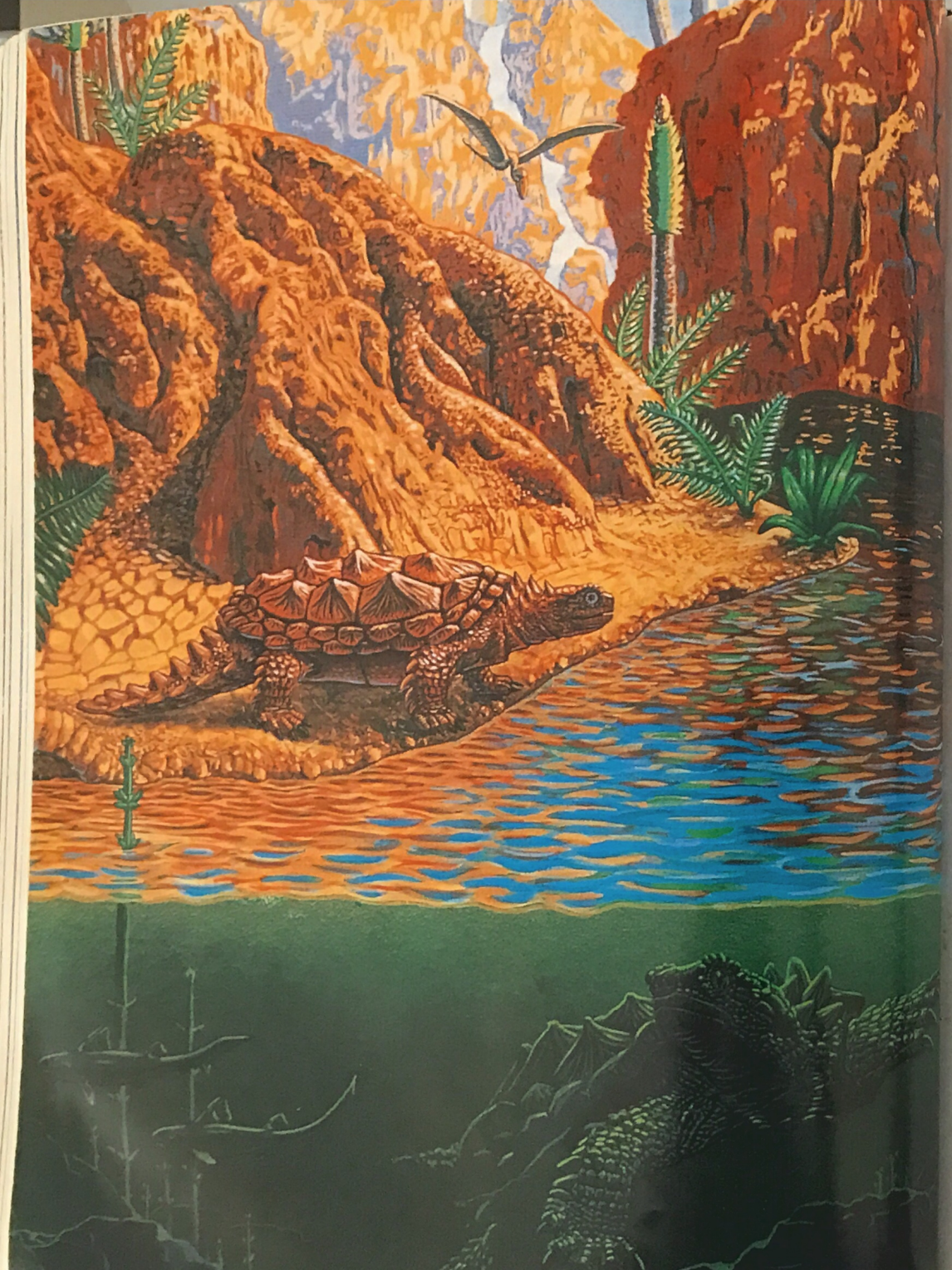


The first reptiles arose in the Pennsylvanian Period about 300 million years ago. These animals looked like big stocky lizards and gave rise to many groups, including the mammals, crocodiles, dinosaurs, marine reptiles, lizards, and turtles. The first turtle fossils lie in 220-million-year-old sediments from the Triassic Period in Germany and in sediments from about the same time in Greenland and Thailand. The distribution of these fossils, even considering the subsequent movement of continents, suggests that turtles were widespread during this era. They became successful in the Triassic and in most regards have not changed much since then.

