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Last Chance For the Sea Turtle

By Archie Carr

Scientists are working to plug the gaps in our knowledge of the life of the sea turtle—and to save it from extinction

Never in the memory of the Torres Strait islanders had the big sea turtles failed to arrive for their yearly nesting on the beaches of Bramble Cay, 75 miles (120 kilometers) north of Cape York, Australia. Every year, hundreds of female green turtles, some of them weighing as much as 400 pounds (180 kilograms), dragged themselves onto the sandy beaches. They would make their way onto the shore and each one would dig a shallow hole in the sand with her flippers and lay her spherical eggs in it, usually as many as 100 or more. This done, she would carefully fill the hole, pushing in sand with her hind flippers to cover the eggs and throwing sand about with her front flippers to conceal the site. Then she would crawl ponderously back to the water. Each female might repeat this process several times, then disappear until the next nesting season, leaving the many turtle eggs to hatch in the warm, moist sand.

But in 1975 only a few sea turtles came back to Bramble Cay, and the turtle hunters who live on the neighboring islands of Torres Strait –which lies between Australia and New Guinea–are worried. Their lives have long been interlocked with the annual cycle of the green turtle. It provides them with meat and eggs to eat. The mysterious failure of the turtles to appear for the annual nesting poses a serious threat to these islanders' food supply.

With the help of the Australian government, the Torres Strait islanders had been trying for several years to develop small turtle farms to provide a constant supply of these animals, whose meat would go into international trade. On some of the islands, the farms were stocked with eggs taken from the huge Bramble Cay nesting ground. But in 1975, for the first time, Bramble Cay could not provide nearly enough eggs for the turtle farms.

Nobody has the vaguest idea why the turtles failed to appear. Something must have happened to them either in their home feeding grounds or along their migratory routes to Bramble Cay. Since nobody knows where the turtles go when they leave the beach, there is nothing the islanders or anybody else can do but hope that the failure of the nesting is only temporary, that it does not signal the disappearance of the green sea turtle as a breeding visitor to their islands.

One colony of another kind of green turtle, one known as the East Pacific black turtle, will probably disappear forever if fishermen using scuba-diving equipment continue to kill its members in great numbers. Scientists only recently learned that these turtles hibernate in the Gulf of California, between Sonora state and Baja California in Mexico, lying half-buried in the bottom mud during winter months. This was the first evidence that any kind of sea turtle hibernates.

However, the Seri Indians, a primitive hunting and fishing tribe in Sonora, have known for a long time that these turtles hibernate, and they have adapted accordingly, spearing the sleeping reptiles with long harpoons from boats. But in 1972, Mexican fishermen with scuba equipment and motorized boats also found the hibernating grounds. Now they are rapidly wiping out the unique turtle colony–and with it, the meat supply of the Seri Indians.

Human destruction cannot be blamed for the crisis facing another species of sea turtle, the huge leatherback. These turtles nested for many years on the Organabo beach along the French Guiana coast, 90 miles (145 kilometers) northwest of Devils Island. That leatherback nesting site, which may have been the largest in the world, was found only in 1968 by zoologist Peter Pritchard of the Florida Audubon Society. In 1975, ocean storms devastated the shore at Organabo, leaving no suitable sand for the leatherbacks to nest in. Turtles frustrated in their nesting sometimes shift to another shore. Sometimes they drop their eggs in the water, where no young can hatch. What most of the Organabo colony of leatherbacks will do when their next egg-laying season comes remains to be seen. Some apparently found

