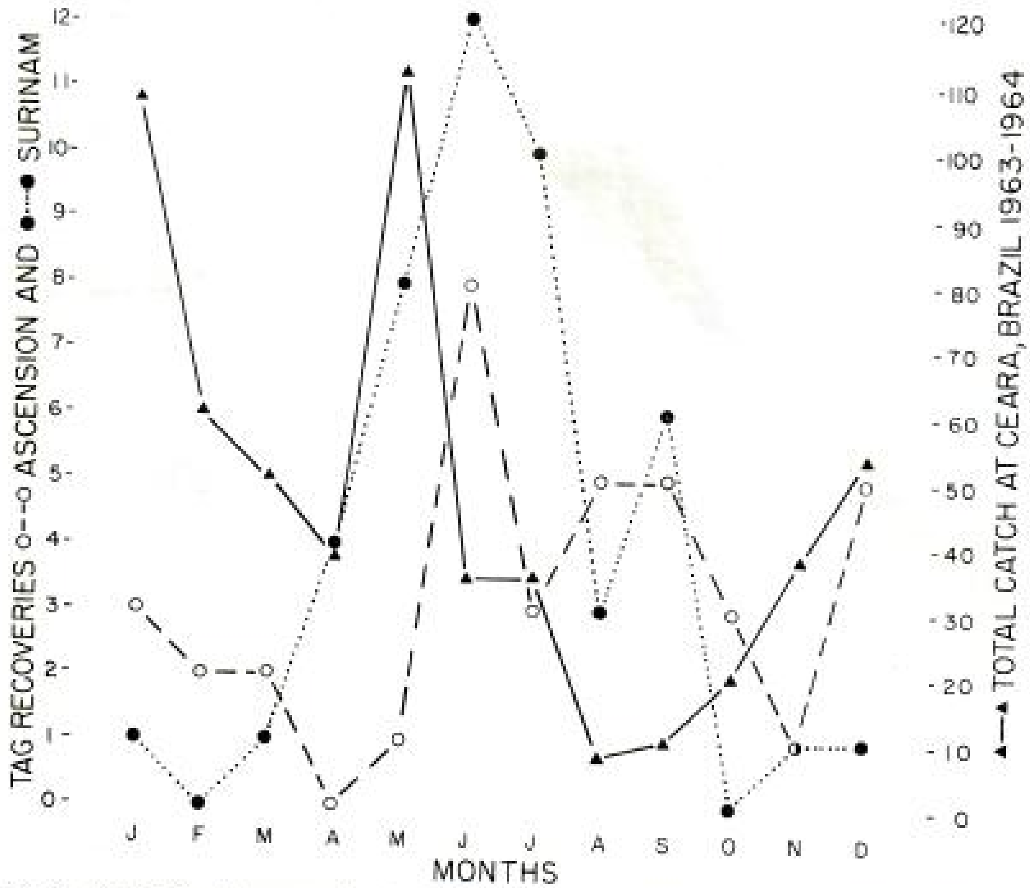

Fig. 5. Monthly Brazilian recoveries of 39 turtles tagged at Ascension and 51 turtles tagged in Surinam, compared with the total monthly commercial catch for Ceará, Brazil for the period 1962–1964. The Ascension and Surinam samples include only mature females; the Ceará totals comprise both mature and immature turtles of both sexes (Surinam data from Pritchard, 1973; Ceará totals from Paiva and Nomura, 1965).

emerging turtle takes fright at lights or rough handling she will sometimes flee at high speed to a distant beach before coming out again. One such female tagged as she emerged at Southwest Beach, emerged and layed 4½ hours later on the opposite side of the island (Kim Critchley, personal communication). A female of *C. m. agassizi* tagged by Peter Pritchard on Sullivan Bay, eastern tip of James Island in the Galapagos Islands, reappeared the following night on the southwest beach at Baltra Island, 40 km away. When a turtle comes ashore bearing an old tag, the field workers are usually especially solicitous in handling her, and in recording attendant data. Such extra solicitude might produce differential reliability in the renesting and the remigration records. Finally, there has probably been some error when false crawls have been diagnosed as nestings. At Tortuguero turtles range more widely in these prospecting, pre-nesting emergences than in those between two successful nesting ventures.

The Ascension colony and the survival outlook of the green turtle.—The declining survival outlook of the green turtle has in recent years received increasing attention. There has been a tendency to consider the *Chelonia mydas* complex as a single vulnerable entity, however, and thus to regard protection given to any green turtle population as a contribution toward the survival of the whole complex. This is surely a mistake. The *mydas* complex has not been adequately studied taxonomically, and it is not yet possible to distinguish morphologically