If you had walked along the edge of a lake 200 million years ago and encountered one of the early turtles, you would have seen *Proganochelys*, an animal that looked much like a snapping turtle does today. *Proganochelys* is the earliest known fossil turtle. It was large for a freshwater turtle, approaching three feet in total length with a shell about two feet long. It had the classic components of a modern turtle—an obvious carapace and plastron, and a skull with a horny beak. A few small teeth remained in the roof of the mouth, but they were soon lost as subsequent generations proceeded through the evolutionary process.

The scutes on the carapace of *Proganochelys* were raised into points and the neck and tail had small spikes, all of which probably offered some much-needed protection. *Proganochelys* lived in shallow, swampy lakes with phytosaurs (ancient crocodile-like reptiles), labyrinthodonts (six-foot-long amphibians that looked like oversized stocky salamanders), and predatory fish. Prowling the edges of swamps were plateosaurs (early dinosaurs that walked upright on two legs).

*Proganochelys* literally pops into the fossil record as a completely formed turtle. Its immediate ancestors are unknown and there is no known transitional animal between other reptiles and turtles. Given that early turtles lived in the water and their shells would readily fossilize in the mud, it is puzzling that no fossils of turtle precursors exist. The hard shell of a turtle enveloped in muddy sediments without oxygen would have been preserved and eventually would have turned to stone. Theories and debates abound. Some scientists think turtles arose in the late Permian Period, about 260 million years ago, directly from the ancient stem reptiles that

Previous pages: *Archelon* was one of the largest sea turtles that ever lived. With a total length of up to 15 feet (4.6 m) and a head more than 3 feet (1 m) long, *Archelon* had a flipper span of 16 feet (4.9 m). This specimen is in the Peabody Museum at Yale University.

Opposite: Painting of *Proganochelys* during the Triassic, by Frank Ippolito. *Proganochelys* was an early turtle that lived in freshwater swamps at the same time that early dinosaurs and primitive fishes inhabited the earth.

## Geological Timescale

| Era | Period | Epoch | Age (millions of years ago) | Major Biological Events |
|---|---|---|---|---|
| Cenozoic | Quaternary | Recent | 0.01 | Historical time |
| | | Pleistocene | 1.8 | Ice ages; humans appeared |
| | Tertiary | Pliocene | 5 | Apelike ancestors of humans evolved |
| | | Miocene | 23 | Continued radiation of mammals |
| | | Oligocene | 35 | Origin of many primate groups |
| | | Eocene | 57 | Angiosperms and mammals dominated |
| | | Paleocene | 65 | Major radiation of birds and mammals |
| Mesozoic | Cretaceous | | 145 | Angiosperms first appeared; mass extinction of many organisms including dinosaurs; modern sea turtles appear |
| | Jurassic | | 206 | Dinosaurs were abundant and diverse; first birds evolved; early sea turtles |
| | Triassic | | 245 | Gymnosperms dominated landscape; radiation of dinosaurs; evolution of first true mammals; first turtles appear |
| Paleozoic | Permian | | 290 | Radiation of reptiles; mammal-like reptiles evolved and most modern insect orders; mass extinction of marine organisms and amphibians |
| | Carboniferous | | 360 | Extensive forests; first seed plants; amphibians dominant and first reptiles evolved |
| | Devonian | | 410 | Diversification of bony fishes; first amphibians and insects evolved |
| | Silurian | | 440 | Diversity of jawless fishes; first jawed fishes and diversification of early vascular plants |
| | Ordovician | | 510 | Colonization of land by plants and arthropods |
| | Cambrian | | 540 | Radiation of most modern animal phyla; origin of the earliest vertebrates occurred |
| Precambrian | | | 4,600 | Earliest traces of life; the oldest fossils of cells; the evolution of invertebrates occurred |

looked like small lizards or dinosaurs. Others suggest a relationship with a later group of reptiles.