The author:
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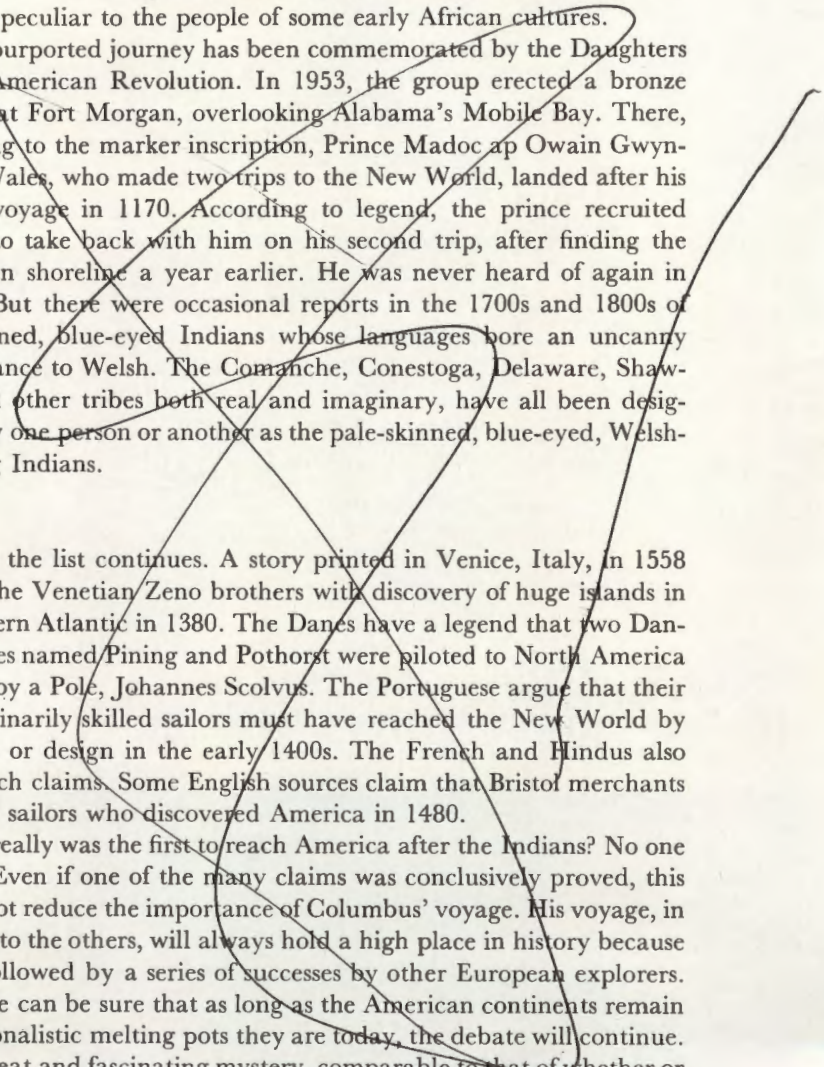
animals otherwise unknown to the Old World before Columbus. They included "a gigantic gourd big enough to feed 20 to 30 people"—presumably a pumpkin—and "a tall sheep with a tail as broad as a fan"—probably a guanaco, a South American animal related to the llama.

West Africa has also found support as a starting point for pre-Columbian explorers. The early Arab historian Ibn Fadi Allah al-Omari reported two expeditions into the Atlantic by sailors from the Mali Empire during the early 1300s. The historian's text is not clear on whether the sailors reached the New World, but American anthropologists have found skeletons in the Virgin Islands predating Columbus that resemble those found in Africa. In February 1975, for example, Smithsonian Institution scientists reported that the teeth of an individual buried in the Virgin Islands in 1250 had been broken in a ritual manner peculiar to the people of some early African cultures.

One purported journey has been commemorated by the Daughters of the American Revolution. In 1953, the group erected a bronze marker at Fort Morgan, overlooking Alabama's Mobile Bay. There, according to the marker inscription, Prince Madoc ap Owain Gwynedd of Wales, who made two trips to the New World, landed after his second voyage in 1170. According to legend, the prince recruited settlers to take back with him on his second trip, after finding the American shoreline a year earlier. He was never heard of again in Wales. But there were occasional reports in the 1700s and 1800s of fair-skinned, blue-eyed Indians whose languages bore an uncanny resemblance to Welsh. The Comanche, Conestoga, Delaware, Shawnee, and other tribes both real and imaginary, have all been designated by one person or another as the pale-skinned, blue-eyed, Welsh-speaking Indians.



And the list continues. A story printed in Venice, Italy, in 1558 credits the Venetian Zeno brothers with discovery of huge islands in the western Atlantic in 1380. The Danes have a legend that two Danish pirates named Pining and Pothorst were piloted to North America in 1476 by a Pole, Johannes Scolvus. The Portuguese argue that their extraordinarily skilled sailors must have reached the New World by accident or design in the early 1400s. The French and Hindus also make such claims. Some English sources claim that Bristol merchants financed sailors who discovered America in 1480.

Who really was the first to reach America after the Indians? No one knows. Even if one of the many claims was conclusively proved, this would not reduce the importance of Columbus' voyage. His voyage, in contrast to the others, will always hold a high place in history because it was followed by a series of successes by other European explorers.