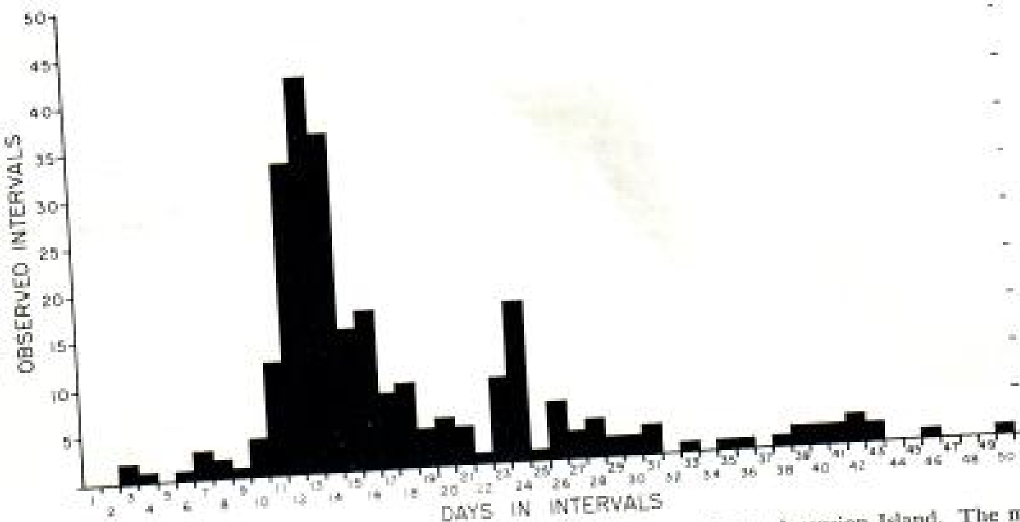

Fig. 6. Intervals between observed nesting emergences of green turtles at Ascension Island. The main peak corresponds to the true internesting interval. The two lesser peaks shown at points corresponding to multiples of the internesting interval time evidently reflect unmonitored intervening nesting emergences.

among its isolated populations, even though they are all virtually cut off from genetic contact among themselves. It seems clear that if *Chelonia* is to get its share of concern as a group of vulnerable, threatened and endangered forms of life, the composite nature of the *mydas* complex must be made known to conservationists and legislating governments. Only two forms of *Chelonia mydas* are at present given nomenclatural recognition: *agassizi* of the eastern Pacific (from Baja California to the Galapagos Islands and Peru, and westward to the Hawaiian Archipelago and the Marshall Islands); and the wide-ranging *mydas*, in which the Atlantic populations and some of those in the Indo-Pacific are superficially quite similar.

Of the latter, the nearest approach to Atlantic *mydas* appears to be the barrier reef form that ranges from the Capricorn Group in southern Queensland to the Eastern and Central Torres Strait Islands. After looking at hundreds of green turtles in this area I am not able to suggest any clear differences between them and Atlantic colonies. In the eastern Indian Ocean adult *Chelonia* of a recently discovered important nesting colony on the Lacépède Islands off the coast of northernmost Western Australia show something of the *agassizi* characters in form and coloration and so, to my eye, do those illustrated by Frazier in the western Indian Ocean (Aldabra) and by Hirth and Carr in South Yemen. However, the young of the Lacépède Island colony, from hatchling through yearling stages, are superficially indistinguishable from comparable stages of typical *Chelonia mydas mydas*.

Pending a much-needed careful taxonomic study of the major green turtle nesting colonies of the world, it seems reasonable and practically useful to use the name *japonica* for *Chelonia* in the Indian Ocean and western tropical Pacific. This form meets *agassizi* somewhere in the Central Pacific islands. What to call the very *mydas*-like turtle of the Barrier Reef is not clear.

The type locality of *Chelonia mydas* is Ascension Island. To that population alone the name *Chelonia mydas mydas* will no doubt one day be restricted. At present no clear distinction can be made between the island population and the Caribbean colony at Tortuguero, Costa Rica, but a host of small differences—morphometric, behavioral and even physiological—appear to exist. Once these have been clearly demonstrated, and trenchant differentiation of the Ascension and Tortuguero green turtles is shown, the latter will be designated *Chelonia mydas viridis* (Schneider) and both it and *mydas* will automatically lay claim to endangered status.

Acknowledgments

This research was supported by the National Science Foundation (Biological Oceanography

Program, current grant GA 36638) and the Caribbean Conservation Corporation. For assistance in arranging travel to Ascension, or in providing quarters and transportation on the island, I am grateful to officials and personnel of the Ascension Island Administrator's Office; British Cable and Wireless, Ltd.; the Ascension Historical Society; the American Military Base at Ascension; and the Down Range Affairs Office of Patrick Air Force Base, Cocoa Beach and Ascension Island. For able collaboration in field work I owe much to Harold Hirth, Thomas Carr, Perran Ross, Stephen Carr, Stephen Stancyk, David Carr, Roger Hannay and Kim Critchley. Peter Critchley of Ascension has been unfailingly kind to the tagging teams of more than a decade. During the past two seasons Marlin Simon of Mariculture, Ltd. has made substantial contributions to the Ascension tagging program. Since the earliest days of the study Melquiades Pinto Paiva, Director, Estação de Biologia Marinha, Ceará, Brasil has been extremely helpful in furthering our tag recovery efforts in Brazil.

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