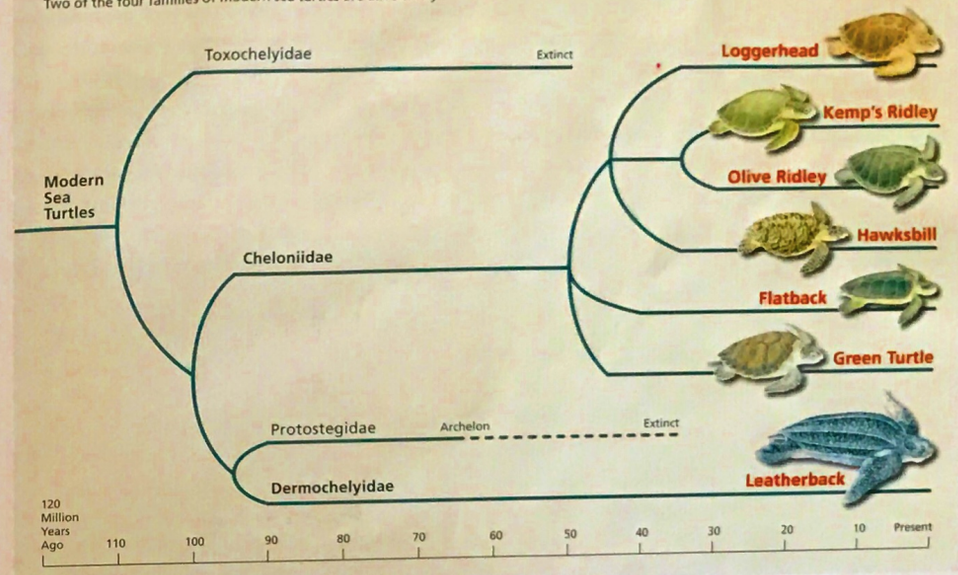
### A Quick Change

The absence of fossil links is probably best explained by the theory that turtles arose very quickly in the Triassic Period and that their immediate ancestors did not live in water so they did not make good fossils. But what could have caused such a rapid change in the reptile line? The most recent research in molecular biology suggests that a change in only one or two genes that control the development of bone cells in the body could have led to the formation of the turtle shell. We know that there are a group of genes, called HOX genes, which control major pathways of development in an embryo. Loss of function by one such gene, for example, led to the loss of teeth in birds (and probably turtles as well). An increase in function of one or two controlling HOX genes may have caused the formation of the carapace and plastron that define the turtle. Since the shell of *Proganochelys* is very similar to that of a modern turtle, it is likely that the change from a stocky, lizard-like animal to a turtle happened in one or two evolutionary leaps.



## Sea Turtle Relationships

Modern sea turtles arose in the Cretaceous Period and are the descendants of an ancient line of marine turtles. Two of the four families of modern sea turtles are alive today.




The added protection of the shell was a great advantage for turtles and most species have not experienced much evolutionary tinkering with that part of their body. The internal structures and the limbs, neck, and head have changed considerably, but the shell remains the same today as it was 200 million years ago.

### The First Sea Turtles

Turtles moved into and out of the oceans several times beginning in the Jurassic Period and into the Cretaceous. These explorers had body forms more like modern freshwater turtles than today's sea turtles, but displayed varying degrees of change, an example being that their limbs formed into flippers. Through evolutionary time, these turtle species came and went. Some were widespread and very successful, but eventually their lineages died out owing to changing environmental conditions or competition with other aquatic animals. By the end of the Cretaceous, the only turtles left in the ocean were from a new lineage.

Modern sea turtles arose about 110 million years ago in the ancient oceans. The oldest fossil of a sea turtle descendant is *Santanachelys gaffneyi*, a specimen found in eastern Brazil from the Early Cretaceous Period about 110 million years ago. It is a fossil of a small sea turtle, about the size of a dinner plate. It seems to have been

a transitional body form, looking somewhat like a sea turtle and somewhat like a freshwater species. Well on the evolutionary path toward the sea turtles we see today, *S. gaffneyi* had relatively primitive, paddle-like front limbs and, unlike its descendants, it still had movable toes. Like today's sea turtles, it had a hard shell and large head as well as something no sea turtle can live without—large spaces in the skull that housed salt glands.

The ocean that this little turtle entered was a forbidding place, filled with predatory fishes, sharks, and now-extinct reptilian predators such as ichthyosaurs, mosasaurs, and plesiosaurs. It was a tough, dangerous world, but *S. gaffneyi* had the advantage of a shell as hard as a rock. *S. gaffneyi* made it through that treacherous beginning and eventually diversified into four distinct types of sea turtles, each sufficiently different that taxonomists have classified them as the four families of prehistoric sea turtles.

Above: *Toxochelys* was an early sea turtle that measured about 24 inches (60 cm) long and had a broad shell. Openings in the bones of the carapace made the turtle lighter and more maneuverable. The shell was covered with muscle and skin. This fossil can be seen at the Smithsonian Institution in Washington, D.C.

Opposite: *Protostega* lived in the late Cretaceous approximately 80 million years ago. This fossil is in the Smithsonian Institution.

All four families were swimming, feeding, and laying eggs on that fateful day some 65 million years ago when a giant asteroid struck the earth near Mexico's Yucatán Peninsula. There is little doubt that the result of that collision was a cascade of events that ultimately changed the earth's climate and led to the extinction of many species. Dinosaurs, which were already declining, soon disappeared, as did many marine invertebrates. While birds and mammals began their march toward domination over the land, a shocking 85 percent of the animal species inhabiting the earth vanished soon after the asteroid hit.