But we can be sure that as long as the American continents remain the nationalistic melting pots they are today, the debate will continue. It is a great and fascinating mystery, comparable to that of whether or not beings from other planets ever visited the earth, but it is a mystery with many more clues and intriguing details.

The Five Kinds of Sea Turtles: What They Weigh and How Big They Are

Leatherback turtle
Dermochelys coriacea
54 to 70 inches (137 to 178 centimeters)
650 to 1,200 pounds (295 to 544 kilograms)

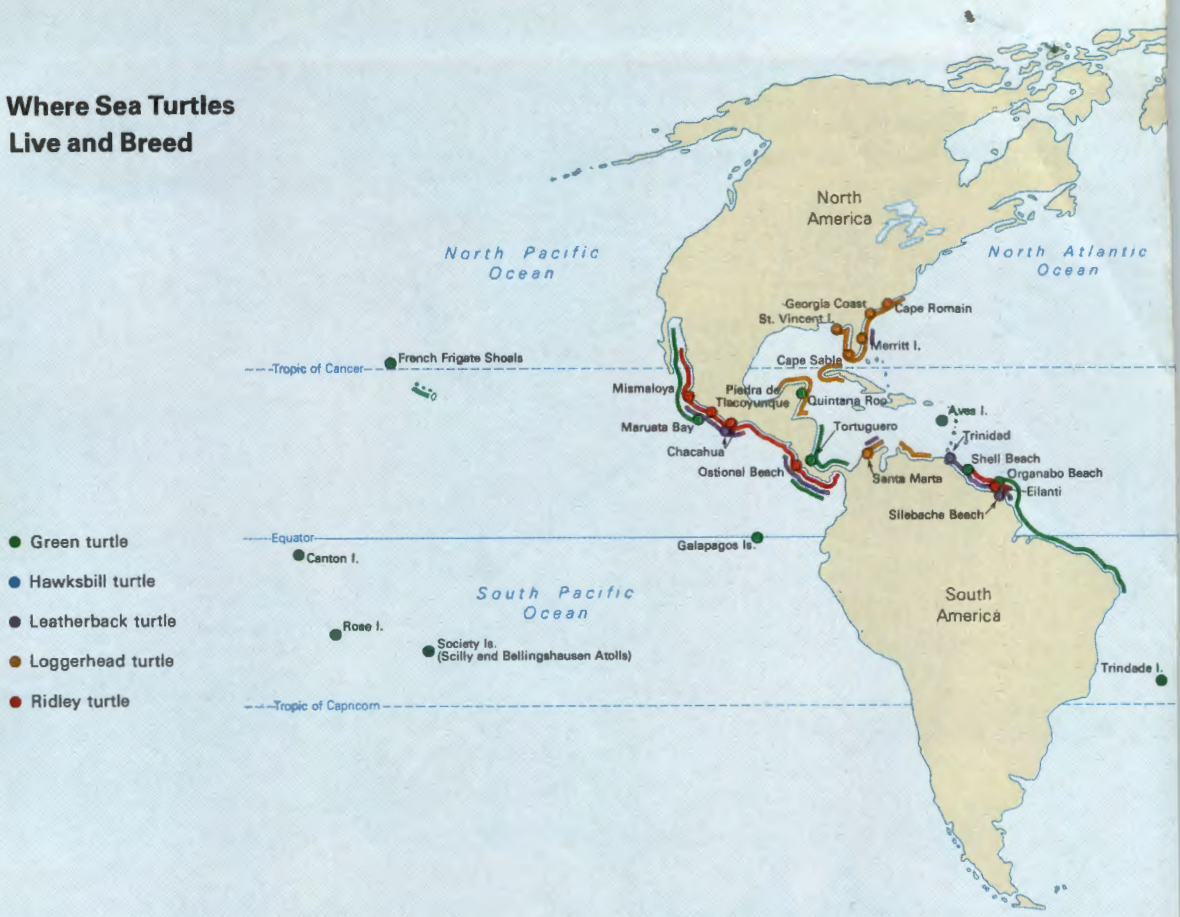
Green turtle
Chelonia mydas
36 to 48 inches (91 to 122 centimeters)
250 to 450 pounds (113 to 204 kilograms)

Hawksbill turtle
Eretmochelys imbricata
30 to 35 inches (76 to 89 centimeters)
95 to 165 pounds (43 to 75 kilograms)

Loggerhead turtle
Caretta caretta
31 to 45 inches (79 to 114 centimeters)
170 to 350 pounds (77 to 159 kilograms)

Ridley turtle
Lepidochelys olivacea
23 to 28 inches (58 to 71 centimeters)
80 to 100 pounds (36 to 45 kilograms)

Where Sea Turtles Live and Breed



Sea turtle feeding areas (shown by lines on map) and breeding sites (dots) are diminishing as turtle hunters find and exploit them. Scientists know little about the routes turtles take between the living and breeding areas, and there may be many areas that are not known.

their way to other beaches along the coast of Surinam, west of French Guiana, to nest during the 1976 season, but it is still too early to determine how disastrous the beach washout has been to the total leatherback population.

For centuries, men have marauded the sea turtle's nesting grounds without eradicating the species, though the harvest of meat, eggs, skin, and shells destroyed many turtle colonies completely. But today the turtles are being killed in much greater numbers. René Márquez, a sea turtle biologist in Mexico, estimates that the Gulf ridley species has dwindled to fewer than 5,000 females from 40,000 in 1947.

It is now clear that the very existence of the sea turtles is being threatened by people seeking profit from the harvest. Turtle steaks–especially those of the green turtle–grace the menus of growing numbers of gourmet restaurants. Soup made from the shell cartilage, or calipee, has long been a prestige dish. Some turtle hunters have even been known to remove only the cartilage from their killed turtles, throwing the rest of the animal away. Turtle skins are tanned and used for expensive shoes and handbags. Turtle oil is promoted as an ingredient of cosmetic lotions. And turtle shells are made into jewelry and are used for inlaid furniture.

A fundamental factor in the present predicament of sea turtles is that they nest in large groups on limited sections of shoreline, where they are particularly vulnerable to human and animal predators who kill them and steal their eggs. There was a time when they were relatively safe when they were out in the ocean, away from shore. But today even the open sea is unsafe. Shrimp trawlers, a fast-growing menace to all the species, inadvertently kill sea turtles that become trapped in their nets. Most modern trawlers drag much larger nets along the ocean floor today than they did 20 years ago, and they leave them in the water longer. Sea turtles that are accidentally caught in these nets often suffocate because they cannot escape and swim to the surface to get air.

Sea turtle populations are declining so rapidly that the United States Department of the Interior placed all species on the threatened and endangered species list in 1976. The International Union for the Conservation of Nature and Natural Resources also lists all of them as either threatened, endangered, or rare.

There are five distinct kinds, or genera, of sea turtles–leatherback, green, ridley, hawksbill, and loggerhead–and some of them have more than one species. The leatherback is the largest sea turtle, weigh-

Polynesian fishermen drag big sea turtles onto the beach, *below.* Then they remove the meat to prepare a feast, *bottom.*

ing from 650 to 1,200 pounds (295 to 544 kilograms) when fully grown. It can be distinguished from the other sea turtles by its body covering–which, instead of a hard shell composed of separate plates, is a leathery surface with seven bony ridges running the length of its back and five along its belly. Until it was washed out, the Organabo beach was the largest known leatherback nesting area. The largest known nesting site now is one on the South China Sea coast of the Malay Peninsula. Leatherback eggs are collected there by Malaysians and auctioned off as a gourmet item.

There are three recognizable forms of green turtles–the worldwide, the black turtle of the eastern Pacific, and the Australian flatback. The largest nesting ground for the worldwide type is probably one recently discovered by zoologists in northern Queensland, Australia. That colony is well protected. Green turtles are not as well protected in the Caribbean, where commercial interests have built large turtle-freezing plants. The demand for turtle meat, which is frozen for sale in Europe, North America, and Japan, is increasing, and the turtles are netted and harpooned in growing numbers on the important feeding ground in Nicaragua and even off the big nesting beach in Costa Rica.

There are two species of ridleys. The olive ridley, sometimes called the Pacific ridley, lives mainly in the Indian and Pacific oceans. H. Robert Bustard, a British zoologist who works in India, has recently located an enormous nesting site of the olive ridley near Wheelers Island in the Bay of Bengal on the Orissa coast of India. These turtles also nest on the coast of West Africa, on the Pacific coast of Costa Rica, and on the Atlantic coast of Guyana. The Gulf ridley, sometimes called the Atlantic ridley, nests only on the Tamaulipas coast of Mexico, north of Tampico.