Sea turtles, however, hardly seemed to notice. In fact, they increased in diversity. They swam, ate, mated, laid their eggs, and tried to grow large enough that even sharks would find them a difficult meal.

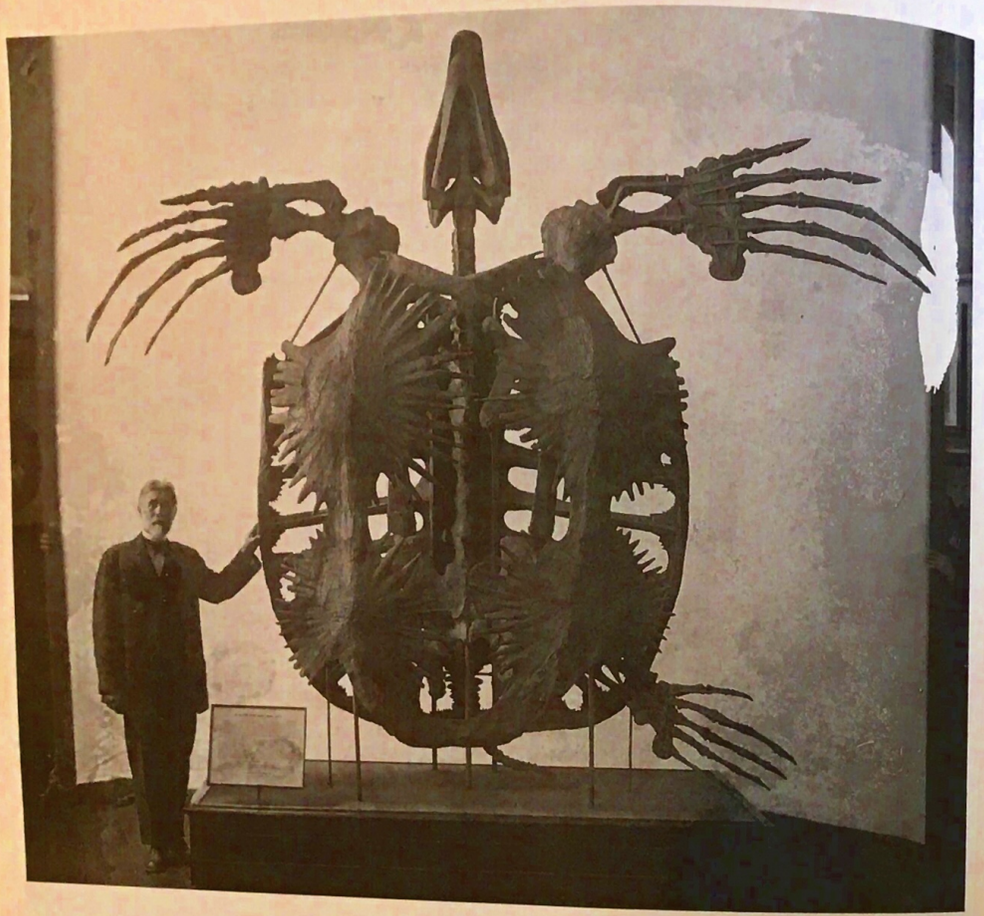
### Surviving in the Ancient Seas

Two of the four families of sea turtles that occupied the oceans of the Cretaceous have since become extinct. The family Toxochelyidae, consisting of nine to ten types of small- to medium-sized sea turtles with broad, circular shells, diverged from the main line of hard-shelled sea turtles in the early Cretaceous. Over time they diversified into many different-looking animals, some of which specialized to live near the coast and others that adapted for the open oceans. Toxochelyidae descendants were abundant in the Great Inland Sea that covered the Great Plains of North America. They also flourished along the East Asian littoral and in the early Atlantic Ocean, which was forming as North America and Europe were spreading apart.

The Toxochelyidae diversifications took on many physical forms. Some species had a solid carapace and others a more reduced shell with large openings between the bones. These openings were covered with skin and perhaps horny scutes. With a smaller, lighter shell these turtles would have been faster swimmers than other species. Some turtles developed a secondary palate like that present in mammals. The secondary palate is the roof of the mouth that separates the air passages from the nose and mouth allowing an animal to breathe and chew food at the same time. It would have allowed these turtles to chew hunks of food while surfacing to breathe.

The Toxochelyidae turtles shared the oceans with modern hard-shelled sea turtles until the Eocene Period some 50 million years ago. Over time this group developed specialized feeding habits that may have been their ultimate undoing. They could not compete with their more generalized sea turtle relatives, which were able to change food sources as the climate and environment changed.