The two largest hawksbill nesting areas are on a little island off Yemen (Aden) in the Gulf of Aden and in Torres Strait. The most important loggerhead nesting is on United States, Australian, and South African shores, though some leave their eggs on beaches in Colombia, Cuba, and a few Pacific sites. The loggerhead is the most frequently seen sea turtle in Florida, where some of its nesting beaches are being disrupted by land development.

Sea turtles could probably live to be 100 years old if human beings would let them. Once they

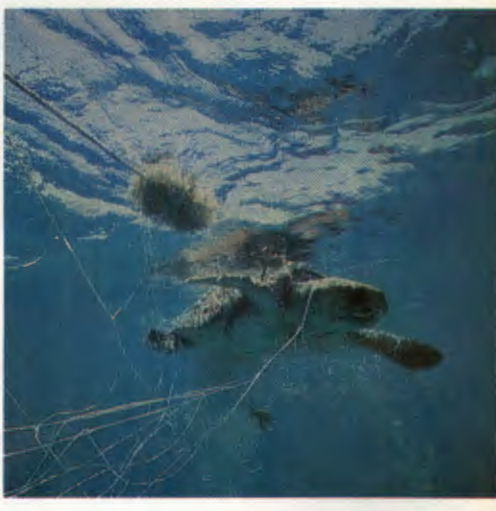
grow to adult size, few natural predators attack them. Each female is capable of laying several hundred eggs, usually every two or three years–though in some cases, at one- or five-year intervals. Sea turtles lay their eggs at night. As a female nears the shore to make her nest, she pauses in the shallow surf wash before moving up onto the sand. She is nervous, and any unnatural sound or sight will send her out to sea again. When she is finally satisfied that the beach is safe, she lumbers across the beach to the edge of dunes or beach vegetation. Laboriously, she thrashes out a depression to rest in while she lays her eggs, then delicately scoops out an urn-shaped nest hole with her hind flippers and drops her eggs into it. She may come up onto the beach to nest several times during one laying season, which may last more than two months.

The eggs hatch about two months later. The little hatchlings scramble out of their sandy nest and instinctively head for the water, even though it may be hidden from their view by dunes, debris, or beach vegetation. They are in great danger at this time, easy prey for raccoons, crabs, vultures, frigate birds, and other beach predators. And the hatchlings that finally get to the water run the risk of being eaten by sharks and other fish that cruise close to the shore. Those few baby turtles that survive and manage to reach the safety of the deeper water disappear for almost a year. Nobody knows where they go. That is one of several mysteries of sea turtle life yet to be solved.

Most of what scientists know about the behavior and ecology of sea turtles has been learned by observing and marking the mature females when they come ashore to nest. They are marked with small metal tags that bear an address and sometimes an offer of a reward for the tags' return. The tags are clipped through the skin of one of their front flippers. Tagging does not harm them, and the tags can be identified on later encounters. The travels of turtles tagged on a single beach can be slowly pieced together when the tags are returned by fishermen and turtle hunters, and when the turtles return to the nesting beach.

We have been tagging members of a green turtle colony at Tortuguero beach in Costa Rica for 21 years, and each year we learn more about the turtle's life cycle. For example, we have found that when the Tortuguero turtles return to the beach, it

Poachers who rob their nests, *below,* and shrimp nets that trap and drown them, *bottom,* are two threats to the survival of the world's sea turtles.



Hundreds of olive ridley turtles crawl onto a Pacific beach to lay eggs, *above.* Predators are not the only hazard that nesting turtles face. A leatherback is trapped by driftwood, *right,* as it heads back to the sea.

is usually surprisingly close to previous sites–rarely more than a few hundred yards or meters from the spot where they nested before. The precision of this site fixity varies somewhat with the changing condition of the beach, however.

Tagging also provides data on remigrations–returns to the same beach in later seasons. We learned years ago that most of the Tortuguero turtles, like those then being studied on the islands in the South China Sea off Sarawak, Borneo, return to lay eggs every three years. However, we also found that a smaller group comes back every two years. And later on we learned that individual turtles can change their nesting interval from two to three years, or vice versa. A growing number of four-year absences suggests that there may be a minor cycle that long or even longer. However, no Tortuguero turtles have ever been found that nest each year.

Our tagging at Ascension Island has revealed similar cycles for the turtles that nest there. But other zoologists report that green turtle colonies they studied include some females that nest every year. This variability undoubtedly has an important bearing on the ecology and survival of a turtle colony, but we cannot explain its causes.

Nevertheless, our knowledge of sea turtle breeding habits has grown faster than our understanding of any other aspect of their life. There is only one way we can learn where green turtles that show up at the breeding ground have come from and where they go, and that is by collecting the tags sent in by the fishermen who harpoon or net them. By then, the turtle has been eaten or sent to market–so that is the end of its record. As a result, we must work back to the breeding place from the locations of returned tags to determine whether females from various places behave and nest differently, and we are only now beginning to have enough returned tags to let us make any helpful guesses.

Perhaps the most puzzling gap in our knowledge is where the young sea turtles live during the first year after they enter the sea. They might be expected to stay in shallow coastal waters. However, exhaustive searching and innumerable interviews with fishermen have failed to produce any evidence of that. The most plausible assumption now appears to be that they swim out to sea and live in the mats of brown sargassum weed that drift with ocean currents. This theory presupposes that the hatchlings that get through the surf can swim far enough on a proper course to reach the currents that carry these mats of weeds. Hatchlings do not need to eat for the first few days of life; they live off the stored yolk in their bodies. The sargassum mats would provide them with both food and refuge from predators. No systematic search for little turtles has yet been made in sargassum mats, but each year a few loggerhead hatchlings are found in or around the mats that drift in the Gulf Stream off the nesting beaches on the lower east coast of Florida. Baby turtles of all species are involved in this lost-year mystery, so huge numbers of them must be hiding somewhere.

One way to get clues to solve this mystery is to trace the paths taken

A green turtle digs a pit in the sand, *above,* then lays her eggs there, *right.* After the babies hatch and dig their way out of the sand, *far right,* they head for the sea, *below.*

by turtles. The green turtle, for example, shares Ascension Island with the sooty tern as well as other birds that make long migrations to get to the island. When two kinds of animals show up on schedule at the same speck of rock in a trackless spread of ocean, we are tempted to look for a common guidance system. Obviously, however, birds cannot be guided over water by their sense of smell, however keen it might be. Aroma-carrying air currents are too erratic. Predictable water currents are the only possible smell-taste carriers for such tremendous distances, and these are available to the turtles but not to the birds.

Continued theorizing is not likely to solve this engrossing mystery. Some progress could probably be made by laboratory experiments. It would be interesting to know, for example, whether green turtles can detect changes in magnetic fields or can maintain a constant heading from a simulated moving sun. The most needed experiments, however, are tracking tests to trace the exact paths taken by turtles migrating across open sea. The green turtle is particularly suitable for open-

Scientists staple a metal identification tag on a flipper, *below,* and weigh the turtle, *below right,* in charting a record of its size and travels. Some turtles get numbers on their shells, *bottom.*

by hatchlings as they swim out to sea. Jane Frick, a young zoologist working at Nonesuch Island in Bermuda, has followed them for long distances by swimming after them. Day after day she swam behind them for hours at a time, tracking some of them as far as 6 miles (10 kilometers) from shore. She has found that the hatchlings can swim for hours, and probably days, on courses that take them directly away from shore. What guides them is unknown, but the paths they take obviously remain oriented long after they move out of sight of fixed landmarks. Because this ability to swim straight away from the shore would eventually take the hatchlings into a mat-bearing current, the studies seem to lend weight to the sargassum-mat theory. Although these studies were made only with green turtles, I think it is reasonable to conclude that hatchlings of other species also live in the current-borne mats.

Another baffling gap in our understanding of the natural history of sea turtles is what guides mature turtles across great expanses of open ocean to gather, on schedule, at specific places to breed. Turtles that nest on a mainland shore are no doubt helped in their search for their nesting ground by landmarks along the coast, underwater bottom conditions, and the different kinds of water that flow into the sea from coastal streams. However, circumstantial evidence indicates that there is much more to the guidance process than that. Scientists know that olive ridley turtles mass in enormous groups, or schools, far out at sea and then move along the shore, sometimes for great distances, to the point on the shore where they nest. Nobody knows how these sea bands form, or even where the turtles come from.

The green turtle's breeding journey is different. Its nesting aggregations are less concentrated than those of the olive ridley, and individuals seem to arrive at the nesting area separately or in small groups. But we do not understand how green turtles locate the breeding shore, and their precisely scheduled arrival at tiny islands after they have traveled hundreds or thousands of miles or kilometers in the open ocean is a classic puzzle.