Another turtle family, Protostegidae, started with little *Santanachelys* in the early Cretaceous but gave rise to gigantic turtles later in the period. The most famous of these was *Archelon*, which grew to 15 feet (4.6 m), weighed over 6,000 pounds (2,700 kg), and its flippers spanned 16 feet (4.9 m). Its head was 3.3 feet (1 m) long and featured a sharply hooked beak. Living in the Inland Sea, *Archelon* probably ate large-shelled invertebrates such as clams, ammonites, and the ancient nautilus. Rooting around on the bottom, it pulled its prey from the sand and mud with its beak and crushed them with its massive jaws. Its carapace was only partially covered with bone



*Archelon* was enormous. The plastron was made up of large spiny, bones that, unlike those in modern turtles, did not fuse together. Giant flippers and a reduced carapace made this turtle very maneuverable. This particular animal lost a hind flipper, perhaps to a giant shark.

and had very large open spaces between the ribs. This reduced its weight, made it faster and more maneuverable, and helped it dive to great depths in a manner similar to the modern leatherback. The plastron was formed from several star-shaped pieces of bone. The Protostegidae all but died out with the dinosaurs; only one member of the family lived on into the Oligocene Period.

### Rise of the Modern Families

Six of the seven species of living sea turtles belong to the third family, Cheloniidae. These turtles all have a well-developed, bony skull with a secondary palate and their carapace and plastron are fully formed of bone. They occupy a variety of ecological roles or niches in the oceans by living in a variety of habitats and eating different types of foods such as seagrass, crabs, clams, and sponges. Their ancestors arose in the early Cretaceous in parallel with the family Toxochelyidae. As many as twenty different types plied the oceans over time, but only four of these survive today as distinct genera, *Chelonia*, *Eretmochelys*, *Lepidochelys*, and *Caretta*. The Chelonids were more generalized species than the Toxochelids and thus were able to out-compete them for resources and were more adaptable to changing conditions in the oceans. During the Paleocene and Eocene periods the Toxochelyidae disappeared.

Finally there is the family Dermochelyidae, which has a sole extant species, the leatherback turtle. Splitting off from the Protostegidae in the late Cretaceous about 100 million years ago, the leatherback family reached a peak of diversity in the Eocene about 50 million years ago after the Protostegids all but disappeared. It was as if new niches opened in the seas and leatherbacks rushed to fill them. At least six different species of leatherbacks lived in the oceans worldwide, their fossils found in Africa, Europe, North America, and New Zealand. These turtles were very much like the modern leatherback, though carapace structure varied from fairly thin, flat shells to thicker, more robust shells with pointed ridges. All of them had shells made up of small bony plates.

As time progressed, competition likely increased with other animals like modern fishes and marine mammals. Indeed, the different leatherback species probably competed among themselves. Food sources likely became more limited and leatherbacks had to specialize as food types diminished. Leatherback diversity decreased to the extent that only two species survived at the end of the Miocene Period, and by two million years ago only *Dermochelys coriacea*, the modern leatherback, survived. It appears that the secret to our leatherback's success was its adaptation into a jellyfish predator. The leatherback had a large food supply all to itself, as the other species seemed to avoid the jellyfishes. With its specialized anatomy and great physiological adaptations it roamed the oceans making a unique living and increasing in numbers.

### In the Days of Humans

In more recent times, millions of sea turtles filled the oceans. Reports by early European sailors indicate that, even as late as the eighteenth century, ships that had lost their way to the Cayman Islands in the Caribbean Sea could steer entirely by the noise generated by green turtles swimming there to lay their eggs. Columbus discovered the Cayman Islands in 1503 and named them Las Tortugas because the ocean was virtually wall-to-wall with green turtles. Ships were constantly bumping into them. Scientists conservatively estimate that there were 100 million green turtles in the Caribbean Sea alone before Europeans arrived there. They ate 13.4 trillion pounds (6.09 trillion kg) of sea grass a year, or about half the Caribbean's annual production of grass biomass. As the grass was consumed, nutrients were recycled and the grass beds were fertilized, resulting in a smoothly working ecosystem. The turtles seemed to completely control which plants and animals lived there.

Extrapolating these estimates from the Caribbean to other areas is risky, but considering that sea turtles were present in all of the tropical oceans, one gets a sense

of what must have been an unbelievable number of green turtles in the world. The Mediterranean probably had 10-20 million green turtles. The littoral from Saudi Arabia to India likely contained 50-100 million and Southeast Asia another 300 million or more. Along Africa's tropical coast there were 100 million or more green turtles and in South America probably twice that.