So far, about all we have been able to do is identify some conceivable explanations. These include *celestial navigation* (taking direction from the stars and sun); *Coriolis force* (sensing differential rotation of the earth with changing latitude); some kind of internal inertial-guidance system that might resemble a ship's gyroscope; random searching; effortless drift with the ocean currents; *chemoreception* (the smell-taste kind of perception)—or perhaps a combination of two or more of these. My own unenthusiastic choice of a mechanism that may guide one group of turtles that cross the vast stretches of ocean between Brazil and their nesting ground at Ascension Island is a combination of chemoreception and celestial navigation. This is not really a good theory; it merely seems less preposterous than any of the other theories that have so far been proposed.

One weakness in it is that birds also nest on most of the islands used

Hungry crabs waiting on the beach and birds that swoop down from the sky take their toll before the newly hatched baby turtles can reach the sea.

ocean tracking experiments, because it travels slowly, stays at or near the surface, and breathes air. It also is big enough to tow tracking buoys or to carry substantial packages of instruments without any seeming inconvenience.

The instruments may be attached to floating buoys that are tied to the turtles by long lines. The turtles pull the buoys through the water with no apparent discomfort. Instrument packages can also be attached directly to a turtle's back, and if these operate properly, a tracking airplane or satellite can pick up the signals when the animal surfaces every few minutes for air.

We learned long ago that when you move a female green turtle away from her nesting ground before she has finished nesting, she will stubbornly return. We have also shown that the turtles are not hindered by a towline and buoy fastened to their shells. So radio tracking should be the ideal way to test the chemoreception-celestial navigation theory of island-finding navigation. One group of instrumented turtles at Ascension Island could be moved downstream in the current that flows past the island toward the Brazilian coast, and another group could be placed away from and across the flow of the current from the island. If the downstream group showed clear superiority in getting back to Ascension, we could conclude that they were responding to chemoreception from the island. But if the turtles placed across the current were the most successful at getting back, the chemoreception theory could be ruled out. If, in other tests, the ability of the turtles to find their nesting area should decrease during darkness or when skies are overcast, celestial navigation would likely be a major guidance component. Special sensors in the instrument package could transmit data on depth, temperature, speed, and other factors. All of this would give us a firm basis for evaluating the various navigation theories, if only a record could be kept over long periods of time and for many turtles. So far, however, a dismal series of instrument failures has held up progress in this promising research.

While radio tracking may help us explain the mechanisms involved in turtle migration, it will not solve the mystery of how natural selection was able to produce a green turtle that lives and feeds most of the time directly off the northeast coast of Brazil and then makes a 1,200-mile (2,000-kilometer) trip eastward to tiny Ascension Island to lay its eggs. The green turtle does this even though there are beaches suitable for egg laying on the mainland not far from the feeding grounds. No matter what sensory mechanisms guide such a journey, it is puzzling how evolution could have given rise to a strain of animals that travel so far to breed when there are equally good nesting grounds nearby.

The solution to this mystery may lie in the geologic process of sea-floor spreading. About 100 million years ago, when the turtles' urge to nest was probably established, the islands they used may have been within hailing distance of the Brazilian coast. But as sea-floor spreading widened the South Atlantic and the distance between South

Attendants bury olive ridley eggs at a hatchery on a Surinam beach, and later release the babies hatched from the eggs.

America and Africa increased, the islands moved farther out to sea. Consequently, as time passed and the spreading sea floor grew to its present dimensions, the turtles would have had to swim a bit farther each breeding season. As a result of this slow, gradual change, evolution produced a strain of green turtles with both the urge and the ability to migrate to the distant islet.

Of all the problems that sea turtles present, their poor survival outlook is the most urgent. Anxiety over their decline is growing, and people are clamoring for ways to save them. The fact that they are now on official endangered species lists has slowed, but by no means stopped, international trade in turtle products. The most important immediate need is for more breeding sanctuaries and better enforcement of turtle laws everywhere. Everything possible should be done to free every nesting colony from exploitation and interference. It is the human turtle-egg robbers and the human turtle hunters that are causing the most destruction to these ancient animals. Along shores where people are settling, or in remote places such as Aves Island in the Caribbean Sea off Guadeloupe or the Lacepede Islands in the Indian Ocean off northern Western Australia, it is difficult for government authorities to prevent illegal poaching. Nevertheless, effectively protected breeding sanctuaries appear to be the single best hope for the survival of the sea turtle.