And these staggering numbers are not reserved for green turtles alone. It is estimated that a population of at least 540,000 hawksbills munched on sponges in the Caribbean before Columbus arrived. This suggests there were at least 4-5 million hawksbills around the world. Loggerheads added tens of millions or more to the total sea turtle population. Imagine an ocean with 500 million olive ridleys and another 300,000-500,000 Kemp's ridleys present in the Caribbean and along the U.S. Atlantic coast. Leatherbacks numbered in the hundreds of thousands or even millions, limited only by the supply of jellyfish. Even the "uncommon" flatback was probably present in the millions. Indeed, its limited distribution today is likely owing to heavy exploitation by early people in Southeast Asia.

Today, biologists and conservationists are encouraged by more modest numbers. For example, the number of Kemp's ridleys nesting at Rancho Nuevo on the Gulf coast of Mexico has risen from 300 to over 2,500 annually. Islands in the Caribbean are now considered important nesting areas when as few as 5-10 hawksbills come ashore to nest on a single night. Our measuring stick has broken off short. As biologist Karen Bjorndal reminds us, we judge the normal and healthy sea turtle population size to be that which existed when we were young. Certainly 200,000 turtles—even 2,000—are preferable to extinction, but we should dream about the day when the ocean once again holds a billion sea turtles.

### First Contact

Humans and sea turtles have been interacting for thousands of years. Our first indication that humans had a major effect on sea turtles comes from the cradle of civilization, ancient Mesopotamia in what we now call the Middle East. Some of the earliest records of civilization come from a period named after an archaeological site called Ubaid in southern Iraq near the ancient city of Ur. About 7,000 years ago the people of Ubaid lived in the delta formed by the famous Tigris and Euphrates Rivers, the Karum River from the east in Persia (Iran), and the once-mighty al-Batin from Arabia. People living along the Persian Gulf coast found large green turtles coming ashore to lay eggs and also caught them in their fishing nets. Pieces of turtle bone are present in archaeological deposits at several sites along the coast, demonstrating the importance of sea turtles as a food source. The oldest Persian Gulf archaeological deposits in which turtle bones appear are at As-Sabiya in Kuwait and Dalma Island in the United Arab Emirates.

During the Bronze Age, from 6,000 to 4,000 years ago, sea turtles were a common food in Arabian Gulf settlements in what are now Saudi Arabia, Oman, and Abu Dhabi. People slaughtered sea turtles at coastal sites and transported the meat inland to the emerging cities of the Sumerians. Records indicate that an organized trade existed in sea turtles, their meat, and their shell or scutes (tortoiseshell). Ancient government storage facilities regularly contained these products. It is likely that the legendary King Gilgamesh of Uruk feasted on green turtle steaks and may even have enjoyed green turtle soup at banquets celebrating the completion of the walls of his great city more than 5,000 years ago. Green turtle shells are also found in graves from this time in Oman, indicating that sea turtles had a special significance to the people. Green turtle parts also occur in archaeological sites of the era along the Mediterranean Sea in what is now Israel.


Later Middle Eastern artifacts, including engraved cylinder seals and stamp seals, bear images of turtles, and tortoiseshell is recorded as having been delivered as inlay for a throne. By the time the Babylonians came to dominate the region some 3,000 years ago, turtles had become cultural icons, specifically honored as Enki, the god of wisdom. At that time sea turtles adorned the walls of palaces in reliefs showing scenes of the Mediterranean shore.

About 2,700 years ago Greek coins bore images of sea turtles. In ancient Greek legend a floundering sailor is saved by climbing on the back of a sea turtle nearly as big as he is. The species is not identified but it was probably a green sea turtle or leatherback. Greek authors also recount the use of sea turtles by islanders living in the Red Sea about 2,300 years ago. These people captured huge sea turtles at sea, pulled them ashore, then opened their shells and cooked their contents with the heat of the sun. They used single shells to make shelters, water vessels, and boats.

Two thousand years ago there was a well-established system for trading tortoiseshell in all of the major ports from the Mediterranean south to the Horn of Africa and east across the Indian Ocean to India, Sri Lanka, Malay, and Sumatra. Sea turtles were also known in Egypt, but archaeologists have not distinguished between land turtle and sea turtle artifacts. The Chinese pictogram character for sea turtle is more than 2,000 years old. There are also sea turtle remains dating from about 800 A.D. in archaeological sites in the Comoro Islands off the East African coast in the Indian Ocean.