Other than protecting sea turtles against human exploitation, the only management techniques that seem to hold any promise are either incubating eggs in hatcheries where they will be safe from predators, or trying to establish new turtle-nesting sites, or rearing young turtles

until they are so big that predators of hatchlings are no longer a menace to them when they are released.

In places where predators are numerous, moving eggs to protected hatching sites seems reasonable, if great care is used in handling them. Such egg hatcheries have been established on the coasts of Florida, Georgia, and South Carolina, and in various other parts of the world. Transplanting eggs or young turtles in order to establish new colonies or rehabilitate old ones is a possibility based on the assumption that the hatchlings will return to the new hatching site—not the one where the eggs or baby turtles came from—when they have reached sexual maturity. A long-term experiment to determine whether this is feasible is now in progress on beaches in Bermuda.

Rearing young turtles for a year or so until they are so big that the host of hatchling predators are no longer a menace is known as head-starting. The only way to test the effectiveness of such a project is to tag the young turtles when they are released, and see how many are recovered—and under what circumstances. Preliminary findings from such studies suggest that much depends on the kind of place in which the yearlings are released. None of the several hundred yearlings released off Costa Rican beaches have been heard from. Those that are released in lagoons, bays, or reef-protected water have a better chance of survival. Recoveries of tagged yearlings released in Bermuda, Surinam, and elsewhere are more encouraging. On the other hand, there have been some interesting returns from a project at Stuart, Fla., where yearlings are released on open sea beach. So much remains to be learned before head-starting should be recommended for widespread use as a conservation technique for sea turtles.

It once seemed that turtle farming, using natural turtle grass to feed stock kept in pens or pastures along the shore, might satisfy the commercial demand for green turtles and thus save them from extinction. The belief was based on the assumption that the first farms would be nonprofit, experimental projects that would not attempt commercial production until pilot studies showed that such

Her nesting finished, a female green turtle lumbers slowly across the beach to the sea.

farming would be feasible. Meanwhile, pen-reared breeding stock could be developed to furnish all the eggs needed to maintain production and eventually even to provide a domesticated strain of sea turtle distinct from all wild stock. While this was going on, a realistic marketing analysis would be made to determine if such an enterprise would be profitable without having to create new demands and outlets for turtle meat and other turtle products.

Although these rearing, pasturing, and marketing conditions have not been met, turtle farmers claim that their efforts will help save the green turtle from extinction. They say that mass production will saturate markets for turtle products, prices will drop, and the hunting of wild turtles will decline.

Most of the eggs for hatcheries and head-starting pens are now taken from natural turtle sanctuaries. Proponents say that the eggs are taken only from badly placed nests that would otherwise be washed out by high waves or raided by predators. But it seems unlikely that such doomed nests could supply enough eggs for a growing industry. The turtle farmers also say that eggs for commercial turtle farming will soon be produced on man-made beaches by turtles that have been reared in breeding pens. Although no farm has yet reached that stage, advances have been made. A few pen-reared turtles have reached maturity and are nesting on artificial beaches. However, there remains serious doubt that the volume of eggs required for a profitable large-scale commercial operation can be produced.

As an effort to justify taking eggs from natural sanctuaries, turtle farmers release a certain number of pen-reared, head-started yearlings at the original nesting ground. They say that each returned yearling, which has a better chance of escaping predators, is the equivalent of hundreds of eggs removed. It is possible that this is true. But there is no statistical evidence to show that it is, and so we must await the accumulation of tag recoveries in numbers sufficient to show that head-started turtles survive, breed, and return to the nesting beaches from which the eggs were taken. Without such proof it seems unwise to raise false hopes by recommending either head-starting or turtle farming as conservation practices.

The most effective way to save sea turtles would be to stop all commercial exploitation of such animals. Market hunting–legal and illegal–results in huge amounts of turtle meat, shell, and leather being shipped or smuggled from one country to another each year. Setting up more breeding and feeding sanctuaries and giving those that exist better protection than they are now getting would also help. But to do this is not simple. It is much easier to comfort ourselves by protecting a few hundred nests from predators, or by releasing a few thousand head-started yearling turtles from time to time. If they could get better protection of their natural breeding and foraging habitats, there might still be time to cure the other ills that make it so hard for sea turtles to live in the same world with human beings.