Sea turtles were common on the shores of India and Sri Lanka even into historic times and played an important role in ancient cultures of that region. They are well known in the Hindu tradition of the Indian subcontinent. In fact, in Hindu mythology the world sits on the back of four elephants standing on the back of a giant sea turtle

that swims in a large ocean kicking up water with its flippers. Because the elephants walked in circles the world rotated during the day, and when the elephants tripped there were earthquakes. When the turtle splashed its flippers it created monsoons.

This Hindu myth even reaches into modern western society. In his book *A Brief History of Time*, author Stephen Hawking tells one version of a well-known story about an old woman and the famous English scientist and philosopher Bertrand Russell. Other versions employ other scientists and philosophers such as William James but tell the same story. The scientist has just given a magnificent lecture on the origin of the universe in which he convincingly described in great detail how the earth revolves around the sun and the sun in turn moves through a galaxy of stars. When he asked for questions an elderly lady in the back of the room got up and said, "That is all rubbish. Everyone knows that the world is a flat plate that rests on elephants on the back of a giant turtle." The scientist smiled and gave a knowing glance to his fellows in the first row before saying, "That is very interesting, but if your theory is correct, what is the turtle standing on?"

"On the back of a second and larger turtle," she replied.

"But what does that rest on?"

"Sir, you are a very clever young man, but not very wise," said the lady. "Everyone knows that it is turtles all the way down!"

### Before Columbus

Although evidence of the impact Europeans had on sea turtles in the New World abounds, it is also clear that Native Americans had a significant effect on many sea turtle populations before the landings of Columbus. Very few such populations were untouched by humans before the first sailing ships arrived from Europe. Native Americans used tortoiseshell from hawksbill carapaces to make ceremonial and ornamental objects. The famous Hopewell Indian mounds, built 2,500 years ago as far inland as Ohio and Illinois, reveal tortoise shell pins, combs, hair pins, and other craft objects. Wooden statues of animals feature tortoiseshell eyes and bird wings. The shell and scutes of hawksbills were also important religious objects and were traded throughout the region.

Indeed, sea turtle remains are found in at least 23 sites in the United States ranging in age from 5,000 to 2,500 years. These sites contain remains of green turtles, hawksbills, Kemp's ridleys, and loggerheads. Native Americans not only ate sea turtles but also placed carapaces, bones, and ornamental objects made from tortoiseshell into burial sites. In the Caribbean region there are more than 40 sites containing sea turtle remains and at least 11 on the Yucatán Peninsula.

Caribbean peoples took turtles not only from nesting beaches but also from feeding grounds. Sea turtles were important components of the diet and culture in many of these societies. People on the smaller islands, Cuba, and on the Miskito coast of Nicaragua all traded in tortoiseshell. The relative contribution of sea turtles to the



remains at some sites decreased through time, indicating that these people reduced the populations of turtles that they hunted. In parts of the Caribbean, aboriginals wiped out entire populations.

Mayan communities on the coastal areas of the Yucatán and Belize ate sea turtles and used their shells for containers and shields. Some communities like Isla Cerritos supplied turtle meat to larger population centers such as Chichén Itzá some sixty miles inland. Sea turtles played a symbolic role in the cultures of the Maya and other peoples of Central America, and are commonly represented in Mayan ceramics, figurines, and stone altars. Gold jewelry was fashioned into the images of turtles throughout the region. Ancient people used sea turtles in Argentina, Venezuela, Ecuador, Peru, and Chile, but the record of their importance in the local cultures is not as strong as that among the Maya.

Consider, for example, Costa Rica's granite and sedimentary rock balls. Ranging in size from a few inches to more than six feet in diameter, these balls are found in the Río Térraba valley on the west coast and in various pre-Columbian burial sites. They are almost perfect spheres and for years people have speculated about their significance. Some have suggested that they were religious symbols, others that they were items of commerce or symbols of wealth. The spheres were found on raised platforms and in rows, and sometimes were associated with burial grounds. There is, however, no consensus of opinion as to what they represent.

This granite sphere (moved to a location at the entrance of Liberia Airport in Guanacaste, Costa Rica) is typical of what some believe to be ancient turtle egg sculptures. The artisans who produced these symbols seemed to be paying homage to the reproductive output of sea turtles. Large and small, these "eggs" can be found at many locations throughout Costa Rica.

Yet to a sea turtle biologist the answer is simple. Ancient peoples were just as amazed by the prodigious reproductive effort of sea turtles as we are today. Sea turtles laid large numbers of eggs on the beaches of Costa Rica, providing a substantial and predictable food supply for local people. The simplest explanation for those large, perfectly round, white spheres is that they represent sea turtle eggs. All ancient cultures suffered from the need to produce enough offspring to overcome losses from disease, starvation, wild animals, and war. People needed symbols to boost their confidence in the bounty of nature and their own reproductive powers. Sea turtle eggs were undoubtedly an aphrodisiac then as they are today. Between 1,000 and 1,500 years ago the Chibcha people of Costa Rica were simply imitating the reproductive excess of the sea turtles that they saw on a regular basis. The giant stone sea turtle eggs were symbolic offerings people made to thank their gods, not only for the bounty brought ashore by the sea turtles but also for the increase in machismo gained by eating those eggs. The Chibcha had sea turtle eggs and we have fancy red sports cars and sport utility vehicles. Which culture is the wiser?

It is clear that since prehistory and antiquity humans have had a great effect on sea turtles. As biologist Jack Frazier points out, sea turtle populations were changed by humans before European technology arrived on the scene. Ancient peoples, seeking to feed their growing populations, affected sea turtle numbers, densities, and geographic distributions. They also affected the location and timing of behaviors such as feeding, mating, and reproduction. One example of a behavioral effect is the fact that sea turtles bask only on deserted islands uninhabited by humans. European expansion obviously escalated the pressures on sea turtles, even if their numbers were down from what they had been 20,000 years before the westerners arrived.

### Food for Mariners

The abundance of green turtles was the main reason that Europeans were able to explore and exploit the Caribbean region. Exploration, settlement, pirating, and war all depended upon a large and dependable supply of food. Green turtles congregated offshore in the Cayman Islands to mate and came ashore in astonishing numbers to lay eggs from June to September. Sailors walked the beaches at night and turned the nesting females onto their backs. In the morning they went back and loaded them into small boats, then returned to their ships. The holds were filled with green turtles laid on their backs where they could survive for months without food. The fresh and tasty meat was also fortified with vitamin C, reducing the sailors' incidence of scurvy.

It seemed for a long time that the supply of turtles was limitless, but as we now know it wasn't. The first turtle nesting colony, or rookery, to disappear was on Bermuda. The next was on the shores of the Greater Antilles. The Bahamas soon followed and then the Florida Keys. The Dry Tortugas, originally named for the many green turtles that nested there, were emptied of their namesake. Finally, sometime in the 1800s, the Cayman Island population disappeared as well.

Efforts to find turtles for the big ships moved to the south shore of Cuba and, when those turtles were depleted, to the vast turtle grounds off Nicaragua's Miskito coast. Eventually the Nicaraguan government closed off the hunt to foreign vessels in the last half of the twentieth century. Fresh or salted, dried or pickled, green turtle meat fed an entire region and was a staple for the crews of ships from Great Britain and Spain. Turtles also helped open up the Caribbean to western influence, but the great turtle fleets passed silently away before the modern conservation movement raised an alarm. In those times the use of turtles was what we would call today "a matter of national security." Powerful nations needed sea turtles as they set out to conquer far away lands. So even had the conservation alarms been sounded, few would have heard and fewer still would have listened.

The hawksbill turtle was abundant in the Caribbean when Europeans arrived. Indeed, Columbus watched Native Americans hunting hawksbills along the southeast coast of Cuba in 1494. Hawksbill tortoiseshell was a significant trade item. As European trade and settlements expanded in the nineteenth century, large amounts were



Green turtles awaiting shipment by steamer to northern markets. In the 1920s people still caught turtles in the Dry Tortugas Islands and west of the Florida Keys. The turtles were held at Key West, with flippers tied and the weight marked on their plastrons, until they were shipped for slaughter.

exported to New York, Britain, and France. Japan used tortoiseshell for centuries in its *bekko* crafts, reducing populations of hawksbills in the western Pacific Ocean. It is likely that the advent of plastic substitutes for tortoiseshell saved the hawksbills from extinction.

As meat and products from sea turtles gained value beyond indigenous markets, sea turtles entered the cash society. Indigenous peoples spent more time hunting turtles for money and less time on traditional subsistence activities. With cash they bought nets and thus turtles became rarer still. The introduction of a cash value for turtles also added a new tension into the social structure of villages as some people became wealthier than others. Catching turtles soon became the path to wealth.

The effects of western expansion on sea turtle populations in the Caribbean were repeated in other parts of the world. As sailing ships reached new areas, sea turtles were a ready source of food. They appeared to be inexhaustible. For decades, even hundreds of years in some areas, sea turtles fed the world's navies and extended their sailing ranges. Without that food supply the spread of European civilization would have been much slower. When we think of the many good things that have resulted, as well as the bad, we should remember that the first step in the process was taken on the back of a sea turtle.